



Honey Bee Colony Collapse Disorder

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Summary

Starting in late 2006, commercial migratory beekeepers along the East Coast of the United States began reporting sharp declines in their honey bee colonies. Because of the severity and unusual circumstances of these colony declines, scientists named this phenomenon colony collapse disorder (CCD). Reports indicate that beekeepers in most states have been affected. Overall, the number of managed honey bee colonies dropped an estimated 35.8% and 31.8% in the winters of 2007/2008 and 2006/2007, respectively. Preliminary loss estimates for the 2008/2009 winter are reported at 28.6%. To date, the precise reasons for colony losses are not yet known.

Honey bees are the most economically valuable pollinators of agricultural crops worldwide. Scientists at universities and the U.S. Department of Agriculture (USDA) frequently assert that bee pollination is involved in about one-third of the U.S. diet, and contributes to the production of a wide range of fruits, vegetables, tree nuts, forage crops, some field crops, and other specialty crops. The monetary value of honey bees as commercial pollinators in the United States is estimated at about \$15-\$20 billion annually.

Honey bee colony losses are not uncommon. However, losses in recent years differ from past situations in that colony losses are occurring mostly because bees are failing to return to the hive (which is largely uncharacteristic of bee behavior); bee colony losses have been rapid; colony losses are occurring in large numbers; and the reason(s) for these losses remains largely unknown.

Based on the available research over the past few years on the numerous possible causes of CCD, USDA concluded in its 2007-2008 progress report (released in June 2009) that “it now seems clear that no single factor alone is responsible for the malady.” This has led researchers to further examine the hypothesis that CCD may be “a syndrome caused by many different factors, working in combination or synergistically.” Currently, USDA states, researchers are focusing on three major possibilities:

- pesticides that may be having unexpected negative effects on honey bees;
- a new parasite or pathogen that may be attacking honey bees, such as the parasite *Nosema ceranae* or viruses; and
- a combination of existing stresses that may compromise the immune system of bees and disrupt their social system, making colonies more susceptible to disease and collapse. Stresses could include high levels of infection by the *Varroa* mite; poor nutrition due to apiary overcrowding, pollination of crops with low nutritional value, or pollen or nectar scarcity; exposure to limited or contaminated water supplies; and migratory stress.

Funding for honey bee and CCD research at USDA’s Agricultural Research Service (ARS) has increased sharply, following both the enactment of the 2008 farm bill (P.L. 110-246) and the FY2009 and FY2010 appropriations process (P.L. 111-8 and P.L. 111-80, respectively). These legislative actions contained additional provisions that would, among other things, provide additional funding for research and conservation programs addressing honey bees and pollinators. Total ARS funding for honey bee and CCD research averaged more than \$7.7 million each in FY2007 and FY2008, increasing to \$8.3 million in FY2009 and \$9.8 million for FY2010.

Contents

Importance of Honey Bee Pollination	1
Extent and Symptoms of Colony Collapse Disorder	4
Past Honey Bee Population Losses	5
Current Colony Losses from Available Surveys	6
How CCD Differs from Past Bee Colony Losses	7
Symptoms of Colony Collapse Disorder	8
Possible Causes of Colony Collapse Disorder	8
Parasites, Mites, and Disease	9
Pesticides and Chemicals	11
Other Factors	12
Other Related Events	12
Issues for Congress	13
Committee Actions and Hearings	13
2008 Farm Bill	14
Conservation Provisions	14
Research Provisions	14
Insurance and Disaster Provisions	15
Other Provisions	15
USDA Actions and Funding	15
USDA's Action Plan	15
USDA's 2007-2008 Progress Report	16
Available USDA Research Funding	16

Figures

Figure 1. Colony Collapse Disorder, Affected States	4
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Tables

Table 1. Estimated Value of the Honey Bee to U.S. Crop Production, 2000 Estimates	2
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Contacts

Author Contact Information	17
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Starting in 2006, commercial migratory beekeepers along the East Coast of the United States began reporting sharp declines in their honey bee colonies. Because of the severity and unusual circumstances of these colony declines, scientists named this phenomenon colony collapse disorder (CCD). Current reports indicate that beekeepers in most states have been affected. Overall, the number of managed honey bee colonies dropped an estimated 35.8% and 31.8% in the winters of 2007/2008 and 2006/2007, respectively.¹ Preliminary loss estimates for the 2008/2009 winter are reported at 28.6%. To date, the precise reasons for colony losses are not yet known.

This report provides an overview of the importance of honey bee pollination to U.S. agricultural production, especially specialty crops. It describes the extent and symptoms of CCD and how it differs from previous honey bee colony losses, describing some of the reasons why scientists believe honey bee colonies are being affected by CCD. Finally, the report discusses policy options and actions that Congress has taken to address this issue.

Importance of Honey Bee Pollination

Honey bees (*Apis mellifera*) are the most economically valuable pollinators of agricultural crops worldwide and are the only bee species kept commercially in the United States.² In the United States, bee pollination of agricultural crops is said to account for about one-third of the U.S. diet, and to contribute to the production of a wide range of high-value fruits, vegetables, tree nuts, forage crops, some field crops, and other specialty crops.³

The monetary value of honey bees as commercial pollinators in the United States is estimated at about \$15 billion annually⁴ (**Table 1**). Some studies report the estimated value of honey bee pollination at as much as \$20 billion annually. This estimated value is measured according to the additional value of production attributable to honey bees, in terms of the value of the increased yield and quality achieved from honey bee pollination, including the indirect benefits of bee pollination required for seed production of some crops. About one-third of the estimated value of commercial honey bee pollination is in alfalfa production, mostly for alfalfa hay. Another nearly 10% of the value of honey bee pollination is for apples, followed by 6%-7% of the value each for almonds, citrus, cotton, and soybeans. Overall, pollinator-dependent crops are reported to make up an estimated 23% of total U.S. agricultural production in 2006, up from an estimated 14% in the 1960s.⁵

¹ D. vanEngelsdorp, J. Hayes, and J. Pettis, "Preliminary Results: A Survey of Honey Bee Colonies Losses in the U.S. Between September 2008 and April 2009," May 19, 2009, <http://www.beealert.info/>.

² Other known animal pollinators are stingless bees, bumble bees, other bees, wasps, hover flies, other flies, beetles, thrips, ants, butterflies, moths, bats, hummingbirds, and other birds.

³ M. R. Berenbaum, University of Illinois, Statement before the Subcommittee on Horticulture and Organic Agriculture, U.S. House of Representatives, March 29, 2007, <http://agriculture.house.gov/testimony/110/h70329/Berenbaum.pdf>; J. Pettis, USDA's ARS, interview with University of Pennsylvania staff, January 23, 2007. Staple crops (wheat, corn, and rice) do not rely on insect pollination and are mostly wind pollinated.

⁴ R. A. Morse and N. W. Calderone, *The Value of Honey Bees as Pollinators of U.S. Crops in 2000*, March 2000, Cornell University, <http://www.masterbeekeeper.org/pdf/pollination.pdf>. Other studies show a range of estimated values from \$5.7 billion to \$19.0 billion (see National Research Council, *Status of Pollinators in North America*, 2006).

⁵ Pollinator Partnership, "Helping the earth by supporting pollinators," 2009 publication.

Table I. Estimated Value of the Honey Bee to U.S. Crop Production, 2000 Estimates

Crop Category (ranked by share of honey bee pollinator value)	Dependence on Insect Pollination	Proportion of Pollinators That Are Honey Bees	Value Attributed to Honey Bees ^a (\$ millions)	Major Producing States ^b
Alfalfa, hay & seed	100%	60%	4,654.2	CA, SD, ID, WI
Apples	100%	90%	1,352.3	WA, NY, MI, PA
Almonds	100%	100%	959.2	CA
Citrus	20%-80%	10%-90%	834.1	CA, FL, AZ, TX
Cotton (lint & seed)	20%	80%	857.7	TX, AR, GA, MS
Soybeans	10%	50%	824.5	IA, IL, MN, IN
Onions	100%	90%	661.7	TX, GA, CA, AZ
Broccoli	100%	90%	435.4	CA
Carrots	100%	90%	420.7	CA, TX
Sunflower	100%	90%	409.9	ND, SD
Cantaloupe/honeydew	80%	90%	350.9	CA, WI, MN, WA
Other fruits & nuts ^c	10%-90%	10%-90%	1,633.4	—
Other vegetables/melons ^d	70%-100%	10%-90%	1,099.2	—
Other field crops ^e	10%-100%	20%-90%	70.4	—
Total	—	—	14,564	—

Source: Compiled by CRS using values reported in R. A. Morse, and N.W. Calderone, *The Value of Honey Bees as Pollinators of U.S. Crops in 2000*, March 2000, Cornell University, <http://www.masterbeekeeper.org/pdf/pollination.pdf>.

- a. Attributed value is the additional value of production attributable to honey bees, in terms increased yield and quality achieved from honey bee pollination, including the indirect benefits of bee pollination required for seed production of some crops. Calculated from total average production value (1996-1998).
- b. For most commodities, major producing states reflect reported 2006 production (<http://www.nass.usda.gov/QuickStats/>). Melon production is based on reported 2002 harvested acreage.
- c. Apricots, avocados, blueberries, brambleberries, cherries, cranberries, grapes, kiwi fruit, macadamia nuts, olives, peaches, pears, nectarines, plums, and strawberries.
- d. Asparagus, cauliflower, celery, cucumbers, pumpkins, squash, watermelon, and vegetable seeds.
- e. Peanuts, canola (rapeseed), and sugarbeets.

A number of agricultural crops are almost totally (90%-100%) dependent on honey bee pollination, including almonds, apples, avocados, blueberries, cranberries, cherries, kiwi fruit, macadamia nuts, asparagus, broccoli, carrots, cauliflower, celery, cucumbers, onions, legume seeds, pumpkins, squash, and sunflowers. Other specialty crops also rely on honey bee pollination, but to a lesser degree. These crops include apricot, citrus (oranges, lemons, limes, grapefruit, tangerines, etc.), peaches, pears, nectarines, plums, grapes, brambleberries, strawberries, olives, melon (cantaloupe, watermelon, and honeydew), peanuts, cotton, soybeans, and sugarbeets.⁶

⁶ Ibid. Another study found that pollinators are essential for the production of some U.S.-grown crops, particularly (continued...)

In the United States, most pollination services are provided by commercial migratory beekeepers who travel from state to state and provide pollination services to crop producers. These operations are able to supply a large number of bee colonies during the critical phase of a crop's bloom cycle, when honey bees pollinate a crop as they fly from flower to flower collecting nectar and pollen, which they carry back to the nest.⁷ Data from the U.S. Department of Agriculture's (USDA) *2007 Census* indicate that there were about 28,000 operations with 2.9 million bee colonies in the United States.⁸ The majority of these, more than 2 million bee colonies, are reported to belong to commercial migratory beekeepers. The Dakotas accounted for a combined 27% of all bee colonies. Another one-fifth of all colonies are in California (about 14%) and Florida (7%).⁹ Montana, Minnesota, Idaho, and Texas accounted for 4%-5% each of all colonies nationwide. Other states with a large number of bee colonies were Michigan, Oregon, Georgia, Nebraska, New York, Washington, Wisconsin, and Wyoming, with about 2% each. Although these operations also produce honey for commercial sale, it is their value as crop pollinators that provides the greatest economic impact in the production of food and feed crops.

It is estimated that, each year, more than 2 million bee colonies are rented for U.S. crop pollination. Available limited information indicates that the greatest number of honey bee colony rentals are for apple and almond production, followed by clover seed, cherries, and pears.¹⁰ About one-half of the nation's honey bee colonies (an estimated 1.3 million colonies) are used to pollinate California's current 550,000 acres of almond trees, and this need is projected to grow to 1.5 million colonies by 2010.¹¹ Both locally and globally, there are concerns that growth in the availability of honey bee stocks is not keeping pace with growing agricultural demands for pollination services.¹²

Rental fees collected by commercial beekeepers for pollination services may vary by crop type, and often tend to be lower for some seed crops and higher for berry and tree crops. In recent years, pollination fees paid by crop producers have increased. For example, fees paid by California's almond industry have risen from a reported \$35 per colony in the late 1990s to about \$75 per colony in 2005.¹³ More recent estimates of fees for pollinating almond trees are even higher, at \$150 per colony or more. Among the reasons for higher pollination fees are expanding almond acreage and relatively high honey prices, but also fewer available honey bees for pollination due, in part, to colony declines and bee mortalities.

(...continued)

macadamia nuts, squash, and pumpkins. A.M. Klein, et. al, "Importance of pollinators in changing landscapes for world crops," *Proceedings of the Royal Society B: Biological Sciences*, Vol. 274, No. 1608, February 7, 2007.

⁷ Some "spillover" pollination occurs, including pollination from colonies owned by part-time beekeepers and hobbyists, or pollination of adjacent fields from commercial hives.

⁸ Based on honey production statistics. USDA, *2007 Census of Agriculture*, Table 31, http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_US/st99_1_029_031.pdf.

⁹ USDA, *Honey*, February 2009, <http://usda.mannlib.cornell.edu/usda/current/Hone/Hone-02-27-2009.pdf>.

¹⁰ M. Burgett, *1999 Pacific Northwest Honey Bee Pollination Survey*, Oregon State University.

¹¹ USDA, CCD Steering Committee, "Colony Collapse Disorder Action Plan," June 20, 2007, at http://www.ars.usda.gov/is/br/ccd/ccd_actionplan.pdf; and USDA, "Questions and Answers: Colony Collapse Disorder," <http://www.ars.usda.gov/News/docs.htm?docid=15572>.

¹² See, for example, M. A. Aizen and L. D. Harder, "The Global Stock of Domesticated Honey Bees is Growing Slower than Agricultural Demand for Pollination," *Current Biology*, May 2009.

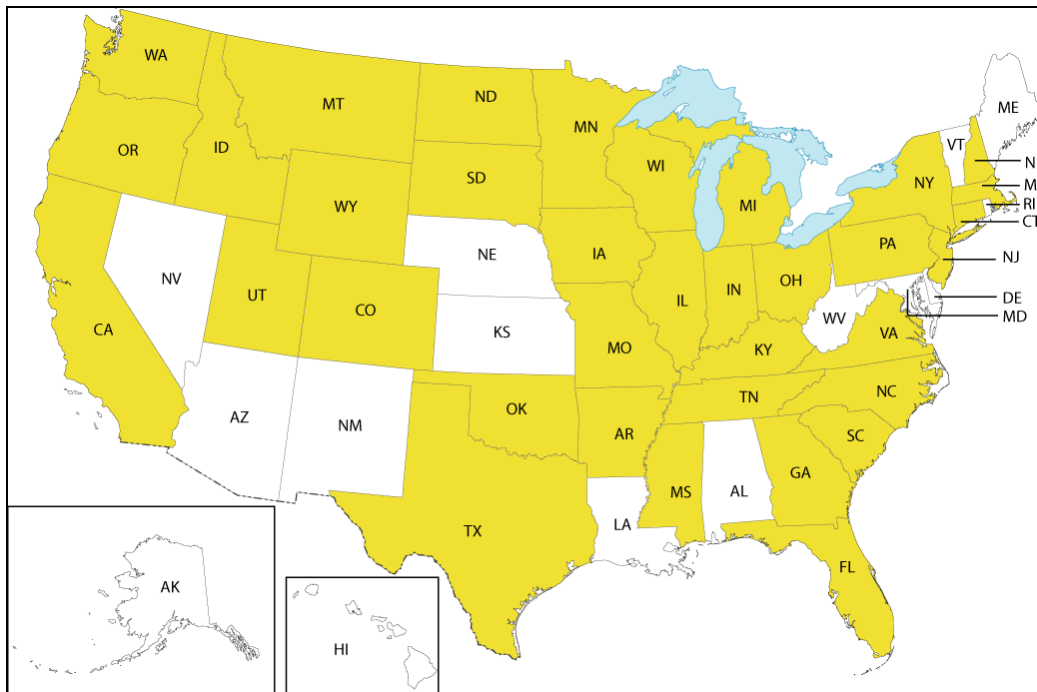
¹³ National Academy of Sciences, National Research Council, *Status of Pollinators in North America*, 2006.

Extent and Symptoms of Colony Collapse Disorder

Starting in the last three months of 2006, a seemingly new phenomenon began to occur based on reports of an “alarming” number of bee colony losses and die-off along the East Coast. By the end of 2006, beekeepers on the West Coast also began to report “unprecedented” losses.¹⁴

Available estimates indicate that beekeepers in 35 states have been affected (**Figure 1**). Because of the severity and lack of precedent, scientists coined a new term, Colony Collapse Disorder (CCD), for this phenomenon.

Figure 1. Colony Collapse Disorder, Affected States



Source: Bee Alert Inc., “Map of U.S. States Reporting Colony Collapse Disorder,” <http://beealert.blackfoot.net/~beealert/USshaded.pdf>. Shaded areas show reported affected states. This is the most recent update (as of December 2009).

Much of the current research on CCD is being conducted by scientists at USDA’s Agriculture Research Service (Beltsville bee laboratory), Pennsylvania State University, the University of Montana, and the Pennsylvania and Florida Departments of Agriculture, among others. Many of these researchers also participate in the CCD Working Group, which includes Bee Alert Inc., the Florida and Pennsylvania Departments of Agriculture, Pennsylvania State University, and USDA. Up-to-date information is regularly posted to the website of the Mid-Atlantic Apiculture Research and Extension Consortium (MAAREC), which represents beekeeping associations in New Jersey, Maryland, Delaware, Pennsylvania, and West Virginia.

¹⁴ D. vanEngelsdorp et al., “Fall Dwindle Disease: Investigations into the Causes of Sudden and Alarming Colony Losses Experienced by Beekeepers in the Fall of 2006,” December 15, 2006.

Past Honey Bee Population Losses

Honey bee colony losses are not uncommon. A recent report by the National Research Council (NRC) documents the extensive literature on honey bee population losses due to bee pests, parasites, pathogens, and disease. Most notable are declines due to two parasitic mites, the so-called vampire mite (*Varroa destructor*) and the tracheal mite (*Acarapis woodi*), and also colony declines due to the pathogen *Paenibacillus larvae*.¹⁵ Other reasons for bee colony declines reported by the NRC include interspecific competition between native and introduced bees, pathogen spillover effects, habitat loss, invasive plant species that reduce nectar- and pollen-producing vegetation, bee genetics, and pesticides, among other factors.

Mite infestations are a relatively new occurrence. The 1980s saw two periods of large die-offs due to *Varroa* and tracheal mites: The first *Varroa* mite infestation was reported in 1987; tracheal mites were first detected in 1984.¹⁶ *Varroa* mites are also said to have eliminated most feral bee colonies in the mid-1990s.¹⁷ *Varroa* parasitism affects both worker bees and male larvae and can affect the ability of the queen to reproduce. It is associated with viral pathogens and if left untreated can cause colony mortalities usually within six months to two years after the initial infestation. Less is known about the effects of the tracheal mite. The pathogen *Paenibacillus larvae* is the most serious honey bee pathogen and causes American foulbrood (AFB), which is a disease of larval honey bees. AFB resulted in large colony losses in the 1940s, but its incidence has been reduced by the use of antibiotics and increased apiary inspection programs. Nevertheless, mite and pathogen infestations have likely raised beekeeper operating costs to pay for miticides and/or antibiotics, labor and expenses for treatment, improved management and inspection, and colony replacement of dead bees.

Symptoms similar to those observed for CCD have been described in the past, and heavy losses have been documented. It is still not clear whether the current colony losses are being caused by the same factors or if new contributing factors are involved.¹⁸ MAAREC also reports that large beekeeper operations may have experienced higher than normal losses compared with the past few years, and heavy overwintering losses were reported in 2003-2004 for many northern beekeepers.

Overall, USDA reports that bee colony losses have averaged 17%-20% per year since the 1990s, attributable to a variety of factors, such as mites, diseases, and management stress. By comparison, bee colony losses between the winters of 2006/2007 and 2007/2008 averaged more than 30% during the year.¹⁹

¹⁵ National Academy of Sciences, National Research Council, *Status of Pollinators in North America*, 2006.

¹⁶ National Academy of Sciences, National Research Council, *Status of Pollinators in North America*, 2006; Interview with Maryann Frazier, Senior Extension Agent, Pennsylvania State University, January 28, 2007.

¹⁷ R. A. Morse and N. W. Calderone, *The Value of Honey Bees as Pollinators of U.S. Crops in 2000*, March 2000, Cornell University, <http://www.masterbeekeeper.org/pdf/pollination.pdf>.

¹⁸ Similar conditions have been termed autumn collapse, May disease, spring dwindle, disappearing disease, and fall dwindle disease.

¹⁹ Pollinator Partnership, "Helping the earth by supporting pollinators," 2009 publication. Estimates attributed to Jeffrey S. Pettis at USDA's Agricultural Research Service (ARS).

Current Colony Losses from Available Surveys

The first report of CCD was in mid-November 2006 by a Pennsylvania beekeeper overwintering in Florida. By February 2007, large commercial migratory beekeepers in several states had reported heavy losses associated with CCD. Their reports of losses varied widely, ranging from 30% to 90% of their bee colonies; in some cases beekeepers feared loss of nearly all of their colonies.²⁰ Surviving colonies were reportedly weakened and might no longer be viable to pollinate or produce honey. Losses were reported in migratory operations wintering in California, Florida, Oklahoma and Texas. In late February, some larger non-migratory beekeepers in the mid-Atlantic and Pacific Northeast regions also reported significant losses of more than 50%.²¹ Bee colony losses also were reported in five Canadian provinces, several European countries, and countries in South and Central America and Asia.

In March 2007, the Apiary Inspectors of America (AIA) conducted a survey of its members in 15 states.²² The survey tracked changes from September 2006 and March 2007. Overall, responding beekeepers suffered an average loss of 38% of their colonies during the winter of 2006-2007. If these losses are representative of the nation, between 651,000 and 875,000 of the nation's estimated 2.4 million colonies were lost over that winter.²³ While a majority of losses were attributable to known causes, approximately 25% of beekeepers are believed to have suffered from CCD.²⁴ The survey indicated that, among the beekeepers surveyed, more than 50% reported "abnormally heavy losses" with total colony losses of 55%. This compared to those reporting "normal losses" with total colony losses of 16%. Of the responding beekeepers, about one-fourth reported conditions associated with CCD.²⁵ Beekeeping operations experiencing CCD-like conditions reported losses of 45% of their managed bee colonies. Among the leading causes reported by most affected commercial beekeeping operations were pest diseases.

A 2007 survey conducted by Bee Alert Technology, Inc., showed that, among the beekeepers surveyed, more than 40% reported "severe losses," with losses of nearly 60% of their colonies.²⁶ Another 48% reported average or lower losses. Smaller operations with less than 100 colonies are more likely to have suffered more severe losses than normal. Respondents were also asked to indicate whether the general cause for colony losses was due to overwinter losses, mites, pesticide

²⁰ Interview with Maryann Frazier, Senior Extension Agent, Pennsylvania State University, January 28, 2007; vanEngelsdorp et al., "Fall Dwindle Disease: Investigations into the Causes of Sudden and Alarming Colony Losses Experienced by Beekeepers in the Fall of 2006," December 15, 2006.

²¹ MAAREC, "Colony Collapse Disorder," <http://maarec.cas.psu.edu/FAQ/FAQCCD.pdf>.

²² D. vanEngelsdorp, R. Underwood, D. Caron, and J. Hayes Jr., "An Estimate of Managed Colony Losses in the Winter of 2006-2007: A Report Commissioned by the Apiary Inspectors of America," *American Bee Journal*, July 2007, <http://www.ento.psu.edu/MAAREC/CCDPpt/CCDJuly07ABJArticle-1.pdf>. Based on a survey of beekeepers that included 384 respondents representing 153,000 managed bee colonies located in AR, FL, GA, MD, MI, MS, MT, NM, ND, OH, PA, SD, TN, and WI.

²³ Estimated at the 95% confidence interval.

²⁴ These statistics may have been misrepresented in the popular press, which often state that 25% of the nation's 2.4 million colonies have been lost (citing the AIA survey as its source).

²⁵ Other reports indicate that the 2007 AIA survey found 30% colony losses.

²⁶ C. Henderson, J. Bromenshenk, L. Tarver, and D. Plummer, "National Honey Bee Loss Survey," June 2007, <http://www.beealert.info/>. Survey based on 625 responses received from operations in the U.S. and Canada, covering 43 states and five provinces. The majority (about two-thirds) of beekeepers surveyed were at smaller operations with less than 100 colonies, with another one-third of surveyed operations roughly split among operations with 100-1,000 colonies, 1,000-10,000 colonies, and more than 10,000 colonies.

exposure, or colony disappearance (or CCD). Among all respondents, colony losses due to disappearance (43%) and overwintering (37%) accounted for the greatest share of total losses, with mites and disease accounting for another 15%. Pesticides were indicated to account for a relatively small share (4%) of surveyed colony failures, regardless of operation size. This compares to other previous estimates of winter losses from various different surveys showing overall colony losses of about 30% during the period 2000–2006, mostly associated with losses due to *Varroa* mites.²⁷

Survey information reported by USDA and AIA indicate that the number of managed honey bee colonies dropped an estimated 35.8% in the 2007/2008 winter and 31.8% in the 2006/2007 winter.²⁸ Preliminary loss estimates for the 2008/2009 winter are reported at 28.6%. This survey data also indicates that 15% of all the colonies lost during the 2008/2009 winter died with symptoms of CCD, compared to a 60% colony loss with CCD-like symptoms in the winter of 2007/2008. Although more recent estimates reflect a possible decrease in the rate of managed colony losses, USDA asserts that this rate of loss remains unsustainable.²⁹ Other information from USDA indicates that colony losses range widely depending on area, from 7% to 80% loss at some surveyed operations.³⁰

How CCD Differs from Past Bee Colony Losses

Current bee colony losses seem to differ from past losses in that colony losses are occurring mostly because bees are failing to return to the hive (which is largely uncharacteristic of bee behavior); bee colony losses have been rapid; colony losses are occurring in large numbers; and the reason why these losses are occurring remains still largely unknown.

The phenomenon was first called “Fall-Dwindle Disease,” but was renamed because of the unusual characteristics of the colony declines. Moreover, the condition is not only seasonal but manifests itself throughout the year. The term “dwindle” implies a gradual loss, whereas CCD onset is sudden. Also, the term “disappearance” is used to describe other types of conditions, which differ from the symptoms currently being associated with CCD. Finally, the term “disease” is usually associated with a biological agent, but none has yet been identified.³¹

²⁷ E. Burdick and D. M. Caron, MAAREC Beekeeper Survey, University of Delaware, <http://maarec.cas.psu.edu/pdfs/MAARECSurveyPub.pdf>.

²⁸ D. vanEngelsdorp, J. Hayes, and J. Pettis, “Preliminary Results: A Survey of Honey Bee Colonies Losses in the U.S. Between September 2008 and April 2009,” May 2009, <http://www.beealert.info/>. Survey based on about 20% of all U.S. colonies.

²⁹ Ibid.

³⁰ Jeff Pettis, “Colony Collapse Disorder Affecting Honey Bee (*Apis mellifera*) colonies,” October 2008 presentation, <http://www.epa.gov/pesticides/ppdc/2008/oct2008/session7-ccd.pdf>. Survey based on 22 operations, managing 10% of U.S. colonies, and AIA surveys.

³¹ D. vanEngelsdorp, D. Cox Foster, M. Frazier, N. Ostiguy, and J. Hayes, “Fall Dwindle Disease: Investigations into the Causes of Sudden and Alarming Colony Losses Experienced by Beekeepers in the Fall of 2006,” December 2006.

Symptoms of Colony Collapse Disorder

The symptoms of CCD, based on the available research, include the following:³²

- rapid loss of adult worker bees,
- few or no dead bees found in the hive,
- presence of immature bees (brood),
- small cluster of bees with live queen present, and
- pollen and honey stores in hive.

Among the key symptoms of CCD in collapsed colonies is that the adult population is suddenly gone without any accumulation of dead bees. The bees are not returning to the hive but are leaving behind their brood (young bees), their queen, and maybe a small cluster of adults. What is uncharacteristic about this situation is that the honey bee is a very social insect and colony-oriented, with a complex and organized nesting colony. Failing to return to the hive is considered highly unusual. An absence of a large number of dead bees makes an analysis of the causes of CCD difficult. Also there is little evidence that the hive may have been attacked. In actively collapsing colonies, an insufficient number of adult bees remain to care for the brood. The remaining workforce seems to be made up of young adult bees. The queen is present, appears healthy and is usually still laying eggs, but the remaining cluster is reluctant to consume feed provided by the beekeeper, and foraging is greatly reduced.

Possible Causes of Colony Collapse Disorder

The initial scientific search of the possible factors involved in CCD focused on four areas:³³

- pathogens,
- parasites,
- environmental stresses, and
- bee management stresses such as poor nutrition.

Early on, researchers had tentatively removed some practices and conditions from the list of possible causes of CCD. These included feeding practices, chemicals used by beekeepers (such as antibiotics and miticides), use of bees (primarily for honey production versus pollination), and queen source.³⁴ However, the scientists researching this phenomenon note that these could contribute to the risk of bee colonies developing CCD. Some scientists also wonder whether a combination of the stressors, including mites, disease, and nutritional stress, are interacting to

³² D. vanEngelsdorp et al., "Fall Dwindle Disease: Investigations into the Causes of Sudden and Alarming Colony Losses Experienced by Beekeepers in the Fall of 2006," December 15, 2006; published interview with Maryann Frazier, Penn State University, January 28, 2007, at <http://podcasts.psu.edu/taxonomy/term/62>; and Jeff Pettis, "Colony Collapse Disorder Affecting Honey Bee (*Apis mellifera*) colonies," October 2008 presentation.

³³ USDA, "Questions and Answers: Colony Collapse Disorder," <http://www.ars.usda.gov/News/docs.htm?docid=15572>.

³⁴ Most queens are purchased from suppliers in Florida, California, Texas, Georgia, and Hawaii, or from suppliers in Canada, Australia, and New Zealand.

weaken bee colonies and are allowing stress-related pathogens, such as fungi, thus causing a final collapse.³⁵ Others note the possible role of miticide resistance in bees.

Others have speculated that because most of the reported colony losses are among large commercial migratory operations, which may move bees two to five times during a growing season, the current disorder may be the result of accumulated stress, and factors such as confinement and temperature fluctuations. These stresses may increase the colony's susceptibility to disease and may also increase its potential exposure to other diseases and parasites.³⁶ A 10% die-off is not uncommon following transportation, with losses of 30% possible.

As outlined in USDA's 2007-2008 progress report, the available research over the past few years on the numerous possible causes for CCD has led USDA and university researchers to conclude that "no single factor alone is responsible" for CCD.³⁷ This has led researchers to further examine the hypothesis that CCD may be "a syndrome caused by many different factors, working in combination or synergistically," including "an interaction between pathogens and other stress factors."³⁸ Currently, USDA states, researchers are focusing on three major possibilities:³⁹

1. pesticides that may be having unexpected negative effects on honey bees;
2. a new parasite or pathogen that may be attacking honey bees, such as the parasite *Nosema ceranae* or viruses; and
3. a combination of existing stresses that may compromise the immune system of bees and disrupt their social system, making colonies more susceptible to disease and collapse. Stresses could include high levels of infection by the *Varroa* mite; poor nutrition due to apiary overcrowding, pollination of crops with low nutritional value, or pollen or nectar scarcity; exposure to limited or contaminated water supplies; and migratory stress.

Parasites, Mites, and Disease

Initially, the potential causes of CCD, as reported by the scientists researching this phenomenon, were thought to include but not be limited to parasites, mites, and disease loads in the bees and brood; emergence of new or newly more virulent pathogens, such as fungal diseases; poor nutrition among adult bees; lack of genetic diversity and lineage of bees; level of stress in adult bees, as indicated by stress-induced proteins (e.g., transportation and confinement of bees, overcrowding, or other environmental or biological stressors); chemical residue/contamination in

³⁵ D. Cox Foster, Pennsylvania State University, Statement before the Subcommittee on Horticulture and Organic Agriculture, U.S. House of Representative, March 29, 2007, <http://agriculture.house.gov/testimony/110/h70329/CoxFoster.pdf>.

³⁶ D. vanEngelsdorp et al., "Fall Dwindle Disease: Investigations into the Causes of Sudden and Alarming Colony Losses Experienced by Beekeepers in the Fall of 2006," December 15, 2006; and C. Rexrod, USDA's ARS, Statement before the Subcommittee on Horticulture and Organic Agriculture, U.S. House of Representative, March 29, 2007, <http://agriculture.house.gov/testimony/110/h70329/Rexroad.pdf>.

³⁷ USDA, *Colony Collapse Disorder Progress Report*, CCD Steering Committee, June 2009, http://www.ars.usda.gov/is/br/ccd/ccd_progressreport.pdf. Also see D. vanEngelsdorp et al., "Colony Collapse Disorder: A Descriptive Study," *Proceedings of the National Academy of Sciences*, Vol. 4, Issue 8, August 2009.

³⁸ *Ibid.*

³⁹ USDA, "Questions and Answers: Colony Collapse Disorder," <http://www.ars.usda.gov/News/docs.htm?docid=15572>.

the wax, food stores, and/or bees, including acute or cumulative exposure to new types of agricultural pesticides as well as exposure to chemicals that beekeepers use to control mites; and a combination of these and/or other factors.⁴⁰

In July 2007, USDA reported that theories about the causes of CCD were focused on increased losses due to the *Varroa* mite; new or emerging diseases, especially mortality by a new species of a single-celled parasite *Nosema ceranae*; pesticide exposure; and potential immune-suppressing stress on bees due to one or a combination of these factors.⁴¹ In September 2007, a research team that included USDA published the results of a genetic screening of CCD-affected honey bee colonies and non-CCD-affected hives.⁴² The only pathogen found in nearly all samples (96.1%) from CCD-affected colonies, but not in non-CCD colonies, was the Israeli acute paralysis virus (IAPV), a dicistrovirus that can be transmitted by the *Varroa* mite.⁴³ USDA considers this research to have identified IAPV as a marker of CCD, since it is found in affected bees, but not to have identified IAPV as the cause of CCD; however, this research indicates there is a strong correlation of the appearance of IAPV and CCD together.⁴⁴

High levels of bacteria, viruses, and fungi have been found in the guts of the recoverable dead bees. Early evidence does suggest the possible presence of a pathogen, given that some bee colonies have recovered once their bee boxes were irradiated.⁴⁵ Researchers have found the fungus *Nosema ceranae* and other pathogens such as chalkbrood in some affected hives throughout the country.⁴⁶ Some researchers have speculated that these high infection levels may be compromising the immune system of the honey bees, resulting in immune deficiencies in bees that may be among the possible causes for bee mortalities and disappearance.⁴⁷ A 2009 study by researchers in Spain found further evidence that infection in bees by *Nosema ceranae* may be among the primary causes of CCD.⁴⁸

⁴⁰ Published interview with Maryann Frazier, Penn State University, January 28, 2007, at <http://podcasts.psu.edu/taxonomy/term/62>; and MAAREC, "Colony Collapse Disorder," <http://maarec.cas.psu.edu/FAQ/FAQCCD.pdf>.

⁴¹ USDA, CCD Steering Committee, "Colony Collapse Disorder Action Plan," June 20, 2007, at http://www.ars.usda.gov/is/br/ccd/ccd_actionplan.pdf.

⁴² D. L. Cox-Foster et al., "A Metagenomic Survey of Microbes in Honey Bee Colony Collapse Disorder," *Science*, September 6, 2007, <http://www.sciencemag.org/cgi/content/abstract/318/5848/283>.

⁴³ USDA, "Questions and Answers: Colony Collapse Disorder," <http://www.ars.usda.gov/News/docs.htm?docid=15572>. The study also found IAPV in honey bees from Australia that had been imported into the United States, as well as in royal jelly imported from China. Further studies challenge the idea that IAPV is a recent introduction from imported bees.

⁴⁴ USDA press release, "Genetic Survey Finds Association Between CCD and Virus," September 2007, <http://www.ars.usda.gov/is/pr/2007/070906.htm>; and MAAREC statement, "Colony Collapse Disorder and Israeli Acute Paralysis Virus," <http://maarec.cas.psu.edu/CCDPpt/CCDbeekeepersStatementIAPV.pdf>.

⁴⁵ K. Ramanujan, "Parasites, pathogens and pesticides called possible suspects in honeybee decimation," *Cornell Chronicle*, Cornell University, May 17, 2007, http://www.news.cornell.edu/Chronicle/07/05_17_07.pdf.

⁴⁶ C. Henderson, J. Bromenshenk, L. Tarver, and D. Plummer, "National Honey Bee Loss Survey," June 2007, <http://www.beealert.info/>.

⁴⁷ D. Cox Foster, Pennsylvania State University, and C. Rexrod, USDA's ARS, statements before the Subcommittee on Horticulture and Organic Agriculture, U.S. House of Representatives, March 29, 2007, <http://agriculture.house.gov/testimony/110/h70329/CoxFoster.pdf> and <http://agriculture.house.gov/testimony/110/h70329/Rexroad.pdf>; and published interview with Jerry Hayes, Florida's Department of Agriculture, Apiary Section, March 2, 2007.

⁴⁸ M. Higes et al., "Honeybee colony collapse due to *Nosema ceranae* in professional apiaries," *Environmental Microbiology Reports*, Vol. 1, Issue 2, February 2009.

Pesticides and Chemicals

Of the possible causes of CCD being examined, one that has become the subject of debate is whether certain chemicals or combinations of chemicals could be contributing to CCD, including some pesticides and possibly some fungicides. Scientists have long been concerned that pesticides may have sub-lethal effects on bees, not killing them outright but instead impairing their development and behavior.⁴⁹

One class of insecticide being studied are neonicotinoids, which contain the active ingredient imidacloprid, and similar other chemicals, such as clothianidin and thiamethoxam. Honey bees are thought possibly to be affected by such chemicals, which are known to work their way through the plant up into the flowers and leave residues in the nectar and pollen (which is the food for young, developing bees). The scientists studying CCD have tested samples of pollen and have indicated findings of a broad range of substances, including insecticides, fungicides, and herbicides.⁵⁰ These scientists note that the doses taken up by bees are not lethal, but they are concerned about possible chronic problems caused by long-term exposure. As noted by the NRC, some studies report sublethal effects of pesticides on bee foraging behavior that may impair the navigational and foraging abilities of honey bees.⁵¹

Concerns about imidacloprid, as reported by beekeeping associations in the United Kingdom and France⁵² and by some U.S. beekeepers,⁵³ have focused on its potential to affect complex behaviors in insects, including flight, navigation, olfactory memory, recruitment, foraging, and coordination. However, the NRC and some scientists who study CCD note there is conflicting information about the effect of these pesticides on honey bees. Still, the U.S. Environmental Protection Agency has identified some of these chemicals as highly toxic to honey bees,⁵⁴ and use of some of these pesticides has reportedly been discontinued in parts of Europe because of their potential effects on pollinators.⁵⁵ However, bee colony losses are also occurring in Europe, where these chemicals are reportedly no longer used. In the United States, the Organic Consumers Association reports that bee colony losses are not occurring at organic beekeeping operations.⁵⁶

⁴⁹ Frazier, M., et. al, "What Have Pesticides Got To Do With It?" *American Bee Journal*, June 2008, <http://maarec.cas.psu.edu/CCDPpt/WhatPesticidesToDoWithItJune08ABJ.pdf>.

⁵⁰ S. Williams, "The Case of the Missing Bees," *Penn State Agriculture Magazine*, Winter/Spring 2008, <http://aginfo.psu.edu/psa/08WinSpr/bees.html>.

⁵¹ National Academy of Sciences, NRC, *Status of Pollinators in North America*, 2006.

⁵² D. Cox-Foster and D. vanEngelsdorp, "Solving the Mystery of the Vanishing Bees," *Scientific American*, March 31, 2009; Northwest Coalition for Alternatives to Pesticides, "Imidacloprid, Fact Sheet," *Journal of Pesticide Reform*, Spring 2001, <http://www.pesticide.org/imidacloprid.pdf>; and Apiculteurs de France, "Composite Document of Present Position Relating to Gaucho, Sunflower and Bees," http://www.beekeeping.com/articles/us/gaucho/manifestation_paris_us.htm.

⁵³ Joe Cummins, "Neonicotinoid insecticides used in seed dressing may be responsible for the collapse of honeybee colonies," April 24, 2007, http://www.organicconsumers.org/articles/article_4972.cfm.

⁵⁴ For example, see EPA's fact sheet on clothianidin, issued May 3002, <http://www.epa.gov/opprd001/factsheets/clothianidin.pdf>.

⁵⁵ D. vanEngelsdorp et al., "Fall Dwindle Disease: Investigations into the Causes of Sudden and Alarming Colony Losses Experienced by Beekeepers in the Fall of 2006," December 15, 2006; published interview with Jerry Hayes, Florida's Department of Agriculture, Apiary Section, March 2, 2007.

⁵⁶ Organic Consumers Association, "Honey Bee Health & Colony Collapse Disorder," <http://www.organicconsumers.org/bees.cfm>.

Nevertheless, a number of environmental groups are taking legal action to highlight the possibility that pesticides and chemical loads may be contributing to colony declines. For example, in December 2009, a federal court in New York invalidated the U.S. Environmental Protection Agency's (EPA's) approval of the pesticide spirotetramat and ordered the agency to reevaluate the chemical, as a result of a suit filed by the Natural Resources Defense Council (NRDC) and the Xerces Society.⁵⁷ The pesticide, manufactured by Bayer CropScience under the trade names Movento and Uitor, is thought to be potentially harmful to honey bees. NRDC also filed a lawsuit against the EPA in August 2008 to obtain information that they allege the U.S. government is withholding about the risks posed by pesticides to honey bees. NRDC claims that EPA has evidence of connections between pesticides and CCD.⁵⁸ Also in August 2008, a German coalition group brought legal charges against Bayer AG, accusing them of "marketing dangerous pesticides" and contributing to bee colony declines.⁵⁹ The coalition filed the charge in cooperation with German beekeepers who claim they lost hives because of the Bayer pesticide clothianidin dating back to May 2008. Some countries, including Germany, Italy and France, reportedly are either considering or have already instituted full or partial bans of neonicotinoid-based pesticides due to their potential impact on honey bee populations.⁶⁰

Other Factors

Other reported theories include the effects of shifting spring blooms and earlier nectar flow associated with broader global climate and temperature changes,⁶¹ the effects of feed supplements that are produced from transgenic or genetically modified crops, such as high-fructose corn syrup,⁶² and also the effects of cell phone transmissions and radiation from power lines that may be interfering with a bee's navigational capabilities.⁶³ The contributions of these possible factors have not been substantiated by evidence examined by the key researchers of this issue.⁶⁴

Other Related Events

In late 2008, beekeepers in some states began to raise concerns about live bee imports from Australia. Specifically, these concerns centered on reports that the Asian honey bee, *Apis cerana*, had been introduced to Australia. Asian honey bees, found in southeast Asia, are considered an

⁵⁷ NRDC press release, "Big Win for Bees: Judge Pulls Pesticide" December 29, 2009, <http://www.nrdc.org/media/2009/091229.asp>.

⁵⁸ NRDC press release, "EPA Buzz Kill: Is the Agency Hiding Colony Collapse Disorder Information?" August 18, 2008, <http://www.nrdc.org/media/2008/080818a.asp>.

⁵⁹ "German Coalition Sues Bayer Over Pesticide Honey Bee Deaths," *Environmental News Service*, August 25, 2008, <http://www.ens-newswire.com/ens/aug2008/2008-08-25-01.asp>.

⁶⁰ BNA's *International Environmental Law Committee Newsletter*, vol. 11, no. 1, February 2009, http://www.abanet.org/enviro/committees/intenviro/newsletter/feb09/IELC_Feb09.pdf.

⁶¹ W. Esaias, "Honey Bees, Satellites and Climate Change," presentation at the Library of Congress, April 3, 2007.

⁶² See, for example, Louise A. Malone and Minh-Hà Pham-Delègue, "Effects of transgene products on honey bees (*Apis mellifera*) and bumblebees (*Bombus* sp.)," *Apidologie*, 32, 2001, <http://www.hortresearch.co.nz/files/science/gmimpacts/m1403malone.pdf>; also research conducted by Hans-Hinrich Kaatz, University of Halle, Germany, cited at <http://www.sierraclub.org/biotech/references.asp>.

⁶³ Reportedly, this theory originated with initial research conducted in 2003 by J. Khun and H. Stever of Landau University in Germany.

⁶⁴ Statements and expert testimony at a public hearing of the U.S. House of Representatives, Subcommittee on Horticulture and Organic Agriculture, March 29, 2007.

invasive species of bees and are known to carry a mite (*tropilaelaps clarae*). Neither the Asian honey bee nor the mite are known to be present in the Western Hemisphere. However, U.S. beekeepers have expressed concerns that bee imports could result in the introduction of mites and other diseases and further contribute to stressors already facing domestic species.⁶⁵

In November 2008, Australia notified APHIS of an incursion of Asian honey bees in the Cairns, Queensland, area of northeastern Australia, and Australia voluntarily stopped issuing export certificates to ship honey bees to the United States. In response, APHIS required that all honeybee exports be derived from colonies 100 miles away from any find of Asian honey bees known to have occurred in the last two years. As of late December, Australian shipments of honey bees to the United States have resumed. APHIS's decision to resume trade was based on data provided by Australia indicating that the areas outside the quarantine zone in Cairns are free the Asian honey bee and of the mites of concern.⁶⁶

Live bees (only queens with attendants and package bees) are allowed for import into the United States from Canada, Australia, and New Zealand. Imports from other countries are restricted. Certain import requirements apply along with general restrictions regarding the transit of live honey bees, bee byproducts, and bee equipment.⁶⁷ Items that are not allowed for transit include imports of whole colonies in hives, used beekeeping equipment, and pollen. Restrictions apply on beeswax for beekeeping and honey for bee feed, and require special treatment.⁶⁸

Issues for Congress

Committee Actions and Hearings

During the 110th Congress there were three House subcommittee hearings on honey bee colony declines and concerns about CCD. The House Subcommittee on Horticulture and Organic Agriculture held two hearings: one in March 2007 and a second in June 2008. The Subcommittee on Fisheries, Wildlife, and Oceans of the House Committee on Natural Resources held a hearing in June 2007 on the role of pollinators in ecosystem health, which also addressed concerns about bee colony declines. In the Senate, in April 2008, Chairwoman Barbara Boxer and other members of the Senate Environment and Public Works Committee hosted a briefing on pollinators and their role in agricultural security.

Policy options discussed at these congressional hearings and briefings focused on the need for increased federal funding for multi-disciplinary research and monitoring to document changes in pollination reserves, as well as additional technical support and assistance for beekeepers. Additional research funding would help support USDA's research efforts and those at its laboratories located in Arizona, Louisiana, Maryland, Texas, and Utah.⁶⁹ Other recommended

⁶⁵ CRS communications with USDA APHIS on December 23, 2008. Also see, e.g., Kim Flottum, "Why the U.S. Should Stop Importing Bees from Australia," December 15, 2008, at <http://www.thedailygreen.com/environmental-news/blogs/bees/australian-bee-imports-88121501?src=rss>.

⁶⁶ CRS communications with USDA APHIS on December 23, 2008.

⁶⁷ For information, see USDA APHIS import requirements: "Regulated Organism and Soil Permits, Honey Bees and Other Bees," at http://www.aphis.usda.gov/plant_health/permits/organism/bees/index.shtml.

⁶⁸ See 7 CFR Part 322, Subpart E, "Importation and Transit of Restricted Articles."

⁶⁹ There were reports in 2007 that the University of California at Davis was considering revitalizing its honey bee (continued...)

options included expanding crop insurance to include beekeepers and honey producers; providing a one-time payment for incurred losses; improving existing USDA conservation programs to better prevent habitat loss and sustain wildlife populations; emphasizing the importance of pollinator diversity and sustaining wild and native pollinator species; developing or improving existing federal and state best management practices for beekeepers; improving regulatory enforcement to prevent misuse of agricultural chemicals; and continuing the current marketing loan program for honey.

2008 Farm Bill

In May 2008, Congress enacted the 2008 farm bill (P.L. 110-246), which, among other things, provided additional funding for research and conservation programs addressing honey bees and pollinators. The law reflects provisions that were included in both the House- and Senate-passed versions of the farm bill, which addressed honey bees and pollinators as part of their conservation, specialty crop, research, and miscellaneous title provisions.

Conservation Provisions

The conservation title of the 2008 farm bill included language that broadly encourages habitat development and protection among the administrative requirements for native and managed pollinators under USDA's conservation programs (Section 2708), and ensures that USDA's conservation technical assistance includes standards that account for native and managed pollinators (Section 2706). These provisions could broaden the focus of USDA's farm conservation programs to include pollinator habitats and habitat improvement among their goals, as well as require USDA to review its conservation practice standards with respect to managed and native pollinators.

Research Provisions

The research title of the 2008 farm bill identified pollinator protection among its so-called high-priority research and extension areas (Section 7204). It provided for research and extension grants (1) to survey and collect data on bee colony production and health; (2) to investigate pollinator biology, immunology, ecology, genomics, and bioinformatics; (3) to conduct research on various factors that may be contributing to or associated with colony collapse disorder and other serious threats to the health of honey bees and other pollinators, including parasites and pathogens of pollinators, and the sublethal effects of insecticides, herbicides, and fungicides on honey bees and native and managed pollinators; (4) to develop mitigative and preventative measures to improve native and managed pollinator health; and (5) to promote the health of honey bees and native pollinators through habitat conservation and best management practices. For this provision, the 2008 farm bill authorized appropriations for grants at \$10 million annually for FY2008-FY2012.

The research provisions also directed USDA to increase its capacity and infrastructure to address colony collapse disorder and other long-term threats to pollinator health (including hiring additional personnel) and to conduct research on colony collapse disorder and other pollinator

(...continued)

research program by hiring a bee breeder and geneticist and renovating the biology facility ("News Briefs," *AgriPulse*, Vol. 3, No. 20, May 16, 2007).

issues at USDA's facilities. Annual appropriations were authorized at \$7.25 million (FY2008-FY2012), with another \$2.75 million annually (FY2008-FY2012) for honey bee pest and pathogen surveillance. The 2008 farm bill also directed USDA to submit an annual report to Congress on its response to CCD, indicating that the report should investigate the cause(s) of honey bee colony collapse and recommend appropriate strategies to reduce colony loss.

Insurance and Disaster Provisions

Other provisions in the 2008 farm bill supported pollinators through the bill's crop insurance and other disaster assistance provisions. One such provision identifies honey farms as possible beneficiaries of the bill's supplemental agricultural disaster assistance (Section 12033); another provision provides contracts for additional policies and studies to carry out research and development regarding insurance policies that cover loss of bees (Section 12023).

Since enactment of the farm bill, USDA has created the Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish Program (ELAP).⁷⁰ This program, administered by USDA's Farm Service Agency (FSA), provides disaster assistance for honey bee producers. The ELAP provides emergency relief to producers of livestock, honey bees, and farm-raised fish to aid in the reduction of losses because of disease, adverse weather, or other conditions, such as blizzards and wildfires. Eligible honey bee producers—those who incur physical losses of honey bees and honey bee hives because of colony collapse disorder—must provide documentation, and/or a certification that the loss of honey bees was due to CCD, from one or more of the following: registered entomologist; cooperative extension specialist; and/or land grant university. Additional information on this program is available at USDA's website⁷¹ and at state county FSA offices.⁷²

Other Provisions

The 2008 farm bill also contained provisions that generally support honey production. These include, for example, provisions pertaining to the National Honey Board (Section 10401-10402); provisions covering rates for marketing assistance loans for certain commodities, including honey (Section 1202); and provisions covering certain nutrition title provisions (such as Section 4231).

USDA Actions and Funding

USDA's Action Plan

USDA released its initial action plan for addressing CCD in July 2007. USDA's action plan focuses on improving coordination and redirecting existing resources and research for mitigation and prevention, including education and outreach, as well as expanding research and diagnostic resources to prevent future losses, working with the land grant universities. It also coordinates activities across three USDA agencies: the Agricultural Research Service (ARS), the Animal and

⁷⁰ USDA's final rule became effective in September 2009: 74 *Federal Register* 175: 46665-46683, <http://edocket.access.gpo.gov/2009/pdf/E9-21906.pdf>. See CRS Report RS21212, *Agricultural Disaster Assistance*.

⁷¹ See, for example, USDA, "Documenting Losses Under the Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish Program (ELAP)," http://www.fsa.usda.gov/Internet/FSA_Notice/ldap_2.pdf.

⁷² For information on individual county offices, see <http://offices.sc.gov.usda.gov/locator/app>.

Plant Health Inspection Service (APHIS), and the National Institute of Food and Agriculture (NIFA). USDA's focus on expanded research is consistent with the approach taken in the most recently introduced congressional bills and with recommendations by the American Honey Producers Association and the American Beekeeping Federation.⁷³

Under the plan, USDA would (1) conduct surveys and collect data on bee health; (2) analyze bee samples for pests, disease-causing pathogens, pesticide exposure, and other factors; (3) conduct controlled experiments to identify factors affecting bee health, including potential causes of colony collapses; and (4) develop best management practices and guidelines to improve general bee health and reduce susceptibility to colony collapses and other disorders among both honey bees and non-*Apis* bees.⁷⁴ Aspects of USDA's action plan were presented at a hearing before the Subcommittee on Fisheries, Wildlife, and Oceans of the House Committee on Natural Resources in June 2007.⁷⁵

USDA's 2007-2008 Progress Report

In June 2009, USDA published its 2007-2008 progress report on ongoing and intended future research efforts related to honeybees and CCD, following on the action items in its action plan. As outlined in USDA's progress report, prior study of the numerous possible causes for CCD has led researchers to further examine the hypothesis that CCD may be "a syndrome caused by many different factors, working in combination or synergistically."⁷⁶ Accordingly, future study will "focus increasingly on combinations and synergistic effects of factors in causing CCD."⁷⁷ The progress report provides detailed information on the status of ongoing research under each of the four elements of USDA's action plan, including survey and (sample) data collection, analysis of existing samples, research to identify factors affecting honey bee health, and mitigative and preventive measures. The progress report is available at USDA's CCD website at http://www.ars.usda.gov/is/br/ccd/ccd_progressreport.pdf.

Available USDA Research Funding

Funding for honey bee and CCD research at USDA's ARS has increased, following enactment of the 2008 farm bill (P.L. 110-246) and also FY2009 and FY2010 appropriations (P.L. 111-8 and P.L. 111-80, respectively), which, among other things, provide additional funding for research and

⁷³ R. Addee, American Honey Producers Association, Statement before the Subcommittee on Horticulture and Organic Agriculture, House Committee on Agriculture, March 29, 2007, <http://agriculture.house.gov/testimony/110/h70329/Adee.pdf>; D. Weaver, American Beekeeping Federation, Inc., Statement before the Subcommittee on Fisheries, Wildlife and Oceans, House Committee on Natural Resources, June 26, 2007, http://resourcescommittee.house.gov/images/Documents/20070626/testimony_weaver.pdf.

⁷⁴ USDA, CCD Steering Committee, "Colony Collapse Disorder Action Plan," June 20, 2007, http://www.ars.usda.gov/is/br/ccd/ccd_actionplan.pdf.

⁷⁵ K. Hackett, USDA, Statement before the Subcommittee on Fisheries, Wildlife and Oceans, House Committee on Natural Resources, June 26, 2007, http://resourcescommittee.house.gov/images/Documents/20070626/testimony_hackett.pdf.

⁷⁶ USDA, Colony Collapse Disorder Progress Report, CCD Steering Committee, June 2009, http://www.ars.usda.gov/is/br/ccd/ccd_progressreport.pdf. This is the first annual report mandated by the 2008 farm bill (Sec. 7204 (h) (4)) on Honey Bee Colony Collapse Disorder (CCD).

⁷⁷ *Ibid.*

conservation programs addressing honey bees and pollinators. Total ARS funding for honey bee and CCD research has been as follows:⁷⁸

- FY2007—\$7,675,000
- FY2008—\$7,798,000
- FY2009—\$8,290,000
- FY2010—\$9,790,000 (includes \$1.5 million increase for CCD research)

ARS also has an “Area-wide Project on Bee Health,” which consists of temporary funding of \$670,000 in FY2008 and will continue for at least four additional years at approximately \$1 million per year.⁷⁹ Additional funding is available to USDA’s NIFA, and includes combined research on honey bees, funding specific to CCD and bee health, and funding for various research labs and grants. Recently, emerging issues grants were awarded to Penn State University and the University of Georgia to study the effects of pesticides, pathogens, and miticides on pollinator populations.⁸⁰

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⁷⁸ CRS communication with USDA personnel, December 18, 2009.

⁷⁹ CRS communication with USDA personnel, December 4, 2008; Jeff Pettis, “Colony Collapse Disorder Affecting Honey Bee (*Apis mellifera*) Colonies,” October 2008 presentation, <http://www.epa.gov/pesticides/ppdc/2008/oct2008/session7-ccd.pdf>.

⁸⁰ Statements by Jeff Pettis, USDA, to Senate Environment and Public Works committee staff, April 9, 2008.