Southern Pine Beetle Outbreak in Belize

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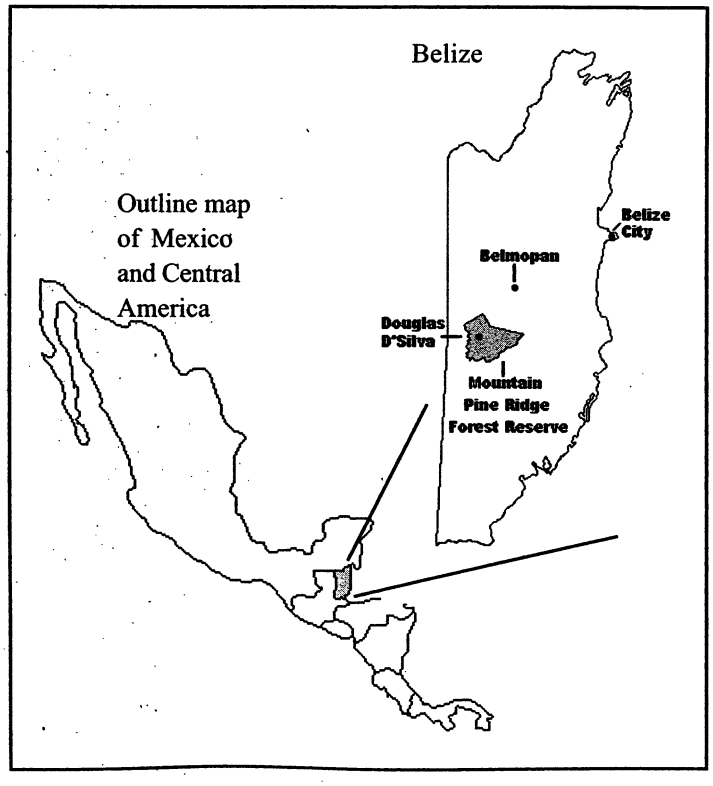
In November 2000, the first author was asked to assist in evaluating a bark beetle (Scolytidae) outbreak in the Mountain Pine Ridge Forest Reserve in western Belize. The invitation was made on behalf of FAO (Food and Agriculture Organization) and the Forest Department of Belize.

Belize is a Central American country that borders Mexico, Guatemala, and the Caribbean Sea (see Map). Belize, formerly called British Honduras from 1862 until 1973, is about 23,000 square kilometers in size, which is about the area of Massachusetts. Elevation varies from sea level to 1120 meters. The major vegetation types include mangrove swamp, broadleaf jungle, savanna, and pine forest. The Maya Mountains occur in western Belize and include an area known as the Mountain Pine Ridge Forest Reserve (see Map).

The Mountain Pine Ridge Forest Reserve (= Forest Reserve) is 41,647 ha in size, of which is 30,417 ha are in pine. Two pine species dominate the Forest Reserve: *Pinus caribaea* occupies about 80% of the pine area while *Pinus patula* subsp. *tecunumanii* (or *P. tecunumanii* according to some authorities) occupies about 20% of the area.



Claus Eckelmann (left) and Earl Green (right) indicating outbreak extent on map.

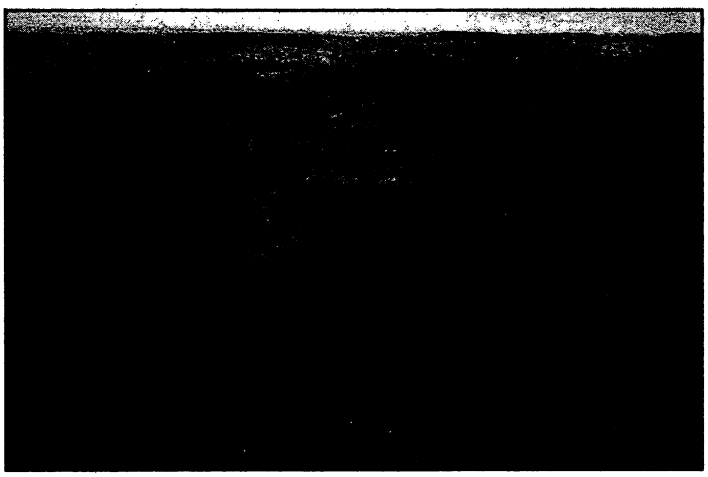
Preparing to conduct aerial survey of the outbreak

The current bark beetle outbreak in Belize was apparently triggered by a severe drought during 2000. In the area of the Forest Reserve the dry season typically occurs between February and May and the wet season from June to January. Local foresters reported that very little rain fell during the 2000 wet season, except in early October when Hurricane Keith crossed the country. Drought has triggered outbreaks of bark beetles throughout the world (Mattson and Haack 1987), including outbreaks nearby in the Dominican Republic (Haack et al. 1989) and Guatemala (Haack and Paiz-Schwartz 1997).

There are three common pine bark beetles that are native to Belize: *Dendroctonus frontalis* Zimmermann, *Ips calligraphus* (Germar), and *Ips grandicollis* (Eichhoff). These same bark beetles are native to the southern United States (US). In the US, *D. frontalis* is called the southern pine beetle, *I. calligraphus* the six-spined engraver, and *I. grandicollis* the southern pine engraver. In Belize, where temperatures are warm year-round, pine bark beetles likely complete one generation every 4 to 5 weeks.

Six multiple-funnel traps were baited with bark beetle pheromones and placed in the pine forests near Douglas D'Silva (formerly called Augustine and is the location of the Belize Forest Department's field headquarters in the Forest Reserve). Two traps were baited with frontalin to attract primarily *D. frontalis*, two with ipsdienol to attract *I. calligraphus*, and two with ipsenol to attract *I. grandicollis*. After the first day in the field, the six traps had captured 1,934 *D. frontalis*, 153 *I. grandicollis*, and six *I. calligraphus* adults. These results along with an inspection of bark beetle galleries along the trunks of several beetle-killed pine trees indicated that *D. frontalis* was the primary mortality agent involved in the outbreak. The traps will be monitored for several more weeks by Forest Department staff to assess changes in the community structure of the bark beetles and their natural enemies, especially predators such as clerid beetles.

Outbreak history. Small pockets of dead pine trees were first seen in the Forest Reserve in February 2000. However, instead of stopping to grow soon after there were a few dead trees, as has always happened in the past, these "spots" (= pockets of dead and infested trees) continued to grow and coalesce during summer and fall 2000. We conducted an aerial survey in November 2000 and noted that the central outbreak zone covered about 20,000 ha, with hundreds of new spots developing around the periphery (see photos). Some of the new infestations were on private land outside the Forest Reserve.



Southern pine beetle outbreak on mountain ridges (light colored trees along ridgetops have died and are red in color.)

This was the first major outbreak of pine bark beetles reported in the history of the Forest Reserve and perhaps in all of Belize. In fact, staff within the Belize Forest Department had never seen a major bark beetle outbreak prior to 2000. The Forest Reserve was officially established in 1944 and it has suffered other natural disasters such as widespread fires in 1949 and 1991, and severe windthrow as a result of Hurricane Hattie in 1961. The current bark beetle outbreak has caused more tree mortality than any of these earlier natural disasters. So far, more than 60% of the pine area in the Forest Reserve has been infested, with nearly complete mortality occurring in most stands. It is estimated that the current volume of beetle-killed pines in the Forest Reserve is 30 times greater than the entire annual demand for timber in all of Belize.

Control practices in the US. *Dendroctonus frontalis* is the most destructive bark beetle in the southern US. When spots are detected early, there is a good chance that they can be controlled (See links at: http://www.barkbeetles.org/). The two most common practices used in the US include "cut-and-leave" and "cut-and-salvage." The cut-and-leave method is best used for small spots (10 to 50 infested trees) where tree removal is not practical. This method involves felling the infested trees and a buffer of uninfested trees and leaving them in the woods. This method somehow disrupts spot growth by causing the new emerging adults to disperse further into the forest and thereby the beetles are not able to congregate in sufficient numbers to mass attack and kill individual trees. Typically, the buffer width is as wide as the average height of the trees in the spot. The cut-and-salvage method is similar to the above method with the exception that the cut trees are removed from the forest.

At times insecticides are used to protect individual high-value trees from bark beetle attack, especially in urban settings. However, chemical control is costly, subject to environmental constraints, and requires special equipment to obtain good coverage of the entire trunk.

Verbenone, which received US EPA registration in 1999, is an anti-aggregation pheromone for *D. frontalis*. In recent years, much work has been conducted on verbenone deployment strategies to protect pine trees from *D. frontalis* attack (Clarke et al. 1999). All of the above control methods are best used when infestations are detected early. To do this, aerial surveys are conducted on a 2 to 4 week schedule in the southern US.

Actions taken in Belize and future prospects. By early fall 2000, the Belize Forest Department recognized that they needed technical assistance. Mr. Vincente Mendoza, a forest entomologist from Honduras where *D. frontalis* is also a severe pest, visited the Forest Reserve in October 2000. He identified the principal pest as *D. frontalis* and advised the forestry staff on control options. The Belize Forest Department cut several 50-m-wide buffers around the active fronts of the outbreak using the cut and leave method. However, the beetles jumped the buffer and continued to attack and kill trees, probably because of the huge numbers of beetles present. When beetle populations are this high, buffers that are at least 100-m-wide may be more effective, along with active surveillance and rapid treatment of any spots that jump the buffer line.

Given that the *D. frontalis* populations are already so high and that the traditional dry season will start again in February 2001, it appears likely that the outbreak will continue. Given this outlook, the Belize Forest Department decided to focus its limited resources on salvaging beetle-killed pine trees but doing so in a manner that will also create fire lanes. With so many dead standing trees, the risk of fire will be very high in 2001. If additional emergency funds are made available to the Forest Department then they will attempt to treat some of the spots along the leading edge of the outbreak, after the salvage operation is underway. Attempts will also be made to initiate regular aerial surveys in 2001 so that bark beetle infestations can be detected early. Plans are also underway to collect pine seed to initiate a large-scale reforestation program.

Ecotourism. The Mountain Pine Ridge area of Belize is a major tourist destination. This area offers whitewater rafting, waterfalls, caves, Maya ruins, hiking, horseback riding, and much more. There are several tourist lodges on the periphery of the Forest Reserve and most of them were built among the pines. In November, *D. frontalis* was already attacking pines on the properties of two lodges. The Forest Department is working with the tourist lodges to educate them about the bark beetle and control options. Two of the lodges have already initiated control programs on their lands.

No one knows when or where the current outbreak will stop. However, staff of the Belize Forest Department are now well aware of what short-term and long-term actions they need to take to reduce the chances of future outbreaks of *D. frontalis*. In addition to the technical knowledge needed to control future bark beetle infestations, Belize also needs sustained public investment in future years so that the country's pine forests are monitored regularly and bark beetle spots are dealt with soon after detection. Once infestations reach the immense size of the current outbreak in Belize, they are almost impossible to stop and so widespread economic and environmental damage often occur.

A river in the Mountain Pine Ridge area of Belize

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MES Entomology Notes: Notice and Request

From time to time the Michigan Entomological Society publishes an insert in the MES Newsletter entitled "Entomology Notes." These publications have covered a variety of topics over the years. Below is a complete list of the 26 Entomology Notes that have been published so far. The MES Governing Board has decided to offer for sale all of the Entomology Notes as a single bound publication later in 2001. Therefore, if you have been thinking of preparing an Entomology Note, now is the time to do so to ensure that your entry gets included in the bound version. Submit your stories to Bob Haack (rhaack@fs.fed.us) or Therese Poland (tpoland@fs.fed.us) as soon as possible. Almost all of the MES Entomology Notes can be viewed on the Web at: http://insects.ummz.lsa.umich.edu/MES/notes/noteslist.html

No. 1 Lions and Tigers in the Sand
No. 2 Insect Galls
No. 3 Rearing and Experimenting with Isopods
No. 4 Drawings Insects Directly from a Stereo Microscope
No. 5 Collecting Aquatic Insects
No. 6 Ladybeetles
No. 7 "Sugaring" for Moths
No. 8 Clowns of the Insect World
No. 9 Collecting Giant Silkmoths
No.10 Flight of the Bumblebee
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No.15 Rearing Insects Indoors
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No.20 Acorn Insects
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No.22 The Honeybee Waggle Dance: An Active Participation, Role-Playing Game
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No. 26 Collecting Odonata Exuviae

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Inside this Issue:

The Purple Loosestrife Project at Michigan State University

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Purple loosestrife (*Lythrum salicaria*) is an exotic invasive plant that has unfortunately become all too common in Michigan wetlands. A native of Eurasia, purple loosestrife has now invaded a variety of wet habitats throughout much of North America, including marshes, swamps, lakes, rivers, streams and ditches. Once established, purple loosestrife can become the dominant vegetation, excluding native plants and the organisms that depend on them. In Europe, purple loosestrife is controlled by a number of insect natural enemies that have become the focus for importation biological control. Among these, two leaf-feeding beetles, *Galerucella calmariensis* and *G. pusilla* (Coleoptera: Chrysomelidae) have been released in Michigan for biological control of purple loosestrife. The *Galerucella* beetles feed on bud, leaf, and stem tissue causing defoliation and prevention of flowering and seed production. Continued defoliation over several seasons favors competition by other plant species and can result in the elimination of purple loosestrife from localized areas.

Initial introductions of *G. calmariensis* and *G. pusilla* in Michigan were made in 1994 by the Michigan Department of Natural Resources-Wildlife Division on three state managed game areas: Crow Island State Game Area, Saginaw Co. (2 releases); Nayanquing

Continued on page 4

Beech Bark Disease – Michigan's New Exotic Forest Pest

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American beech (*Fagus grandifolia* Ehrh.) is found throughout most of Michigan (see map, page 8) and is a favorite of many animals, as well as people. Beech nuts are an important source of hard mast for wildlife such as black bears, squirrels, chipmunks, turkey and deer. Large beech trees often accumulate cavities and dead branches over time. Many birds, from hawks to nuthatches, use these big trees for perching, nesting or insect foraging. A variety of mammals including fishers and pine martens use cavities for dens or shelter. Beech wood is used for many products ranging from flooring to veneer to baskets, and it makes great firewood.

Unfortunately, yet another exotic forest pest has made its way into Michigan and the outlook for our American beech trees is gloomy. Beech bark disease was first discovered in Michigan in spring 2000 in Ludington State Park, Mason County, in the Lower Peninsula and soon thereafter in the Bass Lake campground in Luce County in the eastern Upper Peninsula. Additional surveys during the 2000 field season have detected

Continued on page 8