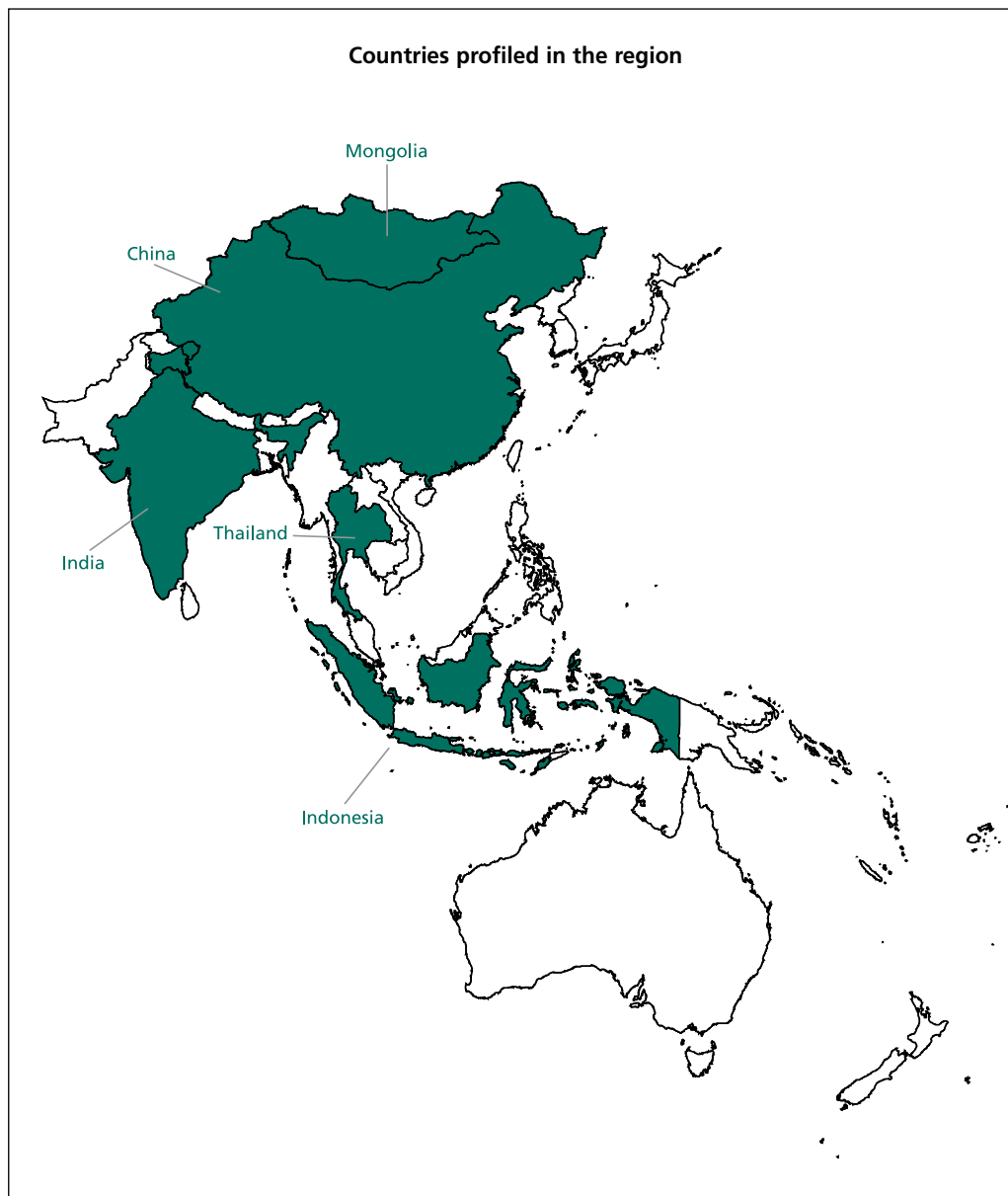


Asia and the Pacific

The total number of forest pest species reported from the five countries in the region was 138 (Figure 3). Insect pests were the most frequently reported pest type (Table 4). Other pests included the pine wood nematode (*Bursaphelenchus xylophilus**) and the mouse (*Apodemus* spp.) from China. Almost 90 percent of the pest species reported are indigenous.

Considerably more pests (77 percent) were reported in planted forests in all countries with the exception of Mongolia, where forest pests were reported equally in naturally regenerated and planted forests. The world's highest plantation rates are found in Asia, particularly China, which is one of the top ten countries for productive forest plantations (FAO, 2006b).



Seventy-eight percent of forest pests were recorded on broadleaf trees, 15 percent on conifers and the remaining 7 percent were recorded on both host tree types. Mongolia was the only country to report more pests on conifer trees, which is consistent with the large area of coniferous forests in the country, particularly in northern areas.

The top two insect pest orders reported in the region were Coleoptera and Lepidoptera (Figure 4). Ascomycota species were the most commonly reported pathogens.

Although this study is primarily concerned with forest pests, the coconut leaf beetle, *Brontispa longissima*, is also included because of its high economic importance to coconuts and ornamental palms in more than one country in the region.

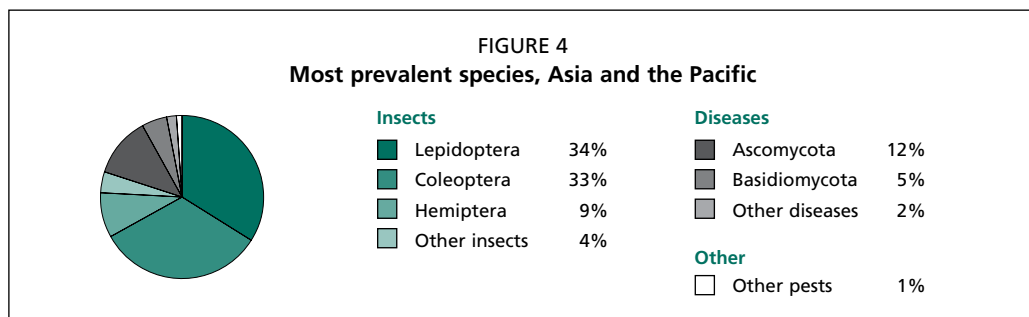
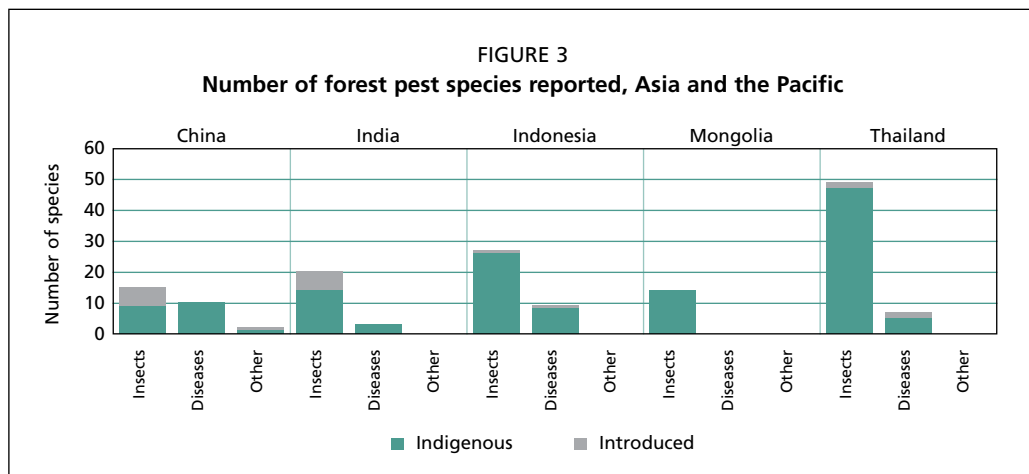


TABLE 4
Summary of the data on forest pest species, Asia and the Pacific

Pest type	Number of pest species						
	Total	In naturally regenerated forests	In planted forests	In both types of forest	On broadleaf	On conifer	On both host types
Indigenous species							
Insects	99	12	68	19	77	15	7
Diseases	24	0	24	0	23	0	1
Other	1	0	1	0	0	0	1
Introduced species							
Insects	11	1	10	0	6	5	0
Diseases	3	0	3	0	3	0	0
Other	1	0	0	1	0	1	0
Total^a	138	13	105	20	108	21	9

^a Note: *Brontispa longissima* is indigenous to Indonesia but has been introduced in Thailand and China; it is counted in both rows (indigenous and introduced) but is not counted twice in the totals.

SPECIES FOUND IN MORE THAN ONE COUNTRY

A number of species were noted to be pests in two or more countries in the region (Table 5). All but one, *Heteropsylla cubana**, are indigenous.

Six of these were recorded in planted forests and seven in both types of forest. Nine species were pests of broadleaf trees, two of conifers and two of both host tree types. Of the 13 species, 12 were insect pests, more than half of which were lepidopteran species.

The Siberian caterpillar, *Dendrolimus sibiricus**, has caused considerable damage to the naturally regenerated forests of China and Mongolia and also to planted forests in Mongolia, especially those planted with *Larix sibirica*.

The Asian gypsy moth, *Lymantria dispar**, was reported on both broadleaf and conifer trees in naturally regenerated forests in China and Mongolia; Mongolia also reported the pest in planted forests of both host types. This pest is a destructive defoliator of many broadleaf and conifer trees, including *Betula*, *Larix*, *Populus*, *Pinus*, *Quercus*, *Salix*, and *Ulmus* species, and is of quarantine concern in many regions of the world.

TABLE 5
Species found in more than one country, Asia and the Pacific

Pest species	Order/phylum: family	Countries of occurrence	Type of forest	Host type
Insects				
<i>Brontispa longissima</i>	Coleoptera: Chrysomelidae	China, Indonesia, Thailand	Planted	Coconut palm
<i>Calopepla leayana</i>	Coleoptera: Chrysomelidae	India, Thailand	Planted	Broadleaf
<i>Coptotermes curvignathus</i>	Isoptera: Rhinotermitidae	Indonesia, Thailand	Planted	Broadleaf, conifer
<i>Dendrolimus sibiricus</i> *	Lepidoptera: Lasiocampidae	China, Mongolia	Naturally regenerated, planted	Conifer
<i>Eutectona machaeralis</i>	Lepidoptera: Pyrilidae	India, Thailand	Naturally regenerated, planted	Broadleaf
<i>Heteropsylla cubana</i> *	Hemiptera: Psyllidae	India, Indonesia, Thailand	Planted	Broadleaf
<i>Hyblaea puera</i>	Lepidoptera: Hyblaeidae	India, Indonesia, Thailand	Naturally regenerated, planted	Broadleaf
<i>Hypsipyla robusta</i> *	Lepidoptera: Pyrilidae	India, Indonesia, Thailand	Planted	Broadleaf
<i>Ips sexdentatus</i> *	Coleoptera: Scolytidae	Mongolia, Thailand	Naturally regenerated, planted	Conifer
<i>Lymantria dispar</i> * (Asian strain)	Lepidoptera: Lymantriidae	China, Mongolia	Naturally regenerated, planted	Broadleaf, conifer
<i>Xyleutes ceramica</i>	Lepidoptera: Cossidae	Indonesia, Thailand	Naturally regenerated, planted	Broadleaf
<i>Zeuzera coffeae</i>	Lepidoptera: Cossidae	Indonesia, Thailand	Naturally regenerated, planted	Broadleaf
Diseases				
<i>Agrobacterium tumefaciens</i>	Rhizobiales: Rhizobiaceae	China, Indonesia	Planted	Broadleaf

Hyblaea puera, *Eutectona machaeralis* and *Xyleutes ceramica* are all major pests of teak in areas of Asia.

Zeuzera coffeae, reported from India and Thailand, typically attacks coffee plants but is also known to cause damage to a wide range of other hosts including *Chukrasia tabularis*, *Eucalyptus deglupta*, *Terminalia brassii*, and species of *Acalypha*, *Psidium*, *Crataegus*, *Citrus*, *Theobroma* and *Casuarina*.

The shoot borer, *Hypsipyla robusta**, is a significant pest of several species of high quality timber species in the region including *Cedrela toona*, *Chukrasia tabularis*, *Swietenia macrophylla*, *S. mahogani*, *Toona australis* and *T. ciliata* as well as species of *Cedrella* and *Tectona*.

Three beetle species were reported: *Brontispa longissima*, a major pest of coconut palms; *Calopepla leayana* a significant defoliator of gamhar, *Gmelina arborea*; and the six-spined engraver beetle, *Ips sexdentatus**, a major pest of many conifer species including *Picea*, *Pinus*, and *Larix*.

Coptotermes curvignathus is a subterranean termite that attacks a wide range of trees and is capable of killing healthy trees. In Southeast Asia, this species is a pest of many planted forest species including all species of conifers, rubber trees (*Hevea brasiliensis*), *Acacia mangium*, *Paraserianthes falcataria* and *Gmelina arborea*.

Recorded in three of the five countries, *Heteropsylla cubana** is a significant pest of *Leucaena leucocephala*, a fast-growing legume native to Mexico and Central America that has been widely planted throughout the region as a source of fuelwood and fodder and for use in agroforestry systems. Between 1985 and 1988, this insect spread rapidly across the Asia and the Pacific region (FAO, 2001).

Only one pathogen was noted to occur in more than one country, the bacterial disease, *Agrobacterium tumefaciens*, which causes significant damage to planted poplar forests in China and planted dipterocarps in Indonesia.

CAPACITY FOR FOREST HEALTH PROTECTION

Monitoring and detection

For the most part, monitoring and detection activities are not part of routine management practices, although some surveillance has been carried out to detect specific problem pests.

In China, a variety of methods are used, ranging from informal surveys to baited traps for specific pests such as the bark beetle, *Dendroctonus valens**. A risk rating system has also been developed for the detection of the pine caterpillar, *Dendrolimus punctatus*, in China.

In Mongolia, some pest surveys have been carried out by scientific institutes. Through an FAO emergency project to assist with outbreaks of the Siberian caterpillar, *Dendrolimus sibiricus**, surveys were carried out to determine the extent of the pest and the subsequent damage. In addition, pest management plans were developed which included monitoring and surveillance.

In both India and Indonesia it was noted that monitoring and detection activities are informal and limited, although a few special surveys have been conducted.

Data management

Most of the information available on forest pests and diseases is qualitative, although some information on the area affected by a few pest species was noted from China and India. No information was found on the capacity for data management in Mongolia and Thailand. A large number of qualitative reviews of pests and damage are available for Indonesia.

Four of the five countries provided data on the area affected by insects and/or diseases for FRA 2005. Two of these countries, China and Mongolia, provided data for both reporting periods, 1990 (average from 1988 to 1992) and 2000 (1998 to 2002). No information was reported from Thailand.

For the 2000 period, China reported that almost 6.2 million hectares of forest were damaged by insects, 883 000 ha by diseases and 820 000 ha by *Apodemus* spp. (mice). For the 1990 period, China reported that almost 7.9 million hectares were damaged by insects, 1.8 million hectares by diseases and 755 000 ha by mice. India reported 1 million hectares of damage due to insects and 8.4 million hectares damaged by diseases for the 2000 period. Mongolia reported that insects damaged 28 000 ha of forest in 1990 and almost 2.8 million hectares for the 2000 reporting period. Indonesia reported that 2 710 ha of forest were impacted by insects for the 1990 reporting period and that no disturbances by insects and diseases occurred during the 2000 period.

Pest management

A number of pest management activities, including use of chemical, biological and silvicultural methods, are carried out in the selected countries, primarily to target specific forest pests.

China has removed more than 200 million infested trees to control outbreaks of the Asian longhorned beetle, *Anoplophora glabripennis**, and has successfully used egg parasitoids and a fungus (*Beauveria bassiana*) to control the pine caterpillar, *Dendrolimus punctatus*. Some tactics applied for controlling defoliating insects in China include aerial and ground application of chemical and biological insecticides, and mass rearing and release of fungi and parasitoids. In addition, investigations are underway for a cytoplasmic virus to control *D. punctatus* and the use of the predator *Rhizophagus grandis* for biological control of the bark beetle, *Dendroctonus valens**.

In Mongolia, continuous attempts have been made by the government to control outbreaks of the Siberian caterpillar, *Dendrolimus sibiricus**, and other defoliators but the vast areas, lack of trained personnel, limited facilities, financial constraints and poor equipment coupled with extreme weather events makes pest management a monumental task.

In India, most pest management tactics are aimed at planted forests and include a combination of biological, chemical and silvicultural methods primarily to manage defoliators of teak. A variety of fungicides have been used for disease control in nurseries in Indonesia and removing infested trees has helped to protect *Paraserianthes falcata* plantations from the stem borer *Xystrocera festiva*.

Ownership

Information on the capacity of private landowners in forest health protection is lacking. Although there are broad trends in the region towards more private ownership of forests (FAO, 2006a), forests are mostly state-owned in countries such as China and Mongolia. In Indonesia, some private plantation companies have organized research units that monitor and study forest pest and disease problems.

ADDITIONAL INFORMATION

In comparison to other regions, reporting on forest health issues for FRA 2005 was fairly complete for Asia and the Pacific, at least for mainland Asian countries. More than 10 million hectares of forest were reported to be affected by insect pests annually (average 1998–2002) and more than 9 million hectares by diseases (FAO, 2007a). It has been suggested that forest pests and other disturbances may have a more widespread impact than fire in this region (FAO, 2007a).

A number of forest pests reported from the profile countries are also significant pests in other countries of the region. A pest of planted forests in China, the Asian longhorned beetle, *Anoplophora glabripennis**, has increased in range as a result of widespread planting of susceptible poplar hybrids (EPPO, 1999). It is also believed to occur in the Democratic People's Republic of Korea and the Republic of Korea (EPPO, 1999). This pest has been introduced into other countries such as Canada

and the United States through international trade. As a result, many countries in other regions have become increasingly concerned about this pest (EPP0, 1999), and this contributed to the international recognition of the importance of International Standards for Phytosanitary Measures (ISPMs), in particular guidelines for regulating wood packaging materials in international trade (ISPM No. 15).

Native to Indonesia and Papua New Guinea, the coconut leaf beetle, *Brontispa longissima*, is potentially one of the most serious insect pests of coconut and ornamental palm plants in Southeast Asia (APFISN, 2006). Recorded in China, Indonesia and Thailand, it is also known as a pest in Australia, Cambodia, Lao People's Democratic Republic, Malaysia, Maldives, Myanmar, Nauru, the Philippines, Singapore and Viet Nam (Rethinam and Singh, 2007). To address the rapid spread of this pest, APFISN organized a regional workshop in 2005 in Viet Nam to develop an Asia and Pacific strategy for forest invasive species with a focus on the coconut leaf beetle (FAO, 2007b). Participants shared information on risk assessment, monitoring and biological control measures for this significant pest.

The pine wood nematode, *Bursaphelenchus xylophilus**, causes a serious wilt disease in pines and other conifers. Recorded in China, the pest is also known to occur in Japan and the Republic of Korea; it is an introduced species of major global phytosanitary concern.

Occurring naturally in India, Myanmar, the Lao People's Democratic Republic and Thailand and planted in many countries, teak (*Tectona grandis*) is a very valuable forest tree in the Asia and the Pacific region. Several pest species cause significant economic losses. Some of the major indigenous teak pests include the leaf-feeding lepidopterans *Hyblaea puera* and *Eutectona machaeralis* and the stem borer *Xyleutes ceramica*. Reported in naturally regenerated and planted forests in India and Thailand, the teak skeletonizer, *Eutectona machaeralis*, is also an important invasive pest of teak in Bangladesh, Lao People's Democratic Republic, Myanmar, the Philippines and Sri Lanka (Nair, 2001; Leuangkhamma and Vongsiharath, 2005). The teak defoliator, *Hyblaea puera*, recorded in three of the selected countries (India, Indonesia and Thailand) is also a pest in Australia, Bangladesh, Cambodia, China, Fiji, Japan, Lao People's Democratic Republic, Malaysia, Myanmar, Nepal, Papua New Guinea, the Philippines, Samoa, the Solomon Islands, Sri Lanka and Viet Nam (Nair, 2001; Chandrasekhar *et al.*, 2005). A pest of naturally regenerated and planted forests, the beehole borer, *Xyleutes ceramica*, was recorded in Indonesia and Thailand and is also known to be a pest in Myanmar.

Indigenous *Dendrolimus* species are a significant problem for the region's forests. The defoliating caterpillar, *D. punctatus*, is a major pest of indigenous pine plantations in China and Viet Nam (FAO, 2001) while *D. tabulaeformis* infests China's naturally regenerated forests. The Siberian caterpillar, *D. sibiricus**, is a significant pest of larch and pines and serious outbreaks occur in China, the Democratic People's Republic of Korea, the Republic of Korea and Mongolia. Recently, the Democratic People's Republic of Korea has been experiencing outbreaks of *D. spectabilis* in coniferous forests and woodlands around Pyongyang and in North Hwanghae Province, affecting more than 100 000 ha of mainly naturally regenerated *Pinus densiflora*. Found also in China, Japan and the Republic of Korea, this pest is a significant defoliator of pines when outbreaks occur. Control options currently being investigated for this pest include the application of pheromones, egg parasitoids, and trunk banding.

The mahogany shoot borer, *Hypsipyla robusta**, reported above to attack several species of high quality timber in India, Indonesia and Thailand, has also been reported to cause damage in Australia, Bangladesh, Pakistan and Sri Lanka. In fact, it has been recorded in all Asia and Pacific countries where *Swietenia* species have been planted with the exception of some Pacific islands such as Fiji, eastern Solomon Islands, and Western Samoa (Nair, 2001).

Several species of *Lymantria* are pests including the ubiquitous Asian strain of *L. dispar*. *L. lepcha* is a pest of broadleaf trees in Indonesia in naturally regenerated forests, while India reported both *L. mathura* and *L. obfuscata* as pests of broadleaf trees in planted forests.

Bark- and wood-boring beetles of the genera *Ips*, *Tomicus* and *Xylosandrus* are important pests of forests in the region and were reported from four of the five countries in the analysis. The six-spined engraver beetle, *Ips sexdentatus**, and the larch bark beetle, *I. subelongatus**, were recorded as indigenous pests in Mongolia. Thailand also reported *I. sexdentatus* as a pest of planted conifers.

Two indigenous species of *Tomicus*, the lesser pine shoot beetle, *T. minor*, and the common pine shoot beetle, *T. piniperda*, are pests of conifers in Mongolia's naturally regenerated and planted forests. Recently, a newly introduced species of pine shoot beetle, *Tomicus* n.sp., has caused extensive mortality of Yunnan pines (*Pinus yunnanensis*) in the Yunnan Province of China, affecting over 200 000 ha of pine plantations (Sun *et al.*, 2005).

Two indigenous *Xylosandrus* species were reported as pests of broadleaf planted forests. In particular, the black twig borer, *X. compactus*, was noted as a pest of *Swietenia macrophylla* in Thailand and the brown twig borer, *X. morigerus*, was reported as a pest in Indonesia.

Although not reported from the selected Asia and Pacific countries, a number of other pests pose considerable threats to forests in the region. These include the following.

- The European woodwasp, *Sirex noctilio**, is a significant pest of exotic pine plantations in the region, primarily in New Zealand and Australia, including Tasmania. Native to southern Europe and North Africa, this insect was probably introduced first into New Zealand on unprocessed pine logs imported from Europe (FAO, 2001).
- Believed to be native to Australia, the blue gum chalcid, *Leptocybe invasa**, is currently spreading through Africa, Europe and the Near East. A serious pest of young eucalypt trees and seedlings, it has been reported from Asia and the Pacific in Viet Nam and more recently in India (Jacob, Devaraj and Natarajan, 2007).
- The eucalyptus or guava rust, *Puccinia psidii*, is a serious threat to eucalypt plantations in many parts of the world, particularly in Australia where eucalypts are native. Considered a severe problem in its native region of Latin America and the Caribbean, there have also been unconfirmed reports of its occurrence in India. In 2004, APFISN, in collaboration with the Australian Centre for International Agricultural Research (ACIAR), the Asia-Pacific Forestry Commission (APFC) and FAO, organized a workshop on the development of an Asia-Pacific regional strategy for eucalyptus rust.
- The North American bark beetle, *Ips grandicollis*, was introduced into Australia where it attacks valuable planted forests of exotic pine species such as *Pinus elliottii*, *P. pinaster*, *P. taeda* and most importantly, *P. radiata* (FAO, 2001; EPPO/CABI, 1997).

REGIONAL PEST MANAGEMENT EFFORTS

Progress has been made in the region in strengthening institutions to support improved forest management, including forest health and protection. The Asia-Pacific Forest Invasive Species Network (APFISN), launched in 2004, focuses on technical and organizational issues to address the prevention, detection, management and control of forest invasive species in the region. National focal points play a key role in facilitating the exchange of information on forest invasive species among network members. Several mechanisms are in place to facilitate information exchange including a network Web site, newsletters and a regional forest invasive species listserver. The Chinese

Academy of Sciences has also begun work on developing a forest invasive species database which will provide a system for collating, storing and readily accessing information gathered by the network. The database will be further developed in collaboration with network members.

The Asia and Pacific Plant Protection Commission (APPPC) administers an intergovernmental treaty, the Plant Protection Agreement for the Asia and Pacific Region, and is an RPPO under the IPPC. Twenty-four countries are currently members of the Commission: Australia, Bangladesh, Cambodia, China, Democratic People's Republic of Korea, Fiji, France (for French Polynesia), India, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, Nepal, New Zealand, Pakistan, Papua New Guinea, Philippines, Republic of Korea, Samoa (Western), Solomon Islands, Sri Lanka, Thailand, Tonga and Viet Nam.