Summary of the Express Pest Risk Analysis for *Neoclytus acuminatus*			
PRA area: Ireland			
Describe the endangered area: Forestry/Wider environment			
Main conclusions *Neoclytus acuminatus* is highly polyphagous and invasive North American cerambycid (longhorn beetle) species. It has become well established as an invasive non-native species in continental Europe, where it continues to spread and expand its range. However, it has not to date become established in north western Europe despite occasional introductions including in Ireland. The species is regarded as a secondary pest since attacks on healthy trees has not been widely reported. Current evidence suggests pest attacks are in association with cut timber/logs or with trees in decline. Overall impacts for Ireland are rated as low. While the highly polyphagous *N. acuminatus* could be associated with a number of commodities for entry into Ireland, uncertainty surrounds how suitable the Irish climate is for establishment. It is likely the Irish climate is not highly favourable for the development of several generations of this species or the build up of population densities as seen in other warmer climates. Irish ash affected by ash dieback may aid establishment and may make trees in Ireland more vulnerable and suitable for attack. With no evidence of significant economic, environmental or social impacts found for *N. acuminatus* in its current distribution (native and invaded), the overall impact rating is low for Ireland.			
Phytosanitary risk for the *endangered area* *(Individual ratings for likelihood of entry and establishment, and for magnitude of spread and impact are provided in the document***)**	High ☐	Moderate ☐	Low **X**
Level of uncertainty of assessment *(see section 17 for the justification of the rating. Individual ratings of uncertainty of entry, establishment, spread and impact are provided in the document)*	High ☐	Moderate **X**	Low ☐
Other recommendations: • A pest factsheet will be produced.			

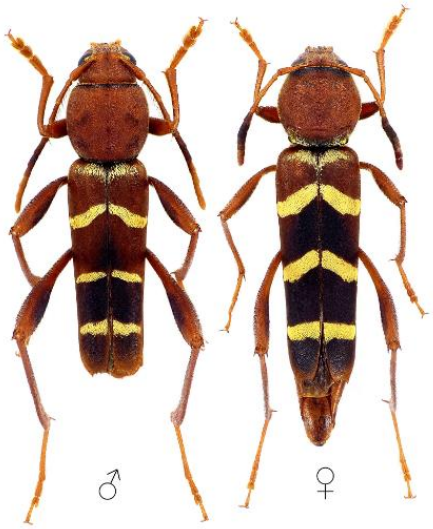

Figure 1. *Neoclytus acuminatus* male and female adults

Express Pest Risk Analysis (Ireland):

……..

***Neoclytus acuminatus* (Fabricius 1775)**

Initial draft prepared by: *Andy Bourke*
Date: 30.06.2021
Authors: Andy Bourke[a] and Conor Francis McGee[a]
Reviewers: Robyn Earl[a]; Michael Gaffney[b], Louise McNamara[b]; Dheeraj Rathore[b]
Affiliation(s): [a] Department of Agriculture, Food and the Marine, Ireland; [b] Teagasc, Ireland.

Stage 1. Initiation

Reason for performing the PRA:

The PRAU were informed of a suspected finding of *Neoclytus acuminatus* (Fabricius 1775) in Dublin by the National Biodiversity Data Centre (NBDC). A member of the public submitted a photo in May 2021 and details of an indoor sighting of a longhorn beetle seen in February 2021. No specimen was retained by the citizen scientist. The longhorn beetle in the photo was identified as suspected *N. acuminatus* but could not be verified as microscopic examination would have been desirable in this case.

The invasiveness and potential impacts of this species were unclear for Ireland therefore a rapid PRA was performed.

PRA area: Ireland

Stage 2. Pest risk assessment

1. Taxonomy & Nomenclature

A member of the Cerambycidae family and the tribe Clytini, the genus *Neoclytus* comprises ~55 species that are seemingly restricted to the Western Hemisphere (Ray *et al*., 2015). The species subject to this risk assessment, *Neoclytus acuminatus* has two recognised subspecies, *Neoclytus acuminatus acuminatus* (Fabricius, 1775) and *Neoclytus acuminatus hesperus* (Linsley, 1935). Heffern (1998) notes since there are no natural boundaries separating the subspecies, intergrades are common. The chief difference between the subspecies is colouration. The majority of the literature reviewed primarily concerns the species *Neoclytus acuminatus,* rather than specifying either of its subspecies.

2. Pest overview

2.1 Origin

North America, in the eastern states of United States of America.

2.2 Current Distribution

Recently Keszthelyi (2021) comprehensively examined the scientific literature, available phytosanitary reports and online sources to determine the global distribution and range of expansion of *N. acuminatus*. Records for a total of 21 countries were found to have either current stable populations or had previous

temporary findings of *N. acuminatus*. In North America, where the species is native and endemic, *N. acuminatus* has since spread south and westward. The analysis by Keszthelyi (2021) determined established populations now exist in Austria, Croatia, Germany, Hungary, Italy, Madeira (Portugal), Montenegro and Slovenia (Fig 2).

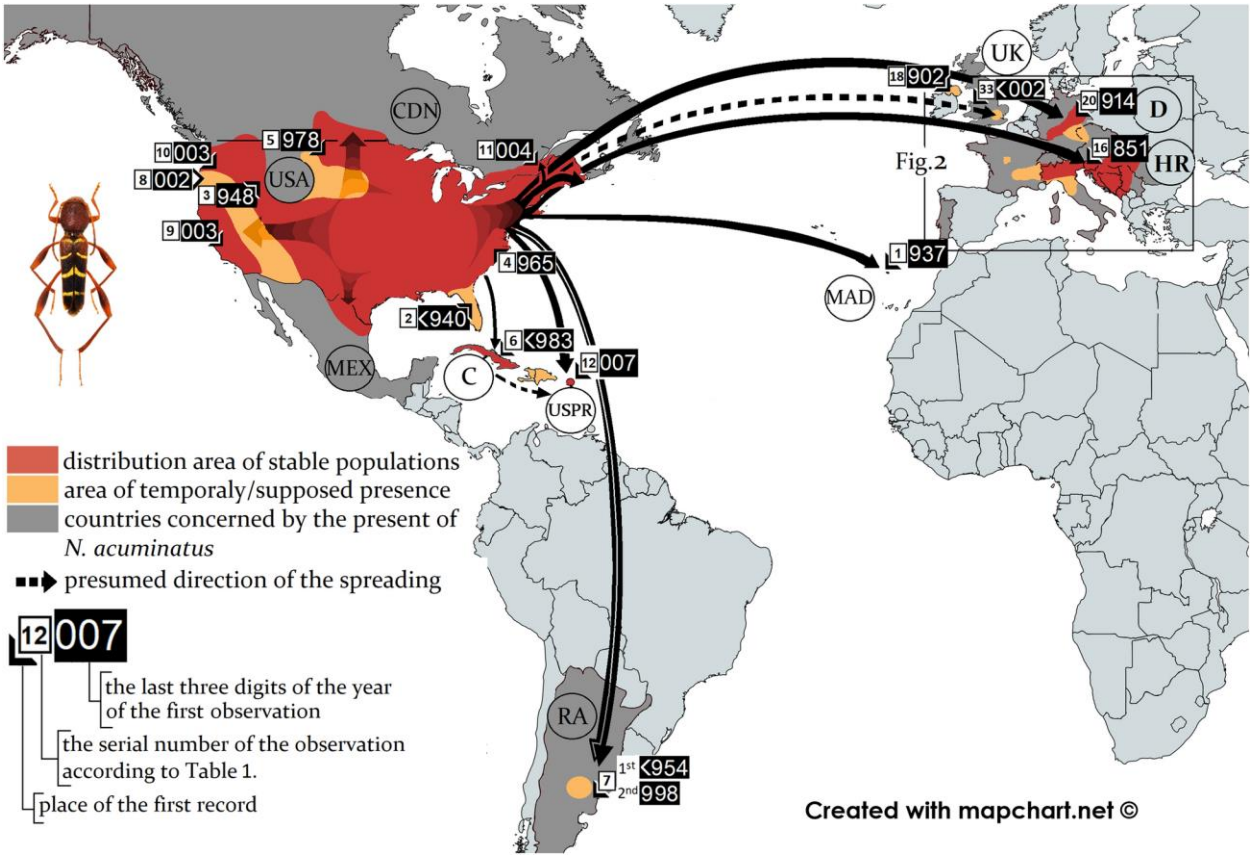

Figure 2. Main first records, distribution and the theoretical spreading of *Neoclytus acuminatus* across the world. From Keszthelyi, (2021).

The oldest recorded European findings were from Croatia in 1851 & 1891 (Pennerstorfer & Kriechbaum, 2018; Keszthelyi, 2021). The next published finding for the species was recorded in Belfast, Northern Ireland in 1902 (Buckle, 1902). Findings in Croatia and nearby in northern Italy were also reported in 1908 (Cocquempot and Lindelöw 2010; Keszthelyi, 2021), these areas in Croatia and Italy are now considered to have stable populations (Fig. 2). Further spreading of *N. acuminatus* in Europe has since occurred and is particularly pronounced in the Balkan region in south eastern Europe (Keszthelyi, 2021). Of note are populations that are geographically separated from these areas, such as in the Mark Brandenburg province in Germany (Keszthelyi, 2021). Occasional records have also been found further westwards in other German provinces (Keszthelyi, 2021).

In regard to further expansion and in particular, any north western expansion in Europe, the most northern records of established populations in continental Europe are from Switzerland and Germany. There are some records from the South of France, however with the last of these records being made in the 1980s and with no recent observations, successful establishment in France cannot be confirmed (Keszthelyi, 2021).

Thus, any westward spread of the species appears not to have reached or established in France or the Benelux states of Belgium, the Netherlands, and Luxembourg.

The newest European record for a country to report a first finding is from Austria from 2018, where some specimens were found in a fig tree (*Ficus carica*). It is not clear if this introduction stemmed from the established populations in Europe or from trade from North America (Pennerstorfer & Kriechbaum, 2018; Keszthelyi 2021).

While a recent paper (Sabol *et al.*, 2020) has confirmed the permanent occurrence of *N. acuminatus* in Slovakia, the species was already reported from Slovakia but there had been uncertainty on its current status as outlined in Keszthelyi (2021). The authors, Sabol *et al.* (2020) produced a current *N. acuminatus* distribution map and remark that due to the relatively rapid spread of the species, other findings in other parts of the Slovakia are expected.

Noteworthy is how Cocquempot and Lindelöw (2010) observe that *N. acuminatus* appears to be one of two non-native longhorn beetles (the other being *Xylotrechus stebbingi*) that have colonized natural habitats and forests in Europe, with the majority of other non-native longhorn beetles established in urban areas, parks and man-made habitats.

In terms of areas with the highest population densities, Keszthelyi (2021) analysis of online records showed eastern and southern parts of the USA had highest population densities (Fig 3). In Europe, Slovenia, Italy, Croatia, Hungary and Bosnia had high population densities (Fig 3). Similar conclusion was drawn when analysis of GBIF records online was performed (see Appendix).

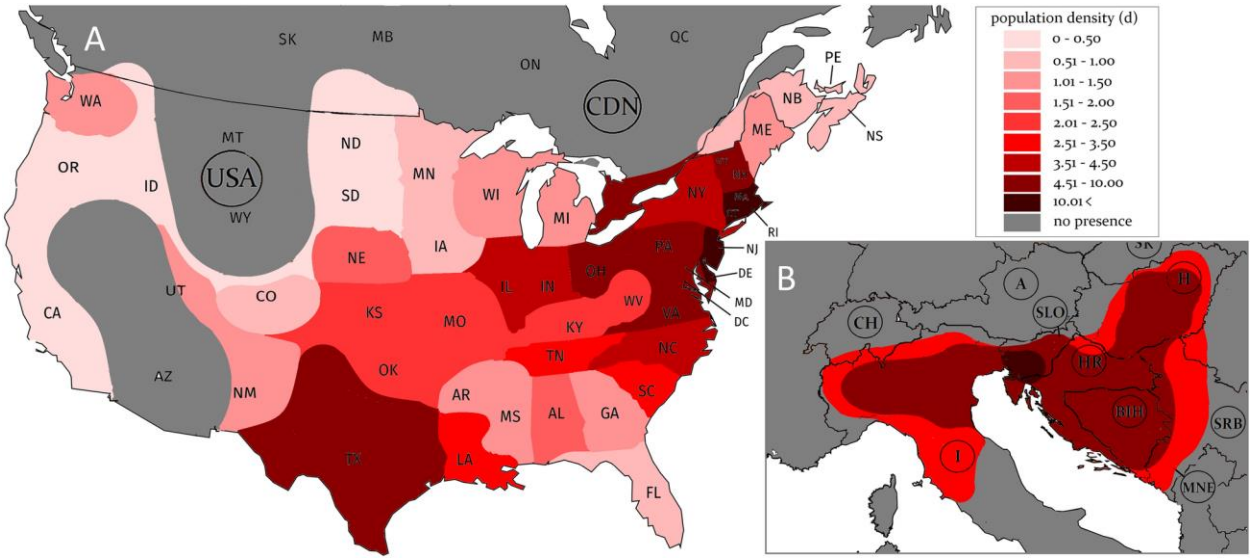

Figure 3. The estimated population density based on the online observation records. a North America; b: Europe. From Keszthelyi (2021).

2.3 Hosts

The major hosts of *N. acuminatus* are species from the *Fraxinus* (Ash) genus in both its native North America and in its invaded region in Europe. For instance, there are records on *Fraxinus excelsior* (European ash) in Europe (Sabol *et al.*, 2020).

Neoclytus acuminatus is considered one of the most polyphagous members of the Cerambycidae family in North America and has been recorded breeding in at least 35 woody plant genera (MacRae & Rice, 2007). No host list is available on EPPO and CABI for this species. Based on several literature sources (Bense 1995; Hack, 2017; Solomon 1995; Cocquempot and Lindelöw 2010) a list of known hosts is presented in the Appendix, to genus level as precise information on its specific hosts to species level is lacking.

Hosts are mostly deciduous trees, including fruit trees and ornamental shrubs. Recently, Maier (2018) confirmed further new hosts, with new conifers hosts like *Picea abies* (Norway spruce) particularly noteworthy.

2.4 Lifecycle & Aetiology

Neoclytus acuminatus adults vary greatly in length ranging from 4 to 18 mm. They are reddish brown in colour with four yellow bands of fine hairs across the elytra (Solomon, 1995; Hack, 2017). The contrasting yellow and black colours of *N. acuminatus* is perhaps linked to wasp mimicry, other species in the tribe

Clytini are known to be Batesian mimics (Hanceanu *et al.*, 2021). Also, of note are the middle and hind legs for this species are longer than the front pair (Solomon, 1995; Hack, 2017).

The species lifecycle and length of development differs across its current locations. In the southern American states such as Texas or Alabama, *N. acuminatus* has multiple generations (two to three) per year. Whereas in the northern American states such as Illinois or Idaho the species is mostly one generation per year (Solomon, 1995; Hack, 2017). In Europe, the beetle takes one to two years to complete its life cycle (Hanceanu *et al.*, 2021).

In the warmer areas and typically those areas with multiple generations, the adult flight seasons (period of adult activity) are longer. For example, in the south-east American states, the flight season is from March until September. In the Mediterranean region of Europe, the flight season was found to be from the beginning of May until the end of July. In contrast, in more northern cooler regions, there is a short flight season such as in Idaho and Canada where the flight period is only from the middle of June to the end of July (Keszthelyi, 2021).

New *N. acuminatus* adults emerge by creating a circular exit hole 2-5mm in size through the bark to emerge (Solomon, 1995; Hack, 2017). Adults apparently do not feed, and usually live for fewer than 16 days (Lacy *et al.*, 2004). The males produce an aggregation pheromone, leading to numerous individuals of both sexes accumulating on host trees (Hanceanu *et al.*, 2021). After mating, eggs are most often deposited in bark crevices and cracks of trees or cut logs. Following egg hatch, usually within 6 days, young larvae rapidly penetrate the bark, tunnel in cambial region and then enter the sapwood. They complete their development by passing through six instars in the sapwood. No studies were found outlining how far the larvae typically bore into the sapwood, although it was found that they never enter the heartwood. The larvae characteristically pack their galleries tightly with fine, granular frass (Solomon, 1995; Hack, 2017).

This species overwinters most frequently in the larval stage, inside the timber. If the infested material is sawed, stored, and dried out, emergence can be delayed several years (Anon, 2021).

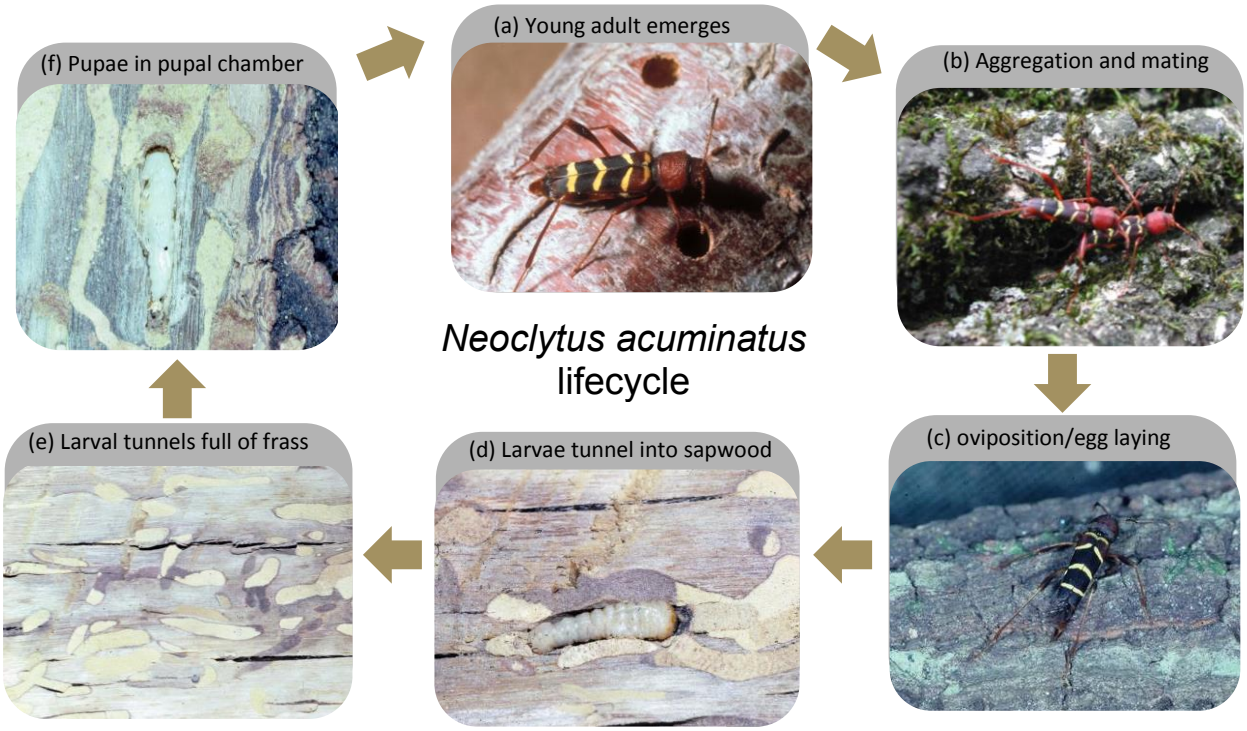

Figure 4: Lifecycle of *Neoclytus acuminatus.* (a) New *N. acuminatus* adults emerge through a circular exit hole (2mm-5mm). (b) Male adults produce an aggregation pheromone, leading to both sexes accumulating on host trees. (c) After mating, eggs are most often deposited in bark crevices and cracks of trees or cut logs (d) Young larvae tunnel in cambial region and sapwood, passing through six instars. (e) The larvae characteristically pack their galleries tightly with fine, granular frass. (f) This species

overwinters in the larval stage, inside the timber. Pupation takes place in early spring in a pupal chamber close to the outer sapwood.

2.5 Management, Monitoring and Control Options

In general, impacts from *N. acuminatus* can be reduced by implementing controls typical for other common wood boring insects. These management practices include removal of infested wood prior to insect emergence, treatment with protective insecticide sprays to coincide with egg laying and cultural practices that overall improve tree vigour (Keszthelyi, 2021).

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

There are no reports indicating *Neoclytus acuminatus* is an important vector. However, in one study by Moore *et al.* (2019) the fungus *Geosmithia morbida* was detected on *N. acuminatus* in eastern USA along with 17 other coleopteran insect species. *Geosmithia morbida* is an EU regulated pest (Annex II B) that causes thousand cankers disease of *Juglans*. The potential role of *N. acuminatus* and other coleopteran in disease transmission remains to be further studied. The bark beetle *Pityophthorus juglandis* is currently the only know vector to transmit the fungus to healthy *Juglans* trees.

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

5. Regulatory status of the pest

Neoclytus acuminatus is a regulated pest in China, Peoples Republic of Korea and New Zealand.

6. Distribution

Continent	***Distribution*** *(list countries, or provide a general indication, e.g. present in West Africa)*	*Provide comments on the pest status in the different countries where it occurs e.g. widespread, native, introduced….)*	***Reference***
Africa			
America	*USA, Canada*		(Keszthelyi, 2021)
Asia			
Europe	*Austria, Croatia, Germany, Hungary, Italy, Montenegro, Serbia, Slovakia, Slovenia, Switzerland, Romania*		(Keszthelyi, 2021)
Oceania			

Neoclytus acuminatus is not known to be present in Ireland. There is one record of a single beetle identified as *Neoclytus erythrocephalus (*synonymous with *Neoclytus acuminatus*) from 1902 found in a Belfast timber yard. The author Buckle (1902) noting that the North American species undoubtedly came from imported timber.

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

Host Scientific name (common name)	**Presence in PRA area** (Yes/No)	**Comments** (e.g. total area, major/minor crop in the PRA area, *major/minor habitats**)	***Reference***
Fraxinus (Ash)	Yes	*Fraxinus* spp. is the host primarily associated with *N. acuminatus*. Fraxinus excelsior is a native and widespread species in Ireland.	See Appendix
Carya, Celtis, Diospyros, Juglans, Quercus, Ulmus	Yes	Other major hosts for the pest. In particular, *Quercus* trees are widespread in Ireland	See Appendix
Acer, Betula, Carpinus, Castanea, Cercis, Cercocarpus, Cornus, Corylus, Euonymus, Fagus, Ficus, Hibiscus, Gleditsia, Ilex, Juglans, Liquidambar, Liriodendron, Lonicera, Maclura, Malus, Morus, Ostrya, Populus, Prunus, Pyrus, Robinia, Rosa, Salix, Sassafras, Syringa, Tilia, Vitis as well as occasionally on conifers such *as Abies, Picea* and *Tsuga*	Yes	Minor hosts for the pest.	See Appendix

8. Pathways for entry

There are several pathways of entry through which *N. acuminatus* could be introduced into Ireland.

Wood including round-wood, sawn wood and debarked wood are possible pathways. *Neoclytus acuminatus* eggs are laid in the bark crevices and young larvae must first penetrate the bark. They then bore further into the sapwood to complete their development, therefore debarking of timber is unlikely to remove them at this stage of their lifecycle. However, debarking would be effective in reducing the risk of entry of eggs and the youngest larvae.

Wood products such as firewood and wood chips are possible pathways. *N. acuminatus* has been associated with timber intended for firewood (Keszthelyi, 2021; Anon, 2021). While longhorn beetles in general, can be associated with the wood chips pathway (EPPO, 2015). Wood chips larger than 2.5cm from initial timber material that was fresh and untreated are particularly high risk (EPPO, 2015).

Wood-packaging material (WPM) is recognized as one of the main pathways of introduction of invasive wood-boring beetles (Rassati *et al.*, 2016). WPM that originates from outside of the EU must be compliant with ISPM 15 phytosanitary standard that requires debarking and treatment in the form of heat or fumigation. ISPM 15 has greatly reduced the rate of living wood-boring beetles infesting WPM (Rassati *et*

al., 2016). For *N. acuminatus*, larvae can burrow into the sapwood and so may still be present on bark free WPM, though heat treatment required for ISPM 15 would likely be effective against this species.

However, some interceptions are still reported of live wood-boring beetles in WPM on international trade and cases of non-compliance with the ISPM 15 phytosanitary measures do occur. In addition, WPM entering Ireland from most EU countries including those where *N. acuminatus* is distributed doesn't have to meet ISPM 15 standard. This indicates a risk of introducing *N. acuminatus* via the WPM pathway is a viable pathway of entry into Ireland. Although this is probably still low risk as it is believed that most of this WPM from Europe entering Ireland is made of conifer wood and not from the hardwood hosts of *N. acuminatus.*

Across some of *N. acuminatus's* existing range in North America, it is a pest of nursery stock and young trees thus plants for planting could be a pathway. Several of the main hosts of *N. acuminatus* are prohibited for import for plants for planting into the EU including *Fraxinus, Juglans, Quercus* and *Ulmus*. There are no reports of any impacts in Europe on young trees.

A hitchhiking pathway is possible, trade and travel to the areas where *N. acuminatus* is currently distributed and Ireland exists. However, the ability of *N. acuminatus* to survive away from a host is unclear.

- To help to further assess these pathways, a search for evidence of *N. acuminatus* moving in trade was completed.

According to Europhyt/TRACES-NT covering all interceptions in Europe since 1995 there were no interceptions of *N. acuminatus* recorded. Despite now a well-established non-native species in Europe, it hasn't been intercepted before. Although since *N. acuminatus* is not regulated in Europe and now widely distributed in some countries, interceptions and new findings may not be reported officially by authorities or NPPOs.

There has been findings of *N. acuminatus* in international ports in north-eastern Italy. Rassati *et al*. (2014) set up traps for wood-boring beetles around four ports. Several non-native species were trapped including three *N. acuminatus*. It could not be determined if the *N. acuminatus* captures corresponded to new arrivals from North America or from movements internally since *N. acuminatus* is already established for a long time all over the country and in surrounding countries.

In Australia, one interception was recorded for *N. acuminatus* associated with wood packaging material in the period 1975–2003 (Biosecurity Australia, 2006).

Lacey *et al*. (2004) reports on how pheromone trap-based surveys for *N. acuminatus* have taken place in New Zealand (where it is a regulated, quarantine and non-notifiable pest) after there was apparently an introduction of this species.

- Trade & Current Regulatory Mitigations

Neoclytus acuminatus is not a regulated pest in Ireland or in Europe.

Ireland imports *N. acuminatus* host material from USA & Canada, the only third countries where *N. acuminatus* is currently distributed. A number of these hardwood host commodities such as *Fraxinus, Juglans, Quercus* and *Ulmus* have phytosanitary requirements that may reduce likelihood of the introduction of *N. acuminatus* also.

Fraxinus is one of the main hosts of *N. acuminatus* and also a commodity likely to imported into Ireland from third countries due to demand from certain industries such as hurley making.

Based on trade for this year from TRACES, ash imports from USA & Canada could only be found for the following commodity
-440795 - Ash "Fraxinus spp.", sawn or chipped lengthwise, sliced or peeled, whether or not planed, sanded or end-jointed, of a thickness of > 6 mm.
Of this commodity, Ireland imported >470 Tonnes from the USA and >170 Tonnes from Canada in 2020 (Eurostat, 2021). Phytosanitary measures for *Agrilus planipennis* (Annex VII point 87 of (EU) 2019/2072

and requirements of (EU) 2020/1002) in particular if the treatments options of removing bark, a portion of the outer sapwood or heat treatment are applied these should minimise the risk of introduction of *N. acuminatus* also.

Neoclytus acuminatus is highly polyphagous and numerous potential trading pathways exist, for this rapid PRA detailed trade & regulations analysis in addition to the main *Fraxinus* host above wasn't performed.

For Europe, trade data isn't readily available for intra EU trade. As *N. acuminatus* is currently well established in a number of European countries and not under official control, the pest could potentially enter in the trade into Ireland in a number of commodities. Hardwood hosts including those of hosts of *N. acuminatus* are generally less regulated within EU than conifer hosts. For instance, Ireland's protected zones for six bark beetles concern requirements for wood of conifers.

Possible pathways *(in order of importance)*	**Short description explaining why it is considered as a pathway**	Pathway prohibited in the PRA area? Yes/No	Pest already intercepted on the pathway? Yes/No
Wood including roundwood, sawn wood and debarked wood from *N. acuminatus* hardwood host species.	Eggs, larvae, pupae and adults may be present	No	No
Wood products including firewood and wood chips from *N. acuminatus* hardwood host species	Eggs, larvae, pupae and adults may be present	No	No
Wood Packaging Material (WPM) made from *N. acuminatus* hardwood host species	Eggs, larvae, pupae and adults may be present	No	Yes
Plants for Planting of *N. acuminatus* host species	Eggs, larvae, pupae and adults may be present on live plants for planting	Yes (Plants for planting hosts *Fraxinus, Juglans, Quercus* and *Ulmus* are prohibited from outside EU according to (EU) 2018/2019)	No
Hitchhiking	Eggs, larvae, pupae and adults	No	No

Neoclytus acuminatus has successfully been introduced into new areas, particularly in Europe. As discussed above, it is a species not commonly intercepted by NPPOs but quite clearly is a highly invasive species that has entered a number of new countries. These new introductions would require human mediated means such as trade for long range dispersal of the species. Recent introductions into new countries have been recorded, such as in Austria in 2018 (Pennerstorfer & Kriechbaum, 2018).

For Ireland, there has been one recent reported introduction into Ireland that initiated this assessment and one historic finding from 1902 in Belfast. Given the recent sighting of *N. acuminatus* in Ireland and given that highly polyphagous *N. acuminatus* could be associated with a number of commodities for future entry, the score for potential for entry was rated high with low uncertainty.

Rating of the likelihood of entry	*Low* ☐	*Moderate* ☐	*High* **X**
Rating of uncertainty	*Low* **X**	*Moderate* ☐	*High* ☐

9. Likelihood of establishment outdoors in the PRA area

Establishment of the species requires adults to emerge from imported commodities and locate new hosts. *Neoclytus acuminatus* has a largely cryptic life cycle living within wood. In addition, initial attacks are often difficult to diagnose because there are no open entrance holes and little frass is ejected (Solomon 1995). This could aid in the initial establishment of the pest and allow the pest to go undetected.

It is likely that Ireland climate is not optimal for quick establishment or for rapid build-up of significant numbers of *N. acuminatus*. No studies were found specifying the developmental or climatic thresholds for this species. However, Stefanelli *et al.* (2014) classes the species as thermophilic, heat loving. While Keszthelyi (2021) found increased *N. acuminatus* adult activity and abundance in the warmer southern regions of America compared to northern regions of America. These warmer regions allow for up to three generations of the species in a year, where a generation can be completed quickly in 60 to 90 days (Solomon, 1995). In the Europe and even in the warmer Mediterranean region, the seasonal activity of adults has not yet reached the level as in the southern states in America (Keszthelyi, 2021). For Europe one generation is most common (Jurc *et al.*, 2016).

While there are some records from GBIF that place *N. acuminatus* in the temperate Köppen-Geiger climate Cfb (see Appendix), the climate type that is found in Ireland, there doesn't appear to be sufficient evidence to say *N. acuminatus* has successfully colonized these regions. Based on the analysis by (Keszthelyi, 2021) there doesn't appear to be any stable populations in the Cfb areas of Europe. The GBIF records may point to temporary introductions.

Neoclytus acuminatus has established in northern states in America and in Canada which suggest cold tolerance of the species would make it suitable to survive Irish winters. The large geographical distribution of the species including into new areas would suggest it's an adaptive species.

A key component of establishment is the availability of host plants. Highly polyphagous species like *N. acuminatus* have higher potential to establish. There is a wide availability of host plants in Ireland for *N. acuminatus.* In particular for ash (*Fraxinus excelsior*) which makes up approx. 3.8 % of the forestry tree species in Irish forests (DAFM, 2020) and is the second most important tree component in Irish hedgerows (McCracken *et al*., 2017). In addition, ash that has been affected by ash dieback may provide suitable host condition (weak, stressed, dying trees) required for *N. acuminatus* colonization.

Since ash dieback is now found in various settings – forests, nurseries, on farm planting, roadside planting, hedgerows and private gardens in all 26 counties (DAFM, 2020) there is an abundance of host material susceptible to attack from *N. acuminatus*.

The score for establishment was rated moderate with high uncertainty due to the lack evidence of continuous establishment of *N. acuminatus* in similar climatic regions to Ireland.

Rating of the likelihood of establishment outdoors	*Low* ☐	*Moderate* **X**	*High* ☐
Rating of uncertainty	*Low* ☐	*Moderate* ☐	*High* **X**

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

The pest is unlikely to pose a threat to the Irish protected cultivation sector given the low number of host plants produced under this condition in Ireland.

Rating of the likelihood of establishment in protected conditions	*Low* **X**	*Moderate* ☐	*High* ☐
Rating of uncertainty	*Low* **X**	*Moderate* ☐	*High* ☐

11. Spread in the PRA area

Neoclytus acuminatus has a history of spreading and expanding its range rapidly. Within countries there is evidence of rapid spread, such as recently in Slovakia (Sabol *et al*., 2020). Spread of the species could become more intense with climate change and with increasing trade and travel.

There is an absence of information on natural spread and flying capabilities of *N. acuminatus*, it is not known how far natural spread is possible. However, longhorn beetles do not generally disperse far. The climate in Ireland should limit *N. acuminatus* to one generation. The rate of spread is rated as low with moderate uncertainty.

Rating of the magnitude of spread	*Low* **X**	*Moderate* ☐	*High* ☐
Rating of uncertainty	*Low* ☐	*Moderate* **X**	*High* ☐

12. Impact in the current area of distribution

Neoclytus acuminatus commonly infests hosts trees in weakened, dead and dying condition (Solomon, 1995; Hack, 2017). Hanks and Wang (2017) list *N. acuminatus* larvae as primarily feeding on trunks and branches of stressed hardwoods.

Although Solomon (1995), Barndt *et al.* (2008) and Hack (2017) state *N. acuminatus* is most destructive to recently felled, unseasoned logs containing bark. When infestations are high, these infested logs can be unmarketable due to the abundance of galleries reducing the quality of the wood.

Therefore, with damage mainly reported on weakened trees or on cut wood *N. acuminatus* could be considered a secondary pest across much of its range in North America but still a pest of economic significance given the impacts listed above.

In his review of "Cerambycid Pests in Forests and Urban Trees", Hack (2017) list *N. acuminatus* among 43 longhorn beetle pests reviewed that could be considered an economic pest.

Neoclytus acuminatus has also been reported as a pest to newly planted living trees and in young nursery stock in the north central American states. Larval tunnels usually follow the direction of wood grain but in young trees, the larval tunnels may extend both horizontally and vertically through the trunk, making it more prone to breakage. The larval damage in the inner bark can also result in the cutting off the sap flow (Anon, 2021).

There has also been reports of apparently healthy *Robinia* trees in America becoming infested and damaged by *N. acuminatus* (Solomon 1995).

In Europe, reports of any significant impacts could not be found. Jurc *et al.* (2016) cited a case (Hrašovec, 2009) of a secondary but intensive attack of *N. acuminatus* on water stressed *Celtis* (nettle tree) planted along a street in Croatia.

Previously in Italy *N. acuminatus* was recorded as boring in the branches of grapevines. However, Manzoni (1930) established that only dead or dying vines were attacked and showed through experiments that eggs were not laid on the living vine hosts.

Frigimelica *et al.* (1999) observed *N. acuminatus* laying eggs into dying *Juglans* trees in Italy.

The first findings of *N. acuminatus* in Austria were collected from a frost damaged *Ficus carica* (Fig tree) (Pennerstorfer & Kriechbaum, 2018) indicating these trees were stressed or weakened.

Given the successful establishment and continued spread of *N. acuminatus* in Europe, there is concern about the potential ecological impact of the invasive *N. acuminatus*. However, to date in Europe there are no studies or measure of this ecological impact on native trees or native fauna (Cocquempot & Lindelöw, 2010).

Due to numerous public accounts of emerged *N. acuminatus* adults indoors in the US that were likely brought inside with firewood, *N. acuminatus* can be considered a nuisance pest but one that causes no damage in homes (Anon, 2021).

Overall, impacts in the current area of distribution are rated as low to moderate. Since dying or recently killed hardwoods are impacted, *N. acuminatus* is considered a secondary pest.

Rating of the magnitude of impact in the current area of distribution	*Low* ☐	*Moderate* **X**	*High* ☐
Rating of uncertainty	*Low* **X**	*Moderate* ☐	*High* ☐

13. Potential impact in the PRA area

12.1 Economic Impact

Since *N. acuminatus* attacks weakened/stressed trees and cut logs the economic impacts are rated as low. *Neoclytus acuminatus* is largely a secondary pest as the species has not been widely reported to date to infest healthy trees and cause tree mortality. Thus, the pest causes no significant economic impact in its current distribution.

It is possible that *N. acuminatus* would hasten the death of a tree. While also wood marketability and quality would likely suffer in some instances from *N. acuminatus*. Economic impacts based on current evidence are rated low with medium confidence due to uncertainty on the extent of the economic effects on quality mentioned above.

Uncertainty also exists around potential impacts on *Robinia* trees, on young plants and in nursery stock for Ireland. Some impacts on these sectors were recorded from North America. However, in its invaded region in Europe there have been no reports. In general, impacts in Europe to-date seem to be much less than in its native region.

12.2 Ecological Impact

It is not yet known what the impact is on local environments in the *N. acuminatus* invaded areas in Europe. *Neoclytus acuminatus* could impact and displace native fauna in Ireland. Conversely *N. acuminatus* can also be viewed in its native area as contributing to healthy forests by hastening the decomposition of dead and dying timber, making more nutrients and space available to healthy plants (Keszthelyi, 2021). In the absence of information and studies on *N. acmuniatus's* negative impact on the environment, the environmental impact here is considered to be low with high uncertainty.

12.3 Social Impact

Neoclytus acuminatus has emerged indoors from plant and wood material brought inside, as has been seen in America and with the recent sighting in Ireland. *Neoclytus acuminatus* could be classed as a nuisance pest, but one that causes no harm to people. The social impacts of the pest in Ireland are considered to be low with medium uncertainty.

Overall, since no evidence of significant economic, environmental or social impacts have been found for *N. acuminatus* in its current distribution (native and invaded), the overall impact rating is low for Ireland.

Rating of the magnitude of impact in the area of potential establishment	*Low* **X**	*Moderate* ☐	*High* ☐
Rating of uncertainty	*Low* ☐	*Moderate* **X**	*High* ☐

14. Identification of the endangered area

Neoclytus acuminatus affects a number of hardwood hosts. Conifer trees are the mainstay in commercial forestry in Ireland, however hardwoods such as ash are used for sawlogs and used in the manufacture of hurleys. In addition, ash is important for firewood. Thus, the endangered area is a significant part of Irish forestry.

15. Overall assessment of risk

Neoclytus acuminatus is highly polyphagous and invasive North American cerambycid (longhorn beetle) species. The species has become well established as an invasive non-native species in continental Europe and continues to spread and expand its range. However, it has not to date become established in north western Europe despite occasional introductions including in Ireland. Current evidence suggests pest attacks are in association with cut timber/logs or with trees in decline. Economic impacts are therefore rated as low and overall impact is rated as low.

While it is uncertain how suitable the Irish climate is for establishment, it is clear Irish climate is not optimal or highly favourable for development of this species. If *N. acuminatus* establishes, eradication from the wider environment would be difficult for this species. In addition, Irish ash affected by ash dieback may aid establishment and may make trees in Ireland more vulnerable and suitable for attack. Wider ecological impacts are very uncertain due to the limited available information about the pest impacts on biodiversity.

Overall, the risk posed by *N. acuminatus* is rated as low.

Stage 3. Pest risk management

16. Phytosanitary measures

No regulatory action is currently recommended, however since uncertainty surrounds many aspects of *N. acuminatus* this could be reviewed in the future. Increased awareness of this species as an unwanted non-native species with potential for entry and establishment in Ireland could be considered. Especially since the characteristics of this beetle are compatible with this type of monitoring (relatively large size (4-18 mm), commonly emerges indoors, distinctive appearance).

17. Uncertainty

Many aspects of the species biology are lacking information, including those important for assessing the risk the species pose to Ireland. These include climatic and thermal requirements, natural spread and flying distance, interaction with ash dieback disease and other weakened susceptible hosts in Europe.

18. Remarks

A pest factsheet will be produced for *N. acuminatus*.
The PRA will be uploaded to the EPPO PRA platform.

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Appendix

A. Photo credits:

Figure 1 © D.Navrátil & M.Hoskovec
http://www.cerambyx.uochb.cz/neoclytus_acuminatus_acuminatus.php

Figure 4 Lifecycle © (a) Howard Ensign Evans, Colorado State University, Bugwood.org (b) Pennsylvania Department of Conservation and Natural Resources - Forestry , Bugwood.org (c), (d), (e) & (f) Lacy L. Hyche, Auburn University, Bugwood.org.

B. Host records

Table 1: Hosts of *Neoclytus acuminatus* with bibliographical references and records from North Armerica and Europe combined.

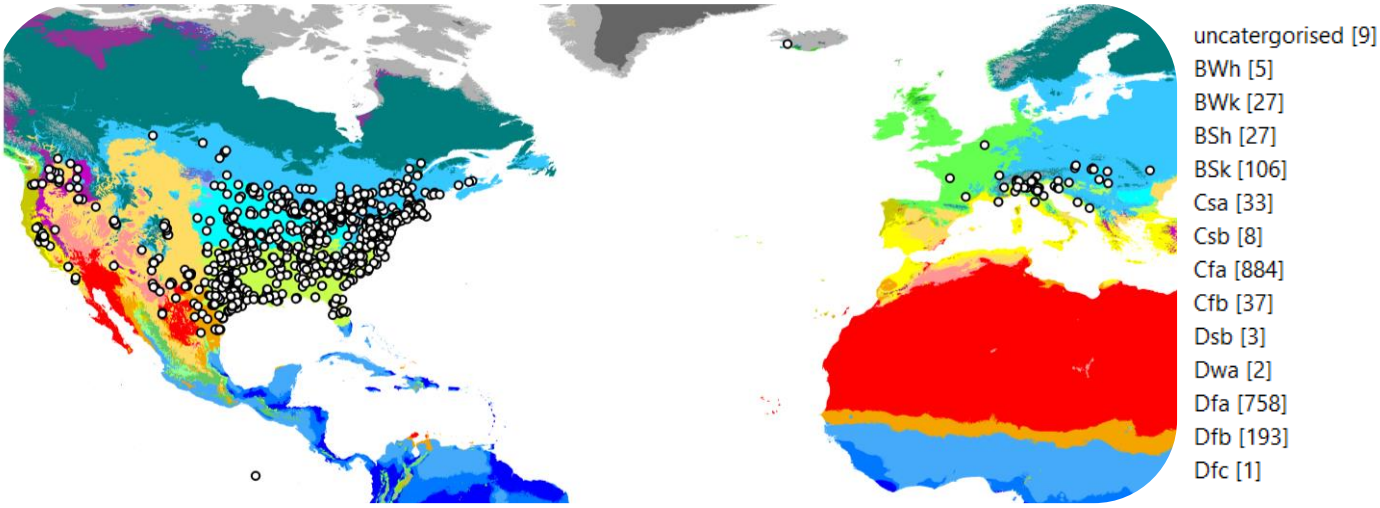
Table 1: Hosts of *Neoclytus acuminatus*

Genus	Host preference	Region	Reference
Fraxinus	Main	North America, Europe	(Hack 2017);(Solomon 1995); (Cocquempot and Lindelöw 2010)
Carya	Main	North America	(Hack 2017);(Solomon 1995)
Celtis	Main	North America, Europe	(Hack 2017);(Solomon 1995); (Jurc et al 2016)
Diospyros	Main	North America	(Hack 2017);(Solomon 1995)
Quercus	Main in NA, Occasional in Europe	North America	(Bense 1995);(Hack 2017);(Solomon 1995)
Abies	Occasional	Europe	(Bense 1995)
Acer	Occasional	North America, Europe	(Bense 1995);(Hack 2017);(Solomon 1995)
Betula	Occassional	North America, Europe	(Bense 1995);(Hack 2017);(Solomon 1995)
Carpinus	Occassional	North America, Europe	(Bense 1995);(Hack 2017);(Solomon 1995)
Castanea	Occassional	North America, Europe	(Bense 1995);(Hack 2017);(Solomon 1995)
Cercis	Occassional	North America, Europe	(Bense 1995);(Hack 2017);(Solomon 1995)
Cercocarpus	Occassional	North America	(Hack 2017);(Solomon 1995)
Cornus	Occassional	North America	(Hack 2017);(Solomon 1995)
Corylus	Occasional	Europe	(Bense 1995)
Euonymus	Occasional	Europe	(Bense 1995)
Fagus	Occasional	North America, Europe	(Bense 1995);(Hack 2017);(Solomon 1995)
Ficus	Occasional	Europe	(Bense 1995)
Gleditsia	Occasional	North America	(Hack 2017);(Solomon 1995)
Hibiscus	Occasional	Europe	(Bense 1995)
Ilex	Occasional	North America	(Hack 2017);(Solomon 1995)
Juglans	Occasional in NA, Main in Europe	North America, Europe	(Hack 2017);(Solomon 1995); (Cocquempot and Lindelöw 2010)
Liquidambar	Occasional	North America	(Hack 2017);(Solomon 1995)
Liriodendron	Occasional	North America	(Hack 2017);(Solomon 1995)
Lonicera	Occasional	Europe	(Bense 1995)

Table 1: Hosts of *Neoclytus acuminatus*

Genus	Host preference	Region	Reference
Maclura	Occasional	North America	(Hack 2017);(Solomon 1995)
Malus	Occasional	North America	(Hack 2017);(Solomon 1995)
Morus	Occasional	Europe	(Bense 1995)
Ostrya	Occasional	Europe	(Bense 1995)
Populus	Occasional	Europe	(Bense 1995)
Prunus	Occasional	North America, Europe	(Bense 1995);(Hack 2017);(Solomon 1995)
Pyrus	Occasional	North America, Europe	(Bense 1995);(Hack 2017);(Solomon 1995)
Robinia	Occasional	North America, Europe	(Bense 1995);(Hack 2017);(Solomon 1995)
Rosa	Occasional	Europe	(Bense 1995)
Salix	Occasional	Europe	(Bense 1995)
Sassafras	Occasional	North America	(Hack 2017);(Solomon 1995)
Syringa	Occasional	North America	(Hack 2017);(Solomon 1995)
Tilia	Occasional	North America	(Hack 2017);(Solomon 1995)
Ulmus	Occasional in NA, Main in Europe	North America, Europe	(Hack 2017);(Solomon 1995); (Cocquempot and Lindelöw 2010)
Vitis	Occasional	Europe	(Bense 1995)

C. Climate matching



GBIF occurrence records for *Neoclytus acuminatus* overlaid and count in [ ] for various Köppen-Geiger climate classifications. Ireland is in Cfb for which there are 37 records of *Neoclytus acuminatus.*