Wolves in Sheep's Clothing: Outbreaks of Previously Obscure Native Forest Insects.

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Well-known native epidemic pests such as the southern pine beetle (*Dendroctonus frontalis* Zimmermann) have exhibited outbreak behavior throughout recorded history. Their outbreaks, although still unpredictable, are expected to occur. Recently, changes in the frequency, severity, and range of certain well-known native forest pests such as the mountain pine beetle, *Dendroctonus ponderosae* Hopkins (among others), have been investigated because of linkages to climate change (Logan and Powell 2001).

The advent of a "global society" has subjected our forests to exotic insect species such as the gypsy moth (*Lymantria dispar* L.), emerald ash borer (*Agrilus planipennis* Fairmaire), and Asian longhorned beetle (*Anoplophora glabripennis* (Motschulsky)). These alien invaders are prone to spectacular outbreaks because they have been liberated from their natural regulatory influences, such as parasites, predators, and diseases. Not surprisingly, these invaders have attracted the attention of forest health specialists.

However, almost no consideration has been given to understanding the effects of direct and indirect anthropogenic disturbance on obscure forest insects with no track record as agents of forest mortality. Outbreaks of previously innocuous native forest insects are rare in their native ranges and on their native hosts, but several examples do exist. In 1999, an outbreak of the red oak borer (*Enaphalodes rufulus)* occurred in the Arkansas Ozarks. More than 400,000 hectares were affected, and more than 60% of the mature red oak component died, drastically altering the dominant forest type (oak-hickory) in the Ozark-Ouachita highlands. Despite no previous reports of outbreaks or association with tree mortality, the red oak borer was a major contributor in the mass death of thousands of trees across the Ozark National Forest.

Red oak borers are native longhorned beetles (Coleoptera: Cerambycidae) that have never before been reported as major pests. Historically, population densities of less than one

adult beetle emerging per tree were considered severe infestations, but densities up to 175 emerging adults per tree were estimated during this outbreak (Riggins 2008). Despite more than 50 oak decline events within the home range of the red oak borer during the last 100 years, red oak borer was never before reported at epidemic densities. Evidence suggests that logging activities at the beginning of the 1900's and fire suppression coincided to bring about densely-stocked, over-mature stands of northern red oak (*Quercus rubra* L.) on relatively poor sites (xeric ridges and southern slopes), where the highest populations of red oak borer were observed. Periods of acute, short term drought 1-2 decades previous to the outbreak may have served as the inciting factor for this event (Stephen et al. 2001).

Another obscure forest insect, a pine looper, *Phaeoura mexicanaria* (Grote), defoliated approximately 25,500 hectares of its native host (ponderosa pine, *Pinus ponderosa*) in southeastern Montana in 1969 and 1970 (Dewey 1972; Dewey et al. 1974). When the outbreak was discovered it represented the first time *P. mexicanaria* had been collected in the state of Montana. In fact there had been no previous reports of high population densities or tree damage anywhere (Dewey 1972; Dewey et al. 1974). Like the red oak borer, very little was known about *P. mexicanaria* before the outbreak. The larval host tree was not even identified until 1962 (Grant 1962). Similar to red oak borer, *P. mexicanaria* has a rather large range (in suitable habitat throughout western Canada and the United States (Dewey 1972; Rindge 1961), but was previously found only in very low numbers. This outbreak was unexplained, but did follow the outbreak of another well-known pest species (the pine tussock moth, *Dasychira grisefacta* (Dyar)), and took place in a densely-stocked forest (Dewey and Meyer 1972), providing an overabundance of host material.

In 1987 in the United Kingdom, a severe wind storm and subsequent fallen trees caused an outbreak of the oak pinhole borer, *Platypus cylindrus* (Fabricius), a species native to the U.K. that had previously been listed as "rare" (Personal Communication 2008, Dr. Hugh Evans, Head of Tree Health Division, Forest Research, Alice Holt Lodge, Wrecclesham, Farnham, Surrey, GU10 4LH). The wind damage likely incited high beetle densities initially, but densities remained high and subsequently spread to other unaffected areas and for the first time on record attacked healthy trees.

Beginning with an outbreak in 1996, three species of native geometrid defoliators in the southeastern U.S. were implicated in major tree mortality events. *Nepytia janetae* Rindge, was noticed in 1996 when it was identified as the causal agent of a major spruce and fir defoliation event (more than 4000 ha) in eastern Arizona. *N. janetae* is another "looper" moth (Lepidoptera: Geometridae), and was un-described to science until 1966 (Rindge 1967). The defoliation attracted secondary attack from bark beetles, ultimately causing extensive tree mortality. Similar to red oak borer, the population suddenly crashed in 1999. Subsequently, *N. janetae* and two other species of native geometrids (*Enypia griseata* and *Galenara consimilis*) have undergone other outbreaks in the southwestern U.S (Pers. Comm. 2008, Bobbe Fitzgibbon, USDA Forest Service, Forest Health Protection. 2500 S. Pine Knoll Drive, Flagstaff, Arizona).

The pale-winged gray moth, *Iridopsis ephyraria* (Walker), is another relatively rare species that normally exists at low population levels and has a rather large range (Alberta to Novia Scotia, and south as far as Texas) (Pinault et al. 2007). However, in southwestern Nova Scotia, Canada in 2002 it was found in very high numbers causing significant damage to eastern hemlock (*Tsuga Canadensis* (L.) Carr.) (Pinault et al. 2007). Causes of this outbreak are not clear, but evidence suggests that an increase in host suitability due to drought-induced tree stress

or airborne pollutants may have contributed to this event (Pers. Comm. 2008, Dr. Graham Thurston, Canadian Forest Service, P.O. Box 4000, Fredericton, NB E3B 5P7).

Three major types of anthropogenic disturbances (climate change, fire suppression and even-aged stand management) may be causing a worldwide increase of insect outbreak severity, frequency, and distribution, as well as allowing normally harmless insect species to exceed limiting factors and breach outbreak thresholds (Harrington et al. 2001; Logan et al. 2003). Climate change is being increasingly indicted for changes in forest pest systems. Some well-known outbreak species are potentially being influenced by climate change (i.e. bark beetles, eastern larch beetle, western pine beetle, mountain pine beetle, etc…), and these changes are expected by some to worsen if global warming continues (Logan et al. 2003). In addition, fire suppression and even-aged stand management during the last century have created conditions more akin to agroforestry (low diversity, high stem density, even age) than natural forests (Coyle et al. 2005; Leather 1986). Therefore, we are now beginning to see agroforestry-like problems: destructive outbreaks of secondary or formerly inconsequential pests.

In the case of red oak borer and some of the other previously mentioned “new” severe pest species, we may have witnessed the beginnings of new pest dynamics brought about by anthropogenic disturbances. The Ozark National Forest may be a prime example of what is to come for future forest decline and insect outbreaks. A common thread among the previous examples may be the drastic overabundance of susceptible host material in combination with severe climatic conditions serving as the igniter.

Due to a general lack of information regarding most forest insect species of little or no economic concern, forest health practitioners are forced into a reactionary stance when an outbreak occurs. After an outbreak occurs, it can be difficult to pinpoint which ecological

factors changed to allow insect populations to exhibit novel instabilities. By the time enough information is gathered to pinpoint the causes of the outbreak, management options are often extremely limited. Our best options are to scientifically observe and research the ecology of both obscure and well-known forest insects over the long term and to optimize forest health conditions through proper management practices, before hints of problems arise.

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