

Gypsy moth invasion: Oak trees fight back

When a red oak is attacked and defoliated by a troop of hungry gypsy moths (*Lymantria dispar*), it arms itself for the next assault by making replacement leaves harder to digest, and, in effect, limiting the population of the destructive insects, say two Dartmouth College entomologists. Jack C. Schultz and Ian T. Baldwin report in the July 9 SCIENCE that "chemical changes in the leaves of oak trees defoliated by gypsy moths are great enough to reduce larval growth and influence the course of outbreaks."

The specific changes they found were higher levels of tannin—a phenolic compound common in plants—in addition to total phenols in the leaves of trees that had been defoliated compared to those that had not been. These compounds appear to interfere with insect digestion by combining with plant proteins, making them indigestible. Leaves of previously defoliated trees also contained less water and were tougher than controls. The total effect, says Schultz, is a "drastic reduction in the quality of food" that inhibits larval growth and makes the insect more vulnerable to predation, disease, parasites and other stresses.

The gypsy moth was imported from Europe to Medford, Mass., in 1869 to start a silkworm factory. It became a forest pest in that state by 1889 and quickly spread throughout New England. Today it occurs as far west as California. Long-distance trips are made when females deposit egg cases on cars and camping equipment of cross-country travelers.

According to the U.S. Department of Agriculture, last year gypsy moths completely defoliated nearly 13 million acres of New England's forests. Ralph E. Webb, a research entomologist with the USDA's Agricultural Research Service and coordinator of the agency's gypsy moth research, says it "was the worst year in history."

Previous field and laboratory observations suggested that gypsy moth larvae grow more slowly when fed leaves of recently defoliated trees. "We went fishing to see if there was a chemical basis for this," says Schultz, and there was. Because tannins are common in plants, he believes "this will turn out to be a general phenomenon." Schultz thinks it also may be an explanation of the curious cyclic population outbreaks and crashes seen in *Lymantria dispar*. While there are notable exceptions, an outbreak of two or three years in a given area will be followed by eight to ten years when practically no moths are seen. There are a number of hypotheses to explain the population crashes, says Schultz, including weather, disease and parasites. "We see plant chemistry as a single focus that could influence all these others."

Michael E. Montgomery of the U.S.

Forest Service's Center for Biological Control of Northeastern Forest Insects and Diseases, agrees that tannins could play a role in population crashes, "but probably other factors like [reduced] nutrient levels and just plain running out of food" are equally important, he says.

Present gypsy moth management strategies are as diverse as theories to explain their strange population dynamics. They include more than 10 insecticides; several imported parasites, bacteria and viruses; and a number of unusual biological control techniques, such as rearing and releasing sterile males. While some of these

approaches have been successful in controlling local outbreaks, none has been able to stop the insect's destructive cross-country march.

Although Schultz believes his research shows that outbreaks "may normally decline under natural circumstances" (and that defoliation will be much lower in New England this year), he does not extend this to mean that gypsy moth control is never necessary. "It's really an economic question." He notes, however, that if an insecticide only reduces the number of moths, rather than eliminating them, the long-term effect could be deleterious if the trees' natural defense mechanisms are subverted by insufficient stimulation.

—L. Tangley

U.S. will not sign Law of the Sea treaty

The United States will not sign the international sea law treaty adopted April 30 by the Third United Nations Conference on Law of the Sea. In a statement July 9, President Reagan said that despite intense negotiations, the treaty as passed does not meet any of the objectives he announced in January along with his decision that the United States again would participate in the UNCLOS negotiations. The United States will continue to be active in subsequent procedures dealing with technical matters related to the treaty's non-seabed provisions.

When the treaty was adopted, 130 nations voted in its favor; four voted against it, including the United States, Turkey, Israel, and Venezuela; and 17 abstained.

The Reagan administration finds that the treaty "contains many positive and very significant accomplishments," such as those elements concerning navigation and overflight. Many of the provisions regarding deep seabed mining, however, are perceived as unacceptable. The president said that the treaty as passed would "actually deter future development of deep seabed mineral resources," that the decision-making process stipulated would not give the United States or others a role that protects their interests, and that it allows amendments to be enacted for the United States without its approval. He also cited as problems the requirement for transfer of technology, lack of assured access for future qualified deep-sea miners, and the possibility that the United States could end up funding "national liberation movements" if the movements shared the economic benefits of the mining provisions.

The ramifications of the U.S. decision to remain outside a convention adopted by most of the developing countries and by many industrialized nations remain to be seen. The United States will rely on bilateral and multilateral agreements with specific nations and will claim customary rights such as unimpeded "innocent passage" through territorial seas and

transit through international straits.

The U.S. decision not to participate in the treaty has wide-ranging effects for domestic deep ocean mining companies. A background paper prepared for the Commerce Department reports that private mining companies have three main choices: "to operate under the Convention, to operate under an alternative regime based on U.S. legislation, or to drop out of the industry altogether."

The paper's author, Lance Antrim, explains that as long as one member of an international mining consortium is from a country that signs the treaty, a U.S. mining company can apply for a license under the aegis of the foreign partner.

A U.S. mining company unprotected by the treaty under such a consortium arrangement runs a high financial risk, Antrim says, because banks are reluctant to finance mining operations unless a company can demonstrate a legal right to mine, and that it has recognized tenure at that site for the entire length of the mining period. "They can't show that," he says. There is a chance that the U.S. government will grant some kind of risk protection, such as insurance, or investment and loan guarantees.

Alex Malahoff, chief scientist with the National Oceanic and Atmospheric Administration's National Ocean Survey, says that much of the U.S. interest in deep ocean mining probably will concentrate on sulfide-rich areas such as the Gorda Ridge and the Juan de Fuca Ridge (SN: 10/3/81, p. 215). These areas are within U.S. territorial waters.

"We'd have lost everything in signing that treaty—all of our rights to the type of equipment we've developed, most of the right to the manganese nodule fields lying between Hawaii and California," he says. Under the treaty the companies involved are obliged to provide an equally valuable acreage to the mining arm of the international seabed mining authority. Says Malahoff: "It's not a very economic proposition."

—C. Simon