

Golden oyster mushroom (*Pleurotus citrinopileatus*)

- A wood decay fungus grown in cultivation commercially and non-commercially.
- Releases large numbers of wind dispersed spores.
- Rapidly colonises and decays dead wood, which is an important habitat in GB.
- Research in the US shows it can exclude native fungi, leading to a significant decrease in fungal richness.



History in GB

Established in two locations: Liverpool and Barnsley. The latter is on elm and has produced fruit over the last two years. It may be under recorded in GB; however, its distinctive fruiting bodies make this unlikely.

Global Distribution

Native to east Russia, China, Korea and Japan.



GB Distribution



Impacts

Environmental (major, medium confidence)

- The main impact of this species is likely to be dominating important dead wood habitat, displacing native fungi and other species that rely on them.
- Research in the US found that *P. citrinopileatus* leads to exclusion of native fungi, most notably *Cerrena unicolor*, which is native to GB.
- It could also form hybrids with other *Pleurotus* species, some of which are native to GB, although this has not been demonstrated yet.

Economic (minor, high confidence)

- No evidence yet that this species damages cut timber or forest products, most likely because the moisture in timber is too low for the fungi to colonise.

Social (minimal, high confidence)

- Not expected to pose a societal impact.

Introduction pathway

Release / escape from commercial stock – a likely pathway given *P. citrinopileatus* is already grown commercially and non-commercially in GB. The sale of this species is not restricted in GB.

Spread pathway

Natural (very rapid, high confidence) – releases enormous numbers of spores. Most settle within a few metres but can travel tens or even hundred of kilometres.

Human-aided (very rapid, high confidence) – can be purchased as a live culture in GB

Summary

	Response	Confidence
Entry	VERY LIKELY	VERY HIGH
Establishment	VERY LIKELY	VERY HIGH
Spread	VERY RAPID	HIGH
Impact	MAJOR	MEDIUM
Overall risk	HIGH	MEDIUM

GB Non-native Species Rapid Risk Assessment (NRRAP)

Rapid risk assessment of: *Pleurotus citrinopileatus* (Singer) (golden oyster mushroom)

Risk assessment area: Great Britain (England, Scotland and Wales)

Author: Matt Wainhouse, Natural England

Version: Draft 1 (June 2025), Peer Review (Aug 2025), NRRAP 1 (Sep 2025), Draft 2 (Oct 2025), NRRAP 2 (Jan 2026)

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Introduction:

The rapid risk assessment is used to assess invasive non-native species more rapidly than the larger GB Non-native Risk Assessment. The principles remain the same, relying on scientific knowledge of the species, expert judgement and peer review. For some species the rapid assessment alone will be sufficient, others may go on to be assessed under the larger scheme if requested by the Non-native Species Programme Board.

Guidance notes:

- We recommend that you read all of the questions in this document before starting to complete the assessment.
- Short answers, including one word answers, are acceptable for the first 10 questions. More detail should be provided under the subsequent sections on entry, establishment, spread, impacts and climate change.
- References to scientific literature, grey literature and personal observations are required where possible throughout.

Section A – Organism information

1 - What is the principal reason for performing the risk assessment? (Include any other reasons as comments)

Response: To assess the potential threats from *Pleurotus citrinopileatus* in GB following rapid invasion in North America and recent establishment in Europe, including GB where it has recently been discovered.

2 - What is the name of the organism (scientific and accepted common; include common synonyms and notes on taxonomic complexity if relevant)?

Response: *Pleurotus citrinopileatus* (Singer) (golden oyster mushroom (English), tamogitake (Japan), yuhangmo (China), weishenga limonaya (Russia))

3 – Briefly describe the organism

Response: A wood decay fungus grown in cultivation as an edible species. The mushroom produces dense clusters of yellow fruitbodies 2-10cm wide with decurrent gills (Fig. 1).



Fig 1. *Pleurotus citrinopileatus*.

4 – Where is the organism native?

Response: Native to eastern Russia, Korea, northern China, and Japan (Bruce, 2018).

5 - What is the global distribution of the organism (excluding the risk assessment area)?

Response: *P. citrinopileatus* is native to east Russia, China, Korea and Japan. It was first recorded in the US in 2012 and has since spread to at least 25 states, predominantly in the North-East and Mid-West of the US and one Canadian province (Veerabahu *et al* 2025). In Europe, it has established in Denmark, Hungary, Italy, France, Germany, Spain, Switzerland, Austria and Belgium (GBIF, 2025 – note GBIF maps do not show all records so some

locations are not shown. All records are given in the GBIF species metrics). This fungus also has recent records in Kenya, Nigeria, India, Vietnam, Nepal, Honduras and Cameroon (GBIF, 2025) (see Fig. 2).



Fig 2. Global distribution of *P. citrinopileatus*, excluding the risk assessment area, from GBIF (2025).

6 - What is the current distribution of the organism in the risk assessment area?

Response: There are currently two known locations where *P. citrinopileatus* has been recorded in GB - one in Liverpool and one in Barnsley, South Yorkshire, the latter fruiting over the last 2 years on *Ulmus*.

Until very recently, it was thought by field mycologists that *P. citrinopileatus* had not yet established in GB. It had been recorded by the foraging community and publicised via social media. Since the foraging community do not typically make biological records, the locations were poorly known. *P. citrinopileatus* is a bright, charismatic species, so it probable that there are still very few locations for it in GB.

7 - Is the organism known to be invasive anywhere in the world?

Response: Yes.

In North America, the species has spread rapidly since it was first recorded in the wild in 2012. As of 2025, it is known from 20 states in the main centre of invasion, with four additional states separated from the main cluster by >1000 km. Population genetics of this species in the US has shown all wild individuals studied were closely related to two commercial, cultivated strains (Bruce, 2018). Research in the US has found that *P. citrinopileatus* has a strong, negative impact on native fungal communities in deadwood (Veerabahu *et al*, 2025). It is outcompeting native species and strongly associated with a decrease in a fungal diversity.

Section B – Risk assessment

Entry

Estimate the overall likelihood of entry into the risk assessment area for this organism (comment on key issues that lead to this conclusion).

Response: *very likely*
Confidence: *very high*

Comments (include list of entry pathways in your comments):

The one likely entry pathway is release/escape from commercially available stock. *P. citrinopileatus* is a prized edible species which is already grown commercially and non-commercially in GB. Cultures of this species are widely available to purchase for home cultivation from a number of online shops. Grow-kits containing inoculated spawn are available from large superstores operating nationally. The sale of this species is not restricted in GB. The provenance of strains is often not known, so it is unknown whether the two commercial strains linked to the rapid invasion in the US are available in the UK. However, the increase in European records over the past five years (GBIF, 2025) suggests this is very likely.

Establishment

Estimate the overall likelihood of establishment (comment on key issues that lead to this conclusion).

Response: *very likely*
Confidence: *very high*

Comments (state where in GB this species could establish in your comments, include map if possible):

This species has established in at least two locations in Barnsley, South Yorkshire and Liverpool, though there are no formal biological records e.g. on NBN Atlas, Fungal Records Database for Britain and Ireland (FRDBI) (The British Mycological Society, 2009) as *P. citrinopileatus* has not yet been added to the UKSI. From social media posts, it is understood that the foraging community were aware of this species in the wild for two years before the mycological community became aware of it. *P. citrinopileatus* is bright yellow with masses of large fruitbodies. Fungal fruitbodies are likely to last at least one week and can fruit multiple times in a season. Given how conspicuous this species is, it is highly unlikely that it is under recorded. However, we do not know how long this species lives in wood as mycelium before it fruits so more locations are possible. Given how quickly it has spread in the US, it would be reasonable to assume that it can fruit within 1-2 years after colonisation.

The South Yorkshire record is on elm *Ulmus*, which is consistent with its host preference in North America.

Climate and habitat preferences are discussed under the spread section below.

Spread

Estimate overall potential for spread (comment on key issues that lead to this conclusion).

Overall response: *very rapid*

Confidence: *high*

Sub scores:

Natural spread only:

Response: *very rapid*

Confidence: *high*

Human facilitated spread only:

Response: *very rapid*

Confidence: *high*

Comments (in your comments list the spread pathways and discuss how much of the total habitat that the species could occupy has already been occupied):

Wood decay fungi, like *P. citrinopileatus*, release enormous numbers of spores which are predominantly wind dispersed. Though there is no specific research into the natural dispersal of *P. citrinopileatus* other species in the genus are known to be dispersed by wind (Vilgalys & Sun, 1994), and mycophagous invertebrates (Kitabayashi, Kitamura, & Tuno, 2017). In the context of spread and rapid expansion, wind dispersal is expected to be the most important natural mechanism of dispersal. In most fungi, the majority of spores settle within metres of the parent fruitbody, however they can travel tens or even hundreds of kilometres (Stenlid & Gustafsson, 2001). While long distance dispersal is possible, spore viability decreases with distance (Norros et al, 2015) leading to less frequent establishment events.

In the US, the spread of *P. citrinopileatus* has been very rapid (GBIF, 2025; see Fig. 3). Since it was first recorded outside of cultivation 13 years ago it has expanded to 25 States and now encompasses an area of c.2 million km² as of July 2025 (Veerabahu *et al*, 2025). In the period 2012-2016, there were just five observations of the species in the wild with rapid expansion in the period 2016-2025. Observations of *P. citrinopileatus* are clustered near large urban settlements. These densely populated areas could be linked to more cultivation and a higher likelihood of escape, but it more likely represents recorder bias (Veerabahu pers. comms.) The majority of US records have been on elm (*Ulmus* spp.).

The rapid spread in the US has been linked to two cultivated strains (Bruce, 2018). Commercial strains of fungi are selectively bred for specific qualities such as growth rate, large fruitbodies, multiple fruiting, mould resistance, temperature tolerance etc., depending on purpose (e.g. food, industrial processing, pharmaceuticals) (Doing *et al*, 2022). Selection of these traits is thought to have contributed to the invasiveness of these cultivated strains.

The rapid spread through North America is presumed to have been through multiple escapes from cultivation in geographically isolated locations and then dispersed locally via wind dispersed spores. However, based on the temporal and spatial distribution of records (GBIF, 2025), a reasonable estimate for viable spore dispersal may be very high (e.g. 10-50 km). Recent observations of *P. citrinopileatus* in the south and west of the US (>1000 km from the main invasion front and against the prevailing winds) are well beyond reasonable spore dispersal distances and expected to be new escapees from cultivation rather than natural dispersal (Veerabahu *et al*, 2025).

Landscape topography of the colonised area in the US is not thought to be associated with its spread (Veerabahu pers. comms.). While parts of the Mid-West are very flat, the topography of other areas within the invaded range are more varied, particularly in the coastal North East. Major barrier features such as the Great Lakes and Appalachian Mountains have not prevented or slowed the spread of *P. citrinopileatus*. This is thought to be due to multiple outbreak loci as well as wind dispersal and viability of spores (Veerabahu pers. comms.).

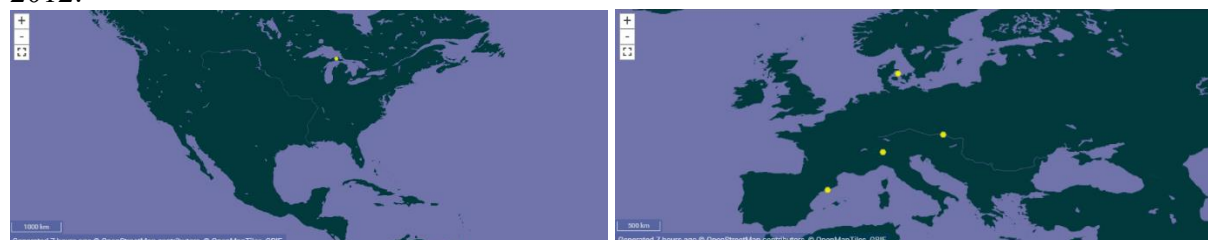
In the UK, this species can be purchased as a live culture online or ‘off the shelf’ in superstores as a grow-kit. It is not known whether the cultivated strains linked to spread in the US are circulating in the UK and Europe, but it is highly probable. Commercial cultivation (including grow-kits) is likely to have been the source of propagules of the South Yorkshire and Liverpool colonies, as well as in Europe (see Fig. 3). Continued and unabated cultivation of *P. citrinopileatus* will likely lead to its continued spread in GB as larger volumes of spores are released into the air increasing the likelihood of new establishment events. Each grow-kit presents a geographically dispersed and human mediated risk of spread.

P. citrinopileatus is a generalist of broadleaf woods. In the US, it is found predominantly on elm (*Ulmus* spp) but has also been found on wood of *Fraxinus*, *Populus*, *Acer*, and *Prunus* as well as mulch and wood chip (Veerabahu *et al*, 2025). In GB, there are fewer *Ulmus* logs which could slow its spread, but otherwise habitat and deadwood resource availability would not be a limit to its spread. It is possible that availability of large amounts of dead *Fraxinus excelsior* from ash dieback (*Hymenoscyphus fraxineus*) could assist its spread.

P. citrinopileatus has a broad climate tolerance, however, its spread in the US is limited by cold winter climates. The mean and minimum annual temperatures across the whole of GB are comparable to the current area of invasion the US (Climate Maps, 2025). Colder climates in Scotland may slow its spread but would not stop it completely.

In the absence of human cultivation, under natural spore dispersal processes this species would be highly unlikely to establish in GB from its native range.

2012:



2018:



2025:

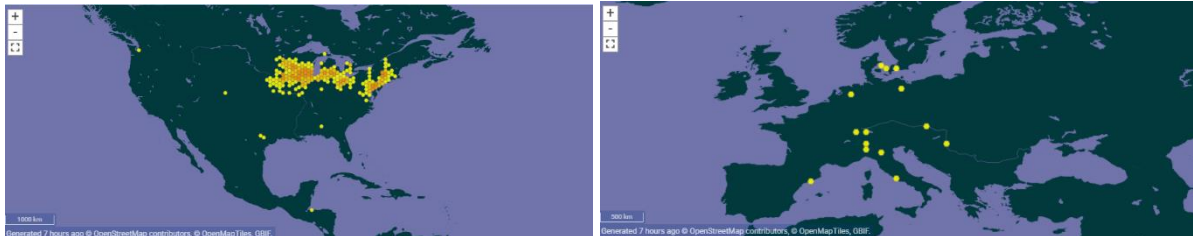


Fig 3. Maps showing the increase in distribution in its invaded range in North America and Europe from 2012-2025 (GBIF, 2025).

Impact

Estimate overall severity of impact (comment on key issues that lead to this conclusion)

Overall response: *major*

Confidence: *medium*

Sub-scores

Environmental impacts:

Response: *major*

Confidence: *medium*

Economic impacts:

Response: *minor*

Confidence: *high*

Social impacts:

Response: *minimal*

Confidence: *high*

Comments (include list of impacts in your comments):

Environmental:

This saprotrophic fungus rapidly colonises and decays dead wood, which is an important and significantly depleted resource for biodiversity in GB (Hodge and Peterken, 1998).

The interaction of saprotrophic fungi in wood is well studied and typically leads to

competitive exclusion of less combative fungi from the resource (Boddy, 2000). The main concern is for native saprotrophic fungi that could be outcompeted and excluded by *P. citrinopileatus* (interference competition). Research in the US has found that *P. citrinopileatus* leads to exclusion of native fungi from woody resources (Veerabahu, 2025). The most affected species in this study was the wood decay fungus *Cerrena unicolor* (also a GB native) which decreased by 55%. This study found that presence of *P. citrinopileatus* led to a significant decrease in fungal richness where trees colonised by *P. citrinopileatus* had half the number of fungal species than trees without it. Furthermore, *P. citrinopileatus* also dramatically altered the fungal community composition and structure of the trees it inhabited. Thirty-one putative taxa (Operational Taxonomic Units) occurred significantly less in trees with *P. citrinopileatus*, and three significantly more including *Armillaria gallica*.

If *P. citrinopileatus* also has a preference for *Ulmus* spp in GB, it risks further endangering *Ulmus* associated species that have already declined due to Dutch elm disease, such as *Rhodotus palmatus* (VU in Europe) (Iršénaitė, Kaľucka, & Olariaga Ibarguren, 2019).

Exploitative competition could also have a major impact on native wood decay fungi. One of the major characteristics of the invasive *P. citrinopileatus* is the large number of fruitbodies it produces and that it can fruit several times in a season. This could lead to large volumes of spores being produced which are able to colonise a higher proportion of available resources relative to other species. Research is needed to better understand the relative importance of these competitive mechanisms.

Other species also depend on deadwood and dominance of *P. citrinopileatus* could result in a trophic cascade. Priority effects frequently occur in deadwood, so another concern is that by altering the physicochemical properties of the wood, it alters the successional impacts on invertebrates and later colonising fungi (Weslien et al 2011).

P. citrinopileatus can form hybrids with other *Pleurotus* species including the native wood decay fungus *P. pulmonarius* (Rosnina et al, 2016) (hybridisation has been used to ‘improve’ genetics of cultivated *Pleurotus* strains). This has not known to occur in the wild and there may be other species which it can hybridise with but there is an unknown risk of genetic swamping of native *Pleurotus* species (Bruce, 2018).

P. citrinopileatus appears to have a very high growth rate and produces large quantities of fruit. Rapid growth, and production of fruitbodies and spores, are energy intensive and so it is anticipated that decomposition and subsequent C turnover is also rapid to meet its energy demand (Lustenhouwer et al, 2020). Rapid decomposition could also reduce quality of wood substrate for other taxa.

Economic:

Economic impact is expected to be minor. There is no evidence thus far that this species will damage cut timber, or forest products. This is most likely because wood moisture in timber is too low for the fungi to colonise it (Schmidt, 2006) however, more research would be needed to test this. In the US, the aggressive wood decay fungus *Armillaria gallica*, was found to be strongly associated with *P. citrinopileatus* though the relationship was correlative not causal. *A. gallica* is considered pathogenic to trees through Armillaria root rot (Cromey et al, 2020)

and expected to increase as an opportunistic pathogen with climate change (Kubiak *et al*, 2017). It is plausible that *A. gallica* is a secondary coloniser of *P. citrinopileatus*, which, if true, could plausibly lead to localised tree mortality, but likely only to be an issue where trees are already stressed. The relationship between *A. gallica* and *P. citrinopileatus* requires further investigation.

There could be a positive economic benefit through wild harvesting and selling of mushrooms.

Societal:

This species is not expected to pose a societal impact. It is a prized edible and an easily identifiable mushroom. As such it is possible that tensions arise between foragers and landowners/managers.

Climate Change

What is the likelihood that the risk posed by this species will increase as a result of climate change?

Response: *very high*

Confidence: *high*

Comments (include aspects of species biology likely to be effected by climate change (e.g. ability to establish, key impacts that might change and timescale over which significant change may occur):

P. citrinopileatus has a broad climatic tolerance (Veerabahu *et al*, 2025) and this may well be a trait that commercial strains have been selected for. It originates from a temperate to sub-tropical region in east Asia. The centre of invasion in the US is also relatively temperate, avoiding areas with cold winter temperatures (Veerabahu *et al*, 2025). Climate modelling based on its invaded range in the US showed that climate change, specifically warmer winters, will increase the spread of this species. When this model is applied to Europe, Great Britain is within its climatic optimum in both current and projected climate change scenarios (Veerabahu, unpublished data). Based on these projections, climate change, and warmer winters in particular are likely to benefit *P. citrinopileatus* through increased mycelial activity in winter (Kausarud *et al*, 2012). It has already established in Italy, indicating that it can establish under a warmer climate.

Conclusion

Estimate the overall risk (comment on the key issues that lead to this conclusion).

Response: *high*

Confidence: *medium*

Comments:

P. citrinopileatus has been found to have spread very rapidly in the US and now known to be established in Europe including GB. All wild colonies that have been tested in the US are derived from two highly invasive strains that have escaped cultivation. It is highly likely these strains are available to purchase and being cultivated in GB. Evidence from US has shown *P. citrinopileatus* is capable of very rapid spread and now covers an area of c. 2 million km² in <10 years. Its establishment in deadwood leads to competitive exclusion of native species resulting in half the fungal richness of uncolonised trees and dramatically changing the fungal community structure (Veerabahu *et al*, 2025). The large number of fruitbodies and spores mean that its direct competitive ability may be exacerbated through exploitative competition for deadwood resources which in the UK are already depleted.

Although there are no formal biological records of this species at present, it has been reported in at least two locations, South Yorkshire and Liverpool. In South Yorkshire, it has been recorded for at least two years.

There are a number of evidence gaps that could be investigated to give additional confidence to the risk assessment. The following research is needed in GB to fill these gaps:

- The provenance of commercial strains being used/grown in GB should be established and whether the highly invasive strains are available.
- DNA barcoding of the wild colonies in South Yorkshire and Liverpool to establish if they are of the invasive strains.
- Citizen science campaign to encourage recording of this species among foragers and field mycologists.
- Research into competitive interactions with wood decay fungi, native to GB.
- Research into the impact on other taxa inhabiting deadwood.
- Research into decomposition rates and its impact on carbon turnover in woodlands.
- Establish spore dispersal distances, spore volumes and spore viability.

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