

## Forest pest pathways: where do we go from here?

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and

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Non-native invasive insect pests and pathogens introduced since the late 1800s have caused substantial damage to the diversity and sustainability of forests in the United States. We examined the evidence for the most likely pathway of introduction for 82 damaging invasive forest insects and pathogens based on historical records and knowledge of pathogen biology. Identification of pathways is critical to preventing new pathogen introductions.

For wood boring insects, such as bark beetles and longhorned beetles, wood products and packaging were the most important pathway. But for all other insect guilds, and for plant pathogens, live plant trade was most important. Overall, about 70 percent of the damaging non-native forest insect pests and pathogens established in the U.S. today arrived via the plants for planting pathway.

Currently U.S. regulations rely on 1) prohibition of plants known to harbor serious pests, after completion of a pest risk assessment, 2) phytosanitary certificates issued by the exporting country's national plant protection organization, and 3) inspections at certain ports of entry with plant inspection stations. Plant imports increased 500% since 1967, with 2.5 billion plants imported in 2010. About 65 inspectors are employed nationwide to inspect live plants.

The International Plant Protection Convention adopted a new international standard in March 2012 to harmonize regulations of plants for planting. The standard supports the development of integrated measures to produce clean plant stock. Our findings emphasize the importance of improved mitigations for pathogens on live plants as global plant trade escalates.

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