ASSESSING THE PEST RISKS OF WOOD IMPORTS INTO THE UNITED STATES OF AMERICA*

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(Revision received for publication 14 May 2003)

ABSTRACT

Interest in importing unmanufactured wood products into the United States increased significantly in the late 1980s. The United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) has lead responsibility for import regulations and quarantines for plant and animal products; the USDA Forest Service has lead responsibility for managing forest pests and minimising their impacts on federal lands in the United States. USDA APHIS and the Forest Service collaborated to provide the technical information needed for the development of sound import regulations for potential wood imports. The Forest Service established a team of forest entomologists and plant pathologists to develop pest risk assessments at the request of APHIS. This team adds experts depending on the specific risk assessment needs and situation. Assessments have been completed for logs and/or wood chips from Russia, New Zealand, Chile, Mexico, and South America. An assessment is under way for imports from Australia. These assessments have looked at a number of tree species. The Forest Service and APHIS have developed a pest risk assessment process to identify risks associated with the importation of unmanufactured wood articles. This process is similar to International Standards for Phytosanitary Measures developed by the United Nations Food and Agriculture Organisation, but with modifications to meet areas of concern peculiar to wood imports. APHIS issued regulations in 1995 specifying universal requirements for importation of unmanufactured wood products. They use the pest risk assessments to determine if modifications to these regulations are required.

Keywords: log imports; wood import; pest risk assessment; log pests; wood import regulations; exotic forest pests; U.S. wood import requirements

INTRODUCTION

Numerous exotic insects and pathogens of woody plants have entered the United States since Europeans first arrived. It is estimated that over 20 introduced pathogens and 360 insects are causing some level of damage to woody plants (Mattson *et al.* 1994; Liebhold *et al.* 1995). Some of these pests, such as the European gypsy moth (*Lymantria dispar* L.), have been introduced into the United States and have accidentally escaped into native

* Paper presented at the 8th International Congress of Plant Pathology, 2–7 February 2003, Christchurch, New Zealand.

environments. Some have entered on seed, seedlings, scions, and other reproductive material; these include the chestnut blight fungus (*Cryphonectria parasitica* (Murr.) Barr) and white pine blister rust (*Cronartium ribicola* J.C. Fischer). Others have entered on manufactured commodities — e.g., Japanese cedar longhorned beetle (*Callidielleum rufipenne* (Motschuslky)) on artificial Christmas trees. A few have also been identified as hitchhikers on transport vehicles, notably Asian gypsy moth (*Lymantria dispar* L.), although it is currently not established in the United States.

Unmanufactured wood products, mainly logs, and solid-wood packing material have been a common pathway for introductions. Logs were the means of introduction for Dutch elm disease (*Ophiostoma ulmi* (Buis.) C. Moreau) in the 1920s. Asian longhorned beetle (*Anoplophora glabripennis* (Motschulsky)) arrived in the United States on solid-wood packing material in the 1990s. Additional pathogens and insects continue to be discovered either at ports of entry or established in the United States.

The purpose of this paper is to describe the history of import requirements into the United States and the current pest risk assessment process that is followed to determine regulatory requirements.

WOOD IMPORTS INTO THE UNITED STATES

The United States is a significant user of wood products. The main source of the material has been, and continues to be, the United States itself. Timber products to supply about 86% of United States consumption were produced in the United States in 1999 (Howard 2001). However, the amount of wood material imported by the United States since 1965 continues to increase, both in actual amount (Fig. 1) and in proportion to the total production in the United States (Fig. 2) (Howard 2001). Since the early 1990s this proportion has increased dramatically and exceeds the previous 30-year highs.

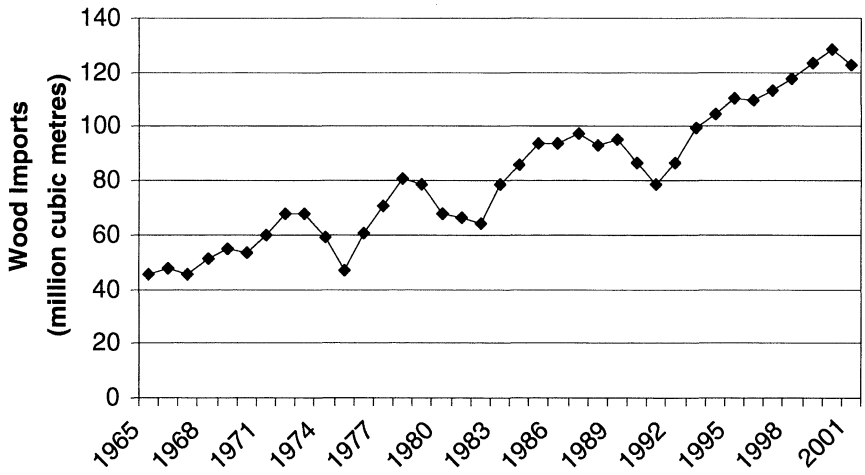

FIG. 1–Total imports (million cubic metres) of timber products by the United States since 1965 (Howard 2001).

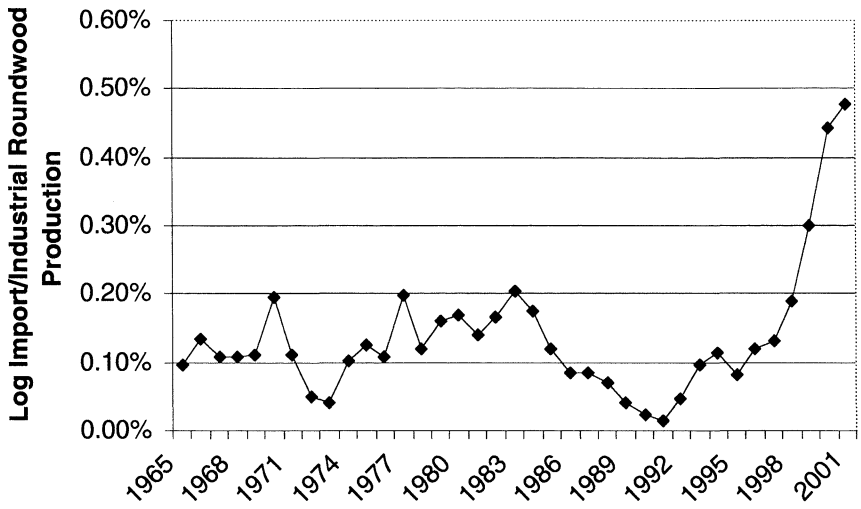

FIG. 2–Proportion of total imports to production of industrial roundwood in the United States (Howard 2001).

Most of the imported wood material is sawn or processed prior to arrival but an increasing quantity of unprocessed logs has been arriving since 1998 (Fig. 3). This increase has been primarily in softwood logs, and hardwood log imports have held steady (Fig. 4). Pulpwood chip imports, on the other hand, have declined since 1996 (Fig. 5) (USDA Foreign Agricultural Service 1998, 2002). Pulpwood demand is likely to drop further

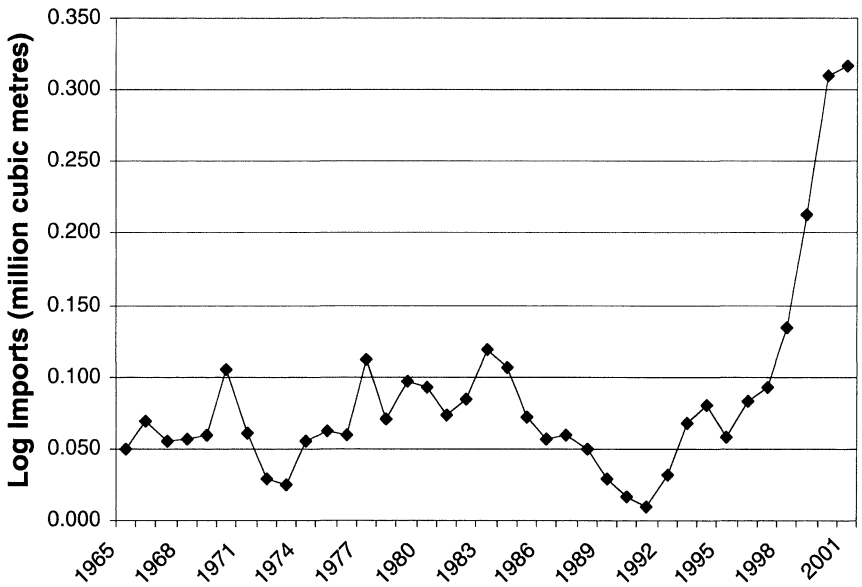

FIG. 3–Log imports (million cubic metres) into the United States, 1965–2001 (Howard 2001).

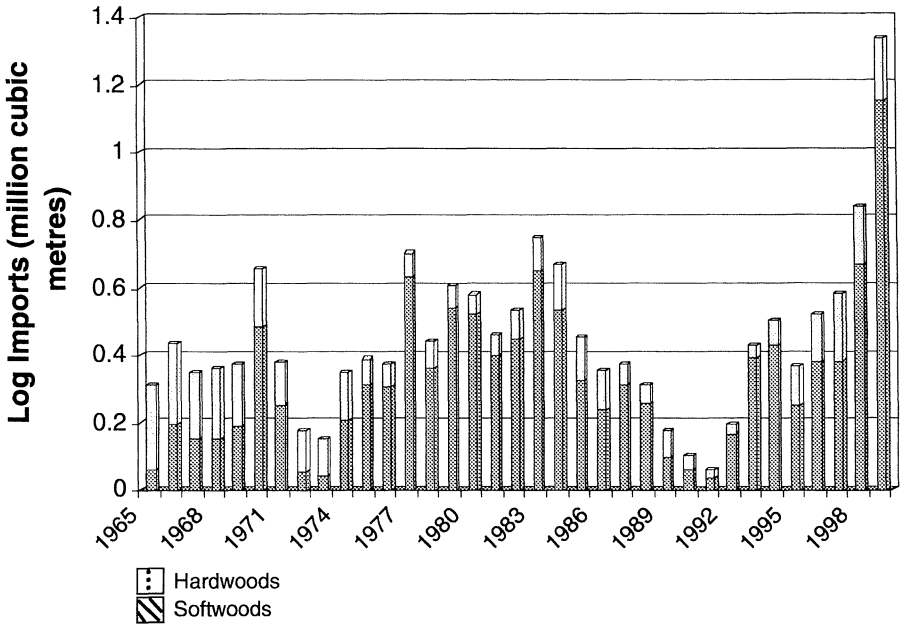

FIG. 4–Imports (million cubic metres) of hardwood and softwood logs into the United States, 1965–1999 (Howard 2001).

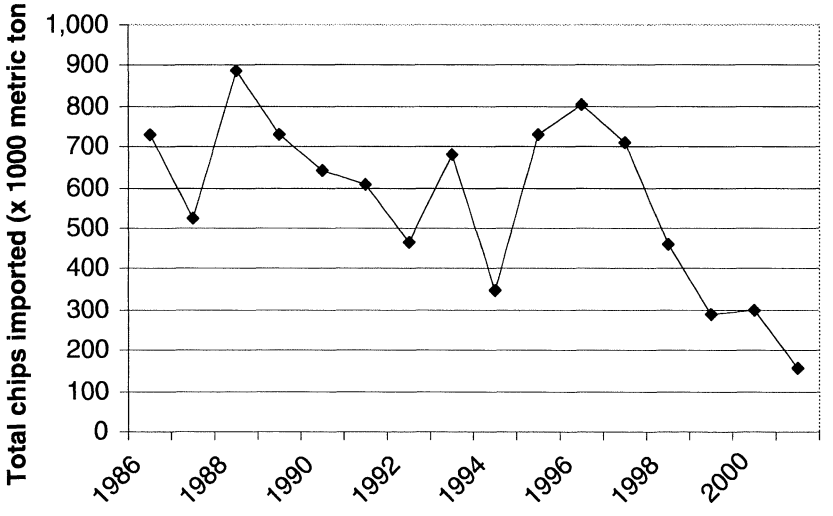

FIG. 5–Imports (metric tons) of pulpwood chips into the United States, 1986–2001 (USDA Foreign Agricultural Service 1998, 2002).

(Howard 2001), thereby reducing the likelihood of increases in pulpwood chip imports by the United States in the near future. There are no estimates available on the amount of wood products that enter or pass through the United States in the form of solid-wood packing material.

The USDA APHIS is the Federal Government agency that has the authority to protect America's animal and plant resources from exotic invasive pests and diseases. It accomplishes part of this mission by regulating international commerce into the United States through permits and inspections.

HISTORY OF LOG IMPORTATION AND RISK ASSESSMENT IN THE UNITED STATES

Through the 1980s, no specific regulations were in place for timber import and permits were not required. When the small quantities of timber did arrive at United States' ports of entry, they were detained and inspected. Any identified risks were required to be mitigated by importers prior to release.

In the late 1980s, several companies proposed importing much larger volumes of timber from the then Soviet Union. Test shipments identified several insect pests of concern and so the USDA initiated a pest risk assessment of this commodity and placed a temporary ban on further importation. APHIS requested the assistance of the USDA Forest Service in developing a risk assessment on the importation of larch (*Larix* spp.) from Siberia and the Russian Far East (USDA Forest Service 1991). The Forest Service has multiple authorities, including Federal land management, providing technical and financial assistance to States and private entities, and research. Within these authorities is included the authority to provide expertise on forest insect and disease issues to all federal agencies. It was through this authority that APHIS requested the forest pest expertise within the Forest Service. A team of APHIS and Forest Service scientists, with input and collaboration of a wide range of Federal, State, and university scientists and specialists, developed the assessment.

The methodology used had been developed within the risk analysis group of APHIS and was adapted to meet the needs of the particular commodity (Orr *et al.* 1993). The objective of this process was to provide a standard method for pest risk assessment that would be comprehensive, logically sound, practical, conducive to learning, and open to evaluation.

Six organisms were evaluated in detail because they were considered to represent the greatest risk to North American forests. These included nematodes (*Bursaphelenchus* spp.), larch canker (*Lachnellula willkommii* (Hart.) Dennis), annosus root disease (*Heterobasidion annosum* (Fr.) Bref.), gypsy moth, nun moth (*Lymantria monacha* L.), and spruce bark beetle (*Ips typographus* L.). A qualitative assessment of the likelihood of any of these organisms gaining entry into the United States on larch logs from the Russian Far East or Siberia was carried out. The economic and ecological consequences of these potential introductions were also assessed. The overall risk for each of these six pests was estimated to be high. In addition to these pests, a total of 23 other potential pest organisms and groups of organisms were assessed (USDA Forest Service 1991). These organisms were selected because of their association with larch logs and their location either on or in the bark or in the wood.

APHIS initiated a ban on the importation of logs from Siberia in 1990 because of the potential plant pest problems that had been identified during the risk assessment. It issued a notice of the proposed rule in the United States Federal Register with the intent to develop comprehensive regulations on the importation of logs, lumber, and other unmanufactured wood products.

After the release of the pest risk assessment (PRA) on larch from Siberia, APHIS received requests for importation of unmanufactured wood products from New Zealand and Chile. APHIS sought the assistance of the Forest Service in completing these separate risk assessments. The earlier assessment addressed the potential importation of *Pinus radiata* D. Don and *Pseudotsuga menziesii* (Mirb.) Franco logs from New Zealand (USDA Forest Service 1992). A later assessment was completed for the importation of *P. radiata*, *Nothofagus dombeyi* (Mirb.) Oerst., and *Laurelia philippiana* Looser logs from Chile (USDA Forest Service 1993).

As with the Siberian PRA, the New Zealand assessment collected information on all known insects and pathogens (over 300) that injure the host species of interest in New Zealand. These organisms were segregated based on their location on the host: on the bark, in the bark, or in the wood. The potential risk of 31 of these organisms to United States forest resources was assessed. Seven organisms were assessed in more detail as representatives of groups of organisms posing the greatest potential problem. These organisms included New Zealand drywood termite (*Kalotermes brouni* Froggatt), *Leptographium truncatum* (Wingf. & Maraxas) Wingf., pinhole borers (*Platypus apicalis* White and *P. gracilis* Broun), huhu beetle (*Prionoplus reticularis* White), *Sirex noctilio* F., and *Amylostereum areolatum* (Fr.) Boidin. The primary pest of concern from this analysis was *S. noctilio.*

The Chilean PRA similarly compiled lists of potential pest organisms on the three hosts. Fourteen pests or groups of pests on *P. radiata* were evaluated in detail. These included bark beetles (*Hylurgus ligniperda* (F.), *Hylastes ater* (Paykull), and *Orthotomicus erosus* Wollaston), bark weevils (*Rhyephenes* spp.), a pine bark anobiid (*Ernobius mollis* L.), a siricid (*Urocerus gigas gigas* (L.)), wood-boring beetles (*Buprestis novemmaculata* L., *Colobura alboplagiata* Blanch. O Sol., and *Callideriphus laetus* Blanch.), termites (*Cryptotermes brevis* Walker, *Neotermes chilensis* (Blanch.), and *Porotermes quadricollis* (Rambur)), the spiny pine caterpillar (*Ormiscodes cinnamomea* Feisth.), a bagworm (*Thanatopsyche chilensis* Ph.), white grubs (*Hylamorpha* spp., *Brachysternus* sp., and *Sericoides* sp.), the European pine shoot moth (*Rhyacionia buoliana* Denis & Schiffermüller), diplodia shoot blight (*Sphaeropsis sapinea* (Fr.) Dyko & Sutton), needle diseases (*Dothistroma pini* Hulbary), stain and vascular wilt fungi (*Ophiostoma* spp.), and root and stem rots (*Armillaria* spp., *Phellinus* spp.).

Information on pests of the two native hardwood species was more limited. Much of the input was received from professionals working in Chile. The following pests of *Nothofagus dombeyi* and *Laurelia phillipiana* were assessed: *Callisphyris semicaligatus* F. & G., *Chilecomadia valdiviana* (Phil.), *Calydon submetallicum* Blanch., *Rhyephenes maille* (Gay & Sol.), *Epistomentis* spp., *Gnathotrupes* spp., *Ophiostoma* spp., and *Ceratocystis* spp. The assessors who worked on these two native hosts noted the lack of literature, especially on the life histories of organisms and the lack of breadth in taxonomic groups examined. This identified the difficulty of preparing risk assessments for species with little previous commercial value.

APHIS used the information from these two PRAs to publish interim regulations on the importation of *P. radiata* logs from Chile and *P. radiata* and *Ps. menziesii* logs from New Zealand in 1993, while more comprehensive regulations were developed and put in place. These interim regulations required that:

(1) Logs must be from live healthy trees apparently free of pests, damage, and decay;

(2) Logs must be debarked;

(3) Logs must be fumigated within 45 days of felling and prior to arrival in the United States in holds or sealable containers;

(4) During shipment, no other regulated articles be permitted in the same hold or sealed container with logs or raw lumber, unless the other regulated articles had been heat-treated or fumigated;

(5) Upon arrival in the United States, logs must be kept segregated from other regulated articles and moved to a facility operating under an APHIS compliance agreement;

(6) All logs or products from logs must be heat-treated or heat-treated with moisture reduction within 60 days of release from port of first arrival and raw lumber must be treated within 30 days of release;

(7) All products and waste must be burned, heat-treated, or processed to destroy any plant pest that may be associated with them; and

(8) Sawdust, wood chips, and waste are prohibited for composting or use as mulch unless fumigated or heat-treated (Code of Federal Regulations 58:59348, November 9, 1993).

On 25 May 1995, APHIS announced a Final Rule on Importation of Logs, Lumber, and Other Unmanufactured Wood Articles (Title 7, Code of Federal Regulations, parts 300 and 319). This regulation required regulated articles (logs; lumber; whole tree; cut tree or portion of a tree, not solely consisting of leaves, flowers, fruits, buds, or seeds; bark; cork; laths; hog fuel; sawdust; painted raw wood products; wood chips; wood mulch; pickets; stakes; shingles; humus; compost; and litter) to be accompanied by a specific permit issued for importation. Certain articles were allowed to be imported under a general permit, namely articles from Canada and the adjacent states of Mexico, except for a few plant families. Additional articles related to solid-wood packing material, loose wood packing materials, and bamboo timber were also exempted from the specific permit requirement.

Other articles could receive a specific permit without further assessment if they met certain requirements. This included *P. radiata* logs and lumber from Chile and New Zealand, and *Ps. menziesii* logs and lumber from New Zealand. These articles needed to meet the requirements specified above in the interim rule.

Requirements were spelled out in this regulation controlling the types of articles not in one of the above groups that could be imported under a specific permit. This was known as the universal importation option. This required logs to be debarked and heat-treated or heat-treated with moisture reduction. Heat treatment could use any method that raised the centre of each article to at least 71.1°C and maintained that temperature for 75 minutes. Heat treatment with moisture reduction required that the centre of each article sustain a temperature of 71.1°C for 75 minutes and that moisture content be reduced to 20% or less, or that the article be kiln dried according to established standards. Wood chips were also permitted to be imported under a specific permit if they were tropical in nature or fumigated with methyl bromide, heat-treated, or heat-treated with moisture reduction. They were also to be free of rot unless fumigated or heat-treated. More stringent requirements were put in place for articles from places in Asia further than 60°E, and north of the Tropic of Cancer.

On 11 June 1999 APHIS issued a proposed rule in the Federal Register (Title 7 Code of Federal Regulations 64:31512-31518) to remove the general permit requirement on the importation of *Pinus* and *Abies* logs and lumber from adjacent states of Mexico. This proposed regulation change was based on information provided in a pest risk assessment completed for the importation of such products from Mexico (Tkacz *et al.* 1998). Currently, unmanufactured wood products from the states of Mexico adjacent to the United States are under less restrictive requirements based on the premise that the forests in the United States share a common boundary and share the same forest pests. The pest risk assessment, however, identified that biological islands exist on the mountaintops of the adjacent states of Mexico and that these islands contain unique forest pests not present in the United States. This regulatory change is nearing completion and issuance.

RISK ASSESSMENT METHODOLOGY

The 1995 Final Rule put into place new requirements for evaluating a request to import regulated articles not allowed importation, or to import regulated articles under conditions other than those described above. Plant pest risk assessment standards were codified in this regulation. These standards follow those presented by Orr *et al.* (1993) and used by the USDA Forest Service in the first three PRAs. They are also very similar to the International Standards for Phytosanitary Measures adopted by FAO for pest risk analysis (FAO 2001). This analysis is a pathway-initiated pest risk analysis and is qualitative rather than quantitative.

The process followed is the second of three stages of an overall pest risk analysis. The first stage documents the event that initiates the PRA. The third stage is the development of risk management measures. Both of these responsibilities are under the authority of APHIS. The second stage is the actual pest risk assessment that is conducted by the Forest Service.

Following the production of the Chilean PRA, the Forest Service established a permanent team of entomologists and plant pathologists to develop future risk assessments as needed. This team is advised by quarantine specialists from APHIS and brings on additional technical experts to fill needs related to specific assessments.

The pest risk analysis that is employed is a five-step process and has been used for assessments of *Pinus* and *Abies* logs from Mexico (Tkacz *et al.* 1998), *Eucalyptus* logs from South America (Kliejunas *et al.* 2001), and *Eucalyptus* logs and chips from Australia (Kliejunas *et al.* 2003). The first step is the collection of information on the commodity. This includes the origin, processing, treatment, and handling of the regulated article in the exporting country. This information is provided by the importing party and by local government and industry personnel in the country of origin. Other information gathered in this step is an examination of past interception and introduction records in the United States and in other countries that have received this commodity. The second step is the cataloguing of potential pests of the article. These are then classified in one of the following categories:

(1) Non-indigenous plant pest not present in the United States;

(2) Non-indigenous plant pest, present in the United States and capable of further dissemination in the United States;

(3) Non-indigenous plant pest that is present in the United States and has reached probable limits of its ecological range, but differs genetically from the plant pest in the United States in a way that demonstrates a potential for greater damage in the United States;

(4) Native species of the United States that has reached probable limits of its ecological range, but differs genetically from the plant pest in the United States in a way that demonstrates a potential for greater damage;

(5) Non-indigenous or native plant pest capable of vectoring another plant pest that meets one of the above criteria.

These categories define pests that are quarantine risks according to APHIS (Title 7 Code of Federal Regulations Subsection 319.40-11). The Forest Service team has added to these criteria because of concerns related to genetic variability. A broader definition of Category 4 was used to include native species that have reached the probable limits of their ecological range but may differ in their capacity for causing damage, based on the genetic variability exhibited by the species. A more cautious approach was taken in the assessments because of uncertainties about the genetic variability and damage potential of many pest organisms, especially pathogens, in forest ecosystems. Category 2 also had a modified version of native organisms with limited distributions within the United States but capable of further dissemination. We classify these organisms as pests of concern. Neither of these categories is recognised as quarantine pests by international regulatory agencies and organisations. This comprehensive list of potential pests of concern is sent to entomology, plant pathology, and forestry experts in the United States, the country of origin, and other locations for review and comment. The list is subsequently edited to reflect these comments.

The third step is a determination of which pests to assess. This begins with a segregation of the pests of concern into the locations where they are found on the log — namely, on the bark, under the bark, or in the wood. These groupings are examined to determine which pest(s) may cause the most damage if introduced and the amount of information that is available. The lack of biological information on any given pest is not equated with low risk, however. We then determine for which pests of concern to develop individual pest risk assessments. We believe that by developing detailed assessments for known pests that inhabit different locations on logs, effective mitigation measures can be developed in the risk mitigation stage that will address other organisms that inhabit the same niches.

Each individual PRA uses seven elements and rating criteria to determine a risk value for the element. This value is based on the available information and the subjective value of the assessment team. Each element is assigned a certainty code as a measure of the reliability of the information describing the element. The risk values for the seven elements are combined to determine a final rating level and evaluation of overall risk of high, moderate, or low. The seven elements are broken into two parts — the likelihood of introduction, and the consequences of introduction.

The likelihood of introduction is a measure of the likelihood of a pest entering and becoming established in the United States. Establishment requires the formation of a self-sustaining, free-living population at a given location (U.S. Congress, Office of Technology Assessment 1993). There are four elements within this part. These include:

(1) Presence with host or commodity at origin. This is an estimate of the pest being on, with, or in the commodity at the time of importation.

(2) Entry potential. This is an estimate of the pest surviving transit and being undetected.

(3) Colonisation potential. This is an estimate of successful colonisation in the United States.

(4) Spread potential. This is an estimate of the pest spreading beyond the area of initial colonisation or establishment.

The overall rating for likelihood of introduction is the same rank as the element with the lowest rating.

The consequences of introduction evaluate the impacts an established pest would have on United States forest resources. There are three elements within this part. These include:

(1) Economic damage potential;

(2) Environmental damage potential;

(3) Social and political considerations.

The overall rating for consequences of introduction is a blending of the risk values of the three elements. The consequence rating receives the highest rating given to either the economic or the environmental element. The social and political element is considered only when the other two ratings are low.

The ratings for likelihood of introduction and consequences of introduction are combined (according to Table 1) to arrive at a final pest risk for the organism. This approach is conservative. Higher ratings are used when borderline cases are encountered (Orr *et al.* 1993).

TABLE 1–Method for determining pest risk potential

Likelihood of introduction	Consequences of introduction	Pest risk potential
High	High	High
Moderate	High	High
Low	High	Moderate or Low*
High	Moderate	High
Moderate	Moderate	Moderate
Low	Moderate	Moderate or Low*
High	Low	Moderate
Moderate	Low	Moderate
Low	Low	Low

* If two or more of the single elements that determine likelihood of introduction are low, pest risk potential is considered low, rather than moderate, for this assessment.

Once the individual PRAs are completed and the overall pest risk assessment is compiled, a draft version is sent for review to specialists and contacts in the country of origin and in the United States. Review comments are used to modify the documents and are answered either in individual PRAs or in the general document. The display of the methods used for the assessment, the opportunity for review, and the responses to comments help to make the assessment transparent to further scrutiny.

Once the assessment is completed, it is published and delivered to APHIS whose officers review the assessment and determine what, if any, mitigation measures are needed for safe entry of the commodity as part of the risk management process. If requirements other than those under the universal importation option are identified, a rule-making process is followed and new rules are issued in the Federal Register specifying the conditions under which the requested article may be imported.

CONCLUSION

In conclusion, risk management is a policy- and science-driven process that leads to risk regulation. Risk assessment, on the other hand, should be science-driven to provide the information necessary for risk management decisions. However, even though risk assessments should be derived from facts, not all of the data are available to provide certainty in the assessment. A level of uncertainty will always be present in any risk assessment. The risk manager needs to decide the level of uncertainty that is acceptable in determining management responses to protect resources while not arbitrarily inhibiting trade.

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