Forest Research

What role can the systems approach play in preventing the introduction of invasive alien species?

Hugh Evans[1], Eckehard Brokerhoff[2], Richard Baker[3] and René Eschen[4]

[1]Forest Research, Aberystwyth, UK,
[2]Scion, Christchurch, New Zealand,
[3]Fera, York, UK
[4]CABI, Delemont, Switzerland

Development of a Systems Approach: Current processes

- Management of phytosanitary threats is generally pest list-based or commodity-based
- In the European Union this is regulated through the EU Plant Health Directive (2000/29/EC)
- Further lists are provided by the European & Mediterranean Plant Protection Organisation (EPPO)
- Similar approaches are adopted globally, e.g. Canada
- Some examples of listed forest pests follow:

Recognised threats: prohibited pests around the world

European Union Directive 2000/29 EC	Named pests		
	Forest	Other	Total
Insects & nematodes	17	88	105
Bacteria	0	8	8
Fungi	16	21	37
Viruses	1	47	48
	34	164	**198**

Canada	Forest	Other	Total
Bacteria	1	7	8
Fungi	7	31	38
Insects & mites	14	46	60
Molluscs	0	11	11
Nematodes	0	9	9
Phytoplasmas	0	10	10
Viruses	0	62	62
	22	176	**198**

EPPO A1 & A2 lists

342 of which 135 are insects

Each country will have its own list but probably broadly similar in the temperate forest sector

Based on Evans, H. F. Pest risk analysis - organisms or pathways? *New Zealand Journal of Forestry Science* 40 suppl. (2010) S35-S44

Most organisms are missed!

Successful establishment of pests, including those not on lists

% of invertebrate sps established in Europe (from Roques, *et al* , 2008)

	Total Inverts	Arthropods	Non-arthropods
Africa	12.3	12.9	3.2
North America	19.8	19.6	22.6
C & S America	10.8	10.9	9.7
Asia	29.4	29.3	32.3
Australasia	6.5	6.6	4.3
Tropics	6.7	7.1	1.1
Cryptogenic	14.5	13.7	26.9
Total (number)	**1517 (135*)**	1424	93

* EPPO lists

Lists – after the event!

- Successful establishment of major pests not on lists before arrival in receiving country
  - *Anoplophora glabripennis*: USA, several EU countries. From Asia
  - *Agrilus planipennis*: USA, Russia. From Asia
  - *Megaplatypus mutatus*: Italy. From S America
  - *Dryocosmus kuriphilus*: USA, parts of EU. From Asia
  - *Phytophthora ramorum*: USA, EU. Origin unknown
  - *Phytophthora kernoviae*: EU, NZ. Origin unknown
  - *Etc.*
  - *Etc.*

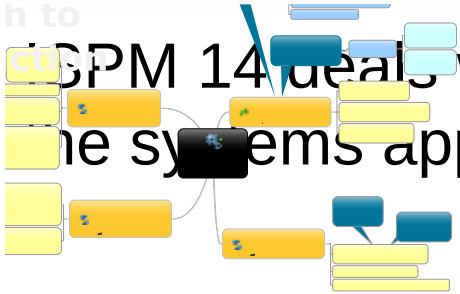
The need for measures to reduce phytosanitary risks

- The need for measures to manage risks from pests is driven by a balance between:
  - Recognition of a threat, usually (ideally) by prior recognition and supported by formal Pest Risk Analysis
  - Determining whether that threat is severe enough to require application of measures so that trade in the pathway carrying the pest can continue
- Globally, measures are determined through consensus and, particularly, bilateral agreement with the receiving country predominant.

Range and feasibility of measures

- Range of measures and feasibility of use is driven by the pathway and type of pest on the pathway:
  - Non-living material: all direct measures (e.g. heat, fumigation) can be considered and used
  - Living material: direct measures restricted and also dependent on type of pest
- Both types of pathway are potentially manageable by a Systems Approach, but particularly relevant to living material

Some key elements of a Systems Approach to Risk Reduction



ISPM 14 deals with the systems approach

Pest prevalence and reduction by process

Reduce pest at place of production

Reduce pest in transit

Reduce pest at import point(s)

ISPM 14 parameters

Systems approaches may be considered when one or more of the following circumstances apply:

- individual measures are:
  - not adequate to meet phytosanitary import requirements
  - not available (or likely to become unavailable)
  - detrimental (to commodity, human health, environment)
  - not cost effective
  - overly trade restrictive
  - not feasible
- the pest and pest-host relationship is well known

ISPM 14 parameters

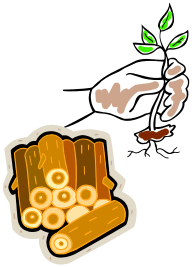
Systems approaches may be considered when one or more of the following circumstances apply (Cont'd):

- a systems approach has been demonstrated to be effective for a similar pest/commodity situation
- there is the possibility to assess the effectiveness of individual measures either qualitatively or quantitatively
- relevant growing, harvesting, packing, transportation and distribution practices are well-known and standardized
- individual measures can be monitored and corrected
- prevalence of the pest(s) is known and can be monitored
- a systems approach is cost effective (e.g. considering the value and/or volume of commodity).

Application of phytosanitary measures in a Systems Approach

- Measures can and should be applied sequentially, with greatest emphasis on pest reduction or removal as close to the start of the pathway as possible.
- Measures can be independent or used additively as a combination of measures.

Steps in the Systems Approach (based on EPPO PRA system)



GROWING | **HARVESTING** | **PACKING** | **TRANSPORT AND STORAGE** | **ENTRY / IMPORT** | **POST ENTRY**

Control natural spread at origin

Detectable by visual inspection or tests

Post-entry control possible

Destroyable by treatments (chemical, etc.)

Preventable by treatment of crop

Preventable by limiting use

Preventable by cultivars

Preventable by removal of non-required parts

Pathway is natural spread

Pest already entering

Entry with human travellers

Regional collaboration and communication for intractable problems

Preventable by growing conditions

Pest freedom can be guaranteed

Preventable by choice of harvesting times

Natural spread is major

Detectable by post-entry quarantine

Entry on machinery or transport

Preventable by production certification

Degree of spread in production area

Preventable by packing methods

Surveillance or eradication measures in importing country

Possible pathway prohibition

Measures identified against introduction? Adequacy or partial adequacy of single or combined measures?

Measures identified which do not interfere with trade, too expensive or socially/environmentally undesirable?

Other pests on pathway? Select measures effective for all pests (assuming pathway-initiated analysis)

Consider measure(s) for phytosanitary regulation

Possible requirement for phytosanitary certificate

Major pathways analysed

Consider relative importance of pathways

Example: *Anoplophora chinensis* mitigation measures per pathway: EU requirements

Plants for planting, e.g. *Acer*

Source in natural range of pest

Pest free place of production

2 years growth free of CLB (ISPM 5 & 10)

+

2 official inspections (NPPO)

+

complete physical protection

+

official inspection prior to export

Pest free area

2 km wide demarcated zone with pest reduction

or

growth from rootstock – grafted scion & inspection

Miniature plants, Bonsai or Penjing

be potted, in pots which are placed on shelves at least 50 cm above ground

+

Grown and trained for at least two consecutive years in officially registered nurseries, which are subject to an officially supervised control regime

+

treated to ensure freedom from non-European rusts

+

officially inspected at least six times a year for the presence of harmful organisms in place of production and on plants in the immediate vicinity

+

have been planted in unused artificial growing medium or sterilized natural growing medium

+

maintained free from harmful organisms and within two weeks prior to dispatch, shaken and washed with clean water to remove the original growing medium and kept bare rooted, **or** replanted in pest-free growing medium, **or** treated to ensure that the growing medium is free from harmful organisms

+

be packed in closed containers which have been officially sealed and registered along with a phytosanitary certificate

Hosts of *A. chinensis* as pathways regulated by the EU

Acer spp. – the most common pathway: 57 potential pest genera intercepted

Pathway	Number of species intercepted
Acer	57
Order of pest	
Insects	13
Coleoptera	6
Cerambycidae	6
Hemiptera	5
Aphididae	1
Cicadellidae	1
Diaspididae	2
Hymenoptera	1
Eurytomidae	1
Thysanoptera	1
Thripidae	1
Nematodes	44

30 _Anoplophora_ interceptions!

EU Directive: Specified plants: *Acer* spp., *Aesculus hippocastanum, Alnus* spp., *Betula* spp., *Carpinus* spp., *Citrus* spp., *Cornus* spp., *Corylus* spp., *Cotoneaster* spp., *Crataegus* spp., *Fagus* spp., *Lagerstroemia* spp., *Malus* spp., *Platanus* spp., *Populus* spp., *Prunus laurocerasus*, *Pyrus* spp., *Rosa* spp., *Salix* spp. and *Ulmus* spp.;

All listed pathway genera: a further 97 genera/species intercepted

Genus	No. of species intercepted
Acer	57
Aesculus	1
Alnus	1
Betula	5
Carpinus	4
Citrus	11
Cornus	4
Corylus	1
Cotoneaster	1
Crataegus	1
Fagus	4
Lagerstroemia	11
Malus	5
Platanus	1
Populus	1
Prunus	9
Pyrus	3
Rosa	13
Salix	1
Ulmus	20

Source: EPPO Interceptions data 1995-2010

Conclusions

- Our current, and difficult, challenge is how to manage the complexity and pest-carrying capacity of Plants for Planting as a pathway
- A process-based approach using exemplar pests with particular biological attributes should now be used; it is not the name of the pest that matters, it is how it is associated with the pathway that counts
- The process is to remove/prevent the exemplar pest association leading to successful application of the *manage once remove many* concept
- Worked examples of the positive and negative aspects of the Systems Approach would be valuable in developing a process to cope with both known and unknown pests

Acknowledgements

Hugh Evans would like to acknowledge:

- The organisers for their generous support
- Funding from the European Union's Seventh Framework Programme FP7/2007-2013 under grant agreement number 265483 (REPHRAME project)

René Eschen would like to acknowledge:

- The Swiss Secretariat for Education and Research (SER)

Thank you for your attention!