Forestry Commission

Updated Contingency Plan for Emerald Ash Borer (*Agrilus planipennis*)

INTRODUCTION

1. Outbreaks of serious or significant pests require strategic-level plans, developed at a national level, describing the overall aim and high-level objectives to be achieved, and setting out the response strategy to either eradicate or contain the outbreaks.
2. The Plant Health Risk Group (PHRG) has commissioned, following identification by the Risk Register, pest-specific contingency plans for those pests that pose the greatest risk and require stakeholder consultation. This includes the emerald ash borer. The Forestry Commission is also prioritising plans that require updating including that for *Agrilus planipennis* (Emerald Ash Borer).
3. The purpose of these pest-specific contingency plans is to ensure rapid and effective responses to outbreaks of the pests or diseases described.
4. Contingency planning starts with the anticipation and assessment of potential threats, includes preparation and response, and finishes with recovery.

Anticipation

5. Sourcing information and intelligence about the pest, including surveillance and horizon scanning.

Assessment

6. Identifying concerns and the preparation of plans.
7. Setting outbreak objectives.

Preparation

8. Ensuring staff and stakeholders are familiar with the pest.

Response

9. Determining the requirements for either contain or eradicate including work to determine success.

Recovery

10. Identifying when the response strategy has been effective, or when the response is not considered feasible, cost effective or beneficial.

11. The Defra Contingency Plan for Plant and Bee Health in England (February 2017) provides details of the teams and organisations involved in pest response in England, and their responsibilities and governance. It also describes how these teams and organisations will work together in the event of an outbreak of a plant health pest.

INTRODUCTION

The purpose of pest-specific contingency plans is to ensure rapid and effective responses to outbreaks of the pests or diseases described: in this case *Agrilus planipennis* (Emerald Ash Borer).

Scope

This contingency plan was prepared by the Forestry Commission's (FC) Cross-Border Plant Health Service to be used at country and national (Great Britain) levels. It should be used in England in conjunction with Defra's Generic Contingency Plan for Plant and Bee Health, which provides details on the level of response required and by whom depending on the scenario. The Scottish (2009) and Welsh (2011) Governments have their own generic contingency plans which are currently in review. FC England's Forest Services will use OGB17b 'Managing Incidents in the Forestry Commission' for relevant incidents. FC Scotland and the Welsh Government will develop similar documents detailing their management of outbreaks. When an outbreak becomes of UK or Great Britain (GB) wide concern, the UK Chief Plant Health Officer will form an incident management team to co-ordinate the activities in the different countries.

This contingency plan falls into three main parts:

- background information about the pest;
- official action following a presumptive diagnosis; and
- official action following the confirmation of an outbreak.

This contingency plan covers outbreaks of *Agrilus planipennis* in all situations where ash (*Fraxinus* species) is planted or occurs naturally, i.e. forestry, natural and semi-natural habitats, agricultural landscapes, urban environments, and

parks and gardens. It is designed to help government agencies anticipate, assess, prepare, respond and recover from outbreaks of the pest.

This plan will be updated following new information, lessons identified from outbreaks of other pests, or changes in policy or contact details. (Last updated August 2017).

Objectives of this plan

- To raise awareness in the event of an outbreak of the potential threats posed by *A. planipennis*, and therefore, ensuring that stakeholders are aware of how to identify the pest and the symptoms caused by infestation by this pest.
- To provide guidance on steps to be taken whenever the pest, or symptoms of attack by it, are observed.
- To ensure that infestations of *A. planipennis* are managed promptly with the aim of eradicating pioneer populations or, if a population is found to be established, slowing the rate of spread and lessening its impact.
- To ensure that all relevant staff of the Forestry Commission, other Government agencies and Local Authorities are conversant with the contents of this contingency plan so that effective and immediate action is implemented.
- To ensure that good communications are put in place so that all stakeholders (including relevant media) are kept fully informed of the scale of infestation both at regional and national levels.

Anticipation and Assessment

1.1. *Agrilus planipennis* (Fairmaire) (Coleoptera: Buprestidae), commonly known as the emerald ash borer, is a highly destructive species affecting ash trees in north-east North America and also the Moscow region of Russia.

1.2. Its native range includes north-east China, Korea, Mongolia, Japan and the Russian Far East. It has been introduced into North America and the Moscow region of the European part of Russia.

1.3. It occurs in parts, but not all, of the native range of ash in both of these regions.

1.4. It can cause extensive mortality of ash.

1.5. It is officially absent from the UK.

Preparation

2.1. *A. planipennis* is listed in Annex IAI of the EC Plant Health Directive 2000/29/EC (as a harmful organisms whose introduction into, and spread within, all member states shall be banned).

2.2. *A. planipennis* appears on the EPPO A2 list and, given the threat it poses to the native and ornamental ash population in the UK despite mitigations, it has a very high mitigated risk rating in the UK risk register of 75/125.

2.3. The pest has been moving rapidly westwards from Moscow (where it is not yet under official control measures), and should it move into the Baltic States the risk of accidental introduction could increase significantly. At the time of the review of this plan (Aug 2017) it is very likely that EAB has spread further to the west and south-west of Moscow, but an increase in range in these directions has yet to be demonstrated on the ground. In terms of the knowledge base, nothing has changed since the original contingency plan was published in January 2016.

2.4 The EU has placed import restrictions on wood of ash from regions where *A. planipennis* is present (North America, Russia, China, Japan, Mongolia, North Korea, South Korea), but not for any movement within the EU.

2.5. EPPO has undertaken a Pest Risk Assessment (PRA) of the species, which indicated that the likelihood of the pest establishing in the EU and causing significant damage is high.

2.6 A statutory notification scheme (SNS) for landing consignments of solid fuel wood (firewood) was introduced via an amendment to the Plant Health (Forestry) (Amendment) (England and Scotland) Order 2016 (SI No.1167), and came into force on 1 January 2017. See 'Main pathways for entry and further spread' page 30.

Legislation

2.7. A list of all the relevant legislation which might be pertinent in an *A. planipennis* outbreak is given in Appendix 3.

Response

Trigger

3.1. The key indicators which would trigger a response are findings of or reports of:

- a characteristic D-shaped exist hole in an ash tree or trees;
- a live insect found in a consignment of wood or wood packaging material or dunnage; or
- a live insect found in the wider environment (e.g. discovered by amateur entomologists).

This may be reported by nursery growers, arboriculturists, woodland owners or managers, or members of the public.

Official action following a presumptive diagnosis

Strategic actions on suspicion

3.2. In England, a duty officer from FC England or the Animal & Plant Health Agency (APHA) will act as a point of contact for incidents, and it is their job to assign a response officer to incidents when they occur. Similar arrangements are expected to be in place for Scotland and Wales. The response officer investigates and reports back to the Defra Core Contingency Group, which is an 'ad hoc' group put together in response to a notification, and which is usually chaired by the Chief Plant Health Officer. Country teams in Scotland and Wales will fully manage the outbreak in accordance with their own generic contingency plans, but will provide updates to the Defra Core Contingency Group for information purposes and for Defra to report to the European Commission (EC).

3.3. The response officer will gather information including the: location, likely origin, host or commodity, level of damage, extent of outbreak and chance of spread. The Core Contingency Group will comprise plant health officials and specialists from the risk group.

3.4 Based on the information fed back to the Core Contingency Group in England, they will decide upon the alert status given (black, amber or red), which will determine the level of response (see appendix 4 for alert status table). In Scotland and Wales, the Core Contingency Group can advise on alert status and the appropriate response. If required the Core Contingency Group will request the relevant organisation/s to set up an Incident Management Team to resolve the incident.

Tactical actions on suspicion

Holding consignments and movement / planting restrictions

3.5. Until further investigation, and under a containment notice, no material shall leave the site. Local operations associated with tree management will be halted until the suspected case is confirmed as a false alarm. The extent of the site under containment will be determined by the Incident Management Team controller.

Preliminary trace forward / trace backward

3.6. Depending upon the pathway of entry, tracing forwards and backwards to identify suspect material will be conducted, if the pathway is known, to identify other potentially contaminated stock or sites. This will include suppliers of plant, wood and wood products, propagators and wholesalers, and include any clonally related or potentially contaminated stocks, where appropriate.

Confirming a new outbreak

How to survey to determine whether there is an outbreak

3.7. An outbreak of *A. planipennis* is most likely to be detected through general surveillance, or following a report from the public of ash trees showing canopy thinning, dieback or mortality, with suspect insect galleries and damage beneath the bark (Appendix 1). Confirmation that *A. planipennis* is present will require expert examination of samples and follow-up inspections, particularly to differentiate it from Chalara dieback of ash, both of which are characterised by foliar wilt and crown dieback. The presence of D-shaped exit holes and larval galleries under the bark are two key indicators of the presence of *A. planipennis* which are not indicators of Chalara dieback of ash.

3.8. If there is evidence of the presence of *A. planipennis* then follow-up inspections in line with ISPM 6 (guidelines for surveillance) should gather information about:

- likely origin of the pest and, if a consignment of plants or plant products including wood and wood products is suspected to be the origin of the outbreak, details such as other destinations;
- geographical location and ownership of the affected site, including any other abiotic factors which might influence the outbreak, e.g. public access, accessibility for machinery to remove trees etc. Include detailed maps;
- hosts infested at the site (species, variety, development stage, etc.);
- when and how the pest was detected and identified (including photographs of symptoms);
- level of pest incidence and, where appropriate, life stages present;
- extent and impact of damage (including part of host affected);
- recent import or movement of host plants or host plant products into and out of the affected site;
- movement of people, products, equipment and vehicles, where appropriate;
- accessibility to the site for machinery to remove trees;
- relevant treatments applied to host plants that may affect development of symptoms, or detection and diagnosis of the pest;

- history of the pest at the site or place of production, or in the area; and
- likely biodiversity impacts of any control measures, including any duty of care obligations under the Natural Environment & Rural Communities (NERC) (2006) Act.

These surveys should be conducted by an APHA inspector or an FC Plant health Officer depending on the location.

Sampling

3.9. Samples from infested plant material including wood and wood products should be either:

a. triple-wrapped in robust plastic bags; or

b. double-wrapped in robust plastic bags and the bags placed inside a secure box or vial and sent immediately to the Tree Health Diagnostic & Advisory Service at Forest Research for diagnosis. Suspect insects should be preserved in alcohol and sent in a similar manner. The samples should be accompanied by information about the date when the samples were collected, the location (address, postcode, GPS) and contact details of the person collecting the samples. The address is: Tree Health Diagnostic & Advisory Service, Forest Research, Alice Holt Lodge, Gravel Hill Road, Wrecclesham, Farnham, Surrey, GU10 4LH.

c. samples collected by APHA's PHSI staff should be sent to Fera Science Ltd. for analysis.

Confirming a new outbreak

Diagnostic procedures

3.10. Positive identification of *A. planipennis* is based on morphological characteristics (see factsheet in Appendix 1) and/or DNA sequencing of adults, larvae or pupae. Adult *A. planipennis* in most instances can be identified by comparing published descriptions of the adult beetle. This can be done by comparing the taxonomic keys from North America that include this species to the taxonomic keys for *Agrilus* species that occur in the UK

and Europe (e.g. Levey, 1977) See:

http://www.emeraldashborer.info/files/eab_id_guide.pdf

The following two guidance documents provide further information on identification.

a) The eggs, larvae and pupae of *A. planipennis* are described and illustrated by Chamorro et al. (2013).

b) Several primers for DNA sequencing and identification of *A. planipennis* are available (Bray *et a*l., 2010). These can be sourced via a number of websites, e.g.

http://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi

Samples should only be removed from the site by trained individuals using safe and appropriate equipment, and operating according to biosecurity guidelines.

Criteria for determining an outbreak

3.11. An outbreak of *A. planipennis* should be declared when a positive identification is associated with either:

a) the discovery of living life-stages in ash trees; or

b) the discovery of living life-stages in ash wood, waste wood, chips or plants for planting, and from which adults have (or might have) emerged; or

c) the capture of live adults of *A. planipennis* in circumstances where the adults might have had the opportunity to escape into the wider environment.

3.12 The discovery of dead specimens would not automatically trigger an outbreak response, but should be followed up with a trace forward and backward exercise, possibly resulting in a survey of trees and woodlands to provide further information about the location of specimens, numbers of individuals etc.

Official action to be taken following the confirmation of an outbreak

Strategic actions on confirmation

3.13. On positive confirmation, the following actions should be initiated to:

- notify Westminster Ministers and senior Defra and Forestry Commission officials;
- set up regular (determined by scale of outbreak) Lead Government Department (LGD) meetings to keep partners aware of the current status, actions and possible future requirements, and to agree a communications strategy;
- notify the Devolved Administrations and the EC; and
- inform and discuss with stakeholders.

Incident Management and Communication

3.14. In most instances where the outbreak is in woodland or parkland, Forestry Commission England, is likely to appoint an incident controller and an incident management team. APHA would take the lead for outbreaks in nurseries. In Wales the Welsh Government, with Natural Resource Wales's support, would take the lead in woodland situations. Forestry Commission England's Forest Services will work to the generic Defra contingency plan (in draft 2016), which will be enacted in response to a confirmed outbreak. Forestry Commission Scotland and the Welsh Government will have similar documents detailing their management of outbreaks.

3.15. Initial efforts will be directed towards eradicating new outbreaks following the procedures set out below. Failing eradication, efforts will concentrate on containment.

3.16. The incident controller will set up a management structure to deliver the functions of incident management. The outbreak will determine the size and nature of the management structure. Identification of and liaison with key stakeholders is a crucial part of this process. An example list of such stakeholders would include, but not exclusively: ICF, Confor, Scottish

Government, Welsh Government, Natural Resources Wales, Environment Agency, Natural England and other members of the Defra Group, SEPA, Forest Research, Woodland Trust, National Trust, Country Land & Business Association, Scottish Land & Estates, Royal Horticultural Society, National Farmers' Unions and local councils.

Surveillance

3.17. A delimiting survey should be set up as soon as possible after the first finding of *A. planipennis* to determine the geographic limits of the infested area and to demarcate a regulated area. The two elements of the delimiting survey are:

- an **intensive survey** of all ash trees within at least a 1km radius of the first tree(s) found to be infested, or where adults appear to have escaped into the wider environment. This should include all ash wood, derived from both small and large material, and live plants with a stem diameter ≥1.5cm; and
- **line transects** outwards to at least 10km, along which visual inspection of ash trees are carried out at regular intervals (e.g. every 100m) to estimate the full extent of spread. Ash trees with any signs of canopy thinning should be felled (this could be on a sample basis to start with, to establish the spread of the pest), and branches destructively sampled. Using transects will indicate spread of the pest from the point of outbreak, but the number of transects needed will depend on the distribution of ash within the 10km zone. This will need to be mapped out first, using available data from the National Forest Inventory and if in Scotland the Native Woodland Survey of Scotland.

3.18. The surveys should focus first on open-grown ash trees and those growing along the edges of woodlands, and should include the inspection of previously cut trunks and branches, cutting residues, and naturally occurring debris showing signs of beetle activity. A sample of ash trees showing canopy thinning and dieback should be felled and the bark removed to look for galleries and immature life stages. Apparently healthy trees might also be infested with *A. planipennis,* and these will therefore also require to be checked for the presence of the pest. This should be approached in a standardised manner, e.g. by removing two

branches of 5–8cm diameter from the mid-crown of each tree, and peeling the bark from the first 50cm above the base of the branches to look for larval galleries (Ryall *et al*., 2010, 2011). Who should conduct such surveys will be determined by the outbreak management team, and will depend on the location and distribution of ash in the area. However, such procedures will require teams of specialist tree climbers, so it can be useful before an outbreak to have contractors identified and sufficiently trained in the required survey protocols. This will require specific call-off contracts to be in place before any outbreak occurs.

3.19. If more trees are found to be infested, the surveys should be extended so that the intensive survey covers all ash trees out to at least 1km from the new infested trees, and the line transects extend a full 10km from the new infested trees. This process should be continued to provide a preliminary assessment of the infested area, and should be repeated in subsequent years to monitor the spread of *A. planipennis* and to update the boundaries of the infestation and regulated area. A survey on such a scale will be a huge commitment of resources, and advanced planning should reflect this.

3.20. Reporting on the outbreak should be done through regular situation reports. The frequency of these will be determined by the outbreak management team and will be used as the basis for informing ministers, stakeholders and the media.

3.21. There is no formal survey protocol in place for surveying *A. planipennis* in the UK, and the methodology described above should therefore be viewed as a first version based on the guidance available. It might well require modification and refinement in future. Different methodologies have been used for assessing the spread of *A. planipennis* in North America and the Moscow region of Russia but, particularly in the case of North America, the pest has now become well established and eradication is no longer viewed as an option.

Demarcated zones

3.22. A statutory regulated area should be established as soon as possible after the discovery of an outbreak of *A. planipennis*, to help minimise spread of the pest within the infested area, and to prevent human-assisted

transport to areas outside the infested area. An initial regulated area of at least a 20km radius around the infested trees will need to be established, within which measures to prevent the movement of potentially infested ash material should be implemented. These measures should include a prohibition on the movement of untreated ash wood (including firewood, round wood, sawn wood, wood chips, waste wood and arboricultural arisings) and plants for planting of ash. The prohibition should prohibit the movement of such material from the infested area to the rest of the regulated area, and from the regulated area to regions outside the regulated area.

3.23. Subsequently, the size of the regulated area might need to be increased, depending on the spread of *A. planipennis*. Relevant parties will be informed via the communications lead in the incident management team. These would include the stakeholders listed above in paragraph 3.16 as well as local community councils, schools, landowners and neighbours.

Tracing forwards / backwards

3.24. Depending upon the confirmed pathway(s) of entry, tracing forwards and backwards to identify suspect material will be conducted to identify other potentially contaminated stock or sites.

Pest management procedures

3.25. The management programme should focus on monitoring and the phased removal of the worst affected ash trees, to reduce the *A. planipennis* population and slow the rate of spread, particularly during the flight period. In the USA, this begins from late May to early June, and lasts between three and six weeks. *A. planipennis* is a strong flyer and is capable of making long-distance flights longer than 1km (Haack et al., 2002). In an intensive quarantine area in the USA, Sargent et al. (2010) recorded flight distances of 0.3-19.3km, with a maximal dispersal distance of 1.4km. In windmill experiments in the laboratory, the average flight distance was more than 3km, with 20% of mated females able to fly more than 10km in 24 hours, and 1% capable of flying more than 20km (Taylor et al., 2010). The maximum distance covered was 7.2km in four days. Taylor et al. (2010) noted that an 800m ash-free zone, which was used in past eradication attempts, did not prevent spread, because adult beetles

were capable of flying further to locate host trees. However, it is unclear whether the species would be capable of flying such distances or even further in UK climatic conditions.

3.26. The general advice (based on experience in N. America) is that the creation of a clear-cut area is not appropriate, because this will not eradicate *A. planipennis* (except perhaps in the very early stages of an outbreak and under very restrictive circumstances). It could also remove resistant ash genotypes which might otherwise survive. In addition, cutting large numbers of infested or potentially infested trees reduces the resources available locally to the pest, and therefore might stimulate spread further afield.

3.27. As soon as possible after an outbreak is discovered, and at least annually thereafter, all ash trees within the known infested area should be assessed during mid to late summer for canopy thinning and dieback, e.g. by using the scale illustrated by Smitley *et al.* (2008). All trees with more than 50% canopy thinning should be felled and the material chipped to less than 1.5cm in three dimensions and/or burned. (Burning will only be feasible for relatively small outbreaks, and should not exceed more than 10 tonnes per 24-hour period, according to Environment Agency and SEPA regulations). Trees that are felled should be inspected to confirm whether *A. planipennis* is present, and this information should be forwarded to Forest Research and Defra, where it will be used to help monitor spread.

3.28. Annual surveys will be required to monitor the spread of *A. planipennis*, to redefine the infested area and the boundaries of the regulated area, and to identify ash trees with more than 50% canopy thinning. Surveys of canopy thinning and dieback would need to be carried out during mid or late summer, although surveys at other times of the year can be useful for identifying heavily infested trees. Trees marked up in the summer may be felled during autumn or winter.

3.29. Assessing trees for canopy thinning and dieback can be based on visual, ground-based surveys. Traps that capture adult *A. planipennis* could also be used to detect the presence of beetles in areas outside the known infested area, which would provide advance warning that regular surveys and tree removal might soon be required. In Canada, green delta traps with a lure of green leaf volatiles have been shown to be effective. The

addition of lactone to lures will increase their efficacy. Traps need to be placed in a sunny, exposed position (normally on the south-western side of trees) to catch the maximum number of *A. planipennis*. In contrast, the use of trap logs to detect *A. planipennis* does not seem to be effective, because the beetle prefers to attack live standing trees.

3.30. Prophylactic application of chemical insecticides by injection can be effective at reducing attacks by *A. planipennis,* and can also provide some control of the pest in trees at an early stage of attack by the pest. Insecticides are used in the USA and Canada to protect ash trees in urban areas from *A. planipennis*.

3.31. Revive (containing emamectin benzoate), an insecticide applied by trunk injection, is approved for use in Portugal, Spain and Switzerland, but is not currently approved in the UK. Defra will consider possibilities for off-label approvals for products that are registered in the EU. Comprehensive guidance on types of insecticides used in the USA to control *A. planipennis,* and on timing of insecticide application at different stages of the lifecycle, are given in 'Insecticide options for protecting ash trees from emerald ash borer'. These might be of use in the future should any products become registered for use in the UK.

3.32. Likewise, several species of parasitoid wasp originating in Asia (including *Spathius agrili*, Sapthius galinae, *Tetrastichus planipennisi* and *Oobius agrili*) are being researched in the USA as a means of controlling *A. planipennis*. See https://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/downloads/EAB-FieldRelease-Guidelines.pdf However, it is not known how effective this control method would be in the UK.

Disposal plan

3.33. Ash trees felled to reduce *A. planipennis* infestation should be destroyed within the infested area by chipping to less than 1.5cm in three dimensions, and/or burning. If burning is used for disposal, no more than 10 tonnes can be burnt in a 24-hour period as per Environment Agency and SEPA guidelines. Firewood, round wood, sawn wood, wood chips, waste wood and debris found to contain A. planipennis life-stages, or showing signs of infestation, should be destroyed in the same way. All equipment used in the disposal of *A. planipennis*-infested trees should undergo a

thorough cleaning between sites to remove any wood chips in particular, as per standard biosecurity protocols.

3.34. For previous plant health outbreaks in England, Forestry Commission England has put in place framework incineration contracts with prior agreement from the Environment Agency, allowing it to exceed the 10 tonnes per day limit. Such contracts might be required in the event of an *A. planipennis* outbreak. Site-by-site burning agreements with the Environment Agency or SEPA would be good practice, whether seeking approval to exceed 10 tonnes per day or not.

Public outreach

3.35. It is crucial to have public support for the management programme and to help with general surveillance. Engaging the public will require the provision of timely, balanced and accurate information about monitoring and control. It can also provide opportunities for the public to participate in monitoring and reporting suspect trees using the reporting tool Tree Alert. The voluntary tree health surveillance network, Observatree, could also be deployed. Information, subject to available budget, can be made available through newspapers, radio, TV, publicity materials, the internet, social media, and face-to-face contact. It should be targeted locally, especially within the infected and regulated areas and, where appropriate, regionally and nationally.

3.36. It is important to provide information on the location and size of the infected and regulated areas, statutory and voluntary responsibilities, indications of changing or enlarging distribution, management options, pathways by which the pest might have arrived and could be dispersed, the prospects for GB forestry and the host species more generally, and what people can do to help, especially in terms of monitoring. Managing this level of public engagement will require a central administration office capable of handling a large number of enquiries and able to provide general and specific information. Liaison with communications and press teams from other countries will be required for cross-border outbreaks.

Review measures in the cases of prolonged official action

3.37. Where eradication proves ineffective (as per para 3.26, and eradication is only likely to be feasible in the very early stages of an outbreak and under very restrictive circumstances), efforts should shift to containment, with the focus moving from outbreak management for eradication to a plan for containing the outbreak. If continuing action is required within the demarcated area over a prolonged period, a review of the management programme should be undertaken regularly (e.g. annually) to determine the success and cost effectiveness of the measures in the longer term. This review will involve consultation with stakeholders and should include:

- evaluation of the effectiveness of current measures;
- evaluation of the economic impact and cost effectiveness of continuing existing measures;
- consideration of further measures to strengthen containment and eradication actions;
- consideration of statutory obligations and impact on import and export procedures;
- consideration of alternative approaches or the cessation of statutory action; and
- consideration of the impacts on biodiversity from control methods.

Criteria for declaring / change of policy and reviewing the contingency plan

3.38. This and other contingency plans will be reviewed on a regular basis to accommodate any significant changes in pest/pathogen distribution, dispersal, refinement of surveillance techniques, legislation changes or changes in policy. When and if policy makers in the country or countries affected deem that eradication is no longer a viable option, there will be a move towards containment. The criteria for determining such a break point could be based on a proportion of host species lost, a set number of hectares lost, the number of individual outbreaks, resources needed, or a combination of these. However, this will be determined by the policy makers in the country or countries affected. Further details can be found in the Defra generic contingency plan.

In circumstances where official action is no longer considered appropriate, stakeholders should be consulted and a timetable and mechanism agreed for the removal of official measures and for the dissemination of information on managing the pest as appropriate.

The plan should only be re-consulted upon if significant new information is presented which affects the approach to the management of an outbreak

Recovery

4.1. Eradication will be impossible if *A. planipennis* is found in the wider environment, and therefore there is no scope for any recovery. Alternative species to ash could be planted to help restore woodland and urban landscapes. Replanting with 'resistant' ash is not currently an option because there is no evidence to date of the existence of *A. planipennis*-resistant ash.

Appendix 1: Factsheet for *A. planipennis*

Background information

Identity of organism and quarantine status

Species name: *Agrilus planipennis* Fairmaire, 1888 (Coleoptera: Buprestidae)

Synonyms: *Agrilus feretrius* Obenberger, 1936; *Agrilus marcopoli* Obenberger, 1930; *Agrilus ulmi* Kurosawa, 1956

Common name: Emerald ash borer

UK Risk Register rating: Unmitigated 125/125; Mitigated 75/125

EU status: *Agrilus planipennis* is on the EPPO A2 List of pests recommended for regulation.

Hosts

European species known to be a host:

Fraxinus excelsior

European species that are potential hosts:

Fraxinus angustifolia
Fraxinus ornus
Fraxinus raibocarpa
Fraxinus xanthoxyloides

Hosts in North America:

Fraxinus americana
Fraxinus nigra
Fraxinus pennsylvanica (also found in Moscow area)
Fraxinus profunda
Fraxinus quadrangulata
Fraxinus velutina

Ulmus davidiana
Ulmus parvifolia

Hosts in the native region in East Asia:

Fraxinus chinensis
Fraxinus lanuginosa
Fraxinus mandshurica

Life cycle of pest

Larvae of *A. planipennis* tunnel beneath the bark of ash trees and feed on the cambium and outer sapwood. The tunnels disrupt the transport of water and nutrients, and effectively girdle the branches and stem, which then die above this area of infestation.

The adult beetles are active from mid-May through to the end of June. The adults are 8.5-14mm long, and 3.1-3.4mm wide. The body is narrow and elongate, fusiform and metallic blue-green. Most live for about three weeks, feeding on ash foliage and chewing out small, irregularly shaped pieces from around the margins of the leaves. At least a few days of feeding are required before the adult beetles mate, and 1–2 weeks of feeding can be required before the females begin to lay eggs (CABI 2015).

The eggs are laid singly or in small groups in crevices in the bark of ash trees, usually inside bark cracks and crevices (68-90 eggs per female; Haack *et al.*, 2002). The pest usually oviposits (lays eggs) on live trees: it has been observed to occasionally oviposit on freshly cut ash logs, although larvae emerging from such eggs rarely complete their development (Petrice & Haack, 2007).

On hatching, first-instar (first-stage) larvae tunnel through the bark to the cambium, then feed in the inner bark and outer sapwood. As they feed, the larvae produce frass-filled galleries that can eventually reach 26-32cm in length. The galleries are sinuous, i.e. cutting backwards and forwards across the stem under the bark, becoming progressively broader as the larva grows. Most larvae are fully developed by late autumn, and overwinter in this state, pupating the following spring in a pupation chamber excavated in the outer sapwood and just under the bark. In more thickly barked trees the pupation chamber is formed within the bark. The adult beetles emerge in May by chewing an exit hole

through the bark. The exit holes produced by *Agrilus* species are D-shaped, i.e. with one flat and one curved side. Those produced by *A. planipennis* are relatively large and 3–4mm wide. The presence of D-shaped exit holes in branches and the main stem of an ash tree is an indication that the tree is infested by a species of bupestrid beetle (CABI 2015).

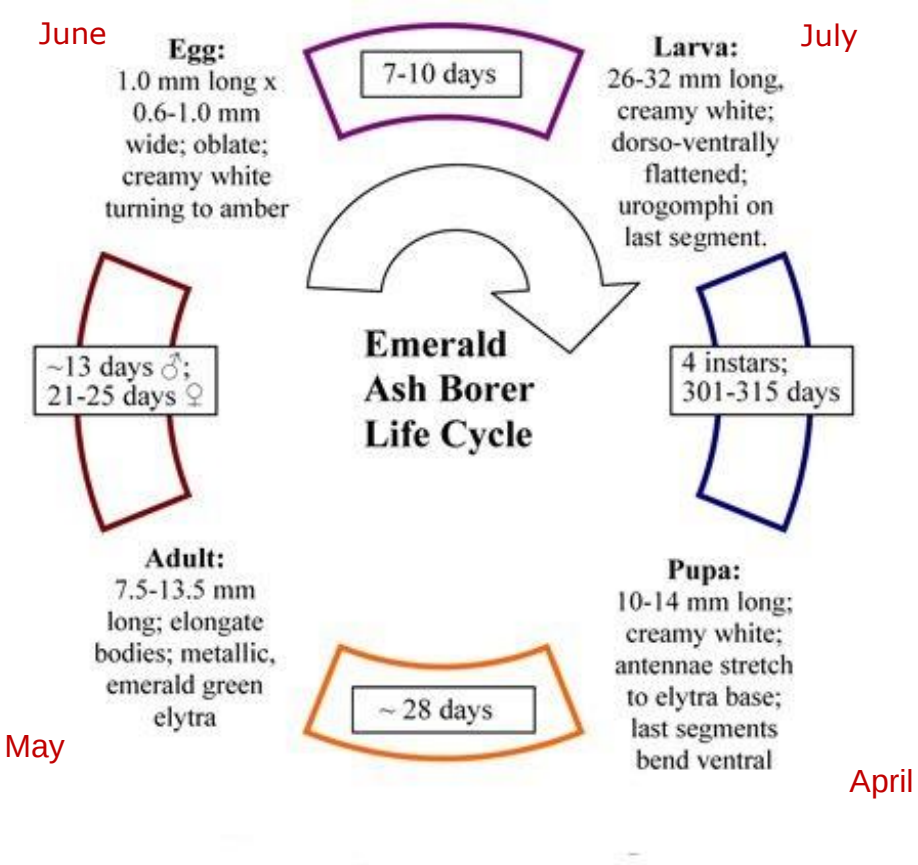

Figure 1 – typical one-year life cycle of *A. planipennis* in the United States. Source: USDA emerald ash borer programme manual

Identification of the organism

The four life stages of *A. planipennis* are egg, larvae, pupae and adult. Eggs are usually less than 1mm long and orange coloured.

Figure 1 – Eggs of *A. planipennis*. Source: D. Cappaert, Forestryimages.org

There are four larval instars. Larvae are white or cream-coloured, elongate and flattened, and the lateral margins are characteristically saw-toothed in outline. When fully developed they measure 26–32mm long.

Figure 2 - *A. planipennis* larvae.
Source: K. Law, USDA

Pupae are naked (i.e. there is no pupal case) and form directly under or within the bark. As they mature they change colour from white to the metallic green colour of the adult form.

Figure 3 – *A. planipennis* pupae.
Source: D.B. Lyons, Canadian Forest Service

A. planipennis are typical buprestid beetles. They have elongated, fusiform bodies, and are a bright metallic green or purple colour. They can be identified using morphological characteristics or by DNA sequencing.

Figure 4 – Adult *A. planipennis*.
Source: L. Bauer, USDA Forest Service

There are only eight native species of *Agrilus* in the UK that might be confused with *A. planipennis*, (Duff 2012). *Agrilus viridis* has been recorded from *Fraxinus* species, and *A. cyanescens* recorded from *Fraxinus ornus* (Jendek & Poláková (2014). However, any insect damage in ash that looks as though it might have been caused by an *Agrilus* species should be considered as highly suspicious, and should be investigated in all cases.

Damage and other typical signs of infestation are illustrated by Scarr *et al* (2002), de Groot *et al.* (2006), and McCullough *et al*. (2008). See:

Emerald ash borer information (2013):
http://www.emeraldashborer.info/files/eab_id_guide.pdf

USDA-APHIS (2017):
http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/downloads/survey_guidelines.pdf

Canadian Food Inspection Agency (CFIA) (2012). Emerald:
http://www.inspection.gc.ca/plants/plant-protection/insects/emerald-ash-borer/eng/1337273882117/1337273975030

It is difficult to distinguish canopy thinning and dieback in the early phases of *A. planipennis* infestation from the same symptoms caused by other factors, such as competition, drought stress, and disease such as Chalara dieback of ash. Consequently, reports and enquiries of possible *A. planipennis* damage require checking and verification by experts.

Distribution of the organism

Agrilus planipennis is native to north-east China, Korea, Mongolia, Japan and the Russian Far East. It has been introduced into North America and the European part of Russia (Moscow region). The outbreak of *A. planipennis* in Russia is spreading, and the pest is now well established at least 240km west and south of Moscow, and 155km to the north-west (Straw *et al*., 2013; Orlova-Bienkowskaja, 2013; Selikhovkin et al., 2017).

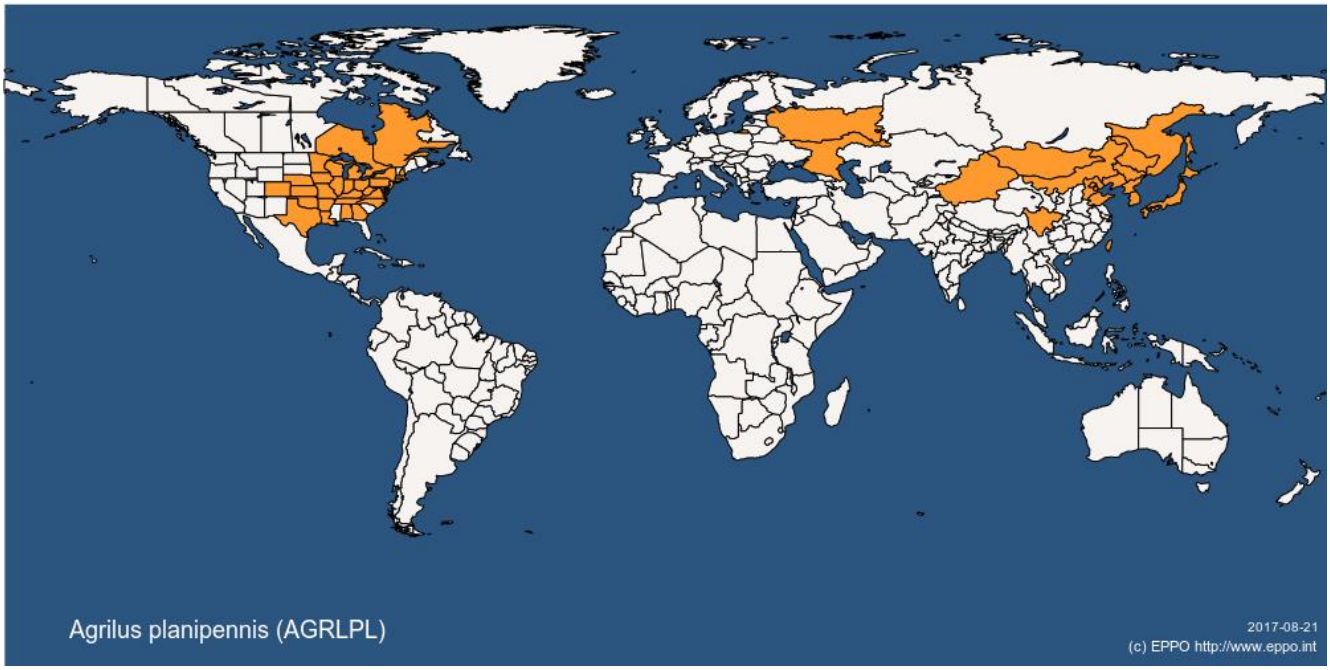

Figure 5 - Current distribution of *A. planipennis* as of July 2017 - (EPPO PQR database)

A map of the distribution of *A. planipennis* in North America is available at: http://www.emeraldashborer.info/files/MultiState_EABpos.pdf

Damage, impact and control methods

In its native range (China and other countries in East Asia) *A. planipennis* is a minor secondary pest of the local ash species *Fraxinus mandshurica* and *F. chinensis,* and only attacks severely stressed and dying ash trees. It is not particularly common, and is not subject to any controls.

In contrast, in its introduced range in North America and European Russia, *A. planipennis* is highly damaging to ash, and has caused extensive and widespread mortality. Tens of millions of ash trees have been killed in the United States and Canada, with mortality rates of 99% observed amongst *F. pennsylvanica*, *F. americana* and *F. nigra*. In the Moscow region of Russia, *A. planipennis* has killed more than 1 million *F. pennsylvanica* along roadsides and in parks and gardens, and it has also attacked *F. excelsior*. Trees are typically killed within three to four years of initial attack.

Signs and symptoms of infestation are described in the PRA and datasheet for *A. planipennis*. They include:

- yellowing and thinning foliage;
- dying branches;
- dieback and mortality of whole trees;
- frass-filled, sinuous larval galleries under the bark;
- D-shaped exit holes 3–4mm wide; and
- the presence of *A. planipennis* life-stages in the trees.

Figure 6 – Larval gallery of *A. planipennis*. Source: T. Kimoto, Canadian Food Inspection Agency

Figure 7 – Yellowing and thinning of the canopy associated with *A. planipennis* damage.
Source: S. Katovich, USDA Forest Service

Figure 8 – Typical D-shaped exit hole associated with emergence of adult *A. planipennis*.
Source: W. Ciesla, Forest Health Management International.

Official control measures in North America have included large-scale sanitation felling, the use of chemical insecticides, and restrictions on the movement of plants for planting and ash wood (especially firewood). However, these measures have not prevented *A. planipennis* from spreading, and they have had little effect on the total numbers of trees killed. The aim of current management strategies in North America is to try to slow down the rate of spread and the progression of ash mortality by employing as wide a range of survey and control measures as possible. These measures include biological control through the introduction and release of three species of parasitoid wasp from the native region of *A. planipennis* in China. This method has yet to be considered for approval in the UK.

Some infested trees have been felled in the Moscow region of Russia, primarily for safety reasons, but otherwise no official control measures have been implemented to try to contain the outbreak or to reduce its impact. The pest is not regulated in Russia.

Main pathways for entry and further spread

A. planipennis has been shown to move along a number of different pathways. In North America, infested crating, dunnage or pallets are suspected to have been responsible for the initial introduction. *A. planipennis* then spread naturally and through human-assisted pathways, the latter including the movement of infested ash logs, firewood (identified as one of the most important long-distance pathways in North America) and nursery plants. USDA-APHIS (2011) also identifies timber, wood chips and mulch (composted and un-composted) as further potential pathways.

A. planipennis was well established in Moscow by 2003, and might have been introduced initially in the late 1990s (Izhevskiy and Mozolevskaya, 2010). Up to 2005, the rate of spread was estimated to be about 4km a year^{-1}, and subsequently it has been estimated to be 10–12km a year^{-1} (Baranchikov and Kurteev, 2012). The rate of spread between 2009 and 2013 was much greater, and suggests an increase in the rate at which the outbreak was expanding, at least to the west and south. The previous estimates of spread are within the natural dispersal capabilities of *A. planipennis*. Even though most adult female *A. planipennis* lay their eggs within a few hundred metres of their point of emergence (Mercader et al., 2009; Siegert et al., 2010), they have the capacity to fly up to 10km over several days (Taylor et al., 2010).

The original outbreak of *A. planipennis* in Michigan, in the USA, spread initially at a rate of 10–11km a year^{-1}, primarily at that time through natural dispersal (Smitley et al., 2008). Subsequently, the *A. planipennis* outbreak in the United States has expanded at a rate of more than 20km a year^{-1} and this can only have been achieved through human-assisted movements. In North America this appears to involve particularly the transport and redistribution of firewood from infested to un-infested areas (Muirhead et al., 2006).

Information on pathways is summarised in the PRA for *A. planipennis* (EPPO 2013) and the EPPO datasheet and CABI datasheet

The pathways covered include the importation and movement of:

- ash wood with and without bark, including round wood, sawn wood and firewood;
- ash plants for planting;
- waste wood, scrap wood and hardwood wood chips, including woodfuel;
- wood packaging material; and
- ash foliage.

A. planipennis adults can also be spread by 'hitch-hiking' in or on vehicles.

A. planipennis attacks ash trees of all ages and sizes, and larvae have been found in branches with a diameter of 1–2cm. Consequently, all ash wood, derived from both small and large material, and live plants with a stem diameter greater than 1.5cm, can contain *A. planipennis* life-stages and will need regulation. The EPPO pest risk analysis identifies all stems and branches of more than 1.5cm diameter as capable of being infested (EPPO, 2013).

Once introduced and established, *A. planipennis* is capable of spreading rapidly through natural dispersal, irrespective of any human-assisted movement. The adult beetles are strong flyers and can travel more than 1km in a single flight, and between 10 and 20km over several days. Evidence suggests that mated females in particular are capable of flying further than males and non-mated females, which raises further concerns about spread of the pest (Taylor *et al* 2010).

Import restrictions are in place on wood of ash into the U.K: see the link below for full details.

'Importing wood, wood products and bark Requirements for landing controlled material into Great Britain from non-EU countries'

Statutory notification scheme for landing consignments of solid fuel wood (firewood)

The statutory notification scheme (SNS) for landing consignments of solid fuel wood (firewood) was introduced via an amendment to the Plant Health (Forestry)

(Amendment) (England and Scotland) Order 2016 (SI No.1167) and came into force on 1 January 2017.

http://www.legislation.gov.uk/uksi/2016/1167/contents/made

The notification scheme for firewood does not alter procedures for importers of controlled firewood imported from third countries as these imports are already subject to advanced notification of landing requirements

The Forestry Commission has now introduced a specific requirement in respect of firewood (solid fuel wood), not previously subject to regulation, via SNS. The SNS requires imports of firewood into England and Scotland, regardless of species or country of origin, to be notified to the Forestry Commission. All relevant consignments, irrespective of size or weight must be notified.

Imports of some species (mainly conifers, birch, oak, ash, maple, plane and poplar/aspen) of firewood from certain third countries must already be notified in advance to the Forestry Commission. The new notification scheme extended this pre-notification requirement to all other imports of firewood from third countries and also to imports from the EU.

The information gathered from the notifications of ash firewood into GB from EU countries and non EU countries where EAB is not yet present and targeted inspections will provide an early warning of pathways that may need to be regulated. Data gathered to August 2017 shows that there has been one consignment of ash firewood from the Ukraine. Contact with the importer in question has confirmed that trade in ash from the Ukraine has now ceased.

Appendix 2 – Alert status levels for an outbreak – (based on alert status levels for draft Defra generic contingency plan).

ALERT	STATUS	COMMAND LEVEL
White	Plant pest/disease with potential for limited geographical spread	Instigation of incident management plan involving operational command at appropriate level, and following Standard Operating Procedures or scientific advice where applicable
Black	Significant plant pest/disease with potential for limited geographical spread	Instigation of incident management plan, usually involving joint tactical and operational command at appropriate level, and following plant pest/disease-specific response plans where applicable
Amber	Serious plant pest/disease with potential for relatively slow but extensive spread leading to host death and/or major economic, food security or environmental impacts	Instigation of incident management plan, usually involving joint strategic and tactical command, and following plant pest/disease-specific response plans where applicable
Red	Serious or catastrophic plant pest/disease with potential for rapid and extensive geographical spread leading to host death and/or major economic, food security or environmental impacts	Instigation of incident management plan involving strategic, tactical and operational command, and following plant pest/disease-specific response plans where applicable

Appendix 3: Relevant legislation

Domestic:
The Waste Management Licensing (Scotland) Regulations 2011
The Environmental Permitting (England and Wales) Regulations 2010
Natural Environment and Rural Communities Act 2006
Plant Health (Forestry) Order 2005
Plant Health (England) (Amendment) Order 2015
The Plant Health (Forestry) (Amendment) (Wales) Order 2015
Plant Health Act 1967
Forestry Act 1967

European:
EC Council Directive 2000/29/EC
Commission Implementing Decision 2015/2416

Commission Implementing Decision (EU) 2015/2416 of 17 December 2015 recognising certain areas of the United States of America as being free from Agrilus planipennis Commission Implementing Decision 2015/2416

Temporary Derogation in Respect of Imports of Ash Wood Originating or Processed in Canada: Commission Implementing Decision EU 2016/412

Commission Implementing Decision (EU) 2017/204 of 3 February 2017 authorising Member States to provide for a temporary derogation from certain provisions of Council Directive 2000/29/EC in respect of ash wood originating or processed in the United States of America, and **repealing** Implementing Decision (EU) 2015/2416 recognising certain areas of the United States of America as being free from Agrilus planipennis

Commission Implementing Decision (EU) 2017/204

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