



ENHANCEMENTS OF PEST RISK ANALYSIS TECHNIQUES

D 3.1 Guidance for scoring levels of risk supplied via hypertext links within each component of the web-based EPPO PRA scheme

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(and see acknowledgements)**

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Final draft submitted: 25 July 2011

EU Framework 7 Research Project
Enhancements of Pest Risk
Analysis Techniques

(Grant Agreement No. 212459)



PROJECT OVERVIEW: PRATIQUÉ is an EC-funded 7th Framework research project designed to address the major challenges for pest risk analysis (PRA) in Europe. It has three principal objectives: (i) to assemble the datasets required to construct PRAs valid for the whole of the EU, (ii) to conduct multi-disciplinary research that enhances the techniques used in PRA and (iii) to provide a decision support scheme for PRA that is efficient and user-friendly. For further information please visit the project website or e-mail the project office using the details provided below:

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Disclaimer:

This publication has been funded under the small collaborative project PRATIQUE, an EU 7th Framework Programme for Research, Technological Development and Demonstration addressing theme: [kbbe-2007-1-2-03: development of more efficient risk analysis techniques for pests and pathogens of phytosanitary concern call: fp7- kbbe-2007-1].

Techniques and tools for enhancing consistency in pest risk assessment

*PRATIQUE Work Package 3 with contributions from Work Packages 2 and 4
Task 3.1 Guidance for scoring levels of risk within the EPPO DSS for PRA*

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1. Background to this deliverable and introduction

According to the description of work, the subtasks for this deliverable, for which two milestone reports were also produced, are:

“Subtask 3.1.1 Review of best practice in enhancing consistency

Best practice worldwide for achieving and enhancing consistency will be identified by reviewing PRA schemes and risk analysis procedures in other sectors, e.g. animal health. Although the principal emphasis will be to locate methods for ensuring a consistent approach to scoring levels of risk, in addition, the review will determine how definitions in international standards are applied and guidance is given on the procedures to be adopted when undertaking the risk analysis. The choice of words to describe risk in different schemes will also be investigated since many terms used in PRA, e.g. “unlikely”, can be subject to widely different interpretations, directly influencing consistency. The information obtained will be provided to WP2 (Task 2.3) and WP4 (Subtask 4.2.2) that will develop methods for enhancing consistency in the scoring of spread, impacts and entry potential. JKI, Fera, CRCNPB and EPPO will be primarily responsible for this subtask.”

See Milestone 3.1 (Annex 1) for this subtask, and Schrader *et al.* 2010 (Annex 2).

“Subtask 3.1.2 Guidance for scoring levels of risk within the EPPO PRA scheme

Examples and/or values for each of the five levels of risk in the 17 questions of the establishment potential section of the EPPO PRA scheme will be developed. Together with the examples and/or values for spread and impacts produced by WP2 (Task 2.3) and entry potential by WP4 (Subtask 4.2.2), this will provide risk analysts with a clear guide to the level of risk that is appropriate for each question when following the EPPO PRA scheme, greatly enhancing consistency. The examples and/or values will be incorporated into the EPPO PRA scheme by WP6 so that they are always directly available to pest risk analysts. A first version will be provided for the validation exercise and a final version will be produced that takes all the comments into account. JKI, Fera, CRCNPB and EPPO will be primarily responsible for this subtask.”

See Milestone 3.2 (Annex 3) for this subtask.

The version of the EPPO Pest Risk Analysis decision support scheme (EPPO DSS for PRA; EPPO, 2009) available at the start of PRATIQUE requires answers to a series of questions that are based on, and in line with, the International Standard on Phytosanitary Measures (ISPM) No. 11, Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms (FAO, 2004). However, it has to be noted here, although the EPPO DSS for PRA is consistent with ISPM No. 11 and ISPM No.2 (FAO, 2007), certain logical difficulties made it necessary to deviate from the structure of risk analysis presented in these standards, e.g. spread is considered with impacts in the new version. Following initiation and pest categorization, the detailed risk assessment stage (Section B) of the EPPO

DSS for PRA contains questions that primarily require the assessor (a) to select one of five alternative risk ratings from an ordinal scale with five divisions, e.g. “very unlikely”, “unlikely”, “moderately likely”, “likely”, “very likely” (only a few are yes/no questions), (b) to choose one of three levels of uncertainty (low, medium or high) and (c) to justify the selection with detailed referenced comments. The choice of risk rating should reflect the expert opinion of the assessor with regard to the likelihood or magnitude of the risk depending on the topic addressed by the question. The notes attached to the questions are intended to give assistance in answering the question but, in the 2009 version, generally give little guidance on how to make a choice between the different levels of rating. The notes accompanying the questions in the EPPO DSS for PRA are mainly based on the explanatory notes in ISPM No. 11.

It has long been recognised that rating guidance is necessary to provide consistency in the different risk assessments performed with the EPPO DSS for PRA (MacLeod & Baker, 2003) and to help assessors answer the questions by providing examples which they can compare in relation to the organism being assessed. However, because of the difficulty of creating generic rating guidance, the emphasis up to now has been (a) to enhance consistency by ensuring that all the questions are worded as simply and as unambiguously as possible with notes for clarification where appropriate, and (b) to ensure that risk assessors provide sufficient detailed justification for the choice of risk rating so that independent reviewers can adjust the rating if the initial rating does not appear to match the justification or new evidence becomes available. PRATIQUE provided an opportunity to address this issue thoroughly for the first time.

Methods for summarising and communicating risk (see also the combined PRATIQUE Deliverable D3.2/3.4) can only be reliably applied to the question responses if all the questions and the rating methods are consistent, unambiguous and clearly described. Consistent scales and terminology in rating systems make the information more portable allowing different PRAs and the work of different risk assessors to be compared. For example, although it is recognised that the probability of pest entry is specific to each location, the scale at which it is assessed should be consistent across different pest entry locations. This will enable entry risks between PRA areas and between different pests to be directly compared and allow greater harmonisation between datasets to permit iterative reanalysis of data through time.

The framework for PRA for any species is essentially the same irrespective of taxonomic group and/or entry pathway. Additionally, several factors are similar or comparable for different pests. Thus, having a systematic way of retrieving detailed data for the entry, establishment, spread and impact of pests from previous PRAs also helps in the assessments of potential pest threats in future PRAs.

Enhancing consistency will increase the user-friendliness of the PRA scheme to assessors, give greater credibility to the PRA process, increase the

reproducibility of the results, provide a more transparent basis for risk management and improve clarity when communicating with stakeholders. A relevant, consistent response to each question is not only of importance because of each question's contribution to the overall assessment of risk but also because several questions in the EPPO DSS for PRA are correlated and the answer from one question can be used to inform other parts within the PRA process. For example, the assessment of spread is related to the reliability of pest free areas (see also PRATIQUE, Deliverable 4.6). Consistent question responses coupled with the enhancements of mechanisms for summarising risk, while taking uncertainty into account (as outlined in the combined PRATIQUE Deliverable D3.2/3.4), should enable National Plant Protection Organizations and risk managers at the EU level to rank pest threats with greater confidence than before. In addition, sets of consistently performed PRAs could allow tools, such as neural networks, to be applied to identify key questions and the patterns of responses that denote different overall levels of risk.

The protocol on consistency that has been developed in Task 3.1 and which is described here is designed to enhance consistency by providing guidance for rating both the questions that require the choice of one of five risk ratings and those that require a yes/no response. Issues, such as the consistency in selecting the appropriate level of uncertainty to assign to each question is partly covered by this deliverable (i.e. a rating guidance for the three levels of uncertainty is given), whereas the quantification and communication of uncertainty as well as the methodology for consistently summarising and communicating overall risk is covered by the combined PRATIQUE Deliverable D3.2/3.4.

This "protocol on consistency" also is based on the review of best practice in enhancing consistency conducted by PRATIQUE in the report for Milestone 3.1 (Annex 1 and 2). Based on an extensive survey of risk assessment schemes worldwide, the recommendations for increasing consistency given in that milestone that are relevant here include the need to:

- a) give clear guidance and explanation for all questions (questions should be unambiguous)
- b) provide a selection of standardised answers and clear rating guidance with examples
- c) include guidance on ratings in a way that allows assessors to clearly distinguish between different ratings, e.g. the difference between likely and very likely
- d) specify the elements that must be addressed in the text to justify the ratings given.

As a consequence of implementing these recommendations, the same assessor should, when assessing different pests representing similar risks, obtain results that describe a similar level of risk for each pest. Equally, if different assessors were to assess the same pests for the same PRA area, with the same information, each should produce similar assessments and reach the same result. In addition, when drawing a conclusion about risk elements, such as the overall likelihood of entry and establishment or the

overall magnitude of spread and impacts, the answers to questions should be used in a consistent way to determine the overall likelihood or magnitude for each combined risk element. Furthermore, as appropriate, each conclusion about the likelihood or magnitude for each risk element should be used in a consistent way to determine the overall pest risk. Clear and explicit definitions and explanations are essential to improve the transparency of risk assessments and increase the consistency of the ratings between risk assessors. A risk assessment procedure that is consistent and transparent should ensure fairness and rationality. If consistency in the EPPO DSS for PRA is increased, e.g. by comparison of risks, this would also facilitate stakeholder engagement, risk communication and improve understanding by all stakeholders.

While it is clear that it is relatively straightforward to assign risk ratings to some questions, some still require further development and testing. The protocol on consistency is seen as a “living document”, which continues to be revised according to the experience of assessors over the years. Though the risk rating proposals have been tested in workshops, EPPO panels and EPPO Expert Working Groups on PRA (see results of PRATIQUE Deliverable 6.3), further testing, review and evaluation is recommended to refine this protocol. However, subject to these refinements in the future, it was recommended to keep the EPPO DSS for PRA stable for several years in order to gather experience and learn to work with it and the new tools. The revised version was therefore presented to the EPPO Working Party in June 2011 for adoption and was accepted.

Detailed discussions on the changes are recorded in the reports of the meetings of the Panel on PRA development (see PRATIQUE Deliverable 6.3) as well as PRATIQUE meeting reports.

2. Methods

With such a diversity of questions across a variety of both spatial and temporal scales and the differentiation between likelihood and magnitude, no single approach worked best for every question. Thus this protocol demonstrates that several different approaches to provide rating guidance are appropriate: not only focussing on enhancing consistency but also on increasing simplification, user friendliness and improving presentation to risk managers by:

1. transforming the notes to some of the questions into sub-questions or by formulating new sub-questions,
2. rephrasing some questions so that they are answered “yes” or “no” rather than by selecting from a scale with five divisions.

Both approaches are accompanied by rating rules, which either combine the different sub-questions in such a way that the different alternatives/rating levels can easily be identified or they are arranged as a binary decision tree, directly guiding the assessor to the appropriate rating level for the question. Taking a rule based approach

adds to consistency. The review of other risk assessment schemes (see Annex 1 and 2) concluded that those with yes/no questions or those where characteristics need to be counted to determine a category rating seemed to provide a structure that provided the most consistent outputs. In other words assessors should be able to agree with yes / no answers more easily than selecting *ad hoc* choices from a five-point scale. The sub-questions need to be broad to make the system generic. For the time being, each factor or situation is weighted equally. This will need some testing and fine tuning as part of further development of this protocol. In addition it needs to be noted here that not all questions or sub-questions are equally important for all types of pests;

3. listing factors, characteristics or conditions relevant to each rating. This was done when the yes/no approach was not practicable, e.g. because there were too many different factors to be considered.
4. providing examples for different types of pests (insects, fungi, bacteria, plants, nematodes, viruses, see Annex 5b for the establishment section) so that the assessor can decide on the appropriate rating by comparing the pest that is being evaluated with another pest (usually of the same taxon). In some cases, it was not possible to come up with examples for all ratings for all types of pests, as no relevant information was found. This is especially true for the lowest risk ratings, because such organisms are not sufficiently important to be considered in the context of plant health risk, or because no publications are available. These examples have to be checked very thoroughly as the different ratings for the different taxa have to be consistent. More examples need to be considered.

For the protocol on consistency, not only were different rating schemes explored, but also other approaches were taken: many questions were reworded, some questions were combined (e.g. transfer), some questions were moved (e.g. eradication), some questions were deleted and some sections were restructured (e.g. in the establishment section) to enhance consistency.

This paper briefly describes the amendments. The revised sections on entry, establishment and spread can be found in the annexes to this document. The results of testing the new versions in EPPO panels and workshops can be found in Deliverable D6.3.

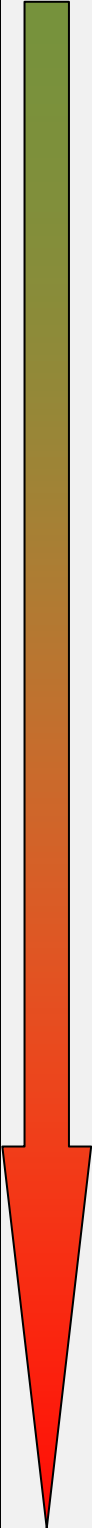
3. Uncertainty

For every question in the 2009 version of the EPPO DSS for PRA (EPPO 2009), a three level rating for uncertainty had to be made, but no rating guidance was provided. In PRATIQUE, a simple table (Tab. 1) has been developed, that explains what is meant by low, medium or high uncertainty and gives some examples that show how to justify the level of uncertainty that has been selected for each question.

The Intergovernmental Panel on Climate Change (IPCC, 2005) table that links qualitative descriptions to probabilities provided the basis for the definitions of uncertainty that were used in the Rule-based Matrix Models and in IRIS (see PRATIQUE Combined Deliverable D3.2/3.4). Within the revised EPPO DSS for PRA, the uncertainty scores low, medium, and high, correspond to frequency distributions of risk rating which are progressively wider as uncertainty increases. In principle, assessors could have complete freedom to define their own rating distributions but discussions with pest risk analysts at meetings specifically designed to test and provide feedback on the PRATIQUE deliverables (see PRATIQUE Deliverable D6.3) showed that a more popular option was a 'multiple-choice' in which the assessor chooses from three predefined distributions. These distributions have two essential characteristics: the favoured rating has a higher frequency than the others and the frequency distribution is spread more widely over the available range when the uncertainty is higher (Fig. 1). Adapted from the IPCC definitions, the distributions allowed the assessors to choose between 90, 50 and 35% confidence that the favoured rating is the correct one, corresponding to low, medium and high uncertainty, respectively.

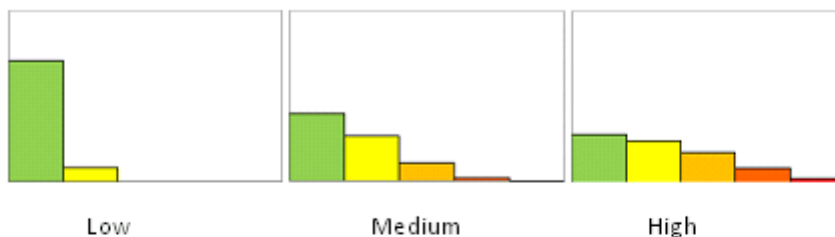
For ease of use in the EPPO DSS for PRA, implemented in CAPRA, the computer assisted DSS for PRA developed under PRATIQUE, there is an automated link between the linguistic definitions of uncertainty and the rating distributions. It is important for assessors when running the matrix models that the selected distribution that appears under each question is the closest to their perception of uncertainty and, if not, to change it.

Tab 1. Table to provide guidance regarding the use of the uncertainty rating within the EPPO DSS for PRA

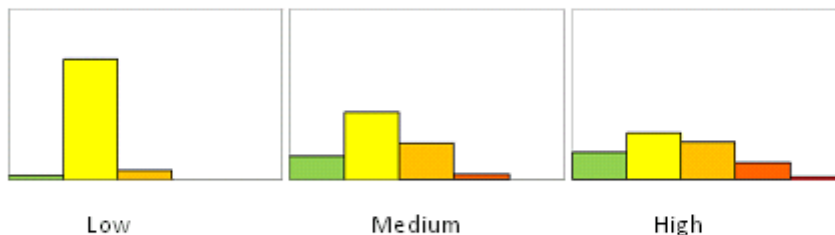
Uncertainty		Interpretation / Meaning	Examples to justify the uncertainty rating	Certainty
	Low	<p>There is little doubt about the assessment and the risk rating</p> <p>The assessor is confident</p>	<p>There is direct relevant evidence to support the assessment.</p> <p>The situation can easily be predicted.</p> <p>There are reliable / good quality data sources (e.g. for pest records data provided by NPPOs/RPPOs).</p> <p>The interpretation of data/information is straight forward.</p> <p>Data/information are available from a peer reviewed journal article.</p> <p>Data/information are not controversial or contradictory</p> <p>Personal communication is from experts regarded as specialists on the question raised.</p>	High
	Medium	<p>There is some doubt about the assessment and the risk rating</p> <p>The assessor has some confidence</p>	<p>There is some evidence to support the assessment.</p> <p>Some evidence for the prediction of the situation is available, but this prediction may be unreliable</p> <p>Some information is indirect, e.g. data from a other species has been used as supporting evidence,</p> <p>The interpretation of the data is to some extent ambiguous or contradictory.</p>	Medium
	High	<p>There is considerable doubt about the assessment and the risk rating</p> <p>The assessor has little confidence</p>	<p>There is no direct evidence to support the assessment, e.g. only data from other species have been used as supporting evidence.</p> <p>The situation cannot be readily predicted because the evidence is poor, and difficult to interpret, e.g. because it is strongly ambiguous.</p> <p>The information sources are considered to be of low quality or contain information that is unreliable, e.g, because it is strongly contradictory.</p>	Low

The distributed scores/ratings corresponding to the three levels of uncertainty

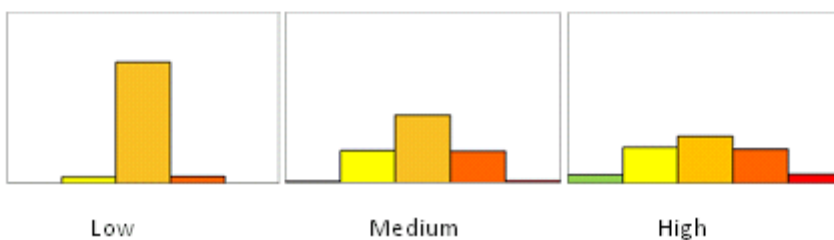
Very Unlikely / Minimal (Score / rating of 1)



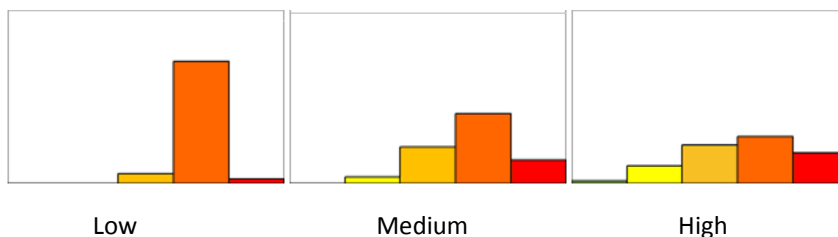
Unlikely / Minor (Score/ rating of 2)



Moderately Likely / Moderate (Score / rating of 3)



Likely / Major (Score / rating of 4)



Very Likely / Massive (Score / rating of 5)

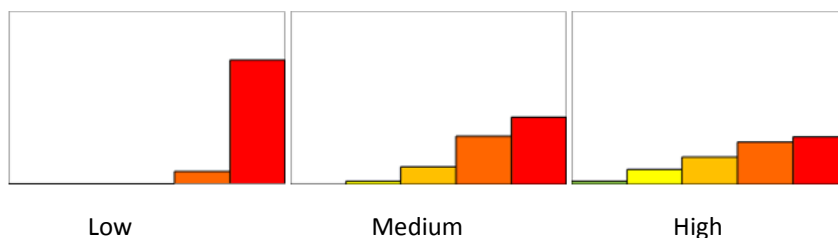


Fig. 1

Proportion of distributed scores in each score class at three different uncertainty levels. These apply to the IPCC style class boundaries used in entry, establishment and spread. Low uncertainty = 90% of distribution is in the expert selected rating; medium = 50%; high = 35%.

4. Background explanations on the suggestions for revision of the different sections in the assessment part of the EPPO DSS for PRA

In the following, the revision of the questions for the different section is described and explained.

4.1 Revision of the Probability of Entry Section of the EPPO DSS for PRA (Contribution from WP 4 and WP 6)

While most questions remain largely similar, the review of this section suggests four types of modifications: textual edits, merging of multiple questions into a single question, renumbering the sequence of questions to reflect merging, and a general renumbering of questions that concerns the whole EPPO DSS for PRA. The approach to reordering and regrouping questions arose in particular from a PRATIQUE Work Package meeting in London in July 2009, during PRATIQUE meetings and testing phases in the panel on PRA development and the EPPO/PRATIQUE workshop in Hammamet, Tunisia, in November 2010. The logical sequence of events leading to entry was represented graphically in a flowchart (see Fig. 2)

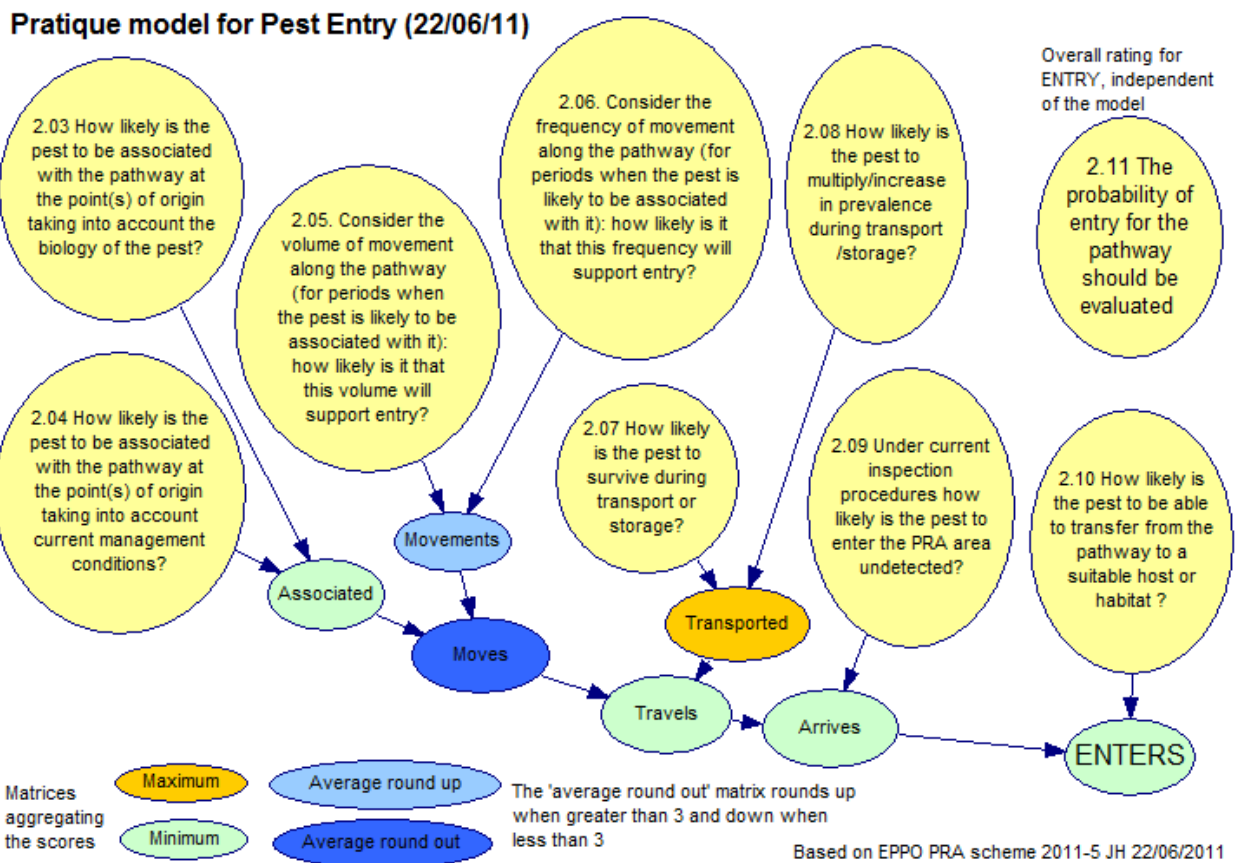


Fig. 2. Flowchart (ontology) showing how the questions in the entry section are structured and combined with matrices.

In the draft protocol on consistency (Milestone 3.2, Annex 3), question 1.9 had been split into two separate questions as it included two concepts (likelihood of the pest surviving existing management practice on the pathway and likelihood of the pest to enter undetected). In the final version only one question remained as management practices are covered by previous questions in the section. The same approach has been used in the establishment section; all the questions have now been phrased in terms of likelihood, whereas previously there was a mixture of likelihood and magnitude. This makes it conceptually easier to combine the answers to the different questions. For some questions rating guidance has been suggested but this has not been possible for all questions.

The changes in the entry section in detail

Question 2.01 (relevant pathways), which is question 1.1 in EPPO (2009), is a minor rewording of the question, rating guidance has been added in the form of examples of pathways.

Question 1.2 (i.e. PRATIQUE question 2.02 - the selection of pathways) has been shortened and the deleted text was slightly reformulated and put into a note.

Question 2.03 (association of the pest with the pathway; EPPO (2009) question 1.3): The text of the current question has been slightly reformulated and a note is added that helps assessors answer the question by listing some relevant criteria to be considered.

Question 1.4 on the concentration of the pest on the pathway (i.e. PRATIQUE question 2.04) has been completely reformulated. Instead of asking for the concentration of the pest on the pathway, which usually caused considerable difficulties for many risk assessors, the question now asks for the likelihood of association of the pest with the pathway at origin under current management conditions. Assessors are asked to consider the concentration of the pest in the note. Phytosanitary measures implemented in the country of origin are taken into account at this early stage of the entry section rather than later (i.e. in EPPO (2009) question 1.9).

The previous questions 1.5 (volume of movement) and 1.6 (frequency of movement) are retained. However, question 1.5 just asked for the volume of movement along the pathway. The revised question (question 2.05) is more to the point, as it requires the assessor to assess the volume of movement along the pathway and combine this with how likely it is that the specific volume will support entry. This avoids the problems of considering volumes of highly diverse commodities when each present their own associated risks, e.g. a small volume of one commodity may present a greater probability of entry than a large volume of another. The change ensures that the question is also more directly related to the risk of entry and, by asking for likelihood and not magnitude, is consistent with other questions in the entry and establishment sections. Question 1.6 on frequency has also been modified in a similar way

for the new question 2.06 and, in addition, rating guidance is provided by giving the number of months for each of the five levels of rating.

Question 1.7 on pest survival during transport and storage (PRATIQUE question 2.07) remains the same, the note has been slightly reformulated and a tentative rating guidance is given (that needs further development) for the highest and lowest rating levels. When answering this question, phytosanitary measures implemented during transport and transit (i.e. treatments) are taken into account here rather than later (i.e. in former question 1.9).

Question 1.8 (multiplication/increase during transport/storage, PRATIQUE question 2.08), remains unaltered except for the deletion of the “impossible” response option.

Question 1.9 (survive or remain undetected during existing management procedures, PRATIQUE question 2.09) has been reformulated to improve comprehensibility. The question asked for the likelihood of the pest to survive or remain undetected during existing management procedures. The new question asks for the likelihood of the pest to enter the PRA area undetected under current inspection procedures. As explained above, phytosanitary measures which were once included in 1.09 are now included in questions 2.04 (measures applied at origin that may reduce the concentration) and 2.07 (measures implemented during transport including pre-shipment measures). This follows more logically the sequence of events that may lead to entry described in the flow diagram (Fig. 2) The note has been slightly revised, another example has been added and the text mentioning phytosanitary measures has been removed.

Questions 1.10 (distribution of commodity in PRA area), 1.11 (arrival of consignments in the PRA area at a suitable time), and 1.12 (transfer of the pest from the pathway) have been merged by keeping question 1.12 as question 2.10 and converting questions 1.10 and 1.11 into notes to this question. A rating guidance has been added that needs testing.

In PRATIQUE question 2.11, the probability of entry for each assessed pathway needs to be evaluated. Question 1.15 (PRATIQUE question 2.12) on the need to assess additional pathways has not been changed. The conclusion on the probability of entry has been given a number (question 2.13) to help identify it in the CAPRA system and it describes in more detail what needs to be taken into account when summarising the risk of entry. No rating guidance is provided, but the visualiser and the matrix models (see PRATIQUE combined Deliverables 3.2 and 3.4) have been developed by PRATIQUE to help summarise the different ratings.

A comparison of the questions in the previous (EPPO, 2009) and the revised EPPO DSS for PRA are presented in Annex 4.

4.2 Revision of the Probability of Establishment Section of the EPPO DSS for PRA (Contribution from WP 3 and WP 6)

The section on probability of establishment has been significantly reorganised. Detailed rating guidance has been added and several questions have been reformulated and amended. The revision of this part of the EPPO DSS for PRA has been governed by three principal objectives:

a) to focus the assessment on the most relevant factors influencing establishment

Establishment potential is assessed by first considering the availability and suitability of a variety of ecological factors in the PRA area and secondly the extent to which intrinsic factors, e.g. the pest's reproductive strategy, aid establishment. Previous versions of this section of the scheme have been complicated by the requirement to rate every ecological factor even when it is already known that some factors have no influence on establishment potential or are only relevant for a smaller area (see below). In this new version, the assessor can decide at the outset which factors are important so that the questions relating to any irrelevant factors can be omitted. A justification for omitting any factors is required.

b) to make it easier to determine the suitability of the PRA area for establishment by first identifying the area where establishment is possible

An additional difficulty with the assessment of the ecological factors has also been addressed. This arose when trying to provide a rating for, e.g. climatic suitability, because it was not clear to assessors whether the rating required referred to the whole PRA area or just the area of potential establishment. In this new version, the area of potential establishment has already been defined so the rating is clearly intended to refer only to that area. A rating is required to ensure that, for example, it is possible to distinguish the establishment potential of two species, each with a similar area for potential establishment but where one species will find the climate in this area marginal and the other optimal for establishment. An additional advantage of this approach is that the area of potential establishment is derived in a logical manner by considering each relevant factor in turn. In previous versions the area had to be described in a single step taking many factors into account and little guidance was given.

c) to enhance consistency by providing rating guidance and sub-questions

Detailed rating guidance and examples have been provided for most of the questions and for some of the sub-questions which help to answer the main question. Although the addition of sub-questions may seem to make the scheme more complex, the additional questions are easier and more straightforward for risk assessors to answer and they contribute to an improved and more consistent scheme.

Also for this section, the logical sequence of events leading to establishment is represented graphically in a flowchart (see Fig. 3).

Pratique model for establishment 22/06/2011

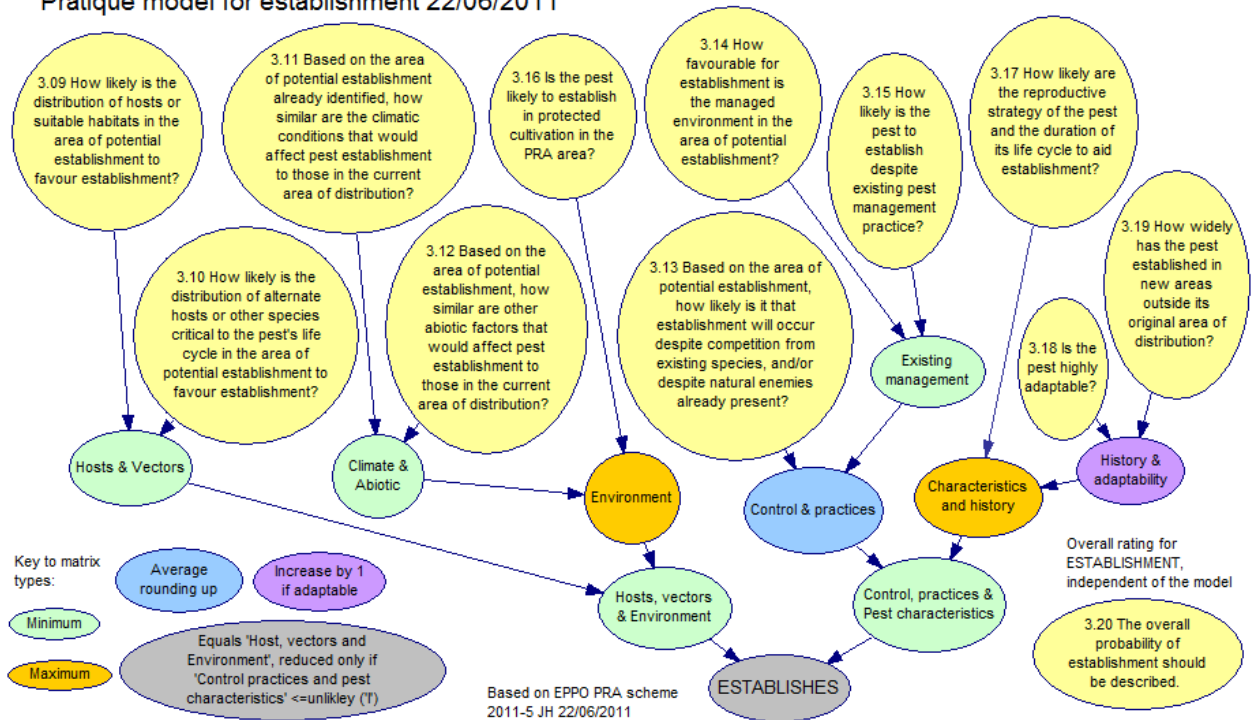


Fig. 3. Flowchart (ontology) showing how the questions in the establishment section are structured and combined with matrices.

The changes in the establishment section in detail

In the first part of the establishment section, the ecological factors that may influence the limits to the area of potential establishment and the suitability for establishment within this area have to be selected. While host plants/suitable habitats, and climate are very likely to influence the potential for establishment, the other five factors listed (alternate hosts and other essential species, other abiotic factors, competition and natural enemies, the managed environment, protected cultivation) may be less relevant. In order to identify the relevant factors and the questions that need to be answered, a table, relevant for the revised PRATIQUE questions 3.01 to 3.16 is provided. The table does not include questions 3.17 – 3.19 and 3.20, since they always need to be answered. In addition, question 3.20 has been moved to a new section (see below).

Questions 1.15 – 1.22 in the previous scheme (EPPO, 2009) already ask for an assessment of the ecological factors influencing establishment, but a delimitation of the area of potential establishment is not taken into account in these questions and the risk ratings are based on magnitude for some questions and on likelihood for other questions. In the revision, questions 3.01 to 3.07 (host plants and habitats; alternate hosts; climatic suitability; other abiotic factors; competition and natural enemies; managed environment and protected cultivation) are yes/no questions that need justification and lead to a delimitation of the area of potential establishment. Guidance is provided in the form of notes. Question 3.08 summarises the answers to questions 3.01 to 3.07. Questions 3.09 to 3.16 then assess the suitability of the factors for which

a yes response has been given in questions 3.01-3.07 in the area of potential establishment. A choice from five levels of rating (likelihood, similarity, favourability) is required. Rating guidance for these questions has been developed.

Question 3.09 has been formed by merging questions 1.15 and 1.16 in the previous version (Question 1.15 asked for the number of host plant species or suitable habitats in the PRA area and question 1.16 asked “How widespread are the host plants or suitable habitats in the PRA area”). Question 3.09 has a new rating guidance that displays, in the form of maps, how the two factors distribution and abundance need to be rated (see below).

Having already defined the area of potential establishment, we can ask question 3.09 in the following ways:

- (i) How likely is the pest to come in contact with hosts or suitable habitats in the area suitable for establishment?
- (ii) How favourable are the presence and distribution of the hosts or suitable habitats for establishment in the area of potential establishment? [This requires a favourability index]
- (iii) How likely is the distribution of hosts or suitable habitats in the area of potential establishment to favour establishment? [This requires a likelihood index]

Option (i) was rejected at the Hammamet PRA workshop in November 2010 as being too similar to the transfer question at the end of the entry section (though this only relates to hosts and habitats in close proximity to the entry location). Option (iii) was preferred to option (ii) but difficulties arose with the wording of the rating guidance that needs to take into account not only host/habitat abundance but also the degree to which the hosts/habitats are scattered or clumped. It was agreed that it would be more useful to provide simple distribution diagrams (see Annex 5a) as rating guidance. These have been provided but, in further work, it would also be worth exploring additional appropriate accompanying text, e.g. with percentage cover and use of the terms “scattered” and “clumped”. Some examples have already been suggested for plant habitats but examples for other pests would also be useful, e.g. hosts of polyphagous pests are likely to be answered “very likely”, maize in the EU as “likely”. It is intended to complete the guidance with crop and habitat distribution maps. In order to continue this work, a survey on the perception of assessors on the different maps will be organized by the EPPO Secretariat post PRATIQUE.

Question 3.10, which relates to question 1.17 in the previous scheme, follows the same principles as above for alternate hosts or other species critical to the pest’s life cycle.

Questions 3.11 (climatic conditions), 3.12 (other abiotic factors), and 3.13 (competition from existing species and natural enemies) remain basically the same as questions 1.18, 1.19, and 1.21 in the previous scheme, except that

they now refer only to the area of potential establishment that has been defined in question 3.08.

For question 3.11, a detailed note, a rating guidance (both as a table giving percentages for similarity with examples/explanations for the five levels of rating and a separate annex) and a detailed climatic risk mapping decision support scheme (see PRATIQUE Deliverable 3.3) have been provided.

The rating guidance for question 3.12 consists of a table using soil conditions as an example for the percentage of similarity in the five levels of rating.

For question 3.13, the rating guidance explains how each level of rating is related to the presence of competitors/enemies, their distribution and abundance and the presence of other organisms occupying the pest's niche. It should be noted that this question has always triggered much debate amongst pest risk assessors. Most find it difficult to answer. No examples could be identified to illustrate this question. Regarding competition with other species the example of fruit flies was suggested but recent examples do not show quarantine pests being outcompeted by existing pests, rather it is the other way round, i.e. new species outcompete existing ones, for example *Bactrocera invadens* displaced *Ceratitidis cosyra* in Eastern Africa. A review of how this question had been answered in recent PRAs showed that it was rated "very likely" in the majority of assessments, and "likely" in the remaining assessments. If a question is almost always answered the same way, regardless of the pest being assessed then the question does not help discriminate between pests and the value provided by the response can be considered negligible.

The text of questions 3.14 (managed environment) and 3.15 (pest management practice) have only been slightly edited in the new scheme compared to the equivalent questions 1.22 and 1.23 in the previous scheme. However, for both questions, a detailed rating guidance is now provided, leading the assessor step by step to reach the rating for this question by asking sub-questions regarding different cultivation practices etc. and pest management practices respectively. These sub-questions are yes/no questions and, for question 3.14, the answer either provides the rating, advises the assessor to decrease or increase the rating by 1, or takes the assessor to the next sub-question. Organism examples for the different sub-questions are given. For question 3.15, the answer to the sub-question either provides the rating or takes the assessor to the next sub-question.

Question 3.16 (protected cultivation), the previous question 1.20, was slightly modified to a yes/no question. The question can be answered by referring to question 3.07, therefore no further guidance is provided except that some examples have been added.

Questions 1.24 (eradication) and 1.29 (transience) in the previous scheme have been removed from the establishment section and transferred, together with question 1.32 (containment) from the spread section, to a new section

“Eradication, containment of the pest and transient populations” that follows the spread section and will be commented under that section.

Question 3.17 (reproductive strategy), previously question 1.25, was not modified, but a rating guidance has been added that includes six sub-questions regarding the characteristics of the pest. The more characteristics are exhibited by the pest, the higher the likelihood that the reproductive strategy and life cycle of the pest aid establishment.

Question 3.18 (adaptability of the pest), previously question 1.27, has been transformed into a yes/no question. The rating guidance lists factors that help to determine if the pest is or is not highly or very highly adaptable.

Question 3.19 (distribution of the pest), a reformulation of the previous question 1.28, is no longer asking for how often the pest was introduced into new areas outside its original area of distribution but how widely it has established in new areas. A rating guidance is provided referring to the seven inhabited biogeographic realms of the earth.

As it the revision of this section was substantial, it was not useful to present the changes in a full comparison of the questions of the EPPO DSS for PRA (EPPO, 2009) and the questions revised by PRATIQUE. Therefore, only a reference was made to the former question. The revision is presented in Annex 5a.

4.3 Revision of the Probability of Spread Section of the EPPO DSS for PRA (Contribution from WP 2, WP 3 and WP 6)

Changes have been made to the original questions of this section to reformulate them so they refer to the magnitude of spread at a given future time rather than to the likelihood of rapid spread. The major change is to the summary of the spread section where assessors are asked to predict what proportion of the area suitable for establishment will be invaded in the time scale chosen by the assessor.

Fig. 4 shows a graphical overview of the questions relevant for spread.

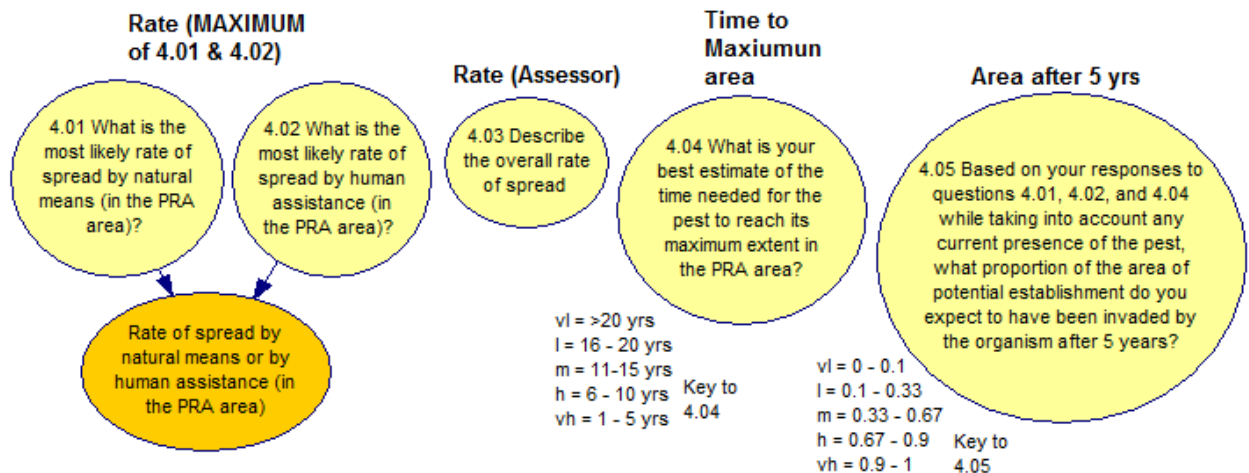


Fig. 4. Flowchart (ontology) showing how the questions in the spread section are structured and combined with matrices.

In the version presented at the PRATIQUE EPPO PRA Workshop in Hammamet (23rd - 26th November 2010), it was suggested that an additional question be added to separate the assessment of the two principal methods by which human activities can spread pests: (i) mechanical transmission and (ii) spread by other human-assisted methods. This change was not considered appropriate at the workshop and by the EPPO Panel on PRA Development that met in January 2011, since the logic behind the separation of mechanical transmission from other human assisted spread was difficult to understand and consequently too confusing. Experts explained that they understand better the separation between natural spread and human spread which includes mechanical spread. Therefore the additional question has been deleted.

The changes in the spread section in detail

The previous spread section contained three questions, one referring to natural spread, one to human assisted spread and one to containment. As mentioned above, the containment section has been transferred to a new section on eradication, containment of the pest and transient populations.

While the previous questions 1.30 and 1.31 asked, respectively, how likely the pest is to spread rapidly in the PRA area by natural means and human assistance, the revised questions 4.01 and 4.02 ask for the most likely rate of spread. For question 4.01, the rating guidance is in the form of a binary decision tree that guides the assessor in selecting a rating from a very low rate of spread to a very high rate of spread. The rating guidance for question 4.02 helps the assessor by using three yes/no questions on pathways and transmission of the pest to lead to a rating which is "very low" if there is no (human assisted) pathway. Otherwise the rating is at least "moderate" (i.e. there is no "low" or "very low"), which is logical as a human assisted pathway is not likely to have a low rate of spread.

As already mentioned above, the previous question 1.32 (containment) has been moved to a new section “eradication, containment of the pest and transient populations” that follows the spread section (see below).

Finally, a major change has been made in the conclusion to the spread section. In the PRATIQUE version, assessors are asked to predict what proportion of the area suitable for establishment will be invaded in future. This is done by answering three questions: a description of the overall rate of spread (question 4.03), an estimate of the time needed by the pest to reach its maximum extent in the PRA area (question 4.04), and finally the proportion of the area of potential establishment that the pest is expected to have reached after 5 years (question 4.05). For these questions, a rating guidance is not provided. However, for question 4.03 (overall rate of spread) the visualizer and the matrix model presented in the combined PRATIQUE Deliverable D3.2/3.4 can be used.

A comparison of the questions of the EPPO DSS for PRA (EPPO, 2009) and the questions revised by PRATIQUE are presented in Annex 6.

4.4 Addition of a new section on Eradication, containment of the pest and transient populations

The previous questions 1.24 (eradication) and 1.29 (transience) have been removed from the establishment section and have been transferred, together with question 1.32 (containment) from the spread section, to this new section.

Fig. 5 shows a graphical overview of the questions on eradication, containment and transient populations.

Eradication, containment of the pest and transient populations

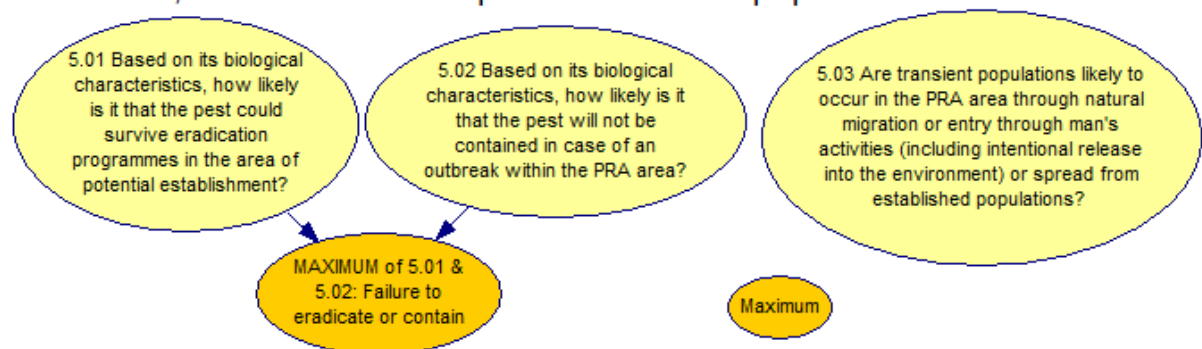


Fig. 5. Flowchart (ontology) showing how the questions in the eradication, containment and transient populations section are structured and combined with matrices.

For question 5.01 (eradication), a detailed rating guidance is provided. For each level of rating, examples of characteristics or conditions are listed to help the assessor give a consistent rating on the likelihood that the organism would be able to survive eradication programmes. The listing is composed of the

following categories: detection, natural spread, reproduction, climatic conditions, hosts and habitats and other relevant biological characteristics of the pest. A similar rating guidance has been provided for question 5.02 (containment), the categories are slightly different: detection, spread, reproduction, control, hosts and habitats.

Question 5.03 on transience is a simple yes/no question, no rating guidance is needed.

The new section is presented in Annex 7

4.5 Revision of the Assessment of potential economic consequences section of the EPPO DSS for PRA (Contribution from WP 2)

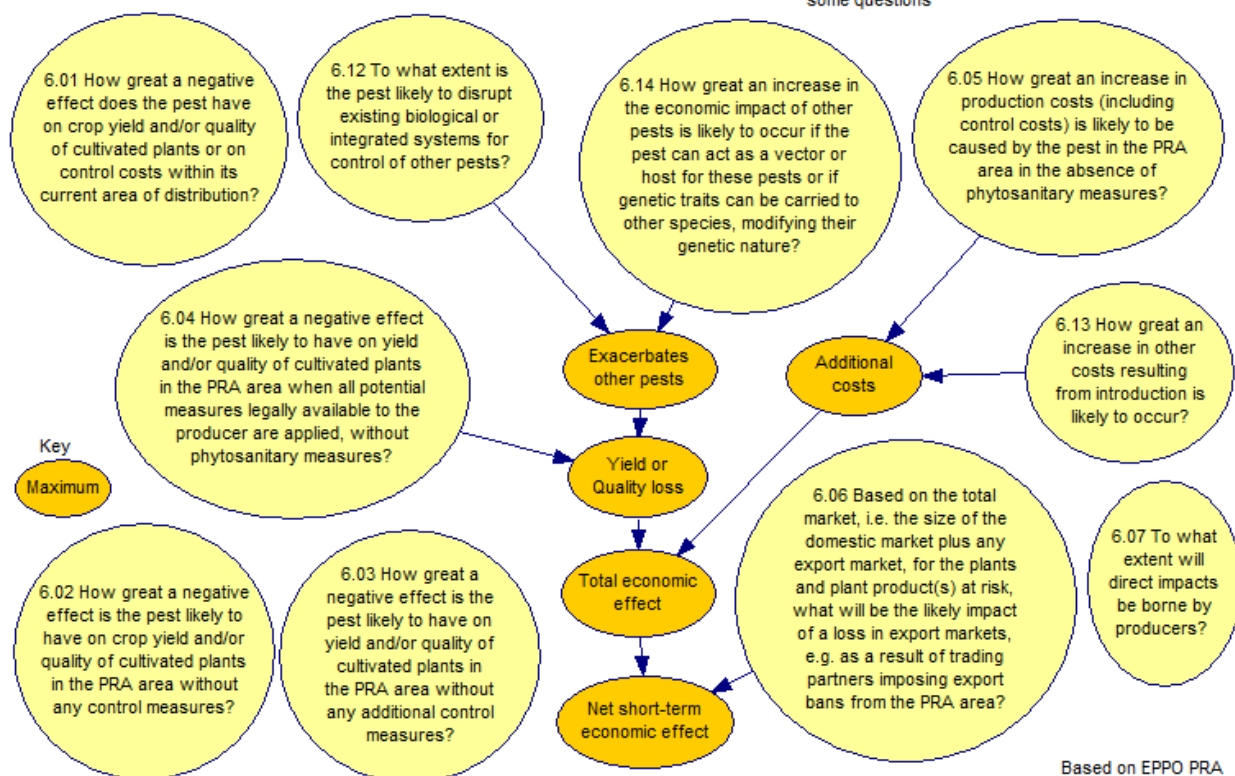
One of the objectives of PRATIQUE regarding economic impact assessment has been to determine the indicators that can be related to the different types of impacts evaluated through the EPPO DSS for PRA (e.g. the percentage reduction in yield and quality). A team of economists and ecologists studied the current version of the scheme. Revisions to the scheme have been proposed and a new question has been formulated. In addition, the structure has been revised as follows:

- The economic, environmental and social questions are grouped together (consequently the previous question 2.10 on export losses has been moved forward to question 6.06), see Annexes 8a, 8b and 8c.

The logical sequence of factors and questions relevant for economic impact is represented graphically in a flowchart (see Fig. 6).

Pratique model for Pest Economic Impact, Version 2 (23/06/11)

Version 2 incorporates a 'Not Answered' option for some questions



The scheme description says: If the responses to question 6.04 and 6.05 are "major" or "massive" or any of the responses to questions 6.06, 6.09, and 6.11 is "major" or "massive" the evaluation of the other questions in this section may not be necessary
 If questions 6.12, 6.13 or 6.14 are not answered, the option 'NA' should be selected for the questions concerned

Based on EPPO PRA Scheme 2011-5, model modified after Bremmer, Hennen & Holt JH 23/06/2011

Fig. 6. Flowchart (ontology) showing how the questions in the economic impact section are structured and combined with matrices.

- To assess environmental impacts, sub-questions have been developed to help the assessor answer the two separate questions (see Annexes 8b and 8c)
- For social impacts, a note has been developed to give better guidance on how to answer this question (see Annex 8a).

A matrix model for combining the answers given to different questions has also been developed for the economic and environmental questions. The answers given to selected individual questions provide the input for the qualitative impact assessment module and the outputs of the modules are then related to the 5-level scoring system (see Fig. 7)

Qualitative economic impact model (Pratique) Enter the decision for each score S and its assoc (To enter values, right-click S or U and set decision)

matrix method by: John Holt (Imperial College, London)
 application: Wil Hennen (LEI/WUR, The Hague)
 conceptual model: Johan Bremmer (LEI/WUR, The Hague)

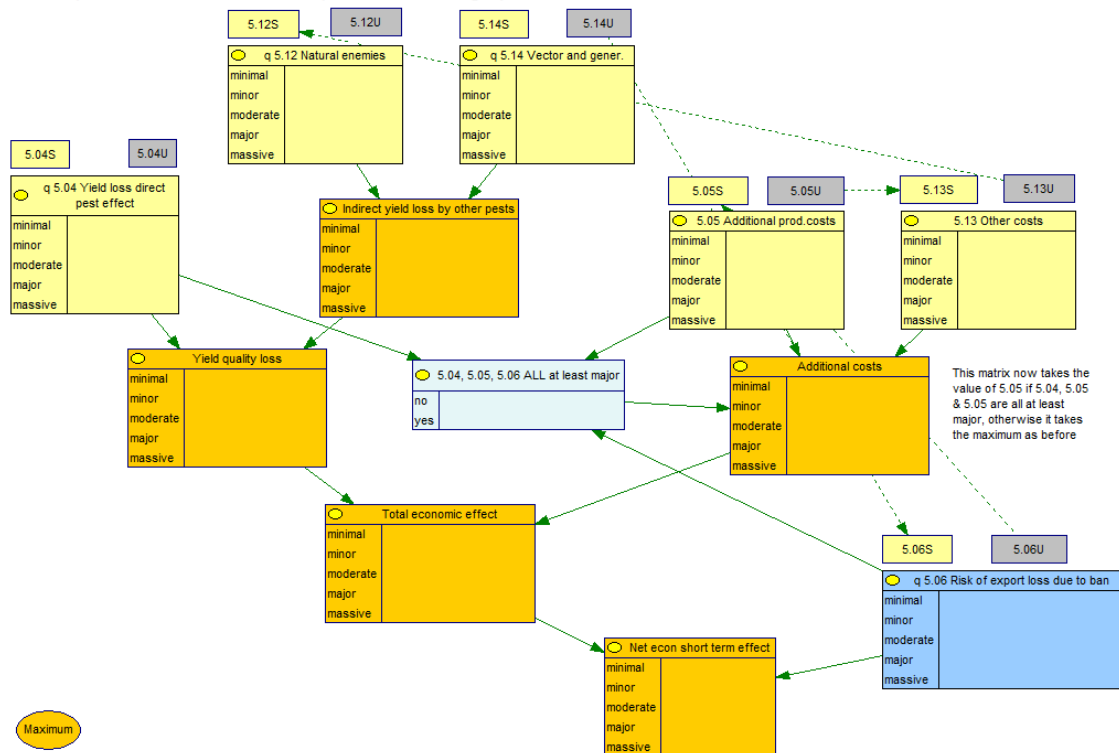


Fig. 7. Qualitative economic impact assessment module.

The section on impact assessment is preceded by an introduction. In the new version of the EPPO DSS for PRA, this introduction has had to be adjusted because some basic principles needed to be added. In the PRATIQUE version of CAPRA, a link is provided to the module that provides an explanation of how to quantify direct and indirect economic impacts. This link is not provided in the EPPO version because the module has yet to be fully tested by the EPPO Panel for PRA Development.

The changes in the economic impact section in detail

Question 6.01 (negative effect of the pest on crop yield etc. in current area of distribution) keeps the same formulation as in the previous question 2.1. The note, however, has been extended and now explains more clearly what this question is meant to cover. A rating guidance has been added that provides a qualitative description of the different levels. Several examples are provided.

Question 6.02 (negative effect of the pest on crop yield etc. in the PRA area without any control measures) also keeps the same formulation as the previous question 2.2, but it was considered that the previous question 2.11 on the presence of natural enemies in the PRA area duplicated this question. Therefore an addition was made to the note regarding natural enemies. Rating guidance is provided in the same way as for 6.01 and examples are described.

Question 6.03 (negative effect of the pest on crop yield etc. in the PRA area without any additional control measures) is a new question. This was added because question 6.02 considers the hypothetical situation where no control measures at all are applied, for example, in experimental field trials, whereas question 6.03 considers a more realistic situation when the normal, current crop protection measures are applied. Again, a similar rating guidance is given, but no examples are provided.

Question 6.04 (negative effect of the pest on crop yield etc. in the PRA area with all measures available except phytosanitary measures) is also new and is used to assess the situation if additional measures are applied.

With these revisions, the responses to questions 6.02 to 6.04 now consider impacts under scenarios with increasing intervention / control efforts in place against the pest being assessed, from a situation where no measures are applied at all to the most interventionist case where everything available (except phytosanitary measures) is applied. The responses are also useful for risk management, as it compares the cost of measures in comparison to the reduction in impacts.

Question 6.05, previously question 2.4, assesses the increase in production costs caused by the pest in the PRA area. It is the same as the previous question but “in the absence of phytosanitary measures” is added. During the discussion with risk assessors evaluating invasive alien plants it appeared that it was not obvious where the costs of control for invasive alien plants could be included in the economic impact assessment as these are not production costs *sensu stricto*. This was discussed at the last project meeting and it was agreed that the best place was question 6.05 but that the note should be amended to make this clear. A brief rating guidance describing the different levels was added and some examples are given.

Question 6.06, previously question 2.10, was completely reformulated to correspond more closely to economic principles. Question 2.10 simply asked for the likelihood of the pest to cause losses in export markets but the new question asks for the magnitude of these losses and bases the question on the total market and the effects of the pest on the export market. When a producer is able to redirect his production to the internal market (or another market) the export losses linked to a prohibition established by a country may be completely or partly compensated by the redirection of the production. A new note has been added as well as a brief rating guidance and examples.

Question 6.07 is also a complete reformulation of the previous question 2.5, which asked for the reduction in consumer demand caused by the pest in the PRA area. The new question asks for the direct impacts that will be borne by the producers. It needs to be noted that direct impacts are related to the magnitude of the impact whereas indirect impacts are related to the distribution of the impacts among the producers affected, producers in the same sector and consumers. If the producer is able to increase the price of the product or can shift to the production of alternative crops, the economic losses of the producers affected can (partly) be compensated. A detailed note

is added that explains what information is needed. A rating guidance is given describing the five levels of magnitude with regard to this question. If this question cannot be rated, a second option is provided, in which the assessor can state that no judgement is possible or that more work is needed with the help of an economist.

Questions 6.08 and 6.09 on environmental impacts are discussed below in section 4.6.

PRATIQUE questions 6.10 and 6.11 (2.8 and 2.9 in the previous version) deal with social damage in the current area of distribution and the PRA area respectively. The questions have not been changed, but the note (question 6.10, but also relevant for question 6.11) has been extended and explains better what is meant by social impacts. A rating guidance – separated into rating guidance for landscape effects and for loss of employment – is given for both questions, but not for human health effects and products and services in order not to dominate the overall score.

Question 6.12 (previous question 2.12) on control measures disrupting / disturbing biological or integrated systems for control of other pests has been slightly reformulated and changed from a likelihood rating to a magnitude rating. A rating guidance describing the five different levels of magnitude has been added.

Question 6.13 (previously question 2.13) has not been altered but the note now refers to question 6.05 to make it easier to answer and a brief general rating guidance describing the five levels of magnitude has been incorporated.

Question 6.14 is a combination of the previous questions 2.14 and 2.15, i.e. the pest carrying genetic traits to other species and acting as a vector or host for other pests. A brief general rating guidance (the same as for question 6.13) is provided.

Question 6.15 is the conclusion on the assessment of economic consequences. No rating guidance is provided, but the visualiser and the matrix model integrated into CAPRA and the Invasive Risk Impact Simulator IRIS (see PRATIQUE combined Deliverable D3.2/3.4) are available to help summarise the results. A decision support scheme for mapping endangered areas (see PRATIQUE Deliverable D3.3) is also provided.

A comparison of the questions of the EPPO DSS for PRA (EPPO, 2009) and the questions revised by PRATIQUE are presented in Annex 8a.

4.6 Revision of the Assessment of potential environmental consequences sub-section of the EPPO DSS for PRA (Contribution from WP 2)

The logical sequence of factors and questions relevant for environmental impact is represented graphically in two different flowcharts (see Fig. 8 and 9).

Pratique Environmental impact model for pests of plants

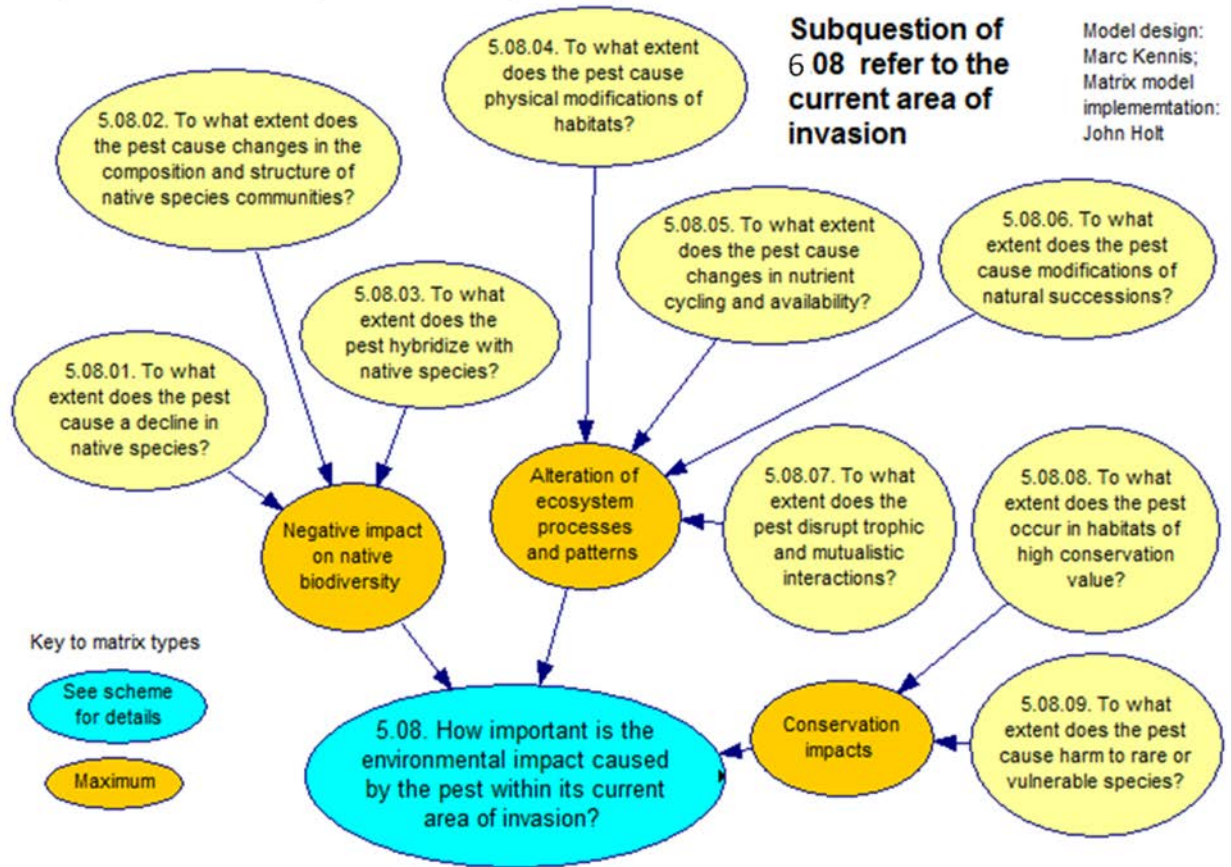


Fig. 8. Flowchart (ontology) showing how the questions in the environmental impact section for question 6.08 are structured and combined with matrices.

Pratique Environmental impact model for pests of plants

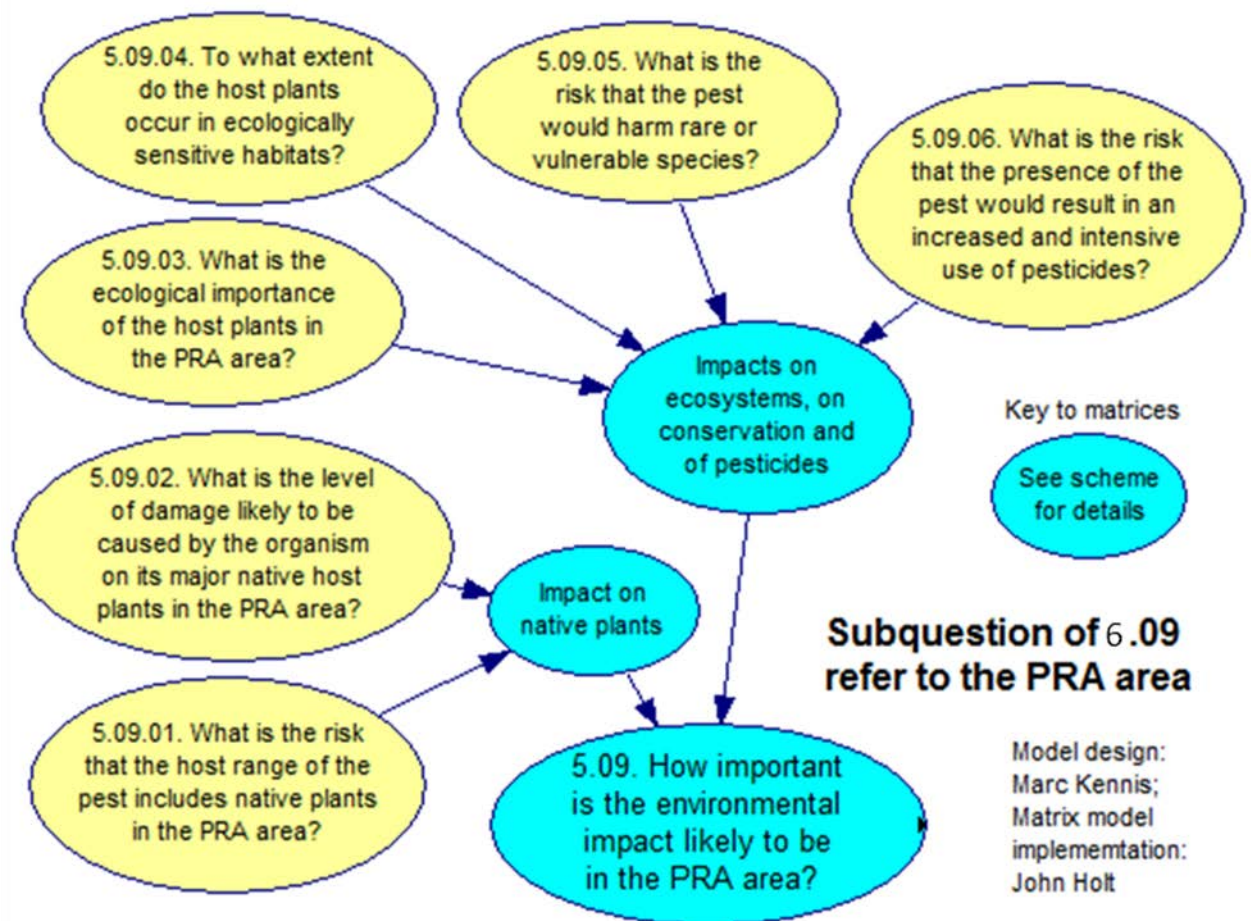


Fig. 9. Flowchart (ontology) showing how the questions in the environmental impact section for question 6.09 are structured and combined with matrices.

In the previous version of the EPPO DSS for PRA, questions 2.6 (environmental damage caused by the pest within its current area of distribution) and 2.7 (environmental damage caused by the pest in the PRA area) were judged to be notoriously difficult to answer. Firstly, indicators of environmental impact were not properly described and there was no guidance on how to rate these impacts. Secondly, the link between the two questions was not explicit, although question 2.7 (i.e. likely impact in the PRA area), which is the important question, is best answered based on the answer given to question 2.6 (i.e. actual impact in the current area of distribution). Furthermore, not enough emphasis was put on the impact observed in previously invaded areas, which is clearly a better predictor for potential impact than the impact in the area of origin. Finally, the two parallel questions give the impression that they can be answered in the same way, using the same indicators, although assessing a current impact is much easier and can be done with much more precision than predicting a potential impact. Therefore, in the PRATIQUE version, the two questions (6.08 and 6.09) remain the same (except that, in question 6.08, the “current area of distribution” has become “the current area of invasion”), but each question is divided into sub-questions and guidance, including examples, is provided for

each sub-question while there is also guidance on how to combine the sub-questions to allow a consistent rating for the two main questions. Two versions are available, one for plant pests, and one for plants as pests.

The changes in the environmental impact section in detail

Question 6.08 (How important is the environmental impact caused by the pest within its current area of invasion?) starts by asking whether sufficient knowledge is available on environmental impact in the areas of current distribution, in particular in already invaded areas, to answer this question. If not, the assessor should go immediately to question 6.09. In addition, if the assessor is certain that, in any case, the environmental impact will be lower than the economic impact (e.g. for a purely agricultural pest not known to occur in other environments), he/she has the possibility to skip both question 6.08 and question 6.09.

In all other cases, question 6.08 is rated by answering 9 sub-questions (8 for the plant version), in three categories of impact: “Negative impact on native diversity” (3 sub-questions), “Alteration of ecosystem processes and patterns” (4), and “Conservation impacts” (2). For each sub-question, a rating guidance (low, medium, high) with examples is provided. Each of the three impact categories is scored by taking the highest indicator score within its category. A final five level rating is calculated by counting the scores (e.g. 3 times “high” means “massive”, 2 “high” and 1 “medium” means major, etc.). As with other questions in the scheme, the uncertainty has to be rated as well (low, medium, high), both in each sub-question and for the final rating.

Question 6.09 first starts by asking whether, if question 6.08 has been answered, an environmental impact is also likely to occur in the PRA area, and, if yes, if this is at a comparable level, using two sub-questions.

Question 6.09A then asks for similarities between the current area of invasion and the PRA area, question 6.09B for similarities between native species, communities and threatened ecosystem services in the current area of invasion and the PRA area. If both sub-questions are answered with yes (i.e. conditions in the PRA area sufficiently similar to those in the area of invasion to expect a similar level of impact), the rating for question 6.09 is the same as for question 6.08. If this is not the case, sub-question 6.09C has to be answered with a simpler rating system and simpler impact predictors. Four categories have to be answered (direct impact on native plants, impact on ecosystem patterns and processes, conservation impact, impact of pesticides) by the help of six sub-questions, which are combined to obtain a final five level rating for question 6.09.

For the version for plants as pests, no rating guidance is provided for sub-question 6.09C. Instead, it is stated that if question 6.08 could not be answered, i.e. the species has not invaded any other area, or if the invasion is too recent and too little is known on its ecology in the invaded areas, an environmental impact assessment cannot be properly made using this scheme.

A comparison of the questions of the EPPO DSS for PRA (EPPO, 2009) and the questions revised by PRATIQUE are presented in Annex 8b (plant pests) and 8c (plants as pests).

5. Example

To show how the new version of the EPPO DSS for PRA can be applied in practice, an example is given of a PRA conducted on the cherry vinegar fly *Drosophila suzukii* by using CAPRA, which implements all the revisions discussed in this document (see Annex 9).

6. References

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7. Acknowledgments

The rating guidance has been prepared by 3 different groups from WP 2 (economic and environmental impact), WP3 (establishment and spread) and WP4 (entry).

Valuable comments and examples were included from Andrea Sissons, Lesley Cree and Louise Dumouchel from CFIA, Christina Devorshak from USDA APHIS, Olivier Pruvost from Inra, Zhenya Ilieva from BPI. Thanks are due to Sophie Petter for the formatting of the examples and to Claire Petter for a final check of the consistency of Annex 5b with CAPRA.

We also would like to thank the EPPO Panel on PRA Development, several EPPO Expert Working Groups for PRA, the participants in the Hammamet PRA workshop, and the participants in the PRATIQUE meetings for discussion and useful amendments.

8. List of Annexes

List of Annexes to the Protocol on Consistency

Section	Title	File Name
Annex 1	Milestone 3.1 Review of best practice in enhancing consistency	Annex_1_M_3.1_Consistency_best_practice_FINAL
Annex 2	Schrader <i>et al.</i> 2010: Contribution to Work Package 3: enhancing techniques for standardising and summarising pest risk assessments – review of best practice in enhancing consistency	Annex_2_Schrader_et_al_2010
Annex 3	Milestone 3.2 First draft of the protocol on consistency in PRA	Annex_3_M_3.2_Consistency_draft_protocol_FINAL
Annex 4	Revision of the probability of entry section of the EPPO PRA scheme	Annex_4_Section 2 Entry
Annex 5a	Revision of the establishment section of the EPPO PRA scheme	Annex_5_a_Section 3 Establishment
Annex 5b	Examples for different types of pests	Annex_5_b_Examples for the establishment part
Annex 6	Revision of the spread section of the EPPO PRA scheme	Annex_6_Section 4 Spread
Annex 7	Stage 2 pest risk assessment Section B Eradication, containment of the pest and transient populations	Annex_7_section 5 pest risk assessment eradication containment transient
Annex 8a	Revision of the impact section of the EPPO PRA scheme	Annex_8_a_Section 6 Economic_impact_sensus stricto

Annex 8b	Revision of the questions on the environmental impact of the EPPO PRA scheme Version for plant pests	Annex_8_b_Section 6 Env impact pests
Annex 8c	Revision of the questions on the environmental impact of the EPPO PRA scheme Version for plant	Annex_8_c_section 6 Envl impact plants
Annex 9	PEST RISK ANALYSIS FOR : <i>Drosophila suzukii</i>	Annex_9_Drosophila_suzukii test