

Appendix 1. Revision of the questions on the environmental impact of the EPPO PRA scheme
Version for plant pests

6.08. How important is the environmental impact caused by the pest within its current area of invasion?

N/A, Minimal, minor, moderate, major, massive

In this question we rate the current environmental impact in other invaded regions that can be used as indicator for determining the potential environmental impact in the PRA area (Q6.09).

If the species has not invaded any other area, or if the invasion is too recent and too little is known about its ecology in the invaded areas, this question cannot be answered properly (assuming that no additional investigations can be undertaken during the time available for producing the PRA). The assessor may choose to go directly to Q 6.09. He/she may also choose to answer these questions based on well studied closely-related species or data for the target species from the region of origin. Although the concept of “environmental impact” of an indigenous species on native biodiversity and ecosystem is debatable, in some cases native species clearly have an environmental impact, usually resulting either from climate change or ecological mismanagement (e.g. *Dendroctonus ponderosae* presently causing serious outbreaks and extending its range in Canada, various weeds now invasive in their native range, etc.). Nevertheless, the assessor should take into account the fact that the environmental impact of a pest in its region of origin is often a very poor predictor of potential impact in regions where it has been introduced. In particular, the absence of any obvious environmental impact in a region of origin should not be considered as a predictor for a low impact in a new area.

Examples of species for which Q6.08 may be difficult to answer include:

- *Choristoneura fumiferana* and *Pissodes strobi*: These North American species have never invaded any area.
- *Anoplophora glabripennis* and *A. chinensis*: For the moment (2010) all outbreaks in invaded areas worldwide are still under eradication and the beetle has not yet been studied in natural areas or even semi-natural forests in invaded areas.
- *Diaphania perspectalis* and *Paysandisia archon*: Their invasion in Europe is too recent to accurately assess their current impacts, and they have never invaded any other region.
- Most pathogens and strictly agricultural pests have been poorly studied for their environmental impact.

When data on impact are available in several invaded regions, priority should be given to impact observed in regions that are most closely related, geographically and eco-climatologically, to the PRA region. However, data from other regions should not be excluded. For example, when performing a PRA on an invasive pest for the entire Europe, data on impact already observed in Europe should be given priority, but information from other regions should also be provided. In any case, the assessor should specify the region where the information on impact has been gathered.

6.08.0A Based on the above, do you consider that the question on the environmental impact caused by the pest within its current area of invasion can be answered?

If Yes: Go to 6.08.01

If No, but information is available for the native area of the pest, Go to 6.08.01.

If No, but there is some evidence that the environmental impact may be significant in the PRA area: answer N/A for 6.08 and Go to 6.09.0C

If No, and the assessor is certain that, in any case, the environmental impact will be lower than the economic impact (e.g. a purely agricultural pest not known to occur in other environments): answer N/A for 6.08 and 6.09 (the assessor will have to justify this decision).

The pest has to be assessed for three categories of impact using several indicators that need to be rated. The precise region (and whether invaded or native) and the species (target species or closely-related species) for which the question is answered should be clearly described by the assessors.

The subquestions to be answered are organized as follows:

Negative impact on native biodiversity

6.08.01. To what extent does the pest cause a decline in native species?

6.08.02. To what extent does the pest cause changes in the composition and structure of native species communities?

6.08.03. To what extent does the pest hybridize with native species?

Alteration of ecosystem processes and patterns

6.08.04. To what extent does the pest cause physical modifications of habitats?

6.08.05. To what extent does the pest cause changes in nutrient cycling and availability?

6.08.06. To what extent does the pest cause modifications of natural successions?

6.08.07. To what extent does the pest disrupt trophic and mutualistic interactions?

Conservation impacts

6.08.08. To what extent does the pest occur in habitats of high conservation value?

6.08.09. To what extent does the pest cause harm to rare or vulnerable species?

For each of the indicators, a rating is given based on three choices: *Low*, *Medium* or *High*. Information is provided for each indicator on the meaning of these scores.

For each answer, the associated uncertainty should also be assessed, the possible options are *Low*, *Medium* or *High*.

Low: the assessor has low uncertainty that the rating is correct (i.e. the impact has been studied and measured, or the observed damage, the bio-ecological characteristics of the species, or the environmental conditions allow the assessor to be highly confident of the accuracy of the rating).

Medium: The assessor has moderate uncertainty that the rating is correct (i.e. the impact has been studied but some contradictory results have been identified, or the observed damage, the bio-ecological characteristics of the species, or the environmental conditions allow the assessor to be moderately confident of the accuracy of the rating).

High: The assessor has high uncertainty that the rating is correct (i.e. the impact has been studied but the results are contradictory, or the observed damage, the bio-ecological characteristics of the species, or the environmental conditions do not allow the assessor to be moderately confident of the accuracy of the rating).

Negative impact on native biodiversity

Note 1: The word “native” in “native species” or “native biodiversity” throughout Questions 6.08 and 6.09 should be understood in a broad sense, i.e. it should also include species that have been naturalised for centuries and that play an important role in the ecosystems or local cultural heritage, such as walnut (*Juglans*) or chestnut (*Castanea*) in Europe. The assessor may also include other, more recently introduced beneficial organisms such as biological control agents or exotic plants that play a role in ecosystem services, e.g. plants used against erosion.

Note 2: If possible, all mechanisms of impact on native biodiversity should be considered, but only the mechanism providing the highest score and lowest uncertainty is kept for the scoring of the indicators. Mechanisms of impact may include, among others:

Herbivory: Most impacts by plant pests occur through direct feeding on native plants. E.g., the emerald ash borer *Agrilus planipennis* feeds on, and kills native *Fraxinus* spp. in North America. The hemlock woolly adelgid, *Adelges tsugae*, severely affects natural stands of *Tsuga* spp. in Eastern North America.

Plant pathology: A pathogen directly impacts its host plant by causing disease, e.g. *Ophiostoma novo-ulmi* decimated *Ulmus* spp. by causing Dutch elm disease in Europe and North America. Nematodes may also cause plant disease, e.g. *Bursaphelenchus xylophilus* causes pine wilt, which devastates native pine stands in East Asia.

Disease transmission: Alien pests can affect native plants through disease transmission, e.g. *Scolytus multistriatus*, a European bark beetle, is a vector of the Dutch elm disease in North America. This can also include pests that facilitate the attack of a pathogen, without being vectors themselves. For example, the European beech scale,

Cryptococcus fagisuga, increases the susceptibility of the fungus *Neonectria faginata*, causal agents of the beech bark disease in North America.

Hybridization: Hybridization between an alien and a native species or sub-species may affect the genetic identity of native species or sub-species, although well documented examples are rare for plant pests. The Australian lycaenid butterfly *Zizina labradus* has apparently locally displaced the endemic *Z. oxleyi* in New Zealand. In insects, examples are most common between alien and native honey-bee and bumble-bee sub-species.

Competition for resources: Alien herbivores may affect native biodiversity by competing for food or by affecting the quality and availability of food. For example, the scale insect *Icerya purchasi*, by killing endangered plants in the Galapagos, has also caused local extinction of host specific Lepidoptera. In North America, the Asian adelgid *Pineus boernerii*, is displacing *P. coloradensis* in red pine plantations, by reducing host plant quality and forcing the native species to move to other hosts.

Predation: Plant pests may also affect native species through predation on other animals. For example, the ladybird *Harmonia axyridis*, a pest of vineyards in North America also affects native ladybird populations through predation.

Apparent competition: Apparent competition occurs when the presence of one species indirectly decreases the fitness of another through the increased presence of a shared enemy. An example is the variegated leafhopper, *Erythroneura variabilis*, which, when introduced into California, affected populations of the native *E. elegantula* by enhancing populations of a shared egg parasitoid.

Pesticide use: An intensive use of non-specific pesticides (including biopesticides) over wide areas may affect native biodiversity, in particular when used in natural or semi-natural habitats (e.g. forests, swamps, etc.) . For example, the use of Bt over wide areas in North America to control *Lymantria dispar* locally affects the Lepidopteran fauna; the chemical control of alien mosquitoes over wide areas worldwide has a negative impact on the aquatic fauna.

6.08.01. To what extent does the pest cause a decline in native species populations?

Low extent, Medium extent, High extent

| | | | |
|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
|------------------------------|------------|---------------|-------------|

| Rating guidance | |
|------------------------|--|
| Low | <p>The decline in native species populations has been studied but not observed. If no study has been carried out to determine the level of impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, a decline in native species is unlikely.</p> <p>Examples: The impact of alien gall wasps <i>Andricus</i> spp. on native gall wasps in Britain has been studied but no significant impact was found. <i>Phytophthora infestans</i> mainly attack cultivated crops in Europe and the effect on native species populations is unlikely.</p> |
| Medium | <p>A decline in native species populations has been observed but the decline is not persistent and is limited in area. If no study has been carried out to determine the level of impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, the impact level is considered to be medium.</p> <p>Examples: Severe outbreaks of <i>Lymantria dispar</i> in North America are known to cause local decline in host trees and associated fauna (e.g. birds), but most studies suggest that the decline is usually temporary. <i>Cryphonectria parasitica</i> has severely affected populations of European chestnut when it arrived in Europe, but chestnut forests have largely recovered.</p> |
| High | <p>A decline in native species populations has been observed, and the impact is likely to be widespread within the habitats occupied by the species and persistent if no management option is taken. If no study has been carried out to determine the level of impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, the impact level is considered to be high.</p> <p>Examples: <i>Adelges piceae</i> has decimated natural Fraser fir populations in Eastern North America. <i>Ophiostoma novo-ulmi</i> has caused the general decline of elm species in Europe and North America.</p> |

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| Although studies to accurately measure the impact of <i>Agilus planipennis</i> on populations of several ash species in North America are still lacking, the fact that the beetle has already killed over 40 million trees and the prediction that the damage is going to continue unabated for the foreseeable future strongly suggests that it has a severe effect on ash populations and the associated fauna. |
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6.08.02. To what extent does the pest cause changes in the composition and structure of native species communities?

Low extent, Medium extent, High extent

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|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
|------------------------------|------------|---------------|-------------|

| Rating guidance | |
|------------------------|--|
| Low | Changes in native community composition and structure have been studied but not observed. If no study has been carried out to determine the level of impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, a decline in native community composition and structure is unlikely. Examples: All alien pests and pathogens attacking mainly or exclusively crop species will fall into this category. Species (e.g. <i>Lilioceris lili</i>) that are specific to plants species that do not, or rarely dominate plant communities (e.g. lilies) will also score <i>Low</i> here. |
| Medium | Changes in native community composition and structure have been observed but the changes are not persistent and limited in area. If no study has been carried out to determine the level of impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, the impact level is considered to be medium. Examples: Defoliation by <i>Lymantria dispar</i> can cause a major shift in tree species in North America either through tree mortality or via seed failure or mortality of oak seedling. Bird communities may also be modified. However, in general, defoliations by <i>L. dispar</i> only induce temporary changes. |
| High | Significant changes in native community composition and structure have been observed and the impact is likely to be widespread within the habitats occupied by the species and persistent if no management option is taken. If no study has been carried out to determine the level of impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, the impact level is considered to be high. Examples: Mortality of Fraser fir caused by <i>Adelges piceae</i> in North America has totally altered plant communities in these forest ecosystems. <i>Cryphonectria parasitica</i> has had a same effect on plant communities associated to American walnut forests. The decline of eastern hemlock due to <i>Adelges tsugae</i> in North America strongly affects bird species composition. |

6.08.03. To what extent does the pest hybridize with native species?

Low extent, Medium extent, High extent

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|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
|------------------------------|------------|---------------|-------------|

| Rating guidance | |
|------------------------|---|
| Low | Hybridization with native species has been studied but has not been observed. If no study has been carried out to determine the level of impact, according to the information available, hybridization with native species is very unlikely. Examples: All alien species without taxonomically very closely related species (congeneric sister-species or sub-species) will fall into this category. |
| Medium | Hybridization with native species/subspecies has been observed in the field or in the lab, but no fertile offspring have been produced, or if fertile offspring have been produced, the hybrid has a lower fitness than its parents and will not replace the native species/subspecies. If no study on hybridization has been carried out, hybridization is considered possible because of the presence of sister species or subspecies |

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| | <p>in the invaded area.</p> <p>Examples: Hybridization between alien and native <i>Bombus</i> spp. is obtained in the laboratory, but their offspring is usually sterile. In Japan, fertile hybridization is obtained in the lab between the native parasitoid <i>Torymus beneficus</i> and the alien <i>T. sinensis</i>, but studies showed that hybridization in the field was marginal.</p> |
| High | <p>Hybridization with native species/subspecies has been observed in the field or in the laboratory and fertile offspring have been produced. The hybrid has a high fitness and is replacing, or is able to replace the native species or sub-species. If no study on hybridization has been carried out, fertile hybridization is considered likely because of the presence of sister species or subspecies in the invaded area and the occurrence of other, similar cases with taxonomically closely-related species.</p> <p>Example: The Australian lycaenid butterfly <i>Zizina labradus</i> has apparently locally displaced the endemic <i>Z. oxleyi</i> in New Zealand. Introductions in North-Western Europe of two southern European sub-species of <i>Apis mellifera</i> has caused large-scale gene-flow and introgression between these sub-species and the native sub-species, whose native populations are now threatened.</p> |

Alteration of ecosystem processes and patterns

Note : Only the impact on natural or semi-natural habitats should be considered when assessing the impact on ecosystem processes and patterns. However, natural and semi-natural habitats have to be considered in a broad sense, i.e. every habitat that is not under constant human management. It includes all EUNIS habitat types 1 (<http://eunis.eea.europa.eu/habitats-code-browser.jsp>), except I (Regularly or recently cultivated agricultural, horticultural and domestic habitats) and J (Constructed, industrial and other artificial habitats). For example, grasslands that are regularly mown are included as well, but not those that are repeatedly re-seeded.

6.08.04. To what extent does the pest cause physical modifications of habitats (e.g. changes to the hydrology, significant increase of water turbidity, light interception, alteration of river banks, changes in fire regime, etc.)?

Low extent, Medium extent, High extent

| | | | |
|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
|------------------------------|------------|---------------|-------------|

| Rating guidance | |
|------------------------|---|
| Low | <p>The physical modification of habitats has been studied but not observed. If no study has been carried out to assess the impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, a physical modification of habitats is unlikely.</p> <p>Examples: All alien pests and pathogens attacking mainly or exclusively crop species will fall into this category, as well as those impacting non-dominant plants, in particular herbaceous plants.</p> |
| Medium | <p>A physical modification of habitats has been observed but the impact is not persistent and limited in area. If no study has been carried out to assess the impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, the impact level is considered to be medium.</p> <p>Examples: Defoliations and tree mortality by <i>Lymantria dispar</i> in North America increases light penetration to the forest floor and water drainage. These changes are usually considered as temporary. Tree mortality caused by <i>Elatobium abietinum</i> in relatively dry areas such as Arizona increases the amount of dry fuel material in the forest and increases the risk of wildfire.</p> |
| High | <p>A physical modification of habitats has been observed and the impact is likely to be widespread within the ecosystem where the species is present and persistent if no management option is undertaken. If no study has been carried out to assess the impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, the impact level is considered to be high.</p> <p>Examples: Hemlock mortality due to <i>Adelges tsugae</i> in North America modifies hydrological processes</p> |

and the forest floor microclimate.

6.08.05. To what extent does the pest cause changes in nutrient cycling and availability (e.g. significant changes in nutrient pools in topsoils or in water)?

Low extent, Medium extent, High extent

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|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
|------------------------------|------------|---------------|-------------|

| Rating guidance | |
|------------------------|---|
| Low | Changes in nutrient cycling have been studied but not observed. If no study has been carried out to assess the impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, a change in nutrient cycling is unlikely. Examples: All alien pests and pathogens attacking mainly or exclusively crop species will fall into this category, as well as those impacting non-dominant plants, in particular herbaceous plants. |
| Medium | Changes in nutrient cycling have been observed but the impact is not persistent and limited in area. If no study has been carried out to assess the impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, the impact level is considered to be medium. Examples: Defoliation by <i>Lymantria dispar</i> in oak forests in North America alters carbon allocation and nitrogen cycling, which has consequences such as acidification of stream water. These effects are usually considered as temporary. |
| High | Changes in nutrient cycling have been observed and the impact is likely to be widespread where the species is present and persistent if no management option is undertaken. If no study has been carried out to assess the impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, the impact level is considered to be high. Examples: In Western North America, spruce defoliation by <i>Elatobium abietinum</i> influences short- and long-term nutrient cycling in forest stands. Nutrient availability may be increased in the short-term, but over longer periods defoliation may result in a net loss of nutrients from the stand. Hemlock mortality caused by <i>Adelges tsugae</i> results in a dramatic increase in inorganic N availability and the nitrification rate, resulting in nitrate leaching. |

6.08.06. To what extent does the pest cause modifications of natural successions (e.g. acceleration or temporary freezing of successions)?

Low extent, Medium extent, High extent

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|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
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| Rating guidance | |
|------------------------|---|
| Low | The modification of natural successions has been studied but has not been observed. If no study has been carried out to assess the impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, a modification of natural successions is unlikely. Examples: All alien pests and pathogens attacking mainly or exclusively crop species will fall into this category, as well as those impacting non-dominant plants, in particular herbaceous plants. |
| Medium | A modification of natural successions has been observed but the impact is not persistent and limited in area. If no study has been carried out to assess the impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, the impact level is considered to be medium. Examples: <i>Lymantria dispar</i> outbreaks modify natural successions in defoliated oak forests but changes are only temporary. |
| High | A modification of natural successions has been observed and the impact is likely to be widespread |

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| | <p>within that ecosystem in the current distribution of the species and persistent if no management option is taken. If no study has been carried out to assess the impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, the impact level is considered to be high.</p> <p>Examples: <i>Cryptococcus fagisuga</i> facilitates beech bark disease in North America, which causes long term changes in natural successions that disadvantages beech. The predation of <i>Anoplolepis gracilipes</i> on the red land crab in the rain forest of Christmas Island has totally modified natural successions in this natural ecosystem.</p> |
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6.08.07. To what extent does the pest disrupt trophic and mutualistic interactions (e.g. disruption of food web, pollination or plant-mycorrhiza webs leading to ecosystem imbalance)?

Low extent, Medium extent, High extent

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|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
|------------------------------|------------|---------------|-------------|

| Rating guidance | |
|------------------------|---|
| Low | <p>The disruption of trophic and mutualistic interactions has been studied but not observed. If no study has been carried out to assess the impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, a disruption of trophic and mutualistic interactions is unlikely.</p> <p>Examples: Studies have investigated the impact of <i>Cameraria ohridella</i> on trophic interactions between native leaf miners and parasitoids, but no impact was found. All alien pests and pathogens attacking mainly or exclusively crop species will fall into this category.</p> |
| Medium | <p>A disruption of trophic and mutualistic interactions has been observed but the impact is not persistent and limited in area. If no study has been carried out to assess the impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, the impact level is considered to be medium.</p> <p>Examples: <i>Lymantria dispar</i> outbreaks enhance parasitoid populations, leading to increased parasitism on rare butterfly and favour mouse populations, leading to an increase in tick populations and Lyme disease incidence. <i>Linepithema humile</i> displaces floral arthropods, including pollinators on various plants in South Africa, but no long term effect on seed sets is observed. The introduction of <i>Apis mellifera</i> and <i>Bombus terrestris</i> worldwide causes local decline of native bees and birds which may locally affect pollination.</p> |
| High | <p>A disruption of trophic and mutualistic interactions has been observed and the impact is likely to be widespread within that ecosystem in the current distribution of the species and persistent if no management option is taken. If no study has been carried out to assess the impact, according to the information available on observed damage, bio-ecological characteristics of the species and environmental conditions, the impact level is considered to be high.</p> <p>Examples: The strong decline of important trees such as American chestnut (due to <i>Cryphonectria parasitica</i>), elm species (due to <i>Ophiostoma novo-ulmi</i>), Fraser fir (due to <i>Adelges piceae</i>) and Hemlock species (due to <i>Adelges tsugae</i>) undoubtedly has a strong, long term effect on food webs closely associated with these trees and their specific herbivores. The introduction of <i>Anoplolepis gracilipes</i> in Christmas Island and the Seychelles has lead to new associations with scale insects, leading to important tree mortality and long-term changes in forest ecosystems.</p> |

Conservation impacts

6.08.08. To what extent does the pest occur in habitats of high conservation value (includes all officially protected nature conservation habitats)?

Low extent, Medium extent, High extent

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|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
|------------------------------|------------|---------------|-------------|

| Rating guidance | |
|-----------------|--|
| Low | The pest occurs exclusively, or nearly exclusively outside habitats of high conservation value. Examples: In Central Europe, <i>Cameraria ohridella</i> attacks nearly exclusively horse-chestnut, which is an exotic ornamental tree that is rarely found in habitats of high conservation values. The <i>Potato Spindle Tuber Viroid</i> is found nearly exclusively in agricultural and horticultural habitat. |
| Medium | The pest occurs only occasionally in habitats of high conservation value or, if it occurs commonly, no major host is an important component of these habitats (e.g. dominant or keystone species, ecological engineers, etc.). Examples: <i>Lilioceris lili</i> in North America may be found in protected areas, but its hosts (<i>Lilium</i> spp.) cannot be considered as important components of these protected habitats. <i>Phyllonorycter robinella</i> is restricted to <i>Robinia pseudoaccacia</i> , which occurs occasionally in protected areas in Europe. However, the host is an alien species and, so, is not an important component of the protected habitats. |
| High | The pest occurs commonly in habitats of high conservation value and at least some major hosts are important ecological components of such habitats (e.g. dominant or keystone species, ecological engineers, etc.) Examples: <i>Adelges tsugae</i> attacks hemlock species in nature reserves and national parks, where its hosts are keystone species. <i>Cryphonectria parasitica</i> has nearly eradicated American chestnut, a keystone tree species of several forest ecosystems in Eastern America, including in protected areas. |

6.08.09. To what extent does the pest cause harm to rare or vulnerable species (includes all species classified as rare, vulnerable or endangered in official national or regional lists within the PRA area)?

Low extent, Medium extent, High extent

| Level of uncertainty: | Low | Medium | High |
|-----------------------|-----|--------|------|
|-----------------------|-----|--------|------|

| Rating guidance | |
|-----------------|--|
| Low | The pest has no rare or vulnerable species as hosts. Examples: <i>Agrilus planipennis</i> is restricted to <i>Fraxinus</i> spp. But, so far, none of these species are considered to be rare or vulnerable in North America. <i>Diabrotica virgifera</i> attacks mainly maize and some grasses in Central Europe, none of which are rare or vulnerable. |
| Medium | The pest has rare or vulnerable species as minor hosts. “Minor hosts” means that, if they have already been in contact, severe damage has never been observed on these hosts. If they have never been in contact, there is indication that the development on these hosts is less favourable. Examples: In North America, no major host of <i>Lymantria dispar</i> is rare or vulnerable. However, the pest is so polyphagous that, during outbreaks, the chance that it will feed on rare woody species is high. |
| High | The pest has rare or vulnerable species as major hosts. “Major hosts” include all hosts on which severe damage has been observed, i.e. damage for which the species has gained its pest status. If the pest and the host have never been in contact in the field, laboratory observations suggest that damage may be as high as on its recognised major hosts. Examples: In North America, one of the major hosts of <i>Adelges piceae</i> is <i>Abies fraseri</i> , which is classified as a vulnerable species by the IUCN. In Florida, <i>Cactoblastis cactorum</i> attacks several endangered <i>Opuntia</i> spp. and <i>Aulacaspis yasumatsui</i> threatens the survival of several rare and endangered cycad species. |

Final rating:

- Each of the three impact categories will be scored with the highest indicator score within its category
- A final rating is obtained as follows:
 - *Massive*: 3 x High

- *Major*: 2 x High and 1 x Medium
- *Moderate*: 1 x High and at least 1 x Medium or 2 x High and 1 x Low
- *Minor*: 1 x High and 2 Low or 2 or 3 x Medium
- *Minimal*: Maximum 1 x Medium, all others Low

Q 6.09. How important is the environmental impact likely to be in the PRA area?

Minimal, minor, moderate, major, massive

Verify that, based on Q 6.08, an environmental impact is also likely to occur in the PRA area, and, if yes, at a comparable level, using the following questions. For this, answers to the section in the “likelihood of establishment” section should be taken into account:

6.09.0A Taking into account the responses to the relevant questions (on hosts and habitats, climatic conditions, abiotic factors and management methods) in the establishment section, are the conditions in the PRA area sufficiently similar to those in the area of invasion to expect a similar level of impact?

If No: the situation regarding environmental impact may be different, Go to 6.09.0C

If Yes: go to next question (6.09.0B)

Note: If Q 6.08 has been answered for the native area only, it is highly advisable to go to 6.09.0C.

| | | | |
|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
|------------------------------|------------|---------------|-------------|

6.09.0B Does the same native species or community, or the same threatened ecosystem services, occur in the PRA area and, if not, is it known whether the native species or communities, or ecosystem service in the PRA area are similarly susceptible?

Examples: *Agrilus planipennis* (for a PRA for Europe), *Bursaphelenchus xylophilus* (for a PRA for Europe), *Diabrotica virgifera* (for a PRA for Western Europe) or the Potato spindle tuber viroid (for a PRA for Europe) will most likely have a similar impact in the PRA area and in the areas where they are already invasive (susceptible hosts and habitat, compatible climate, etc.). Therefore, the rating of Q 6.08 can be used for Q 6.09. In contrast, species such as *Adelges tsugae* (for a PRA for Europe) will encounter a suitable climate but the main host plants do not occur naturally in Europe. Similarly, *Aulacaspis yasumatsui* will not encounter suitable native host plants in Europe and, in addition, will not encounter a very suitable climate outdoors. These species **have to** be assessed separately in Q 6.09.

If No: the situation regarding environmental impact may be different, Go to 6.09.0C

If Yes: The situation regarding environmental impact is likely to be similar between the invaded and the PRA areas, the score of Q 6.08 can be given in Q 6.09 **as the impact elsewhere will be the most reliable criterion to predict impact in the PRA area.**

| | | | |
|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
|------------------------------|------------|---------------|-------------|

6.09.0C If the assessor considered that Q6.08 has could not be answered, or if answered only for a native region, or if answered for another invaded region, but the situation in the PRA area is likely to be different: use another, simpler rating system based on simpler impact predictors. For plant pests, six indicators will be related to:

- Direct impact on native plants (2 indicators)
- Impact on ecosystem patterns and processes (1)
- Conservation impact (2)
- Impact of pesticides (1)

Impact on native plants:

6.09.01. What is the risk that the host range of the pest includes native plants in the PRA area?

6.09.02. What is the level of damage likely to be caused by the organism on its major native host plants in the PRA area?

Impact on ecosystem patterns and processes

6.09.03. What is the ecological importance of the host plants in the PRA area?

Conservation impacts

6.09.04. To what extent do the host plants occur in ecologically sensitive habitats?

6.09.05. What is the risk that the pest would harm rare or vulnerable species?

Impact of pesticides

6.09.06. What is the risk that the presence of the pest would result in an increased and intensive use of pesticides?

Uncertainty:

For each rating, the assessors should choose among three levels of uncertainty:

Low: the assessor has low uncertainty that the rating is correct (i.e. the impact has been studied and measured, or the observed damage, the bio-ecological characteristics of the species, or the environmental conditions allow the assessor to be highly confident of the accuracy of the rating).

Medium: The assessor has moderate uncertainty that the rating is correct (i.e. the impact has been studied but some contradictory results have been identified, or the observed damage, the bio-ecological characteristics of the species, or the environmental conditions allow the assessor to be moderately confident of the accuracy of the rating).

High: The assessor has high uncertainty that the rating is correct (i.e. the impact has been studied but the results are contradictory, or the observed damage, the bio-ecological characteristics of the species, or the environmental conditions do not allow the assessor to be moderately confident of the accuracy of the rating).

Impact on native plants:

6.09.01. What is the risk that the host range of the pest includes native plants in the PRA area?

Low risk, Medium risk, High risk

| | | | |
|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
|------------------------------|------------|---------------|-------------|

| Rating guidance | |
|------------------------|--|
| Low | The pest harms or will harm only exotic plants. Examples: <i>Adelges tsugae</i> , feeds exclusively on <i>Tsuga</i> spp., a genus which does not occur in Europe. <i>Guignardia citricarpa</i> is a fungus that attacks only exotic plants, mainly <i>Citrus</i> spp., in Europe. |
| Medium | The pest harms or will harm native plants as minor hosts. “Minor hosts” means that, if they have already been in contact, severe damage has never been observed on these hosts. If they have never been in contact, there is an indication that development on these hosts is less favourable. Examples: <i>Diabrotica virgifera</i> and <i>Leptinotarsa decemlineata</i> have mainly exotic cultivated plants as major hosts in Europe, but both are able to feed occasionally on native plants as minor hosts. |
| High | The pest harms or will harm native plants as major hosts. “Major hosts” include all hosts on which severe damage has been observed, i.e. damage for which the species has gained its pest status. If the pest and the host have never been in contact in the field, laboratory observations suggest that damage may be as high as on its recognised major hosts. Examples: <i>Phytophthora ramorum</i> has a wide host range and several native European woody plants are major hosts. Many major host trees of <i>Lymantria dispar</i> are native to the UK, e.g. <i>Quercus robur</i> . |

6.09.02. What is the level of damage likely to be caused by the organism on its major native host plants in the PRA area? (If possible, this question should be answered by taking account the impacts on its major host plants in the PRA area. If the effects on the host plants in the PRA area are not well known, then the answer should be based on damage levels in other areas, but with a higher level of uncertainty).

Low level, Medium level, High level

| | | | |
|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
|------------------------------|------------|---------------|-------------|

| Rating guidance | |
|------------------------|---|
| Low | Host plants are not killed and reproduction potential is not altered; or scored “Low” in Q6.09.01. Examples: <i>Pissodes strobi</i> does not kill its host pine and spruce trees but rather reduces the value of timber by crooking stems. <i>Guignardia citricarpa</i> damages citrus fruits but does not kill the trees. |

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| | <i>Adelges tsugae</i> would also score <i>Low</i> for a PRA for Europe because it has no native host in Europe and would thus score <i>Low</i> in Q6.09.01 |
| Medium | Host plants are occasionally killed or reproduction potential is occasionally altered. Examples: <i>Lymantria dispar</i> only occasionally kills its host trees. <i>Leptoglossus occidentalis</i> does not kill pines, but feeds on seeds which may alter their reproduction potential. |
| High | The host plant is often killed or reproduction potential is seriously and frequently altered. Examples: <i>Bursaphelenchus xylophilus</i> or <i>Anoplophora glabripennis</i> usually kill host trees when these belong to the most susceptible tree species. |

Impact on ecosystem patterns and processes

6.09.03. What is the ecological importance of the host plants in the PRA area?

| | | | |
|------------------------------|---|---------------|-------------|
| | Low importance, Medium importance, High importance | | |
| Level of uncertainty: | Low | Medium | High |

| Rating guidance | |
|------------------------|--|
| Low | The pest has no host species that occupy an important role in the functioning of natural or semi-natural ecosystems, e.g. keystone species, ecological engineers, etc. Examples: <i>Leptinotarsa decemlineata</i> has no host in Europe that occupies an important role in the functioning of natural or semi-natural ecosystems. |
| Medium | The pest has minor host species that occupy an important role in the functioning of natural or semi-natural ecosystems, e.g. keystone species, ecological engineers, etc. Examples: <i>Gibberella circinata</i> may attack several pine species, but its major hosts are mainly exotic (e.g. <i>P. radiata</i>) while only minor hosts (e.g. <i>P. sylvestris</i> , <i>P. nigra</i> , etc.) are important components of forest ecosystems in Europe. |
| High | The pest has major host species that occupy an important role in the functioning of natural or semi-natural ecosystems, e.g. keystone species, ecological engineers, etc. Examples: <i>Bursaphelenchus xylophilus</i> and <i>Choristoneura fumiferana</i> may attack several conifer species in Europe, many of which are keystone species in several forest ecosystems. |

Conservation impacts

6.09.04. To what extent do the host plants occur in ecologically sensitive habitats (includes all officially protected nature conservation habitats)?

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|------------------------------|---|---------------|-------------|
| | Low extent, Medium extent, High extent | | |
| Level of uncertainty: | Low | Medium | High |

| Rating guidance | |
|------------------------|---|
| Low | The hosts occur exclusively outside habitats of high conservation value. In Europe, <i>Aulacaspis yasumatsui</i> would only occur outside habitats of high conservation value because it only feeds on cycads, which are ornamental exotic species. In Europe, <i>Diabrotica virgifera</i> will be largely restricted to agricultural areas. |
| Medium | The hosts occur only occasionally in habitats of high conservation value. |

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| | Examples: <i>Rhagoletis completa</i> feeds on <i>Juglans regia</i> in Europe, which only occasionally occurs in habitats of high conservation value. |
| High | The hosts occur frequently in habitats of high conservation value. Examples: <i>Bursaphelenchus xylophilus</i> and <i>Choristoneura fumiferana</i> may attack several conifer species in Europe, many of which frequently occur in nature reserves and other protected nature conservation areas. |

6.09.05. What is the risk that the pest would harm rare or vulnerable species? (includes all species classified as rare, vulnerable or endangered in official national or regional lists within the PRA area)

Low risk, Medium risk, High risk

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|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
|------------------------------|------------|---------------|-------------|

| Rating guidance | |
|------------------------|---|
| Low | The host has no rare or vulnerable native species as hosts. Examples: In Europe, <i>Agrilus planipennis</i> will only attack three <i>Fraxinus</i> species, none of which is rare or vulnerable. <i>Adelges tsugae</i> will not attack any native species in Europe and, thus, no rare or vulnerable native species. |
| Medium | The host has rare or vulnerable native species as minor hosts. Examples: <i>Anoplophora glabripennis</i> and <i>A. chinensis</i> have such a broad host range that they will undoubtedly include rare or vulnerable species in their host range while spreading through Europe. |
| High | The host has rare or vulnerable native species as major hosts. Examples: If introduced in the Rocky Mountains and the West coast of the USA, <i>Lilioceris lillii</i> will undoubtedly cause a threat to native, threatened <i>Lilium</i> spp. <i>Cactoblastis cactorum</i> will represent a threat to rare <i>Opuntia</i> spp. if introduced into Mexico. |

Impact of pesticides

6.09.06. What is the risk that the presence of the pest would result in an increased and intensive use of pesticides?

Low risk, Medium risk, High risk

| | | | |
|------------------------------|------------|---------------|-------------|
| Level of uncertainty: | Low | Medium | High |
|------------------------------|------------|---------------|-------------|

| Rating guidance | |
|------------------------|---|
| Low | The introduction of the pest is not likely to result in an increased and intensive use of pesticides over wide areas. Examples: <i>Bursaphelenchus xylophilus</i> and the <i>Potato Spindle Tuber Viroid</i> cannot be successfully controlled by pesticides and, thus, it is very unlikely that their introduction in the PRA area will result in an intensive use of pesticides. |
| Medium | The introduction of the pest is likely to result in an increased and intensive use of pesticides over wide areas, but this will occur predominantly if not exclusively in agricultural and urban areas; or there will be limited use of non-specific pesticides over wide areas with natural or semi-natural habitats (e.g. forests, swamps, etc.). Examples: If introduced in UK, <i>Leptinotarsa decemlineata</i> will increase the amount of insecticides used in potato fields, but it will be restricted to agricultural areas. |
| High | The introduction of the pest is likely to result in an increased and intensive use of non-specific pesticides over wide areas including natural or semi-natural habitats (e.g. forests, swamps, etc.). Examples: If introduced in Europe, <i>Choristoneura fumiferana</i> may require an intensive and frequent |

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| use of Bt (<i>Bacillus thuringiensis</i>) over wide forest areas, which may have a negative impact on Lepidoptera living in conifer forests. |
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Final rating:

There are only six sub-ratings, all being considered. However, the ratings for Q6.09.01 and Q6.09.02 are essential because, without having a native plant as host, and without the host being killed by the pest, the environmental impact is very unlikely to be high.

- *Massive*: 4 x High, incl. Q6.09.01 and Q6.09.02
- *Major*: 2 or 3 x High, incl. Q6.09.01 and Q6.09.02
- *Moderate*: Q6.09.01 High and Q6.09.02 at most Medium
- *Minor*: at least two "Medium" or "High" and Q6.09.01. not "High"
- *Minimal*: Max 1 x Medium or High (High being not Q6.09.01.), all others Low