Australian Government

Biosecurity Australia

Extension of existing policy for the importation of fresh mango fruit from the Republic of the Philippines to Australia

– Inclusion of the additional growing area of Davao del Sur, Mindanao Island

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Cover image: Mango fruit

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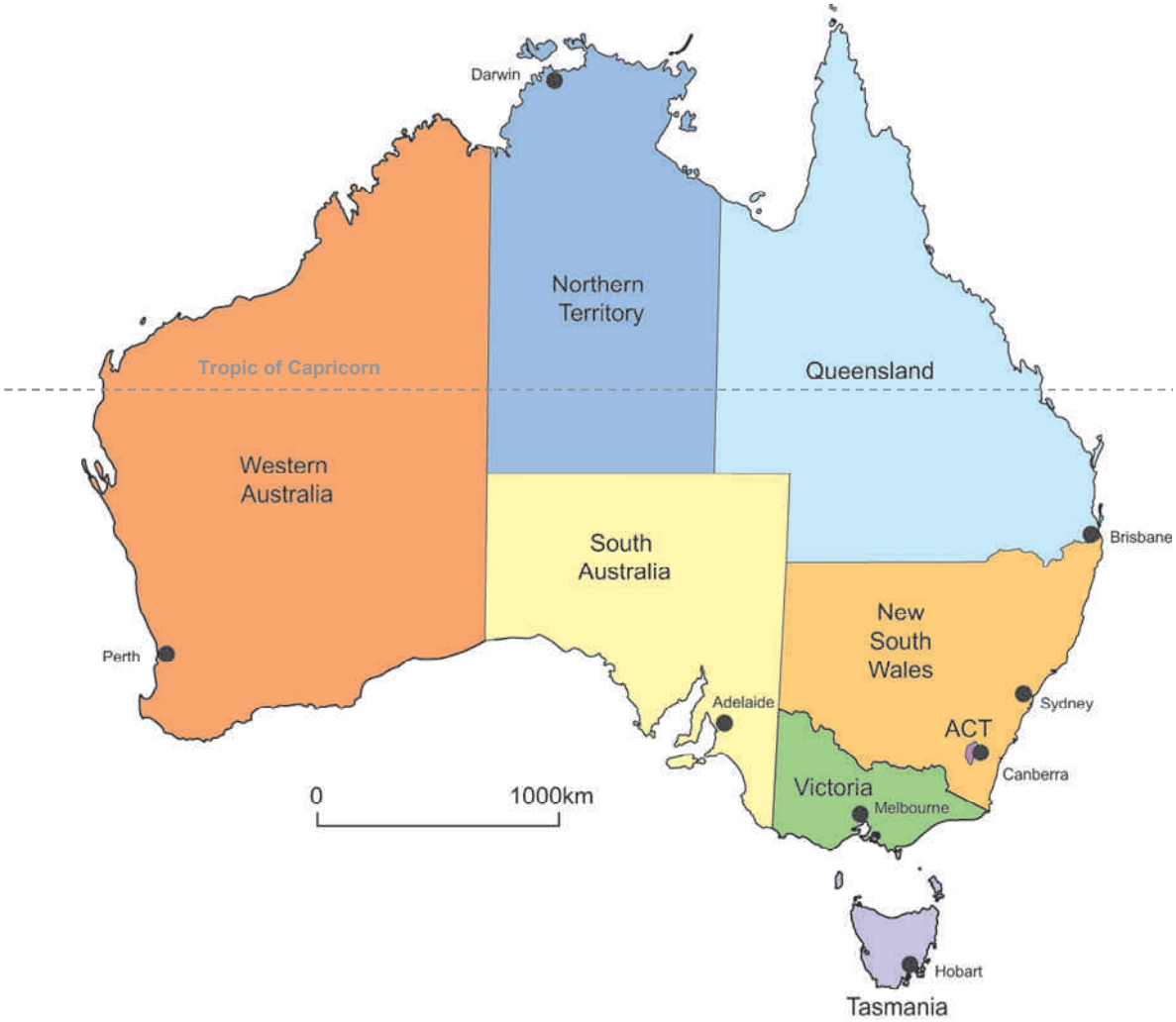


Acronyms and abbreviations

Term or abbreviation	Definition
ACT	Australian Capital Territory
ALOP	Appropriate level of protection
AQIS	Australian Quarantine and Inspection Service
BPI	Bureau of Plant Industry, Philippines
BSG	Biosecurity Services Group
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
FAO	Food and Agriculture Organization of the United Nations
IPC	International Phytosanitary Certificate
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
IRA	Import Risk Analysis
ISPM	International Standard for Phytosanitary Measures
NPPO	National Plant Protection Organization
ACT	Australian Capital Territory
NSW	New South Wales
NT	Northern Territory
Qld	Queensland
SA	South Australia
Tas.	Tasmania
Vic.	Victoria
WA	Western Australia
WTO	World Trade Organization

Summary

This report assesses a proposal from the Philippines for an extension of the growing area to include Davao del Sur for fresh mango fruit to Australia.

Australia has existing policies for fresh mango fruit from a number of countries including India, Haiti, Mexico, the Philippines (Guimaras Island) and Taiwan. The import risk analysis for fresh mango fruit from India was completed in July 2008. Pests considered in this policy and other previous policies were taken into consideration and included in this report, where appropriate.

The report recommends that the importation of fresh mango fruit into Australia from Davao del Sur be permitted subject to specific quarantine conditions.

The report in conjunction with the current Philippines policy for Guimaras Island identifies fruit flies, mango pulp and seed weevils, and mealybugs as pests that require quarantine measures to manage risks to a very low level in order to achieve Australia's appropriate level of protection (ALOP).

The recommended quarantine measures are a combination of risk management measures and an operational system that will reduce the risk associated with the importation of fresh mango fruit from the Province of Davao del Sur, of Mindanao Island, the Philippines into Australia to a very low level consistent with Australia's ALOP, specifically:

- Area freedom from mango pulp weevil (*Sternochetus frigidus* Fabricus) and mango seed weevil (*Sternochetus mangiferae* Fabricus);
- Pre-export vapour heat treatment for the management of fruit flies (*Bactrocera cucurbitae* Colquillett, *Bactrocera occipitalis* (Bezzi) and *Bactrocera philippinensis* Drew & Hancock);
- Pre-export phytosanitary certification and on-arrival inspection for mealybugs of quarantine concern *Plannococcus lilacinus* (Cockerell, 1905); *Rastrococcus invadens* Williams, 1986; and *Rastrococcus spinosus* (Robinson, 1918); and
- Operational systems to maintain and verify phytosanitary status, including the application of recommendations outlined in the report: *Improving mango industry sustainability and small holder income generation in the Philippines through expansion of area freedom certification against mango pulp and seed weevils* (Appendix A).

The conclusions of this report are based on the current conditions for Guimaras Island[1], while also taking into account the Philippines' existing commercial production practices. The existing commercial production practices, including fruit bagging are a requirement for export to Australia.

[1] Specific conditions and treatment schedules for the Guimaras Island policy are outlined in: AQIS (1999) 'Final import risk analysis on the proposal to change the treatment for mango (*Mangifera indica* L.) fruit from the Republic of the Philippines'. (Australian Quarantine and Inspection Service: Canberra).

1. Introduction

1.1. Australia's Biosecurity policy framework

Australia's biosecurity policies aim to protect Australia against the risks that may arise from exotic pests[2] entering, establishing and spreading in Australia, thereby threatening Australia's unique flora and fauna, as well as those agricultural industries that are relatively free from serious pests.

The pest risk analysis (PRA) process is an important part of Australia's Biosecurity policies. It enables the Australian Government to formally consider the risks that could be associated with proposals to import new products into Australia. If the risks are found to exceed Australia's appropriate level of protection (ALOP), risk management measures are proposed to reduce the risks to an acceptable level. But, if it is not possible to reduce the risks to an acceptable level, then no trade will be allowed.

Successive Australian Governments have maintained a conservative, but not a zero-risk, approach to the management of biosecurity risks. This approach is expressed in terms of Australia's ALOP, which reflects community expectations through government policy and is currently described as providing a high level of protection aimed at reducing risk to a very low level, but not to zero.

More information about Australia's biosecurity framework is provided in Appendix B of this report and in the *Import Risk Analysis Handbook 2007* (update 2009) located on the Biosecurity Australia website: www.biosecurityaustralia.gov.au.

1.2. This pest risk analysis

1.2.1 Background

Prior to 1999, the Republic of the Philippines (the Philippines) exported fresh mango fruit to Australia with a mandatory fumigation treatment using ethylene dibromide (EDB). As a consequence of concerns over the use and limited supplies of this chemical, the Philippine authorities sought an alternative treatment to address the risk posed by some pests and proposed vapour heat treatment. In 1999, the Philippines gained access into Australia for fresh mango fruit from Guimaras Island only, subject to area freedom from mango pulp and seed weevils, vapour heat treatment for fruit fly and visual inspection for a mealy bug species *Planococcus lilacinus*. State quarantine regulations also prohibited the entry of Philippine mangoes into the State of Western Australia on the basis that fruit is sourced from areas where mango scab (*Elsinoe mangiferae*) is known to occur.

In 2003, the Philippines Bureau of Plant Industry (BPI) sought an extension of the existing Guimaras Island arrangements to include other production areas within the Philippines. In 2005,

[2]A pest is any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2009)

the Philippines BPI requested Biosecurity Australia's comments and agreement on a proposed AusAID survey methodology for mango pulp and seed weevils to determine the boundaries for infested and non-infested areas within the entire Philippines.

In 2007, the Philippines BPI requested that Davao del Sur, a province in the island of Mindanao, be added to the permitted export regions for fresh mango. The Philippines' request was supported by data gathered by the above mentioned AusAID funded survey, newly enacted legislation that stated the area is free from pests of quarantine concern to Australia, and measures prescribed to maintain freedom from these pests.

A map of the Philippines highlighting the location of Guimaras Island and the province of Davao del Sur is shown in Figure 2.

1.2.2 Scope

The scope of this report is to consider the quarantine risk that may be associated with the importation of commercially produced fresh mango fruit from Davao del Sur, the Philippines, for human consumption in Australia. It focuses on the application to extend the area freedom status from mango seed and pulp weevils, and also considers the phytosanitary risks posed by two other Lepidoptera species in light of new information supplied by the Philippines.

Biosecurity Australia has also reviewed all pests previously considered to be present on the fresh mango fruit pathway from other trading partners (particularly India and Taiwan) and considered them in reference to existing Philippines mango policy for Guimaras Island and whether they are relevant to this current application.

1.2.3 Existing policy

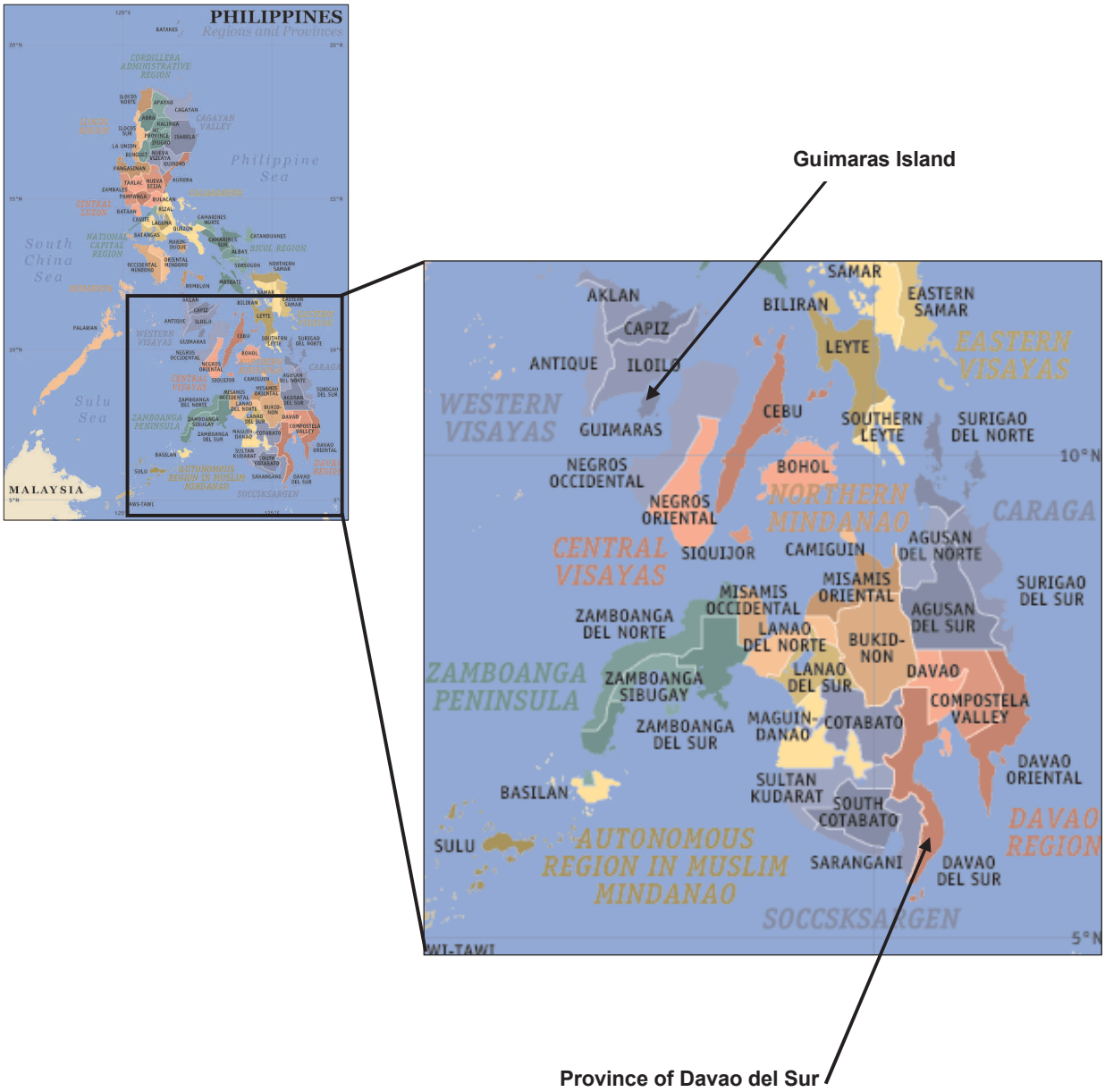
Australia has existing policies for fresh mango fruit from a number of countries including India, Haiti, Mexico, the Philippines (Guimaras Island) and Taiwan. The pest risk analysis for fresh mango fruit from India was completed in July 2008. Pests considered in this policy and other previous policies were taken into consideration and included in this report, where appropriate.

The import requirements for these commodities can be found at the Australian Quarantine and Inspection Service (AQIS) Import Conditions Database: http://www.aqis.gov.au/icon

1.2.4 Contaminating pests

In addition to the pests of mango from from Davao del Sur, the Philippines that are identified in this report, there are other organisms that may arrive with the mango fruit. These organisms could include pests of other crops or predators and parasitoids of other arthropods. Biosecurity Australia considers these organisms to be contaminating pests that could pose sanitary and phytosanitary risks. These risks are addressed by the procedures indicated in section 5.4.

Figure 2: **Map of the Philippines highlighting the location of Guimaras Island and province of Davao del Sur, of Mindanao Island.**



2. Method for pest risk analysis

This section sets out the method used for the pest risk analysis (PRA) in this report. Biosecurity Australia has conducted this PRA in accordance with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for Pest Risk Analysis* (FAO 2007) and ISPM 11: *Pest Risk Analysis for Quarantine Pests, including analysis of environmental risks and living modified organisms* (FAO 2004).

A PRA is 'the process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it' (FAO 2009). A pest is 'any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products' (FAO 2009).

Quarantine risk consists of two major components: the probability of a pest entering, establishing and spreading in Australia from imports; and the consequences should this happen. These two components are combined to give an overall estimate of the risk.

Unrestricted risk is estimated taking into account the existing commercial production practices of the exporting country and that, on arrival in Australia, the Australian Quarantine and Inspection Service (AQIS) will verify that the consignment received is as described on the commercial documents and its integrity has been maintained.

Restricted risk is estimated with phytosanitary measure(s) applied. A phytosanitary measure is 'any legislation, regulation or official procedure having the purpose to prevent the introduction and spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests' (FAO 2009).

A glossary of the terms used is provided at the back of this report.

PRAs are conducted in three consecutive stages: initiation, pest risk assessment and pest risk management.

2.1. Stage 1: Initiation

Initiation identifies the pest(s) and pathway(s) that are of quarantine concern and should be considered for risk analysis in relation to the identified PRA area.

The initiation point for this PRA was the receipt of a technical submission from the National Plant Protection Organisation (NPPO) for access to the Australian market for the commodity. This submission included information on the pests associated with the production of the commodity, including the plant part affected, and the existing commercial production practices for the commodity.

For this PRA, the 'PRA area' is defined as Australia for pests that are absent, or of limited distribution and under official control. For areas with regional freedom from a pest, the 'PRA area' may be defined on the basis of a state or territory of Australia or may be defined as a region of Australia consisting of parts of a state or territory or several states or territories.

For pests that had been considered by Biosecurity Australia in other risk assessments and for which import policies already exist, a judgement based on the specific circumstances was made on the likelihood of entry of pests on the commodity and whether existing policy is adequate to

manage the risks associated with its import. Where appropriate, the previous risk assessment was taken into consideration when developing the new policy.

2.2. Stage 2: Pest risk assessment

A Pest Risk Assessment (for quarantine pests) is: 'the evaluation of the probability of the introduction and spread of a pest and of the likelihood of associated potential economic consequences' (FAO 2009).

In this PRA, pest risk assessment was divided into the following interrelated processes:

2.2.1 Pest categorisation

Pest categorisation identifies which of the pests with the potential to be on the commodity are quarantine pests for Australia and require pest risk assessment. A 'quarantine pest' is a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled, as defined in ISPM 5: *Glossary of phytosanitary terms* (FAO 2009).

The pests identified in Stage 1 were categorised using the following primary elements to identify the quarantine pests for the commodity being assessed:

- presence or absence in the PRA area
- regulatory status
- potential for establishment and spread in the PRA area
- potential for economic consequences (including environmental consequences) in the PRA area.

2.2.2 Assessment of the probability of entry, establishment and spread

Details of how to assess the 'probability of entry', 'probability of establishment' and 'probability of spread' of a pest are given in ISPM 11 (FAO 2004). A summary of this process is given below, followed by a description of the qualitative methodology used in this PRA.

Probability of entry

The probability of entry describes the probability that a quarantine pest will enter Australia as a result of trade in a given commodity, be distributed in a viable state in the PRA area and subsequently be transferred to a host. It is based on pathway scenarios depicting necessary steps in the sourcing of the commodity for export, its processing, transport and storage, its use in Australia and the generation and disposal of waste. In particular, the ability of the pest to survive is considered for each of these various stages.

The probability of entry estimates for the quarantine pests for a commodity are based on the use of the existing commercial production, packaging and shipping practices of the exporting

country. These practices are taken into consideration by Biosecurity Australia when estimating the probability of entry.

For the purpose of considering the probability of entry, Biosecurity Australia divides this step of this stage of the PRA into two components:

- **Probability of importation**: the probability that a pest will arrive in Australia when a given commodity is imported
- **Probability of distribution**: the probability that the pest will be distributed, as a result of the processing, sale or disposal of the commodity, in the PRA area and subsequently transfer to a susceptible part of a host.

Factors considered in the probability of importation include:

- distribution and incidence of the pest in the source area
- occurrence of the pest in a life-stage that would be associated with the commodity
- mode of trade (e.g. bulk, packed)
- volume and frequency of movement of the commodity along each pathway
- seasonal timing of imports
- pest management, cultural and commercial procedures applied at the place of origin
- speed of transport and conditions of storage compared with the duration of the lifecycle of the pest
- vulnerability of the life-stages of the pest during transport or storage
- incidence of the pest likely to be associated with a consignment
- commercial procedures (e.g. refrigeration) applied to consignments during transport and storage in the country of origin, and during transport to Australia.

Factors considered in the probability of distribution include:

- commercial procedures (e.g. refrigeration) applied to consignments during distribution in Australia
- dispersal mechanisms of the pest, including vectors, to allow movement from the pathway to a host
- whether the imported commodity is to be sent to a few or many destination points in the PRA area
- proximity of entry, transit and destination points to hosts
- time of year at which import takes place
- intended use of the commodity (e.g. for planting, processing or consumption)
- risks from by-products and waste.

Probability of establishment

Establishment is defined as the 'perpetuation for the foreseeable future, of a pest within an area after entry' (FAO 2004). In order to estimate the probability of establishment of a pest, reliable

biological information (lifecycle, host range, epidemiology, survival, etc.) is obtained from the areas where the pest currently occurs. The situation in the PRA area can then be compared with that in the areas where it currently occurs and expert judgement used to assess the probability of establishment.

Factors considered in the probability of establishment in the PRA area include:

- availability of hosts, alternative hosts and vectors
- suitability of the environment
- reproductive strategy and potential for adaptation
- minimum population needed for establishment
- cultural practices and control measures.

Probability of spread

Spread is defined as 'the expansion of the geographical distribution of a pest within an area' (FAO 2004). The probability of spread considers the factors relevant to the movement of the pest, after establishment on a host plant or plants, to other susceptible host plants of the same or different species in other areas. In order to estimate the probability of spread of the pest, reliable biological information is obtained from areas where the pest currently occurs. The situation in the PRA area is then carefully compared with that in the areas where the pest currently occurs and expert judgement used to assess the probability of spread.

Factors considered in the probability of spread include:

- suitability of the natural and/or managed environment for natural spread of the pest
- presence of natural barriers
- potential for movement with commodities, conveyances or by vectors
- intended use of the commodity
- potential vectors of the pest in the PRA area
- potential natural enemies of the pest in the PRA area.

Assigning qualitative likelihoods for the probability of entry, establishment and spread

In its qualitative PRAs, Biosecurity Australia uses the term 'likelihood' for the descriptors it uses for its estimates of probability of entry, establishment and spread. Qualitative likelihoods are assigned to each step of entry, establishment and spread. Six descriptors are used: high; moderate; low; very low; extremely low; and negligible (Table 2.1). Descriptive definitions for these descriptors and their indicative probability ranges are given in Table 2.1. The indicative probability ranges are only provided to illustrate the boundaries of the descriptors. These indicative probability ranges are not used beyond this purpose in qualitative PRAs. The standardised likelihood descriptors and the associated indicative probability ranges provide guidance to the risk analyst and promote consistency between different risk analyses.

Table 2.1 Nomenclature for qualitative likelihoods

Likelihood	Descriptive definition	Indicative probability (P) range
High	The event would be very likely to occur	$0.7 < P \leq 1$
Moderate	The event would occur with an even probability	$0.3 < P \leq 0.7$
Low	The event would be unlikely to occur	$0.05 < P \leq 0.3$
Very low	The event would be very unlikely to occur	$0.001 < P \leq 0.05$
Extremely low	The event would be extremely unlikely to occur	$0.000001 < P \leq 0.001$
Negligible	The event would almost certainly not occur	$0 \leq P \leq 0.000001$

The likelihood of entry is determined by combining the likelihood that the pest will be imported into the PRA area and the likelihood that the pest will be distributed within the PRA area, using a matrix of rules (Table 2.2). This matrix is then used to combine the likelihood of entry and the likelihood of establishment, and the likelihood of entry and establishment is then combined with the likelihood of spread to determine the overall likelihood of entry, establishment and spread.

For example, if the probability of importation is assigned a likelihood of 'low' and the probability of distribution is assigned a likelihood of 'moderate', then they are combined to give a likelihood of 'low' for the probability of entry. The likelihood for the probability of entry is then combined with the likelihood assigned to the probability of establishment (e.g. 'high') to give a likelihood for the probability of entry and establishment of 'low'. The likelihood for the probability of entry and establishment is then combined with the likelihood assigned to the probability of spread (e.g. 'very low') to give the overall likelihood for the probability of entry, establishment and spread of 'very low'.

Table 2.2 Matrix of rules for combining qualitative likelihoods

	High	**Moderate**	**Low**	**Very low**	**Extremely low**	**Negligible**
High	High	Moderate	Low	Very low	Extremely low	Negligible
Moderate		Low	Low	Very low	Extremely low	Negligible
Low			Very low	Very low	Extremely low	Negligible
Very low				Extremely low	Extremely low	Negligible
Extremely low					Negligible	Negligible
Negligible						Negligible

Time and volume of trade

One factor affecting the likelihood of entry is the volume and duration of trade. If all other conditions remain the same, the overall likelihood of entry will increase as time passes and the overall volume of trade increases.

Biosecurity Australia normally considers the likelihood of entry on the basis of the estimated volume of one year's trade. This is a convenient value for the analysis that is relatively easy to estimate and allows for expert consideration of seasonal variations in pest presence, incidence and behaviour to be taken into account. The consideration of the likelihood of entry, establishment and spread and subsequent consequences takes into account events that might happen over a number of years even though only one year's volume of trade is being considered.

This reflects biological and ecological facts, for example where a pest or disease may establish in the year of import but spread may take many years.

These considerations have been taken into account when setting up the matrix. Therefore, any policy based on this analysis does not simply apply to one year of trade. Policy decisions that are based on Biosecurity Australia's method that uses the estimated volume of one year's trade are consistent with Australia's policy on appropriate level of protection and meet the Australian Government's requirement for ongoing quarantine protection. Of course, if there are substantial changes in the volume and nature of the trade in specific commodities then Biosecurity Australia has an obligation to review the risk analysis and, if necessary, provide updated policy advice.

Although volumes of fresh mango fruit under the existing Guimaras Island policy have been minimal, advice from the Philippines Bureau of Plant Industry (BPI) has indicated that export volumes would likely increase with the approval of this new area. In assessing this application Biosecurity Australia has considered that the existing conditions are still suitable to manage the risk to a level below Australia's ALOP, even if a substantial volume of trade was to occur.

2.2.3 Assessment of potential consequences

The objective of the consequence assessment is to provide a structured and transparent analysis of the likely consequences if the pests or disease agents were to enter, establish and spread in Australia. The assessment considers direct and indirect pest effects and their economic and environmental consequences. The requirements for assessing potential consequences are given in Article 5.3 of the SPS Agreement (WTO 1995), ISPM 5 (FAO 2009) and ISPM 11 (FAO 2004).

Direct pest effects are considered in the context of the effects on:

- plant life or health
- other aspects of the environment.

Indirect pest effects are considered in the context of the effects on:

- eradication, control, etc
- domestic trade
- international trade
- environment.

For each of these six criteria, the consequences were estimated over four geographic levels, defined as:

- **Local**: an aggregate of households or enterprises (a rural community, a town or a local government area).
- **District**: a geographically or geopolitically associated collection of aggregates (generally a recognised section of a state or territory, such as 'Far North Queensland').
- **Regional**: a geographically or geopolitically associated collection of districts in a geographic area (generally a state or territory, although there may be exceptions with larger states such as Western Australia).
- **National**: Australia wide (Australian mainland states and territories and Tasmania).

For each criterion, the magnitude of the potential consequence at each of these levels was described using four categories, defined as:

- **Indiscernible**: pest impact unlikely to be noticeable.
- **Minor significance**: expected to lead to a minor increase in mortality/morbidity of hosts or a minor decrease in production but not expected to threaten the economic viability of production. Expected to decrease the value of non-commercial criteria but not threaten the criterion's intrinsic value. Effects would generally be reversible.
- **Significant**: expected to threaten the economic viability of production through a moderate increase in mortality/morbidity of hosts, or a moderate decrease in production. Expected to significantly diminish or threaten the intrinsic value of non-commercial criteria. Effects may not be reversible.
- **Major significance**: expected to threaten the economic viability through a large increase in mortality/morbidity of hosts, or a large decrease in production. Expected to severely or irreversibly damage the intrinsic 'value' of non-commercial criteria.

The estimates of the magnitude of the potential consequences over the four geographic levels were translated into a qualitative impact score (A–G)[3] using Table 2.3[4]. For example, a consequence with a magnitude of 'significant' at the 'district' level will have a consequence impact score of D.

Table 2.3 Decision rules for determining the consequence impact score based on the magnitude of consequences at four geographic scales

		Geographic scale			
		Local	District	Region	Nation
Magnitude	Indiscernible	A	A	A	A
	Minor significance	B	C	D	E
	Significant	C	D	E	F
	Major significance	D	E	F	G

The overall consequence for each pest is achieved by combining the qualitative impact scores (A–G) for each direct and indirect consequence using a series of decision rules (Table 2.4). These rules are mutually exclusive, and are assessed in numerical order until one applies.

[3] In earlier qualitative IRAs, the scale for the impact scores went from A to F and did not explicitly allow for the rating 'indiscernible' at all four levels. This combination might be applicable for some criteria. In this report, the impact scale of A-F has changed to become B-G and a new lowest category A ('indiscernible' at all four levels) was added. The rules for combining impacts in Table 2.4 were adjusted accordingly.

[4] The decision rules for determining the consequence impact score are presented in a simpler form in Table 2.3 from earlier IRAs, to make the table easier to use. The outcome of the decision rules is the same as the previous table and makes no difference to the final impact score.

Table 2.4 Decision rules for determining the overall consequence rating for each pest

Rule	The impact scores for consequences of direct and indirect criteria	Overall consequence rating
1	Any criterion has an impact of 'G'; or more than one criterion has an impact of 'F'; or a single criterion has an impact of 'F' and each remaining criterion an 'E'.	Extreme
2	A single criterion has an impact of 'F'; or all criteria have an impact of 'E'.	High
3	One or more criteria have an impact of 'E'; or all criteria have an impact of 'D'.	Moderate
4	One or more criteria have an impact of 'D'; or all criteria have an impact of 'C'.	Low
5	One or more criteria have an impact of 'C'; or all criteria have an impact of 'B'.	Very Low
6	One or more but not all criteria have an impact of 'B', and all remaining criteria have an impact of 'A'.	Negligible

2.2.4 Estimation of the unrestricted risk

Once the above assessments are completed, the unrestricted risk can be determined for each pest or groups of pests. This is determined by using a risk estimation matrix (Table 2.5) to combine the estimates of the probability of entry, establishment and spread and the overall consequences of pest establishment and spread. Therefore, risk is the product of likelihood and consequence.

When interpreting the risk estimation matrix, note the descriptors for each axis are similar (e.g. low, moderate, high) but the vertical axis refers to likelihood and the horizontal axis refers to consequences. Accordingly, a 'low' likelihood combined with 'high' consequences, is not the same as a 'high' likelihood combined with 'low' consequences – the matrix is not symmetrical. For example, the former combination would give an unrestricted risk rating of 'moderate', whereas, the latter would be rated as a 'low' unrestricted risk.

Table 2.5 Risk estimation matrix

Likelihood of pest entry, establishment and spread	Negligible	Very low	Low	Moderate	High	Extreme
High	Negligible risk	Very low risk	Low risk	Moderate risk	High risk	Extreme risk
Moderate	Negligible risk	Very low risk	Low risk	Moderate risk	High risk	Extreme risk
Low	Negligible risk	Negligible risk	Very low risk	Low risk	Moderate risk	High risk
Very low	Negligible risk	Negligible risk	Negligible risk	Very low risk	Low risk	Moderate risk
Extremely low	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Very low risk	Low risk
Negligible	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Very low risk

Consequences of pest entry, establishment and spread

2.2.5 Australia's appropriate level of protection (ALOP)

The SPS Agreement defines the concept of an 'appropriate level of sanitary or phytosanitary protection (ALOP)' as the level of protection deemed appropriate by the WTO Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory.

Australia expresses its ALOP in qualitative terms. Australia's ALOP, which reflects community expectations through government policy, is currently expressed as providing a high level of sanitary or phytosanitary protection aimed at reducing risk to a very low level, but not to zero. The band of cells in Table 2.5 marked 'very low risk' represents Australia's ALOP.

2.3. Stage 3: Pest risk management

Pest risk management describes the process of identifying and implementing phytosanitary measures to manage risks to achieve Australia's ALOP, while ensuring that any negative effects on trade are minimised.

The conclusions from pest risk assessment are used to decide whether risk management is required and if so, the appropriate measures to be used. Where the unrestricted risk estimate exceeds Australia's ALOP, risk management measures are required to reduce this risk to a very low level. The guiding principle for risk management is to manage risk to achieve Australia's ALOP. The effectiveness of any proposed phytosanitary measure (or combination of measures) is evaluated, using the same approach as used to evaluate the unrestricted risk, to ensure it reduces the restricted risk for the relevant pest or pests to meet Australia's ALOP.

ISPM 11 (FAO 2004) provides details on the identification and selection of appropriate risk management options and notes that the choice of measures should be based on their effectiveness in reducing the probability of entry of the pest.

Examples given of measures commonly applied to traded commodities include:

- options for consignments – e.g., inspection or testing for freedom from pests, prohibition of parts of the host, a pre-entry or post-entry quarantine system, specified conditions on preparation of the consignment, specified treatment of the consignment, restrictions on end-use, distribution and periods of entry of the commodity
- options preventing or reducing infestation in the crop – e.g., treatment of the crop, restriction on the composition of a consignment so it is composed of plants belonging to resistant or less susceptible species, harvesting of plants at a certain age or specified time of the year, production in a certification scheme
- options ensuring that the area, place or site of production or crop is free from the pest – e.g., pest-free area, pest-free place of production or pest-free production site
- options for other types of pathways – e.g., consider natural spread, measures for human travellers and their baggage, cleaning or disinfestation of contaminated machinery
- options within the importing country – e.g., surveillance and eradication programs
- prohibition of commodities – if no satisfactory measure can be found.

Risk management measures are identified for each quarantine pest where the risk exceeds Australia's ALOP. These are presented in the 'Pest Risk Management' section of this report.

3. Pest information

3.1. Davao del Sur pest free area for mango seed and pulp weevils

The Philippines has tendered the following report to support the acceptance of Davao del Sur, Mindanao Island as a pest free area for mango seed weevil and mango pulp weevils:

> Pinese B, Golez H, Lacson L (2007) *Improving mango industry sustainability and smallholder income generation in the Philippines through expansion of area freedom certification against mango pulp and seed weevils*. January 2007. AusAID Public Sector Linkages Program: Project no: ROU 14039. [Appendix A].

The project involved an extensive detection survey in the Province of Davao del Sur to determine whether mango seed weevil (*Sternochetus mangiferae*) and mango pulp weevil (*Sternochetus frigidus*) are present in mango fruits grown in this area.

3.1.1 Survey methods

The survey was conducted in the Province of Davao del Sur, excluding the City of Davao. The province is bound on the east by the Philippine Sea (Davao Gulf), and to the west by a mountain range. The political border with the City of Davao forms the northern border and the survey area extends south to the Sarangani Strait. The province occupies an area of 3828 km^2.

The sampling intensity was based on the minimum number of fruit bearing trees required to achieve a 99% probability of pest detection when at least 1% of trees had 15% of their fruit infested. Wherever possible, a 70:30 bias towards trees that were not treated with any pesticides ('backyard') was undertaken to maximize the likelihood of weevil detection. To ensure year long sampling, most locations were visited and sampled over four separate periods. Each period included two months during the fruiting or "on" season, or three months in the low fruiting season or "off" season. The majority of mango cultivars present were sampled to ensure that any cultivar bias was accounted for.

Eight mango fruit were sampled and processed from each of 22 621 individual fruit bearing trees surveyed. Trees and fruit were randomly selected, fruit were cut open and the flesh and seed visually inspected for the presence of weevils and/or symptoms. At the same time, fruit were assessed for damage from other insect pests to provide data on significant insect activity and diversity.

3.1.2 Survey outcomes

Not a single specimen (egg, larva, pupa or adult) of mango seed or pulp weevil was found during the inspection of 180 968 cut mango fruit. Additionally, no symptoms of attack were detected.

The desired 70:30 ratio of backyard to commercial trees was not achieved. The actual ratio was 51:49. However, this is considered to be adequate due to the extensive and comprehensive nature of the survey.

Following this outcome in March 2007, the Philippines Bureau of Plant Industry released BPI Special Quarantine Administrative Order No. 01, Series 2007: Declaring the Province of Davao del Sur as Area Free from Mango Pulp and Seed Weevil. The movement, transfer or carrying of

mango planting materials, fruits or parts thereof into the province of Davao del Sur is hereby prohibited. Mechanisms to maintain the area freedom status, including operational detail of enforcements are also outlined in BPI Special Quarantine Administrative Order No. 01, Series 2007.

3.1.3 Conclusions

The survey data provided by the Philippines demonstrates the area is free of mango pulp and seed weevils to a standard which achieves Australia's ALOP. Based on survey data, and subject to inspection and verification of ongoing procedures to maintain and demonstrate freedom from both pests, Biosecurity Australia considers the Province of Davao del Sur on Mindanao Island, the Philippines, to be free from mango seed and pulp weevils, and recommends its addition to the areas currently permitted to export mangoes to Australia.

3.2. Red banded mango caterpillar and black borer in Davao del Sur

While no mango seed or pulp weevils were detected during the survey conducted in Davao del Sur, two other species of quarantine concern to Australia were recorded from the sampled fruit.

These species were the red banded mango caterpillar (*Deanolis sublimbalis* Snellen, 1899) (Previously called: *Noorda albizonalis* (Hampson, 1903) [Lepidoptera: Pyralidae], which was recorded in 4.6% of fruit sampled; and the black borer (*Nephopteryx* sp.) [Lepidoptera: Pyralidae], which was recorded in 0.36% of fruit sampled[5]. The Philippines has advised that there is currently no species name for the black borer.

These two pests were previously identified as pests of quarantine concern in the Import Risk Analysis (IRA) on the proposal to change the treatment for mango (*Mangifera indica* L.) fruit from the Republic of the Philippines (AQIS 1999) which allows importation from Guimaras Island only. This previous policy stipulated visual inspection and fruit cut for these pests.

The following information has been compiled based on published scientific literature—much of which was also included in the IRA for Indian mangoes (Biosecurity Australia 2008), information provided by the Philippines Bureau of Plant Industry and discussions with the project leader of the Philippines pest free area study.

3.2.1 Biology

Red banded mango caterpillar

Red banded mango caterpillar (RBMC) is considered a minor pest of mango in the Philippines. Studies of its biology and ecology have demonstrated it is monophagous and can only develop in

[5] Although the report: *Improving mango industry sustainability and small holder income generation in the Philippines through expansion of area freedom certification against mango pulp and seed weevils* (Appendix A) identifies infestations of red banded mango caterpillar and black borer at 6.1% and 0.5 % respectively, actual calculations from the data available in the report indicate infestations are actually at 4.6% and 0.36% respectively. These values have been confirmed through additional information supplied to Biosecurity Australia by the Philippines Bureau of Plant Industry in September 2008.

mango fruit (Krull and Basedow 2006). Efforts to rear this species on other parts of mango plants (leaves, shoots and stem) as well as on other fruits all failed (Golez 1991).

Eggs are laid in small crevices (often dried anthracnose spots) on the peduncle, on non-fruiting vegetative branches close to fruit, or on the fruit itself (Krull and Basedow 2006). Eggs are typically laid on fruit of marble size (Krull and Basedow 2006). Few eggs are observed on mature fruit (Krull and Basedow 2006).

After 3–4 days, larvae hatch and burrow into the distal end of the mango fruit (Golez 1991). Larvae pass through 5 instars within the fruit, with a larval development period of 14–20 days (Golez 1991).

Early instars feed on the fruit pulp forming a network of tunnels which may eventually cause the fruit to collapse (Golez 1991). Later instar larvae feed on the seed (Krull and Basedow 2006). Up to 11 larvae have been found in a single fruit, however larvae disperse to search for fresh fruit as the food source diminishes (Tenakanai *et al*. 2006). Commonly, there is only a single larva in a fruit (Waterhouse 1998). Fruit infested at the young stage is misshapen and may not complete development (B. Pinese 2008, pers. comm.). Although red banded mango caterpillar feeds internally, the damage is conspicuous as sap oozing from entry holes stains the skin of the fruit (Tenakanai *et al*. 2006). Frass may also be produced and deposited around the hole and infected fruits may split at the apex and develop longitudinal cracks (Krull 2004). Fruit infested with later instars has a conspicuous entry hole that leads to visible sap staining on the surface of the fruit (B. Pinese 2008, pers. comm.). Other symptoms include secondary fungal and bacterial infections of the fruit (Golez 1991). Larvae exit the fruit to pupate in deadwood, cracks or crevices in the bark of the host tree (Sujatha and Zaheruddeen 2002; Krull 2004; Krull and Basedow 2006; B. Pinese 2008, pers. comm.), or soil (Golez 1991).

The larvae enter a pre-pupal stage lasting 2–3 days followed by a pupal period ranging from 9–14 days (Golez 1991). Total development (from egg to adult emergence) is completed in 28–41 days (Golez 1991). Emergence of adults appears to be synchronised with early mango fruit development (Golez 1991), although the mechanism is unknown. Fruit set in the Philippines is typically chemically induced and this may play a role in the synchronised emergence. The pest is controlled by spraying with the synthetic pyrethroids deltamethrin and cyfluthrin at 75 and 90 days post flowering (BPI 2007).

Pupation in fruit was not observed in surveys by Sujatha and Zaheruddeen (2002) and Krull and Basedow (2006). Early reports of pupation in fruit in India (Sengupta and Behura 1955, 1957) probably mistakenly refer to larvae undergoing pre-pupal diapause.

Black borer

There is limited published information available on this species. The following information represents a general description and life history of species in the genus and also details specific observations of black borer in the Philippines as provided by the Philippines Bureau of Plant Industry. The genus *Nephopteryx* Hübner belongs to the family Pyralidae Latreille, subfamily Phycitinae Zeller. Phycitinae larvae are mostly leaf rollers, seed feeders or predators of Homoptera (Christofaro *et al.* 1998).

Damage by black borer appears as several random holes rather than damage at the apex. Like RBMC, larvae initially feed on the flesh of the mango fruit, ultimately ending up feeding on the seed. The adult moth is a light brown colour. Larvae are usually dark brown to black, covered in

fine hairs, and measure about 6–8 mm in length. Details of the lifecycle are as follows: eggs (3–4 days), larvae (5 instars, 15–16 days), pupae (10–11 days) and adults (8–12 days) (BPI 2007). Chemical control for red banded mango caterpillar is also effective against black borer.

4. Pest risk assessments for quarantine pests

This chapter assesses the probability of the entry, establishment and spread of quarantine pests associated with fresh mango fruit from Davao del Sur, the Philippines and the likelihood of associated potential economic consequences.

4.1. Red banded mango caterpillar – *Deanolis sublimbalis* [Lepidoptera: Pyralidae]

Australia has previously assessed Red Banded Mango Caterpillar (RBMC) – *Deanolis sublimbalis* in the policies for the importation of fresh mango fruit from India (Biosecurity Australia 2008) and the Philippines (Guimaras Island) (AQIS 1999). However in the recent application for additional mango growing areas, the Philippines requested their standard production practices, including fruit bagging, be taken into consideration.

In light of this, the following additional information has been taken into account in reviewing the probability of entry for this species on fresh mango fruit from the Philippines:

- In the comprehensive survey of 180 968 fruit in Davao del Sur, the Philippines, only 4.6% were infested with RBMC (Appendix A). To maximise the likelihood of detection, bagged, un-bagged and fallen fruit were sampled during the survey. Because of its bias, this sampling method may significantly over-estimate levels of infestation in orchards managed under standard production practices, where most fruit is bagged.

- The practice of fruit bagging to manage insect pests (including RBMC) is widespread in the Philippines. Information from the Philippines Bureau of Plant Industry indicates that 80–90% of bagged fruit are suitable for export when harvested. The synchronised chemical inducement of mango fruit-set in the Philippine mango production systems assists in the coordinated timing of fruit-bagging.

- Fruit-bagging is typically undertaken when fruit approaches 3 cm in size, the size most prone to egg lay. Fruit of this size, if already infested, would not mature to harvestable fruit. This is because the RBMC normally completely consumes small fruit and is forced to infest a new mango fruit to complete development.

- Fruit-bagging would also be effective in removing the risk associated with infestation of fruit by late-season oviposition. Infestation at this stage would be more difficult to detect as the larval entry holes at the apex would be less conspicuous and development is more likely to be completed in a single piece of fruit. However, it is unlikely that bagged fruit would be subject to attack.

- These pests are specifically targeted through the use of synthetic pyrethroids deltamethrin and cyfluthrin sprays at 75 and 90 days post flowering (BPI 2007).

- Under standard Philippine mango agricultural practice, inspection, sorting and culling of infested fruit occurs four times between picking and shipping: in the field after harvest, during packing, before treatment and after treatment. Multiple inspections would significantly increase the chances of infested fruit being detected and removed from any export consignment.

The estimated probability of importation for RBMC in Indian mango based on standard production practices undertaken in India was 'moderate'. When additional pest management practices undertaken in the Philippines and data on infestation levels in the Philippines are taken into account, the estimated probability of importation is 'very low'.

In Biosecurity Australia's expert judgement, the probability of distribution, establishment, spread and consequences for RBMC in mangoes will not differ significantly between India and the Philippines.

To complete the risk assessment for RBMC in Philippines mangoes sourced from Davao del Sur, the revised estimated probability of importation has been combined with the probability of distribution, establishment, spread and consequences from the Indian mango IRA (Table 4.1).

Table 4.1 Summary of the pest risk assessment (PRA) for red banded mango caterpillar for fresh mango fruit from the Philippines

PRA criterion	Risk rating
Probability of importation	Very low
Probability of distribution*	Moderate
Probability of entry (importation x distribution)	Very low
Probability of establishment*	Moderate
Probability of spread*	Moderate
Overall probability of entry, establishment and spread	Very low
Consequences*	Moderate
Unrestricted risk estimate	Very low

* Existing probability ratings for red banded mango caterpillar as determined in the IRA for fresh mango fruit from India (Biosecurity Australia 2008).

4.1.1 Unrestricted risk estimate

When infestation levels in the Philippines and additional pest management practices, including fruit bagging at the early stage of development are taken into account, the unrestricted risk estimate for red banded mango caterpillar is 'very low', which is below Australia's ALOP. Therefore specific risk management measures are not required for this pest.

4.2. Black borer – *Nephopteryx* sp. [Lepidoptera: Pyralidae]

The estimated probability of importation is 'extremely low'. This estimate reflects the extremely low level of infestation (0.36%) (Appendix A) and takes account of additional pest management practices including fruit bagging at the early stage of development.

Due to the paucity of information on black borer and similarities in biology and ecology between black borer and RBMC, the probability of distribution, establishment and spread ratings from RBMC have been applied for black borer in this assessment. When these ratings are incorporated into the risk matrices with the estimated probability for importation for black borer the unrestricted risk estimate is determined to be at the most 'negligible' (Table 3.2). This is well below Australia's ALOP and therefore does not warrant further consideration.

Table 4.2 Summary of the pest risk assessment (PRA) for black borer for fresh mango fruit from the Philippines

PRA criterion	Risk rating
Probability of importation	Extremely low
Probability of distribution*	Moderate
Probability of entry (importation x distribution)	Extremely low
Probability of establishment*	Moderate
Probability of spread*	Moderate
Overall probability of entry, establishment and spread	Extremely low
Consequences*	Moderate
Unrestricted risk estimate	Negligible

* Existing probability rating for red banded mango caterpillar as determined in the IRA for fresh mango fruit from India (Biosecurity Australia 2008).

4.2.1 Unrestricted risk estimate

When infestation levels in the Philippines and additional pest management practices, including fruit bagging at the early stage of development are taken into account, the unrestricted risk estimate for black borer is at most 'extremely low', which is below Australia's ALOP. Therefore specific risk management measures are not required for this pest.

4.3. Mealybugs [Hemiptera: Pseudococcidae]

Plannococcus lilacinus was previously assessed in the considered in 1999 Guimaras Island policy (AQIS 1999). Following a review of all pests previously considered to be present on the fresh mango fruit pathway from other trading partners (particularly India and Taiwan) two additional mealybug species, *Rastrococcus invadens* and *Rastrococcus spinosus* were identified, to be of quarantine concern, and associated with fresh mango fruit in the Philippines.

The mealybugs of quarantine concern associated with mango fruit from the Philippines are now considered to be *Plannococcus lilacinus* (Cockerell, 1905); *Rastrococcus invadens* Williams, 1986; and *Rastrococcus spinosus* (Robinson, 1918).

All three of these species have recently been assessed with the importation of mangoes from India with an unrestricted risk rating of 'low'. The existing policy for these mealybugs is adopted

for the importation of mango from the Philippines as the risk of importation and distribution are judged to be similar. Therefore these mealybugs are not considered further in this policy.

5. Pest risk management

This chapter provides information on the management of quarantine pests with an unrestricted risk exceeding Australia's appropriate level of protection (ALOP). The proposed phytosanitary measures are described below.

5.1. Pest risk management measures and phytosanitary procedures

Pest risk management evaluates and selects options for measures to reduce the risk of entry, establishment or spread of quarantine pests for Australia where they have been assessed to have an unrestricted risk above Australia's ALOP. In calculating the unrestricted risk, existing commercial production practices in the Philippines have already been considered, as have post-harvest procedures and packing of fruit.

5.1.1 Pest risk management for pests

In addition to the Philippines' standard existing commercial production practices for fresh mango fruit, and minimum border procedures in Australia, specific pest risk management measures including operational systems, are proposed to achieve Australia's ALOP. These are:

- Area freedom from mango pulp weevil (*Sternochetus frigidus* Fabricus) and mango seed weevil (*Sternochetus mangiferae* Fabricus);
- Pre-export vapour heat treatment for the management of fruit flies (*Bactrocera cucurbitae* Colquillett, *Bactrocera occipitalis* (Bezzi) and *Bactrocera philippinensis* Drew & Hancock);
- Pre-export phytosanitary certification by the Philippines Bureau of Plant Industry and on-arrival inspection by AQIS for a mealybugs of quarantine concern (*Plannococcus lilacinus* (Cockerell); *Rastrococcus invadens* Williams, 1986; and *Rastrococcus spinosus* (Robinson, 1918)); and
- Operational systems to maintain and verify phytosanitary status, including the application of recommendations outlined in the report: *Improving mango industry sustainability and small holder income generation in the Philippines through expansion of area freedom certification against mango pulp and seed weevils* (Appendix A).

Pest risk management measures and phytosanitary procedures of this report are based on the current conditions for Guimaras Island, while also taking into account the existing commercial production practices. The existing commercial production practices, including fruit bagging are a requirement for export to Australia. Specific conditions, treatment schedules and details of the operations systems to maintain and verify phytosanitary status for the Guimaras Island policy, that will apply to this application, are outlined in: AQIS (1999) 'Final import risk analysis on the proposal to change the treatment for mango (*Mangifera indica* L.) fruit from the Republic of the Philippines'. (Australian Quarantine and Inspection Service: Canberra).

5.1.2 Operational systems for the maintenance and verification of phytosanitary status

A system of operational procedures is necessary to maintain and verify the phytosanitary status of fresh mango from the Province of Davao del Sur of Mindanao Island, the Philippines. This is to ensure that the recommended risk management measures have been met and are maintained.

Implementation of quarantine in the province of Davao del Sur, Mindanao Island
Australia requires that internal legislation, currently in place, continue to be enforced to ensure that there is no movement, transfer or carrying of mango planting material, fruits or parts thereof from other areas of the Philippines into the Province of Davao del Sur of Mindanao.

An audit of the operational application of this internal legislation by the Biosecurity Services Group (BSG) on the movement, transfer or carrying of mango planting material, fruits or parts thereof from other areas of the Philippines into the Province of Davao del Sur of Mindanao is required before exports can commence.

Provisions for traceability

Security of fruit from approved production areas to treatment plants
BPI will have in place procedures to ensure that fruit for export to Australia is only sourced from approved growing/production areas. The fruit must be packed securely and identified as "Davao del Sur of Mindanao Island fruit" before being transported to the registered treatment plants. The procedures to ensure that security of fruit is achieved will be detailed in a specific commodity understanding (SCU) and will be audited and required to be found satisfactory by BSG, before exports will be permitted.

Security on-arrival at treatment centres
On arrival at the registered treatment centre the consignment will be checked by a BPI officer to ensure that integrity of the consignment has not been compromised. If the packages are accepted they will be stored in a designated area away from other fruit to ensure that only fruit from approved growing / production areas (Province of Davao del Sur of Mindanao Island and Guimaras Island only) is sent for treatment for export to Australia. Transfer of fruit into treatment trays will be done under the supervision of BPI. The treatment trays will be marked indicating that the fruit is sourced from the Province of Davao del Sur of Mindanao Island for export to Australia only. Fruit for other destinations may be treated in the chamber at the same time as fruit for Australia, if it meets the minimum requirements for fruit destined for export to Australia as set out in this document.

Packing, storage and loading of treated fruit
The fruit is to be packed in new cartons sealed with a BPI sticker or seal securely placed across the carton opening. No unprocessed packing material of plant origin is to be used.

Any openings in cartons are to be either screened with mesh no greater than 1.6mm diameter or covered with tape to ensure any opening greater than 1.6mm diameter is closed.

All cartons will be marked "For Australia", labelled with packing date, registered packing house name or number and registered treatment centre establishment name or number.

Fruit sourced from approved growers in *Davao del Sur* for export to Australia is to be stored and transported (before and after treatment) in a quarantine secure manner, segregated from fruit for other markets and any other fruit. The segregation to be one metre in all directions for fruit stored under ambient temperature or 100mm gap for fruit under cool storage

Treatment facilities
BSG will only approve designated and identified VHT facilities that are registered by BPI. These facilities must be designed to prevent the entry of fruit flies into areas where unpacked treated fruit is held. This will include a provision for treated fruit to be discharged directly into insect proof and secure packing rooms.

The management of the treatment facility will be required to provide details of systems that are in place to ensure isolation and segregation from other fruit throughout the treatment, packing, storage and transport stages before exports commence. This will be audited for compliance with BSG requirements in the initial export season by BSG before exports will be permitted.

After the initial season's approval of the registered treatment centres, BSG will require BPI to audit the facilities at the beginning of each season to ensure that they comply with BSG requirements before registration is renewed. BPI would then monitor the treatment centres on an ongoing basis during their operational season to ensure continued compliance with BSG requirements. Reports of audits noting any non-conformities together with appropriate corrective action will be submitted to BSG.

BPI officers will ensure the following:

- registered treatment facilities are maintained in a condition that will provide efficacy in treatment programs
- all areas are hygienically maintained (cleaned daily of damaged, blemished, infested fruit)
- the premises are maintained to exclude the entry of pests from outside and between treated and untreated fruit
- all measurement instruments are regularly calibrated and records retained for verification
- the movement of fruit from the time of arrival at the registered treatment centre through to the time of export is recorded and
- the security of fruit is maintained at all times that fruit is on the premises.

Should BPI officers find that any one of the above requirements is not being undertaken the registered facility will be suspended until corrective action has been completed and AQIS agreement to the reinstatement is obtained.

Vapour heat treatment (VHT) requirements
The VHT treatment specified in the SCU has been assessed as effective against all quarantine fruit flies.

VHT sensors will be calibrated by an appropriate BPI Plant Quarantine Officer using a certified thermometer. All certified thermometers will be checked annually against a reference thermometer calibrated by the appropriate national standards authority.

The number and location of fruit sensors in each chamber will depend on the make and model of the treatment unit which will be specified in the SCU.

Sensors will be placed in fruit chosen from amongst the largest size fruit in each chamber load. Placement of probes within the chamber and the method to insert probes will be specified within the SCU.

Treatment time will commence when the pulp core temperature of all probe monitored fruit reaches 46 °C, and this temperature will be maintained for 10 minutes.

BPI will ensure that copies of the data logger records of each treatment, supplied to BPI by the respective registered facility operators after each treatment, are forwarded to AQIS. This documentation will include the Phytosanitary Certificate (PC) numbers and import permit number that are applicable to that treatment. Information regarding the mode of conveyance and port of entry will be included in the relevant sections on the PC. This requirement may be reviewed after one season of operation to determine whether this provides adequate control.

Pre-export phytosanitary inspection and certification

An inspection 'lot' is no greater than all mango fruit treated for export to Australia on one day from one registered treatment centre.

The fruit will be sampled by BPI in accordance with the sampling plan which will be detailed in the SCU document, at 600 fruit per lot. Up to 500 fruit to make up the sample may come from treated fruit culled during packing. One hundred fruit, or enough fruit to make up 600 fruit if not enough fruit is available from the cull, will be taken from treated fruit selected for packing. The sample fruit will be examined externally first and then cut to check for internal feeding insects.

Internal feeding insects found in the sampled fruit must be identified by a designated technical expert and the resulting determinations together with the source and date of harvest submitted to AQIS. No fruits are permitted to be exported to Australia while identification is pending.

If MPW or any previously unrecorded fruit or seed feeding species are identified, all mango exports from the Philippines will be suspended and AQIS informed immediately. Fruit in transit will be refused entry.

If live fruit flies are found in exports from a registered treatment plant they will be suspended and any previously treated fruit in storage rejected for export. BPI will isolate the cartons and label the cartons "not for export to Australia" or deface the "For Australia" marks. AQIS will be informed immediately.

If other quarantine pests, including *Deanolis sublimbalis* (RBMC) and/or *Nephopterix* sp. (BB) are identified the lot will be rejected for export to Australia. BPI will isolate the cartons and label the cartons "not for export to Australia" or deface the "For Australia" marks.

If fruit sampling and inspection is carried out with no quarantine pests detected, a Phytosanitary Certificate (PC) is to be issued by BPI for each 'lot'. The PC will bear the number of cartons per

lot and the treatment centre name and details of the treatment undertaken, container seal number if applied, and the additional declarations required under the SCU.

On-arrival phytosanitary inspection by AQIS
A consignment is the fruit covered by one PC that arrives at one port in one shipment.

On-arrival inspection for quarantine pests will be carried out by AQIS on each consignment in accordance with the sampling plan outlined in the SCU which will be at the rate of 600 fruit per consignment. AQIS will take the following action if quarantine pests including exotic fruit flies are found or the certification does not conform to specifications or the seals on the shipping containers are damaged. Fruit showing damage or punctures may be cut for internal examination.

Fruit flies
Any consignment found to be infested with fruit flies will be refused entry with the options of re-export or destruction. AQIS will inform BPI that the export program is suspended immediately and fruit from the Philippines would be refused entry until the source of the infested fruit is identified, the reasons for failure established and appropriate corrective action is agreed between the BPI and AQIS.

Mango pulp weevil
Any consignment found to be infested or containing dead MPW will be refused entry with the options of re-export or destruction. AQIS will inform BPI that the export program is suspended immediately and fruit from the Philippines would be refused entry until the source of the infested fruit is identified, the reasons for failure established and appropriate corrective action is agreed between the BPI and AQIS.

Other quarantine pests
Any consignment found to be infested with other quarantine pests will be given the options of re-export, destruction or treatment. AQIS will inform BPI of the details of such findings including documentation, and request corrective action.

Documentation errors
Any consignment found with defective or incomplete documentation may be refused entry with the options of re-export or destruction. AQIS will hold consignments and inform BPI immediately so that they can attempt to address the problem.

5.2. Responsibility of competent authority

The Phillipines Bureau of Plant Industry (BPI) is the designated NPPO under the International Plant Protection Convention (IPPC).

The NPPO's responsibilities include:

- inspecting plants and plant products moving in international trade
- issuing certificates relating to phytosanitary condition and origin of consignments of plants and plant products

- ensuring that all relevant agencies participating in this program meet the proposed service and certification standards and proposed work plan procedures
- ensuring that administrative processes are established to meet the requirements of the program.

5.3. Review of processes

5.3.1. Audit of protocol

Prior to the first season of trade BSG will visit mango production areas in the province of Davao del Sur to audit the operational procedures, treatment facilities and the MSW and MPW area freedom protocols before mangoes can be exported from the province of Davao del Sur, of Mindanao Island, Philippines to Australia. In addition, the results of ongoing MSW, MPW area freedom verification requirements, as outlined within the existing SCU for Guimaras Island, will be audited for the province of Davao del Sur to ensure ongoing compliance with specified requirements.

5.3.2. Review of policy

Biosecurity Services Group reserves the right to review the adopted policy after the first year of trade or when there is reason to believe that the pest or phytosanitary status of the Philippines has changed.

BPI must inform Biosecurity Australia or AQIS immediately on detection in the Philippines of any new pests of mango fruit that are of potential quarantine concern to Australia.

5.4. Uncategorised pests

If an organism is detected on mango fruit, either in the Philippines or on-arrival in Australia, that has not been categorised, it will require assessment by Biosecurity Australia to determine its quarantine status and if phytosanitary action is required. The detection of any pests of quarantine concern not already identified in the analysis may result in remedial action and/or suspension of trade while a review is conducted to ensure that existing measures continue to provide the appropriate level of phytosanitary protection for Australia.

FINAL REPORT

Improving mango industry sustainability and smallholder income generation in the Philippines through expansion of area freedom certification against mango pulp and seed weevils

AusAID Public Sector Linkages Program: Project no: ROU 14039

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Date of Final report: January 2007.

EXECUTIVE SUMMARY

A detection survey funded by AusAID via the Public Sector Linkages Program (PSLP) was undertaken in the Philippines during 2006 for mango seed and pulp weevils, both pests of Quarantine importance. Survey methodology was developed and agreed to at a meeting held in Canberra in December 2005 between Biosecurity Australia (BA) and the project partners, the Department of Primary Industries and Fisheries (DPI&F), Queensland and the Department of Agriculture - Bureau of Plant Industries (DA-BPI), Philippines. The survey was conducted in the Province of Davao del Sur in south eastern Mindanao, an important mango producing area in the southern Philippines.

Prior to project implementation, staff of the Local Government Unit (LGU) of Davao del Sur were briefed at a meeting of Provincial Administrators where the project outline and anticipated outcomes were presented. The project received the full support of the LGU who pledged logistics assistance. Seventeen local field staff were recruited and trained in random sampling techniques, insect identification, site and tree selection and data recording. Field surveys commenced in late February 2006 to coincide with the main mango fruiting season and continued up to the end of November 2006.

Eight mango fruits from each of 22,621 individual bearing trees were collected and processed from the 14 municipalities and 325 barangays which had been previously identified as areas containing bearing mango trees. Trees and fruit were randomly selected, fruits were cut open and the flesh and seed visually inspected for presence of weevils and/or symptoms. At the same time fruit were assessed for damage from other insect pests to provide data on significant insect activity. This information will be useful in a current ACIAR funded project to improve mango pest management and post harvest handling for mango in the Philippines.

No evidence of any stage of either seed or pulp weevil was detected in 180,968 mango fruits collected from all producing areas in Davao del Sur throughout 2006. Satellite maps (1:50,000) showing location of all sample trees have been prepared.

The project also supported research into the district wide distribution of mango seed weevil in north Queensland commercial and domestic mango trees during 2005/06 and studies have commenced to develop field control strategies.

The next steps involve verification of area freedom by Quarantine officials and the implementation of internal Quarantine measures to maintain area freedom in Davao del Sur. Furthermore, this project provides a model for future detection surveys in adjoining provinces, thus expanding area freedom for mango seed and pulp weevils to other mango producing provinces in Mindanao.

Recommendations

1. The Local Government Unit (LGU) of Davao del Sur request the Bureau of Plant Industry to provide an Administrative Order, declaring Davao del Sur as being free from both the pulp and seed weevils.

2. Fast track the evaluation of this survey by Biosecurity Australia (BA) to obtain the final document for area freedom certification of Davao del Sur from pulp/seed weevils.

3. The Plant Quarantine Service, Philippines in collaboration with the LGU to fast track the construction of road blocks and check points in strategic entry points into Davao del Sur to protect the province's current and future area freedom status.

4. Conduct information campaigns regarding the area freedom status of Davao del Sur, from the pulp/seed weevils via construction of billboards, print material and radio broadcasts.

5. Strengthen municipal ordinance concerning the prohibition of mango fruits and its parts from entering Davao del Sur.

Construct a common packing facility to consolidate large volume of fruits for consistent supply of better quality mangoes and fruit monitoring.

Acknowledgements

This survey could not have been possible without the funding support of the Australian Federal Government through its AusAID and the Public Sector Linkages Programs (PSLP) and the commitment of DA-Bureau of Plant industry, Philippines and the Department of Primary Industries and Fisheries, Queensland, Australia.

The project staff in Davao del Sur worked tirelessly, at times under difficult conditions, to collect and process mango fruit. The extensive and intensive sampling would not have been achieved without the team's commitment which we gratefully acknowledge.

We also thank the Local Government Unit of Davao del Sur particularly the Department of Agriculture and the Office of the Provincial Agriculturist (OPAg), Digos city and in particular to Ma Epifania Solomon, Officer in Charge, OPAg for her support and permission to use the office facility in Digos.

We also thank Mr Rob Bauer for his involvement in the staff training in the Philippines and for the initial sampling guidance and for his work in preparing the GPS data for incorporation into topographic maps and Mr Peter Bannink of the Department of Natural Resources, Mareeba GIS unit for preparation of the satellite maps of the survey area.

We also thank the many mango growers who willingly and freely provided the fruit samples and who have served as a driving force and inspiration to uplift the socio-economic lives of Davaoweños.

DETAILED FINAL REPORT

Introduction

Mango is the third most important fruit crop in the Philippines after banana and pineapple but unlike these two crops, which are mostly owned and controlled by the multi-nationals, mango remains primarily a small-holder or backyard crop with 74% of mango farms being small holdings (Anon, 2002). For this reason, higher mango prices will benefit a significant proportion of the rural sector in regions where mango is an important cash crop. Currently, seasonal gluts result in low farmer returns and the expansion of export markets is viewed as an opportunity to reduce periods of extended domestic low prices for fresh and processed mangoes and lead directly to improved living standards in rural areas.

In 2004, the area planted to mango in the Philippines was about 159,000 ha producing over one million metric tons of fresh fruit. The national mango industry generates an estimated 4.6 billion Piso annually and supports 2.5 million Filipinos. Annual value of exported fresh and processed mango products is 31 and 29.7 million US dollars respectively (Anon, 2004).

At present, only limited volumes of mangoes from the small Philippine island of Guimaras, which is certified free of seed and pulp weevil, can be exported into the USA and Australia. The alleged presence of these pests in other areas is preventing exports of fresh mango fruit from other parts of the Philippines. Johnson (1987) conducted a national survey for the seed weevil, *Sternochetus mangiferae*, but failed to detect its presence in 33 mango growing provinces of the country. However, a related species, the mango pulp weevil, *S. frigidus*, was found on the western Philippine island of Palawan (Basio *et al* 1994). Plant quarantine order No. 20 was issued and implemented in 1987 placing the entire province under quarantine. This prevented the movement of fruits and other vegetative mango material from Palawan. Up to the present day there is no substantiated evidence that the mango pulp weevil or the related species, the mango seed weevil, is present in other parts of the Philippines.

This project conducted an extensive and intensive detection survey for both mango seed and pulp weevils in the Province of Davao del Sur to determine if either weevil was present in mango fruits. A negative finding would be used to support a request to the appropriate quarantine authorities to recognize area freedom and allow exports of fresh mango fruit into overseas markets that currently prohibit mango imports from Mindanao due to the perceived presence of pulp and seed weevils. The project also links with the national USAID funded program to demonstrate freedom from seed and pulp weevils in other mango producing areas of the Philippines and an ACIAR funded project to improve fruit quality by improving insect and disease management and post harvest handling.

Methodology

Survey Area

The survey was conducted in the Province of Davao del Sur, excluding the autonomous region of City of Davao in the north. Davao del Sur is part of Region XI in southern Mindanao, Philippines (Appendix A.1). The province comprises 14 municipalities and 325 barangays (Table 1) Digos is the provincial capital.

The province is bounded on the east by the Philippine Sea (Davao Gulf), a mountain range to the west, which acts as a natural and political boundary between Cotabato in the north west and Southern Cotabato and Sarangani in the south west. The political border with City of Davao forms the northern border and the survey area extends south to the Sarangani Strait. The province occupies an area of 3,828 km^2 representing 20 percent of the total land area of Region XI (Appendix A.1, Fig. 1a and 1b).

Since only three major roads enter the province, one from General Santos City in South Cotabato, one from North Cotabato in the west and one from Davao City in the north it will be possible to implement internal quarantine measures to maintain area freedom with appropriate road checks. These are currently being implemented with LGU logistic and financial support and supervision and professional support from Mr Larry Lacson from DA-BPI Plant Quarantine Service.

The mango development program is aggressively pursued in Davao del Sur and its adjacent provinces, providing the country with enough fruits during the off season production periods in other parts of the Philippines. Davao del Sur has also established export credibility by supplying high quality mangoes to important markets of Hong Kong and Japan and has modern vapour heat treatment facilities for pest disinfestation. Other export destinations are being pursued including China.

In order to facilitate the survey, the province was divided into 4 zones (Table 1)

Table 1. Detail of survey area demographics - Davao del Sur, 2006

Zone	Municipalities	Land Area (km^2)	No. of Barangays
1 (North Eastern)	Sta. Cruz	335	18
	Digos City	318	26
	Hagonoy	132	21
	Padada	45	17
2 (North Western)	Bansalan	200	25
	Magsaysay	76	22
	Matanao	174	33
3 (Central)	Sulop	161	25
	Kiblawan	183	30
	Malalag	187	15
	Sta. Maria	168	22
4 (Southern)	Malita	564	30
	Don Marcelino	449	15
	Jose Abad Santos	836	26
Total 4	14	3,828	325

Data collection

A one day consultative meeting was held in Digos City during which the LGUs represented by the governor, mayors, provincial/municipal agriculturists and mango stakeholders were briefed on the project objectives and project benefits. The LGU pledged operational logistics assistance as well as providing information on mango tree statistics. Safety issues were also discussed in relation to entry into barangays for the field visits. All local government representatives and mango producers were enthusiastic and supportive of the activity.

Seventeen field staff (Appendix A.2) were given an intensive training course in pest identification, sampling methodology and practical use of global positioning system (GPS) over a 5 day program in Digos City. Scientific staff from DPI&F and DA-BPI provided the training and, to ensure close adherence to sampling methodology as specified in the protocol, one DPI&F technical officer assisted with all aspects of field operations during the first 3 weeks of sampling.

The agreed sampling intensity was based on the minimal number of bearing trees and fruit required to achieve a 99% probability of pest detection when at least 1% of trees were infested and 15% of their fruits were infested (Chinese protocol to demonstrate farm or area freedom (Anon, 2005)). In this instance the "area" was deemed to be the municipality. The sampling intensity (number of required sample trees per municipality) was then deduced from the total number of trees in each of the 14 municipalities. On this basis, municipalities with more than

10,000 bearing trees required a sample size of 631 trees and 5048 fruits. Furthermore, wherever possible, a 70/30 bias towards trees that were not treated with any pesticides ("back yard") was suggested to maximize the likelihood of weevil detection. Trees were chosen opportunistically while searching for mango trees with appropriate fruit maturity within barangays or at random within established orchards. If only one or few trees were present, fruit samples were taken from all fruit bearing trees. To ensure year long sampling, most locations were visited and sampled over four separate periods. Each period included two months during the fruiting or "on" season or three months in the low fruiting season. Sampled trees were marked with permanent paint to ensure that once sampled these trees were not included in subsequent samplings.

Eight (8) mango fruits were collected per tree (2 fruits from each of 4 quadrants) by hand or with the assistance of a picking pouch on a short pole. To ensure the maximum opportunity to detect weevils, only fruits older than 65 days after flower induction (DAFI) and, if date of flower induction was unknown, only fruits with length greater than 70 mm (stalk to apex) were sampled. Whenever possible, fruit that were not bagged were preferentially sampled, again to maximise the likelihood of being infested. Sound fallen fruit of adequate size were allowed to be included in the sample.

Fruits were either cut and visually inspected in the field or transported to a central location for cutting depending on available conditions. A purpose designed mango fruit slicer was used to split fruit along the central longitudinal axis to expose the cotyledons, seed coat and flesh. Visual inspections were used to detect presence of all insect stages and damage. Data was processed by the project coordinator who was responsible for data entry into a specifically designed Access® data base. The GPS location of all sample trees was recorded and plotted on topographic maps using GIS ArcInfo Workstation Ver 9.3 software to provide a visual representation of the province-wide distribution of sample sites.

The experience obtained in the previous survey conducted on Guimaras Island was used as a model with modifications to methodology to suit local conditions and newly available technologies such as GPS,GIS and Access® database.

Results and Discussions

A full breakdown of numbers of bearing mango trees and the current number of bearing mango trees per Municipality and cultivars sampled in Davao del Sur is presented in Tables 2 and 3 respectively.

Not a single specimen (egg, larvae, pupae and adult) or symptoms of mango seed and pulp weevil attack was detected. The results of this survey (Table 4) demonstrate that these insects are extremely unlikely to be present in Davao del Sur as demonstrated by the negative findings from a cut and inspection of 180,968 mango fruit. Based on the Chinese protocol, to satisfy the area or farm freedom requirements, the survey required that eight fruit from each of 8,771 trees from the 14 Municipalities be cut, inspected and found free of the weevil. This comprehensive survey exceeded the Chinese sampling intensity by 2.5 times overall and, per Municipality, the required number of trees and fruits were exceeded by between 112% and 532%.

Because of a shortage of "backyard" trees, the original 70:30 ratio of backyard to commercial trees was not achieved. The actual ratio was 51:49. This is considered to be adequate in view of the extensive and comprehensive nature of the survey, furthermore, in eastern Australia, where the seed weevil is endemic, infestation levels of 1 to 10% or higher are common in commercial orchards even when subjected to medium to heavy pesticide regimes. Therefore, if the pests were present it is highly likely that they would have been detected even from fruit originating from commercial orchards.

The majority of mango cultivars present were sampled to ensure that any cultivar bias was accounted for (Table 3). Carabao cultivar (the main commercial cultivar) represented the majority of samples making up 77.6% of all fruit. Other cultivars were Paho, Native Carabao, Indian, Spanish/Batuta/Cabayo and Pico which made up 4.3%, 4.1%, 1%, 0.99% and 0.19% respectively. Approximately 12% were from unclassified mono-embryonic cultivars. As the Carabao is the cultivar of choice for export, sampling was concentrated on this cultivar.

Although not directly impacting on the result of the detection survey, other insect pests were recovered or damage observed from a significant numbers of fruit (Table 5). Symptoms of the mango gall midge (cecid fly), *Procontarinia spp* were the most common damage (8%) followed by fruit fly, *Bactrocera philipinensis/occipitalis* (6.6%), seed borer (red banded mango caterpillar), *Deanolis sublimbalis* (6.1%), capsid bug, *Helopeltis spp.* (4.2%), various mealybugs (1.5%) various scale insects (0.7%) and black borer, *Nephoteryx sp.* (0.5%).

Table 2. Breakdown of bearing mango trees and tree sampling for each zone in Davao del Sur (February - November 2006)

Municipality		No. of barangays surveyed	Reported no. of bearing trees	Target no. to be sampled *	Actual no. of trees sampled	Type of planting **	
						Backyard	Orchard
Zone 1							
	Sta. Cruz	18	17,650	631	730	602	128
	Digos City	26	105,048	631	3,362	2,143	1,219
	Hagonoy	21	93,234	631	2,979	548	2431
	Padada	17	8,549	617	752	582	170
	sub-total	**82**	**224,481**	**2,510**	**7,823**	**3,875**	**3,948**
Zone 2							
	Bansalan	25	83,864	631	2,767	2,014	753
	Magsaysay	22	51,740	631	1,766	1,153	613
	Matanao	33	61,560	631	2,229	755	1,474
	sub-total	**80**	**197,164**	**1,893**	**6,762**	**3,922**	**2,840**
Zone 3							
	Kiblawan	30	34,478	631	1,346	680	666
	Malalag	15	61,000	631	1,956	818	1,138
	Sta. Maria	22	26,300	631	967	356	620
	Sulop	25	29,650	631	1,099	463	636
	sub-total	**92**	**151,428**	**2,524**	**5,568**	**2,317**	**3,060**
Zone 4							
	Malita	30	28,120	631	1,281	613	668
	Don Marcelino	15	6,800	617	692	402	290
	J.A. Santos	26	3,162	596	686	474	212
	sub-total	**71**	**38,082**	**1,844**	**2,659**	**1,489**	**1,170**
	TOTAL	**325**	**611,155**	**8,771**	**22,621**	**11,603**	**11,018**

*** Required sample size based on China Protocol (Anon, 2005): viz. 400-500 trees per area = 414 trees; 501-600 = 442; 601-1000 = 506; 1001 - 2000 = 564; 2001 - 3000 = 585; 3001 - 4000 = 596; 4001 -5000 = 603; 5001 - 10,000 = 617 and >10,000 = 631 trees**

** **Backyard** - tree receiving no pesticide treatments and, if managed, only receiving flower induction treatments.

Orchard - trees usually well managed and receiving some pesticide treatments.

Table 3. Number of fruits collected and dissected by Municipality and cultivar (February – November 2006)

Municipality	Target fruits for collection	Actual no. of fruits collected/dissected	Classification of mango fruits collected by variety						
			Carabao	'Pico'	'Native Carabao'	'Indian'	'Spanish/Batuta/ Kabayo'	'Paho'	Others *
Zone 1									
	Sta. Cruz	5,840	3,256	0	648	8	48	640	160
	Digos City	26,896	14,304	0	1,160	0	152	952	392
	Hagonoy	23,832	16,780	8	520	1,680	16	272	3,320
	Padada	6,016	3,024	8	280	0	112	168	72
	sub-total	**62,584**	**37,364**	**16**	**2,608**	**1,688**	**328**	**2,032**	**3,944**
Zone 2									
	Bansalan	22,136	11,296	32	248	0	0	296	512
	Magsaysay	14,128	7,244	24	464	0	0	200	450
	Matanao	17,832	8,780	48	336	0	8	80	232
	sub-total	**54,096**	**27,320**	**104**	**1,048**	**0**	**8**	**576**	**1,194**
Zone 3									
	Kiblawan	10,768	5,588	88	984	16	632	176	64
	Malalag	15,648	9,400	48	592	0	416	536	72
	Sta. Maria	7,736	4,976	24	232	8	56	224	64
	Sulop	8,792	4,168	32	376	0	128	152	32
	sub-total	**42,844**	**24,132**	**192**	**2,184**	**24**	**1,232**	**1,088**	**232**
Zone 4									
	Malita	10,248	1,577	0	0	0	0	1,560	6,568
	Don Marcelino	5,536	1,056	0	0	0	0	840	3,056
	J.A. Santos	5,488	344	0	0	0	0	400	848
	sub-total	**21,272**	**2,977**	**0**	**0**	**0**	**0**	**2,800**	**10,472**
	TOTAL	**180,968**	**91,793**	**312**	**5,840**	**1,712**	**1,568**	**6,496**	**15,842**

* Others - unidentified mango cultivar.

** Percentage of minimal sample required

Table 4. Incidence of mango pulp/seed weevils from total mango fruits dissected (February – November 2006)

	Municipality	No. of fruits collected and dissected	Incidence of weevils *	
			MPW	MSW
Zone 1				
	Sta. Cruz	5,840	0	0
	Digos City	26,896	0	0
	Hagonoy	23,832	0	0
	Padada	6,016	0	0
	sub-total	**62,584**	0	0
Zone 2				
	Bansalan	22,136	0	0
	Magsaysay	14,128	0	0
	Matanao	17,832	0	0
	sub-total	**54,096**	0	0
Zone 3				
	Kiblawan	10,768	0	0
	Malalag	15,648	0	0
	Sta. Maria	7,736	0	0
	Sulop	8,792	0	0
	sub-total	**42,944**	0	0
Zone 4				
	Malita	10,248	0	0
	Don Marcelino	5,536	0	0
	J.A. Santos	5,488	0	0
	sub-total	**21,272**	0	0
	TOTAL	**180,968**	**0**	**0**

* MSW - Mango Seed Weevil
MPW - Mango Pulp Weevil

Table 5. Incidence of other pests detected on or in fruit(Feb – Nov 2006)

Municipality	No. of fruits collected	Incidence of other insect pests – local common name							Fruit status	
		Seed borer	Fruit fly	Black borer	Helopeltis	Cecid fly	Scale Insects	Mealy bug	Non-infested	Infested
1.1.1 Zone 1										
Sta. Cruz	5,840	167	451	23	41	317	4	16	4,765	1,019
Digos City	26,896	551	1,917	47	165	1,785	29	81	18,033	4,575
Hagonoy	23,832	628	1,906	62	137	693	152	180	19,678	3,758
Padada	6,016	179	358	14	56	208	10	18	4,677	843
sub-total	**62,584**	**1,525**	**4,632**	**146**	**399**	**3,003**	**195**	**295**	**47,153**	**10,195**
1.1.2 Zone 2										
Bansalan	22,136	841	370	0	343	1,077	51	298	17,468	2,980
Magsaysay	14,128	555	472	0	297	777	52	432	10,757	2,585
Matanao	17,832	1,628	882	0	362	2,112	96	525	9,327	5,605
sub-total	**54,096**	**3,024**	**1,724**	**0**	**1,002**	**3,966**	**199**	**1,255**	**37,552**	**11,170**
1.1.3 Zone 3										
Kiblawan	10,768	398	191	124	767	605	52	9	8,690	2,146
Malalag	15,648	444	205	116	1,021	1,158	60	15	11,333	3,019
Sta. Maria	7,736	560	307	125	831	426	14	16	4,537	2,279
Sulop	8,792	476	92	143	596	444	73	17	5,761	1,831
sub-total	**42,844**	**1,878**	**795**	**508**	**3,215**	**2,633**	**199**	**47**	**30,321**	**9,275**
1.1.4 Zone 4										
Malita	10,248	995	1,121	0	672	319	226	238	6,286	3,971
Don Marcelino	5,536	337	477	0	394	111	112	135	4,066	1,566
J.A. Santos	5,488	142	379	0	312	13	98	42	4,462	986
sub-total	**21,272**	**1,474**	**1,977**	**0**	**1,378**	**843**	**436**	**415**	**14,814**	**6,523**
TOTAL	**180,968**	**7,901**	**9,128**	**654**	**5,994**	**10,445**	**1,029**	**2,012**	**129,840**	**37,163**

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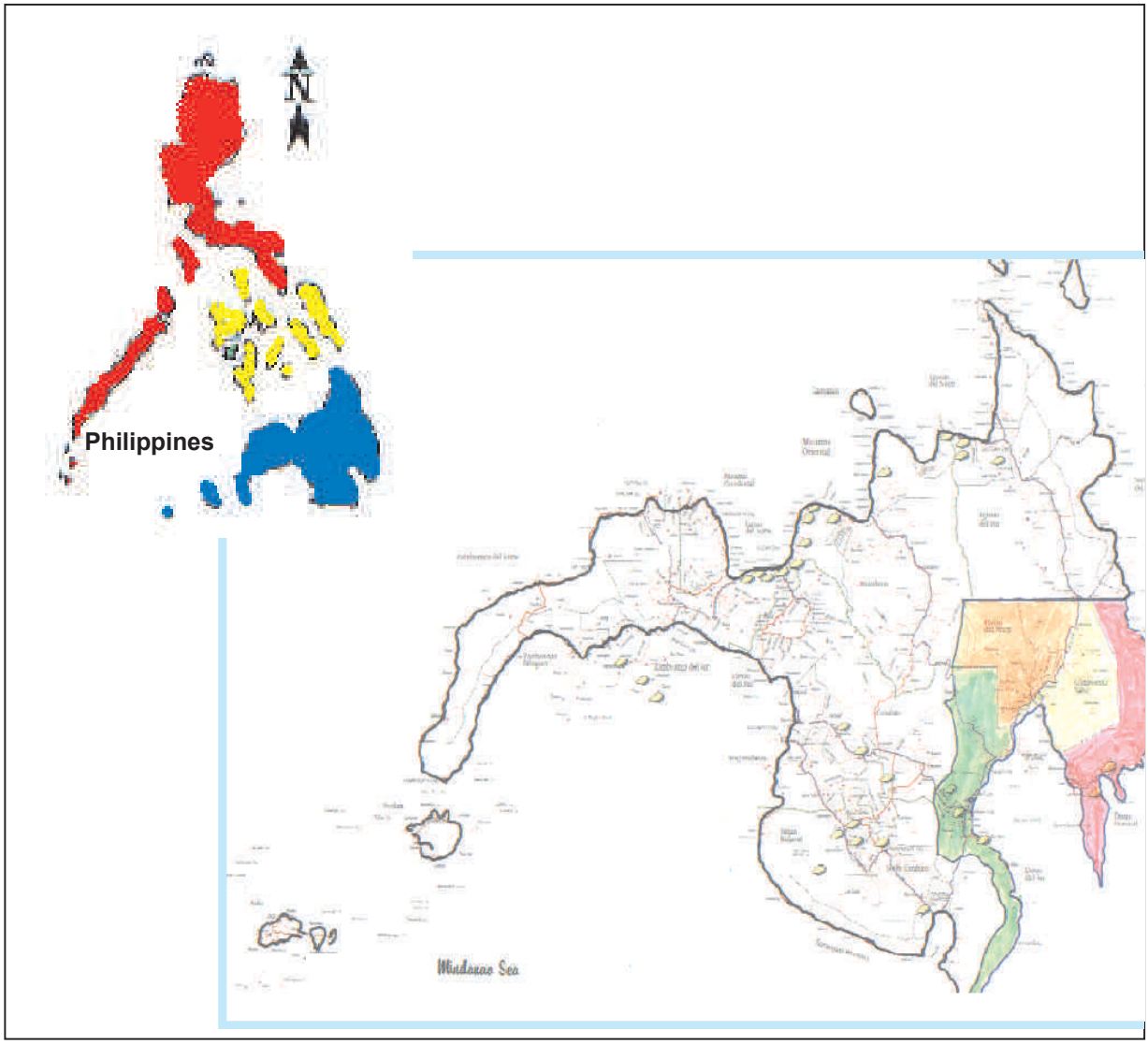
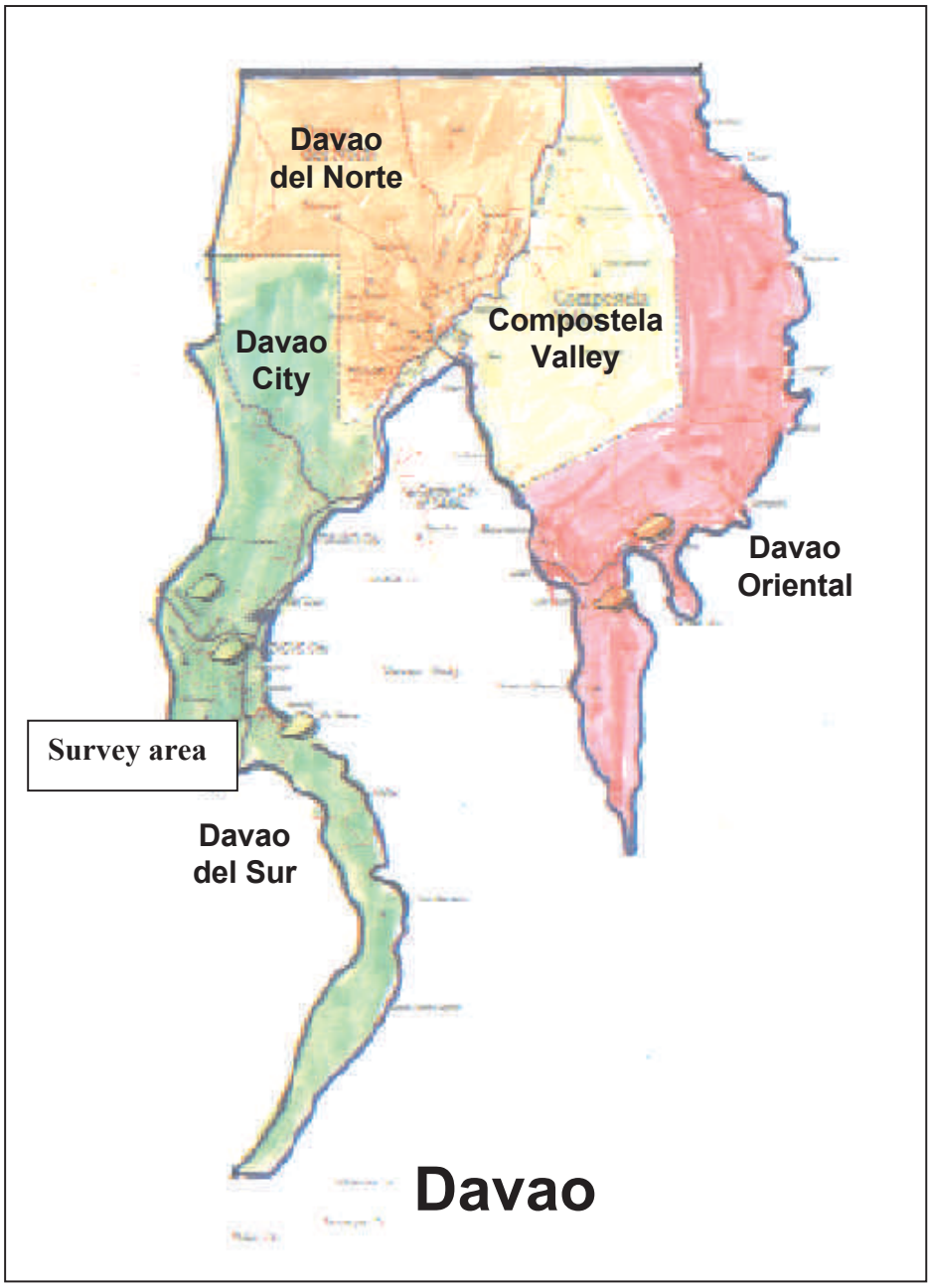
Appendix A.1

Figure 1a. Map of the Philippines showing Mindanao and Region XI (Davao Province)



Appendix A.1 (cont.)

Figure 1b. Detail of Davao del Sur



Appendix A.2

Name of Survey Enumerators, Designation and Area of Assignment

Name	Designation	Area of Assignment
Erwin John V. Comilang	Project coordinator	Davao del Sur
Larry L. Solomon, Jr.	Project Driver	Davao del Sur
Marlon F. Siatan	Zone 1 Supervisor	Sta. Cruz, Digos, Hagonoy & Padada
Rey M. Bernardino	Zone 2 Supervisor	Matanao, Bansalan Magsaysay
Leonaveth L. Nedamo	Zone 3 Supervisor	Sulop, Kiblawan, Malalag & Sta. Maria
Ferdinand L. Crispino	Zone 4 Supervisor	Malita, Don Marcelino & Jose Abad Santos
Emie D. Abadies	Zone 1 Enumerator	Sta. Cruz,Digos, Hagonoy & Padada
Amor M. Lanticse	Zone 1 Enumerator	Sta. Cruz,Digos, Hagonoy & Padada
Marie Ann N. Mejares	Zone 1 Enumerator	Sta. Cruz,Digos, Hagonoy & Padada
Amor L. Claud	Zone 2 Enumerator	Matanao, Bansalan & Magsaysay
Josephine P. Parilla	Zone 2 Enumerator	Matanao, Bansalan & Magsaysay
Rodolfo L. Camporedondo	Zone 2 Enumerator	Matanao, Bansalan & Magsaysay
Allan V. Fernandez	Zone 3 Enumerator	Sulop, Kiblawan, Malalag & Sta. Maria
Ferdinand Caesario I. Briones	Zone 3 Enumerator	Sulop, Kiblawan, Malalag & Sta. Maria
Mervin A. Abella	Zone 3 Enumerator	Sulop, Kiblawan, Malalag & Sta. Maria
Olimark Jon V. Comilang	Zone 4 Enumerator	Malita, Don Marcelino & Jose Abad Santos
Ginalyn A. Lantecse	Zone 4 Enumerator	Malita, Don Marcelino & Jose Abad Santos
Aubrey E. Bautista	Zone 4 Enumerator	Malita, Don Marcelino & Jose Abad Santos

Appendix B Biosecurity framework

Australia's biosecurity policies

The objective of Australia's biosecurity policies and risk management measures is the prevention or control of the entry, establishment or spread of pests and diseases that could cause significant harm to people, animals, plants and other aspects of the environment.

Australia has diverse native flora and fauna and a large agricultural sector, and is relatively free from the more significant pests and diseases present in other countries. Therefore, successive Australian Governments have maintained a conservative, but not a zero-risk, approach to the management of biosecurity risks. This approach is consistent with the World Trade Organization's (WTO's) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement).

The SPS Agreement defines the concept of an 'appropriate level of protection' (ALOP) as the level of protection deemed appropriate by a WTO Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory. Among a number of obligations, a WTO Member should take into account the objective of minimising negative trade effects in setting its ALOP.

Like many other countries, Australia expresses its ALOP in qualitative terms. Australia's ALOP, which reflects community expectations through Australian Government policy, is currently expressed as providing a high level of sanitary and phytosanitary protection, aimed at reducing risk to a very low level, but not to zero.

Consistent with the SPS Agreement, in conducting risk analyses Australia takes into account as relevant economic factors:

- the potential damage in terms of loss of production or sales in the event of the entry, establishment or spread of a pest or disease in the territory of Australia
- the costs of control or eradication of a pest or disease
- and the relative cost-effectiveness of alternative approaches to limiting risks.

Roles and responsibilities within Australia's quarantine system

Australia protects its human[6], animal and plant life or health through a comprehensive quarantine system that covers the quarantine continuum, from pre-border to border and post-border activities.

Pre-border, Australia participates in international standard-setting bodies, undertakes risk analyses, develops offshore quarantine arrangements where appropriate, and engages with our neighbours to counter the spread of exotic pests and diseases.

At the border, Australia screens vessels (including aircraft), people and goods entering the country to detect potential threats to Australian human, animal and plant health.

[6] The Australian Government Department of Health and Ageing is responsible for human health aspects of quarantine.

The Australian Government also undertakes targeted measures at the immediate post-border level within Australia. This includes national co-ordination of emergency responses to pest and disease incursions. The movement of goods of quarantine concern within Australia's border is the responsibility of relevant state and territory authorities, which undertake inter- and intra-state quarantine operations that reflect regional differences in pest and disease status, as a part of their wider plant and animal health responsibilities.

Roles and responsibilities within the Department

The Australian Government Department of Agriculture, Fisheries and Forestry is responsible for the Australian Government's animal and plant biosecurity policy development and the establishment of risk management measures. The Secretary of the Department is appointed as the Director of Animal and Plant Quarantine under the *Quarantine Act 1908* (the Act).

The Biosecurity Services Group (BSG) within the Department takes the lead in biosecurity and quarantine policy development and implementation of risk management measures across the biosecurity continuum, and:

- through Biosecurity Australia, conducts risk analyses, including IRAs, and develops recommendations for biosecurity policy as well as providing quarantine advice to the Director of Animal and Plant Quarantine
- through the Australian Quarantine and Inspection Service (AQIS), develops operational procedures, makes a range of quarantine decisions under the Act (including import permit decisions under delegation from the Director of Animal and Plant Quarantine) and delivers quarantine services and
- coordinates pest and disease preparedness, emergency responses and liaison on inter- and intra-state quarantine arrangements for the Australian Government, in conjunction with Australia's state and territory governments.

Roles and responsibilities of other government agencies

State and territory governments play a vital role in the quarantine continuum. The BSG works in partnership with state and territory governments to address regional differences in pest and disease status and risk within Australia, and develops appropriate sanitary and phytosanitary measures to account for those differences. Australia's partnership approach to quarantine is supported by a formal Memorandum of Understanding that provides for consultation between the Australian Government and the state and territory governments.

Depending on the nature of the good being imported or proposed for importation, Biosecurity Australia may consult other Australian Government authorities or agencies in developing its recommendations and providing advice.

As well as a Director of Animal and Plant Quarantine, the Act provides for a Director of Human Quarantine. The Australian Government Department of Health and Ageing is responsible for human health aspects of quarantine and Australia's Chief Medical Officer within that Department holds the position of Director of Human Quarantine. Biosecurity Australia may, where appropriate, consult with that Department on relevant matters that may have implications for human health.

The Act also requires the Director of Animal and Plant Quarantine, before making certain decisions, to request advice from the Environment Minister and to take the advice into account when making those decisions. The Australian Government Department of the Environment, Water, Heritage and the Arts (DEWHA) is responsible under the Environment Protection and Biodiversity Conservation Act 1999 for assessing the environmental impact associated with proposals to import live species. Anyone proposing to import such material should contact DEWHA directly for further information.

When undertaking risk analyses, Biosecurity Australia consults with DEWHA about environmental issues and may use or refer to DEWHA's assessment.

Australian quarantine legislation

The Australian quarantine system is supported by Commonwealth, state and territory quarantine laws. Under the Australian Constitution, the Commonwealth Government does not have exclusive power to make laws in relation to quarantine, and as a result, Commonwealth and state quarantine laws can co-exist.

Commonwealth quarantine laws are contained in the *Quarantine Act 1908* and subordinate legislation including the Quarantine Regulations 2000, the Quarantine Proclamation 1998, the Quarantine (Cocos Islands) Proclamation 2004 and the Quarantine (Christmas Island) Proclamation 2004.

The quarantine proclamations identify goods, which cannot be imported, into Australia, the Cocos Islands and or Christmas Island unless the Director of Animal and Plant Quarantine or delegate grants an import permit or unless they comply with other conditions specified in the proclamations. Section 70 of the Quarantine Proclamation 1998, section 34 of the Quarantine (Cocos Islands) Proclamation 2004 and section 34 of the Quarantine (Christmas Island) Proclamation 2004 specify the things a Director of Animal and Plant Quarantine must take into account when deciding whether to grant a permit.

In particular, a Director of Animal and Plant Quarantine (or delegate):

- must consider the level of quarantine risk if the permit were granted, and
- must consider whether, if the permit were granted, the imposition of conditions would be necessary to limit the level of quarantine risk to one that is acceptably low, and
- for a permit to import a seed of a plant that was produced by genetic manipulation – must take into account any risk assessment prepared, and any decision made, in relation to the seed under the Gene Technology Act, and
- may take into account anything else that he or she knows is relevant.

The level of quarantine risk is defined in section 5D of the *Quarantine Act 1908*. The definition is as follows:

> reference in this Act to a *level of quarantine risk* is a reference to:
>
> (a) the probability of:
>
> (i) a disease or pest being introduced, established or spread in Australia, the Cocos Islands or Christmas Island; and

(ii) the disease or pest causing harm to human beings, animals, plants, other aspects of the environment, or economic activities; and

(b) the probable extent of the harm.

The Quarantine Regulations 2000 were amended in 2007 to regulate keys steps of the import risk analysis process. The Regulations:

- define both a standard and an expanded IRA,
- identify certain steps, which must be included in each type of IRA,
- specify time limits for certain steps and overall timeframes for the completion of IRAs (up to 24 months for a standard IRA and up to 30 months for an expanded IRA),
- specify publication requirements,
- make provision for termination of an IRA, and
- allow for a partially completed risk analysis to be completed as an IRA under the Regulations.

The Regulations are available at www.comlaw.gov.au.

International agreements and standards

The process set out in the *Import Risk Analysis Handbook 2007 (update 2009)* is consistent with Australia's international obligations under the SPS Agreement. It also takes into account relevant international standards on risk assessment developed under the International Plant Protection Convention (IPPC) and by the World Organisation for Animal Health (OIE).

Australia bases its national risk management measures on international standards where they exist and when they achieve Australia's ALOP. Otherwise, Australia exercises its right under the SPS Agreement to apply science-based sanitary and phytosanitary measures that are not more trade restrictive than required to achieve Australia's ALOP.

Notification obligations

Under the transparency provisions of the SPS Agreement, WTO Members are required, among other things, to notify other members of proposed sanitary or phytosanitary regulations, or changes to existing regulations, that are not substantially the same as the content of an international standard and that may have a significant effect on trade of other WTO Members.

Risk analysis

Within Australia's quarantine framework, the Australian Government uses risk analyses to assist it in considering the level of quarantine risk that may be associated with the importation or proposed importation of animals, plants or other goods.

In conducting a risk analysis, Biosecurity Australia:

- identifies the pests and diseases of quarantine concern that may be carried by the good
- assesses the likelihood that an identified pest or disease or pest would enter, establish or spread
- assesses the probable extent of the harm that would result.

If the assessed level of quarantine risk exceeds Australia's ALOP, Biosecurity Australia will consider whether there are any risk management measures that will reduce quarantine risk to achieve the ALOP. If there are no risk management measures that reduce the risk to that level, trade will not be allowed.

Risk analyses may be carried out by Biosecurity Australia's specialists, but may also involve relevant experts from state and territory agencies, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), universities and industry to access the technical expertise needed for a particular analysis.

Risk analyses are conducted across a spectrum of scientific complexity and available scientific information. An IRA is a type of risk analysis with key steps regulated under the Quarantine Regulations 2000. Biosecurity Australia's assessment of risk may also take the form of a non-regulated analysis of existing policy or technical advice to AQIS. Further information on the types of risk analysis is provided in the *Import Risk Analysis Handbook 2007(update 2009)*.

Glossary

Term or abbreviation	Definition
Additional declaration	A statement that is required by an importing country to be entered on a phytosanitary certificate and which provides specific additional information on a consignment in relation to regulated pests (FAO 2009).
Appropriate level of protection (ALOP)	The level of protection deemed appropriate by the Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory (WTO 1995).
Area	An officially defined country, part of a country or all or parts of several countries (FAO 20069).
Area of low pest prevalence	An area, whether all of a country, part of a country, or all 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 (FAO 20069).
Biosecurity Australia	The unit, within the Biosecurity Services Group, responsible for recommendations for the development of Australia's biosecurity policy.
Biosecurity Services Group (BSG)	The group responsible for the delivery of biosecurity policy and quarantine services within the Department of Agriculture, Fisheries and Forestry.
Certificate	An official document which attests to the phytosanitary status of any consignment affected by phytosanitary regulations (FAO 20069).
Consignment	A quantity of plants, plant products and/or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots) (FAO 20069).
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO 20069).
Endangered area	An area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss (FAO 20069).
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO 20069).
Establishment	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 20069).
Fresh	Living; not dried, deep-frozen or otherwise conserved (FAO 20069).
Host range	Species capable, under natural conditions, of sustaining a specific pest or other organism (FAO 20069).
Import permit	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 20069).
Import risk analysis	An administrative process through which quarantine policy is developed or reviewed, incorporating risk assessment, risk management and risk communication.
Infestation (of a commodity)	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 20069).
Inspection	Official visual examination of plants, plant products or other regulated articles to determine if pests are present and/or to determine compliance with phytosanitary regulations (FAO 20069).
Intended use	Declared purpose for which plants, plant products, or other regulated articles are imported, produced, or used (FAO 20069).
Interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment (FAO 20069).
International Standard for Phytosanitary Measures (ISPM)	An international standard adopted by the Conference of the Food and Agriculture Organization, the Interim Commission on phytosanitary measures or the Commission on phytosanitary measures, established under the IPCC (FAO 20069).
Introduction	The entry of a pest resulting in its establishment (FAO 20069).
Lot	A number of units of a single commodity, identifiable by its homogeneity of composition, origin etc., forming part of a consignment (FAO 20069).

National Plant Protection Organization (NPPO)	Official service established by a government to discharge the functions specified by the IPPC (FAO 2009).
Official control	The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests (FAO 2009).
Pathway	Any means that allows the entry or spread of a pest (FAO 20069).
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 20069).
Pest categorisation	The process for determining whether a pest has or has not the characteristics of a quarantine pest or those of a regulated non-quarantine pest (FAO 2009).
Pest free area (PFA)	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 (FAO 20069).
Pest free place of production	Place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period (FAO 20069).
Pest free production site	A defined portion of a place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period and that is managed as a separate unit in the same way as a pest free place of production (FAO 20069).
Pest risk analysis (PRA)	The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it (FAO 20069).
Pest risk assessment (for quarantine pests)	Evaluation of the probability of the introduction and spread of a pest and of the associated potential economic consequences (FAO 2009).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 20069).
Phytosanitary certificate	Certificate patterned after the model certificates of the IPPC (FAO 20069).
Phytosanitary measure	Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO 20069).
Phytosanitary regulation	Official rule to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including establishment of procedures for phytosanitary certification (FAO 2009).
Polyphagous	Feeding on a relatively large number of hosts from different genera.
PRA area	Area in relation to which a pest risk analysis is conducted (FAO 20069).
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 20069).
Regulated article	Any plant, plant product, storage place, packing, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved (FAO 20069).
Restricted risk	Risk estimate with phytosanitary measure(s) applied.
Spread	Expansion of the geographical distribution of a pest within an area (FAO 20069).
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures (WTO 1995).
Stakeholders	Government agencies, individuals, community or industry groups or organizations, whether in Australia or overseas, including the proponent/applicant for a specific proposal, who have an interest in the policy issues.
Systems approach(es)	The integration of different risk management measures, at least two of which act independently, and which cumulatively achieve the appropriate level of protection against regulated pests (FAO 20069).
Unrestricted risk	Unrestricted risk estimates apply in the absence of risk mitigation measures.

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