2.14. Step 12. Timing of the survey

Choosing when and how often to survey is another critical step.

2.14.1. When to survey

Ideally, the survey should be performed when the pest is most likely to be present and in an identifiable state.

> The timing of survey procedures may be determined by:
> - the life cycle of the pest
> - the phenology of the pest and its hosts
> - the timing of pest management programs
> - whether the pest is best detected on crops in active growth or in the harvested crop.
>
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If the best time to survey is not known for the pest, start by finding out its seasonal habits. At what stage of the host's life cycle does the pest prefer to infest it? How long will it persist? Does it die back, such as during the wet or dry season, can it survive if the host is dead or dying? Will normal management of the crop or forest control or eradicate the pest? How quickly does it reproduce and spread? How long can the pest survive under different conditions and at different stages of its life cycle? Are there weather conditions or weather events that may influence the pest's life cycle or survival?

Other factors that may determine the timing of your survey are:

- when the pest is most active
- accessibility, and availability of vehicles
- time of local festivals or community events
- time of sowing, seedling emergence, flowering, fruit maturation and harvesting of hosts
- time of flowering for weeds
- time of obvious symptoms.

A useful website that discusses the appropriate timing for pests on a number of crops is produced by the European and Mediterranean Plant Protection Organization (EPPO). This is at <http://www.eppo.org/STANDARDS/gpp.htm>. While these are standards developed for the European climate, the information on timing is relative to the pest or host life cycle and so can be applied to other regions.

Clearly, the timing of surveying in a delimiting survey will follow the date of detection of the pest as closely as possible.

Pest lists

The timing of a survey is particularly important when developing pest lists, as it is critical that host plants are examined throughout their life cycle since different pests prefer different stages of the host development. The minimum stages of development that should be surveyed are:

- seedling emergence
- vegetative flushing stage
- flowering stage
- fruiting stage.

Examples from the case studies:

Case study C—Mahogany shoot borers: when insects are most active.

Case study E—Khapra beetle: to coincide with the peaking of beetle emergence.

Case study F—Fruit flies: continuous every 1 or 2 weeks to maintain pest-free-area status.

Case study H—Mango pulp weevil and mango seed weevil: when mango production is highest in the year.

Case study K—*Pseudomonas*: 70 days after planting to when symptoms would be visible.

Case study L—Giant wood moths: either during winter, as the exit holes are visible and new attacks are easy to assess; or during midsummer if taking specimens, as the exit holes are visible, late-instar larvae or pupae are still in the stems, and pupal skins, which aid detection, may be present.

Case Study M—Damping-off: 1 week after seed sowing, at seedling emergence when symptoms are visible.

Case Study V—Red-banded mango caterpillar: when fruit is developed but while roads remain passable.

2.14.2. Frequency of the survey

Some surveys need to be performed several times. For example, this may be every 2 weeks when managing a pest in a crop, or annually during harvest to support a pest-free-area status, or according to periods in the pest's life cycle.

If trading partners are involved, the frequency would need to be agreed upon. Also, there may be need to revise the timing and frequency if they are dependent on weather conditions or events.

The New Zealand Department of Conservation provides guidance on the frequency required in searching for weeds in forests and other natural habitats in the following publication:

Harris, S., Brown, J. and Timmins, S. 2001. Weed surveillance—how often to search? Science for conservation 175. Wellington, New Zealand, Department of Conservation.

This publication contains a table of effort required to achieve 80% and 95% certainty of detection in different habitat types and weed growth forms, and includes costs-to-control thresholds—i.e. how often you need to survey for a $500 or $5000 recovery management program.

Step 12

- Record the best timing for the survey, detailing the reasons.
- Record the frequency if the survey is to be performed more than once.

2.15. Step 13. Planning data to collect in the field

2.15.1. Identifying the sampling sites

2.15.1.1. Tagging the site

It is wise to mark sampling sites in the field whenever possible, even if you do not intend to return to the same site. It is possible that a specimen or observation taken could be lost or destroyed, and so with careful notebook entries and a marked site, you would be able to revisit the site if needed. Remember to choose tags that will survive a variety of weather conditions, and use a pencil or ink that does not smear when wetted to label the tags.

Options for marking the site include:

- spray-painting a mark
- placing sticks with a bright tassel or tag, particularly where a pest has been completely removed (such as weeds), but only when the stick or marker will not interfere with the management of the site, such as getting caught in harvesting equipment
- tying a tag or tassel to a plant stem or branch.

2.15.1.2. Recording site details

The location and unique identifying details of each site need to be recorded in a notebook. These details may be entered using a standard form that can be used for each site. For help to design your own form, see Section 2.15.2.1.

Describing the sampling site would include information such as a GPS reading, a unique number, distances from visual cues (e.g. 20 metres from roadside), number or nearest number of plant in a row (e.g. tenth tree in third row from the northeastern corner), or any distinguishing topographical features (e.g. edge of a ravine, in a ditch).

2.15.2. What data to record in the field

The most important tool you will have with you in the field will be your notebook and notes. In your notes you would record any information that could otherwise be forgotten, such as the dates of surveying, the weather at the time, the site details, the names and contact details of the local people involved, variations in who was present or absent in the survey team on the day, and any other details that you may wish to have to hand either during or after the survey.

Notebooks with carbon paper duplicate pages can be very useful when recording information to accompany a specimen taken. In this way, the details are written once only but you then have a permanent record in your notebook and a copy to be kept with the specimen. Duplicate notes could have other applications, such as at data entry time.

A custom-designed form is another useful tool to record data.

2.15.2.1. Designing a form

The simplest way to record data is to design a form that allows for recording all the information that you intend to collect. The forms could be bound together to ensure loose pages are not lost. Additional information that does not fit in or suit a form structure should be recorded in your notebook. You need to ensure that there is an understanding between the team members of the information to record and of a standard format, so that if multiple notebooks are used, each should be understandable at least to the team leader.

A simple way to save a lot of time is to work out ahead of the survey how the data will be stored and to design your form so that it is easy to transfer the information to the storage system. See also Section 2.17, Electronic data storage and Section 2.23, Reporting the results. When designing a form, you could include the following:

- observer's name
- field site number or name
- sampling site number or name
- targeted pest names—common and scientific
- time and date
- brief description of weather conditions
- locations, such as by GPS readings, of sampling sites
- description of habitat (e.g. aspect, vegetation, soil type)
- scale/population density categories that could be ticked
- symptoms of the pest or host
- pest life stage or state (e.g. larvae, pupae, adults for insects; anamorph/teleomorph state for fungi; seedling, budding, senescent, first flush for plants)
- caste of colonial insects surveyed, such as of termites, ants and some wasps
- behavioural notes on possible vectors (e.g. 'insect ovipositing on fruit' or 'insect resting on plant leaf')
- area or length of plot or transect assessed
- cross-reference to pest example in a pest photo library
- colour of identifying features, such as of flowers
- any quarantine measures applied at the field site, such as hygiene measures
- treatments applied to site
- additional comments.

If you are collecting specimens, you could include space on the form for:

- parasites, hyperparasites and/or biological control agents present on the specimen
- description and identifier number of specimen
- location, such as by GPS, of where specimens were collected.

See also Section 2.16.3, Labelling specimens.

Examples of information recorded in three of the case studies are:

- Case study C—Locality, situation (e.g. plantation, amenity), host species, symptoms, incidence (number of trees affected), severity (number of shoots attacked per tree), date, observer, GPS reading.
- Case study J—Cane mill area, farm name, farm number, inspection date, block number, area of block, cultivar, crop class, actual area inspected, diseases noted.
- Case study N—Location of any dead or infected tree, health status of tree, presence and extent of infection centres along a transect.

2.15.2.2. Units for data

Data are normally reported in terms of a unit of measure, usually the number of pests per unit area. The number might be a direct count of the pests or could be a scale of intensity of the pest that is recorded. The area examined might be per tree, fruit, field, crop, kilometre, quadrat, sweep of a net, trap etc. For example:

- Case study C—Number of shoots attacked per tree.
- Case study N—Number of trees affected as compared with the total number of trees examined.

In the case of surveys targeting pests that are generally expected to be absent, such as for early detection or to support pest-free-area status, the pests will rarely be found. The pest count will usually be zero, but it is still important to quantify the amount of effort expended for statistical purposes. For example, '600 trees were examined in each of 20 farms in an area, with no evidence of the pest'.

In some situations, an early detection surveillance program may regularly detect very small numbers of the pest. The total number of pests found in the region is the unit reported. An example is a fruit-fly trapping program in a border area where there are regular cross-border movements. A risk-based response strategy could be based on the number of flies trapped in a season:

- 2 or fewer—continue to monitor;
- 2–5—increase trap density;
- more than 5—incorporate quarantine and control measures to eliminate infestation.

In the case of delimiting surveys, presence or absence at a site is the essential unit of information.

Use of scales and scores

In some cases where the pest is numerous, or particularly for symptoms of plant pathogens, whole numbers of pests are not possible or useful. Instead, a scale of cover of the host or a standardised measure of the pest could be used. Scales are semi-quantitative as the scale intervals can be wide and may not be consistent in their range.

Example 1 for infection rating:

Case study M: Assigning an infection rating (area of total leaf surfaces of host affected by a pest) of zero a score of '0'; 1–25% as 1; 26–50% as 2 and more than 50% as 3.

Example 2 for estimating weed coverage:

The Braun-Blanquet coverage scale.

Cover class	% cover
5	75–100
4	50–75
3	25–50
2	5–25
1	1–5
Few	< 1
Rare	<< 1

Reference: Mueller-Dombois, D. and Ellenberg, H. 1974. Aims and methods of vegetation ecology. New York, John Wiley and Sons.

Example 3 for estimating crown damage in eucalypts:

This index involves visual estimates of:

- the percentage damage of entire tree crowns
- the average percent of defoliation on individual leaves
- the average percent of necrosis on individual leaves
- the average percent of discoloration on individual leaves.

The visual estimates are based on colour photographs of leaves displaying different degrees of damage.

Reference

Stone, C., Matsuki, M. and Carnegie, A. 2003. Pest and disease assessment in young eucalypt plantations: field manual for using the crown damage index. In: Parsons, M., ed., National forest inventory. Canberra, Australia, Bureau of Rural Sciences.

2.15.2.3. Importance of negative data

It is very important to record negative data, i.e. locations surveyed where the pest was not observed, so that there is a record of the effort expended to look for the pest. While this may seem obvious, it is often overlooked. It is particularly important in delimiting surveys (Chapter 5) to track pests, and in surveys to support pest-free-area status (Chapter 3).

The validity of negative records depends on a number of factors:

- the pest is known to produce easily noticed signs or symptoms
- the host species is widely distributed and has high population levels

- the host is economically important and is likely to have been examined by plant protection specialists
- the pest is relatively easy to identify
- environmental conditions are conducive to infection and pest development.

Step 13

- ▶ Decide if and how you will mark the sites. Record an example.
- ▶ Design and include a form for recording data—if appropriate.
- ▶ Do you need to collect specimens? If yes, continue to Step 14; otherwise go to Step 15.

2.16. Step 14 Methods of collecting pest specimens

It is important that pest specimens be collected and handled with the best possible care to preserve the diagnostic features for identification, especially if they are to be submitted to a permanent reference collection or herbarium.

If specimens are to be sent away for identification, often they will not be returned. Consider collecting two or more specimens, assuming you can preserve them adequately—one to keep and one to send for identification. In that way, when the specimen is identified, you will have a specimen in your possession for future reference. You may need to amend your labelling system to accommodate multiple samples.

Methods for collecting plant pests are the subject of numerous books and manuals and will not be covered here in detail. Instead, a brief review of useful references is provided below, followed by generic sampling methods for pests, to be used when specific protocols are not available. See also Box 8, What equipment to take along, on page 75.

2.16.1. Useful references

2.16.1.1. Insects and allied forms

Reference one

Upton, M. 1991. Methods for collecting, preserving and studying insects and allied forms, 4th ed. Australian Entomological Society. ISBN 0 646 04569 5. This is available at <http//: www.entosupplies.com.au>. In 2005, this book was priced at $A24.20.

This small and detailed handbook covers:

- netting
- beating
- aspirating and vacuuming

- trapping
- extracting
- specialised collecting.

Reference two

Schauff, M.E. Collecting and preserving insects and mites: techniques and tools. Washington, DC, Systematic Entomology Laboratory, USDA, National Museum of Natural History, NHB 168.

This document can be downloaded from the Internet for free at: <http://www.sel.barc.usda.gov/selhome/collpres/collpres.htm>.

The book covers the equipment needed followed by information on

- trapping
- baiting, luring and other attractants
- collecting aquatic and soil insects and ectoparasites.

The book goes on to discuss killing, preservation, mounting, labelling, housing insect collections and details on packaging and shipping specimens.

2.16.1.2. Plant pathogens

Reference

Anon. 2005. Management of plant pathogen collections. Canberra, Australia, Department of Agriculture, Fisheries and Forestry.

This handbook describes the methods for collecting plant-disease specimens, covering:

- leaves, stems and fruits
- roots and soil
- macrofungi.

This publication would be a useful companion to these guidelines when surveying plant pathogens. It also describes how to establish a plant pathogen herbarium, as well as methods of identification and preservation of the pests to be kept for permanent collections.

2.16.1.3. Weeds

Reference

Bedford, D. and James, T. 1995. Collection, preparation & preservation of plant specimens, 2nd ed. Sydney, NSW, Australia, Royal Botanic Gardens. ISBN 0 7305 9967.

This book can be obtained directly from the Royal Botanic Gardens, Sydney. In 2005, the price was $A6.95. Go to <http://www.rbgsyd.nsw.gov.au/sydney_gardens_domain>.

2.16.2. Generic specimen collection protocols

2.16.2.1. Insects and allied forms, and plant pathogens

The generic procedures outlined here for insects and plant pathogens (see extract below) are those presented in PLANTPLAN: Australian Emergency Plant Pest Response Plan, by Plant Health Australia, 2005. For more information, go to <http://www.planthealthaustralia.com.au>.

- Sterilise any implements with a sterilant (eg. 70% v/v ethanol or 0.5% v/v available chlorine solution, as appropriate) before and after each sampling.
- If considered to be a root problem, include soil and crown (lower stem) tissues with root samples.
- It is essential that the time between sampling and dispatch of the sample for identification be kept to a minimum.
- When sampling a suspected EPP [exotic plant pest] do not drive from paddock to paddock when sampling as this increases the potential for spread of the EPP.
- If possible, sample from perceived area of minimal damage to perceived high damage within field and on individual plant

Insect samples (use specific protocols where available)

i. Where possible it is advisable to collect a large number of specimens of all life stages. For example, with the adult stage collect a number of specimens of varying size and colour depicting variation in the morphology of that species/biotype. Collection of different life stages can assist in diagnosis.

ii. Collect specimens in duplicate that are clean and in good condition, i.e. complete with appendages such as antennae, wings and legs.

iii. Use a small leak-proof alcohol resistant receptacle, such as a film canister, glass bottle with air- and liquid-tight stopper, or plastic container with screw-top lid.

iv. If sending small and/or soft bodied insects (e.g. thrips, aphids, mites and larvae), place specimen in 65% ethyl alcohol (methylated spirits can be used)–35% water and completely fill the container.

v. Tape the lid securely to avoid accidental spillage. Note: Do not remove mealy bugs or scale insects from the leaves or stems on which they are feeding as this will damage their mouth parts and make identification difficult. Instead, cut out leaf tissue around the insect and place this in alcohol.

vi. If sending hard-bodied insects (e.g. beetles, moths, grasshoppers and fruit flies), carefully fold specimen in tissue paper and place in crush-proof plastic tube or container with several holes in the lid for ventilation.

vii. Retain and store a spare sample in a secure, cool and dark location.

viii. If possible, store sample in freezer for 2 hours before dispatch to kill the insect.

ix. Clearly label all samples (see Section 2.16.3, Labelling specimens)

x. Do not send live insects.

Note: In exceptional circumstances, the diagnostic laboratory may require live material; for example, if only immature stages are available and the diagnostic lab needs to rear material through to adult (in secure facilities). In such cases, special arrangements would have to be made, ensuring secure transportation, prompt collection of samples from airports etc.

Pathogen samples (use specific protocols where available)

i. Try to select the sample on the same day it is to be sent, to ensure freshness.
ii. Select samples in duplicate. Retain second sample as reference material.
iii. For fungal and bacterial samples, store under appropriate conditions.
iv. Store sample in a refrigerator at 2–5°C until it is sent. Note: Some pathogens do not survive cold conditions. If this is true of the suspect EPP you are sampling, store under appropriate conditions.
v. Select samples at the margin between the diseased portion of the plant and the healthy portion.
vi. Select a fresh, representative and generous sample covering the full range of symptoms.
vii. If considered to be a root problem include soil and crown (lower stem) tissues with root samples.
viii. Place samples in self-sealing plastic bags with some dry tissues or paper towel to absorb excess moisture.
ix. If submitting a fruit or vegetable sample, wrap in dry tissues or paper towel and pack firmly in a crush-proof container.
x. Retain and store a spare sample using the same methods described above.
xi. Do not send dead plant material.
xii. Do not add extra moisture or pack a sample that is wet.
xiii. Do not allow sample material to dry out.

2.16.2.2. Nematodes

The extract below is from the following CABI Bioscience training manual:

Ritchie, B.J., ed. 2003. Laboratory techniques for plant health diagnostics, a practical guide for scientists, researchers and students, 11th ed. Egham, UK, CABI Bioscience.

Taking a sample

Sampling of soil that is very wet or very dry should in most cases be avoided. The soil for the sample should be taken at least 5–10cm below the surface as the nematodes congregate in the root zone. If a crop shows patches of poor growth then separate samples should be taken from the badly affected and normal areas so that a comparison can be made. Tree crops such as citrus and vines may be sampled at the drip circle[9] where the surface roots are often most abundant. Individual sample size should be about 250–300g. After the samples have been bulked and thoroughly mixed, a sub-sample of the same weight can be taken and analysed.

[9] The drip circle is where water would drip to the ground from the plant's outermost leaves.

If at all possible, roots should be either included in the sample or taken separately – about 25–100g, taken at random, should be sufficient, the lower weight being suitable for vegetables or citrus whilst the higher weight being more applicable to plants with large roots such as banana.

If stems and/or leaves appear to be attacked by nematodes, affected material can be removed and placed in polythene bags. The leaves should be removed from the bag and examined as soon as possible to avoid rotting of the tissue. Such samples should be kept separate from soil and/or root samples. Soil samples to a depth of 5 cm may be needed if above ground material is severely affected (the nematodes may be migrating to a healthy plant).

Care of samples

Samples should be placed in strong polythene bags and immediately labelled by means of a pencil-written paper or plastic label placed inside the bag.

Samples should be kept cool – do not leave in the sun or in a closed vehicle left in the sun – and should be treated with care and processed or despatched for analysis as soon as possible. If immediate despatch or processing is impossible then samples can be stored in a refrigerator at 4–8°C for several days without severe deterioration or alteration in relative composition of the nematode population.

2.16.2.3. Viruses

The following instructions are from Anon. 2005. Management of plant pathogen collections. Canberra, Australia, Department of Agriculture, Fisheries and Forestry.

Plant material that is suspected of being infected with a virus can be collected and temporarily preserved using small desiccators. This technique is best carried out at temperatures of 0 to 4°C, but will also work quite well at ambient temperatures. A plastic tube should be filled with calcium chloride ($CaCl_2$) crystals. Filling the tube up to a third of its volume is usually sufficient.

Use scissors or a safety scalpel blade to cut up leaf tissue. If the leaves are dusty or covered in sooty mould or scale insects, swabbing with water or alcohol can clean them. Leaf sections should be collected from near the centre of the lamina. Cut the leaf into 3 to 5 mm squares and place 5 to 10 squares in a plastic container containing calcium chloride ($CaCl_2$) crystals or silica gel, but separated by cotton wool … Sterilise the scissors or safety blades in alcohol or a 10% sodium hypochlorite (NaOCl) solution between samples to prevent cross contamination.

2.16.2.4. Phytoplasmas

The following instructions are adapted from Anon. 2005. Management of plant pathogen collections. Canberra, Australia, Department of Agriculture, Fisheries and Forestry.

Because phytoplasmas are obligate parasites they cannot live freely in the environment and have not been successfully grown in culture. Identification of phytoplasmas is through resultant symptoms, host range, vector specificity, appearance under transmission electron

microscopy of ultra-thin sections of diseased tissue and, recently, by specific PCR primers. Specimens that are to be submitted for DNA tests could be prepared as for viral specimens. Seek advice about specimen collection and handling from your diagnostician.

2.16.2.5. Weeds

Reproduced below is a set of guidelines for collecting and submitting plant specimens, as recommended by the Australian National Herbarium. The Herbarium's website address is <http://www.anbg.gov.au/cpbr/herbarium>. At the time of writing, these details were stored at <http://www.anbg.gov.au/cpbr/herbarium/collecting/collection-procedures.html>.

Collecting

Select vigorous, typical specimens. Avoid insect-damaged plants.

Specimens should be representative of the population, but should include the range of variation of the plants. Roots, bulbs, and other underground parts should be carefully dug up, and the soil removed with care.

Make sure the specimen includes flowers and/or fruits. It may be a good idea to collect extra flowers and fruit for identification purposes.

In collecting large herbs, shrubs and trees, different types of foliage, flowers and fruits should be collected from the same plant. Collect sufficient material to fill a herbarium sheet (c. 450 × 300 mm) and still leave enough room for the label. Plants too large for a single sheet may be divided and pressed as a series of sheets.

Bark and wood samples are often desirable additions when collecting woody plants. There are special requirements for the identification of some plants. A Eucalyptus specimen, where possible, should include mature leaves, juvenile leaves, buds, fruits, and bark.

Other general hints for collecting are:

- Bulky plants or parts can often be halved or sliced before pressing. Odd fragments—bark, fruits or seeds—should be kept in numbered or labelled envelopes or packets with the main specimen.
- Very bushy twigs should be pruned to make a flatter specimen, in such a way that it is obvious where pieces have been broken off.
- With spiny plants, first place the plant under a board and stand on the board before pressing, to prevent the spines tearing the paper
- Succulent plants need to be killed first by soaking in methylated spirits for 15–20 minutes. Bulbs should also be killed, or may sprout on the herbarium sheet!
- Water plants must be floated out in a dish of water and lifted out on a sheet of stiff white paper slipped under them in the water; dry excess water, then press the plant in the usual way leaving it on the white paper on which it can remain permanently stuck. A piece of waxed paper over the top of the plant will prevent it adhering to the drying paper.
- Tall rosette plants and grasses may be pressed complete by bending them once or more into the shape of a 'V', 'N' or 'M'.
- Dioecious plants should be represented by both sexes.

- Palms—several herbarium sheets are necessary to show the various portions of the leaf, inflorescence and fruit of these species. Photographs of the tree and of each part are essential.
- Cones of some gymnosperms and Pandanaceae may need to be enclosed in a wire mesh to prevent them falling apart.

Pressing and care of specimens

Specimens should be pressed as quickly as possible after collection. If this is not possible, specimens may be stored in plastic bags, preferably wrapped in damp (but not wet) papers. Bags should not be packed tightly, and should be kept cool and moist. Make sure that each bag is correctly labelled for locality.

Place each specimen, with numbered tie-on tag attached, in a fold of several sheets of newspaper, and place in the press. If necessary, occasionally add a sheet of corrugated cardboard to act as a ventilator. As you fill the press, try to keep it level to allow even distribution of pressure. This may mean the use of alternate corners of the fold for bulky roots and other parts, or packing around a bulky specimen with foam. Close the press and exert pressure with the straps.

The plants in the press should be dried fairly quickly, in a warm place if possible. The specimens must not be left in damp papers or they will go mouldy. It is therefore necessary to go through the press daily during the first few days and change the plants into dry newspapers. Then continue to inspect press daily and change newspapers as necessary until the plants are dry.

Delicate plants and petals may be lost in changing and should be kept in tissue-paper (e.g. 'Kleenex' or toilet-paper) folders throughout changes. A properly dried plant specimen is brittle.

2.16.3. Labelling specimens

Plan to label your specimens in the field, at least in a temporary fashion until later in the day when a full and appropriate label can be made. It can be very easy to confuse unlabelled specimens, especially after some time has passed.

2.16.3.1. Minimum requirements when labelling specimens

For specimens to be scientifically useful, a set of basic data needs to be recorded at the time of collection. According to ISPMs 6 and 8, records of pest specimens collected in the field need to include as much information as possible. The list of minimum requirements varies between the two ISPMs and so both are reproduced here (facing page):

- scientific name of pest and Bayer code if available
- family/order
- scientific name of host and Bayer code if available, and plant part affected or means of collection (e.g. attractant trap, soil sample, sweep net)
- locality, e.g. location codes, addresses, coordinates
- date of collection and name of collector
- date of identification and name of identifier
- date of verification and name of verifier
- references, if any
- additional information, e.g. nature of host relationship, infestation status, growth stage of plant affected, or found only in greenhouses. Reports of pest occurrence on commodities need not be so specific on locality or verification, but should refer precisely to the exact type of commodity, the collector and the date, and if appropriate the means of collection. Reports of new occurrences of pests should also include information on any measures taken, and such reports made available on request.

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- current scientific name of the organism including, as appropriate, subspecific terms (strain, biotype, etc.)
- life stage or state
- taxonomic group
- identification method
- year, and month if known, recorded; normally the day will only be required for specific circumstances (e.g. the first detection of a particular pest, pest monitoring)
- locality, e.g. location codes, addresses, geographical coordinates; important conditions such as if under protected cultivation (e.g. greenhouses) should be indicated
- scientific name of host, as appropriate
- host damage, or circumstances of collection (e.g. trap or soil sample), as appropriate
- prevalence, indication of the level of pest presence or pest numbers
- bibliographical references, if any.

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If you intend to submit specimens to a diagnostic laboratory or expert for identification, check with them about the type and format of details that must accompany specimens. The people who will identify the specimens are likely to have advice about how the specimen should be sent in terms of its state of preservation, temperature requirements and packaging. There is more information on packaging at Section 2.16.4, General guidelines for transporting specimens.

2.16.3.2. Unique identifiers for labelling specimens

Specimens need to be assigned a unique identifier that could involve numbers, letters or a combination of both. These need to be recorded both on (or with) the specimen and in your notebook.

Develop a standard numbering system that is logical for you. If you take duplicate specimens, your numbering system should be able to accommodate this.

For example:

F23S45Sp1b: this could mean field site number 23, sampling site number 45 and duplicate b of specimen 1. In your notebook and also on the label, you would include extra information about what specimen 1 is or might be.

AW200511235a: duplicate 'a' of the 5th sample collected on 23 November 2005 by collector AW. Arranged this way, the specimen numbers will always sort chronologically. Furthermore, there is no risk of using the number again at a future date.

2.16.3.3. Attaching labels to specimens

Where specimens are simply wrapped in paper, the specimen details (identifier etc.) can be written on the paper, as long as it is not going to be wetted and deteriorate.

Specimen details can also be written on firm paper with pencil or permanent/waterproof markers. Make sure the writing is allowed to dry before placing it with the specimen if it is possible that the specimen will sweat or is wet. The label can be attached by tying string through a hole in the paper and securing it to a sturdy part of the plant that will not fall off if knocked or squashed.

If the specimen is in a jar or container, the jar itself is best labelled rather than the lid as once lids are removed they can easily be mixed up. Alternatively, tape a paper label or use stickers to label the container.

If specimens are to be put into alcohol in a see-through container, a paper label can be placed in the alcohol before the specimen. In this case, the label needs to be written with a moderately soft, lead pencil (HB, B or 2B) or in India ink ensuring that the ink has dried well before placing it in the alcohol. The writing needs to be visible from outside the specimen container so the label needs to be facing outwards. Do not fold the label or place two separate labels that could end up lying face to face. Small labels that float around may also damage specimens. Do not completely fill the vial with alcohol as this may allow the specimen and the label to float freely, which may increase the chance of damage to the specimen.

If pests such as insects are pinned to a surface, attach the paper label with the same pin. The label should be made of paper that is heavy enough that it remains flat and does not rotate loosely on the pin.

If you are taking soil specimens, secure labels to both the inside and outside of the specimen bag.

Microscope slides can be labelled with small stickers on the upper side of the slide, away from the specimen itself. Stickers could also be placed exactly beneath the top label on the underside of the slide, but it is important that nothing is under the specimen or it will not be possible for it to be examined under a microscope as the label will block the light.

2.16.4. General guidelines for transporting specimens

If you are transporting the specimens with you, it will be easier to ensure that they are being properly protected. If the specimens need to be sent by a shipping or postal service, greater care will need to be taken in packaging them to cope with possible mishandling during transport. Keep in mind that transport may take a few days.

If you are sending specimens to a laboratory or specialist, discuss with them how to package the specimens, when staff will be there to receive them and any other requirements they have about the preparation and transport of the specimen. Check if there are any specimen submission forms that need to be completed and despatched with the package.

Take extra care when dealing with the following:

- **Live pests.** These will require ventilation, so ensure that air can get in and the pest cannot get out. Keep plant specimens alive by wrapping in slightly damp paper and sealing in a plastic bag. Ensure that the specimens will be protected from extremes of temperature on the journey.
- **Glass or breakable containers.** These need to be packed carefully so that the glass does not touch other glass or hard surfaces and break. Such containers can be protected by packing them into a second container that is at least 2.5 cm larger on all sides, with packing material placed in the gap.
- **Multiple specimens.** If two or more specimens are to be packaged together, make sure that each is well labelled.
- **Specimens preserved in alcohol.** The containers need to be leak-proof.
- **Timing.** Submit specimens as soon as possible after collecting.
- **Postal or courier service requirements.** Check whether the postal or courier system has restrictions on sending particular volumes of alcohol, pests, container types or anything else you might think is relevant to what you are sending. This might avoid having the specimens confiscated or destroyed.

2.16.5. Special considerations when collecting a new exotic pest

As some new exotic pests pose a great threat to industry or natural environments, extreme care must be taken when a pest is first sighted or suspected to be present. If the pest has windborne spores or is a winged insect, it may be best not to disturb it as it may spread further. If a specimen needs to be collected, additional hygiene and containment steps should be taken.

It may be critical to adhere to the following instructions to ensure that a clear chain of evidence is established about the possible movements of high biosecurity risk pests, in case the pest escapes.

The instructions below refer to pests that could stick to collecting equipment, vehicles or people. For some pests, such as new fruit flies, these steps would not assist in containing the pest.

1. Leave vehicles outside the infested area.
2. Sterilise all collecting equipment before and after collecting at each site.
3. Proceed through your survey site from parts least likely to be infested to those most likely.

4. Ensure all specimens collected are well-secured and contained.
5. Do not throw away specimens that may have been cross-contaminated with a possible exotic pest. Label these specimens clearly so they can be destroyed appropriately.
6. If vehicles have been in the infested area and the pest could have adhered to the vehicle (such as seeds, pathogens in soil or fungal spores), disinfect vehicles where possible using a pressure wash with detergent within the infested area to reduce the likelihood of transporting the pest. To pressure wash vehicles in an emergency, refer to Case Study J (Section 8.11). That case study also describes personal disinfection equipment that can be carried.
7. Clothing: consider using disposable clothing such as overalls, boot covers and gloves. When you have finished at the site, place disposable clothes in a sealed bag. If the clothes can be sterilised by autoclave, use autoclave bags where possible. Use a fresh set of clothes at each survey site where the exotic pest has been found. Instead of disposable boot covers and gloves, shoe soles and hands can be sprayed with methylated spirits.
8. If the specimen is to be sent to a laboratory:
   - Pack it securely.
   - Label the package with:
     - the recipient's name, address and telephone number
     - the sender's name, address and telephone number
     - the message 'Urgent—suspect exotic plant pest specimens, keep cool'.
   - Include a covering note to the diagnostic facility outlining that the specimen is a suspect exotic pest, and indicate what you suspect the pest might be.
   - Control of the specimen must be formally passed on to each person in the chain; for example, the courier must sign for the specimen on receipt and then obtain a signature from a specified person on delivery.
   - Do not send live insects unless specifically required for identification (such as fruit fly larvae in fruit)
   - Notify the laboratory that you will be sending them a suspected exotic pest and arrange for someone to be available to collect and identify the specimen.

Step 14

- ▶ Record what types of specimens you would collect if the pest is found.
- ▶ Record how you will label the specimens.
- ▶ Record how the specimens will be prepared, treated and identified.
- ▶ Create a list of things that you will need to take when surveying.

2.17. Step 15. Electronic data storage

Irrespective of whether the data are collected in notebooks or on forms, if the numbers need to be analysed statistically or a report has to be written, the information will need to be transferred into a computer program of some sort.

You may wish to have a database program created for your survey if you have access to such resources, particularly if the survey is to be large and data entry will be repetitive.

If you think about what you will enter the data into and plan the structure of that spreadsheet or database in relation to the form and structure of notes in your notebook, it could save you and your team a lot of time and energy.

If you organise a structure before you go out into the field, it may be possible to take along a laptop computer with the program on it, so that data can be entered on-site, or after the surveying is completed for the day. A personal digital assistant (PDA) such as a Palm Pilot can also be used if available. PDAs are hand-held computers that can communicate with laptops and desktops, and are equipped with a GPS system to keep track of the user's position (latitude and longitude) to an accuracy within a few metres. They can be programmed to function as an electronic notepad form with fields to capture all the information a surveyor needs in relation to each field observation and any samples collected. The information can then be uploaded to a database in a computer on return from the survey without any need to key in the data. Otherwise, the data can be entered from paperwork when you return to your workplace.

Data need to be saved securely. Create backups of the data and keep the copies physically separate, such as on another computer or on disks or CDs and in other locations. Consider scenarios of the computer crashing and of the building catching fire or being otherwise destroyed. Ensure that the file names for backup copies are well labelled with dates or stages of the data entry that they contain and create backup copies at least weekly, or daily during the data-entry phase. Loss of even one day's data entry can be frustrating to have to repeat, and may increase labour costs.

Step 15

- Design a spreadsheet or database in which to electronically store the data.
- Decide how you will create backup copies of the data and how often you will do so.

2.18. Step 16. People

It is likely that you will have had to involve other people already if you are preparing a survey plan according to these guidelines. In step 2, Chapter 2, you will have identified experts capable of identifying the pest and laboratories where any specimens would be sent.

If your survey plan involves a statistical component, you may need to involve a statistician. You will also need to think about who will be in the survey team that goes out in the field. Consider how experienced they are in recognising the pest and if they will need training. The team will need to be informed of the whole process, including the standard methods that will be used to identify and record pests.

If you will have both men and women on your team, ensure that suitable toilet and accommodation facilities are available for everyone. You may need to consider religious, medical and dietary needs of the team members, especially if they are to be away from their home and workplace for days. You may need to ensure personal security and safety; for example, ensuring that there are always at least two people surveying in isolated situations such as forests or cargo bays in ports, and that first aid kits are available for bites, cuts and stings. Some sites may be hazardous and require special attention; for example, when heavy equipment or harvesting vehicles are present in the same area. You will need to be aware of any disabilities that a team member may have, such as poor hearing or impaired mobility, because they will need special care when around noisy or fast-moving machinery. Consider allergies of the team members and be appropriately prepared. If you will be using vehicles, be aware of the type of drivers licences that the team members have.

> Personnel involved in surveys should be adequately trained, and where appropriate audited, in sampling methods, preservation and transportation of samples for identification and record keeping associated with samples.
>
> **ISPM 6**

The size of the team may also affect morale and productivity. Having three or more members can help to keep motivation high. When members are looking for one or two pests continuously and the pests are rare or absent, consider adding additional things for the teams to look for. Keeping a record of the potential hosts (numbers and distribution) also provides positive activities that can maintain interest. Looking for and recording the status of other established pests or endangered plant species are other useful complementary activities that also maintain interest.

People's skills can be tested before going into the field, or during a pilot study. Tests of accuracy in identification can be created from photos of pests of similar appearance to the target pests or preserved specimens with the labels concealed.

Keep in mind that if the team is working long hours, and especially if the pest is mostly absent, people can become tired and bored, and their ability to observe may be lowered. If the terrain is rough or hilly, consider rotating those who will survey in the less-accessible sites. Consider planning to perform fieldwork in the mornings and processing and data entry in the afternoons, or break up the tasks in some other convenient way.

Box 8. What equipment to take along

Below is a list of equipment for you to consider taking on field trips. If you will be staying in temporary accommodation for the field trip, you may need to take extra equipment, particularly if you need to culture or preserve the samples during the trip. The list was compiled on the basis of advice from a number of people who have performed surveys.

Personal items

- Hat
- Light raincoat
- Snake-proof boots and pants
- Drinking water and food; e.g. glucose in the form of hard lollies etc.
- Mosquito repellent; fly spray can also be used on plant specimens to kill or deter insects on the specimens
- Sunscreen cream
- Sunglasses
- Bandages
- Watch
- First-aid kit: standard items plus bite cream, paracetamol, anti-diarrhoeal medication, anti-allergy tablets, antiseptic swabs, rehydrating drink sachets, chlorine water-purifying tablets, small screwdrivers, scissors, gloves and forceps
- Mobile phone with a local SIM card
- Photocopy of passport if a team member is a foreigner
- Spare clothing if surveying for quarantinable pests

Pest information sheets or pest field guide

- For more information as to what should be on pest information sheets see Section 2.4, Step 3 Identify target pests.

Recording data

- Waterproof/alcohol-proof pens/permanent markers (but not ball points) and moderately soft lead pencils (HB, B or 2B)
- Field notebook. If you use a duplicating notebook, you can record the specimen information, tear out one copy to keep with the specimen and then maintain a record of what was collected
- Waterproof paper may be needed to write on when it is raining

Specimen-collecting equipment

- Collectors tags, acid-free paper if possible
- Plastic and paper bags
- A magnifying glass/hand lens on a chain can be convenient

- Specimen tubes
- Preserving alcohol, well-sealed with a rubber top stopper (e.g. typically 70–90% ethanol)
- Fibre-free tissue
- Parafilm
- Tweezers/forceps/scalpel
- Camera
- Small pair of binoculars
- Secateurs
- Spade
- Hand-held geographic positioning system (GPS) unit that records date, time and location

SPECIAL NOTES on GPS units:

GPS units report coordinates in different ways. For example, it could be in terms of degrees, minutes and seconds or as a single number in decimal degrees. Check that any collaborative survey teams are reporting in the same unit and that the unit is acceptable to any database that the GPS reading may be entered into.

As people often fiddle with units, the coordinates can be incorrect. It is best practice to check all GPS units being used for a survey at the same spot and at the same time on each day of the survey. In this way, it will quickly become apparent if one or more have errors and need recalibrating.

- Maps
- Compass
- Diagnostic keys (identification, surveying, disease/pest rating scales)
- Collection permits, documentation of your permission to survey, permits needed to transport specimens overseas if needed
- Penknife (on a chain)
- Non-rubber household gloves/gardening gloves
- Random number generator (pack of cards, dice, calculator, stats table…)
- Cigarette lighter
- Whistle
- Disinfectant wipes (for cleaning tools to avoid cross-contamination, or cleaning hands before eating)
- Large handkerchief/hand towel
- Measuring tape
- Spray paint (for marking trees, landmarks etc.)
- Brightly coloured ribbons/tape

- Trowel or spade
- Plastic bags of various sizes—plastic zip-lock bags can be handy
- Machete
- Cardboard boxes
- Portable icebox (e.g. 'Esky' or 'chillibin')
- Small buckets (e.g. to carry intact soil samples with plants)

Survey bag

- This should preferably be waterproof and non-leather, and have a long shoulder-strap. Back-pack type bags are generally unsuitable, because it is difficult to load and to retrieve items from them. The bag should have one or two main sections with lots of little pockets.

Extra items for foresters

- A hammer and chisel are invaluable for extracting small blocks of wood/bark from the stem/roots (a 25-mm chisel is a good size). Alternatively, a half axe kept sharp can also be used to extract wood/bark chips for culturing.
- A small combination pick/mattock is better than a trowel for examining the roots of trees.
- A pruning saw (ideally the folding type) is particularly useful for trimming specimens to manageable sizes.

Note: A compact version would include a sturdy knife that has a blade strong enough to prise out bits of wood/bark, a folding pruning saw, secateurs, plastic bags, permanent pens, a GPS unit, a digital camera, binoculars, a compass and a notebook.

Extra items for other plant specimens

- Water spray—use where plant specimens are to be kept alive
- Sturdy plant press. If you are visiting more than one site, use a thin or smaller one in the field and have a second one to which you transfer the specimens after surveying.
- Newspaper
- Corrugated cardboard
- Scissors, tape and clear plastic bags if using the ethanol technique (see also Section 8.21, Case study T)

Extra items for entomologists

- Sweep net
- Pooter or aspirator
- Lures or traps
- Mounting boards and pins for insects

Cottonwool to place in tube with live insect to prevent damage in field

Extra items for plant pathologists

- Spade and sieve for nematodes
- Razor blades and scalpels to section plant material for culturing
- Culture plates
- Parafilm to seal plates
- Specimen pots
- Calcium chloride chips to act as a desiccant
- Ethanol
- Ethanol flame lamp to sterilise scalpels, tweezers etc.

Wet or windy weather can be demoralising if the team is not well prepared with appropriate protective clothing, footwear, writing material and a sheltered place in which specimens can be labelled and bagged.

2.18.1. Checking for consistency in diagnostic skills of surveillance team members

To assess if people in the team similarly observe and record pests, begin by selecting five or more infested plants or fixed areas (such as for weeds) and number them. Each team member then assesses all the plants, recording details per plant on their own. Compare the results between people, both per plant and as an average over the five (or more) plants. If there are differences in the records, inspect the plants together to develop a consensus on the results. Repeat the process with new plants or sites until consistent results are obtained within the group. If there is debate concerning the diagnostic characteristics, seek further information about their appearance for the given conditions.

See also Box 6, Validating data collected by viewing from a distance, on page 48.

Step 16

- ▶ Record the members of survey team.
- ▶ Organise information and training for the team.
- ▶ Record other people who will be involved in the design, data analysis, pest identification or any other part of the survey.

2.19. Step 17. Obtaining permits and access permission

Consider whether you will need to seek permission to visit islands, villages, communities, forests or farms where you intend to survey. You will need to inform and involve people, as appropriate, particularly those in charge of the area. You will need to tell them on what dates you would like to visit and give them a clear explanation of what you will be doing and any possible ramifications for them. The timing may clash with cultural events and so access may be denied. It is possible that you will not be given access when you arrive, even if you have been given permission, because unexpected events can arise, such as a funeral procession. You may need to reconfirm permission before leaving.

You may need to obtain a visa to enter a country or island, and you may need to obtain quarantine permits for international transfer of specimens collected.

Be aware that you may not receive an immediate response and that you should check how long requests normally take to process.

You will need to allow ample time to receive these permissions and permits before your intended field trip.

Step 17

- Record what sort of permits and permissions will be needed, and who to seek them from. You may wish to note the time frames for permission to be obtained.
- Begin seeking permissions when appropriate.

2.20. Step 18. Pilot study

A pilot study involves going out to the survey site to reconnoitre—that is, to have a look at the site, or a few of the sites, to meet and inform all the people involved, to examine the conditions of accommodation and transport, and to practise surveying, collecting and transporting specimens from a site. If there is an opportunity for at least one member of the team to perform a pilot study, it can be a valuable way of increasing the quality of data obtained during the real survey. Problems encountered during the pilot study can be overcome, particularly with the help of local knowledge. You will be able to have much clearer communication with the people involved and it may be the only way to introduce yourself and your survey to the people from whom you need to seek access permission.

A pilot study can include a structured component; for example, what the expected prevalence of the pest would be. Experiments on team members' ability to detect pests could be performed in this time (see Section 2.18, Step 16 People; and Section 2.12.3.11, Drive/walk through surveys).

Step 18

- Perform pilot study.
- If you perform a pilot study, add the new information found to your survey plan.

2.21. Step 19. Performing the survey: collecting data and specimens

You and your team should now be equipped with enough plans, information and tools to carry out the survey. Good luck!

Step 19

- Perform survey.
- Collect data in the field.

2.22. Step 20. Analysing data

After your survey, you will have a set of forms or data that will be 'raw'—that is, not processed or analysed as a whole, even if all the data are zeros.

The data can be used to:

- calculate basic statistics, such as the average and total numbers of pest
- estimate the confidence of the data collected (see Section 2.13.1.4, Confidence)
- create a map of the pest distribution
- examine changes in pest locations and densities if monitored over time.

Step 20

- Store, tabulate and analyse the survey data.

2.23. Step 21. Reporting the results

As reporting requires particular attention, step 21 is covered in Chapter 7.

2.24. Where to from here?

Chapters 3, 4, 5, 6 provide extra information about detection surveys, monitoring surveys, delimiting surveys and general surveillance, respectively. Use the table of contents at the start of these guidelines to find the type of survey information you require.

Specific surveys may be detection, delimiting or monitoring surveys. These are official surveys and should follow a plan which is approved by the NPPO.

The survey plan should include:

- definition of the purpose (e.g. early detection, assurances for pest free areas, information for a commodity pest list) and the specification of the phytosanitary requirements to be met
- identification of the target pest(s)
- identification of scope (e.g. geographical area, production system, season)
- identification of timing (dates, frequency, duration)
- in the case of commodity pest lists, the target commodity
- indication of the statistical basis (e.g. level of confidence, number of samples, selection and number of sites, frequency of sampling, assumptions)
- description of survey methodology and quality management including an explanation of
  - sampling procedures (e.g. attractant trapping, whole plant sampling, visual inspection, sample collection and laboratory analysis); the procedure would be determined by the biology of pest and/or purpose of survey
  - diagnostic procedures
  - reporting procedures.

ISPM 6

Chapter 3

More about detection surveys

Detection surveys are possibly the most common surveys performed. They involve looking for pests not known to be present. The ISPM definition is simply:

> A survey conducted in an area to determine if pests are present
>
> **ISPM 5**

As the ISPMs separate all surveys into detection, monitoring and delimiting surveys, Chapters 3, 4 and 5 have been written to align with these definitions. Both delimiting and monitoring surveys involve surveying pests that are known to be present. Therefore, any monitoring of the *absence* of a pest, is classed as a detection survey until the pest is detected.

By definition, detection surveys include surveying to develop pest and host lists (where it is not known which pests are present), as well as surveying to support pest free areas (PFAs), pest free places of production (PFPP) or pest free production sites (PFPS).

Detection surveys also include surveys of crops and forests for early detection of pests to minimise the chance of pest incursions and permit crop/forest management.

3.1. Surveying to develop pest or host lists

There are a few reasons why you might want to develop a pest or host list. Pest lists for a host or location can be used in crop management to develop a baseline of pests present in a crop or at a site. Lists are also used in pest risk analyses that form part of the negotiations in accessing international markets (see ISPM 11).

Host lists for targeted pests can provide information on alternative hosts. This can permit better pest management of crops if there are alternative host plants or sites that need to be dealt with in nearby sites or verges. The knowledge of alternative hosts can be used to determine whether a pest could pose additional risk to other crops or native vegetation in the importing country.

3.1.1. The role of pest records in pest lists

Pest lists are a compilation of any pests recorded in the area of interest. Records are usually taken from publications and reports such as NPPO records, pest surveys, research reports, journal articles and the web-based CABI Crop Protection Compendium.

Pest lists are required for pest risk analyses that are undertaken as part of negotiations for market access. Trading partners with agricultural industries at risk of exotic pests may require evidence that the pest list is accurate and reliable. Pest records will typically be the basis of the evidence provided and so can be a determining factor in whether or not market access is granted.

Pest records have a basic set of information that needs to be provided. These are set out in ISPM 8 and are reproduced in Chapter 2, at step 14 (Section 2.16). The standard provides guidance on how to assess the reliability of any pest records found. The records should be assessed in terms of the level of expertise of the collector/identifier of the pest, the techniques used to identify the pest, the conditions in which the location and date were recorded (more value is given to formal surveys than casual observations) and the publication in which the record appears (more value is placed on NPPO records and scientific journals than in unpublished documents and personal communications).

The standard also places value on specimens that have been submitted to an official[10] or general collection—a herbarium, plant pathogen herbarium or insect and allied forms collection, where a specialist will verify the identity of the pest—in addition to the recording of the details associated with the specimen.

Pest records that are linked to a specimen maintained in an official collection will provide strong evidence that the pests listed were correctly identified, as the specimens can always be viewed by others, such as trading partners, who may require confirmation.

It has been argued that pest records that do not have a specimen to verify the pest identity should be termed a 'pest report' to distinguish the quality of the observation.[11]

Pest records collected during a survey are well regarded. Certainly, pest records collected during detection, delimiting or monitoring surveys would be acceptable. However, a survey could be designed and performed specifically to increase the number of pest records for a targeted area, such as to develop a pest list for a host plant, or a host list for a targeted pest.

According to ISPM 6, NPPOs or institutions designated by an NPPO should act as a national repository for plant pest records.

Other sources of information to help identify which pests are associated with host plants are detailed in Chapter 2 at step 3 (Section 2.4).

10 The ISPM does not specify what deems a collection to be 'official' or 'general'.

11 This is not to be confused with the ISPM definition of 'Pest report' applied in ISPM 17 which is used in the context of NPPOs reporting a phytosanitary barrier breach to trading partners.

3.1.2. Pest list surveys

A pest list survey involves rigorously and intensively examining the targeted hosts for any pests. Like other surveys, follow the steps described in Chapters 2 and 7.

Steps 1 to 4

Complete these steps.

Step 5

Not applicable. Alternative hosts cannot be predicted or surveyed until the pests are known.

Steps 6 and 7

Complete these steps. ISPM 4 requests additional details in the description of the area. Include the size, degree of isolation and the ecological conditions. If the targeted area is large, surveying will need to examine the range of ecological or climatic zones and all production areas.

Steps 8 and 9

Complete these steps. The districts surveyed must cover all the major growing areas for the host.

Step 10

Possible survey designs are blitz surveys (Section 2.12.3.2) and full sampling (Section 2.12.3.3), which may need to be supplemented with insect trapping (Section 2.12.3.8). These may need to be performed at a number of targeted sites.

Step 11

See Section 3.1.4, Species accumulation curves.

Step 12

Examine the plants (or among the plants if targeting weeds) at different times of the year and different stages of the host life cycle.

The timing is particularly important when developing pest lists as it is critical that host plants be examined throughout their life cycle—different pests prefer different stages of the host development. The minimum stages of development that should be surveyed are:

- seedling emergence
- vegetative flushing stage
- flowering stage
- fruiting and seeding stage.

Consider examining the host plants under different weather conditions.

Steps 13 and 14

Specimens should be collected, with details recorded in accordance with ISPM 8, and submitted to an official collection.

Examine for pests on different parts of the host plant—roots, stem, leaves, buds, flushes, fruits, seeds and any other parts—and the soil in the root zone.

Steps 15 to 17

Complete these steps.

Step 18

You may decide that you do not need to perform a pilot study especially if the survey is to be short and intense.

Step 19

Complete this step.

Step 20

As the purpose of the survey is to generate a list of pests, there is no analysis of data required, unless you wish to assess a related aspect such as a cost–benefit assessment relating time expended to the value of the data generated.

Step 21

Publication of the list in a journal or technical report is encouraged. This will not only add to the validity of the list, but also make it more widely available.

3.1.3. Example pest list case studies

The following case studies are in Chapter 8.

Case study A

Sugarcane pests in Papua New Guinea, Indonesia and northern Australia

Case study B

NAQS and SPC early detection and pest list survey design for plant pathogens

Case study C

Pest status and early detection survey for shoot borers in mahogany and cedar trees

Case study D

Urban pest status survey in Cairns

3.1.4. Species accumulation curves (when is the list 'finished'?)

Because it may be unclear how much sampling you need to do before your pest list is 'rigorous', the concept of species accumulation curves has been developed to help make this decision. The idea is that, after looking at a number of quadrats, the number of new species added to the list will be fewer and the increasingly smaller amounts of information gained need to be weighed against the effort.

The sequential sites need to be chosen by random selection so that they are unlikely to cluster together.

If there are different parts of the field site that could affect how pests are distributed (for example, is there a fence line or creek along any of the edges, are there higher or lower parts of the ground, is there a slope?), then stratify the field site into sections of trees or area in square metres dividing up the different sections of the field site, and assign host plants or subunits of area an identifier so that locations for the survey sites can be selected.

A species accumulation curve is used to determine the number of sampling sites you need to survey. The process requires recording the number of new pests collected at each new site, then plotting the accumulated number of pest species—with sites across the X axis and number of pests along the Y axis (Figure 4). The number of new species will eventually decline with the increasing number of sites examined.

A curve of best fit is then added to the data points. When the curve has flattened for say, five consecutive sampling sites, i.e. when no or few species are added with each additional site, the survey is complete.

This exercise will probably need to be repeated in different production areas or districts if there is reason, such as different climates, to suspect that the pest list may vary from site to site.

Species accumulation curves can also be drawn for the one location but over time. This means that you would plot the number of new pests on the Y axis against time intervals on the X axis. You may wish to do this if the pest distribution on a given host is seasonal.

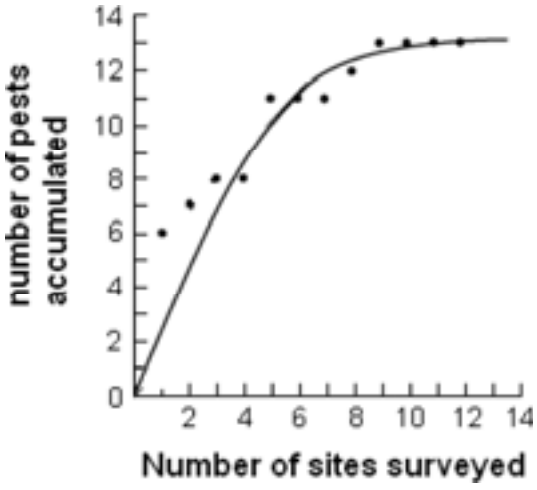

Figure 4. Species accumulation curve; returns versus sampling effort

3.1.5. Host lists and pest records

Host lists can be important to trading partners if they suspect the pest could pose a risk to a number of crops or to native vegetation as well. Host lists are also useful in pest management if multiple hosts grow near each other. In some cases, alternative hosts, such as weeds growing around fields, can present niches where a pest can survive during the months between host crops.

Pest records can be used as a basis for developing a host list for a pest. For pest lists to be useful in developing a host list, they must have information on the hosts and be searchable on this basis. Clearly, pest records that are held on searchable databases would speed up the process.

Performing a specific survey to build a host list for a pest—that is, examining many plants to determine which the pest interacts with—would be a difficult task in most circumstances. The plants surveyed could be restricted to crop plants, but this would not provide information on weedy or native alternative hosts. As a result, host lists would usually be built from general surveillance based on publications and other pest records.

3.1.6. Pest record databases

Some regional databases of pest records have been established.

- The Pacific Pest List Database developed by the SPC for the 22 Pacific Island countries and territories for their own use to facilitate trade and pest management.
- CABI Crop Protection Compendium, developed by CABI International. This can be bought online from the CABI website at <www.cabicompendium.org/cpc>.

3.1.7. Published pest lists

NPPOs are likely to have the most information on published pest lists and so you could check with them. Here are a few that are available to the public.

- Anon. 2000. List of potential plant pests already reported in Indonesia. Ministry of Agriculture, Centre for Agriculture Quarantine.
- Waterhouse, D.F. 1993. The major arthropod pests and weeds of agriculture in Southeast Asia. Canberra, Australia, ACIAR. This is provided free to developing countries.
- Waterhouse, D.F. 1997. The major invertebrate pests and weeds of agriculture and plantation forestry in the southern and western Pacific. Canberra, Australia, ACIAR. This is provided free to developing countries.

- Henty, E.C. and Pritchard, G.H. 1988. Weeds of New Guinea and their control, 4th ed. Lae, Papua New Guinea, Department of Forests, Botany Bulletin No. 7.
- Li Li-ying, Wang Ren and Waterhouse, D.F. 1997. The distribution and importance of arthropod pests and weeds of agriculture and forestry plantations in southern China. Canberra, Australia, ACIAR. This is provided free to developing countries.

3.2. Surveys to determine pest free areas, places and sites

3.2.1. Pest free area status

Pest free area (PFA) is a term that can be applied to an area of any size that is free of a pest. The term is used when negotiating and maintaining international market access.

The ISPM definition is:

> An area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained.

This statement points out that the exporting country is responsible for scientifically demonstrating that the area is free of the specific pest. Article 6 of the SPS Agreement states that any importing country has the right to ask for this evidence.

Pest free area status has the benefit that it

> … provides for the export of plants, plant products and other regulated articles… without the need for application of additional phytosanitary measures when certain requirements are met.
>
> **ISPM 4**

3.2.2. Pest free places of production and pest free production sites

If pest free status is not possible for an entire area, the status can still be established for particular places and sites within an area as alternative risk-management options for meeting phytosanitary requirements. The terms used are pest free places of production (PFPP) and pest free production sites (PFPS), where PFPS are located within a place of production.

> The concept of a pest free place of production can be applied to any premises or collection of fields operated as a single production unit. The producer applies the required measures to the entire place of production.
>
> Where a defined portion of a place of production can be managed as a separate unit within a place of production, it may be possible to maintain that site pest free. In such circumstances, the place of production is considered to contain a pest free production site.
>
> **ISPM 10**

> This standard uses the concept of 'pest freedom' to allow exporting countries to provide assurance to importing countries that plants, plant products and other regulated articles are free from a specific pest or pests and meet the phytosanitary requirements of the importing country when imported from a pest free place of production. In circumstances where a defined portion of a place of production is managed as a separate unit and can be maintained pest free, it may be regarded as a pest free production site.
>
> Where necessary, a pest free place of production or a pest free production site also includes the establishment and maintenance of an appropriate buffer zone.
>
> **ISPM 10**

Having a defined PFPP can have the additional advantage that, if it or a series of PFPPs are located within a PFA and the pest is detected, it is possible that some or all of the PFPPs can maintain their pest free status. The importing country may, however, require verification of their pest free status.

> The choice of a pest free place of production or pest free area as a management option will depend on the actual distribution of the pest concerned in the exporting country, on the characteristics of the pest and on administrative considerations. Both systems can offer adequate phytosanitary security: the main security of the pest free area lies in the common application of measures to an area covering many places of production; the main security of the pest free place of production arises from the fact that management procedures, surveys and inspections are applied specifically and intensively to it.
>
> **ISPM 10**

3.2.3. The role of surveys in determining PFAs, PFPPs and PFPSs

Surveys are only one component in the process of establishing and maintaining pest free status, as stated below:

> Three main components or stages are considered in the establishment and subsequent maintenance of a PFA:
> - systems to establish freedom
> - phytosanitary measures to maintain freedom
> - checks to verify freedom has been maintained.
>
> The methods used to achieve these components may include:
> - data assembly
> - surveys (delimiting, detection, monitoring)
> - regulatory controls
> - audit (review and evaluation)
> - documentation (reports, work plans).
>
> **ISPM 4**

The results of surveys will not be the sole determining factor for establishing a pest free area status. A systems approach—essentially an integrated pest management process—will be necessary (see ISPM 14). The example provided at Box 10 (page 97) of conditions imposed by an importing country on an exporting country illustrates the types of components in a system that may be required to maintain pest free area status.

In accordance with the definitions of the different types of specific surveys defined at the start of this chapter, the surveys used would primarily fall into the category of a detection survey as the pest is expected not to be present. ISPM 4 states that the surveys used in establishing pest free area status may include delimiting and monitoring surveys. These surveys become necessary when a pest is detected—a delimiting survey would be used to determine the extent of the pest incursion and monitoring surveys would then be put in place to determine changes in the pest population, such as during an eradication program. Once the pest is eradicated from the area, the survey would revert to being a detection survey. This does not mean that pest free area status will automatically return, as there may be stipulations, such as the area must be pest free for 2 years, before the pest area status can be reinstated.

Surveys can also be used to delimit the area that is free of a pest, once pest free area status has been established (see Chapters 6 and 7 for more on delimiting surveys and monitoring surveys). This section will discuss surveying only in the circumstance in which the pest is thought to be absent from the area or site.

3.2.4. Designing a survey to establish a PFA, PFPP and PFPS

A few standards have been developed for surveillance of specific pests, but these are mostly from the North American Plant Protection Organization for its region. The standards target citrus canker, fruit flies and karnal bunt. For more information, see Box 9 below. There are also many bilateral agreements in place for pest free areas and pest free places of production. Your country may have applications that could be the basis for any new applications.

For all other surveys, the design will encompass the steps outlined in Chapters 2 and 4. Remember that the importing country will need to approve any survey protocols used, and the maintenance of a pest free area status may be audited by the importing country to verify that the pest is indeed absent.

Box 9. Pest-specific standards

Citrus canker

There is a draft ISPM for citrus canker: Guidelines for surveillance of specific pests: *Xanthomonas axonopodis* pv. *citri* (citrus canker) (2002 CEPM draft standard). This draft standard describes a specific survey plan for determining the presence or absence of citrus canker (e.g. in the establishment and maintenance of pest free areas).

Fruit flies

- Draft RSPM No. 3. Requirements for the establishment and maintenance of pest free areas for tephritid fruit flies. APPPC.[12]
- Draft RSPM No. 4. Guidelines for the confirmation of non-host status of fruit and vegetables to tephritid fruit flies. APPPC.[12]
- RSPM No. 10: Surveillance for quarantine fruit flies (in a portion of a generally infested area). This standard deals with the surveillance requirements for verifying and permanently maintaining fruit-fly-free areas within a generally infested area. NAPPO.
- RSPM No. 17: Guidelines for the establishment, maintenance and verification of fruit fly free areas in North America. This standard outlines procedures to establish, maintain and verify fruit-fly-free areas in North America. It provides measures to manage the risk of introduction and establishment of the pest, criteria for monitoring fruit flies, quarantine operations and emergency planning. NAPPO.

Karnal bunt

RSPM No. 13: Guidelines to establish, maintain and verify Karnal bunt pest free areas in North America. This standard provides guidance on the establishment, maintenance and verification of Karnal bunt PFAs and applies to seeds and grains of wheat, triticale and other hosts and regulated articles. NAPPO.

[12] At the time of publication of these guidelines, this standard had not been finalised by APPPC member countries.

3.2.5. Pest free area survey design steps

Apply this additional information to the steps outlined in Chapters 2 and 7.

Steps 1 and 2

Follow steps 1 and 2 in Chapter 2, detailing the title and reason for surveying. At step 2, include the conditions that the survey must satisfy to obtain a provisional pest free status; no pests to be detected in two life cycles of the host, for example.

Step 3

Complete this step. When applying for PFPP and PFPS, the essential attributes of the pest are:

- spread needs to be slow and over short distances
- limited chance of the pest being spread artificially
- limited host range
- low survival rate between seasons
- slow or moderate rate of reproduction
- easy to detect
- effective and practical control measures are available.

Step 4

Additional information needs to be provided about hosts, beyond what would be detailed in other surveys. In essence, the host is the commodity being considered for export. While, for example, grains contaminated with weed seeds are not a 'host' of the weed seeds, provide information about the grain plants. You will have detailed the weed seeds in the pest section at step 3.

Provide information on the location and extent of host plants within the PFA in:

- commercial production areas
- home gardens
- amenity areas
- uncultivated areas, including weed and native species, and hosts that have escaped from cultivation.

It might be useful to prepare maps showing host distribution with respect to:

- geographic features (e.g. mountain ranges, waterways)
- roads and railways
- cities and towns,
- jurisdictional boundaries
- land-use types (commercial production, residential, cultivated and public-access areas),
- individual hosts, host types and host density.

The mapped area can be divided into sub-units based on these differences; such as geography, climate, land use or accessibility.

Step 5

This step may not be applicable, but include if necessary.

Step 6

Complete this step.

Step 7

For these surveys, the area becomes the proposed PFA, PFPP or PFPS.

> A 'pest free area [PFA]' is: 'an area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained'.
>
> **ISPM 4**

You will still need to provide details as to which country and region the area is in. The borders of the area need to be clearly defined and may include administrative boundaries (e.g. country, state or province, shire or county, address), physical features (e.g. rivers, roads, mountain ranges), and geographical coordinates.

PFPP and PFPS: If a buffer zone is involved, its size should be determined by the NPPO.

Steps 8 and 9

Complete these steps. PFPP and PFPS: The acceptable characteristics of the pest free place of production or production site are as follows:

- it needs to be at a single property
- it should have clearly defined boundaries, including any buffer zones
- it should be sufficiently isolated from possible pest infestations
- no other known hosts should be within the boundaries, including the buffer zone.

Step 10

This step will not be applicable where the survey is for PFPP or PFPS, as the sites will already be determined.

For PFA status surveys, you will need to choose a method of site selection. There are few applicable site selection methods. Comprehensive data will need to be collected to allow the level of confidence to be calculated. For example, drive-by surveys would not provide data that could be statistically tested.

Appropriate methods are:

- full sampling
- random sampling
- stratified random sampling
- systematic sampling
- flying insect trapping.

Step 11

This step will be appropriate for all applications, as within PFPPs or PFPSs commodities or other parts of the commodity-handling process will need to be sampled for pest contamination.

Step 12

Complete this step. Detail how often and how long surveys must be performed to maintain the PFA status. You will need to perform the survey at intervals throughout the year or the host's life cycle. The frequency might be adjusted according to the perceived risk of the site. For example, survey low risk sites twice per year, and high risk sites at least four times per year.

PFPP and PFPS: Depending on the circumstances, the importing country may require that pest free area status be verified for 'one or more years' before the year in which export would commence, or simply from the year of export onwards.

For buffer zones:

> 'Monitoring surveys should be conducted at adequate frequency over one or more growing seasons.'
>
> **ISPM 4**

Step 13

Complete this step. PFPP and PFPS: Surveying 'may be required' of the harvested commodity at the production site.

Step 14

This step will be appropriate only to PFPPs and PFAs if specimens are to be collected when the pest is observed.

Step 15

Complete this step.

Step 16

Complete this step. PFPP and PFPS: The NPPO is responsible for the surveys, inspections and any other systems needed to verify pest status. The surveys are to be carried out by NPPO personnel, or by people authorised by the NPPO.

NPPO must certify the management, technical and operational skills of the producer to prevent the pest entering the place or site and their ability to manage the pest if it was detected on site.

NPPO is to provide the producer with training in pest-management systems when necessary.

NPPO is also responsible for checking the regulations of the importing country and assisting the producer in establishing conditions that would lead to compliance.

Steps 17 to 21

Complete these steps.

3.2.6. Example PFA status case studies

The following case studies are in Chapter 8.

- Case study E: PFA status survey for khapra beetle in stored grain
- Case study F: PFA status survey of Queensland fruit fly and Mediterranean fruit fly
- Case study G: PFA status survey for dodder weed
- Case study H: PFA status survey for mango pulp weevil and mango seed weevil

3.2.7. Additional steps for PFA

You will also need to detail what happens if the pest is found, and what requirements there might be before a pest free area status can be reinstated.

If eradication has been undertaken, reinstatement of pest free status cannot start until there is compliance with:

- the criteria for provisional pest free status, which may be based on the life cycle of the pest (for example, no pests have been detected for two life cycles), plus
- the pest control measures being withdrawn because they prevent the multiplication and/or detection of the pest.

3.2.8. Additional steps for PFPP and PFPS

The verification stage also requires that the commodity be labelled throughout the export process so that it can be traced back to the pest free place of production or site and traced forward to point of sale. The labelling would be critical if the pest were detected and passed through the system, as it would enable the extent of spread to be identified by a delimiting survey and increase the chance of control and eradication of the pest.

3.3. 'Early detection' surveys

Surveys designed for the early detection of new or reappearing pests in an area can use a more straightforward design than those required to obtain PFA status. The design would again follow the steps laid out in Chapters 2 and 7, except that you would work through all of the steps.

There are no considerations that are specific only to early detection surveys that are not covered in the steps presented in Chapters 2 and 7.

3.3.1. Example early detection case studies

The following case studies are in Chapter 8.

- Case study B: NAQS and SPC early detection and pest list survey design for plant pathogens
- Case study C: Pest status and early detection survey for shoot borers in mahogany and cedar trees

Box 10. Example of conditions imposed by an importing country on an exporting country: tomatoes from Morocco and Western Sahara to the USA

Pink tomatoes may be imported into the United States from Morocco and Western Sahara under the following conditions:[13]

- The tomatoes must be grown in the provinces of El Jadida or Safi in Morocco or in the province of Dahkla in Western Sahara in insect-proof greenhouses registered with, and inspected by, the Moroccan Ministry of Agriculture, Division of Plant Protection, Inspection, and Enforcement (DPVCTRF).
- The tomatoes may be shipped from Morocco and Western Sahara only between 1 December and 30 April inclusive.
- Beginning 2 months before the start of the shipping season and continuing through to the end of the shipping season, DPVCTRF must set and maintain Mediterranean fruit fly (Medfly) traps baited with trimedlure inside the greenhouses at a rate of 4 traps per hectare. In Morocco, traps must also be placed outside registered greenhouses within a 2 km radius at a rate of 4 traps per square kilometre. In Western Sahara, a single trap must be placed outside and immediately adjacent to each registered greenhouse. All traps in Morocco and Western Sahara must be checked every 7 days.
- DPVCTRF must maintain records of trap placement, checking of traps, and any Medfly captures, and make the records available to the Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture upon request.
- Capture of a single Medfly in a registered greenhouse will immediately result in cancellation of exports from that greenhouse until the source of the infestation is determined, the Medfly infestation has been eradicated, and measures are taken to preclude any future infestation. Capture of a single Medfly within 200 m of a registered greenhouse will necessitate increasing trap density in order to determine whether there is a reproducing population in the area. Six additional traps must be placed within a radius of 200 m surrounding the trap where the Medfly was captured. Capture of two Medfly within 200 m of a registered greenhouse and within a 1-month time period will necessitate malathion bait sprays in the area every 7–10 days for 60 days to ensure eradication.
- The tomatoes must be packed within 24 hours of harvest and must be pink at the time of packing. They must be safeguarded by an insect-proof mesh screen or plastic tarpaulin while in transit to the packing house and while awaiting packing. They must be packed in insect-proof cartons or covered by insect-proof mesh or plastic tarpaulin for transit to the airport and export to the United States. These safeguards must be intact upon arrival in the United States.

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[13] US 7CFR319 Subpart—Fruits and Vegetables, Sec. 319.56-2dd.

- Each shipment of tomatoes must be accompanied by a phytosanitary certificate and bearing the declaration, 'These tomatoes were grown in registered greenhouses in El Jadida or Safi Province, Morocco, and were pink at the time of packing' or 'These tomatoes were grown in registered greenhouses in Dahkla Province, Western Sahara and were pink at the time of packing.'

- Case study I: Insect pests of food plants in Aboriginal communities in the Northern Territory
- Case study J: Early detection survey for sugarcane smut
- Case study K: *Pseudomonas* in rice

Consider also Case Studies L–R that were designed as monitoring surveys but could serve as early detection surveys.

3.4. References

Vernon, R. 2003. The Pacific Pest List Database for agricultural trade facilitation. Bulletin OEPP/EPPO Bulletin, 33, 501–504.

ISPM No. 4: Requirements for the establishment of pest free areas. Rome, FAO, 1996.

ISPM No. 10: Requirements for the establishment of pest free places of production and pest free production sites. Rome, FAO, 1999.

Chapter 4

More about monitoring surveys

ISPM 5 defines a monitoring survey as an

> Ongoing survey to verify the characteristics of a pest population

By this definition, monitoring surveys apply where a pest is known to be present and the survey is planned to examine aspects of the pest population such as the prevalence of the pest and changes in prevalence over time. These surveys can be used to assist with pest management.

The concept of being able to trade with and between areas with a low prevalence of a pest was introduced recently by the IPPC. Surveys that would underpin market access of areas of low pest prevalence fall into the category of monitoring surveys.

4.1. To support crop- and forest-pest management

The reasons you might survey a pest that is present in a crop or area are:

- to determine the optimal timing of field treatments by measuring prevalence
- to evaluate an eradication campaign at targeted sites (e.g. the perimeters of the known infestation). This overlaps with delimiting surveys (see Chapter 5). Delimiting surveys locate the boundaries of a pest infestation. Monitoring surveys can be used to determine if the pest populations change within those boundaries.

4.1.1. Pest management survey design steps

The survey design would follow all steps 1 to 21 in Chapters 2 and 7.

4.1.2. Case study examples

The following case studies of monitoring surveys are in Chapter 8.

- Case study L: Monitoring survey of giant wood moth on eucalypt and teak trees
- Case study M: Monitoring survey for damping-off in garden nurseries

- Case study N: Monitoring for root diseases in hardwood plantations
- Case study O: Monitoring survey of defoliation caused by a leaf disease in a plantation
- Case study P: Survey to measure the incidence of trees with stem wounds
- Case study Q: Monitoring survey in pine plantations
- Case study R: Aphids on crucifers
- Case study S: Monitoring survey for phosphine-resistant grain insects

4.2. To support areas of low pest prevalence status

'Areas of low pest prevalence' (ALPP) is an official term used by the IPPC in the international standards for agricultural trade. A draft ISPM on ALPPs is currently being considered—Draft ISPM May 2004: Requirements for the establishment, maintenance and verification of areas of low pest prevalence.

An ALPP is defined as:

> An area, whether all of a country, part of a country, or all or parts of several countries, as identified by the competent authorities, in which a specific pest occurs at low levels and which is subject to effective surveillance, control or eradication measures.
>
> They are distinguished from pest free areas as follows.
>
> The main difference between an ALPP and a PFA is that the presence of the pest below a specified population level is accepted in an ALPP, whereas the pest is absent from the PFA.

This means that, in some cases, a low population of the pest can be tolerated on the imported commodities, and phytosanitary measures can be employed—from seeding to selling—to manage the pests to a level acceptable to the importing country.

4.2.1. ALPP survey design steps

Apply this additional information to the steps outlined in Chapters 2 and 7. Because the draft guidelines single out extra details to be added to applications involving insects, see also Box 11 (page 102), which presents the additional specified information. Ideally, these details would already be included if the steps are followed.

Steps 1 to 6

Complete these steps.

Step 7

The NPPO should describe the proposed ALPP with supporting maps demonstrating the boundaries of the area. The description may also include the places of production, the host plants close to commercial production areas, and the natural barriers and buffer zones which may isolate the area.

Steps 8 and 9

Complete these steps.

Step 10

Sites to be surveyed should cover commercial, non-commercial and wild hosts.

Step 11

Complete this step.

Step 12

Technical reports of pest detections, phytosanitary procedures applied and results of the surveillance activities should be produced for at least the year before the application. Data should be provided for as many years as possible. One year of data may be insufficient, depending on the biology, reproductive potential, and host range of the specified pest(s).

Step 13

The NPPO where the ALPP is located should establish threshold levels for the specified pests.

Step 14

Complete this step.

Step 15

Records need to be maintained of sampling and the identification of intercepted specimens as part of the requirements of demonstrating effective phytosanitary procedures.

Steps 16 to 21

Complete these steps.

4.2.2. Additional steps for ALPP

If eradication has been undertaken, reinstatement of ALPP status cannot start until there is compliance with:

- the criteria for low pest prevalence, which may be based on the life cycle of the pest (for example, no pests have been detected for two life-cycles)
- the pest control measures being withdrawn because they prevent the multiplication and/or detection of the pest.

Box 11. Draft ISPM Appendix 1. Elements required for establishment of an ALPP for some insects

The following is a list of elements that may be considered in order to determine if an ALPP

1. Geographic description of the proposed ALPP

- maps
- places of production
- natural barriers
- buffer zone
- size
- location of regulatory control check-points.

2. Surveillance protocols for establishment and maintenance of ALPP

- pest
- surveillance time period
- reporting of surveillance results
- trapping
- trap type
- bait or lure type
- density of traps
- trap servicing intervals
- visual surveillance
- host or commodity sampling
- surveillance intervals.

3. Quality control protocols for surveillance

- validation of surveillance activities
- trapping
- visual surveillance
- verification of lure efficacy
- placement and recovery of marked pests
- regular reviews of surveillance documentation
- audits of trap placement and servicing
- confirmation of identifier competency.

4.2.3. Case study example

The excerpt below relates to an Australian import risk analysis for bananas from an area in the Philippines with a low prevalence of Moko disease.

> Bananas from the Philippines could be granted access if they were sourced from an Australian-approved plantation area, for which it can be demonstrated that the prevalence of Moko is below a level deemed acceptable by Australia—an ALPP. The low pest prevalence (LPP) level for Moko in an approved ALPP would not exceed 0.003 cases (infected mats) per hectare per week, which is about 1 case per 7 hectares per year—i.e. no more than one infected mat in 11,900 mats per year. This LPP level would be demonstrated by weekly surveys over a minimum period of 2 years immediately preceding harvest of fruit intended for export to Australia. If the prevalence of Moko exceeded the set LPP level, the affected area would be suspended for a minimum period of 2 years.

Reference

Revised draft import risk analysis (IRA). Report for the importation of bananas from the Philippines. Department of Agriculture, Fisheries and Forestry, Australia, Plant Biosecurity Policy Memorandum 2004/19, 16 June 2004.