The Food & Environment Research Agency

Rapid Pest Risk Analysis (PRA) for

Platynota flavedana
Platynota idaeusalis
Platynota rostrana

STAGE 1: INITIATION

1. What is the name of the pest?

Three species are considered in this PRA because there are considerable similarities in their biology and all three are only present in the new world. All are tortricid moths (Lepidoptera, Tortricidae).
Platynota flavedana Clemens, variegated leafroller (VLR)
Platynota idaeusalis (Walker), tufted apple bud moth (TBAM)
Platynota rostrana (Walker), orange leafroller

Brown *et al.* (2011b) have suggested that *P. rostrana* may be a species complex, but the precise status has not been confirmed and it is treated as one species here.

There are no known taxonomic issues with either *P. flavedana* or *P. idaeusalis*. However, many species in *Platynota* are very similar, both as larvae and adults, and species identification can be problematic, particularly where the precise geographic origin of the specimen is unclear or the adult is in a worn condition.

2. What initiated this rapid PRA?

Platynota sp. larvae, believed to be either *P. rostrana* or *P. flavedana*, were detected on *Annona muricata* (custard apples) imported from Jamaica in August 2011. Although the consignment was not held in this case, it was anticipated that statutory action would be recommended following any future finds. As a result, the three species of *Platynota* included in this PRA (as well as a fourth species, *P. stultana*, which is covered in a separate PRA) were included in Phase I of the UK Plant Health Risk Register in 2013, and all were identified as a priority for PRA.

3. What is the PRA area?

The PRA area is the United Kingdom of Great Britain and Northern Ireland.

STAGE 2: RISK ASSESSMENT

4. What is the pest's status in the EC Plant Health Directive (Council Directive 2000/29/EC[1]) and in the lists of EPPO[2]?

None of these pests are listed in the EC Plant Health Directive.
They are also not currently listed in any EPPO lists. However, *Platynota* spp. were listed on the EPPO Alert List between October 1998 and January 2002, with details on three species: *P. flavedana, P. idaeusalis* and *P. stultana*.

5. What is the pest's current geographical distribution?

[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000L0029:20100113:EN:PDF
[2] https://www.eppo.int/QUARANTINE/quarantine.htm

Table 1: Distribution of *Platynota flavedana*	
North America:	USA (throughout the eastern states, including): Massachusetts, New York, Pennsylvania and down the East coast to Florida. Louisiana, south-east Texas, Arkansas and north to Iowa and Michigan (MacKay 1962), Virginia (Bobb 1972, Lam *et al.* 2011), Ohio, New Jersey (in Bobb 1972), Illinois (Sandberg & Passoa 1989) Records from the western USA are unverified (Gilligan & Epstein 2012), while Hull *et al.* (1995) state it is more common in southerly parts of its range
Central America:	Jamaica (EPPO 2014) Unconfirmed records from Hispaniola (Dominican Republic and Haiti) (Perez-Gelabert 2008)
South America:	No records
Europe:	No records
Africa:	No records
Asia:	No records
Oceania:	No records

Table 2: Distribution of *Platynota idaeusalis*	
North America:	Canada: British Colombia (EPPO 2014, Mayer & Beirne 1974), Nova Scotia (Hillier & Lefebvre 2012), Quebec, Ontario and Manitoba (MacKay 1962) USA (likely to be in all northern areas (Gilligan & Epstein 2012)): Michigan (EPPO 2014, Hogmire & Howitt 1979), New York (Powell & Brown 2012, Roelofs *et al.* 1976), Pennsylvania (e.g. Simelane *et al.* 1992), Virginia (e.g. Knight *et al.* 1990a, Lam *et al.* 2011), North Carolina (Meissner *et al.* 2001, Walgenbach 1990), Georgia, Delaware, New Jersey (Knight *et al.* 1990a), Nebraska (Powell & Brown 2012)
Central America:	No records
South America:	No records
Europe:	No records
Africa:	No records
Asia:	No records
Oceania:	No records

Table 3: Distribution of *Platynota rostrana*	
North America:	USA (southern states, including): Texas, North Carolina (MacKay 1962), Virginia (Lam *et al.* 2011), Florida (Rajapakse 1989), North Carolina (Powell & Brown 2012) Mexico (Brown *et al.* 2011b, Varela-Fuentes *et al.* 2009)
Central America:	Throughout Central America: Guatemala, Honduras, Nicaragua (Maes 2004), Costa Rica (MacKay 1962, Netherlands NPPO 2014), Panama (Maes 2004) Many islands in the Caribbean, and probably others not listed here: Cuba (de Armas & Nunez 2005, Vasquez *et al.* 1991), Jamaica (Fera unpublished data), Hispaniola (Dominican Republic and Haiti) (Perez-Gelabert 2008), Puerto Rico (MacKay 1962), Dominica, St Vincent, Grenada (Maes 2004)
South America:	Colombia, Venezuela (MacKay 1962, Maes 2004), Brazil (Nava *et al.* 2006)
Europe:	No established populations known. See also answer to question 6.
Africa:	No records
Asia:	No records
Oceania:	No records

The genus *Platynota* contains 35 described species (with many more still undescribed), and is native to the Americas, with species found from Canada to Argentina (Brown 2013). All

three species considered here are only known from the Americas, but their distribution differs: see Tables 1–3.

In summary, *P. flavedana* is found throughout the eastern half of the USA with a few records in the Caribbean, *P. idaeusalis* has been recorded through much of southern Canada and in all but the south-west of the USA (though the majority of records are from the East coast of the USA), and *P. rostrana* is found in the southern part of the USA, through Central America and the Caribbean, to parts of Brazil. Additionally, Hillier and Lefebvre (2012) report *P. rostrana* from Nova Scotia in eastern Canada (based on a museum collection), but no other reports of this species could be found from this far north. Therefore, this Nova Scotia record is not considered further in the remainder of this PRA.

6. Is the pest established or transient, or suspected to be established/transient in the UK/PRA Area? *(Include summary information on interceptions and outbreaks here).*
In the UK, *P. rostrana* was found in high numbers in the Palm House at Stapeley Water Gardens (Cheshire) between 1987 and 1988, with the suspected origin being palms from Florida, USA; by 1989 the moth had been eradicated (Hardwick 1998). There has been one confirmed interception, of a single larva on the outside of a box of produce from Jamaica in 2012; additionally, a single larva on Jamaican *Annona muricata* fruit (soursop) in 2011 was identified as a *Platynota* species, with *P. rostrana* as one of the possibilities.

Elsewhere in Europe, one larva of *P. rostrana* was detected in 2013 in the Netherlands on Costa Rican *Schefflera* plants for planting (Netherlands NPPO 2014). One adult male *P. rostrana* was caught in Madeira in 1996 (Franquinho Aguiar and Karsholt 2006). It is not known if this was an isolated individual or from an established population, but no reports of other specimens from this region have been found.

Neither *P. idaeusalis* nor *P. flavedana* have been intercepted in the UK, neither species has any European interception records on Europhyt (database searched 11 July 2014), and no findings of either species in Europe are known.

7. What are the pest's natural and experimental host plants; of these, which are of economic and/or environmental importance in the UK/PRA area?
All three species are extremely polyphagous, feeding on a wide range of hosts from many plant families. The following list of hosts is merely a selection of plants of potential importance to the UK, and is in no sense a comprehensive host list for any of the three species. More complete host lists are available from several sources, including Sandberg and Passoa (1989), Brown *et al.* (2011a), Lam *et al.* (2011) and Gilligan and Epstein (2012).

Selected host genera and species of particular relevance to the UK:

Outdoors:	*Rubus idaeus* (raspberry), *Malus* sp. (apple), *Trifolium* sp. (clover), *Abies* sp. (fir), *Pinus* sp. (pine), *Phaseolus* sp. (beans)
Protected cultivation:	*Solanum lycopersicon* (tomato), *Capsicum* sp. (pepper), *Fragaria* sp. (strawberry), *Dianthus caryophyllus* (carnation), *Rosa* sp. (roses)
Gardens, ornamental:	*Laurus nobilis* (bay laurel), *Clematis* sp., *Viburnum* sp., *Helianthus* sp. (sunflower), *Rhododendron* sp.
Wider environment:	*Betula* sp. (birch), *Salix* sp. (willow), *Fraxinus* sp. (ash)

8. What pathways provide opportunities for the pest to enter and transfer to a suitable host and what is the likelihood of entering the UK/PRA area? (*By pathway*):
The potential pathways for all three species are judged to be similar: all could be associated with a wide variety of plants and plant parts, though the exact origin of the commodity will influence the species of *Platynota* most likely to be associated with it. Accordingly, all three *Platynota* species are discussed and rated here together.

Plants for planting: Larvae and pupae are associated with all parts of the plant, and are at least partially cryptic, hidden in leaves spun together with silk. Eggs are laid in a flattened mass, usually on the underside of the leaves, and will also be hard to detect. Growing plants

are likely to give larvae time to complete their life cycle. One species, *P. rostrana*, has previously arrived with plants for planting, both in the Netherlands in 2013 (Netherlands NPPO 2014), and the UK in the 1980s (Hardwick 1998). While neither of the other two species considered here has been detected in Europe (Europhyt data search, 11 July 2014), all three *Platynota* species share similar cryptic larval feeding habits and, with their very wide host ranges, all could potentially be associated with many different hosts. Though one species has been detected moving in trade, the number of interceptions is not high, and overall, this pathway is considered likely with medium confidence.

Produce (including cut flowers): While *Platynota* larvae have twice been detected on produce imported to the UK, both interceptions were of single larvae. The highly polyphagous natures of these three pests mean that many alternate hosts are likely to prove suitable for the larvae to complete their development if the original host is destroyed. However, larvae are not a particularly mobile life stage, and, in reality, transfer to a new host may not prove possible. Additionally, produce is more likely to be rapidly dispersed, then eaten, processed or disposed of before the larva has a chance to complete its development, hence reducing the chance that sufficient numbers of larvae will be found in close enough proximity to form a breeding population. Overall, this pathway is assessed as unlikely with medium confidence.

Plants for planting	Very unlikely	☐	Unlikely	☐	Moderately likely	☐	Likely	☑	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			
Produce	Very unlikely	☐	Unlikely	☑	Moderately likely	☐	Likely	☐	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			

9. How likely is the pest to establish outdoors or under protection in the UK/PRA area? (*The likelihood rating should be based on the area of potential establishment, e.g. where hosts are present and the climate is suitable, within the UK/PRA area)*
As all three species are highly polyphagous, and so suitable hosts will be present in all parts of the PRA area. None of the species is particularly distinctive in appearance, and, unless caught and examined by a specialist, are unlikely to be identified as non-native. Thus, there is a potential for new colonies to be overlooked, and populations may have an opportunity to build up before detection.

As the species have native ranges in substantially different parts of the Americas, climate seems more likely to influence potential establishment in the UK. At least *P. flavedana* and *P. idaeusalis* overwinter as larvae; details of the life history of *P. rostrana* are not apparently recorded. All three species seem capable of multiple generations each year, if temperatures are favourable. As each of the three *Platynota* species considered is judged to have different climatic requirements, each species will also have different likelihoods for establishment in the UK. Therefore, each species is considered separately below.

Platynota flavedana is found outdoors throughout the eastern side of the USA, but it is not apparently found in Canada. Hull *et al.* (1995) state that this is a more southerly species than *P. idaeusalis*: *P. flavedana* is found less commonly north of 42º, and is also less frequent in the higher-altitude areas of North Carolina. Lower threshold development temperatures and degree days above threshold were calculated by David *et al.* (1989), and are summarised in Table 4. These lower threshold development temperatures are only a little higher than *Cacoecimorpha pronubana,* a species that was first found in the UK in the early 1900s, and which is now found throughout much of the southern half of England, and also in Wales.

The overwintering stage of *P. flavedana* is the larva, but it does not appear to have a true diapause, instead becoming quiescent at low temperatures (Wilde & Semel 1966). Using plant hardiness zones as a guide to minimum winter temperatures, *P. flavedana* is a damaging pest in Virginia (USA) (Hull *et al.* 1995). Virginia plant hardiness zones range from 6a to 7b, i.e. extreme minimum temperatures from -23ºC to -12ºC (Daly *et al.* 2010). This suggests this species would be capable of overwintering outdoors in all parts of the UK, and its northerly distribution in Massachusetts also suggests that winter survival in the UK will not limit establishment. Summer temperatures in the UK are, however, on average much lower than those found in the species' range in the USA. For example, in Virginia the mean maximum monthly temperatures in summer are around 29-31ºC, which are much hotter than in the south of England, where the mean maximum monthly temperatures are around 22-23ºC (World Meteorological Organisation 2014). Theoretically, one generation per year is possible in Kent, but even in Pennsylvania (one of the more northern states of this species' range), a significantly larger number of generations per year are theoretically possible (data presented in Appendix 1: Table 5 and Figure 4). Overall, outdoor establishment is considered unlikely with low confidence, and it may be that only transient populations can occur: capable of surviving hot summers, but dying out in the years with cooler summers.

Platynota flavedana is only rarely recorded as a pest in protected cultivation. Only one record could be found, and that was from over 70 years ago on roses in New Jersey, USA (Hamilton 1940). However, as this pest is polyphagous, suitable hosts will be present in protected cultivation, and if it was able to enter such an environment, temperatures would seem favourable for the development of multiple generations. Nevertheless, as *P. flavedana* is not apparently a common glasshouse pest, overall establishment in protected cultivation is assessed as moderately likely with low confidence.

<u>*Platynota flavedana*</u>

Outdoors	Very unlikely	☐	Unlikely	✓	Moderately likely	☐	Likely	☐	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	✓			
Under Protection	Very unlikely	☐	Unlikely	☐	Moderately likely	✓	Likely	☐	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	✓			

Table 4. Thermal requirements for *Platynota flavedana, P. idaeusalis* and two species of tortricids established in the UK (egg to adult).

Species	Lower threshold development temperatures (ºC)	Degree days above threshold	Source
Platynota flavedana	9.1	607.2	David *et al.* (1989)
Platynota idaeusalis	7.5	699.2	David *et al.* (1989)
Epiphyas postvittana	7.5	609	Danthanarayana (1975)
Cacoecimorpha pronubana	8.8	665.2	Quaglia (1983)

<u>*Platynota idaeusalis*</u>: The distribution of this species in the northern parts of the USA and southern Canada suggests that overwintering outdoors in the UK will be well within the capabilities of this species. Additionally, the larvae show a true diapause, influenced by short day length and temperature (Rock *et al.* 1983), that may help to increase winter survival under adverse conditions. The minimum experimental temperature required for *P. idaeusalis*

females to lay eggs was >10ºC (Rock & Stinner 1990). Lower threshold development temperatures and degree days have been calculated by David *et al.* (1989), summarised in Table 4. Mawby and Rock (1986) have also investigated the thermal requirements for larvae and pupae, though these data are not included in Table 4 as they are not directly comparable with the other values presented there. Mawby and Rock (1986) also noted that fluctuating temperatures appear to lower the threshold from approximately 10ºC to around 6ºC. As *P. idaeusalis* is the species found furthest north of the three considered here, it is also the most likely to be capable of establishing outdoors. While parts of Canada have a continental climate, with warmer summers than seen in the UK, Halifax in Nova Scotia has mean monthly maximum temperatures that are comparable to warmer parts of southern England (World Meteorological Organisation 2014). Overall, establishment outdoors in the UK is considered very likely for this species with high confidence.

No records of *P. idaeusalis* in protected cultivation could be found, but, following the same reasoning used for *P. flavedana*, the overall rating for establishment in protected cultivation is moderately likely with low confidence.

Platynota idaeusalis

Outdoors	Very unlikely	☐	Unlikely	☐	Moderately likely	☐	Likely	☐	Very likely	☑
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				
Under Protection	Very unlikely	☐	Unlikely	☐	Moderately likely	☑	Likely	☐	Very likely	☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑				

Platynota rostrana: The current distribution of this species (southern USA, throughout Central America and the Caribbean, and warmer parts of South America) suggests that *P. rostrana* requires subtropical or tropical temperatures. Therefore, it is considered very unlikely to be capable of establishing outdoors in any part of the UK, with high confidence.

In protected cultivation, there is some uncertainty. Although *P. rostrana* was able to breed under glass in the UK in the 1987-8 outbreak, Hardwick (1998) only found this species in the warmer more humid palm glasshouse, and not in the more temperate glasshouses. *Platynota rostrana* has previously occurred in warm glasshouses, and overall, establishment under protection is considered to be moderately likely, but with low confidence.

Platynota rostrana

Outdoors	Very unlikely	☑	Unlikely	☐	Moderately likely	☐	Likely	☐	Very likely	☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				
Under Protection	Very unlikely	☐	Unlikely	☐	Moderately likely	☑	Likely	☐	Very likely	☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑				

10. If the pest needs a vector, is it present in the UK/PRA area?
No vectors are required. These are free-living organisms.

11. How quickly could the pest spread in the UK/PRA area?
Though adults of all three species can fly, they are not particularly strong fliers, and none is a known migratory species. Research into dispersal has focussed on only one species, *P.*

idaeusalis, but the capabilities of the other species are likely to be broadly similar and thus the ratings given here apply to all three species.

In mark-recapture experiments, male *P. idaeusalis* were caught in pheromone traps up to 800 m away from their release sites (Knight & Hull 1988), while females reared from a larval diet containing rubidium subsequently laid rubidium-marked eggs that were detected a maximum of 250 m from their release site (Knight *et al.* 1990b). In both sexes, these are the maximum distances reached, and the majority of released moths travelled much shorter distances. Newly hatched larvae of *P. idaeusalis* may balloon (float in the wind under strands of silk), and it seems likely that the larvae of the other two species are also capable of this behaviour, though no sources could be found to confirm this. In experiments with *P. idaeusalis*, larval dispersal was short-range, and did not seem to occur if the larvae fed soon after hatching (Simelane *et al.* 1991, 1992).

As the larvae and pupae can be hidden in rolled leaves, movement of all species in trade could potentially be very fast. At least one species, *P. rostrana*, has been detected in Europe several times, indicating that it is capable of long-range dispersal through trade.

Natural Spread	Very slowly	☐	Slowly	☑	Moderate pace	☐	Quickly	☐	Very quickly	☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				
With trade	Very slowly	☐	Slowly	☐	Moderate pace	☐	Quickly	☐	Very quickly	☑
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				

12. What is the pest's economic, environmental and social impact within its existing distribution?

Larvae of all three species are mainly leaf feeders, rolling leaves together and tying them with silk. While heavy defoliation will weaken plants, leading to yield reduction, the majority of economic damage is caused by larvae spinning leaves onto the surface of many types of fruit, and proceeding to feed directly on the fruit from the shelter of the leaf. Fruit surface scarring may have only a cosmetic effect, but such fruit will not be suitable for the premium 'table fruit' market, and instead will be have to be sold to the lower value processing market. However, as with any injury, the larval feeding wounds may allow the entry of secondary rot or other pathogens, and on occasion, the larva may tunnel further into the fruit, both of these causing more serious injury and loss of crop.

<u>*Platynota flavedana*</u> reports of damage in the peer-reviewed literature are all rather dated, and therefore, the current pest status of this species is unclear. Specific reports on damage follow, but overall, the damage caused by *P. flavedana* in the USA is assessed as medium with low confidence.

Apples are can be badly affected by this pest. Up to 75% of apples were damaged in an area of Virginia: damage to fruit early in the season was usually surface pitting, but later in the season, as the leaves grew older, more substantial areas of fruit could be eaten (Bobb 1972). While this species is usually seen as a relatively minor apple pest, Hull *et al.* (1995) states that the relative importance of *P. flavedana* and *P. idaeusalis* as apple pests differ by geographic region, and that *P. flavedana* is the major apple pest in central Virginia, and also eastern New York state on occasion.

Strawberry plants were weakened by leaf feeding, but larvae were also recorded feeding on flowers and green fruit (Wilde & Semel 1966). In Tennessee, little damage to strawberries was noted unless *P. flavedana* was found with other species of tortricid (Bennett 1961).

Peach orchards in Indiana had damage rates in excess of 2% (Summerland & Hamilton 1954).

Roses in a greenhouse were attacked by larvae of *P. flavedana*, together with another unidentified tortricid: together, they were causing "considerable damage" to leaves and flowers in New Jersey (Hamilton 1940).

Platynota flavedana

Impacts	Very small	☐	Small	☐	Medium	☑	Large	☐	Very large ☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑			

Platynota idaeusalis has the most literature available on impacts of the three species. In the 1990s, following increasing levels of resistance to organophosphate insecticides (e.g. Carlini *et al.* 1995, Karoly *et al.* 1996, Knight *et al.* 1990a), *P. idaeusalis* became a pest of some importance in orchards in the eastern states of the USA, including Pennsylvania. Much of the recent work on this species has been on alternative control strategies, such as pheromones (e.g. Borchert & Walgenbach 2000, Gronning *et al.* 2000), alternative insecticides (e.g. Biddinger *et al.* 2006, Myers & Hull 2003) and strategies to enhance biological control of the species, for example increasing the parasitism rates (e.g. Brown *et al.* 2010, Brown 2012). Selected reports on damage follow, but overall, the impact of *P. idaeusalis* in North America is assessed as large with medium confidence.

Apples are the crop most commonly affected, with Hull *et al.* (1995) stating that *P. idaeusalis* is "probably the most serious direct pest of apples in the mid-Atlantic region". Agnello *et al.* (2009) notes that, while *P. idaeusalis* is the key species of leafroller in the mid-Atlantic states, another tortricid, *Choristoneura rosaceana* (oblique-banded leafroller), is the most damaging species in more northern locations such as Michigan and New York state. Attempts at damage quantification vary quite considerably. Meagher and Hull (1986) considered that the major impact would be to commercial fresh fruit growers, as only between 70 and 77% of fruit would have been suitable for selling fresh, but almost all of the damaged fruit was suitable for processing. Knight and Hull (1987) stated that the highest damage level (of 6%) in Pennsylvania represented a loss of about $1 million. Different cultivars have differing levels of attack and this may be due, at least in part, to physical properties of the tree: the cultivar that clusters apple fruit together on short stalks, providing more hiding places for the larvae, showed the most fruit damage (over 10%, which was more than double the damage seen on the least attacked cultivar) (Hunter *et al.* 1994). Analysing a 16-year dataset from Pennsylvania, Robertson *et al.* (2005) developed a management model to quantify the cost vs. benefit of insecticide treatment in apple orchards against *P. idaeusalis*.

As apples are commonly stored for long periods, the effect of *P. idaeusalis* feeding damage on the storage properties has also been studied. Damage to fruit from the first generation of larvae, or with less than 10 mm^2 of the fruit surface injured had little effect on the storage capability of the apples, but second generation damage or more extensive injury increased the amount of apple decay (Barden & Hull 1998). The amount of sugar was higher in the more heavily damaged fruit, which also softened more rapidly than undamaged fruit, or fruit with only a small amount of feeding damage (Hull & Rajotte 1988).

No specific data on damage to other crops could be found, though it is often mentioned that other fruits (such as cherry and peach) can also be attacked. Other hosts appear to be of importance for overwintering, e.g. ground cover in orchards, but again no reports of damage were found, and thus it can be assumed that the main impact of *P. idaeusalis* is on apple crops.

Platynota idaeusalis

Impacts	Very small	☐	Small	☐	Medium	☐	Large	☑	Very large ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			

Platynota rostrana has comparatively few reports of damage attributed to it, and the sources listed below may be highlighting unusually high levels of damage, rather than the more common situation. Overall, the damage caused by *P. rostrana* is assessed as small with low confidence.

Coffee fruit was attacked in Cuba, with either the fruit falling before it was ripe, or becoming susceptible to secondary rot (Vasquez *et al.* 1991).

Citrus: in São Paulo, Brazil, *P. rostrana* was formerly considered to be a minor pest, but Nava *et al.* (2006) suggested that it has increased in importance due to the efforts at controlling other pests, which allowed this species to prosper in the imbalance created. Chewing damage to unripe fruit and leaves was noted, together with the boring of holes that may result in fallen fruit (Nava *et al.* 2006). Damage to Mexican citrus was also noted by Varela-Fuentes *et al.* (2009), though neither author attempted to quantify the damage caused.

Psophocarpus tetragonolobus (winged bean) damage by various invertebrates was assessed in Florida: while *P. rostrana* commonly fed on leaves, no pod damage due to this species was recorded (Rajapakse 1989).

Platynota rostrana

Impacts	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large ☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑			

13. What is the pest's potential to cause economic, environmental and social impacts in the UK/PRA area?

The three species are judged to have different potential impacts to the UK, and are accordingly assessed separately.

Platynota flavedana

While this species is found throughout the eastern part of the USA, damaging populations have only been reported from Virginia, where most damage is caused by the second generation of larvae (Hull *et al.* 1995). This part of the USA, while colder in winter, has warmer summers than are typically present in most parts of the UK. To investigate if a second generation could develop in the UK, climate data from East Malling in Kent were compared to the thermal requirements of this species. This shows that, even theoretically, only one generation per year of *P. flavedana* is likely to be possible at this location (data presented in Appendix 1: table 5 and figure 4). In its native range, it is a pest of orchards, and there is only one, very old, glasshouse record, suggesting protected cultivation may not be at particular risk from *P. flavedana*. Overall, the assessment is that the economic impact will be small, as it is primarily a leaf-roller, fruit damage is less common, and the UK is too cool to allow the development of the more damaging second generation. There are no records of any environmental impacts in the USA, and the environmental impact in the UK is accordingly assessed as very small. Social impacts are also judged to be very small. All the assessments for impacts have high confidence, as this species does not appear to be capable of two generations per year in the UK and this is expected to limit potential damage to small.

Economic Impacts	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				
Environ - mental Impacts	Very small	☑	Small	☐	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				
Social Impacts	Very small	☑	Small	☐	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				

Platynota idaeusalis

While this species can be a major pest in orchards in the parts USA, it is of less importance in northern areas and southern Canada, which have similar summer temperatures to the UK. Most damage appears to be done by the second generation of larvae. Limited climate modelling was carried out, comparing East Malling in Kent with a site in Pennsylvania, USA where two generations are known to occur. Theoretically, two generations are also just possible in Kent, but, even in the warmest years, the UK is significantly cooler than Pennsylvania and fewer generations will be capable of developing (data presented in Appendix 1: Table 5 and Figs. 1–3).

Apples are an important crop in parts of the UK, with around 8,700 ha (both dessert and cooking apples) planted between 2010 and 2013, with a combined value of over £100 million (Defra 2014). However, the UK has native tortricid pests of apples, such as *Cydia pomonella* (codling moth), against which the industry has developed management practices, and control measures against these species may also limit potential populations of *P. idaeusalis*. Like *P. flavedana*, *P. idaeusalis* is not recorded as a glasshouse pest, and protected cultivation may be less at risk from this species.

Overall, the potential economic impact in the UK is judged to be small with high confidence. There are no reports of environmental impacts in North America, so the potential for the UK is assessed as very small with high confidence. Some hosts are important crops for amateur gardeners, but damage would not seem to be greater than that caused by current UK pests, so the social impact is judged to be very small, again with high confidence.

Economic Impacts	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				
Environ - mental Impacts	Very small	☑	Small	☐	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				
Social Impacts	Very small	☑	Small	☐	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				

Platynota rostrana

This species would only cause damage in protected environments, and, even then, it is unclear if all types of protected cultivation would be suitable, or if *P. rostrana* would be restricted to the warmer and/or more humid environments. If a population was to establish in protected cultivation and then fly out in summer to form transient field populations, this species seems likely to require high temperatures to build up to damaging populations, and

hence it seems unlikely to be capable of causing severe damage outdoors except possibly in the warmest years in the UK.

Overall, the potential for economic damage is judged to be very small with medium confidence, while both environmental and social impacts are thought to be very small with high confidence, as this species is very unlikely to establish outdoors.

Economic Impacts	Very small	✓	Small		Medium		Large		Very large	
Confidence	High Confidence		Medium Confidence	✓	Low Confidence					
Environ - mental Impacts	Very small	✓	Small		Medium		Large		Very large	
Confidence	High Confidence	✓	Medium Confidence		Low Confidence					
Social Impacts	Very small	✓	Small		Medium		Large		Very large	
Confidence	High Confidence	✓	Medium Confidence		Low Confidence					

14. What is the pest's potential as a vector of plant pathogens?
None of the three *Platynota* species are known to be vectors of any plant pathogen.

15. What is the area endangered by the pest?
Outdoors, the south-east of England, which has both higher temperatures than much of the rest of the UK, and is the principal top fruit growing region, would be most at risk of economic damage from *P. idaeusalis*, and possibly *P. flavedana*. However, as it is the second generation of both species that cause high levels of damage in the USA, and neither *P. idaeusalis* nor *P. flavedana* seem capable of having more than one generation per year in the UK, it seems likely that neither species will be capable of causing damage greater than that already caused by native orchard pests. Although neither *P. flavedana* nor *P. idaeusalis* are common glasshouse pests in their native range, if either species was able to establish in protected cultivation, temperatures are likely to favour the build-up of damaging populations.

As *P. rostrana* apparently requires higher temperatures for development, it is likely to be restricted to protected cultivation, and it may be that only the warmer or more humid glasshouses will prove suitable for this pest, though this is uncertain.

STAGE 3: PEST RISK MANAGEMENT

16. What are the risk management options for the UK/PRA area?
(Consider exclusion, eradication, containment, and non-statutory controls; under protection and/or outdoors).
Continued exclusion would seem possible to achieve. The only species (of the three considered here) that has been detected moving in trade to Europe is *P. rostrana,* the one judged to be the least threat to the UK. While the UK does import apples from the USA (just over 10,000 tonnes in 2013, though the quantity is highly variable from year to year (Eurostat data, extracted July 2014), no *Platynota* species has been detected on this commodity to date in the UK. Also, the larvae are mainly surface feeders on fruit, rarely burrowing deeper, and so are more likely to be detected pre-export, especially if they are feeding under a leaf spun to the surface of the fruit. Leaves attached to fruit and other such hiding places for the larvae are likely to be removed during the packing and inspection processes, and any larvae destroyed or detected. However, detecting rolled leaves and larvae on plants for planting might be more difficult. It should be noted that, as these species are so polyphagous, most plants and plant parts imported from the native range could contain larvae. The PHSI do detect tortricid larvae in leaves and produce, from the Americas and elsewhere, and hence the prospect of continued exclusion seems relatively good.

If one of the *Platynota* species was able to establish in the UK, eradication within a glasshouse would be feasible, at least in theory: the UK outbreak in the 1980s of *P. rostrana* was successfully eradicated by a combination of pruning and insecticides (Hardwick 1998). However, if *P. idaeusalis* or *P. flavedana* was to establish outside, eradication in the wider environment would be very challenging. Both these species are highly polyphagous, and so potentially could be found on almost any host. Additionally, none of the adults or larvae are particularly distinctive, thus potentially allowing a large population to build up and/or spread before it was detected.

If an outbreak was to occur, there are several monitoring and control options used in the USA for *P. flavedana* and *P. idaeusalis*.

Pheromone traps are available for detection of both *P. flavedana* and *P. idaeusalis*, but no pheromones have been identified to date for *P. rostrana.* There is some evidence that both *P. idaeusalis* and *P. flavedana* can be controlled using mating disruption with the same pheromone blend (Gronning *et al.* 2000). However, while fewer male *P. idaeusalis* were caught in pheromone traps in orchards with mating disruption, damage to fruit, though very variable, was higher in the plots with mating disruption than in plots that had conventional insecticide treatments (Borchert & Walgenbach 2000, Meissner *et al.* 2001).

The larvae of all three species have some protection from insecticide treatments because they can roll leaves and silk around them. Products containing spinosad (e.g., Conserve) and *Bacillus thuringiensis* (e.g., Dipel DF) have been recorded as being effective against tortricid pests in the USA and are approved for some protected crops in the UK. Products containing chlorantraniliprole (Coragen) are used for the control of *Tuta absoluta* in Europe and may also be effective against these *Platynota* species, and control measures targeted against native tortricid pests in orchards may also reduce populations of these species. The potential efficacy of the biocontrol agents that could be used against these pests in the UK is unknown.

Resistance to insecticides including organophosphates has been seen in both *P. flavedana* and *P. idaeusalis* (e.g. Dominguez-Gil & McPheron 2006, Myers & Hull 2003, Pfeiffer *et al.* 1993), but resistance has not been recorded in *P. rostrana*.

17. Summary and conclusions of the rapid PRA.
Provide an overall summary and conclusions and then short text on each section:

This rapid PRA shows:
The three species of *Platynota* covered in this PRA are all polyphagous leaf-rolling moths, native to the Americas and not known to be established in any other region of the world. *Platynota rostrana* is a tropical/subtropical species, *P. flavedana* is found in eastern and northern parts of the USA, and *P. idaeusalis* is distributed in the northern states of the USA and southern states of Canada. *Platynota rostrana* has been intercepted at least twice, in the UK and the Netherlands, and there has also been an outbreak of this species in a glasshouse in the UK in the 1980s, which was eradicated.

Risk of entry
At least *P. rostrana* is moving in trade, having been intercepted on plants for planting in the Netherlands and produce in the UK. There are no recorded interceptions in Europe of the other two *Platynota* species considered here. For all three species, entry on plants for planting is considered likely, but entry on produce is considered unlikely.

Risk of establishment
Platynota flavedana is considered unlikely to establish out of doors, and moderately likely to establish under protection, though both judgements have been made with low confidence. While temperatures will be more favourable for the species in protected cultivation, this is not

a common glasshouse pest in its native range, but as *P. flavedana* is highly polyphagous, suitable hosts will be present.

Platynota idaeusalis is judged to be very likely to be able to establish outdoors (with high confidence), and moderately likely in protected cultivation (with low confidence): though this species is not recorded as a glasshouse pest in its native range, again, suitable hosts will be present.

Platynota rostrana is considered very unlikely to be capable of outdoor establishment in the UK (with high confidence), but moderately likely to be able to establish in protected cultivation (with low confidence). This uncertainty is due to the unknown suitability of commercial protected cultivation for the establishment of *P. rostrana*: no climatic requirements could be found for this species.

Economic, environmental and social impact
Platynota flavedana is considered to have a medium economic impact in the USA (though there are very few contemporary references for this species), but as UK summers are cooler than in the native range, more than one generation outdoors does not seem likely. Therefore, in the UK populations will not be able to build up and cause high levels of damage. Overall, the potential economic impact to the UK is assessed as small with high confidence.

Platynota idaeusalis has a large impact in North America, due in part to resistance to organophosphate insecticides which means that control in orchards against this pest has been compromised, and apples are a high value crop with low tolerance for damage. Again, UK summer temperatures are lower than those seen in the states where this species is most damaging, and the more damaging second generation is unlikely to be capable of developing here. Thus, the potential economic impact in the UK is considered to be small with high confidence.

Platynota rostrana has the most uncertainty on impacts, due to the lack of literature, but they are judged to be small in the native range (with low confidence), and potentially very small in the UK (with medium confidence).

For all three species, potential environmental and social impacts in the UK are considered very small, with high confidence in the judgements.

Endangered area
Outdoors, the major orchard areas of south-east England would seem most at risk from *P. idaeusalis* and, possibly, *P. flavedana*. Apples are widely grown in and around Kent and the south coast, and apples are the host which suffers most economic damage in North America. *Platynota rostrana* is not considered capable of establishing out of doors in the UK.

None of the three *Platynota* species are common glasshouse pests, but *P. flavedana* and *P. rostrana* have occasionally been recorded under protection. Theoretically, all protected cultivation could be at risk from all three species as they are so polyphagous. There is, however, some uncertainty about whether *P. rostrana* would be able to establish in all protected cultivation, or only in warmer and more humid environments.

Risk management options
Continued exclusion would seem the best option for the UK.

Key uncertainties and topics that would benefit from further investigation
The key uncertainty is the suitability of protected cultivation for the establishment of all three species. If any, or all, of the three species considered here were able to establish in protected cultivation, due to the warmer temperatures enabling more generations in such environments, damage and impacts could be much greater than assessed here.

18. Is there a need for a detailed PRA or for more detailed analysis of particular sections of the PRA? If yes, select the PRA area (UK or EU) and the PRA scheme (UK or EPPO) to be used.
(For completion by the Plant Health Risk Group) ✓ *(put a tick in the box)*

No	✓

Yes		PRA area: UK or EU		PRA scheme: UK or EPPO	

19. IMAGES OF THE PESTS

Platynota flavedana pinned adult
© Todd M. Gilligan and Marc E. Epstein, CSU, Bugwood.org

Platynota idaeusalis pinned adult
© Todd M. Gilligan and Marc E. Epstein, CSU, Bugwood.org

Platynota rostrana larva with silk webbing
© Crown Copyright, Fera

20. Given the information assembled within the time scale required, is statutory action considered appropriate / justified?
[*For completion by the Plant Health Risk Group*] *(put a tick in the box)*

Yes Statutory action	✓	No Statutory action	

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Appendix 1.

The potential for second generations of *P. flavedana* and *P. idaeusalis* in the UK.

As it is the second generation larvae of *P. flavedana* and *P, idaeusalis* that are considered to be most damaging in the USA, brief investigations were carried out into the climatic suitability of the UK for the development of two generations of each species. East Malling was selected as it is in the south of England, thus potentially most at risk from these moths, as well as being a prime orchard location. The comparison site was near Gettysburg in Pennsylvania because both species are known to be present in this state, and *P, idaeusalis* is considered a damaging pest here. Data for the last 5 years were used, i.e., 2009–2013 inclusive.

For East Malling, twice-daily maximum and minimum air temperatures were obtained (provided at 0.1ºC intervals). The highest maximum and lowest minimum temperatures for each day were used. For Gettysburg, only one value was available for each daily maximum and minimum air temperature (provided at 1ºF intervals). These temperatures were converted into ºC. Some data points from this site were also missing.

For both species of *Platynota*, there were two sets of developmental data available, which differ slightly. On a precautionary basis, the dataset with the minimum threshold development temperature was used for each species, i.e. for *P. flavedana*, 9.1ºC and 607.2 degree days and for *P. idaeusalis*, 7.5ºC and 699.2 degree days (both sets of data from David *et al.* 1989).

The degree days above the minimum threshold were calculated individually for each species for each date. Nominally, the mean of the maximum and minimum temperatures is used, and the threshold development temperature is then subtracted from this value. However, in cases where the maximum was above the threshold but the mean value was at or below the threshold, a correction was applied to take account of the fact that, during the warmer parts of the day in question, some development could still take place (Baker 1980). The cumulative totals for the degree days were then calculated for each species, and compared against the published values to obtain an indication of the date that each generation (egg to adult, not egg to egg) could be expected. These data are summarised in Table 5.

Maps based on the thermal requirements of *P. idaeusalis* were generated by applying these degree day calculations to a 10 minute latitude and 10 minute longitude gridded 1961-90 monthly climatology (New *et al.* 2002) and mapping the number of generations possible in North America and Europe (Figs 1–2).

Graphs of accumulated degree days and the number of generations possible were also produced, comparing Pennsylvania and East Malling for *P. idaeusalis* (Fig. 3) and *P. flavedana* (Fig 4).

Table 5. Theoretical earliest emergence dates for first and second generations of two species of *Platynota* at East Malling in Kent, UK and Gettysburg in Pennsylvania, USA.

Species	Year	First generation		Second generation	
		East Malling	Pennsylvania	East Malling	Pennsylvania
Platynota flavedana	2009	28 July	22 June	09 December	08 August
	2010	31 July	12 June	-	20 July
	2011	03 August	11 June	-	20 July
	2012	02 August	08 June	-	15 July
	2013	05 August	18 June	-	24 July
Platynota idaeusalis	2009	17 July	19 June	03 October	06 August
	2010	24 July	09 June	03 November	19 July
	2011	18 July	09 June	06 October	20 July
	2012	22 July	31 May	21 November	13 July
	2013	29 July	17 June	01 November	25 July

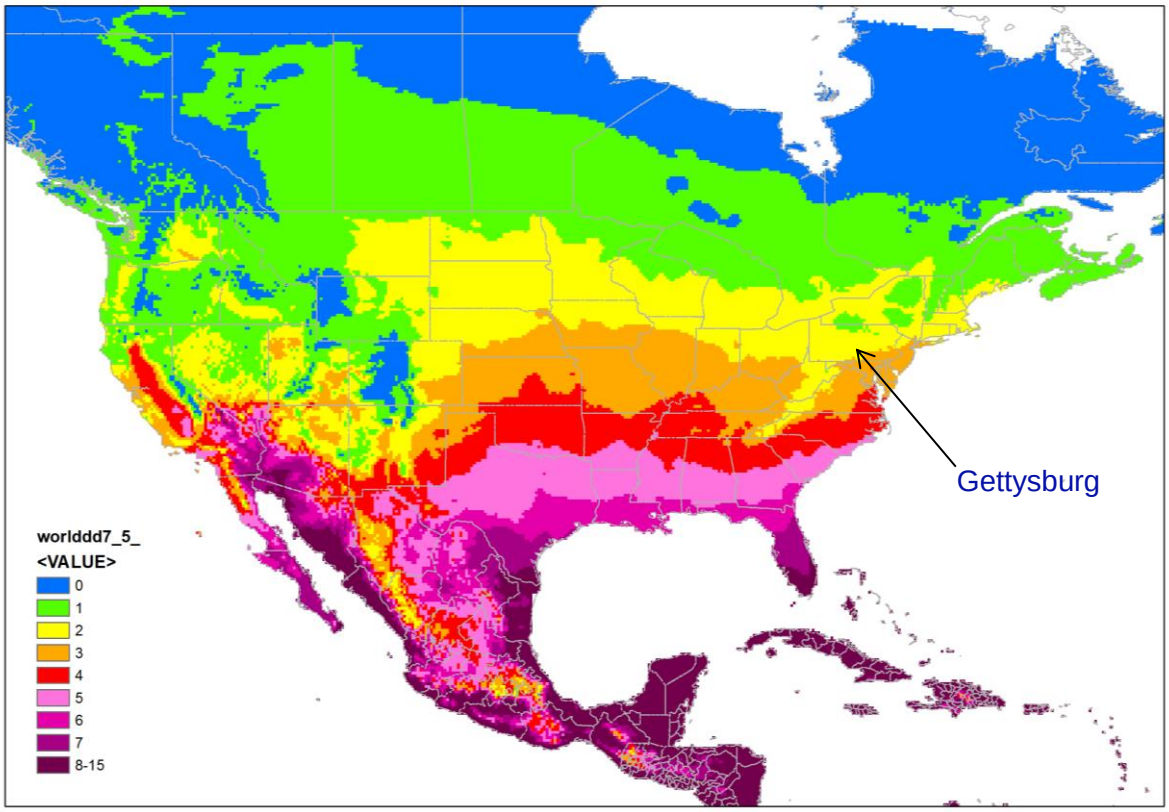

Figure 1. A map of North America showing the number of generations of *P. idaeusalis* that could potentially develop every year (note, the degree days are for egg to adult, not egg to egg).

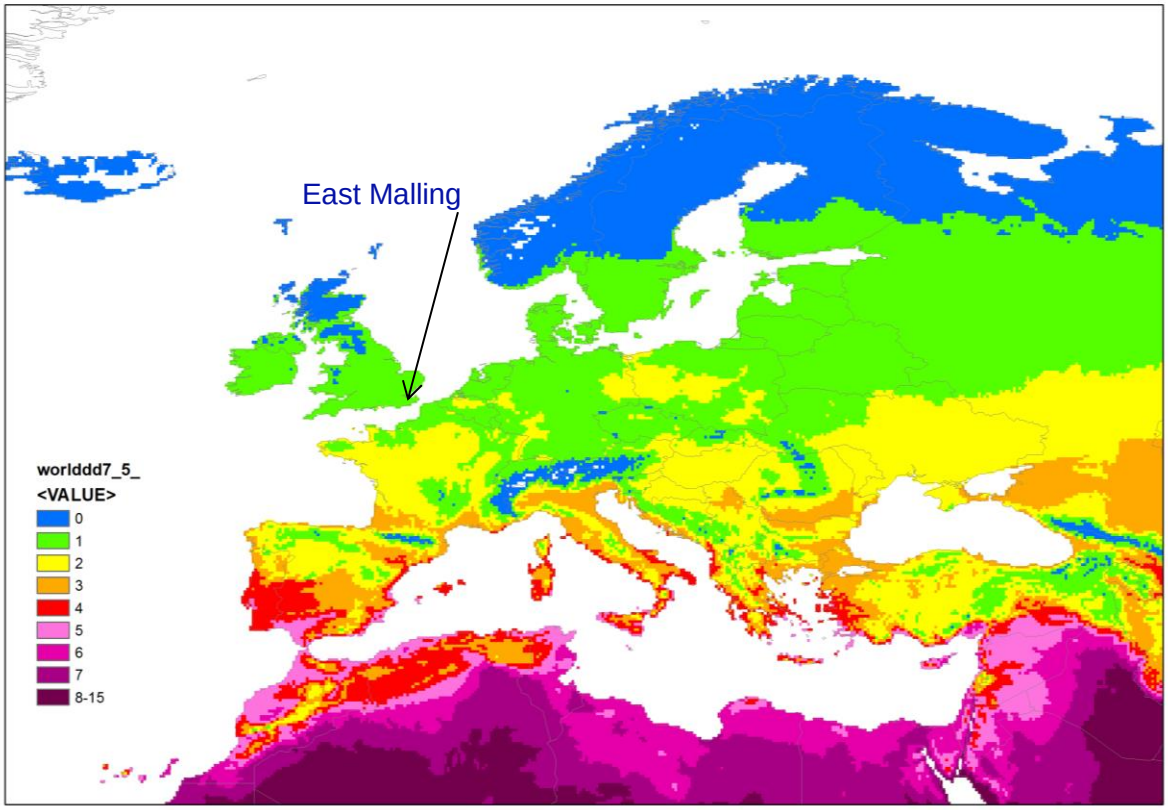

Figure 2. A map of Europe showing the number of generations of *P. idaeusalis* that could potentially develop every year (note, the degree days are for egg to adult, not egg to egg).

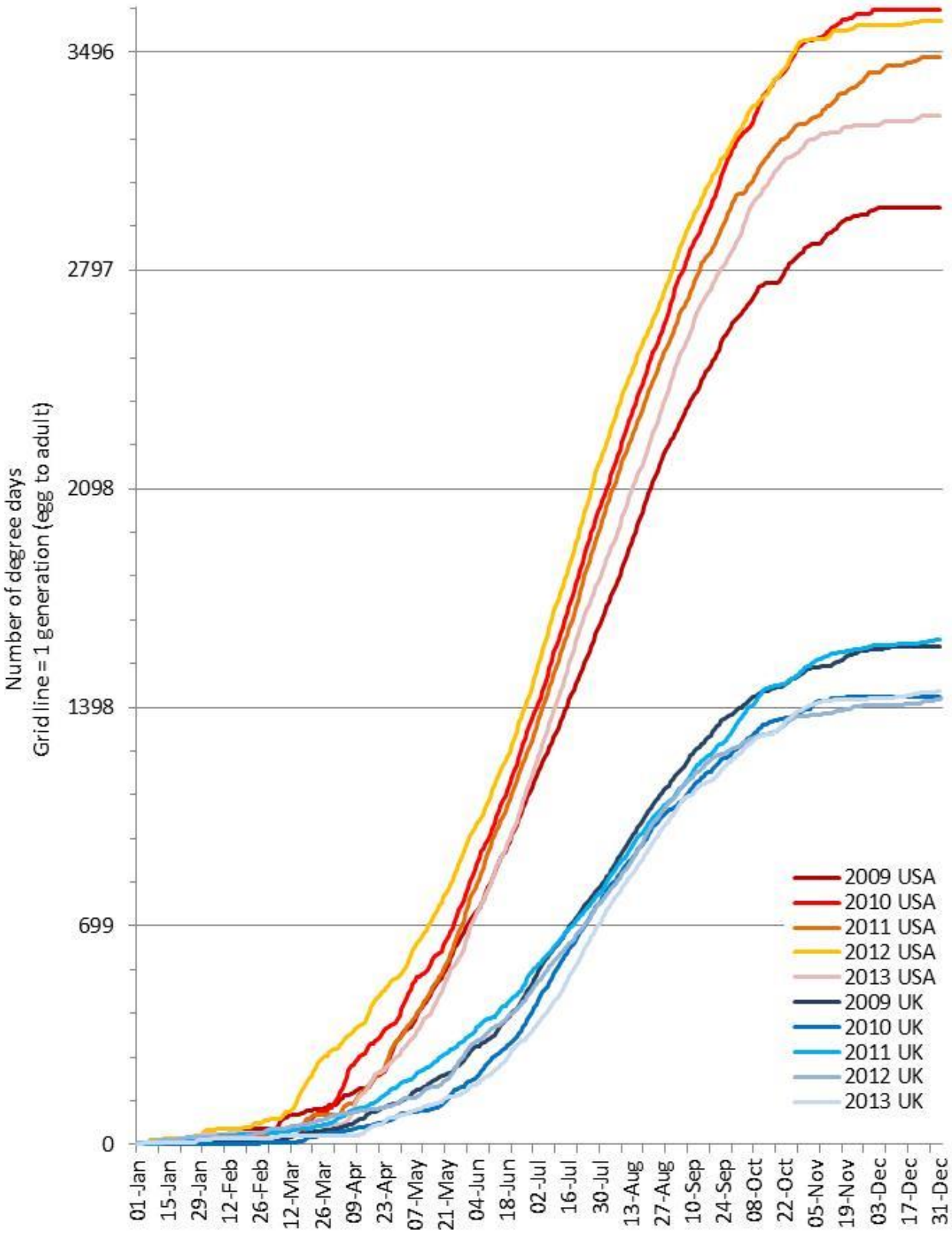

Figure 3. Accumulated degree days at East Malling (blue) and Pennsylvania (red) for *Platynota idaeusalis* between 2009 and 2013. Degree days for one generation = 699.2 and lower threshold development temperature = 7.5°C.

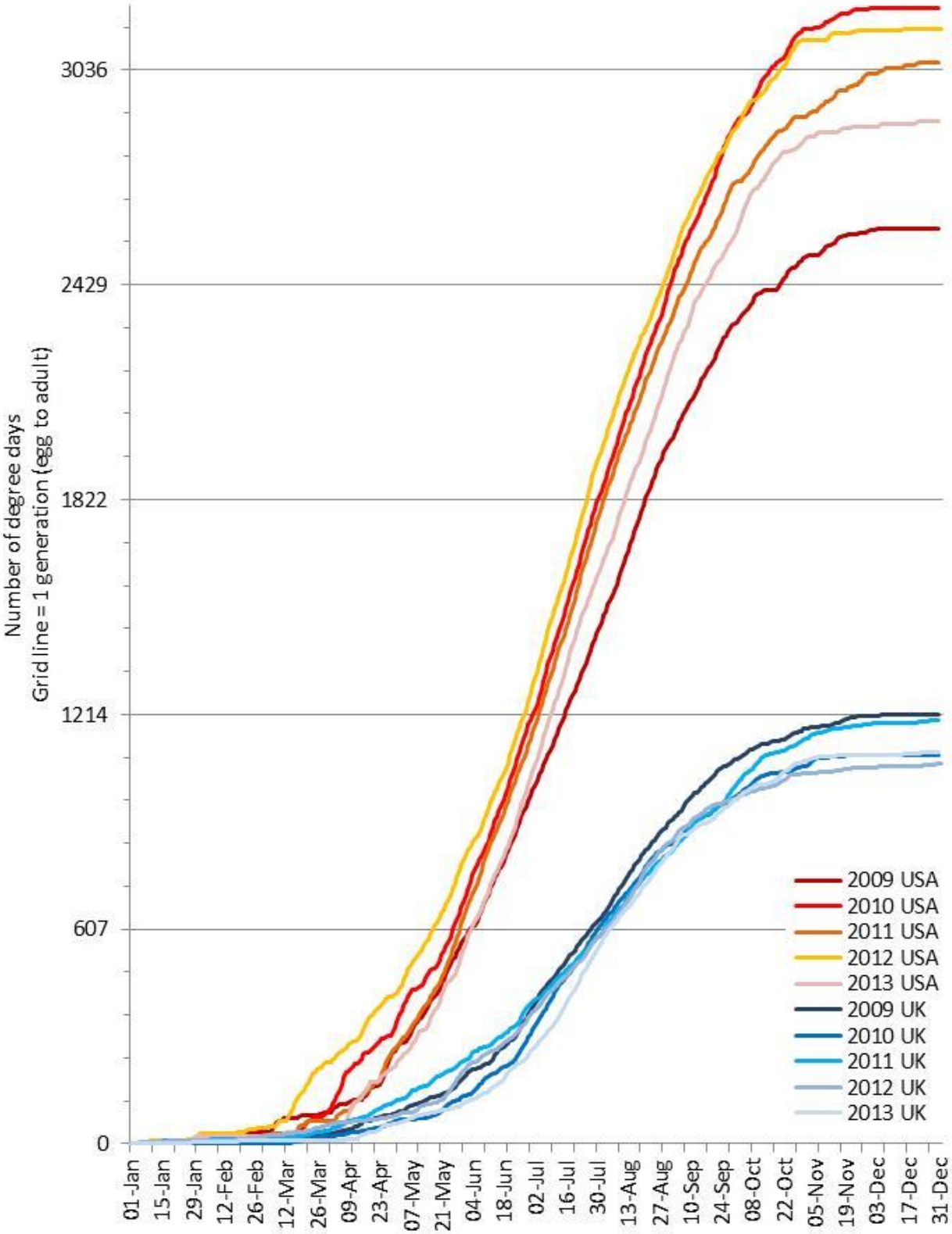

Figure 4. Accumulated degree days at East Malling (blue) and Pennsylvania (red) for *Platynota flavedana* between 2009 and 2013. Degree days for one generation = 607.2 and lower threshold development temperature = 9.1°C.