Committee on Resources

Witness Testimony

Testimony of
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Wildlife and Oceans
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Mr. Chairman and Members of the Subcommittee, I am pleased to have this opportunity toappear before you today to discuss the impacts of Varroa and tracheal mites on domestic andwildbee populations. Before I begin my testimony, let me briefly introduce myself.

My name is Dr. Hachiro Shimanuki. I am a research microbiologist and the ResearchLeaderof the U.S. Department of Agriculture, Agricultural Research Service, Bee Research Laboratoryat Beltsville, MD. I began my career as a bee disease specialist in 1963. In 1996, I made a factfinding trip to Italy as the sponsoring scientist for a cooperative research project on Acarapiswoodi, one of the two parasitic mites causing major losses in the honey bee populations andaffecting the availability of honey bees for pollination. Over my 33 year career, I have authoredand co-authored more than 100 scientific publications on bee diseases and parasitic mites. I havealso sponsored cooperative research on parasitic mites in Italy, India, Tunisia, Brazil andMexico.

As this introduction indicates, I've spent many years conducting research on bee diseases andpests. The first thing to know about the Western honey bee, Apis mellifera, is that it is not anindigenous species. It was introduced to the New World by the Jamestown Company in colonialVirginia to produce honey to sweeten their tea. It was not until the late 1800's and early 1900'sthat the value of the honey bee for pollination was recognized.

In 1921, a report was published implicating the mite, Acarapis woodi (or A.woodi), as thecause of devastating honey bee losses on the British Isle of Wight. As a result of the losses, theU.S. Department of Agriculture (USDA) conducted a limited survey of honey bees in 38 states,the District of Columbia, and Canada and found no A. woodi. In 1922, the Congress adoptedandthe President signed into law what today is known as the "the Honeybee Act" which regulates importation of adult honey bees. In 1923, implementing rules and regulations were approved bythe Secretary of Agriculture.

Because of the threat of parasitic mites to U.S. agriculture, the USDA initiated cooperativeresearch in Italy and India in the mid-1960s to learn more about A. woodi. In both countries, theresearch objective was to learn more about the diagnosis, biology and control of the mite. TwoUSDA scientists were sent to Italy to learn about the different methods to detect and control A.woodi. The detection methods that were learned in Italy 30 years ago are still being used todayinmost laboratories. Menthol, identified as a candidate for the control of A. woodi in the sameItalian project, is the only chemical registered by the EPA and used today by U.S. beekeepers.

In 1982, a team of USDA Agricultural Research Service (ARS) scientists reported thediscovery of A. woodi in Mexico. In 1984, just prior to the discovery of A. woodi in honey beesin Texas along the United States - Mexican border, the ARS negotiated cooperative researchprojects with Cornell University and the University of Georgia on the development of regulatorytreatments for Varroa jacobsoni and A. woodi, respectively. In addition, in 1984, a Joint BoardProject between the United States and Yugoslavia was negotiated to conduct cooperativeresearch on the development of bee stocks resistant to V. jacobsoni. In 1986, ARS moved thehoney bee pesticide laboratory from Laramie, WY to Weslaco, TX and redirected three scientistsand their resources to research on the biology and control of A. woodi.

Acarapis woodi is a parasite of the adult bee. It lives in the breathing tube (tracheae) of theadult bee, hence the popular name, the honey bee tracheal mite (HBTM). The mite feeds on thehemolymph (blood) of the adult bee and when large numbers are present in the tracheae, theymayinterfere in the respiration of the bee. The HBTM reduces the life span of the adult bee. Withinlimits, there is a direct correlation on mite numbers to life expectancy: the more mites present,theshorter the life expectancy. In temperate climates, where brood rearing ceases in the winter andno replacement bees are being produced, the population of the colony frequently falls below acritical mass especially when this loss is combined with losses from other stress conditionsincluding bee diseases.

It was several years before there was general agreement among beekeepers and scientists thatHBTM was an economic pest. Beekeepers in the temperate climates were reporting unusuallyhigh winter losses associated with the HBTM, and beekeepers in the more tropical climates werefinding no adverse effects from the mite. By the time everyone agreed, the mite spreaduncontrolled to every State except Hawaii. Five years after the HBTM was detected, a generallabel for the use of menthol to control HBTM was finally registered with the EPA. However,many beekeepers were unhappy with menthol because its efficacy was directly related to ambienttemperatures and its use was restricted to only those periods when there was no nectar flow. Analternative HBTM control method, formic acid, was submitted to EPA by the IR-4 project staffat Rutgers University in March 1996.

When Varroa was found in the U.S., there was none of the controversy associated with theHBTM on the economic impact. Scientists and beekeepers were all in agreement on the need forimmediate action. This mite parasitizes both the developing brood and adult bees. The femaleadult mite lays its eggs in the cell of a developing bee so its offspring can feed on the bee. Themore mites that are produced in a cell, the higher the expected mortality. The developing mitefeeds on the bees' legs, wings and other appendages which results in imperfect bees which are nottolerated by other normal worker bees in a colony. Since the mites develop in honey bee broodcells that have a semi-impervious capping, the efficacy of chemical treatment is reduced. If thedeveloping bee is able to emerge as an adult it frequently is undersized. In the winter, whenthereis no developing honey bee brood, the adult bee can once again be parasitized. The adult mitefinds a safe haven from the elements and applied chemical controls by crawling between theintersegmental membranes of the adult honey bee abdomen. There, the mite feeds on thehemolymph of the adult bee and thereby reduces the life expectancy of the host. As in the caseofHBTM, since there are no replacement bees in the temperate climates, Varroa infestations canreduce the population of adult bees below the critical level. In some cases, the combination ofother diseases and mites causes the death of a colony. Approximately 30% of all honey beecolonies with Varroa are also infested with the HBTM.

Consequently, beekeepers musttreat honey bee colonies for both mites.

In 1988, the Department's Animal and Plant Health Inspection Service (APHIS) entered intoanegotiated rulemaking process with industry and other Federal and State agencies to develop aregulatory program to retard the interstate spread of Varroa mite. On March 16, 1989, APHISpublished in the Federal Register a proposal based on the consensus-based recommendations ofthe negotiated rulemaking committee. However, most commenters objected to the proposaloutright, and the rest were ambivalent at best. Lacking data to refute commenters' objections,APHIS found it unlikely that any Federal action could result in workable regulations that wouldwin widespread support. As a result, APHIS withdrew its proposal, deferring to the efforts of theStates and the research and beekeeping communities to slow the spread of Varroa mite. Consequently, Varroa eventually spread to every state except Hawaii.

Because of the contact with Israeli scientists on the United States-Israel BinationalAgricultural Research and Development (BARD) project, ARS scientists were able to provideinformation to support an emergency registration of the chemical, fluvalinate, for the control ofVarroa in 1988. ARS scientists subsequently helped formulate and test three new productscontaining fluvalinate for U.S. beekeepers, one each for queen mailing cages, package beeshipping cages and beehives. All three products were registered by the EPA in less than twoyearsafter the discovery of the mites in the U.S.

In 1995, scientists in Italy reported evidence that Varroa populations are developingresistance to fluvalinate. This would be a major problem for U.S. beekeepers who rely on onlyfluvalinate for mite control.

ARS scientists are looking for natural products of botanical originformite control that are environmentally safe, efficacious, and economical. For Varroa, thecandidatecompounds include mixtures of linalool, eucalyptus oil, clove oil, and thymol. For the HBTM,mixtures of sugar and vegetable oils are being evaluated.

Chemical controls are the best solutions only for the short-term because of the developmentof resistance to miticides as in the case of Varroa. Therefore, scientists from the ARS andacademia are working together to provide long-range solutions, developing honey bee stock thatare resistant to the ravages of the mites. Introduction of candidate mite-resistant bee stocks fromEurope, England and Yugoslavia (Serbia) were made in the U.S. in 1990 and later released. Sincethese introductions, a number of bee breeders have also developed their own HBTM-resistantstock which are available on the market to other bee breeders. Further research on developingstocks of bees resistant to HBTM and also Varroa is underway in U.S. universities, ARSlaboratories and the private sector. The ARS has a cooperative project on the evaluation ofVarroa-resistant honey bees from Russia.

No country has ever eradicated either the HBTM or Varroa once it is established. It isunlikely that any one chemical, resistant bee stock or biorational method will fully mitigate theimpact of the parasitic mites. The challenge for scientists and beekeepers is to developIntegratedPest Management techniques with resistant bee stocks and judicious use of environmentallycompatible chemicals. From the beekeeper standpoint, the present methods for the control of theparasitic mites is costly. Since 1984, when the HBTM was first found, beekeeper costs forcolonymaintenance, because of the mites, have increased on an annual basis $8.00 - 15.00 per colony,exclusive of labor. Using current honey prices, this represents a loss of 10 - 20% of thebeekeepers' gross income per colony.

Beekeepers in the United States are generally divided into three categories: (1) the hobbyistor amateur beekeeper who owns 1 - 24 colonies; (2) the sideliner, whose primary source ofincome is not from bees and owns 25 - 299 colonies; and (3) the professional or commercialbeekeeper who makes a full-time living from keeping honey bees and owns more than 300colonies.

The colony mortality in the winter and spring of 1995-96 strongly suggests that survivalduring this time of the year is more complex than just treating for mites. While there are noprecise figures on the number of managed colonies that did not survive during this timeframe, thecolony losses reported by the hobbyist and sideliner ranged from 0 - 100% because in some casesthe percentage is based on only a few colonies. In an American Beekeeping Federation survey,data from Maryland, where colony losses were separated from commercial and non-commercialbeekeepers', the non-commercial beekeepers suffered loses of 50 - 75% and the commercialbeekeepers losses were 25 - 35%. In states that didn't separate their statistics such as Floridawhich reported 200,000 colonies in 1993, the 1995-96 winter and spring report showed a loss of25%. In South Dakota, a state that reported 245,000 colonies in 1993, reported a 1995-96 winterand spring loss of 30- 60%.

Thousands of managed honey bee colonies have died across the U.S. even in the hands of thebest beekeepers. Also, there is no good estimate of losses of the unmanaged feral population ofhoney bees. New Jersey and New York both report that the feral population of honey bees hasbeen decimated. Those two states are not alone, the loss of the feral population is a nationalproblem. Added to this loss is the decrease in the number of beekeepers, in the 20 states thatparticipated in the survey, in the past two years, they report a loss of 22.5%. Most of those losseswere in the hobbyist and sideliner category. But putting this in perspective, if the estimates areclose, we probably have less than 110,000 beekeepers today.

Why should we be concerned over the loss of beekeepers and honey bee colonies? Honeybees pollinate about 90% of all the cultivated crops pollinated by non-indigenous and indigenousbees. It is estimated that over one million honey bee colony rentals are negotiated each year forthe pollination of the estimated $10 billion of cultivated crops in the U.S. Bees pollinate aboutone-third of our diet. If it were not for bees, our diets would lack the infinite variety Americanshave learned to enjoy.

Honey bees are being used as the general pollinator for many crops. Two examples of majorindigenous crops pollinated by bees are blueberries as well as the cranberries we eat withtraditional Thanksgiving and Christmas dinners. Also, many major bee-pollinated crops arenon-indigenous including apples, almonds,

alfalfa, cantaloupes, peaches, apricot, safflower, andpears. These crops were imported into the New World without their pollinators.

One area that has been frequently overlooked is the contribution bees make to the duneecosystem. In a University of Georgia study, scientists reported that bees are not essential but dobenefit the dune stabilizing plant, sea oats (Uniola paniculata). From the bees' viewpoint, thisecosystem is important because it is free from pesticides.

Commercial growers who lease honey bee colonies may have experienced some difficultiesinobtaining sufficient number of honey bee colonies. They had to call more beekeepers and had topay a slightly higher price for colony rentals. It is likely that the home gardener and wildernessareas will suffer the effects of a pollinator shortage. For many years, the home gardener andwilderness areas have been receiving free pollination from the feral honey bee colonies in beetreesand abandoned buildings. The winter and spring of 1995-96 may be a harbinger of things tocome. For many years, honey bee colonies and beekeepers have been decreasing for a number ofreasonsincluding parasitic mites. Harsh and long winters, cool springs, late summers, and low honeyprices are some of the factors that have contributed to fewer honey bees and beekeepers.

The ARS and the universities have been evaluating indigenous and non-indigenouspollinatorssince the 1940s. In the case of alfalfa seed production, the primary pollinator is a non-indigenouspollinator, Megachile rotundata, commonly called the alfalfa leafcutting bee from Eurasia. Thisbee is also a pollinator of hybrid onions, carrots and squash. The alkali bee, Nomia mellanderi isan example of an indigenous bee that has found its niche as a pollinator for alfalfa seedproduction. Two indigenous Osmia species are being studied for use in the pollination of suchcrops as almonds, apples, cherries, and blueberries. Two indigenous species of the bumble bee,Bombus, are being propagated artificially for the pollination of tomatoes, peppers, strawberries,melons, and eggplants in greenhouses.

The two parasitic mites of the honey bees, Acarapis woodi and Varroa jacobsoni do notaffectother indigenous and non-indigenous pollinators. However, alkali bees and the alfalfa leafcuttingbees also have disease problems which have impacted negatively on their propagation. Theavailability of non-Apis indigenous and non-indigenous pollinators, except for the leafcuttingbeeis limited and cannot be expected to replace the honey bee. Honey bees and non-Apis pollinatorssupplement each other and are not mutually exclusive.

There are still other parasitic mites that threaten the honey bees. An Asian mite,Tropilaelapsclareae, is probably the next parasitic mite that will be found in the United States. In spite of thisthreat, other honey bees with desirable traits and other non-Apis pollinators must be evaluatedforpossible introduction to ensure an adequate supply of pollinators for the high-tech U.S.agriculture and to help our farmers remain competitive.

This concludes my prepared statement and I will be pleased to answer any questions youmayhave at this time. Again, thank you for the opportunity to participate in this important hearing.

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