The Bee Informed Partnership
A Vast Collaborative Effort to
Find Out What's Up with the Bees
and Your Bees in Particular

by M.E.A. McNeil

What, deal with the bee crisis with data? Well, yes.
Consider that it was data from a national survey that made possible
the current ban on Australian bee imports.

The bees are going down – at about a third per year for the last five years. It's a sad calculation, any way you figure it. But calculating it is a way out, according to a consortium of experts called The Bee Informed Partnership. Thousands of beekeepers have voiced their agreement by responding to two surveys: over 5,700 to the Winter Loss Survey and over 3,000 to the Management Survey.[1] A preliminary analysis shows winter losses have remained relatively steady. Results for the second survey will be available in September. Eventually, participants will be able to privately see and compare their individual information.

Bee populations have ebbed in the past, recovering after a year or two, with the first such downturn reported in North America in 1770; since the 1940s numbers here have fallen by half in short fits. The need for pollinators has, at the same time, increased. Beekeepers are a hardy lot, and many – often over generations – have come through some hard times with their charges. But never this hard or this long.

The disappearance of bees from fodder-filled hives, inexplicably shunned by robbers, was named colony collapse disorder (CCD); it made headlines. Any blessing was not apparent to beekeepers flipping the lids of thousands of lost colonies: their bees were not turning flowers into crops into money. But CCD turned a mystery into public awareness into research funding. Never mind that statistically the losses of hives with CCD symptoms were, and continue to be, a small proportion of overall losses -- the newspapers went for the riddle of the vanishing bee. The media had enough impact to move the image of beekeeper from crusty curmudgeon to protector of our sustenance and the stereotype of entomologist from nerd to hero (and heroine, it was revealed).

The bee crisis -- and it is that, as the losses are unsustainable -- has come at a time when researchers have formed a web of cooperation. At the turn of the 21st century, the grail of decoding the honey bee genome was a pursuit too vast for any one site. Researchers, who until then were often connected only informally outside their institutions or through published work, created an international nexus to share the task and coordinate the report, which came together triumphantly in 2006. It came with surprises, not the least of which is that bees have few genes for immunity. The bee genome project created a cultural shift among researchers – collaboration among sites and across multiple disciplines - that prepared them for what was to come.

When devastating disappearances were discovered by beekeeper David Hackenberg in 2006, he called Pennsylvania State Apiarist Dennis vanEngelsdorp, who subsequently examined losses nationwide with a group of bee experts. A wide swath of researchers have since addressed the problem and, although predictable causes of CCD have not been pinpointed, most agree that the larger overall losses come from combinations of known problems. Beekeeping, very much an individual pursuit, has been undertaken in a patchwork of ways. The idea of finding out what management was working and what was hampering the bees engrossed vanEngelsdorp, who had embarked on a PhD in epidemiology at Pennsylvania State University, a national center for honey bee research.

What was lacking was a bank of information to work with. Noted entomologist May Barenbaum testified to Congress in 2007 that "there is an extraordinary paucity of reliable data….It is difficult in fact to think of any other multi-billion-dollar agricultural enterprise that is so casually monitored" with methods "outdated and disturbingly inadequate." Over sixty years a survey had been done by the National Agricultural Statistics Service, but it focused on honey production, excluded small scale beekeepers, and did not track migratory practices or health of the bees.

To fill that need, vanEngelsdorp brought together a diverse team that has received a $5 million extension grant, the largest ever, from the USDA through Penn State to survey and make available national data on what is happening with the bees.

"The Bee Informed Partnership wasn't really any one person's idea. It was an idea that beekeepers, many beekeepers, had. As I traveled across the country sampling bees to try to find out what was killing them, beekeepers everywhere said that what they needed was a way to find out what other beekeepers did and which of those things worked," said vanEngelsdorp.

Data may not be the first synonym for silver bullet that comes to mind, but consider that it was survey information that stopped the importation of Australian bees. The National Honey Bee Disease Survey, under Robyn Rose of APHIS, established that a particular virus found in Australia, slow paralysis virus, is not found here. That fact established the ban, which no amount of speculation had accomplished. So gathering more facts, a lot more, makes sense as a tool.

The new program incorporates and continues the Winter Loss Survey, started in 2007 by vanEngelsdorp and Florida Inspector Jerry Hayes (leaders of the Apiary Inspectors of America) together with Jeffrey Pettis (head of the USDA-ARS Beltsville Honey Bee Lab).

Reading the results requires attention to the difference between total loss and average loss: "*Total* loss is a better measure of what is happening with commercial beekeepers and total colony numbers in the survey population while *average* losses better reflect the losses of beekeepers overall (as it is biased by small beekeepers who were bigger responders)," according to vanEngelsdorp.

Total losses for last winter are 30%, continuing the pattern of the last five years. *Average* losses were 38.4%, a 9% decrease over the previous winter. (This fine point could be lost in the hope for evidence of improvement in the situation.)

Of the 181,765 colonies reported lost in the 2009-10 survey, over 40% were lost to conditions typically thought of as preventable. "The stark fact is that there are no aggregated data to address the simple question: Which practices or combination of practices are proving effective at minimizing colony losses?" said vanEngelsdorp. "We propose to provide beekeepers access to data that links losses with management practices, enabling them for the first time in their history to objectively evaluate management practices." This unique approach, he says, is "not a research project but an extension project using epidemiological and econometric tools to be communicated to beekeepers in ways that enable them to make real-time data-informed decisions."

The idea is for the data to speak for themselves. At first, statistics will be posted on the web, where they will be available to the public; in addition, participating beekeepers will have protected access to their own results.[2] Eventually beekeepers will be able to contribute online interactively to the database, which will allow them, for example, to compare management practices or disease loads with historical and regional figures. Boots-on-the-ground support teams of bright young apiarists have already been trained to collect samples and assay for disease.[3]

The goal, writes vanEngelsdorp, is to "increase the number of beekeeping operations engaged in sustainable practices, decrease risks associated with unneeded antibiotic and pesticide use, and increase beekeeper profitability." It's a heady prospect and it has the support of a large number of the nation's honey bee scientists and educators.

The approach is to examine the problem every which way: the consortium includes entomologists, agricultural economists, statisticians, extension apiarists, computer scientists, epidemiologists, industry experts, a farm advisor and a NASA scientist. Also on board are a support team,[4] a Stakeholder Advisory Group,[5] and a Science Advisory Board composed of American, Canadian, German, French, Swiss and Belgian bee scientists. Those joining now are the most important component, the beekeepers – large and small scale – who contribute information for analysis.

The core working group of 16 evolved from the collaboration of vanEngelsdorp, Hayes, Pettis and Dave Tarpy of North Carolina State University, founding members of the CCD Working Group. The others are from an array of disciplines.

Epidemiologist Eugene Lengerich, of the Penn State Hershey Cancer Institute, first became involved with bees through his analyses of CCD losses. He will continue work with the new data from an epidemiological point of view – using statistical analysis to determine population level patterns that indicate risk, as well as assessing prevention.

Entomologist Marla Spivak of the University of Minnesota is an established advocate for sustainable management practices. She has focused on bees' social immunity through the development of a line of hygienic bees as well as studies on the anti-bacterial role of propolis in the hive. Her project to facilitate hygienic and disease testing to assist Northern California queen producers in stock selection is in its third year. The program, now managed by Katie Lee, will continue as an adjunct to the Bee Informed Partnership, contributing data.

Agricultural economists Kathy Baylis, of the University of Illinois, and Brian Gross, of the University of British Colombia, are developing economic models to show the effects of management choices and disease. George Muraya of Lincoln University will contribute his expertise as a statistician. "It's such a big puzzle," said Baylis. "The scientists are measuring the physical efficacy of different practices, and we are measuring the economic efficacy…We are starting almost from ground zero… It is amazing to me that for such an important industry there is so little data, but loads of anecdotal evidence."

The advantage of having diverse disciplines involved with the project, according to Gross is that "We are looking at the same data from different points of view. Economically there is another level of analysis, from the beekeeper's point of view – how many beekeepers are surviving? When we put our heads together we will come up with something better than I could on my own."

Susan Donahue, who heads the University of California Extension in Oroville, has seen to it that the project has office and lab space in their building, a converted art nouveau hospital, and she helps with logistical details. Joe Connell, a crop specialist at that office, is contributing his expertise on bee-pollinated tree crops.

Keith Delaplane of the University of Georgia has provided a pre-existing framework established through his leadership of the Coordinated Agricultural Project (CAP), a national consortium of scientists and extension agents.[6]

James Wilkes, Professor of Computer Science at Appalachian State University, says of the project "It is a way to marry my passion for computer science with my passion for beekeeping." He started an online program called Hive Tracks, a web-based recordkeeping system that has come out of his experience keeping 50 colonies on a family farm. He is working on the Bee Informed Partnership with Mark Henson, a software engineer. By the second year, said Wilkes, "We can pipe data from the survey to flow seamlessly electronically into the database." With past surveys, he says, there has been a lag between collection and availability of data. "We want to squeeze that down so it can be immediately available." Students at the university will help evaluate the web interface and work on the labor-intensive chore of integrating other databases. "We are big on real world experience here."

A longtime dream for Wilkes is the development of hand-held devices to record apiary data. He hopes to have a prototype for a mobile app during the first year of the project designed for different platforms. As for Henson, he is "looking forward to working with the rock stars of bee research."

John Skinner, entomologist and plant pathologist, puts data on the www.extension.org website, where the whole project has a home. The website, by the way, is already a rich resource.

In addition to current information, widely scattered historical data will be gathered to create the largest database relating to bees ever assembled. Some examples: Wayne Esaias, a NASA scientist and member of the working team, will move his database to ARS; his work aims to understand how changes in climate and land use affect nectar flows and bee forage and includes 120 years of records.[7] Spivak's accumulated and ongoing data for California bee breeders, Delaplane's CAP surveys and Rose's APHIS surveys will all be joined to the base. From the USDA, more than 16,300 disease diagnoses made by Bart Smith and his team will be added, according to Pettis, along with half a million historic data. VanEngelsdorp estimates, conservatively, that over 200,000 colony inspections or disease and parasite load records will be incorporated.

Of the pool of data, Baylis said, "It's very cool…It's not easy to get your mitts on as researchers, but we are able to tap into it and add to it."

Although there are only about 1200 full time commercial beekeepers, they manage by far the majority of hive in the US. Large pollinating operations and queen producers have expressed willingness to have monitoring systems in place for the project. Although they have many fewer colonies, most beekeepers are part-time, small-scale – more than 20,000 of them. The study is also intent on including them, since their management practices will be valuable to assay.

As simple as the questionnaires appear, the process of creating them was arduously developed and tested from prototypes such as the APHIS survey. "Sometimes, as scientist, it makes sense, and when you get into the field it doesn't make sense," said Rose.

"For a researcher, it's a trade-off," said Baylis. "You want to ask an hour of questions, but you want people to do the survey."

The goal of the first phase, with surveys completed in April, is to make results available in September so that beekeepers can make management decisions. Next year's survey will be reevaluated in light of the first results.

A program to be launched in the second year follows some apiaries every three months. Also, there will be colony-level monitoring on the ground for Nosema, Varroa and tracheal mite. Although not much has been seen of the latter lately, the data will confirm its status. By year three, respondents will be able to receive immediate reports comparing their results to historical, seasonal, or regional levels. By year four, a target group of about 60 interested and trained beekeepers will receive sampling kits to begin their own testing.

Later in the program, bee brokers and pollinators will be assessed to establish pollinator demand and supply. "Brokers are working in very different ways," said Baylis.

All of the central consortium members, as well as the support team, have taken a course in protecting confidentiality. A commitment to transparency, open access to data, and respect for the personal privacy of participants is a credo of the program.

The survey will link with foreign data. Pettis and vanEngelsdorp have worked with CLOSS, a European-based consortium representing 53 nations studying the causes of bee loss and standardizing surveys in much of Europe, North America, the Caribbean, and some Asian countries.[8] Baylis and Gross are coordinating with a group in the EU to run a survey in Canada.

"I hope we will come out of this with agricultural policy," said Baylis, who has served as a staff economist in charge of agriculture for the Council of Economic Advisors in the White House. "We can bring better numbers to the table. I hope to work with government policy makers to show the threats and some possible policy options."

She spoke from her "big picture optimistic self" when she speculated on some ideas: "The question of risk – ways to look at better government supported crop insurance (for beekeepers). It would be easy for the government to set up more of an information flow of market information; who needs bees, for how much? Government policy on pollination conservation – like paying farmers to set aside hedgerows or plans to augment with other pollinators. We hope to get the government on board because the beekeeping industry is so important."

The present grant covers five years of data collection and analysis. "We are working toward this being self-sustaining," said vanEngelsdorp. A successful model is Spivak's Northern California project, which has shown that beekeepers are willing to pay a fee-for-service for testing to help with selection of breeder stocks.

Baylis sees two components to successful management – bonding and bridging. "The beekeeping industry in general is not as industrialized or homogenous as others. Markets are in various states of development. A lot is done with beekeepers on a hand shake; social capital matters. It takes trust to turn bees over to a broker. That is bonding. Bridging is tapping into information outside of your community. Beekeepers are good at talking to each other; we hope to bring them more formal information."

Wilkes said, "Beekeepers listen to each other, but there is a limit to what they can learn that way. The idea here is to glean some wisdom out of everyone's experience. This is an interesting new way to get into this –adding this new layer of real experience from beekeepers and supplementing with historic research data. How will this play out? We don't know. But it has a real possibility of providing some answers we haven't had before because we haven't looked at this data all at once."

Rose observed from her experience with the APHIS survey, "What is important is what we are not finding – for example, Tropilaelaps, *Apis ceranae*, or the Cape bee."[9] Evidence, maintains Pettis, is our best way to protect our borders.

"At first I didn't think it was possible to put such a program together," said vanEngelsdorp, but now it is gathering a tsunami of information.

"What's exciting about this is that all these different experts in different disciplines are brought together," said Rose. "This will be the first website of its kind. I would hope for participation – that's the partnership."

"As more beekeepers join this effort, the database grows stronger and becomes more useful," said Karen Rennech, who manages the project. "It taps into the tribal knowledge of beekeepers."

"This project has the potential to revolutionize bee management by providing beekeepers easy access to trustworthy data," said Spivak.

"Information is power," added Tarpy.

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[1] The most responses came from North Carolina – over 600. California nearly doubled its responses – 328 vs 166 from last year.

[2] BeeInformed website and e-extension site

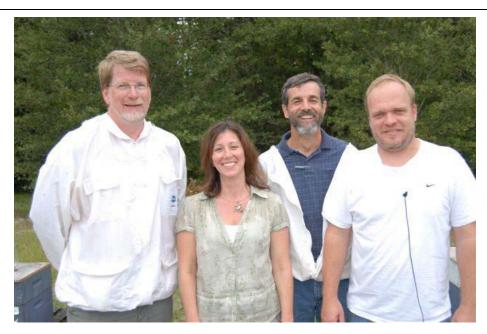[3] Crop protection specialists: Katie Lee, Mike Andree, Robert Snyder

[4] Support team members: Mark Henson, Nishit Patel, Karen Rennich, Gary Reuter, Karen Roccasecca, Angela Spleen, Robyn Underwood, Linda Wertz, Michael Wilson.

[5] American Beekeeping Federation, the American Honey Producers Association, the Apiary Inspectors of America, project Apis m, the Eastern Apicultural Society, the Western Apicultural Society, the California Queen Producers Association, as well as pollinator-dependent producers such as The Almond Board and Paramount Farms

[6] For reports on the Coordinated Agricultural Project (CAP), see http://www.beeccdcap.uga.edu/ and also the University of Georgia website http://www.extension.org/

[7] http://honeybeenet.gsfc.nasa.gov/

[8] www.coloss.org

[9] Tropilaelaps is a virulent Asian mite, *Apis ceranae* is the Asian bee that has entered Australia, and the Cape bee, *Apis mellifera capensis*, is an African bee that takes over honey-producing bees.

Katie Lee and Gary Reuter test for honey bee health at Lohman Apiaries in Northern California.
Photo: Marla Spivak

The Limited US Honey Bee Survey found information that helped stop the importation of Australian bees. The survey steering committee (from left to right): Jeff Pettis, USDA/ARS Bee Research Lab, Research Leader Robyn Rose, USDA APHIS, National Program Manager for Honey Bees and Coordinator for the Limited National Honey Bee Survey, Jerry Hayes, Chief Apiary Inspector for the Florida Department of Agriculture and Consumer Services, Dennis vanEngelsdorp, head of the Bee Informed Project, which includes these members. Photo: Stephen Thornton, Florida DPI

Bee Informed Project team members at a day-long meeting at the University of California Davis Extension in Oroville: clockwise from left, Mike Andree and Rob Snyder, who are doing apiary testing; Katie Lee of the queen breeder project, Dennis vanEngelsdorp, project coordinator; Marla Spivak, who also initiated the associated project to test California breeding stock; Jeff Pettis, head of the USDA Beltsville bee lab; Joe Connell, UC Extension farm advisor; Susan Donahue, head of the extension office.
Photo: M.E.A. McNeil

At the Bee Informed pizza party are, left to right, team members Rob Snyder, Mike Andree and Katie Lee; California queen breeder Glenda Wooten; project leader Dennis vanEngelsdorp. Photo: M.E.A. McNeil

Explaining the Bee Informed survey project are: foreground right, Katie Lee speaking with commercial queen breeder Pat Heitkum; background left Mike Andree and right Rob Snyder with queen breeder Shannon Wooten. Photo: M.E.A. McNeil

Listening to the presentation at the Bee Informed Project pizza party are: left to right, Jeff Pettis, USDA; Sue Cobey, UC Davis and Washington State University; Northern California queen breeders Bonnie and Pat Stayer; Marla Spivak, University of Minnesota. Photo: M.E.A. McNeil

Left to right, Rob Snyder, Bee Informed team member, talks about the program with Steve Park and Shannon Wooten, large scale queen breeders. Photo: M.E.A. McNeil

Team member Mike Andree exchanges ideas about the new survey project with queen breeders Pat and Bonnie Stayer. Photo: M.E.A. McNeil

Jackie Park-Burris, left, receives test results from her apiaries from Katie Lee who now heads a project initiated by Marla Spivak that shares data with the Bee Informed survey. Photo: M.E.A. McNeil

Shannon Wooten, queen breeder, and Jeff Pettis, head of the USDA Beltsville lab, share information at the California pizza meeting that introduced the Bee Informed survey to beekeepers. Photo: M.E.A. McNeil

Marla Spivak, left foreground, with queen breeder Jackie Park-Burris with Nosema and hygienic behavior testing results, a valuable and confidential selection tool. In the background, from left, queen breeders Russell Heitkam and Frank Pendell talk bees – what else? Photo: M.E.A. McNeil