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Intercepted Scolytidae (Coleoptera) at U.S. ports of entry: 1985–2000

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Abstract

Since 1985, the U.S. Department of Agriculture, Animal and Plant Health Inspection Service has maintained the 'Port Information Network' (PIN) database for plant pests intercepted at the U.S. ports of entry. As of August 2001, PIN contained 6825 records of beetles (Coleoptera) in the family Scolytidae that had been intercepted during the years 1985–2000 from countries outside of North America. Of the 6825 scolytid interceptions, 2740 (40%) were identified to the species level, 2336 (34%) to only the genus level, and 1749 (26%) were identified to only the family level. Of the 49 identified scolytid genera, the 10 most common were *Hypothenemus* (821 interceptions), *Pityogenes* (662), *Ips* (544), *Coccotrypes* (520), *Orthotomicus* (461), *Hylurgops* (327), *Hylurgus* (266), *Tomicus* (194), *Dryocoetes* (166), and *Hylastes* (142). The 10 most common identified species were *Pityogenes chalcographus* (565 interceptions), *Orthotomicus erosus* (385), *Hylurgops palliatus* (295), *Ips typographus* (286), *Hylurgus ligniperda* (217), *Ips sexdentatus* (157), *Tomicus piniperda* (155), *Hylastes ater* (75), *Hypothenemus hampei* (62), and *Polygraphus poligraphus* (48). Of these 10 species, *H. palliatus*, *H. ligniperda*, and *T. piniperda* are known to be established in the continental U.S. The scolytids were intercepted from 117 different countries; the top 12 countries were Italy (1090 interceptions), Germany (756), Spain (457), Mexico (425), Jamaica (398), Belgium (352), France (261), China (255), Russia (247), India (224), U.K. (151), and Portugal (150). The scolytids were intercepted in 35 U.S. states and 97 port cities. In general, there was a positive relationship between the number of scolytid interceptions from individual countries and the value of the imports from those countries. Overall, 73% of the scolytids were found in solid wood packing materials, 22% in food or plants, and 5% in other or unspecified materials. The products most commonly associated with scolytid-infested wood packing materials were tiles, marble, machinery, steel, parts, ironware, granite, aluminum, slate, and iron. The food products and plants that were commonly infested with scolytids included nutmeg, palms, coffee beans, kola nuts, and macadamia nuts.

Introduction

More than 2000 species of exotic (non-native) insects are now established in the U.S. (U.S. Congress 1993; Pimentel *et al.* 2000), of which more than 400 feed on trees and shrubs (Mattson *et al.* 1994; Niemela & Mattson 1996). Several exotic forest insects, such as the gypsy moth [*Lymantria dispar* (L.): Lymantriidae], smaller European elm bark beetle [*Scolytus multistriatus* (Marsham): Scolytidae], hemlock woolly adelgid [*Adelges tsugae* (Annand): Adelgidae], and beech scale (*Cryptococcus fagisuga* Lindinger: Eriococcidae), have severely impacted forest ecosystems throughout the U.S. and elsewhere (Gibbs & Wainhouse 1986; Ciesla 1993; Haack & Byler 1993; Liebhold *et al.* 1995; Morrell & Filip 1996; Wallner 1996; Humble & Allen 2001; USDA APHIS 2002). Others, like the recently detected Asian longhorned beetle [*Anoplophora glabripennis* (Motschulsky): Cerambycidae] and emerald ash borer

(*Agrilus planipennis* Fairmaire: Buprestidae), have the potential to cause widespread damage in the U.S. (Haack *et al*. 1997, 2002; Nowak *et al*. 2001).

International trade is one of the primary pathways by which exotic insects enter the U.S. (Kahn 1989; U.S. Congress 1993; USDA APHIS 2002). Exotic insects are commonly found in association with imported nursery stock, cut flowers, seed, fresh food, wood packing materials, logs, and lumber. Solid wood packing materials often harbor insects because they are (1) typically made from recently cut trees, (2) often retain some bark, and (3) are seldom treated with heat or chemicals (USDA APHIS 2002). As the number of established exotic pests and the volume of U.S. imports has continued to grow, there has been a concomitant increase in awareness of the threat posed by exotic organisms. For example, in recent years, United States Department of Agriculture, Animal and Plant Health Inspection Service (USDA APHIS) has organized five formal pest risk assessments for the importation of logs from Siberia (USDA Forest Service 1991), New Zealand (USDA Forest Service 1992), Chile (USDA Forest Service 1993), Mexico (Tkacz *et al*. 1998), and Australia (USDA Forest Service 2003). In addition, USDA APHIS has recently strengthened regulations and conducted a major pest risk assessment of imported solid wood packing materials such as crating, dunnage, and pallets (USDA APHIS 1995, 1998, 2002). Moreover, at the request of APHIS, the National Research Council (2002) recently completed a special analysis on predicting the invasiveness of exotic plants and plant pests.

Beetles (Coleoptera) in the family Scolytidae are among the most damaging insects worldwide. Because most scolytids breed under bark or inside wood, it has long been recognized that scolytids can easily be moved through international trade (Francke-Grosmann 1966; Jones 1967; Marchant & Borden 1976; Wood 1977; Schroeder 1990; Siitonen 2000). Scolytids are among the most commonly intercepted families of insects on solid wood packing materials at U.S. ports of entry, representing 93–94% of all reported insects (Haack & Cavey 1997; 2000). In addition, scolytids are also commonly intercepted in food products such as seeds and nuts (Wood 1977). Similarly, scolytids were the most commonly intercepted group of insects found in association with solid wood packing materials in Chile (Beeche-Cisternas 2000) and New Zealand (Milligan 1970; Bain 1977). Scolytids exhibit several kinds of feeding and breeding habits. Scolytids that reproduce under the bark of the woody host plants at the wood-bark interface are known as 'true bark beetles.' Scolytids that tunnel and breed in wood, and where the larvae feed on fungi ('ambrosia') that grows on the gallery walls, are commonly called 'ambrosia beetles.' However, there are many other scolytids that breed in seeds, fruits, pods, petioles, roots and stems of herbaceous plants, and pith of twigs (Wood 1982; Kirkendall 1983; Wallenmaier 1989; Rabaglia 2002).

As of December 2002, 50 species of exotic scolytids are known to be established in the continental U.S. and Canada (Table 1). Of these 50 species, all are known to be present in the U.S. except for *Trypodendron domesticum* (L.), which is now present in eastern and western Canada (Humble 2001). Undoubtedly, even more exotic scolytids would be found in the U.S. if nationwide surveys were conducted. Of these 50 exotic scolytids, 13 are outbreeding species (the *Crypturgus, Hylastes, Hylastinus, Hylurgops, Hylurgus, Hypocryphalus, Phloeosinus, Pityogenes, Scolytus*, *Tomicus*, and *Trypodendron* species) and 37 are inbreeding species (the *Ambrosiodmus, Coccotrypes, Dryoxylon, Euwallacea, Hypothenemus, Premnobius, Xyleborinus, Xyleborus*, and *Xylosandrus* species) (Wood 1977, 1982; Kirkendall 1983, 1993). The fact that there are nearly three times more exotic inbreeding scolytid species than outbreeding species, suggests that inbreeding species are more successful at establishing new populations. Inbreeding species practice brother–sister mating prior to emergence from the host plant, and therefore single females can initiate new populations once suitable host plants are found. Twelve of these 50 exotic scolytids were first collected since 1990 (Hoebeke 1991, 2001; Wood 1992; Wood & Bright 1992; Haack & Kucera 1993; Vandenberg *et al*. 2000; Haack 2001, 2002; Humble 2001; Mudge *et al*. 2001; Rabaglia 2002; Table 1). Likewise, several North American scolytids have become established on other continents, e.g., *Dendroctonus valens* LeConte in China, *Gnathotrichus materiarius* (Fitch) in Europe, and *Ips grandicollis* (Eichhoff) in Australia (Marchant & Borden 1976; Wood 1977, 1982; Britton & Sun 2002).

In addition to scolytids being moved between continents, several species have also moved within individual countries or continents through either natural means or inadvertently by humans. For example, two scolytids from western North America that have recently been found in the eastern U.S. are *Dendroctonus pseudotsugae* Hopkins (S.J. Seybold, U.S. Forest Service, Davis, CA; pers. comm.) and *Hylesinus californicus* (Swaine) (Rabaglia & Williams 2002). Similarly, three scolytids from eastern North America that are now established in western North America include *Gnathotrichus materiarius*,

Table 1. Exotic Scolytidae known to be established in the continental U.S. and Canada as of December 2002

Species	Probable continent of origin	Year first collected or reported	Reference
Ambrosiodmus lewisi (Blandford)	Asia	1990	Hoebeke 1991
Ambrosiodmus rubricollis (Eichhoff)	Asia	1942	Bright 1968; Wood 1977; Wood 1982; Wood & Bright 1992
Coccotrypes advena Blandford	Asia	1982[c]	Atkinson & Peck 1994; Wood 1982
Coccotrypes carpophagus (Hornung)	Africa	1926[c]	Atkinson & Peck 1994; Wood 1982
Coccotrypes cyperi (Beeson)	Asia	1934	Atkinson & Peck 1994; Wood 1982
Coccotrypes dactyliperda (Fabricius)	Africa	1915	Atkinson & Peck 1994; Wood 1982
Coccotrypes distinctus (Motschulsky)	Asia	1939	Atkinson & Peck 1994; Wood 1982
Coccotrypes rhizophorae (Hopkins)[a]	Asia	1915	Atkinson & Peck 1994; Wood 1982
Coccotrypes robustus Eichhoff	Asia	1985[c]	Atkinson & Peck 1994; Atkinson *et al*. 1991
Coccotrypes rutschuruensis Eggers	Africa	1992[c]	Wood & Bright 1992
Coccotrypes vulgaris (Eggers)	Asia	1985	Atkinson & Peck 1994; Wood & Bright 1992
Crypturgus pusillus (Gyllenhal)	Eurasia	1868	Wood 1982; Wood & Bright 1992
Dryoxylon onoharaensum (Murayama)	Asia	1977	Bright & Rabaglia 1999
Euwallacea validus (Eichhoff)	Asia	1975	Wood 1977, 1982; Atkinson *et al*. 1991
Hylastes opacus Erichson	Eurasia	1987	Rabaglia & Cavey 1994; Mudge *et a*l. 2001
Hylastinus obscurus (Marsham)	Europe	1878	Wood 1977, 1982; Wood & Bright 1992
Hylurgops palliatus (Gyllenhal)[b]	Eurasia	2001	Haack 2001; RJ Rabaglia & ER Hoebeke, unpub. data[b]
Hylurgus ligniperda (Fabricius)	Eurasia	1994	Hoebeke 2001
Hypocryphalus mangiferae Eggers	Asia	1949	Wood 1977, 1982; Atkinson & Peck 1994
Hypothenemus africanus (Hopkins)	Africa	1933	Wood 1982
Hypothenemus areccae (Hornung)	Asia	1960	Atkinson & Peck 1994; Wood 1982
Hypothenemus birmanus (Eichhoff)	Asia	1951	Atkinson & Peck 1994; Wood 1977, 1982
Hypothenemus brunneus (Hopkins)	Africa	1915	Atkinson & Peck 1994; Wood 1982
Hypothenemus californicus Hopkins	Africa	1915	Atkinson & Peck 1994; Wood 1977, 1982
Hypothenemus columbi Hopkins	Africa	1915	Atkinson & Peck 1994; Wood 1982
Hypothenemus crudiae (Panzer)	Asia	1868	Atkinson & Peck 1994; Wood 1982
Hypothenemus erectus LeConte	Africa	1876	Wood 1982
Hypothenemus javanus (Eggers)	Africa	1975[c]	Atkinson & Peck 1994; Wood 1975, 1982
Hypothenemus obscurus (Fabricius)	S. America	1915	Atkinson & Peck 1994; Wood 1982
Hypothenemus setosus (Eichhoff)	Africa	1982[c]	Atkinson & Peck 1994; Wood 1975, 1982
Phloeosinus armatus Reiter	Asia	1992	Wood 1992; Wood & Bright 1992
Pityogenes bidentatus (Herbst)	Eurasia	1988	Hoebeke 1989
Premnobius cavipennis Eichhoff	Africa	1939	Atkinson & Peck 1994; Wood 1982
Scolytus mali (Bechstein)	Europe	1868	Wood 1977, 1982; Wood & Bright 1992
Scolytus multistriatus (Marsham)	Europe	1909	Wood 1982; Wood & Bright 1992
Scolytus rugulosus (Muller)	Europe	1878	Wood 1982; Wood & Bright 1992
Tomicus piniperda (L.)	Eurasia	1991	Haack & Kucera 1993; Haack & Poland 2001
Trypodendron domesticum (L.)	Europe	1997	Humble 2001; LM Humble, pers. comm.
Xyleborinus alni (Niisima)	Eurasia	1995	Humble 2001; Mudge *et al.* 2001; LM Humble, pers. comm.
Xyleborinus saxeseni (Ratzeburg)	Europe	1915	Atkinson & Peck 1994; Wood 1982
Xyleborus atratus Eichhoff	Eurasia	1988	Atkinson *et al*. 1990, 1991; Wood & Bright 1992
Xyleborus californicus Wood	Asia	1944	Hobson & Bright 1994; Vandenberg *et al*. 2000; Wood 1975
Xyleborus dispar (Fabricius)	Europe	1817	Wood 1977, 1982; Wood & Bright 1992
Xyleborus glabratus Eichhoff[b]	Asia	2002	Haack 2002; RJ Rabaglia & ER Hoebeke, unpub. data[b]
Xyleborus pelliculosus Eichhoff	Asia	1987	Atkinson *et al*. 1990; Wood & Bright 1992
Xyleborus pfeili (Ratzeburg)	Eurasia	1992	Vandenberg *et al*. 2000; Humble 2001; Mudge *et al.* 2001
Xyleborus similis Ferrari[b]	Asia	2002	Haack 2002; RJ Rabaglia & ER Hoebeke, unpub. data[b]
Xylosandrus compactus (Eichhoff)	Asia	1941	Atkinson & Peck 1994; Wood 1977, 1982
Xylosandrus crassiusculus (Motschulsky)	Asia	1974	Atkinson *et al*. 1991; Wood 1977; 1982
Xylosandrus germanus (Blandford)	Asia	1931	Bright 1968; Wood 1977, 1982
Xylosandrus mutilatus (Blandford)[b]	Asia	1999	Haack 2002; TL Scheifer & DE Bright, unpub. data[b]

[a]Atkinson & Peck (1994) suggest that *Coccotrypes rhizophorae* could have arrived in the New World by natural means, i.e., floating, infested *Rhizophora mangle* seedlings.
[b]*Hylurgops palliatus* was detected in Erie, PA in 2001 and again in several nearby locations in 2002, indicating establishment. Adults were identified by E. Richard Hoebeke, Cornell University. *Xyleborus glabratus* was collected for the first time in 2002 in GA, and identified by Robert J. Rabaglia, Annapolis, MD. *Xyleborus similis* was collected for the first time in 2002 near Houston, TX, and identified by RJ. Rabaglia. *Xylosandrus mutilatus* was reported for the first time in 2002 in MS; beetles were collected by Terence L. Schiefer, Mississippi State University, and identified by Donald E. Bright, Ottawa, Canada. Subsequently, it was noted that some *X. mutilatus* had been collected as early as 1999 in MS. Later in 2002, *X. mutilatus* was collected in FL by Mark A. Deyrup, Lake Placid, FL.
[c]*Coccotrypes advena* was first reported from Hawaii in 1915 and Cuba in 1934 (Wood 1982), *Coccotrypes carpophagus* from Cuba in 1915 (Wood 1982), *Coccotrypes robustus* from Cuba in 1878 (Wood 1982), *Hypothenemus javanus* from Cuba in 1915 (Wood 1982), *Hypothenemus setosus* from Guadeloupe in 1867 (Wood 1975, 1982).

Xyleborus xylographus (Say), and *Xyloterinus politus* (Say) (Humble 2001; Mudge *et al*. 2001). In Europe, several scolytids have expanded their range as a result of natural spread or trade, including *Dendroctonus micans, Ips amitinus* (Eichhoff), *Ips cembrae* (Heer), and *Ips typographus* (L.) (Bevan & King 1983; Gregoire 1988; Siitonen 2000).

Since the early 1900s, USDA APHIS has published lists of pest interception records made at U.S. ports of entry, e.g., USDA APHIS (1982). From 1975 to 1984, APHIS maintained the interception records on a mainframe computer. Then, beginning in 1985, APHIS entered all interception records in a national computerized database known as the Port Information Network (PIN). Several data fields are completed for each pest interception, including the pest species name, date of interception, country of origin, U.S. port of entry, and commodity with which the pest was associated. Pests are intercepted on a wide variety of commodities, such as fresh food, cut flowers, seeds, nursery stock, and wood articles such as crating, dunnage, pallets, lumber, and logs. On average, more than 50,000 pest interceptions are made annually by APHIS inspectors (National Research Council 2002). However, APHIS now inspects only about 2% of the international cargo that arrives in the U.S. (National Research Council 2002). Therefore, the interceptions listed in PIN represent only a small percentage of the pests that actually enter the U.S. Nevertheless, the PIN database provides valuable historical information on the types of pests that have entered the U.S., the most common pathways by which they arrived, the countries of origin, and the products or commodities with which they were associated. In this paper, summary data are provided on the numbers, kinds, and origins of Scolytidae that were intercepted by USDA APHIS inspectors at U.S. ports of entry during the years 1985–2000.

The USDA APHIS port information network

As mentioned above, USDA APHIS has maintained the electronic database known as the PIN for plant pests intercepted on materials of foreign origin at the U.S. ports of entry since January 1985. There are more than 500 locations in the U.S. that can receive international cargo, and about 100 of these are considered major international shipping ports. In general, only pests of quarantine significance are included in PIN, so the PIN database contains only a subset of what is actually intercepted. The APHIS considers pests of live plants to be of the highest quarantine significance. As a result of this policy, APHIS considers true bark beetles, which often breed in live trees, to be of higher quarantine significance than ambrosia beetles, which less frequently infest live trees. Therefore, it is likely that a much higher percentage of the intercepted true bark beetles are entered into PIN compared with the corresponding percentage of intercepted ambrosia beetles. It is important to keep this policy in mind when viewing the data tables below. The APHIS personnel add new interception records to PIN on a daily basis. Occasionally, delays can occur in adding new records depending on the workload and taxonomic skills of the local inspectors as well as the life stage of the pest when it is intercepted. For pest groups that are taxonomically difficult, local inspectors often send the intercepted organisms to specialists for final determination. When I queried the PIN database in August 2001, there were 577,829 insect interception records from 1985 to August 2001, representing 11 orders of insects (Table 2). I then restricted the search to the years 1985–2000, assuming that by August 2001 almost all interceptions from 2000 and earlier would have been entered. After further restricting the search to scolytids intercepted during 1985–2000, there were 6827 records of which two records were on shipments from Canada. In general, insects intercepted on goods from Canada are not considered to be of quarantine importance because many species occur in both countries. Therefore, few of the insects intercepted on goods from Canada are ever entered into PIN and thus the two records from Canada were dropped in the analyses below, resulting in a dataset of 6825 records.

For each interception, APHIS inspectors complete a document known as 'PPQ Form 309A' (http://www.aphis.usda.gov/ppq/manuals/pdf_files/AMOM%20in%20PDF/AppA-CompForms.pdf), which contains 25 data fields. Inspectors complete the form as appropriate and later enter the data into PIN. The PIN database can be searched using any of the data fields. I selected the following PIN data fields: taxon (family, genus, and species), country of origin, imported product (e.g., marble, logs, and coffee), type of plant part infested (e.g., seed, fruit, root, leaf, and wood), interception date, port city, and type of port (e.g., airport, maritime port, and land border). When insects are collected in the larval stage, identification is often made to only the order, family, or genus level. Similarly, when the exact country of origin cannot be determined for a particular interception, then the most likely

Table 2. Number of recorded insect interceptions and insect families made at the U.S. ports of entry during the period 1985–August 2001 by insect order

Insect order	No. of interceptions	No. of families	Six most common families and corresponding number of interceptions
All insect interceptions			
Coleoptera	73,649	20	Curculionidae 42,915; Scolytidae 6992; Scarabaeidae 6617; Chrysomelidae 6249; Tenebrionidae 3934; Cerambycidae 1777
Collembola	167	1	Sminthuridae 167
Diptera	117,515	11	Tephritidae 69,637; Agromyzidae 43,783; Cecidomyiidae 1621; Lonchaeidae 1004; Anthomyiidae 385; Chloropidae 196
Heteroptera	22,405	31	Miridae 9126; Pentatomidae 3726; Lygaeidae 3007; Rhyparochromidae 2410; Oxycarenidae 419; Rhopalidae 404
Homoptera	210,621	38	Diaspididae 116,257; Pseudococcidae 31,922; Coccidae 19,500; Aleyrodidae 19,464; Aphididae 10,865; Cicadellidae 5597
Hymenoptera	2124	14	Formicidae 831; Apidae 452; Torymidae 210; Eurytomidae 112; Tenthredinidae 107; Siricidae 103
Isoptera	571	4	Kalotermitidae 234; Termitidae 172; Rhinotermitidae 88; Hodotermitidae 73
Lepidoptera	119,555	75	Noctuidae 45,527; Pyralidae 21,966; Tortricidae 21,312; Crambidae 5420; Geometridae 5037; Gracillariidae 4435
Orthoptera	5213	11	Gryllidae 2959; Tettigoniidae 1762; Acrididae 264; Gryllacrididae 25; Tettigometridae 15; Tetrigidae 11
Phasmida	6	1	Phasmatidae 6
Thysanoptera	25,517	4	Thripidae 22,905; Phlaeothripidae 1686; Aeolothripidae 451; Heterothripidae 4
Unidentified insects	486	—	
Total	577,829	210	
Insects listed as specifically associated with wood[a]			
Coleoptera	7242	16	Scolytidae 4561; Cerambycidae 1054; Curculionidae 879; Bostrichidae 284; Buprestidae 165; Lyctidae 83
Collembola	1	1	Sminthuridae 1
Diptera	20	4	Tephritidae 5; Cecidomyiidae 3; Agromyzidae 2; Tipulidae 1
Heteroptera	241	13	Rhyparochromidae 142; Pentatomidae 39; Lygaeidae 22; Oxycarenidae 9; Miridae 8; Pyrrhocoridae 5
Homoptera	22	8	Cicadellidae 5; Aphididae 4; Diaspididae 4; Cercopidae 2; Membracidae 2; Pseudococcidae 2
Hymenoptera	127	4	Siricidae 85; Formicidae 29; Cynipidae 2; Apidae 1
Isoptera	104	3	Kalotermitidae 69; Rhinotermitidae 27; Termitidae 8
Lepidoptera	110	20	Noctuidae 24; Tineidae 13; Arctiidae 11; Cossidae 10; Pyralidae 7; Psychidae 6
Orthoptera	22	2	Gryllidae 18; Acrididae 2
Phasmida	1	1	Phasmatidae 1
Thysanoptera	6	2	Thripidae 5; Phlaeothripidae 1
Unidentified insects	1	—	
Total	7896	74	

[a]This data set includes only those insects listed as specifically associated with wood on the original USDA APHIS interception form (PPQ Form 309A). Because of the size of the original file (577,829 interception records), I was unable to physically check each interception and make alterations where appropriate, i.e., where logs were categorized as 'stems' rather than 'wood'. As a result, the above data set of 7896 records of insects associated with wood is only a subset of all the records that should be so categorized. For example, in the unadjusted data set used to generate Table 2, there were 4561 scolytid interceptions originally described as being associated with wood for the period 1985–August 2001, but when just the scolytidae data were acquired and adjusted where possible, 5008 scolytid interceptions were found to be associated with wood for the period 1985–2000 (see Table 3).

continent of origin is often recorded. Also, as a result of political changes during the period 1985–2000, several countries that existed in 1985 now no longer exist (e.g., Czechoslovakia, Hong Kong, and Soviet Union), while during the same period many other new nations emerged (e.g., Croatia, Slovakia, Russia, and Ukraine). In general, I used the country names that were officially recognized by the U.S. as of 2000. I also assigned each country to a continent or world region as a means to look at trends among larger land masses. These world regions included Africa, Asia, Central America, Caribbean, Europe, Pacific, and South America. In the analyses below, I categorized all interceptions from Russia and Turkey as Asia, Mexico as Central America, and Australia and New Zealand as part of the Pacific region.

Overview of all insect interceptions

Of the 577,829 insect interceptions in the PIN database in August 2001, about 36% were Homoptera, 21% Lepidoptera, 20% Diptera, 13% Coleoptera, 4% Thysanoptera, 4% Heteroptera, and less than 1% were Collembola, Hymenoptera, Isoptera, Orthoptera, and Phasmida (Table 2). Overall, the intercepted insects represented 210 families, including 75 families of Lepidoptera, 38 Homoptera, 31 Heteroptera, and 20 Coleoptera. The six most commonly intercepted families for each order are given in Table 2. Of the 73,649 Coleoptera interceptions made during 1985–2001, Curculionidae (weevils) was the most commonly intercepted beetle family (42,915 interceptions) and Scolytidae was second (6992) (Table 2).

Of the 577,829 insect interceptions, 7896 (1.4%) were associated with wood articles such as crating, pallets, and logs (Table 2). Insects representing 11 insect orders and 74 families were found in association with wood. Although Coleoptera represented only 13% of all insect interceptions, they accounted for 92% of the insect interceptions on wood articles (Table 2). Besides Coleoptera, the other most commonly intercepted insect orders on wood were Heteroptera (3.1%), Hymenoptera (1.6%), Lepidoptera (1.4%), and Isoptera (1.3%) (Table 2). Of the 7896 wood-associated interceptions, 4561 (58%) were scolytidae (Table 2). It is not surprising that Coleoptera made up the bulk of the insect interceptions on wood articles considering that bark- and wood-infesting beetles are common worldwide, with some developing in live trees, others in recently dead trees, and still others in dry lumber (Haack & Slansky 1987; Wallenmaier 1989). Most of the Heteroptera and Orthoptera found in association with wood articles were likely hitchhikers, occurring as a result of handling practices, and were not directly associated with the wood articles (Haack & Cavey 1997, 2000). In Chile, of the 1059 insect interceptions made on wood packing materials during 1995–1999, 12 insect orders were represented and 84% were Coleoptera (Beeche-Cisternas 2000).

Overview of scolytid interceptions during 1985–2000

As of August 2001, the PIN database contained 6825 scolytid interception records from countries outside North America for the years 1985–2000. Of these 6825 records, 2740 (40%) were identified to the species level, 2336 (34%) to only the genus level, and 1749 (26%) to only the family level. In the discussion and tables below, these 6825 records are sorted and presented in a variety of ways, including analyses by continent and country of origin, receiving U.S. state, genus and species of the intercepted scolytids, and details on those scolytids that were intercepted on wood.

Continent of origin

Scolytids from seven continents or major world regions were intercepted in the U.S. (Table 3). Overall, about 55% of the 6825 scolytid interceptions in the PIN database originated in Europe, 16% in Asia, 11% in Central America, 8% in the Caribbean, 5% in South America, 2% in Africa, 1% in the Pacific region, and 2% were of unknown origin. About 59% of the European and 28% of the Asian intercepted scolytids were identified to the species level, whereas only 3% of the Central American, 9% of the Caribbean, and 11% of the Pacific scolytids were identified to species (Table 3). Although less often identified to species, the Central American (86%), Caribbean (95%), and Pacific (88%) scolytids were the most likely to be identified to the genus level. Overall, scolytids intercepted from Europe and Asia were primarily conifer-infesting bark beetles found in association with solid wood packing materials, while most Central American, Caribbean, and Pacific scolytids were fruit- and seed-infesting species of *Coccotrypes* and *Hypothenemus* (Table 3). Overall, 49 genera and 67 species were identified among the intercepted scolytids. The diversity of intercepted scolytids was greatest for Asia and Europe, and least for the Caribbean and Pacific regions (Table 3). The five most common scolytid genera and the four most common products associated with the intercepted scolytids are given by continent in Table 3. *Hypothenemus* species were commonly intercepted from six of the seven world regions, *Coccotrypes* from five world regions, and *Hylurgus*, *Orthotomicus*, and *Pityophthorus* each from three world regions (Table 3). As for the products, coffee, kola nuts, nutmeg, macadamia nuts, and palms were some of the most common food and live plant items that were actually infested with scolytids, whereas ironware, marble, machinery, steel, and tiles were the products that were most frequently associated with scolytid-infested wood packing materials.

Table 3. Summary data by continent of origin for the 6825 scolytid interceptions made at U.S. ports of entry during 1985–2000

Continent	No. of interceptions	No. identified to only the: Family level	Genus level	Species level	No. of identified Genera	Species	Five most common genera in decreasing order	Four most common associated products or actual infested articles in decreasing order
Africa	130	25	81	24	14	6	*Hypothenemus, Coccotrypes, Orthotomicus, Pityophthorus, Hylastes*	Palms, machinery, parts, ironware
Asia	1092	260	526	306	31	35	*Hypothenemus, Orthotomicus, Hypocryphalus, Pityogenes, Dryocoetes*	Ironware, tiles, household goods, parts
Central America	721	102	577	18	24	7	*Coccotrypes, Hypothenemus, Gnathotrichus, Ips, Pityophthorus*	Palms, melons, bananas, coffee
Caribbean	560	30	512	48	13	2	*Hypothenemus, Coccotrypes, Xyleborus, Araptus, Pityophthorus*	Nutmeg, kola nuts, coffee, palms
Europe	3745	1208	312	2225	30	56	*Pityogenes, Ips, Orthotomicus, Hylurgops, Hylurgus*	Tiles, marble, machinery, steel
Pacific	95	11	76	8	10	4	*Hypothenemus, Coccotrypes, Hylurgus, Xyleborus, Crypturgus*	Macadamia nuts, palms, kiwi, apples
South America	345	64	220	61	25	9	*Hypothenemus, Coccotrypes, Hylurgus, Pagiocerus, Hylastes*	Tiles, bananas, corn, coffee
Unknown	137	49	32	56	19	13	*Pityogenes, Ips, Hypothenemus, Hylurgops, Orthotomicus*	Steel, tiles, ironware, woodenware
Total	6825	1749	2336	2740	49	67	*Hypothenemus, Pityogenes, Ips, Coccotrypes, Orthotomicus*	Tiles, marble, machinery, steel

The number of interceptions by year and continent for the 5008 scolytid interceptions found in association with wood articles at the U.S. ports of entry during 1985–2000 are presented in Table 4. Several more of the original 6825 interceptions were likely associated with wood articles but could not be classified appropriately for a number of reasons. For example, in some cases, not all of the PIN data fields were completed. In other cases, inspectors selected the category 'stem' rather than 'wood' when some scolytids were intercepted in logs. If the corresponding plant genus of the 'stem' was not also given, then it was not possible to determine if the host plant was a woody plant. During 1985–2000, there was a downward trend in the annual number of scolytid interceptions reported on wood articles (Table 4). For the individual world regions, the downward trend was most apparent for Europe, while a slight upward trend was seen for Asia and Central America. Increased interceptions from China and Russia, especially during the mid-1990s, were primarily responsible for higher interception rates for Asia, and similarly, higher interception rates on goods from Mexico were the primary reason for the increase noted for Central America. Notwithstanding this downward trend in the number of scolytid interceptions (Table 4), there has been a steady increase in the number of newly established scolytids being discovered in the U.S., with 20 of the 50 exotic scolytids being first found since 1980 (Table 1).

At first, the overall downward trend in the number of interceptions seems unusual given that the U.S. imports tend to increase every year (Table 4, bottom row). Haack & Cavey (1997, 2000) suggest several reasons for the overall downward trend in the interception rate. One reason was that many exporters shifted from solid wood packing materials to other packing materials that are less suitable for insect survival such as older or kiln-dried wood, plywood, particle board, or non-wood materials like metal. Another factor was the dramatic increase in the U.S. imports of perishable goods, which far exceeded increases in the number of U.S. inspectors at the ports. Because perishable goods such as fresh fruit, vegetables, and cut flowers typically demand more immediate attention by the inspectors, there was probably less time available to inspect solid wood packing materials. Another contributing factor, especially

Table 4. Number of interceptions by year and continent of origin for the 5008 scolytid interceptions made on wood articles at U.S. ports of entry during 1985–2000, and value of general imports to the U.S. by year in billions of U.S. dollars (unadjusted for inflation; U.S. Census Bureau 2001)

Continent	Total on wood	Number of interceptions by year: 1985–2000															
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Africa	67	1	7	1	5	5	8	1	1	2	4	5	5	16	2	2	2
Asia	914	80	70	39	47	52	19	19	36	62	130	130	70	55	68	20	17
Central America	199	2	4	8	6	4	7	5	5	9	10	9	2	15	25	23	65
Caribbean	14	2	1	0	0	0	2	4	2	0	1	0	0	1	1	0	0
Europe	3488	584	498	417	291	321	213	144	161	122	180	143	86	87	101	67	73
Pacific	11	0	0	2	1	0	0	2	0	0	0	0	4	0	1	1	0
South America	197	22	32	14	26	5	8	9	8	10	17	6	4	16	12	8	0
Unknown	118	10	23	14	8	6	11	15	1	7	8	4	2	4	2	3	0
Total	5008	701	635	495	384	393	268	199	214	212	350	297	173	194	212	124	157
U.S. imports (U.S. billions)		345	370	406	441	473	495	487	532	581	663	744	795	871	912	1025	1217

since 1996, was a change in the U.S. import regulations that required that all unmanufactured solid wood items be 'totally free from bark and apparently free from live plant pests' or else be certified as treated for wood pests by the exporting country (USDA APHIS 1995). This regulation could have resulted in fewer interceptions because (1) APHIS inspectors then only needed to find bark rather than a live insect to require treatment (e.g., fumigation) and (2) high exporter compliance with the new regulation significantly reduced the incidence of insects like many of the true bark beetles that develop under bark (Haack & Cavey 1997, 2000). On the other hand, the discovery of an Asian longhorned beetle, *Anoplophora glabripennis*, in the U.S. (Haack *et al.* 1997), resulted in more targeted inspection of wood articles from China as well as stricter regulations on wood articles from China (USDA APHIS 1998). High compliance by China was a major factor in the marked decrease in insect interceptions from Asia in 1999 and 2000 (Table 4; USDA APHIS 2002).

Country of origin

Scolytids intercepted at the U.S. ports of entry originated from 117 different countries or individual islands, including Hawaii (Table 5). Hawaii, although a U.S. state, was included in the list because many Hawaiian goods are inspected prior to shipment to the continental U.S. Of these 117 countries, 18 were in Africa, 22 in Asia (including Russia and Turkey), eight in Central America (including Mexico), 20 in the Caribbean, 29 in Europe, eight in the Pacific region (including Australia, Hawaii, and New Zealand), and 12 in South America (Table 5). There were 14 countries from which more than 100 interceptions were made during 1985–2000: Italy (1090 interceptions), Germany (756), Spain (457), Mexico (425), Jamaica (398), Belgium (352), France (261), China (255), Russia (247), India (224), U.K. (151), Portugal (150), Japan (113), and Brazil (107). Similarly, there were 26 countries from which only one scolytid interception was made during the same 16-year period.

The number of scolytid interceptions reported to be associated with wood articles from each country is given in Table 5. In general, the difference between the total number of interceptions for an individual country and the corresponding number of interceptions that were associated with wood represents those scolytids that were associated with live plants and food products such as fruit, seeds, and nuts. Overall, scolytid interceptions from temperate countries tended to be associated with wood articles, while most scolytid interceptions from tropical and subtropical countries were associated with live plants, fruit, seeds, and nuts.

The numbers of scolytid genera and species identified from each country are listed in Table 5. Of the 49 identified genera, 26 genera were associated with imports from Italy, the most genera for any single country. Similarly, 21 scolytid genera were identified from Mexico; 20 from Germany; 17 each from Belgium, China, and France; 16 each from Brazil, Japan, and The Netherlands, and 15 from Spain. Considering the intercepted scolytids that were identified to the species

Table 5. Summary data by country of origin for the 6825 scolytid interceptions at U.S. ports of entry during 1985–2000, and the value of U.S. general imports in 2000 in millions of U.S. dollars by country (U.S. Census Bureau 2001)

Country	Continent	No. of interceptions		No. of genera	No. of species	No. of receiving U.S.		No. of years intercepted	Value of U.S. general imports in 2000 (millions U.S.$)	Five most commonly intercepted genera in decreasing order
		Total	Wood			States	Cities			
Algeria	AF[a]	1	1	1	0	1	1	1	$2724	*Taphrorychus*
Antigua	CAR	4	0	1	0	2	3	3	2	*Hypothenemus*
Argentina	SA	3	2	2	0	3	3	3	3102	*Gnathotrichus, Hypothenemus*
Aruba	CAR	7	0	1	1	2	2	3	1511	*Hypothenemus*
Australia	PAC	22	4	6	2	5	7	7	6439	*Coccotrypes, Crypturgus, Hylurgus, Ips, Xyleborus*
Austria	EUR	31	30	4	4	9	10	11	3233	*Pityogenes, Ips, Hylurgops, Pityokteines*
Azerbaijan	AS	1	1	1	1	1	1	1	21	*Polygraphus*
Bahamas	CAR	23	2	2	0	2	5	9	275	*Hypothenemus, Coccotrypes*
Bangladesh	AS	1	1	1	0	1	1	1	2418	*Hypocryphalus*
Belgium	EUR	352	346	17	24	20	29	16	9931	*Pityogenes, Hylurgops, Scolytus, Taphrorychus, Ips*
Belize	CA	16	5	5	1	3	4	7	94	*Hypothenemus, Scolytus, Coccotrypes, Pityophthorus, Xylosandrus*
Bermuda	CAR	1	0	1	0	1	1	1	39	*Hypothenemus*
Bolivia	SA	4	1	2	0	2	2	3	191	*Coccotrypes, Hylastes*
Brazil	SA	107	68	16	6	12	19	15	13,855	*Hypothenemus, Coccotrypes, Hypocryphalus, Pityogenes, Pityophthorus*
Bulgaria	EUR	1	1	1	1	1	1	1	235	*Pityogenes*
Cambodia	AS	1	0	1	0	1	1	1	—	*Hypothenemus*
Cameroon	AF	3	2	2	0	3	3	3	155	*Hypothenemus, Xyleborus*
Canary Islands	AF	1	0	1	1	1	1	1	—	*Dactylotrypes*
Cape Verde Islands	AF	2	0	1	0	1	1	1	—	*Coccotrypes*
Cayman Islands	CAR	1	0	1	0	1	1	1	7	*Hypothenemus*
Central African Rep	AF	1	0	1	0	1	1	1	—	*Coccotrypes*
Chile	SA	67	65	4	2	9	10	15	3228	*Hylurgus, Hylastes, Hypothenemus, Orthotomicus*
China	AS	255	234	17	9	16	24	16	111,515[b]	*Dryocoetes, Orthotomicus, Hypothenemus, Cryphalus, Xyleborus*
Colombia	SA	17	7	6	1	2	5	10	6969	*Hypothenemus, Coccotrypes, Cryptocarenus, Monarthrum, Dryocoetes*
Costa Rica	CA	73	7	9	3	7	9	15	3547	*Hypothenemus, Coccotrypes, Xyleborus, Gnathotrichus, Araptus*
Croatia	EUR	2	2	2	2	1	1	1	141	*Dryocoetes, Pityogenes*
Cuba	CAR	2	0	1	0	1	1	1	—	*Hypothenemus*
Curacao	CAR	1	0	1	0	1	1	1	—	*Hypothenemus*
Czech Republic	EUR	5	5	3	2	3	3	2	1071	*Taphrorychus, Ips, Pityogenes*
Denmark	EUR	4	4	1	1	3	3	4	2974	*Pityogenes*
Dominica	CAR	7	0	3	0	0	0	3	7	*Coccotrypes, Hypothenemus, Scolytodes*
Dominican Republic	CAR	45	5	6	1	5	7	14	4384	*Hypothenemus, Coccotrypes, Xyleborus, Araptus, Pityophthorus*

Table 5. Continued

Country	Continent	No. of interceptions		No. of genera	No. of species	No. of receiving U.S.		No. of years intercepted	Value of U.S. general imports in 2000 (millions U.S.$)	Five most commonly intercepted genera in decreasing order
		Total	Wood			States	Cities			
Ecuador	SA	25	0	3	1	6	7	9	2211	*Coccotrypes, Hypothenemus, Pagiocerus*
Egypt	AF	3	0	1	0	3	3	3	888	*Coccotrypes*
El Salvador	CA	22	1	4	2	6	8	10	1933	*Hypothenemus, Coccotrypes, Pagiocerus, Xyleborus*
Estonia	EUR	6	6	4	4	2	3	3	573	*Pityogenes, Crypturgus, Ips, Orthotomicus*
Fiji	PAC	3	0	2	0	1	2	3	146	*Hypocryphalus, Hypothenemus*
Finland	EUR	55	54	9	9	11	12	12	3250	*Pityogenes, Dryocoetes, Hylurgops, Ips, Polygraphus*
France	EUR	261	254	17	27	20	32	16	29,782	*Tomicus, Pityogenes, Ips, Orthotomicus, Hylurgops*
Germany	EUR	756	735	20	27	26	46	16	58,737	*Pityogenes, Hylurgops, Ips, Dryocoetes, Orthotomicus*
Ghana	AF	11	4	5	1	10	10	6	205	*Hypothenemus, Crypturgus, Xyleborus, Xylosandrus*
Greece	EUR	28	25	8	8	9	9	13	592	*Orthotomicus, Xyleborus, Ips, Pityokteines, Crypturgus*
Grenada	CAR	12	0	2	0	3	4	9	27	*Hypothenemus, Coccotrypes*
Guam	PAC	1	0	1	0	1	1	1	—	*Hypothenemus*
Guatemala	CA	93	14	9	2	5	7	16	2605	*Gnathotrichus, Hypothenemus, Coccotrypes, Pityophthorus, Xyleborus*
Guyana	SA	7	4	2	0	4	4	4	141	*Hypothenemus, Araptus*
Haiti	CAR	17	0	3	0	3	5	8	297	*Hypothenemus, Coccotrypes, Pycnarthrum*
Hawaii	PAC	54	0	4	0	0	4	13	—	*Hypothenemus, Coccotrypes, Xyleborus, Xylosandrus*
Honduras	CA	79	26	7	2	4	6	15	3090	*Hypothenemus, Gnathotrichus, Ips, Xyleborus, Coccotrypes*
Hungary	EUR	4	4	1	1	3	3	3	2716	*Pityogenes*
India	AS	224	208	9	1	13	22	16	10,687	*Hypocryphalus, Hypothenemus, Xylechinus, Coccotrypes, Cryphalus*
Indonesia	AS	11	2	3	2	3	6	7	10,386	*Coccotrypes, Hypothenemus, Polygraphus*
Iran	AS	1	0	1	0	1	1	1	169	*Hypoborus*
Israel	AS	13	9	6	5	6	7	8	12,975	*Orthotomicus, Phloeotribus, Scolytus, Carphoborus, Hypoborus*
Italy	EUR	1090	943	26	41	19	32	16	25,050	*Ips, Orthotomicus, Pityogenes, Hylurgus, Hylurgops*
Ivory Coast	AF	11	11	2	0	3	3	5	—	*Hypothenemus, Hypocryphalus*
Jamaica	CAR	398	4	6	2	14	20	16	648	*Hypothenemus, Coccotrypes, Xyleborus, Chramesus, Pityophthorus*
Japan	AS	113	102	16	8	22	25	16	146,577	*Phloeosinus, Ips, Coccotrypes, Orthotomicus, Hypothenemus*
Jordan	AS	4	1	2	1	2	3	4	73	*Coccotrypes, Phloeotribus*
Kenya	AF	1	0	1	0	1	1	1	110	*Araptus*

Table 5. Continued

Country	Continent	No. of interceptions		No. of genera	No. of species	No. of receiving U.S.		No. of years intercepted	Value of U.S. general imports in 2000 (millions US$)	Five most commonly intercepted genera in decreasing order
		Total	Wood			States	Cities			
Laos	AS	1	1	0	0	1	1	1	—	Identified as Scolytidae only
Latvia	EUR	14	14	6	4	5	5	6	287	*Ips, Crypturgus, Hylurgops, Pityogenes, Scolytus*
Liberia	AF	1	0	1	0	1	1	1	45	*Hypothenemus*
Lithuania	EUR	16	16	4	5	6	6	6	135	*Pityogenes, Ips, Tomicus, Polygraphus*
Madagascar	EUR	16	0	1	0	3	3	9	158	*Coccotrypes*
Malaysia	AS	13	6	5	1	4	5	5	25,568	*Coccotrypes, Cryphalus, Hypocryphalus, Phloeosinus, Xyleborus*
Malta	EUR	1	1	0	0	1	1	1	484	Identified as Scolytidae only
Mexico	CA	425	143	21	2	15	32	16	135,911	*Coccotrypes, Gnathotrichus, Hypothenemus, Ips, Pityophthorus*
Morocco	AF	2	1	2	1	2	2	2	444	*Coccotrypes, Orthotomicus*
Netherlands	EUR	76	70	16	15	14	23	13	9704	*Pityogenes, Hylurgops, Hylurgus, Tomicus, Hylastes*
New Zealand	PAC	11	7	4	3	3	7	5	2081	*Hylurgus, Coccotrypes, Hylastes, Tomicus*
Nicaragua	CA	4	0	2	0	3	3	3	590	*Coccotrypes, Gnathotrichus*
Nigeria	AF	29	9	4	0	11	12	13	10,549	*Hypothenemus, Coccotrypes, Polygraphus, Xyleborus*
Norway	EUR	14	12	4	3	8	8	7	5711	*Pityogenes, Ips, Dryocoetes, Orthotomicus*
Panama	CA	9	3	2	0	3	4	6	307	*Coccotrypes, Hypothenemus*
Paraguay	SA	1	0	1	0	1	1	1	41	*Pityophthorus*
Peru	SA	36	3	6	0	8	11	10	1996	*Pagiocerus, Coccotrypes, Araptus, Hylurgops, Hypothenemus*
Philippines	AS	20	5	6	2	4	6	6	13,937	*Coccotrypes, Cryphalus, Hypothenemus, Xylosandrus, Scolytogenes*
Poland	EUR	38	36	7	5	9	10	11	1040	*Pityogenes, Hylurgops, Crypturgus, Dryocoetes, Ips*
Pohnpei	PAC	2	0	1	0	1	1	1	—	*Coccotrypes*
Portugal	EUR	150	130	10	13	13	20	16	1579	*Hylurgus, Orthotomicus, Crypturgus, Ips, Hylastes*
Puerto Rico	CAR	10	0	2	0	0	0	7	33,173[c]	*Coccotrypes, Hypothenemus*
Romania	EUR	18	17	4	3	8	8	9	470	*Pityogenes, Ips, Hylurgops, Taphrorychus*
Russia	AS	247	198	14	12	16	20	16	7796	*Pityogenes, Ips, Hylurgops, Polygraphus, Orthotomicus*
Saudi Arabia	AS	2	2	1	1	2	2	2	14,219	*Dryocoetes*
Senegal	AF	1	1	1	1	1	1	1	4	*Hylurgus*
Sierra Leone	AF	1	0	1	1	1	1	1	—	*Hypothenemus*
Singapore	AS	6	3	3	1	5	5	6	19,187	*Hypothenemus, Cryphalus, Scolytus*
Slovakia	EUR	1	1	1	1	1	1	1	241	*Pityogenes*
Slovenia	EUR	1	0	1	1	1	1	1	—	*Pityogenes*
Solomon Islands	PAC	1	0	1	0	1	1	1	—	*Coccotrypes*
South Africa	AF	42	36	5	4	8	8	13	4204	*Orthotomicus, Pityophthorus, Hylastes, Hypothenemus, Hylurgus*

Table 5. Continued

Country	Continent	No. of interceptions		No. of genera	No. of species	No. of receiving U.S.		No. of years intercepted	Value of U.S. general imports in 2000 (millions US$)	Five most commonly intercepted genera in decreasing order
		Total	Wood			States	Cities			
South Korea	AS	25	13	9	3	10	12	11	40,300	*Coccotrypes, Orthotomicus, Pityogenes, Cryphalus, Cyrtogenius*
Spain	EUR	457	424	15	27	19	30	16	5731	*Orthotomicus, Pityogenes, Hylastes, Ips, Tomicus*
Sri Lanka	AS	4	2	2	0	3	3	4	2002	*Coccotrypes, Hypocryphalus*
St. Christopher	CAR	3	0	1	0	0	0	2	—	*Hypothenemus*
St. Croix	CAR	5	1	2	0	2	2	4	—	*Coccotrypes, Hypothenemus*
St. Kitts	CAR	2	0	1	0	1	1	2	—	*Hypothenemus*
St. Lucia	CAR	5	0	3	0	2	2	5	22	*Hypothenemus, Coccotrypes, Xylosandrus*
St. Thomas	CAR	2	0	1	0	0	0	1	—	*Hypothenemus*
St. Vincent	CAR	1	0	1	0	0	0	1	9	*Hypothenemus*
Suriname	SA	2	2	1	0	2	2	2	135	*Hypothenemus*
Sweden	EUR	27	27	3	4	9	11	11	9603	*Pityogenes, Ips, Tomicus*
Switzerland	EUR	20	19	5	5	1	9	8	10,174	*Hylurgops, Ips, Pityogenes, Orthotomicus, Tomicus*
Syria	AS	1	0	1	0	1	1	1	158	*Scolytus*
Tahiti	PAC	1	0	1	0	1	1	1	—	*Hypothenemus*
Tanzania	AF	1	0	1	0	1	1	1	34	*Hypothenemus*
Thailand	AS	15	3	2	0	6	10	11	16,389	*Coccotrypes, Hypothenemus*
Trinidad & Tobago	CAR	13	2	5	0	4	4	8	2228	*Hypothenemus, Araptus, Cnemonyx, Coccotrypes, Hylastes*
Tunisia	AF	2	1	1	0	2	2	2	94	*Coccotrypes*
Turkey	AS	57	53	10	12	11	15	15	3042	*Orthotomicus, Tomicus, Ips, Pityogenes, Carphoborus*
Ukraine	EUR	13	13	4	3	7	7	6	873	*Hylesinus, Scolytus, Dryocoetes, Ips*
United Kingdom	EUR	151	150	10	12	14	17	15	43,459	*Hylurgops, Tomicus, Pityogenes, Hylastes, Orthotomicus*
Uruguay	SA	4	4	1	1	2	2	3	313	*Hylurgus*
Venezuela	SA	70	39	9	2	4	7	12	18,649	*Hypothenemus, Coccotrypes, Araptus, Hylurgops, Hylurgus*
Vietnam	AS	6	0	2	1	4	4	4	822	*Hypothenemus, Coccotrypes*
Yugoslavia	EUR	17	15	5	4	6	6	7	2	*Pityogenes, Ips, Cryphalus, Hylurgops, Orthotomicus*
Africa	AF	1	1	1	0	1	1	1	—	*Pityophthorus*
Asia	AS	71	70	9	2	3	3	4	—	*Dryocoetes, Orthotomicus, Cryphalus, Hypothenemus, Scolytus*
Caribbean	CAR	1	0	1	0	1	1	1	—	*Coccotrypes*
Europe	EUR	136	134	13	15	18	24	14	—	*Pityogenes, Hylurgops, Ips, Taphrorychus, Tomicus*
South America	SA	2	2	1	0	2	2	2	—	*Coccotrypes, Hypothenemus*
Unknown	—	137	118	19	13	20	29	16	—	*Pityogenes, Ips, Hylurgops, Hypothenemus, Tomicus*
Grand Total		6825	5008	49	67	35	97	16	1,216,743	*Hypothenemus, Pityogenes, Ips, Coccotrypes, Orthotomicus,*

[a]Continent codes: AF Africa, AS Asia, CA Central America, CAR Caribbean, NA North America, PAC Pacific, SA South America.
[b]The value of US$ 111,515 million for general imports from China represents the sum of US$ 100.063 billion for China itself and US$ 11.452 billion for Hong Kong.
[c]Value for Puerto Rico is for 1999, which is the latest available.

level, Italy exported the most individual species with 41 of the 67 identified species. Other countries that exported several species were France, Germany, and Spain with 27 each; and Belgium with 24 (Table 5).

The number of U.S. states and port cities from which scolytids were intercepted is listed for each originating country in Table 5. Overall, scolytids were intercepted in 35 states and 97 port cities in the U.S. Scolytids from Germany were intercepted at the most locations in the U.S., including 26 states and 46 port cities (Table 5). Other countries whose scolytids were intercepted in 15 or more U.S. states included, in decreasing order, Japan (22 U.S. states), Belgium (20), France (20), Italy (19), Spain (19), China (16), Russia (16), and Mexico (15).

The number of years during the 16-year period 1985–2000 during which scolytids were intercepted from each country is given in Table 5. There were 13 countries from which scolytids were intercepted at least once each year during all 16 years: Belgium, China, France, Germany, Guatemala, Indonesia, Italy, Jamaica, Japan, Mexico, Portugal, Russia, and Spain. Similarly, scolytids were intercepted during 15 years of the 16-year period from Brazil, Chile, Costa Rica, Honduras, Turkey, and the U.K.

The value of U.S. general imports in 2000 is given for each exporting country in Table 5 (U.S. Census Bureau 2001). General imports fall into three major categories: agricultural commodities, manufactured goods, and mineral fuel. The U.S. general imports valued US$1217 billion in 2000, including US$38 billion in imported agricultural commodities, US$1013 billion in manufactured goods, and US$134 billion in mineral fuel (U.S. Census Bureau 2001). In general, more scolytids were intercepted from those countries that sold more goods to the U.S. For example, considering those countries in Table 5 where the value of U.S. general imports were available, there was a significant positive linear relation between the number of scolytid interceptions during 1985–2000 and the value of general imports in 2000 ($r^2 = 0.17$, $P < 0.0001$, $N = 98$ countries). This relationship would likely have been much stronger had the value of those products that are seldom, if ever, associated with scolytids been excluded from the analyses. For example, in 2000, the U.S. imported US$162 billion in vehicles and US$90 billion in crude oil (U.S. Census Bureau 2001), two products that were never reported in the PIN database to be associated with scolytids. Similarly, the U.S. is Chile's leading trading partner as well as the country that shipped the most insects on wood packing materials to Chile during 1995–1999 (Beeche-Cisternas 2000).

The five most frequently intercepted genera from each originating country are listed in Table 5. If fewer than five genera are listed, then all identified genera for that particular country are given. The five scolytid genera that were most often intercepted were, in decreasing order, *Hypothenemus, Coccotrypes, Pityogenes, Ips*, and *Orthotomicus* (Table 5).

Intercepted scolytids by receiving US state

The APHIS personnel intercept pests at five types of ports: airports (generally from baggage), maritime ports, land borders with Canada and Mexico, inspection stations (airports that specialize in air freight), and foreign sites (countries where preclearance inspections are conducted such as Chile, New Zealand, and South Korea). Of the 6825 scolytid interceptions, 1248 were made at airports, 4973 at maritime ports, 201 at land borders, 366 at inspection stations, and 37 at foreign sites.

Scolytids were intercepted at ports of entry in 35 U.S. states as well as during preclearance inspections in Chile, New Zealand, South Korea, Puerto Rico, and the U.S. Virgin Islands (Table 6). Puerto Rico and the U.S. Virgin Islands not only export goods to the U.S. but they also serve as initial U.S. ports of entry. Therefore, Puerto Rico and the U.S. Virgin Islands are listed as both countries of origin for intercepted pests (Table 5) and receiving ports where interceptions are made (Table 6).

The 10 U.S. states that intercepted the most scolytids were Texas (1203 interceptions), Florida (1102), Georgia (612), Louisiana (467), New York (451), Maryland (421), Ohio (327), South Carolina (278), California (240), and Kentucky (232). The number of scolytid interceptions in each state that were listed as being associated with wood articles is presented in Table 6. The majority of scolytid interceptions were made on wood articles in each state except in Arizona, California, Florida, Hawaii, and Washington. Texas intercepted scolytids from 60 different countries, followed by Florida (58), Georgia (45), California (44), New York (41), Louisiana (40), Maryland (29), South Carolina (27), and Kentucky and New Jersey (26 each) (Table 6).

Figure 1 shows the number of scolytid interceptions made in each U.S. state for the years 1985–2000. As expected, most interceptions were made in states with maritime ports on the Atlantic Ocean, Pacific Ocean, and Gulf of Mexico. Many interceptions

Table 6. Summary data by receiving U.S. state for the 6825 scolytid interceptions at U.S. ports of entry during 1985–2000

U.S. state or country	Abbreviation	No of interceptions		No. of countries	Top five countries of origin in decreasing order	No. of genera	Top five genera in decreasing order
		Total	Wood				
Alaska	AK	3	0	1	JP[a]	2	*Orthotomicus, Cryphalus*
Alabama	AL	116	115	16	DE, BE, UK, FR, SE	14	*Pityogenes, Dryocoetes, Orthotomicus, Hylurgops, Hylastes*
Arkansas	AR	2	2	1	DE	2	*Pityogenes, Dryocoetes*
Arizona	AZ	31	9	2	MX, CN	6	*Gnathotrichus, Hypothenemus, Hylastes, Ips, Pityophthorus*
California	CA	240	131	44	CN, FR, MX, IN, PT	29	*Hypothenemus, Coccotrypes, Hylurgus, Orthotomicus, Ips*
Delaware	DE	23	20	9	RU, DE, UA, LV, CR	7	*Pityogenes, Crypturgus, Hylurgops, Euwallacea, Hypothenemus,*
Florida	FL	1102	542	58	IT, JM, ES, GT, CR	35	*Hypothenemus, Coccotrypes, Orthotomicus, Ips, Gnathotrichus*
Georgia	GA	612	523	45	IT, DE, IN, ES, JM	27	*Hypothenemus, Pityogenes, Ips, Hypocryphalus, Hylurgus*
Hawaii	HI	73	0	11	ID, PH, JP, PP, KR	4	*Hypothenemus, Coccotrypes, Xyleborus, Xylosandrus*
Iowa	IA	1	1	1	NL	1	*Xylechinus*
Illinois	IL	46	29	20	BE, KR, JM, JO, PH	9	*Hypothenemus, Pityogenes, Tomicus, Coccotrypes, Orthotomicus*
Indiana	IN	13	13	3	BE, FR, UK	4	*Tomicus, Hylurgops, Ips, Scolytus*
Kentucky	KY	232	208	26	DE, CN, IT, AT FI	20	*Pityogenes, Ips, Hylurgops, Hypothenemus, Orthotomicus*
Louisiana	LA	467	441	40	DE, RU, IT, FR, ES	25	*Pityogenes, Ips, Hypothenemus, Hylurgops, Orthotomicus*
Massachusetts	MA	21	10	12	IT, JM, GR, CV, DO	8	*Hypothenemus, Coccotrypes, Ips, Dryocoetes, Hylastes*
Maryland	MD	421	212	29	JM, IT, DE, ES, PT	22	*Hypothenemus, Orthotomicus, Ips, Pityogenes, Coccotrypes*
Maine	ME	2	2	2	JP, TR	1	*Phloeosinus*
Michigan	MI	114	107	20	BE, FR, IT, DE, JP	14	*Ips, Hylurgops, Tomicus, Pityogenes, Crypturgus*
Minnesota	MN	31	31	6	FR, BE, IT, ES	10	*Ips, Hylurgops, Pityogenes, Tomicus, Orthotomicus*
Missouri	MO	3	1	3	DE, JM, NG	3	*Coccotrypes, Hypothenemus, Ips*
Mississippi	MS	7	6	4	DE, HN, BR, MX	3	*Gnathotrichus, Pityogenes, Pityophthorus*
North Carolina	NC	202	198	15	DE, BE, PL, FI, FR	19	*Pityogenes, Hylurgops, Ips, Taphrorychus, Tomicus*
New Jersey	NJ	192	135	26	IT, ES, DE, PT, DO	18	*Orthotomicus, Ips, Pityogenes, Pagiocerus, Hylurgus*
New MX	NM	3	1	1	MX	2	*Chaetophloeus, Pityophthorus*
New York	NY	451	310	41	DE, RU, IT, JM, IN	26	*Pityogenes, Coccotrypes, Ips, Hypothenemus, Hylurgops*
Ohio	OH	327	321	15	BE, UK, FR, ES, FI	16	*Tomicus, Hylurgops, Pityogenes, Scolytus, Ips*
Oklahoma	OK	28	28	8	DE, ES, BE, NL, FR	7	*Ips, Hylurgops, Orthotomicus, Hylastes, Pityogenes*
Oregon	OR	18	15	7	CN, UA, JP, BE, CL	5	*Orthotomicus, Hylesinus, Hylurgus, Cryphalus, Dryocoetes*
Pennsylvania	PA	47	5	16	JM, RU, BR, FR, CL	16	*Coccotrypes, Hypothenemus, Ips, Pityogenes, Dryocoetes*
South Carolina	SC	278	271	27	DE, IT, ES, ZA, TR	19	*Pityogenes, Orthotomicus, Ips, Hylastes, Hylurgops*

Table 6. Continued

U.S. state or country	Abbreviation	No of interceptions		No. of countries	Top five countries of origin in decreasing order	No. of genera	Top five genera in decreasing order
		Total	Wood				
Tennessee	TN	64	1	12	JM, BE, NL, DE, CN	16	*Hypothenemus, Hylurgops, Taphrorychus, Scolytus, Hypocryphalus*
Texas	TX	1203	9	60	MX, IT, DE, BE, ES	34	*Coccotrypes, Pityogenes, Ips, Hypothenemus, Hylurgops*
Virginia	VA	41	32	11	IT, FR, BE, ES, DE	11	*Ips, Orthotomicus, Tomicus, Coccotrypes, Hylurgus*
Vermont	VT	5	5	1	DE	1	*Pityogenes*
Washington	WA	184	182	9	CN, IN, RU, JP, MX	15	*Dryocoetes, Orthotomicus, Cryphalus, Scolytus, Hypothenemus*
Chile	CL	33	31	1	CL	4	*Hylurgus, Hylastes, Hypothenemus, Orthotomicus*
New Zealand	NZ	3	1	1	NZ	2	*Hylastes, Hylurgus*
Puerto Rico	PR	164	143	21	ES, IT, CL, FR, DE	17	*Pityogenes, Orthotomicus, Hylurgus, Hypothenemus, Ips*
South Korea	KR	1	1	1	KR	1	*Tomicus*
Virgin Islands	VI	21	1	10	DM, SCr, SChr, IT, VE	4	*Hypothenemus, Coccotrypes, Polygraphus, Scolytodes*
Grand Total	—	6825	5008	117	IT, DE, ES, MX, JM	49	*Hypothenemus, Pityogenes, Ips, Coccotrypes, Orthotomicus*

[a]Country codes: AT Austria; AU Australia, AW Aruba, BE Belgium, BR Brazil, BZ Belize, CL Chile, CN China, CR Costa Rica, CV Cape Verde, DE Germany, DM Dominica, DO Dominican Republic, EE Estonia, ES Spain, FI Finland, FR France, GT Guatemala, GR Greece, HN Honduras, ID Indonesia, IL Israel, IN India, IT Italy, JM Jamaica, JP Japan, JO Jordan, KR South Korea, LT Lithuania, LV Latvia, MX Mexico, NG Nigeria, NL Netherlands, NZ New Zealand, PH Philippines, PL Poland, PP Pohnpei, PT Portugal, RU Russia, SCh St. Christopher, British Virgin Islands, SCr St. Croix, U.S. Virgin Islands, SE Sweden, SV El Salvador, TR Turkey, UA Ukraine, U.K. United Kingdom, VE Venezuela, ZA South Africa.

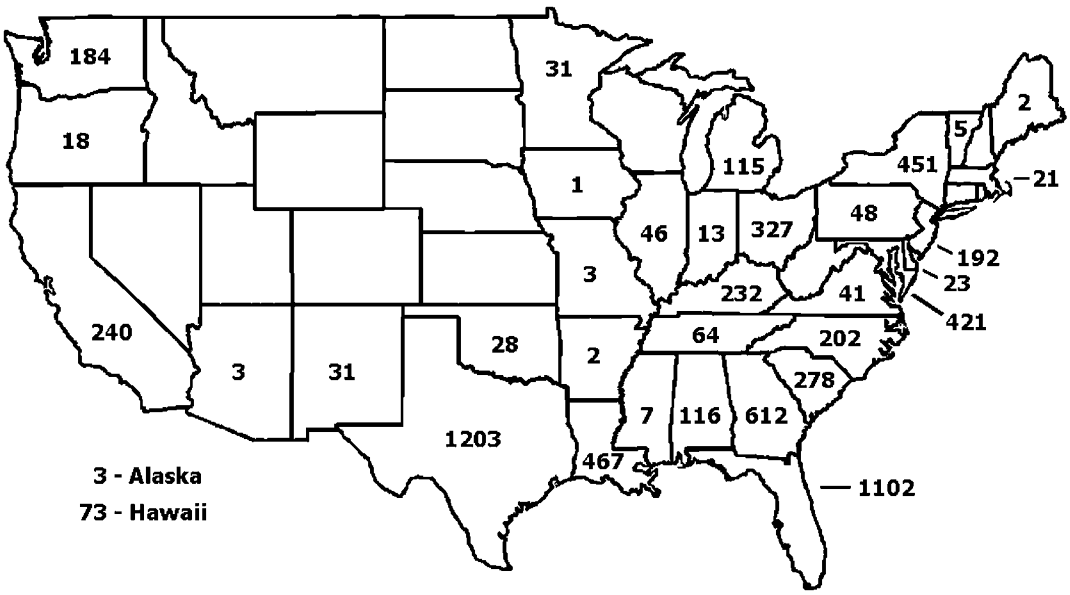

Figure 1. Number of scolytid interceptions made at U.S. ports of entry during 1985–2000 that were entered into the USDA APHIS Port Information Network (PIN) database by state.

were also made at maritime ports along the Great Lakes such as Cleveland, OH; Detroit, MI; Duluth, MN; and Toledo, OH. Of the 46 U.S. airports that reported the 1248 scolytid interceptions, Baltimore, MD, intercepted the most (173 interceptions), followed by Houston, TX (151); Atlanta, GA (143); Miami, FL (131); and Erlanger, KY (117). Similarly, of the 73 U.S. maritime ports that reported the 4973 scolytid interceptions, the top five were Houston, TX (656); Savannah, GA (463); New Orleans, LA (444); Miami, FL (437); and Brooklyn, NY (353). Scolytids were intercepted on 201 occasions at 19 land border crossings; the top five crossings were Laredo, TX (77); El Paso, TX (44); Nogales, AZ (27); Brownsville, TX (13); and Hidalgo, TX (12). Of the 15 inspection stations that reported the 366 scolytid interceptions, Brownsville, TX (171) and Miami, FL (114) reported the most. There were 37 interceptions of scolytids at the three foreign sites, including Chile (33), New Zealand (3), and South Korea (1) (Table 6).

In general, most scolytid interceptions along the U.S. west coast (CA, OR, and WA) were on materials shipped from Asia. Similarly, most scolytid interceptions of European origin occurred at ports along the U.S. east coast and Great Lakes, and most interceptions from Central America occurred in Florida ports.

The number of intercepted scolytid genera and the top five intercepted genera are listed for each receiving U.S. state in Table 6. In general, states with the greatest diversity of intercepted scolytid genera were the same states that had the most interceptions (e.g., FL and TX) (Table 6).

Genera of intercepted scolytids

Of the 6825 scolytid interceptions, 5076 (74%) were identified to the genus level. Overall, there were 49 identified genera (Table 7). The 10 most frequently intercepted genera were *Hypothenemus* (821 interceptions), *Pityogenes* (662), *Ips* (544), *Coccotrypes* (520), *Orthotomicus* (461), *Hylurgops* (327), *Hylurgus* (266), *Tomicus* (194), *Dryocoetes* (166), and *Hylastes* (142). Of the 49 genera, 36 had 100 or fewer interceptions, 29 had fewer than 50 interceptions each, and 20 had fewer than 10 interceptions each (Table 7).

For each scolytid genus, the number of originating continents, countries, and the top four originating countries are listed in Table 7. In general, the genera that were most frequently intercepted in the U.S. also originated from the most countries. The 10 genera that originated from the most countries included *Hypothenemus* (60 countries), *Coccotrypes* (51), *Pityogenes* (34), *Ips* (31), *Orthotomicus* (24), *Hylurgops* (23), *Scolytus* (22), *Xyleborus* (22), *Tomicus* (21), and *Dryocoetes* (20). Of these 10 genera, only *Scolytus* and *Xyleborus* were not among the top 10 genera in total number of interceptions. Twelve scolytid genera were intercepted from only a single country each: *Chaetophloeus*, *Dendroctonus, Micracisella* and *Pseudopityophthorus* from Mexico; *Cnemonyx* from Trinidad and Tobago; *Dactylotrypes* from the Canary Islands; *Liparthrum* from Portugal; *Monarthrum* from Colombia; *Pseudothysanoes* from the Dominican Republic; *Pteleobius* from Italy; *Pycnarthrum* from Haiti; and *Scolytogenes* from the Philippines (Table 7).

The number of receiving U.S. states and ports of entry are listed by scolytid genus in Table 7. *Ips* were intercepted in 26 U.S. states and 50 U.S. port cities. Other genera that were intercepted in 20 or more U.S. states included *Coccotrypes* (20), *Dryocoetes* (21), *Hylurgops* (22), *Hylurgus* (21), *Hypothenemus* (23), *Orthotomicus* (23), and *Pityogenes* (24) (Table 7). Data are also presented in Table 7 for the number of countries where each scolytid genus was intercepted during preclearance inspections in Chile, New Zealand, South Korea, Puerto Rico, and the U.S. Virgin Islands.

The number of years during 1985–2000 that each scolytid genus was intercepted at U.S. ports of entry is given in Table 7. Twelve of the 49 genera were intercepted during each of the 16 years: *Coccotrypes, Hylastes, Hylurgops, Hylurgus, Hypothenemus*, *Ips, Orthotomicus, Pityogenes, Pityophthorus, Polygraphus, Tomicus*, and *Xyleborus* (Table 7).

Species of intercepted scolytids

Overall, the PIN database listed 67 scolytid species that had been intercepted between 1985 and 2000 (Table 8). It is important to note, however, that only 40% (2740 of 6825 interceptions) of the intercepted scolytids were identified to species (Table 3), and therefore several more species were likely intercepted. At times, identification to species is not possible when only immature stages are collected or when specimens are in poor condition. On other occasions, identification to just the family level or genus level may be sufficient to require a regulatory treatment such as fumigation. Therefore, for those scolytids that

Table 7. Summary data by scolytid genus for the 6825 interceptions of scolytids at U.S. ports of entry during 1985–2000

Genus	No. of interceptions			No. of continents	No. of countries	Top four countries of origin in decreasing order	No. of receiving		No. of countries that had preclearance interceptions	No. of years intercepted 1985–2000
	Total	In wood	Identified to species level				States	Cities		
Ambrosiodmus	2	1	2	1	2	MY, PH[a]	2	2	0	2
Araptus	11	1	0	4	9	MX, VE, DO, KE	6	7	1	8
Carphoborus	22	21	16	2	5	ES, IT, TR, DE	11	11	1	10
Chaetophloeus	3	0	0	1	1	MX	3	3	0	3
Chramesus	3	1	0	3	3	BR, JM, MX	2	3	0	3
Cnemonyx	1	1	0	1	1	TT	1	1	0	1
Coccotrypes	520	20	3	7	51	MX, JM, CR, AU	20	34	2	16
Cryphalus	57	54	7	2	13	CN, IT, IN, PH	13	16	1	14
Cryptocarenus	3	0	0	2	2	CO, CR	2	2	0	3
Crypturgus	61	54	34	5	16	PT, DE, ES, FR	14	17	1	14
Cyrtogenius	7	6	0	1	2	CN, KR	5	6	0	6
Dactylotrypes	1	0	1	1	1	Canary Islands	1	1	0	1
Dendroctonus	14	13	0	1	1	MX	1	2	0	2
Dryocoetes	166	159	41	3	20	CN, DE, IT, BE	21	32	1	15
Euwallacea	7	6	7	2	2	CN, CR	5	5	0	4
Gnathotrichus	110	22	0	3	7	MX, GT, HN, CR	5	10	0	14
Hylastes	142	133	119	7	18	ES, CL, IT, FR	18	29	3	16
Hylesinus	13	13	9	1	4	UK, IT, BE, UA	9	9	0	10
Hylurgops	327	309	297	4	23	DE, IT, BE, UK	22	39	1	16
Hylurgus	266	242	218	6	18	IT, PT, CL, ES	21	33	3	16
Hypoborus	2	0	1	1	2	IL, IR	2	2	0	2
Hypocryphalus	107	102	2	4	9	IN, BR, CN, CI	13	17	0	13
Hypothenemus	821	172	63	7	60	JM, IN, BR, MX	23	49	3	16
Ips	544	501	485	5	31	IT, DE, ES, RU	26	50	1	16
Liparthrum	1	0	0	1	1	PT	1	1	0	1
Micracisella	1	0	0	1	1	MX	1	1	0	1
Monarthrum	2	0	0	1	1	CO	1	1	0	2
Orthotomicus	461	434	425	4	24	ES, IT, CN, DE	23	33	2	16
Pagiocerus	24	1	0	2	5	PE, EC, BR, SV	5	7	0	8
Phloeosinus	51	48	22	4	8	JP, CN, MX, NL	12	15	0	13
Phloeotribus	13	6	7	4	9	MX, IL, GT, VE	7	9	0	10
Pityogenes	662	611	641	3	34	DE, IT, RU, BE	24	40	1	16
Pityokteines	19	17	16	2	6	IT, DE, FR, GR	6	7	0	9
Pityophthorus	59	51	11	6	14	MX, ZA, GT, IT	15	22	1	16
Polygraphus	68	59	50	3	14	IT, DE, RU, CN	15	19	2	16
Pseudopityophthorus	2	1	0	1	1	MX	1	2	0	2
Pseudothysanoes	1	1	0	1	1	DO	0	0	1	1
Pteleobius	1	1	1	1	1	IT	1	1	0	1
Pycnarthrum	1	0	0	1	1	HT	1	1	0	1

Table 7. Continued

Genus	No. of interceptions			No. of continents	No. of countries	Top four countries of origin in decreasing order	No. of receiving		No. of countries that had preclearance interceptions	No. of years intercepted 1985–2000
	Total	In wood	Identified to species level				States	Cities		
Scolytodes	5	2	0	4	5	BR, JM, MX, DM	4	4	1	4
Scolytogenes	1	0	0	1	1	PH	1	1	0	1
Scolytus	102	92	18	4	22	BE, CN, RU, IT	16	26	0	14
Taphrorychus	69	67	40	5	14	BE, DE, FR, TR	16	20	0	14
Tomicus	194	182	163	4	21	FR, IT, UK, ES	19	27	2	16
Trypodendron	12	11	12	2	6	IT, DE, BE, TR	4	6	0	9
Xyleborinus	4	1	0	3	3	CN, IT, MX	4	4	0	2
Xyleborus	91	30	21	7	22	CR. CN, IT, MX	15	26	0	16
Xylechinus	13	13	3	2	4	IN, IT, JP, NL	7	7	0	6
Xylosandrus	9	2	5	6	7	PH, BE, BZ, GH	6	6	0	6
Scolytidae	1749	1547	0	7	74	IT, DE, BE, ES	31	71	3	16
Total	6825	5008	2740	7	117	IT, DE, ES, MX	35	97	5	16

[a]Country codes: AT Austria, AU Australia, AW Aruba, BE Belgium, BR Brazil, BZ Belize, CI Ivory Coast, CL Chile, CN China, CO Colombia, CR Costa Rica, CV Cape Verde, DE Germany, DM Dominica, DO Dominican Republic, EC Ecuador, EE Estonia, ES Spain, FI Finland, FR France, GH Ghana, GT Guatemala, GR Greece, HN Honduras, HT Haiti, ID Indonesia, IL Israel, IN India, IR Iran, IT Italy, JM Jamaica, JP Japan, JO Jordan, KE Kenya, KR South Korea, LT Lithuania, LV Latvia, MX Mexico, NG Nigeria, NL Netherlands, NZ New Zealand, PE Peru, PH Philippines, PL Poland, PP Pohnpei, PT Portugal, RU Russia, SCh St. Christopher, British Virgin Islands, SCr St. Croix, U.S. Virgin Islands, SE Sweden, SV El Salvador, TR Turkey, TT Trinidad and Tobago, UA Ukraine, U.K. United Kingdom, VE Venezuela, ZA South Africa.

were entered in the PIN database and identified to the species level, the 10 most commonly intercepted scolytids were *Pityogenes chalcographus* (L.) (565 interceptions), *Orthotomicus erosus* (Wollaston) (385), *Hylurgops palliatus* (Gyllenhal) (295), *Ips typographus* (286), *Hylurgus ligniperda* (Fabricius) (217), *Ips sexdentatus* (Boerner) (157), *Tomicus piniperda* (L.) (155), *Hylastes ater* (Paykull) (75), *Hypothenemus hampei* (Ferrari) (62), and *Polygraphus poligraphus* (L.) (48) (Table 8). The 67 scolytid species represent 31 genera, including six species each of *Hylastes, Ips*, and *Pityogenes.* Thirteen genera were each represented by a single species, including *Coccotrypes* (Table 8) even though it was the fourth most frequently intercepted scolytid genus (Table 7). Although interceptions of *Coccotrypes* were common, only 3 of 520 (0.6%) interceptions were identified to the species level (Table 7).

Ten of the 67 intercepted scolytid species are known to be established in North America, including *Coccotrypes carpophagus* (Hornung), *Euwallacea validus* (Eichhoff), *Hylastes opacus* Erichson, *Hylurgops palliatus, Hylurgus ligniperda, Hypocryphalus mangiferae* Eggers, *Hypothenemus birmanus* (Eichhoff), *Pityogenes bidentatus* (Herbst), *Tomicus piniperda*, and *Trypodendron domesticum* (L.) (Tables 1, 8). For these 10 species, the number of interceptions during 1985–2000 ranged from 1 for *H. birmanus* to 295 for *H. palliatus* (Table 8). The two most commonly intercepted scolytids, *Pityogenes chalcographus* and *Orthotomicus erosus*, both of which infest conifers, are not yet known to be established in North America.

It should also be mentioned that it is APHIS policy that once an exotic species is established in the U.S. and is no longer under official control through an interstate quarantine, then it is not mandatory to report such pests if intercepted. Undoubtedly, if more of the intercepted *Coccotrypes, Hypothenemus*, and *Xyleborus* specimens had been identified to the species level (Table 7), more of the scolytid species listed as established in North America (Table 1) would likely have been found among the intercepted scolytids. Note that among the 50 scolytid species known to be established in North America (Table 1), only two species – *Hylastinus obscurus* (Marsham) and *Premnobius cavipennis* Eichhoff – belong to genera that were never identified among the intercepted Scolytidae in the PIN database (Table 7). According to Wood & Bright (1992), there are four species of *Hylastinus*, all of which are European in origin and infest the roots of leguminous hosts, and there are 16 species of *Premnobius*, of which all are ambrosia beetles native to Africa where they infest several hardwood species. When considering the *Xyleborus* interceptions, it is important to recognize that *Dryoxylon onoharaensum* (Murayama) (Bright & Rabaglia 1999) and *Euwallacea validus* (Wood 1982) were both formerly assigned to the genus *Xyleborus*. In addition, it should be noted that *Dryocoetes autographus* (Ratzeburg) is a Holarctic species, being native to Europe, Asia, and North America, including the U.S. (Wood 1982).

Although only 10 of the 67 scolytids species listed in Table 8 are known to be established in North America, at least 10 others have become established elsewhere in the world, based primarily on data in Wood & Bright (1992): *Dryocoetes autographus, Hylastes ater, Hypothenemus hampei, Orthotomicus erosus, Orthotomicus laricis* (Fabricius), *Phloeosinus rudis* Blandford, *Pityogenes chalcographus, Pityokteines curvidens* (Germar), *Polygraphus poligraphus*, and *Xylosandrus morigerus* (Blandford). For the eight true bark beetles among these 10 species (all but *H. hampei* and *X. morigerus*), the countries where each are known to be established are listed in Table 9. In the case of *H. hampei*, this species has been moved widely from its native range within Africa to almost all coffee growing regions of Asia, the Pacific, Central America, South America, and the Caribbean (Wood & Bright 1992). As for *Xylosandrus morigerus*, Wood & Bright (1992) list several countries in Central America, Europe, and South America where this species has become established.

Of the 10 most commonly intercepted scolytids in the U.S. (Table 8), only *Ips sexdentatus* and *Ips typographus* have so far not become established in the U.S. or elsewhere in the world. Of the eight species that have become established, *Hypothenemus hampei* breeds in coffee seeds, while the other seven species (*Hylastes ater, Hylurgops palliatus, Hylurgus ligniperda, Orthotomicus erosus, Pityogenes chalcographus, Polygraphus poligraphus*, and *Tomicus piniperda*) are true bark beetles. Data on range expansion for the true bark beetles are presented in Table 9. Keeping in mind the limitations of the PIN database, there appears to be a positive relationship, although difficult to measure, between interception rate and establishment rate.

In some cases, scolytids in the PIN database were reported as being intercepted from countries that were outside the species' known range as given in Wood & Bright (1992). Assuming the range data in Wood & Bright (1992) to be complete and there were no errors in scolytid identification or data entry in the PIN database,

Table 8. Summary data for the 67 scolytid species that were identified among all the scolytids intercepted at U.S. ports of entry during 1985–2000

Species	No. of interceptions	No. of years	No of continents	No. of countries	Top five originating countries in decreasing order	No. of receiving States	No. of receiving Cites	Top five receiving U.S. states in decreasing order	Most common host material	Top three associated products
Ambrosiodmus apicalis (Blandford)	1	1	1	1	MY	1	1	TX	Lumber	Lumber
Ambrosiodmus compressus (Lea)	1	1	1	1	PH	1	1	CA	Stem	Orchids (*Dendrochilum*)
Carphoborus minimus (Fabricius)	10	4	2	3	ES, TR, IT	7	7	FL, MD, LA, NJ, NY	Crating	Tiles, marble, books
Carphoborus pini Eichhoff	5	4	1	2	ES, IT	3	3	FL, GA, PA	Crating	Tiles, marble
Carphoborus rossicus Semenov	1	1	1	1	DE	1	1	KY	Crating	Parts
Coccotrypes carpophagus (Hornung)	3	2	2	3	SV, JM, MX	2	3	TX, FL	Seed	Palms, kola nuts
Cryphalus asperatus (Gyllenhal)	2	2	1	2	DE, IT	2	2	AL, PR	Crating	Steel, tiles
Cryphalus piceae (Ratzeburg)	5	4	1	2	IT, FR	4	4	FL, AL, GA, LA	Crating	Tiles, aluminum, marble
Crypturgus cinereus (Herbst)	12	6	4	6	DE, ES, AU, BE, RU	8	8	KY, LA, FL, GA, MD	Crating	Tiles, machinery, household goods
Crypturgus mediterraneus Eichhoff	16	7	1	5	PT, ES, FR, IT, NL	5	7	FL, MD, GA, LA, TX	Crating	Marble, tiles, granite
Crypturgus numidicus Ferrari	6	5	1	4	ES, LV, EE, GR	6	6	DE, NJ, NY, PA, TX	Crating	Tiles
Dactylotrypes longicollis (Wollaston)	1	1	1	1	CIs	1	1	FL	Seed	*Phoenix* palm
Dryocoetes autographus (Ratzeburg)	20	13	4	10	IT, BE, DE, BR, RU	9	12	TX, FL, PA, MD, AL	Dunnage	Tiles, steel
Dryocoetes villosus (Fabricius)	21	10	1	6	BE, DE, UK, FR, IT	10	11	OH, AL, LA, TX, FL	Dunnage	Steel, marble
Euwallacea validus (Eichhoff)	7	4	2	2	CN, CR	5	5	CA, DE, NJ, TN, WA	Crating	Furniture, iron, marble
Hylastes angustatus (Herbst)	4	3	1	2	BE, FR	3	3	OH, CA, MD	Dunnage	Slate
Hylastes ater (Paykull)	75	16	4	11	ES, CL, FR, IT, DE	14	18	GA, OH, TX, FL, SC	Crating	Steel, granite, marble
Hylastes attenuatus Erichson	22	11	2	8	ES, IT, PT, FR, ZA	10	12	FL, SC, OH, MI, AL	Dunnage	Tile, granite
Hylastes cunicularius Erichson	6	5	1	4	DE, IT, BE, ES	5	5	SC, AL, FL, GA, NY	Dunnage	Machinery, tiles
Hylastes linearis Erichson	9	5	1	3	PT, ES, IT	3	4	FL, MD, TX	Crating	Tiles, marble
Hylastes opacus Erichson	3	3	2	2	RU, BR	2	2	NY, TX	Dunnage	Ironware, household goods

Table 8. Continued

Species	No. of interceptions	No. of years	No of continents	No. of countries	Top five originating countries in decreasing order	No. of receiving States	No. of receiving Cites	Top five receiving U.S. states in decreasing order	Most common host material	Top three associated products
Hylesinus varius (Fabricius)	9	8	1	3	UK, BE, IT	7	7	OH, FL, MA, MI, NC	Dunnage	Steel, tiles
Hylurgops glabratus (Zetterstedt)	2	2	1	1	IT	2	2	LA, TX	Crating	Tiles
Hylurgops palliatus (Gyllenhal)	295	16	4	20	DE, IT, BE, UK, ES	22	37	TX, OH, NY, GA, NC	Dunnage	Tiles, machinery
Hylurgus ligniperda (Fabricius)	217	16	6	16	IT, PT, ES, CL, FR	19	29	TX, FL, GA, MD, LA	Crating	Tiles, marble
Hylurgus micklitzi Wachtl	1	1	1	1	IT	1	1	FL	Not given	Tiles
Hypoborus ficus Erichson	1	1	1	1	IL	1	1	GA	Stem	*Ficus*
Hypocryphalus mangiferae Eggers	2	1	1	1	BR	2	2	NY, PA	Crating	Yam (*Dioscorea*)
Hypothenemus birmanus (Eichhoff)	1	1	1	1	SG	1	1	FL	Crating	Marble
Hypothenemus hampei (Ferrari)	62	12	5	14	GT, SV, JM, HN, AW	9	11	FL, CA, GA, IL, LA	Seed	Coffee
Ips acuminatus (Gyllenhal)	25	9	2	9	IT, ES, FR, RU, CN	10	12	NY, LA, FL, GA, TX	Crating	Tiles, aluminum
Ips amitinus (Eichhoff)	2	2	1	2	FI, IT	2	2	OH, TX	Crating	Tiles
Ips cembrae (Heer)	10	8	2	4	DE, BE, CN, IT	7	7	FL, TX, CA, IL, NY	Dunnage	Ironware, parts
Ips mannsfeldi (Wachtl)	5	4	2	2	ES, TR	3	3	NY, SC, TX	Pallets	Tiles, books
Ips sexdentatus (Boerner)	157	16	2	11	IT, ES, FR, PT, BE	19	26	FL, TX, OH, MD, NJ	Crating	Tiles, marble
Ips typographus (L.)	286	16	2	22	IT, DE, RU, BE, FR	24	37	TX, FL, GA, KY, LA	Crating	Tiles, machinery
Orthotomicus erosus (Wollaston)	385	16	4	18	ES, IT, CN, TR, PT	21	31	FL, TX, MD, SC, NJ	Crating	Tiles, marble, granite
Orthotomicus laricis (Fabricius)	28	12	2	7	IT, DE, FR, RU, ES	12	13	NY, KY, TX, LA, OH	Dunnage	Marble, tiles, granite
Orthotomicus proximus (Eichhoff)	2	2	1	2	FI, IT	2	2	OH, TX	Crating	Tiles
Orthotomicus suturalis (Gyllenhal)	10	7	1	4	UK, DE, EE, FR	5	5	AL, KY, LA, MN, SC	Dunnage	Steel, parts, machinery
Phloeosinus rudis Blandford	22	8	2	2	JP, BE	8	8	TX, LA, GA, NC, ME	Dunnage	Steel
Phloeotribus scarabaeoides (Bernard)	7	6	2	6	IL, GR, IT, PT, JO	4	4	NY, IL, CA, FL	Stem	Olive (*Olea europea*), tiles
Pityogenes bidentatus (Herbst)	25	9	1	6	FR, ES, DE, IT, PT	10	12	FL, OH, TX, AL, MN	Dunnage	Tiles, steel, machinery
Pityogenes bistridentatus (Eichhoff)	38	11	3	7	ES, IT, FR, TR, UK	10	13	GA, FL, OH, TX, SC	Crating	Tiles, machinery, parts
Pityogenes calcaratus (Eichhoff)	4	3	1	3	ES, IT, FR	4	4	FL, GA, MN, TX	Crating	Tiles, marble
Pityogenes chalcographus (L.)	565	16	3	31	DE, IT, RU, BE, ES[a]	24	39	NY, TX, GA, LA, KY[b]	Crating	Machinery, tiles, steel
Pityogenes quadridens (Hartig)	8	7	2	5	FI, LT, PT, ES, TR	7	7	FL, AL, KY, LA, NC	Crating	Tiles, steel, parts

Table 8. Continued

Species	No. of interceptions	No. of years	No of continents	No. of countries	Top five originating countries in decreasing order	No. of receiving States	No. of receiving Cites	Top five receiving U.S. states in decreasing order	Most common host material	Top three associated products
Pityogenes trepanatus (Nordlinger)	1	1	1	1	LT	1	1	TX	Dunnage	Not given
Pityokteines curvidens (Germar)	3	3	1	3	GR, FR, IT	3	3	MD, NY, TX	Crating	Tiles, aluminum
Pityokteines spinidens (Reitter)	13	7	2	5	IT, FR, DE, AT, RU	4	4	NY, TX, AL, TN	Crating	Tiles, slate, machinery
Pityophthorus pityographus (Ratzeburg)	11	7	1	4	IT, DE, FR, NL	5	5	KY, LA, NC, FL, MD	Crating	Tiles, marble, parts
Polygraphus poligraphus (L.)	48	14	2	9	IT, DE, RU, UK, BE	14	18	LA, GA, NY, FL, KY	Crating	Tiles, parts, machinery
Polygraphus subopacus Thomson	2	2	2	2	AZ, IT	1	1	TX	Crating	Machinery
Pteleobius vittatus (Fabricius)	1	1	1	1	IT	1	1	FL	Crating	Tiles
Scolytus amygdali Guerin-Meneville	2	2	1	1	IL	1	1	CA	Fruit	Palm (*Bactris*), *Prunus*
Scolytus intricatus (Ratzeburg)	11	6	1	4	BE, FR, DE, IT	7	7	OH, TN, GA, LA, NC	Dunnage	Steel, slate, parts
Scolytus ratzeburgi Janson	4	3	2	3	RU, FI, UA	3	3	NY, LA, NC	Dunnage	Household goods
Scolytus scolytus (Fabricius)	1	1	1	1	UK	1	1	LA	Dunnage	Not given
Taphrorychus bicolor (Herbst)	23	9	1	5	BE, DE, FR, FI, NL	10	11	NC, TX, AL, OH, CA	Dunnage	Steel, parts
Taphrorychus villifrons (Dufour)	17	9	2	5	BE, DE, FR, LV, TR	10	10	TN, LA, NC, OK, GA	Dunnage	Steel, parts, tools
Tomicus minor (Hartig)	8	3	4	4	TR, IT, NZ, BR	4	4	SC, CA, FL, KY	Crating	Tiles, marble
Tomicus piniperda (L.)	155	16	2	17	FR, IT, UK, ES, BE	18	25	OH, FL, TX, LA, MI	Dunnage	Tiles, steel, granite
Trypodendron domesticum (L.)	7	6	2	2	IT, TR	2	2	FL, AL	Crating	Tiles
Trypodendron signatum (Fabricius)	5	4	1	4	DE, BE, FR, NL	3	4	GA, FL, OH	Crating	Machinery, parts, woodenware
Xyleborus eurygraphus (Ratzeburg)	21	11	2	4	IT, ES, GR, TR	6	7	FL, SC, TX, GA, VA	Crating	Tiles, marble, granite
Xylechinus pilosus (Ratzeburg)	3	3	1	2	IT, NL	2	2	FL, IA	Crating	Tiles
Xylosandrus morigerus (Blandford)	5	4	3	3	PH, BZ, BE	3	3	CA, FL, LA	Stem	Orchids (*Dendrobium, Brassavola*)

[a]Country codes: AT Austria, AU Australia, AW Aruba, AZ Azerbaijan, BE Belgium, BR Brazil, BZ Belize, CIs Canary Islands, CL Chile, CN China, CR Costa Rica, CV Cape Verde, DE Germany, DM Dominica, DO Dominican Republic, EE Estonia, ES Spain, FI Finland, FR France, GT Guatemala, GR Greece, HN Honduras, ID Indonesia, IL Israel, IN India, IT Italy, JM Jamaica, JP Japan, JO Jordan, KR South Korea, LT Lithuania, LV Latvia, MX Mexico, MY Malaysia, NG Nigeria, NL Netherlands, NZ New Zealand, PH Philippines, PL Poland, PP Pohnpei, PT Portugal, RU Russia, SCh St. Christopher, British Virgin Islands, SCr St. Croix, U.S. Virgin Islands, SE Sweden, SG Singapore, SV El Salvador, TR Turkey, UA Ukraine, UK United Kingdom, VE Venezuela, ZA South Africa.
[b]State codes as given in Table 6.

Table 9. Species of true bark beetles that have become established in countries outside their native range

Species	Native range	Countries or continents where introduced	Common hosts	Intercepted in U.S.	Reference
Crypturgus pusillus (Gyllenhal)	AS, EUR, N-AF[a]	CA, US[b]	*Abies, Picea, Pinus*	No[c]	Wood & Bright (1992)
Dendroctonus micans (Kugelann)	AS, EUR	UK	*Picea,Pinus*	No	Bevan & King (1983); Gregoire (1988)
Dendroctonus valens LeConte	CA, NA	CN	*Pinus*	No	Wood & Bright (1992)
Dryocoetes autographus (Ratzeburg)	AS, EUR, NA, N-AF	BR	*Picea, Pinus, Abies*	Yes	Wood & Bright (1992)
Hylastes angustatus (Herbst)	AS, EUR	SZ, ZA	*Pinus, Picea*	Yes	Browne (1968); Wood & Bright (1992)
Hylastes ater (Paykull)	AS, EUR, N-AF	AU, CL, NZ	*Pinus, Picea*	Yes	Wood & Bright (1992)
Hylastes linearis Erichson	AS, EUR, N-AF	ZA	*Pinus*	Yes	Wood & Bright (1992)
Hylastes opacus Erichson	AS, EUR	US	*Pinus, Picea*	Yes	Wood & Bright (1992)
Hylesinus toranio (Danthione)	AS, EUR, N-AF	AR	*Fraxinus, Olea, Syringa*	No	Wood & Bright (1992)
Hylurgops palliatus (Gyllenhal)	AS, EUR, N-AF	US	*Abies, Picea, Pinus*	Yes	Haack 2001
Hylurgus ligniperda (Fabricius)	AS, EUR, N-AF	AU, JP, NZ, US, ZA	*Pinus*	Yes	Hoebeke (2001); Browne (1968); Wood & Bright (1992)
Ips calligraphus (Germar)	CA, CAR, NA	AU	*Pinus*	No	Wood & Bright (1992)
Ips grandicollis (Eichhoff)	CA, CAR, NA	AU	*Pinus*	No	Wood & Bright (1992)
Orthotomicus caelatus (Eichhoff)	NA	AU	*Pinus, Picea, Larix*	No	Wood & Bright (1992)
Orthotomicus erosus (Wollaston)	AS, EUR, N-AF	CL, FJ, ZA	*Pinus*	Yes	Wood & Bright (1992)
Orthotomicus laricis (Fabricius)	AS, EUR, N-AF	CL	*Pinus, Picea, Larix*	Yes	Wood & Bright (1992)
Orthotomicus proximus (Eichhoff)	AS, EUR	MG	*Pinus*	Yes	Wood & Bright (1992)
Phloeosinus armatus Reitter	AS	US	*Cupressus*	No	Wood 1992; Wood & Bright (1992)
Phloeosinus cupressi Hopkins	NA	AU, NZ, PA	*Chamaecyparis, Cupressus, Thuja*	No	Wood & Bright (1992)
Phloeosinus rudis Blandford	AS	FR	*Chamaecyparis,Cryptomeria, Juniperus,*	Yes	Wood & Bright (1992)
Pityogenes bidentatus (Herbst)	AS, EUR	MG, US	*Pinus*	Yes	Wood & Bright (1992)
Pityogenes chalcographus (L.)	AS, EUR	JM	*Pinus, Picea, Abies, Larix*	Yes	Wood & Bright (1992)
Pityokteines curvidens (Germar)	AS, EUR	AR, ZA	*Abies, Larix, Pinus, Picea*	Yes	Wood & Bright (1992)
Polygraphus poligraphus (L.)	AS, EUR	ZA	*Picea*	Yes	Wood & Bright (1992)
Polygraphus rufipennis (Kirby)	NA	ZA	*Picea*	No	Wood & Bright (1992)
Scolytus mali (Bechstein)	AS, EUR, N-AF	CA, US	*Malus, Prunus, Crataegus*	No	Wood & Bright (1992)
Scolytus multistriatus (Marsham)	AS, EUR, N-AF	CA, US	*Ulmus*	No	Wood & Bright (1992)
Scolytus rugulosus (Muller)	AS, EUR, N-AF	AR, CA, MX, PE, US, UY	*Malus, Prunus, Crataegus*	No	Wood & Bright (1992)
Tomicus piniperda (L.)	AS, EUR, N-AF	CA, US	*Pinus*	Yes	Haack & Kucera (1993)

[a]Continent codes: AF Africa, AS Asia, CA Central America, CAR Caribbean, NA North America, N-AF North Africa, PAC Pacific, SA South America.
[b]Country codes: AR Argentina, AU Australia, BR Brazil, CA Canada, CL Chile, CN China, FJ Fiji, FR France, JM Jamaica, JP Japan, MG Madagascar, MX Mexico, NZ New Zealand, PA Panama, PE Peru, SZ Swaziland, TR Turkey, U.S. United States, U.K. United Kingdom, UY Uruguay, ZA South Africa.
[c]In all cases where a species is reported to not have been intercepted in the U.S. (‘no’), it is still possible that individuals of that species were intercepted but either not identified to species or not entered in the PIN database.

such interceptions could indicate that a given species has expanded its geographic range. On the other hand, because wood packing materials are often recycled among countries, it is possible that the original infestation occurred in a country different than the most current exporting country. Some examples of where scolytids were intercepted from countries outside their known range as given in Wood & Bright (1992) include: *Dryocoetes autographus* from Colombia (1 interception), *Hylastes ater* from Guatemala (1), *Hylastes attenuatus* Erichson from South Africa (2), *Hylurgops palliatus* from Honduras (1) and Venezuela (1), *Phloeosinus rudis* from Belgium (1), *Pityogenes chalcographus* from Brazil (1), and *Tomicus minor* (Hartig) from Brazil (1) and New Zealand (1).

The number of originating continents, countries, and the top five originating countries are presented for each of the 67 identified scolytids species (Table 8). Considering the top 10 intercepted scolytid species, each originated from at least 2–6 continents and 9–31 countries (Table 8). The 10 countries most often listed among the top five countries of origin for each of the 67 scolytid species were Italy (listed 41 times), France (23), Spain (23), Germany (21), Belgium (19), Russia (10), Portugal (9), Turkey (9), U.K. (8), and The Netherlands (5) (Table 8).

The number of receiving U.S. states, port cities, and the top five receiving states are listed for each of the 67 intercepted scolytid species in Table 8. In general, the scolytid species that were most often intercepted were also intercepted in the most U.S. states and port cities. The 10 U.S. states most often listed among the top five receiving states for each of the 67 intercepted scolytid species were Florida (listed 39 times), Texas (34), Louisiana (23), Georgia (21), New York (16), Ohio (16), Alabama (12), Kentucky (10), California (10), and South Carolina (9) (Table 8).

For the 67 intercepted scolytid species, 36 were most often intercepted in association with crating, 20 with dunnage, one with pallets, and eight with live plant material or with food items, one with lumber, and one was not given (Table 8). The five products that were most often listed among the top three associated products for each of the 67 scolytid species were tiles (listed 40 times), marble (17), steel (14), machinery (12), and parts (11) (Table 8).

Host range of true bark beetles established outside their native range

Based on range data presented primarily in Wood & Bright (1992), at least 29 species of true bark beetles are known to be established in countries outside their native range worldwide (Table 9). Of these 29 species, 20 are Eurasian in origin, six are Central American and North American, two Asian, and one Holarctic (Table 9). The major recipient continents or world regions for these 29 species were, in decreasing order, North America (10 established exotic bark beetles), Africa (9), the Pacific (7), and South America (7). By contrast, only two species of true bark beetles have become established in Europe, and one each in Asia, Central America, and the Caribbean. Similarly, of the 20 recipient countries listed in Table 9, the six countries with the most species of exotic bark beetles were the U.S. (10), South Africa (7), Australia (6), Canada (5), Chile (3), and New Zealand (3). Of these 29 bark beetle species, 25 infest conifers and four infest broadleafed trees (Table 9). Most of the 25 conifer-infesting bark beetles utilize pine (*Pinus*) as their primary or secondary host for breeding. The preponderance of conifer-infesting species among the exotic bark beetles that have become established worldwide reflects the fact that (1) almost every conifer species is host to at least one species of bark beetle, (2) conifer wood is used worldwide for solid wood packing materials, and (3) many countries in the Southern Hemisphere have established large plantations of exotic conifers, using conifers species that are native to the Northern Hemisphere.

Of the 29 bark beetle species that have become established in other countries, 17 are monogamous species where the females initiate attack (*Crypturgus*, *Dendroctonus*, *Hylastes*, *Hylesinus*, *Hylurgops*, *Hylurgus*, *Phloeosinus*, *Scolytus*, *Tomicus*), whereas 12 are polygamous species where the males initiate attack (*Dryocoetes*, *Ips*, *Orthotomicus*, *Pityogenes*, *Pityokteines*, *Polygraphus*). In general, most of the conifer-infesting bark beetles that have become established outside their native range (Table 9) would be considered ‘secondary bark beetles’ or ‘solitary colonizing bark beetles’. Secondary bark beetles are typically species that infest weakened or recently dead host trees, e.g., several species of *Crypturgus, Dryocoetes, Hylastes, Hylurgops, Hylurgus, Ips, Orthotomicus, Phloeosinus, Pityogenes, Polygraphus, Scolytus*, and *Tomicus*. Solid wood packing materials are often made from recently cut live trees, which often become infested with secondary bark beetles prior to manufacturing. *Dendroctonus micans* (Kugelmann) and *Dendroctonus valens* are examples of solitary colonizers of live trees, usually infesting the lower trunk near groundline. Thus, logs or wood packing materials made from trees already infested with *D. micans* and *D. valens* could easily transport these species if bark removal is not complete. Because these species are solitary colonizers they could more easily become established even if few are exported. Gregoire (1988), Schroeder (1990), and Siitonen (2000) provide information on how *D. micans* and other scolytids can be moved internationally on logs. 'Primary bark beetles', such as many of the North American *Dendroctonus* species, typically infest and kill standing and apparently healthy trees. Primary bark beetles typically 'mass attack' their living hosts, using aggregation pheromones to coordinate their attack on individual trees and thereby overwhelm the trees' resistance mechanisms. Although wood packing materials could be made from trees infested with primary bark beetles, so far no such species have become established in other countries. This situation suggests that insufficient numbers of primary bark beetles have been introduced at any one time to ensure successful mass attack of living host trees and thus establishment has not occurred.

Wood articles associated with scolytid interceptions

Of the 6825 scolytid interceptions, 5008 were designated as being associated with various wood articles. Of these 5008 wood-associated interceptions, 44% involved crating, 37% involved dunnage, and 7% involved pallets (Table 10). Of the remaining wood-associated interceptions, 573 (11%) were simply classified as 'wood' and therefore could not be assigned to a more specific type of wood article. Some of the other types of wood articles on which scolytids were found included live trees, logs, and lumber. The preponderance of interceptions on crating and dunnage, compared with pallets, probably reflects the greater ease and thoroughness with which inspections can be made on crating and dunnage compared with pallets. Similarly, when considering all intercepted insects found in association with wood, Haack & Cavey (2000) reported a similar pattern in which more interceptions were made on crating (45%) and dunnage (33%) than on pallets (6%).

For each world region, most wood-associated interceptions involved crating followed by dunnage and pallets (Table 10). However, most wood-associated interceptions from Central America involved pallets. The 15 countries from where the most wood-associated interceptions were made are listed in Table 10. Scolytids were most often intercepted on crating from Italy, Spain, China, India, and Portugal, and on dunnage from Germany, Belgium, France, Russia, U.K., Japan, The Netherlands, Brazil, and Chile. Mexico was the only country where pallets were the most commonly infested type of wood article. The type of wood article that was most commonly associated with scolytid interceptions for a given country reflected its principal wood-associated exports to the U.S. For example, the most common product associated with scolytid-infested crating was tiles from Italy and Spain, ironware from China and India, and marble from Portugal. Similarly, scolytid-infested dunnage was most often associated with machinery from Germany; steel from Belgium, U.K., Japan, The Netherlands, and Brazil; and aluminum from France and Russia. The products associated with scolytid-infested dunnage from Chile were not specified in the PIN database.

The 15 most commonly intercepted scolytid genera and species associated with wood articles are listed in Table 10. Although most of these scolytid genera and species were each found on crating, dunnage, and pallets, certain scolytids tended to be found more often on one type of wood article than another. For example, *Pityogenes, Ips, Orthotomicus, Hylurgus, Hypothenemus, Hylastes, Hypocryphalus, Polygraphus, Cryphalus*, and *Crypturgus* were most often intercepted on crating, whereas *Hylurgops, Tomicus, Dryocoetes, Scolytus*, and *Taphrorychus* were most commonly intercepted on dunnage. Similarly, *Orthotomicus erosus*, *Hylurgus ligniperda, Ips sexdentatus, Polygraphus poligraphus, Pityogenes bistridentatus*, and *Ips acuminatus* were more likely to be intercepted on crating, while *Hylurgops palliatus, Tomicus piniperda, Pityogenes bidentatus, Taphrorychus bicolor* (Herbst), and *Phloeosinus rudis* were most commonly intercepted on dunnage (Table 10).

The 15 U.S. states that intercepted the most wood-associated scolytids are listed in Table 10. The type of wood article that was most commonly associated with scolytid interceptions in any particular U.S. state reflected the principal imports coming into the ports of that state. In states where scolytid-infested dunnage was the most commonly intercepted wood article (Alabama, Louisiana, Michigan, North Carolina, Ohio, and Texas), steel was the product associated with the most interceptions. Similarly, in states where crating was the most common type of scolytid-infested wood article, tiles were the most common associated product in Florida and California; ironware in Georgia and Washington; machinery in New York and South Carolina; marble in Maryland and New Jersey; and parts in Kentucky.

Table 10. Summary data for the number of wood-associated scolytid interceptions made at U.S. ports of entry during 1985–2000, where the wood article was designated as crating, dunnage, or pallets

Parameter	Type of wood article			Total on wood
	Crating	Dunnage	Pallets	
All interceptions on wood	2179	1841	348	5008
Continents or world regions				
Africa	24	20	0	67
Asia	428	311	55	914
Central America	42	13	59	199
Caribbean	3	1	0	14
Europe	1609	1350	210	3488
Pacific	2	3	0	11
15 countries from where the most interceptions were made on wood				
Italy	712	92	51	943
Germany	297	315	65	735
Spain	257	80	48	424
Belgium	34	284	5	346
France	86	119	5	254
China	123	25	20	234
India	168	22	7	208
Russia	34	151	0	198
United Kingdom	12	124	3	150
Mexico	22	7	58	143
Portugal	88	14	4	130
Japan	9	87	1	102
Netherlands	28	35	2	70
Brazil	25	26	11	68
Chile	3	12	0	65
15 most commonly intercepted scolytid genera on wood				
Pityogenes	261	246	39	611
Ips	230	166	34	501
Orthotomicus	269	81	35	434
Hylurgops	81	175	12	309
Hylurgus	140	37	13	242
Tomicus	57	106	7	182
Hypothenemus	103	26	14	172
Dryocoetes	55	67	15	159
Hylastes	51	46	4	133
Hypocryphalus	86	8	6	102
Scolytus	17	60	4	92
Taphrorychus	3	57	0	67
Polygraphus	29	16	8	59
Cryphalus	32	7	8	54
Crypturgus	26	13	8	54
15 most commonly intercepted scolytid species on wood				
Pityogenes chalcographus	220	206	35	517
Orthotomicus erosus	243	49	31	359
Hylurgops palliatus	76	158	10	283
Ips typographus	108	96	19	253
Hylurgus ligniperda	119	27	9	195
Ips sexdentatus	85	48	0	151
Tomicus piniperda	43	87	4	145
Hylastes ater	26	21	2	73
Polygraphus poligraphus	21	11	7	41
Pityogenes bistridentatus	22	9	2	36
Orthotomicus laricis	8	12	4	28
Pityogenes bidentatus	7	15	1	25

Table 10. Continued

Parameter	Type of wood article			Total on wood
	Crating	Dunnage	Pallets	
Ips acuminatus	13	3	3	23
Taphrorychus bicolor	1	20	0	23
Phloeosinus rudis	0	21	0	22
15 states that intercepted the scolytids on wood				
Texas	311	354	65	849
Florida	428	40	18	542
Georgia	312	100	44	523
Louisiana	203	204	17	441
Ohio	0	308	0	326
New York	121	97	56	310
South Carolina	141	96	12	271
Maryland	162	25	2	212
Kentucky	101	23	56	208
North Carolina	18	172	2	198
Washington	107	28	27	182
New Jersey	81	15	12	135
California	46	17	2	131
Alabama	8	107	0	115
Michigan	3	89	3	107
Port activity type				
Airport	186	43	52	385
Maritime port	1977	1789	236	4452
Land border	7	3	59	117
Inspection station	9	6	0	21
Foreign site	0	0	1	33

The number of wood-associated scolytid interceptions made at each of the five port types is given in Table 10. Crating was the most common type of infested wood article at airports, maritime ports, and inspection stations; and pallets were the most common type at land borders. At foreign sites, where preclearance inspections are made, little information was provided on the types of wood articles that were infested.

Conclusions

Although not all cargo is inspected for insects, and not all intercepted insects are entered into the PIN database, PIN nevertheless is a valuable resource that documents historical interception records for pests considered by USDA APHIS to be of quarantine significance. Overall, PIN provides detailed information on which pest species from outside North America are commonly moved in international commerce, the countries of origin, associated products, and historical trends.

Scolytids are easily transported to new countries through international trade as a result of their small size, cryptic breeding habits within a wide variety of host tissues, and large host range, including many species that are important in international trade. Because many scolytid species reproduce and develop in the inner bark or wood of recently dead and dying trees, solid wood packing materials made from such trees will often harbor scolytids and other pests. Although complete debarking of wood packing materials entering the U.S. has been required for several years (USDA APHIS 1995), bark was still found in 10–15% of maritime shipments and 1% of air shipments that contained wood during a 2001 survey (USDA APHIS 2002). Given that complete debarking is difficult to achieve, and that inspectors often examine only a small percentage of international cargo, it is apparent that other mitigation measures are needed to reduce the risk of unintentional movement of pests. Currently the world's plant protection organizations are considering new International Plant Protection Convention standards that were approved in 2002 by the Interim Commission for Phytosanitary Measures of the Food and Agriculture Organization (FAO 2002). The two approved treatments for unmanufactured solid wood packing materials include heat treatment and methyl bromide fumigation. Complete adoption and compliance of such a standard would dramatically lower the risk of moving live insects with such wood products. Nevertheless, until the new standards are in place and compliance is complete, importing countries can reduce the chance of establishment and subsequent spread of exotic insects through improved inspection techniques and regulatory treatments, early detection efforts followed by rapid response to new exotics, pest risk assessments, and research into alternative packing materials (U.S. Congress 1993; Morrell 1995; Morrell & Filip 1996; Campbell 2001; USDA APHIS 2002).

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