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Season's Greetings

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American Bee Journal

Volume 150 No. 12 December 2010

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Hives overwintering in Ontario, Canada. Photo by Tibor Szabo, 309 Hume Rd., RR 1, Puslinch, Ontario N0B 2J0 Canada.

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Letters to the Editor

Send your letters to the editor, Attn: Joe Graham, Dadant, 51 S. 2nd Street, Hamilton, IL 62341, Fax: 1-217-847-3660, or email: abj@dadant.com.

Due to size and content, we may be unable to publish all information received. Thank You!

STILL NO BEEKEEPING MERIT BADGE, BUT BEEKEEPING WILL RECEIVE GREATER EXPOSURE

The national office of the Boy Scouts of America has recently received a number of requests proposing reinstatement of the Beekeeping merit badge, in part because America's bee populations are declining. After receiving input from youth members and review by merit badge volunteers and professionals, the BSA has formulated a way to bring greater exposure of beekeeping to youth.

The plan includes the following:

- Emphasis of the importance of bees and their symbiotic relationship with humankind will be added to or enhanced in eight existing merit badge pamphlets: *Bird Study, Forestry, Gardening, Nature, Plant Science, Pulp and Paper, Environmental Science, and Insect Study*. This will be accomplished by the end of 2015.
- The first merit badge to receive the addition will be Environmental Science, which is required for all Scouts earning the Eagle rank. Annually, 73,000 youth earn this merit badge.
- When fully integrated into the targeted merit badge pamphlets, more than 100,000 Scouts each year will discover the importance of bees and beekeeping as part of a larger environmental picture. The Beekeeping merit badge was first offered in 1915, and from 1980 to 1994, the number of youth earning it ranged from 700 to 1,000 per year.
- Beekeeping projects, such as working with a colony or harvesting honey, will be considered for addition to one or more existing merit badges so that highly motivated youth members can earn advancement recognition for their beekeeping activities.

The BSA believes this will increase the awareness of honeybees and their critical impact on our environment, and training America's young people about caring for this important natural resource.

The Boy Scouts of America invites those associations and experts in the beekeeping community who are interested in helping with this project to e-mail us at merit.badge@scouting.org. Please put "bees" in the subject line. The success of the merit badge program is enhanced by qualified merit badge counselors; if you are interested in serving as a merit badge counselor, contact your BSA local council to initiate the process.

Renee Fairrer
Public Relations Manager
Boy Scouts of America

HOW I BECAME A BEEKEEPER

Here is a short backdrop to our story. I journeyed along as a single mom for almost 13 years. So amazingly blessed in so many ways, dear devoted friends, faithful, loving family, a good providing job and a wonderfully cozy home. My precious son and I have always been tight companions. (Now that he's 14 "tight" has been given a new meaning as his favorite slang, which also applies, as being awesome, "far out" or "rad" depending on your generation.)

However, I lacked and strongly desired a husband and companion in this journey called life. I waited, prayed, made my fair share of mistakes and hoped for all those years. Then, one amazing day, God brought the bees. He was telling me to *bee* patient, I know your heart and I am working on it because I love you and I have good things in store for you. Just as you will see how carefully and diligently the bees work, I am putting something together for you, something sweet and strong. That day I was deeply encouraged. I was also given something for me, something that I cherish.

Carrying the load of a single mom (though it was an amazing blessing in itself), one tends to lose her focus on herself and she finds that all her own hobbies & interests have somehow fallen by the wayside long ago. Needless to say, my son thought I was a bit crazy when I told him I wanted to keep those bees that looked so intimidating. He has since gotten very comfortable in his bee suit and the grin that spread across his face when we first cracked open that honey gate and watched that golden blessing flow into the honey bucket was priceless. Now, I bee-lieve we're both a bit crazy about bees. My hope is that one day he will continue as an adult and a father/grandfather to carry on this new family passion.

But the story doesn't end there and probably never will. Because since the bee's arrived on the scene, God has added a husband and a father to our small family. My Husband now has a giddy grin for honey as well and I think perhaps the bees will grow on him as time carries on.

The Lord continues to teach me things through these sweet little messengers, like how to work hard together to build your home and care for each other. That hard work brings sweet rewards in many ways, one of which we were able to reap together this season for the first time. That he provides for our needs. These bees are a gift, a blessing.

Marnie Griggs-King


(l) Marnie Griggs-King and son extract their first honey crop. (r) Father and son extract honey.

VISITING AN ILLINOIS BEE FARM

Recently this year I went to visit the Hart's Honey and Bee farm in Brimfield, Illinois. I brought a camera and photographed some of the bees doing various things. Bees collecting pollen from flowers, and working in the hive. Also I got to see the worker bees working with the queen bee. This was my first time at a bee farm, so it was different, yet intersting.

I got to be up close to the bees and even wear the suits bee farm owners get to wear while working with bees. I got to see how they fogged out the bees and also all the pollen and nectar in the hive. Luckily, the bees were calm and I could get in close to the bees so I could take pictures of them.

Danny and Janet Hart were very kind for letting me visit their farm and photograph and work with their bees. Danny showed me around the places where they made the wonderul honey they sell. He showed me the big container where they heat and filter the honey. He also showed me where they put the new honey, and he even let me try some of the fresh warm honey.

Being at a bee farm is very interesting for me. Being able to see all the work that goes into the making of honey is really cool to see! I also really enjoyed being one of the first people to try some of the fresh honey!

Taylor Buley, age 14

Two photos taken by Taylor Buley while visiting the Hart's Honey & Bee Farm.

WHERE DID YOU BEGIN?

In 1942 when I was a second-year engineering student at Alabama Polytechnic Institute (i.e. Auburn University, AL), I took a course in vegetable gardening as an elective from Prof. C. L. Isbell. He taught me that if you have a vegetable garden or orchard, you can increase your production by 50% if you have honey bee hives in the vicinity.

During the subsequent 30 years of military service an an Army Aviator, I had a garden during most every assignment, usually on rented land. Upon retirement in Enterprise, AL in 1972, I homesteaded on land that made an excellent vegetable garden, orchard and nut trees. I ordered a cage of honey bees and a queen with only the knowledge I read in books. I contacted the county extension agent for assistance in finding me a beekeeper mentor.

I was referred to a commercial beekeeper some 25 miles away at New Brockton, AL in a backwoods location on a gravel road. Mr. Carlos Harper was an elderly gentleman who would answer my beekeeper questions, but wouldn't elaborate. I returned twice more, and the only way I could get his mentoring was to offer myself as an apprentice for three months, free. He agreed to let me work side by side with his crew, teaching me the operation.

The operation included grafting bee larvae in February in a warmed shed, installing queen cells in nuc boxes, removing the mated queens and placing them in queen cages with worker bees.

In outyard apiaries, I learned to shake bees into a funnel and weigh them as they filled the cage, install syrup can, queen cage and take to the post office for shipping. The postmaster wasn't happy to see us, because there were always a few 'hitchhiker' bees, so we had to stack the cages behind the post office awaiting a 5 p.m. postal truck pickup.

Other learning experiences under Mr. Harper were transporting hives long distances, honey robbing methods, extracting honey using an electric uncapping knife, straining honey cappings, melting and forming wax blocks, labeling and bottling honey, and packing it for shipment.

Mr. Harper gave me all of his unused queen cells, which accelerated my becoming an avocation beekeeper, selling bee hives, honey and pollen eventually.

My difficulty in finding a mentor early on, gave me an incentive to mentor beginner beekeepers during my 36 years of beekeeping; I mentor five at this time. In conjunction with my missionary travels, I have taught beekeeping at a Serbia Bee Convention, Bulgaria Apimondia Symposium and a Chinese University Bee Conclave.

Fred Fulton
1919 Green Acres Drive
Montgomery, AL 36106
loveliestvillage@yahoo.com

APIMONDIA CONGRESS TO BE HELD IN ARGENTINA

On behalf of the Argentine Society of Beekeepers, we have great pleasure in inviting you to the 42nd International Apicultural Congress-APIMONDIA 2011, to be held in Buenos Aires, Argentina, from 21-25 September. At this event you will have the opportunity to promote your business, products or services to beekeepers worldwide.

The Congress, jointly organized by APIMONDIA and the Argentine Society of Beekeepers (SADA), will be a very special event for the marketing of your products, indistinct of your field, as it will bring together a large number of beekeepers, not only from Argentina, but also from all Latin America.

The Argentine apicultural industry has a long tradition of fairs and exhibitions. Between 80 to 120 companies attend the annual exhibition to showcase their products and services to the 3,000 to 5,000 attendees who visit each year.

Our country's beekeepers are eager to learn about the products of foreign manufacturers and equally eager to display and promote the products and services of the current Argentine beekeeping industry.

We look forward to welcoming you to Buenos Aires!

Sincerely,
Lucas Martinez
Pres. of the Argentine Society of Beekeepers
Pres. of the 42nd International Apicultural Congress- APIMONDIA 2011
www.apimondia2011.com

Fred Fulton displays a queen cell starter kit.

TECA BEEKEEPING EXCHANGE GROUP FORMS

We are happy to announce the launching of the TECA Exchange Group on Beekeeping, a new joint initiative between the International Federation of Beekeepers[1] Associations (APIMONDIA) and the Food and Agriculture Organization of the United Nations (FAO) to share knowledge and facilitate networking on beekeeping.

WHY A TECA EXCHANGE GROUP ON BEEKEEPING?

Beekeeping is widely practiced in the world as an income-generating activity and for the benefits that bees and their products offer to mankind: pollination, biodiversity, food, medicines, etc.

Research institutions, farmers, projects and other bodies generate technologies to improve beekeeping practices, processing of beekeeping products and its marketing, but this information often remains scattered and does not reach the wide public that could benefit from these improved technologies and best practices.

In order to address this problem and increase the benefits of research and years of improving practices, FAO in collaboration with APIMONDIA has decided to set up a Beekeeping Exchange Group on the TECA Platform, where information and knowledge can be shared, and beekeepers and stakeholders from all over the world can meet to discuss topics related to beekeeping.

WHAT IS TECA?

TECA stands for Technologies for Agriculture and can be accessed via www.fao.org/teca <http://www.fao.org/teca> . It is an online database of technologies that have been tested by farmers in rural areas. TECA responds to the specific information needs of small producers and those providing advisory services to them.

TECA also provides web-based communication tools (also linked to YouTube and other comparable media) to better document, share technologies and customize its use to each user[1]s characteristics. It is interactive, and has a great potential to improve linkages among extension staff, researchers, farmer organizations and other stakeholders involved in agricultural innovation. TECA also gives visibility to small producers for their achievements and technological developments and at the same time allows them to tap this resource to their own benefit and gain further information and knowledge.

TECA EXCHANGE GROUP ON BEEKEEPING

The aim of the TECA Exchange Group on Beekeeping is to provide a forum to share and discuss beekeeping technologies and best practices, focusing particularly on smallholders. Additionally, the Group offers the opportunity to explore areas of common interest that could potentially serve as the basis for the establishment of partnerships.

We invite you to visit the TECA website and join this initiative for enhancing the sharing of knowledge and technology on beekeeping for smallholders. Check out the information on beekeeping already available in the database and/or share your knowledge by uploading training manuals, technologies that have been tested and validated in the field or videos and pictures demonstrating techniques. In order to ensure the quality of the information available on TECA, technologies submitted for uploading will be validated by APIMONDIA's Standing Scientific Commissions before making them available to the Exchange Group.

A brief Exchange Group User Guide and a Guide on how to use TECA can be downloaded from the TECA Website by clicking here <http://www.fao.org/teca/node/4730> . Guides can also be requested by email from the Beekeeping Exchange Group facilitators (TECA-beekeeping@fao.org).

Please feel free to share this letter with your contacts and partners that could be interested in the information available in TECA or in sharing their proven technologies, or just become a member of this new beekeeping community.

Yours sincerely,
Riccardo Jannoni-Sebastianini
Apimondia Secretary-General

HONEY BEES, MAGNETORECEPTION AND CCD

We thank Jerry Hayes for bringing up the subject of magnetoreception by honey bees to your "*Classroom*" readers (Vol. 150, No. 11). Our theory, briefly, is that foragers use that sixth sense for long distance orientation purposes. When a geomagnetic storm occurs, its magnetoreception ability is impaired and their homing capability is disabled, thereby causing them to get lost and disappear (the leading symptom of CCD). Jerry presented arguments against our theory. We would like the opportunity to rebut his opinion that affects of severe geomagnetic storms on a honey bee's orientation capability is untenable.

First, he states: "According to Randy Oliver, 'The hypothesis that this could be the cause of CCD simply doesn't appear to meet Koch's postulates.'" Actually, we agree, but for different reasons… (Oliver assumed CCD is caused by a disease or combination of diseases.) Koch's postulates are criteria designed to establish a causal relationship between *microbes* and *diseases*. Geomagnetic storms do not fit the definition of a microbe; moreover, the resultant disorder to a honey bee's magnetoreception sense is not a disease. Nor is it contagious, as would be a disease. Thus, using this argument against our theory is bogus. Our theory is that colony collapse is a noninfectious disorder.

Second, Hayes' belief that evolution would have "weeded out" honey bee susceptibility to geomagnetic anomalies over the millennia is also flawed. Fossil evidence indicates *Apis mellifera* evolved in tropical regions in the old world, near the equator. Recent DNA evidence indicates *A. mellifera* originated in Africa, also near the equator, millions of years ago. They existed there long enough for their magnetoreception system to adapt to geomagnetic storms that occurred *in that specific geographic region.* Thereafter things changed! After the last ice age, about 14,000 years ago, *A. mellifera* migrated north, eventually to Europe: a moment in evolutionary terms. Approximately 400 years ago, humans introduced honey bees to America: in evolutionary terms, a mere nano-speck of time!

Severity of geomagnetic storms depends on location and latitude. During storm conditions, they can be nearly 10-times more severe in the northern hemisphere than at the equator, where Darwinian evolution made honey bees (*A. mellifera*) what they are. Only recently, *in an evolution time frame*, has a honey bee's magnetoreception sense been exposed to severe geomagnetic storms typical of northern latitudes. *So, bees have <u>not</u> experienced their new geomagnetic "climate" long enough to evolve tolerance to major storms.*

Third, we recognize that the disappearance disorder is not pervasive in that many colonies survive after a major geomagnetic storm occurs. Obviously, *innate variation is essential for there to be evolution by natural selection to begin with: it is the hallmark of Darwinian Evolution*. This phenomenon explains why some colonies (variants) are affected and others are not, even while located in the same or adjacent apiaries, a situation that often perplexes beekeepers and experts. Evidence indicates that CCD incidents and major geomagnetic storms are correlated. Also, as storm durations increase, their impact on colony losses diminishes. In other words, some colonies must be resistant to a storm's impact, which lends support to our argument that variation exists between colonies and evolution is taking control.

Finally, electromagnetic fields generated by power lines have no motion relative to Earth, and its strength diminishes rapidly with distance. Such fields are miniscule compared to Earth's massive geomagnetic field which, during a major geomagnetic storm, fluctuates radically. It is the severe fluctuations that impair the magnetoreception sense.

In conclusion, the epidemiology of CCD fits nicely with the occurrence of geomagnetic storms, a forager's magnetoreception sense and honey bee behavior.

Dr Thoms Ferrari
Pollen Bank
Bakersfield, CA

TOGETHER for a SWEET FUTURE

NORTH AMERICAN BEEKEEPING CONFERENCE & TRADESHOW

January 4-8, 2011 ▪ The San Luis Resort ▪ Galveston, Texas

Come **"Together for a Sweet Future"** and join 1,200 of your closest beekeeping friends at the 2011 North American Beekeeping Conference and Tradeshow. The conference will be held January 4-8, 2011, on Galveston Island in Texas and promises to be one you won't want to miss.

Features of the conference include:

- Joint participation from the American Beekeeping Federation, the American Honey Producers Association and the Canadian Honey Council
- The American Bee Research Conference
- The Serious Sideliner Symposium
- The largest beekeeping tradeshow, full of the latest beekeeping innovations
- The 2011 American Honey Show
- Optional activities perfect for networking and socializing with fellow beekeepers and industry experts
- Something for everyone, from the new hobbyist to the seasoned professional

Conference Location:

The San Luis Resort
5222 Seawall Boulevard
Galveston Island, TX 77551
www.sanluisresort.com

The San Luis Resort consists of the Galveston Island Convention Center (where the tradeshow and all meetings will be held), the Hilton, the San Luis Resort and the Holiday Inn. Room rates range from $89 – $99 depending on which hotel you select.

2010 Registration Rates

Category	Advanced	On-Site
Single Person (Member)	$275.00	$325.00
Single Person (Non-Member)	$325.00	$375.00
Family (Member)	$375.00	$425.00
Family (Non-Member)	$425.00	$475.00
One-Day/One Person (Member)	$175.00	$225.00
One-Day/One Person (Non-Member)	$225.00	$275.00
One-Day/Family (Member)	$275.00	$325.00
One-Day/Family (Non-Member)	$325.00	$375.00

Non-member rates include a one-year membership to either ABF or AHPA.

Tentative Schedule: (subject to change)

Tuesday, January 4:
Morning/Afternoon: Board and Committee Meetings
Evening: Welcome Reception (complimentary to all registered attendees)

Wednesday, January 5:
Morning: Opening General Session
Noon: Tradeshow Opens
Afternoon: Shared Interest Group Meetings; Honey Show Judging
Evening: Honey Queen Reception & Quiz Bowl

Thursday, January 6:
Morning: Ladies Auxiliary Breakfast/Meeting
All Day: General Session; Serious Sideliner Symposium; American Bee Research Conference; Tradeshow
Evening: "Murder by Honey" Dinner Show (optional)

Friday, January 7:
All Day: General Session; Serious Sideliner Symposium; American Bee Research Conference; Tradeshow; Business Seminar
Evening: AHPA Annual Banquet

Saturday, January 8:
Morning: Interactive Workshops; Tradeshow
Afternoon: Business Meetings
Evening: ABF/CHC Annual Banquet

Sunday, January 9:
Mid-Morning: "The Hive" Beekeepers Social (optional)

For additional information and to register for the conference, please visit www.nabeekeepingconference.com

News Notes

AFRICANIZED HONEY BEES FOUND IN GEORGIA

Courtesy of the
Georgia Department of Agriculture
Tommy Irvin, Commissioner

Entomological tests have confirmed that Africanized honey bees were responsible for the death of an elderly man in Dougherty County in September. News reports say the man accidentally disturbed a feral colony of bees with his bulldozer and that he received more than 100 stings.

"This is the first record of Africanized honey bees in Georgia," said Agriculture Commissioner Tommy Irvin.

Africanized honey bees are a hybrid of African and European honey bees. Because of their extremely defensive nature regarding their nest (also referred to as a colony or hive), they are sometimes called "killer bees." Large numbers of them sometimes sting people or livestock with little provocation.

The Africanized honey bee and the familiar European honey bee (Georgia's state insect) look the same and their behavior is similar in some respects. Each bee can sting only once, and there is no difference between Africanized honey bee venom and that of a European honey bee. However, Africanized honey bees are less predictable and more defensive than European honey bees. They are more likely to defend a wider area around their nest and respond faster and in greater numbers than European honeybees.

Africanized honey bees first appeared in the U.S. in Texas in 1990. Since then they have spread to New Mexico, Arizona, California, Nevada, Utah, Oklahoma, Arkansas, Louisiana, Florida and now Georgia. Entomologists and beekeepers have been expecting the arrival of these bees in Georgia for several years. There has been an established breeding population in Florida since 2005.

Because Africanized honey bees look almost identical to European honey bees, the bees from the Dougherty County incident had to be tested to accurately ascertain they were the Africanized strain. The Georgia Department of Agriculture sent samples of the bees to the Florida Department of Agriculture and Consumer Services which has the capability to do FABIS (fast African bee identification system) testing and the U.S. Department of Agriculture identification test (the complete morphometrics test) to confirm the bees' identity.

"Georgia beekeepers are our first and best line of defense against these invaders. They are the ones who will be able to monitor and detect any changes in bee activity," said Commissioner Irvin.

"The Georgia Department of Agriculture is going to continue its trapping and monitoring of bee swarms to try to find where any Africanized honey bees are," said Commissioner Irvin. "We also want to educate people about what to do in case they encounter a colony of Africanized honey bees. Georgians can visit our website for more information. The University of Georgia Cooperative Extension Service has a publication on Africanized honey bees that is available online (http://pubsadmin.caes.uga.edu/files/pdf/B%201290_2.PDF) or at Extension offices."

CANADIAN ASSOCIATION OF PROFESSIONAL APICULTURISTS STATEMENT ON HONEY BEE LOSSES IN CANADA (2010)

Over the winter of 2009-10, losses in Canadian beekeeping were 21 percent of the number of colonies that were wintered. Though this represents 1.4x the long-term winter loss rate for Canada, this is a substantial improvement over the previous three-year period during which losses averaged 32.6%.

General Trends

In the years subsequent to the introduction of the ectoparasitic mite Varroa destructor into Canada, normal long-term overwintering mortality has been considered to be 15%. During the winter of 2009-10, mortality due to wintering losses and spring dwindling was 21.0%, or 1.4x the normal rate. This loss is substantially less than the 2008-09 mortality figure of 33.9% and is also less than rates of 35.0% and 29.0% recorded, respectively, for the winters of 2007-08 and 2006-07. Though encouraging, it is too early to determine whether this decline in mortality constitutes a sustained improvement in colony health.

Compared with the previous three years, mortality across regions has been less variable and generally lower. Extension professionals in Canada attribute the improvement in colony losses, in part, to the availability of a new Varroa mite control product, Apivar®, which contains the active ingredient Amitraz. This product was made available to beekeepers under emergency use registration (EUR) for the fall of 2010. Effective use of existing mite control products, such as those containing formic or oxalic acid, also contributed to improved mite control in 2009-10.

Additional factors that contributed to increases in colony survival in 2010 were enhanced sampling and control for the honey bee internal parasite *Nosema ceranae* as well as greater intensity of monitoring for other pests and diseases in major beekeeping areas.

Losses on Vancouver Island

Though overall losses in Canada im-

Table 1. Gross Losses by Province, Winter 2009-2010, Canada

Province	Number of Colonies Wintered	Number of Dead or Unproductive Colonies[1]	Wintering Losses (% of Provincial Total)
British Columbia*	41,108	9,882	24.0
Alberta	250,762	43,883	17.5†
Saskatchewan	90,000	18,450	20.5
Manitoba*	78,000	19,968	25.6
Ontario	81,200	17,523	21.6
Quebec*	39,182	8,346	21.3
New Brunswick*	8,800	1,795	20.4
Nova Scotia*	19,000	7,961	41.9
PEI*	3,920	655†	16.7‡
CANADA	**611,972**	**128,463**	**21.0% (of National Total)**

1 Dead and commercially unproductive colonies as of 1 May 2010. Figure calculated from provincial loss rates (derived from survey data) and total colonies put into winter.
*** Denotes participation of province in National Harmonized Survey and their ability to share comprehensive data for analysis.**
† Based on surveys of producers in Alberta with 400 or more colonies.
‡ Wintering losses and number of dead colonies from PEI calculated as of 15 April 2010, as insufficient data available for calculation of losses on 1 May 2010.

proved in 2009-10, one notable exception was Vancouver Island, BC where exceptional mortality was recorded. Based on responses to provincial surveys, 69% of all colonies were lost by 15 April 2010, while the loss rate for commercially viable colonies by 1 May was 76%. Some producers sustained total loss.

Beekeepers on Vancouver Island observed that population declines occurred early, starting in the fall after colonies were prepared for winter with much of the mortality taking place by mid-December.

Based on reports from extension professionals in British Columbia, the majority of producers relied on Apistan (fluvalinate) for their Varroa mite control in the fall. Very few had ever used CheckMite+® (coumaphos) and none used Apivar® (Amitraz). Most also used formic acid treatments (as an alternative treatment in the spring) while others also applied oxalic acid. Generally, follow-up checks for mite levels after treatments were not performed and resistance to fluvalinate, widespread in mainland regions of the province, is suspected.

Nosema spp. are not thought to have played a significant role in Vancouver Island losses as most producers treated with the drug fumagillin. In addition, adult bee samples submitted to BC Ministry of Agriculture and Lands laboratories had low or negligible levels of Nosema spores. For those honey bee viruses monitored in BC (IAPV, KBV), detections have occurred in previous years from Vancouver Island beekeeping operations.

Though no clear answers appear to exist for losses in this region, the efficacy of Varroa mite treatments, the susceptibility of locally-selected stock to mites and the lack of rotational replacement (or disinfection) of beekeeping equipment are all factors being examined as possible causes of high losses in this region.

Is CCD in Canada?

The symptoms by which CCD is being characterized in the U.S. have not been routinely diagnosed by professional apiculturists in Canada. Though Canadian bees do not seem to be experiencing classic CCD-like symptoms, it is important to emphasize that higher levels of wintering and spring mortality in Canada may be related to the same casual factors as CCD losses in the U.S. Because longer winter conditions preclude the active brooding and flying of colonies found in early-season pollination areas of the U.S., colonies in Canada may not exhibit similar colony-level symptoms. Instead, it is conceivable that Canadian producers may simply see these effects as higher numbers of dead colonies following winter or those described as dwindling during early spring.

Most scientists in the U.S. and Canada would agree that what is being described as CCD in the U.S. and the high winter losses seen in Canada are likely being caused by several common interacting stress factors acting on honey bee colonies. Researchers in both countries are examining similar root causes of these stresses and their effects on bees.

What is being done in Canada?

Researchers in Canada remain in close contact with principal scientists participating in U.S. Working Groups on CCD. Members of CAPA have also been actively monitoring the status of bee health across the country and are sharing scientific information.

In 2009, the Canadian Pollination Initiative (CANPOLIN) was launched to address the growing problem of pollinator decline in agricultural and natural ecosystems in Canada. This initiative, funded as a five-year NSERC Strategic Network, includes researchers at 26 universities across the country that are working with government agencies, NGO's and industry to deliver critical insights and sustainable solutions to the pollination problem. The Scientific Director of CANPOLIN is CAPA member, Dr. Peter Kevan, of the University of Guelph. Other CAPA researchers comprise key working groups including those on managed pollinators. Refer to the CANPOLIN website for current information: http://www.uoguelph.ca/canpolin/

Work toward understanding the impact of *N. ceranae* in Canada also continues. Based on efforts in 2007 and 2008, it was initially determined that the parasite was present in all Canadian provinces, with *N. ceranae* and *N. apis* found in approximately similar proportions. This is in sharp contrast to the U.S. where *N. apis* is now seldom found in samples. Changes in the distribution and prevalence of these species will continue to be monitored.

The impact of *N. ceranae* on honey bees is not well understood and it is likely a factor in the survival of colonies already under multiple stresses. Currently, CAPA members employed by federal and provincial governments, as well those in Canadian universities, are undertaking research projects to better understand this parasite. Aims include determining the seasonal occurrence of *N. ceranae* in Canada, developing strategies for effectively managing this parasite, as well as evaluating the use of novel therapeutic agents. Current indications suggest that *N. ceranae* is susceptible to fumagillin, the only registered therapeutic agent against *N. apis*. Nevertheless, much work is needed to determine best management practices to control this organism.

Researchers within CAPA are also evaluating alternative control options for Varroa mites, methods of integrated pest management (IPM) for honey bee colonies and the breeding of honey bee queen stock more tolerant of diseases and mites. Members of CAPA, in cooperation with the Canadian Honey Council, are also pursuing the registration of alternative products for Varroa control in Canada. (CAPA News Release)

NOTED BEE EXPERTS ACCEPTS DUAL APPOINTMENT: UC DAVIS AND WSU

DAVIS, CA---Noted bee breeder-geneticist Susan Cobey of the Harry H. Laidlaw Jr. Honey Bee Research Facility at the University of California, Davis, has collaborated for several years with scientists at Washington State University; now she is dividing her time between the two honey bee research facilities.

Cobey recently accepted a dual appointment—50 percent as a WSU honey bee research extension associate and 50 percent as a UC Davis staff research associate—to continue her work on enhancing domestic honey bee breeding stock and improving colony health. Her WSU appointment is based in western Washington at the Mt. Vernon Research Station.

"The overall goal is to improve colony health to supply the critical and demanding need for pollination of the nation's agricultural crops," she said.

Cobey, who joined UC Davis in May 2007, will continue teaching her spring classes at UC Davis on queen bee rearing and instrument insemination. (See http://entomology.ucdavis.edu/courses/beeclasses/index.html) Her classes draw students from throughout the world.

"A major focus of my dual appointment is to expand the collaborative effort to enhance our domestic honey bee breeding stocks through the incorporation of germplasm collected from bees around the world," Cobey said. "Genetic diversity is critical to maintain healthy honey bee populations."

European colonists brought the honey bee (*Apis mellifera*) to what is now the United States in the 1600s. "Importation was banned in 1922 to avoid the tracheal mite," Cobey related. "To avoid the introduction of tracheal mites, a small founder bee population was established before the importation ban in 1922. This small subset of a few subspecies from limited importations represents a genetic bottleneck. This is an increasing concern with the continuing high losses of colonies due to parasitic mites, the plague of new pathogens and the phenomena of colony collapse disorder."

Cobey has collaborated since 2007 with apiculturist Steve Sheppard, professor and chair of the WSU Department of Entomology, in an ongoing honey bee stock improvement project between the two universities.

WSU holds the APHIS-USDA (Animal and Plant Health Inspection Service) quarantine in an ecological reserve isolated by a sea of wheat. "This is where we are introducing, observing and testing the colonies resulting from the semen importations," Cobey said. "We have brought in *Apis mellifera carnica* stock from Germany, *Apis mellifera ligustica* from Italy, and most recently *Apis mellifera caucasica* from the Republic of Georgia." Carniolans and Cau-

Susan Cobey with a frame of bees at the Harry H. Laidlaw Honey Bee Research Facility, UC Davis. (Photo by Kathy Keatley Garvey)

casians are dark races of bees. The Italian bee (*Apis mellifera liguistica*) is the most prevalent bee in the United States. This effort also includes research into developing protocols for the safe importation of germplasm and the development of cryopreservation techniques for long term storage.

Dividing her time between the two universities, Cobey said, will provide several advantages. "I can enjoy the early spring season in California and then head north to follow the season in Washington state. Queen rearing in California usually can be started in late February. By June, the summer heat and dearth make this more difficult, especially in maintaining a large pool of drones for mating. Spring in Washington kicks in by May, so this is prime queen-rearing season in the Pacific Northwest." Working in both California and the Pacific Northwest will allow the evaluation and selection of stocks in different climates. "This will also provide reservoirs of stock in different places to spread the risk of losing valuable lines."

The wet, cold winter in Washington, she said, is a more rigorous place to select for wintering ability, especially for the dark races of bees, Carniolans and Caucasians "We hope to reestablish *Apis mellifera caucasica* in the Pacific Northwest as the climate is similar to its native home. Only traces of this race currently can be found in the United States."

California is home to the major queen producers responsible for re-stocking colonies nationwide. "Therefore, I will continue to work with this critical segment of the industry," Cobey said. "I'm also looking forward to working with the Pacific Northwest beekeepers, many of whom supply colonies for California almond pollination, which usually begins early February." In addition to teaching spring classes on queen rearing and instrumental insemination at the Laidlaw honey bee lab, Cobey anticipates offering these classes in Washington in the near future. "There is a lot of interest, especially in queen rearing in the north, despite the short season," she said. Cobey will be working closely with beekeepers in both areas:

-- In Washington and other states in the Pacific Northwest, she will provide information and conduct training sessions to assist beekeepers in maintaining healthy colonies for pollination.

-- In California, she will develop programs to enhance the ability of the California bee breeders to select and maintain breeding stock to supply industry demand. Her duties also include developing information and outreach programs to assist beekeepers in honey bee-breeding methods.

Her husband, Tim Lawrence, formerly of UC Davis, was selected the new director of WSU's Island County Extension in May. Earlier, he worked seven months as a research associate in WSU's Honey Bee Health Program. The couple lives in Island County.

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OLD BEES' MEMORY FADES; MIRRORS RECALL OF MAMMALS

Old bees have trouble finding their way to new homes, as learning behavior become inflexible with age.

A study published Oct. 19 in the open access journal Public Library of Science (PLoS) ONE, shows that not just human memories fade. Scientists from Arizona State University and the Norwegian University of Life Sciences examined how aging impacts the ability of honey bees to find their way home.

While bees are typically impressive navigators, able to wend their way home through complex landscapes after visits to flowers far removed from their nests, the study reveals that aging impairs the bees' ability to extinguish the memory of an unsuitable nest site, even after the colony has settled in a new home.

"From previous studies, we knew that old bees are characterized by poor learning when trained to floral odors in the laboratory," says Gro Amdam, an associate professor in the School of Life Sciences in ASU's College of Liberal Arts and Sciences. "So, we wanted to test whether aging also affects learning behavior that is important for a bee's survival in the wild."

A bee is very well-trained as a forager after three to four days of flight time, Amdam says. Whereas mature bees have piloted their way to and from the hive for five to 11 days and old bees have had more than two weeks of flight time.

To test how old bees adapt to a changed home location, researchers trained bees to a new nest box while their former nest was closed off. Groups composed of mature and old bees were given several days in which to learn the new home location and to extinguish the bees' memory of their unusable former nest box.

The scientists then disassembled the bees' new home and forced groups of mixed-age bees to choose between three alternative nest locations, including the former nest box. Old bees with symptoms of senescence preferentially oriented toward the former nest site, despite the experience that should have told them that it was unusable.

"Although many old bees fail in learning tasks, we also discovered that a few still perform with excellence," explains Daniel Münch, lead author of the study and a senior life sciences researcher in Norway.

The scientists believe that their findings with bees offer a new means to model and understand the variability found in brain function between individuals; where some individuals' memories remain intact, while others' learning behavior becomes inflexible with age.

$1.4 MILLION GRANT TO FUND RESEARCH ON ALTERNATIVE POLLINATORS

University Park, Pa. -- Fruits and nuts are high-value crops in the Mid-Atlantic states and are being heavily impacted by honeybee shortages for pollination. A new $1.4 million grant from the USDA NIFA Specialty Crops Research Initiative (SCRI) program to Penn State will look into future impacts on fruit pollination and the development of alternative pollinators to supplement honeybees.

According to David Biddinger, tree fruit entomologist and biocontrol specialist at Penn State's Fruit Research and Extension Center and project co-director, the situation is becoming critical. "We already know the supply of honey bees in the U.S. will not be able to meet the demand for pollination services in the near future," he explained. "We also know that the production costs for apiculturists will go up, and that the cost to fruit growers to rent honey bee hives for pollination has increased three-fold since 2006 and will continue to increase. Alternative pollinators such as native wild bees are greatly needed."

The new project will establish surveys and a monitoring program to identify the importance of wild pollinators to agricultural pollination, assess bee species collected during survey work to determine if any pathogen or other invasive species has infected the population, develop new pollinators and enhance pollinator awareness through education efforts.

According to Biddinger, native bees play an important role in the pollination of fruits and vegetable crops in the Mid-Atlantic region and have probably been underestimated. "In a recent study, almost 50 species of native bees were shown to be key crop pollinators of several vegetable crops and were fully able to pollinate some of these crops without aid of honey bees on the majority of the Pennsylvania and New Jersey farms evaluated." In addition, a two-year survey of 12 Pennsylvania apple orchards conducted by Biddinger found more than 120 species of bees. He found that while honey bee numbers had decreased by 10-fold since 1997, wild bee numbers had increased an average of three to five-fold.

"Native bee pollination hasn't really been studied in the Mid-Atlantic, so we don't know what bee species are here and what fauna we have to conserve. This will be one of the first steps in the project," Biddinger said. Project investigators also plan on examining threats to native pollinators, such as viruses that have affected honey bee populations and pesticides.

The project also will examine the management of key species of wild bees for use in agriculture. "We have fresh market apple growers who have relied upon native pollinators for fruit pollination for over ten years without noticeable loss in yield or quality, but we need to verify this through measurement of yield, fruit set, fruit size and fruit quality in comparison to orchards using recommended rates of honey bees for pollination," Biddinger explained. Native bee populations can vary widely from season to season, so these measurements need to be repeated over several seasons to determine reliability. Native bees, including bumble bees, greatly rely on adjacent woodlots and fencerows for nesting sites and supplemental food after apple bloom. Most native bees don't fly nearly as far as honey bees, so determining the foraging ranges of key bee species will be important in providing reliable pollination of crops. Guidelines for pollinator-friendly land practices also will be developed, including land management practices that avoid harming bees, how to provide habitat for native bees on and around the farm, and guidelines for pesticide use to preserve wild bee populations.

Another goal of the project is to increase the awareness of wild bee pollinators by the public and the agricultural community. "What we learn from pollinator restoration demonstrations, the information assembled from past research on native bee habitat and crop pollination, and our years of experience working on pollinator conservation in agricultural landscapes will be presented to farmers/land managers in a practical way they can use to conserve pollinators on their lands," Biddinger explained. "We will conduct workshops, farm walks, and seminars to farmers and staff from farm-related agencies and develop audience-specific educational materials."

Other collaborators on the project include researchers from Penn State, the Pennsylvania Department of Agriculture, the Xerces Society, Long Island University, the US Department of Agriculture NRCS and the US Department of the Interior (USGS). For more information on bees and other pollinators, visit Penn State's Center for Pollinator Research at http://ento.psu.edu/pollinators.

UC DAVIS NATIVE POLLINATOR SPECIALIST RECEIVES USDA GRANT AIMED AT IMPROVING POLLINATOR HABITAT PLANTINGS NATIONWIDE

DAVIS,CA--Native pollinator specialist Neal Williams, assistant professor of entomology at the University of California, Davis, has received a three-year federally funded research grant aimed at improving pollinator habitat plantings in nationwide agricultural settings.

The $343,884 grant, from the U.S. Department of Agriculture, target projects in three states where crops dependent on insect pollination are concentrated: California, Michigan and New Jersey. The fourth site component is inter-regional research coordinated by the Xerces Society for Insect Conservation, based in Portland, OR.

“Recent declines in honey bee populations and the threat of losses in pollination service to economically important crops has raised awareness of the importance of restoring and conserving native bee diversity and abundance,” Williams said. The economic value of insect-pollinated crops in the United States was estimated at $18.9 billion in 2000.

“We will be developing simplified assessment tools that will allow land stewards to evaluate the cost-effectiveness of future habitat restorations,” Williams said.

The grant, "Development and Validation of Protocols for Assessing Functioning of Pollinator Habitat Plantings for Agricultural Settings,” is closely linked with the USDA's Natural Resources Conservation Services (NRCS) commitment to enroll acreage in its pollinator restoration programs. A key priority of NRCS is to enhance pollinator habitat in agricultural landscapes to promote both managed and wild bees.

The success of NRCS investment in these programs “will depend on the effectiveness of pollinator habitat restorations in supporting native pollination populations and enhancing other beneficial insects, while avoiding the augmentation of pest insects,” Williams said. The team directed by Williams will evaluate shifts in insect populations resulting from restoration practices and establish protocols for insect monitoring data that other practitioners can easily employ. This may encourage farmers to enroll in pollinator planting programs, especially if the sites don’t attract insect pests.

The specific goals:

1. To quantify the effects of pollinator habitat enhancements on populations of pollinators, other beneficial insects and pests
2. To identify the value of individual plant

species and overall level of floral resources required to support pollinators and other desirable insects
3. To develop streamlined monitoring protocols that will enable practitioners to assess success in future pollinator habitat restorations
4. To provide technical notes, trainings and websites that foster implementation of these simplified technical guidelines.

The three-year grant, effective Oct. 1 through Sept. 30, 2013, follows the passage of the 2008 Farm Bill, which identifies pollinators as a priority resource of concern. Honey bees are beset by parasitic mites, diseases, the mysterious colony collapse disorder and other problems. Habitat loss, disease, parasites, pesticide use and agricultural intensification threaten native bees.

Williams said native bees can provide insurance in the face of honey bee declines. Already native bees provide significant pollination services to crops such as watermelon. Research by entomologist Rachael Winfree of Rutgers shows that native bees are capable of "fully pollinating 90 percent of watermelon on farms in central New Jersey and east-central Pennsylvania," Williams said. (Courtesy Kathy Keatley Garvey, Communications Specialist, Dept. of Entomology, UC-Davis)

CAN YOU 'BEE-LIEVE' THESE PIN-UP GIRLS?

Miss January, Miss May, Miss August and Miss December aren't like their counterparts gracing other calendars. First, they never gave their consent. Second, only a few have social skills because most are solitary. Third, they have three body parts: head, thorax and abdomen. And, fourth, none of these pin-ups will ever run for Miss America or promote world peace.

These pin-ups are North American bees and the calendar is appropriately titled the "North American Bee Calendar." Miss January is a honey bee; Miss May, a sweat bee; Miss August, a squash bee; and Miss December, a cuckoo bee.

"It's our second annual calendar, a project aimed at protecting pollinators, raising public awareness and generating funds to carry on the work of The Great Sunflower Project and the Xerces Society for Invertebrate Conservation," said native bee enthusiast and calendar project coordinator Celeste Ets-Hokin of the San Francisco Bay Area. "Most of these bees are commonly found and important pollinators."

The calendar, measuring 9x12, features close-up photos by noted insect photographer Rollin Coville, who received his doctorate in entomology from UC Berkeley. He has been photographing insects--and spiders--for more than 25 years.

The calendar spotlights a different bee genus each month, with notes on preferred plants, nesting needs, and guidance on how to identify the genus, said author Ets-Hokin, who holds a degree in zoology from UC Berkeley.

Bees appearing in the calendar and the scientific names are:

January: Honey Bee (*Apis*)
February: Bumble Bee (*Bombus*)
March: Digger Bee (*Habropoda*)
April: Mason Bee (*Osmia*)
May: Sweat Bee (*Lasioglossum*)
June: Utra Green Sweat Bee (*Agapostemon*)
July: Leafcutter Bee (*Megachile*)
August: Squash Bee (*Peponapis*)
September: Long-horn Bee (*Melissodes*)
October: Carder Bee (*Anthidium*)
November: Carpenter Bee (*Xylocopa*)
December: Cuckoo Bee (*Epeolus*)

Matthew Shepherd, senior conservation associate of the Xerces Society, and Ets-Hokin served as editors, and Miguel Barbosa as the graphic designer. Five scientists shared their research expertise: Neal Williams of UC Davis; Gordon Frankie and Claire Kremen of UC Berkeley; and Rachael Winfree of Rutgers University, New Brunswick, N.J. In addition, Shepherd and Ets-Hokin, along with Kathy Keatley Garvey of the UC Davis Department of Entomology, contributed photos.

Calendars are $15 each, which includes shipping anywhere in the United States. The international price is $18, shipping included. The deadline to submit all orders is Tuesday, Nov. 30. Calendars will arrive by early December. Orders may be placed by accessing the Xerces website at http://www.xerces.org/calendar/ or The Great Sunflower Project website at http://www.greatsunflower.org/product/2011calendar. The calendar can be previewed at http://www.xerces.org/wp-content/uploads/2010/09/reduced-calendar-preview.pdf.

For more information or discount rates for 25 calendars or more, contact Ets-Hokin at celeste.ets@comcast.net.

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This is the cover of the 2011 North American Bee Calendar, a project headed by native bee enthusiast Celeste Ets-Hokin and featuring the work of noted insect photographer Rollin Coville. Proceeds will benefit the Xerces Society for Invertebrate Conservation and the Great Sunflower Project. Coville has a doctorate in entomology from UC Berkeley and Ets-Hokin has a bachelor's degree in zoology from UC Berkeley.

HONEY BEE HOBBYIST

A New Book About the Care and keeping of Bees

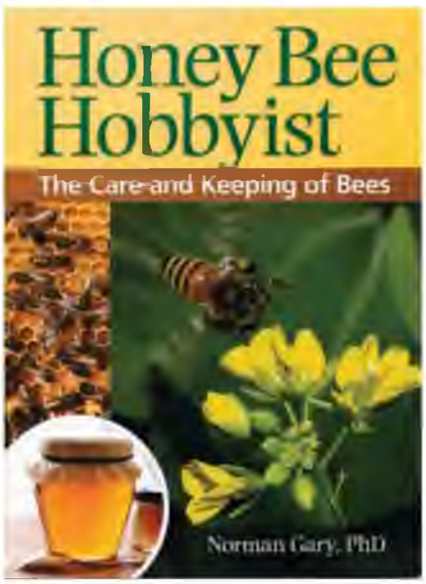
From time immemorial, honey has filled countless needs for mankind. Even the work honey tantalizes and titillates the senses. Great minds from Virgil to Martha Stewart have sung its praises. And now, Honey Bee Hobbyist: The Care and Keeping of Bees shows readers that they don't have to be a scholar or domestic goddess to start their own hives, produce their own honey and reap the benefits of honey's organic goodness

Virgil (and Martha for that matter) would be proud to know that nowadays, areas as urban as downtown Manhattan are becoming lands of honey—thanks to the increasing popularity of beekeeping as a hobby. This colorful book takes readers from the environmental impact (positive) of setting up a hive to the likelihood of stings (low when handled correctly) to the basics of setting up the first hive (easy). Author and esteemed apiarist Norman Gary even dedicates a few pages to "fun things to do wth bees" - quite the concept coming from the man who holds the Guinness World Record for Most Bees in Your Mouth (which, incidentally, does not show up in his list of suggested activities for beekeepers).

The book is a start-to-finish primer for aspiring and experienced beekeepers alike on how to start, maintain and expand your hives. It addresses each stage of the hive's lifecycle, troubleshoots common beekeeping problems and explains how to start your new hobby without bothering the neighbors. Engaging full-color photography invites even the most skeptical to look at bees as beautiful rather than frightening.

Book At a Glance
Title: Honey Bee Hobbyist
Author: Norman Gary, PhD
Price: $16.95
Publisher: BowTie Press, www.bowtieinc.com
Format: Paperback
Illustrations: 75+ full-color photographs
Pages: 144
ISBN-13: 978-1-933958-94-1
Pub Date: November 2010
Distributed: Baker & Taylor

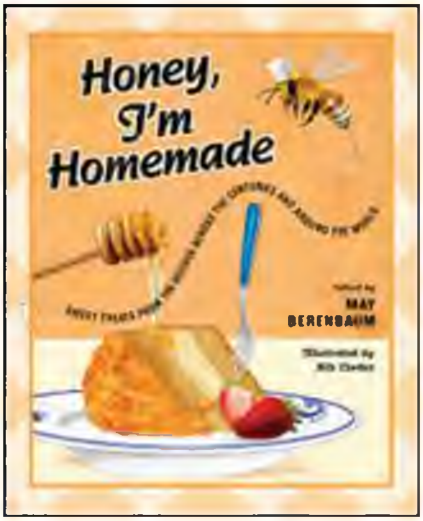
Author Norman Gary, PhD, has over six decades of experience in beekeeping. He has a PhD in Apiculture from Cornell University and had authored more than 100 publications for beekeeping trade journals. Dr. Gary has served as a deputy apiary inspector, wrangled bees for Hollywood blockbusters and served as a honey bee research scientist and entomology professor at the University of California, Davis. His unique perspective and lifelong passion for bees infuses every page with both enthusiasm and common-sense advice.



HONEY, I'M HOMEMADE

Sweet Treats from the Beehive Across the Centuries and Around the World

Author: Edited by May Berenbaum
Editor/Other: Illustrated by Nils Cordes



Honey, I'm Homemade: Sweet Treats from the Beehive across the Centuries and around the World showcases a wealth of recipes for cookies, breads, pies, puddings, and cakes that feature honey as an essential ingredient. Noted entomologist May Berenbaum also details the fascinating history of honey harvesting and consumption around the world, explains the honey bee's extraordinary capacity to process nectar into concentrated sweetness, and marvels at honey's diverse flavors and health benefits.

Honey is a unique food because of its power to evoke a particular time and place. Every time it is collected from a hive, honey takes on the nuanced flavors of a particular set of flowers--clover, orange blossoms, buckwheat, or others--at a certain point in time processed and stored by a particular group of bees. Honey is not just a snapshot of a time and place--it's the taste of a time and place, and it lends its flavors to the delectable baked goods and other treats found here.

More than a cookbook, Honey, I'm Homemade is a tribute to the remarkable work of *Apis mellifera*, the humble honey bee whose pollination services allow three-quarters of all flowering plant species to reproduce and flourish. Sales of the book will benefit the University of Illinois Pollinatarium--the first freestanding science outreach center in the nation devoted to flowering plants and their pollinators.

Because so much depends on honey bees, and because people have benefited from their labors for millennia, *Honey, I'm Homemade* is the perfect way to share and celebrate honey's sweetness and delight.

May Berenbaum is Swanlund Professor of Entomology at the University of Illinois at Urbana-Champaign. She is a Fellow of the American Academy of Arts and a member of the National Academy of Sciences. Her other books include *Ninety-Nine Gnats, Nits, and Nibblers; Ninety-Nine More Maggots, Mites, and Munchers; Bugs in the System: Insects and Their Impact on Human Affairs; Buzzwords: A Scientist Muses on Sex, Bugs, and Rock 'n' Roll; and The Earwig's Tail: A Modern Bestiary of Multi-legged Legends.*

Price: $21.95
Paper: 978-0-252-07744-9
Pages: 184 pages
Dimensions: 6.5 x 8 in.
Illustrations: 10 line drawings
www.press.uillinois.edu

HONEY BEES GAIN AN UNLIKELY ALLY: HACKERS AND GEEKS

Roswell, Georgia – September 12, 2010 – The honey bee has been fighting for its survival for the last 30 years. At risk is a third of the foods we eat that depend on bee pollination. "The honey bee's environment and pathogens have changed dramatically in the last 30 years but the practice of beekeeping has remained unchanged for more than 100 years," says Tom Rearick, a Roswell, Georgia beekeeper, engineer, and serial entrepreneur. "To save the honey bee, we need a better understanding of what is going on inside of the bee hive – and that requires the development of new technologies." So that is exactly what Tom Rearick – aka BeeHacker – has done and he has published his inventions on a new website at www.beehacker.com.

The site documents ongoing projects based on Arduino microcontrollers, acoustic analysis of bee sounds using open source software, biological control using beneficial nematodes, and a novel portable hive scale that anyone can build for $50 based on a hacked digital luggage scale. Using this hive scale, a beekeeper can track the weight of multiple hives to determine nectar flows, swarm events, and to predict winter starvation – one of the leading causes of hive death.

"There are a lot of creative and intelligent people out there that love to hack and build things. If they understood how fascinating the honey bee was and how fertile an area for innovation this is, then we might double or triple the creative talent currently focused on saving the honey bee, " says the site's creator, "the beneficiaries are everyone that enjoys apples, almonds, strawberries, melons, or hundreds of other foods that depend on pollination by bees."

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HONEY BEES AND BEEKEEPING: A YEAR IN THE LIFE OF AN APIARY

The public television documentary, *Honey Bees and Beekeeping: A Year in the Life of an Apiary* is now online at http://www.extension.org/. Presented with permission of the University of Georgia Center for Continuing Education, this classic TV series by Keith Delaplane and the University of Georgia walks the viewer through the establishment of 10 new hives and a year of management. This basic management information is invaluable for the new beekeeper and a real resource for experienced beekeepers to utilize and share with others. Topics covered range from installing packages and the health of colonies, to more advanced topics like queen rearing and migratory beekeeping. Roughly 4 hrs. of instruction is presented in an enjoyable format. Organized in chapters on the Bee Health website, the videos are embedded from the Bee Health YouTube channel at http://www.youtube.com/beehealth. To purchase the complete "Honey Bee and Beekeeping" television series on DVD or acompanying book please call the University of Georgia Center for Continuing Education at 1-800-359-4040.

TOGETHER FOR A SWEET FUTURE

2011 North American Beekeeping Conference & Tradeshow

The 2011 North American Beekeeping Conference & Tradeshow is right around the corner and the excitement is building. A joint effort of the American Beekeeping Federation (ABF), the American Honey Producers Association (AHPA) and the Canadian Honey Council (CHC), this conference is sure to be the largest beekeeping event in the United States – beekeepers at all levels and from all over North America and beyond will gather to share ideas and develop new contacts.

Please plan to join us in Galveston, Texas, Jan. 4-8, 2011, for what promises to be an amazing event. The conference will be held at the San Luis Resort located right on the Gulf of Mexico. The San Luis Resort consists of four properties: The Galveston Convention Center (where most conference activities will occur), the Hilton, The San Luis Hotel and the Holiday Inn. Rooms have been blocked at all three hotels, as we anticipate attendance to exceed 1,200 beekeepers.

The conference will begin on Tuesday evening with a complimentary Welcome Reception. All registered attendees are invited and encouraged to attend. This is a great opportunity to revisit old friendships and meet new beekeepers who share your same interests.

We'll begin Wednesday morning with general sessions featuring presentations from Dave Mendes, president of ABF, Kenny Haff, president of AHPA, and Corey Bacon, president of CHC. We're also honored to have Dr. Jim Tew as our keynote speaker. We'll have legislative updates from all three groups, meet the 2011 American Honey Queen and Princess contestants, and find out what Ralph Jones will be offering during his business seminar, which will occur later in the week. The tradeshow will open at noon on Wednesday and will feature over 50 exhibitors. Please be sure to stop by and see all that's new in the beekeeping industry. The afternoon will be dedicated to the Shared Interest Group meetings, which are open to all in attendance, and the 2011 American Honey Show. We'll conclude the day with the annual ABF Honey Queen Reception and Quiz Bowl.

Thursday is a very full day with lots of options for you to choose from. The General Session will begin at 8:25 a.m. and continue all day. Various topics will be covered, including updates from the USDA-ARS labs, as well as presentations by industry experts from the United States, Canada and Mexico. The American Bee Research Conference (ABRC) and the Serious Sideliner Symposium will also begin on Thursday morning and continue through Friday afternoon. The tradeshow will continue to be open for your perusal. Additionally, we'll have the Ladies Auxiliary Breakfast/Meeting and conclude the day with a social activity designed with your participation. "Murder by Honey" will be the crime we need to solve, and you may just be the suspect. Please plan to join us for what promises to be a hilarious and fun evening.

Friday will have a similar schedule with General Session, the ABRC, the Serious Sideliner Symposium and the Tradeshow continuing throughout the day. Additionally on Friday, Ralph Jones will offer a business seminar and we'll have the Foundation Luncheon, the Honey Show Auction and the AHPA annual banquet (open to all attendees with additional registration required).

On Saturday, we'll start the morning with a variety of interactive workshops. This will also be your final opportunity to visit the tradeshow and make connections with exhibitors and conference sponsors before it closes at noon. The afternoon will feature the ABF Annual Business Meeting and finally the annual ABF banquet, where you'll be introduced to the 2011 American Honey Queen and Princess.

Although Saturday is the official close of the conference, we have one last event planned for you. On Sunday, we have reserved the conference lounge in the San Luis Hotel for "The Hive," which is a social opportunity to meet and mingle, have a little lunch and maybe even play a little pool with fellow beekeepers. You'll also have the opportunity to view a few bee films and relax a little after a very full week of conference activities.

As you can see, the 2011 conference is packed full of educational sessions, social and networking activities, and lots of opportunities to learn about new products and services. Additional information, including registration rates, guest room accommodations, the conference schedule, invited speakers, session topics and much more, can be found on the conference Web site at www.nabeekeepingconference.com. Be sure to check the Web site often as additional conference details will be posted as soon as they are made available. Register now and take advantage of the regular registration rates, which will be honored through Dec. 16, 2010.

WEST VIRGINIA BEEKEEPER OF THE YEAR

Dan O'Hanlon teaches at the Bee Field Day in WV.

The Cabell Wayne Beekeepers Association nominated Judge Dan O'Hanlon for Beekeeper of the Year for West Virginia 2011. The West Virginia Beekeepers chose Dan as Beekeeper of the Year for 2011 at the Fall Meeting Sept. 25, 2010. (Gabe Blatt, President - Cabell Wayne Beekeepers Association)

NEW YORK

Bee Sex in the City will be the topic of a talk given by Dr. Larry Connor for the New York City Beekeepers at 7 pm on December 7, 2010. This reviews the basic reproduction of bee colonies, the development and mating of queens, and their mating behavior. The meeting will be held at the Seafarers International, 123 East 15th Street, New York City. This is one block from Union Square. A question and answer period will follow the talk.

For further information: www.wicwas.com

CONNECTICUT

Backyard Beekeepers Association

2011 Speaker Schedule:
January 25: Mark Bruen
February 22: Ron Ochoa
March 29: Dr. Dewey Caron
April 26: Dr. Marla Spivak
May 24: Rose Lynn Fisher
June 28: Dinner Meeting

September 27: Dr. Deborah Delany
October 25: Mike Embrey
November 29: Mike Simone-Finstrom

Each month we have timely weekend hands-on inspection workshops, mentor program and more. All events are free and open to the public. Please check our web site for the dates and locations or more information at www.backyardbeekeepers.com if you have any questions.

PENNSYLVANIA

Starting With Bees will be the topic of a talk given by Dr. Larry Connor at the Pennsylvania branch of Brushy Mountain bee supplies on Dec. 8, 2010. This will review key aspects of starting bee colonies, equipment needs, how to get bees, personal protection from stings, honey production, and more. A question and answer period will follow the talk.

For information on registration and fees contact Brushy Mountain at 570-568-0870. For further information: **www.wicwas.com**

VIRGINIA

The Northern Virginia Beekeeping Teaching Cooperative Offers Practical Beekeeping for Beginners Class

Practical Beekeeping for Beginners, a series of classes held one night per week from 7-9 pm starting in Jan./Feb., 2011 for 7 weeks (*there is one Sat. am class in Leesburg*). Class size is limited and registration generally fills up so please register early. Classes are open to adults and children (age 9 and up) who are interested in keeping honeybees, as well as those who are just interested in learning about bees. Books are included in the class fee ($75-$100 per family unit) and include Kim Flottum's *Backyard Beekeeping*, Mid Atlantic Apiculture (MAAREC) *Beekeeping Basics* and *Honey Bee Parasite, Pests, Predators & Diseases*, as well as power point handouts and a one year membership in the local beekeeper assoc. Classes are taught by experienced beekeepers and include contacts for you to buy equipment and live bees to start beehive(s).

Beekeepers of Northern Virginia (BANV) (Arlington, Alexandria, and Fairfax)
Location: TBD. Class starts in February, 2011. Contact Pat Haskell (703) 560-3484 See: http://www.beekeepersnova.org

Prince William Regional Beekeepers (PWRBA)(Prince William, Fauquier, Stafford)
Manassas Church of the Brethren, 10047 Nokesville Road (Rt. 28), Manassas, VA. Class starts Thur., Jan. 20th,. Open house TBD. Contact Louise Edsall (703) 369-0756, email PWRBeekeepers@gmail.com or see www.PWRBeekeepers.com

Gateway Beekeepers (King George, Caroline, Westmoreland)
VA Cooperative Ext. Office, Village Center, King George, VA. Class starts Tues., Jan 25, 2011. Contact Mike Church 540-775-9740 churchmj@verizon.net, or Julie Moore 540-644-1138, juliemoore@dirtybirdpottery.com

Loudoun Beekeepers Association (LBA) (Loudoun)
Loudoun County Coop. Ext. Office, Leesburg, VA. Two classes. Fri. night class starts Feb. 11th, Sat. morning class starts Feb. 12th at 8am. Open house, Sat. Feb. 5 from 10-1. Contact Billy Davis (540) 903-9274 or see http://www.loudounbee.org

Beekeepers of Northern Shenandoah (BONS) (Clarke, Frederick, Warren)
Virginia Arboretum, Blandy Experimental Station, Boyce, VA and Winchester, VA. Classes start in Feb., 2011 Contact John Lewis (540) 869-4919 or see: http://valleybees.org

Northern Piedmont Beekeepers
(Culpeper, Rappahannock, Orange, Madison, Fauquier)
Culpeper Depot, 113 S. Commerce St. Class starts Tues., Feb. 8th. Open house and registration Feb. 6th, 2-4pm
Instructors: Billy Davis and Ann Harman
Contact Karen Hunt (540-937-4792) or kahu9@juno.com or see http://www.npbee.org

Rappahannock Area Beekeepers (Spotsylvania, Stafford)
Ray Simms Conference Room - Spotsylvania County Extension 8800 Courthouse Rd. Spotsylvania, VA 22553
Class starts Wed., Feb. 2nd. Location info: http://offices.ext.vt.edu/spotsylvania/programs/anr/index.html Contact Kim Fraser (540-785-8769) or ubbuny@aol.com

Piedmont Beekeepers (Lynchburg and Bedford/Moneta area)
Two classes: Lynchburg location: James River Day School, 5039 Boonsboro Rd, Lynchburg. Classes begin Tuesday, Feb 1. Bedford/Moneta class and dates TBD Contact Ann Z. at 434-660-6063 or annzee@aol.com

Northern Neck Beekeepers Club
(Northumberland, Lancaster, Richmond, Essex, Westmoreland)
Northumberland Library, 7204 Northumberland Highway, Heathsville, VA. Class starts Mon., Jan 24, 2011. Contact Bonnie Wilson (804) 453-7036, or bbwilson@kaballero.com

GEORGIA

Metro Atlanta Beekeepers Association Short Course 2011 is taking registrations online. We are limiting our participants to 100.
Where: Atlanta Botanical Garden
When: Saturday, January 22, 2010
Cost: $95.00 which includes continental breakfast, lunch, parking and presentations from educators and urban beekeepers.

Please go our to MABA Short Course web site for the agenda and registration. http://www.beekeepingshortcourse.com/

LOUISIANA

Louisiana Beekeepers Association (LBA) Annual Convention December 3 – 4, 2010

The Louisiana Beekeepers Association will hold their 49th annual convention on Friday, December 3rd and Saturday, December 4th at the Embassy Suites in Baton Rouge, Louisiana. Please join us for the latest research information from the USDA/ARS Honey Bee Breeding, Genetics & Physiology Lab. Beekeeping basics, pest management and many more topics will be discussed. A block of rooms will be held for the LBA at a special rate of $89.00 plus tax. Please call the hotel at 800.362.2779 to make your reservation. **Remember to mention the Louisiana Beekeepers Association to get the special rate. Please, make your reservations early, since the cut off date is November 25th.** A registration fee of $10.00 is required. There will be something for everyone from beginner to lifetime beekeeper, so please join us in Baton Rouge. For more information contact Alva Stuard at 225.261.2032, Sharon Hebert at 337.937.6722 or Jimmy Dunkley at 225.610.2628 or visit the web site at **www.labeekeepers.org**.

NEBRASKA

Nebraska Beekeepers will host guest speaker Kirk Webster on November 20. Additional speakers include Reed Johnson and UNL graduate students. For more information, visit nebraskabeekeepers.org or contact Todd Fiala at 402-783-0324 or **tf92300@windstream.net**.

IDAHO

The Idaho Honey Industry Association Convention will be held Dec. 2 and 3, 2010 in Boise, Idaho at the Red Lion Downtowner. To reserve rooms call (208) 344-7691 and be sure and tell them you are with the IHIA (bee guys). To register for the convention call Cindy at (208) 888-0988.

Honey Containers Make the Sale!

Queenline Glass Honey Jars

Size of Jar Honey Capacity	Number of Jars Per Carton	Lid* Style (see below)	Order Number	Ship Weight Per Carton lbs.	Price Per Carton 1-99 Cartons
8 ounces	24	(48 mm)	M001952	10	$14.00
1 pound	12	(58 mm)	M001962	8	$8.49
1 pound	24	(58 mm)	M001972	14	$16.30
2 pound	12	(63 mm)	M001982	12	$12.18
4 pound	6	(G70)	M001992	10	$11.49

Lid Style White plastic *(glass not shipped by UPS)*

**We reserve the right to substitute lids should the style you requested not be available.*

Check out our catalog for other types and sizes of quality honey containers!

Honey Bears

M00255

M00255CPN

M00255 12 oz. Regular Bears
with Cap and Collar (38mm) Cartons of 12
Case of 12 Ship Wt. 3 lbs. $6.95

M00255CPN 12 oz. Clear Bears
with Cap and Collar (38mm) Cartons of 12
Case of 12 Ship Wt. 3 lbs. $7.95

M00256 Bulk Pack - 250 per case
1-4 Cases 250 per case . . $86.95 per case
5 & Up Cases . . . . $84.45 per case
Ship wt. 30 lbs. per case

M00256CPN 12 oz. Clear Panel Bears
with Cap and Collar (38mm)
1-4 Cases . . . . $105.95 per case
5 & Up Cases . . . . $99.95 per case
Ship wt. 30 lbs. per case

* 8 oz. and 2 lb. bears are also available.

3 lb. and 5 lb. Plastic Honey Jugs

Great Containers for Packing Yard Rent Honey

With 38mm Yellow Ratchet Style Lids

3 lb. Jugs

150 Jugs per Case
M00280 Ship Wt. 70 lbs. per Case
1-5 Cases . . . . . . $79.30 per Case
6 & Up Cases . . . $76.20 per Case

5 lb. Jugs

120 Jugs per Case
M00281 Ship Wt. 70 lbs. per Case
1-5 Cases . . . . . . $79.30 per Case
6 & Up Cases . . . $76.20 per Case

Glass 3 lb. Round Jars

Carton of 12 with white plastic lids
M001932
1-99 . . . . $13.50 per Carton

(All Ship Wts. 12 lbs. per carton.)

1 lb.
M01158

Closeup of Pattern

Inverted Plastic Jar With Hexagon Pattern

Inverted Plastic Honey Jar
With Hexagon Pattern
with 38mm Snap Caps

Jar Size	No. of Jars Per Ctn.	Item Number	Ship Wt. Per Ctn. lbs.	Price Per Ctn. 1-99 Cartons
1 pound	24	M01158	3	$16.99

1 lb. and 2 1/2 lb. Attractive Plastic Containers

With Honey Bee Emblem

Carton of 24 -1 lb.
Container with plastic lids (43 mm)
M002042
1-99 . . . . . . $10.94 per Carton

Carton of 6 -2 1/2 lb.
Containers with plastic lids (58 mm)
M002052
1-99 . . . . $5.32 per Carton

(Ship Wts. 3 lbs. per carton.)

Call for Pricing on 100+ Cartons

All prices are FOB, Hamilton, Illinois

Note: Plastic containers may ship at individual weights listed not combined weights. All prices are subject to change.

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Michigan	1-877-932-3268
New York	1-877-532-3268
Texas	1-877-632-3268
Virginia	1-800-220-8325
Wisconsin	1-877-232-3268

UNITED STATES

Colonies over much of the country were in fair to good condition going into winter. As this was written, we had not heard of many large colony losses reported. Admittedly, it is still early, but last season a number of colony losses were reported during the fall. Some of our reporters are cautiously optimistic and have said that colonies seem to be healthier with larger bee populations going into fall and winter. Many have also told us that they felt that their varroa mite populations were down. Beekeepers said that the mild fall encouraged more brood rearing at a time when queens are normally slowing their egg laying.

Beekeepers were completing their fall feeding and medication programs. In the northern states, a number of beekeepers are also wrapping their colonies in order to provide extra protection from their long winters. Migratory beekeepers, on the other hand, were busy preparing to move colonies to southern or California locations for the winter. Once on location, colonies will be fed and medicated in order to build bee populations in preparation for the 2011 pollination season.

Prices and demand for bees for pollination have remained strong. Most sources felt almond pollination prices would remain stable or increase due to a continued good grower demand, buoyed by good almond crops and prices. Some spot shortages of bees are expected, which may be further aggravated by the anticipated loss of Australian package bees. The USDA Animal and Plant Health Inspection Service was expected to make their final ruling on this ban in November.

Our reporters also indicate a continued strong market and good prices for honey at both the wholesale and retail levels. Although honey crops are expected to be some better in 2010 than last year's record poor production year, they are still not expected to be back to normal. In fact, a number of beekeepers again reported disappointing honey crops due to erratic weather varying from too cool and wet to very hot and dry. Packer inventories also continue to be rather small at a time of the year when cooler weather and holiday purchases increase honey sales.

NORTHEAST—Dry autumn weather slowed fall flows in some states, while in other locations beekeepers said the warm, dry fall allowed bees to make more late honey than normal. In October and early November rains returned to the Northeast and many beekeepers reported killing frosts, which ended the last of the fall flows from asters, goldenrod, knotweed and other late-blooming wildflowers. Some migratory commercial beekeepers were preparing their colonies for transportation to Southeastern states, while others were finishing their winter preparations such as feeding and wrapping colonies. Bee populations were generally good going into fall, but some beekeepers were worried that bees would run out of stores before next spring. Varroa populations were lower than normal, according to a number of our reporters.

As usual in this area, demand for local honey has been strong. As a result, beekeepers do not anticipate having any problems selling the remainder their honey supplies during fall and winter months.

MIDEAST—The first part of autumn was also quite dry in a number of the Mideastern states. However, quite a few beekeepers had made good spring and summer honey crops before the drought became severe. Sourwood flows in the mountains were much better than last season, so beekeepers were very happy about having more of this premium varietal honey to sell. By late October and early November, a number of beekeepers were receiving rains and some had their first frosts, which put an end to remaining aster and goldenrod flows. Beekeepers were finishing their feeding and medicating. In locations that had poor flows beekeepers were worried about possible colony starvation in late winter or early spring before spring pollen and nectar are available. Bee populations were generally strong as bees went into their winter clusters.

Honey demand remains good at both the wholesale and retail levels, so most beekeepers anticipate having little trouble selling their honey.

SOUTHEAST—Although a number of reporters said their spring crops were fair to good, later flows were down considerably. Hot, dry weather persisted for a couple months during the summer. The dry, hot weather slowed remaining flows until rains returned this fall. Some beekeepers were making honey for winter stores from fall flowers such as goldenrod, aster, smartweed, and Spanish needles. In Florida, the Brazilian pepper flow was hurt by cool, rainy weather. In Mississippi tallow flows were disappointing, but wildflower flows were fair to good.

Despite below average honey crops in a number of Southeast locations, colonies seem to be going into winter in fair to good condition. Bee population numbers are good and stores have been augmented with syrup feeding where necessary. Some reporters said that small hive beetle numbers were an increasing problem in hives now that the cooler weather was starting. Migratory beekeepers are using the down time to prepare colonies for their big move to California for almond pollination in 2011.

Honey prices and demand remain good at both the wholesale and retail levels. Very little white honey remains available for purchase, but beekeepers said that they are still holding some darker grades that they believe will sell before the end of the year.

SOUTHWEST—Late flows from cotton, alfalfa, goldenrod, aster and sunflowers helped replenish winter stores. Honey crops were fair to good over much of the area and this has helped rebuild beekeeper and packer inventories. Demand for honey remains excellent, so beekeepers anticipate having no trouble selling the rest of their crops at either the wholesale or retail levels. Favorite regional honeys have already been sold out in many cases. At last check most of our reporters had already sold over half their entire crops. With holiday sales coming on, the rest of this honey will move quickly.

Migratory beekeepers from the north are moving their colonies into their winter locations in the Southwest where they will begin feeding and building up colonies in preparation for their move to California almond pollination in early 2011.

EAST CENTRAL—Although honey crops were better than last season for many beekeepers, the crops were still very spotty due to a rainy spring and summer followed by a dry fall. In some cases reporters told us that fall flows provided much needed winter stores. Others continued to augment stores with syrup. A number of beekeepers have had trouble with high moisture honey in the rainy parts of this area. Also, since the clover and alfalfa flows were short-lived,

U.S. HONEY, BEESWAX AND POLLEN PRICES FROM OUR REPORTERS

	Northeast	Mideast	Southeast	Southwest	East Central	West-Central	Inter-Mountain	West
Wholesale								
White lb. Blk	$1.40-$2.20	$1.45-$2.00	$1.30-$1.70	$1.35-$1.70	$1.50-$2.00	$1.40-$1.75	$1.30-$1.60	$1.35-$1.60
Amber lb. Blk	$1.35-$1.60	$1.30-$1.75	$1.30-$1.50	$1.30-$1.60	$1.35-$1.75	$1.30-$1.60	$1.30-$1.50	$1.30-$1.50
1 lb. CS 24	$50.00-$80.00	$45.00-$82.00	$48.00-$90.00	$51.00-$85.00	$52.00-$75.00	$55.00-$81.00	$60.00-$95.00	$57.00-$92.00
2 lb. CS 12	$59.00-$80.00	$58.00-$72.00	$60.00 $68.00	$58.00-$73.00	$59.00-$79.00	$51.00-$78.00	$57.00-$76.00	$60.00-$77.00
5 lb. CS 6	$72.00-$88.00	$58.00-$87.00	$60.00-$76.00	$57.00-$75.00	$57.00-$86.00	$60.00 $84.00	$59.00-$85.00	$59.00-$88.00
Retail								
Jars 8 oz.	$1.50-$3.00	$1.40-$4.00	$1.25-$2.95	$1.20-$2.90	$1.50-$3.50	$1.40-$2.95	$1.30-$2.60	$1.25-$3.90
Squeeze Bear 12 oz.	$1.89-$3.50	$2.00-$4.00	$1.75-$3.75	$2.25-$4.00	$2.50-$3.95	$2.25-$4.10	$2.50-$3.85	$2.25-$4.25
Jars 1 lb.	$3.75-$5.50	$3.25-$5.25	$3.40-$4.75	$3.50-$5.00	$3.45-$5.25	$3.95-$5.25	$3.75-$5.25	$3.70-$5.95
Jars 2 lb.	$3.99-$6.75	$3.95-$7.00	$3.99-$5.49	$3.00-$6.25	$3.25-$8.00	$3.29-$6.50	$3.25-$6.25	$3.50 $6.50
Jars 1 1/2 lb. (Pint)	$4.50-$7.00	$4.25-$8.00	$3.50-$6.00	$3.58-$6.50	$3.25-$5.50	$3.50-$5.50	$3.75-$6.00	$4.75 $8.25
Jars 3 lb. (Quart)	$5.50-$9.75	$5.95-$14.00	$5.79-$10.00	$5.25-$9.25	$5.00-$11.50	$5.50-$10.00	$5.10-$9.75	$6.00-$12.50
Jars 4 lb.	$7.50-$12.00	$8.00-$15.00	$7.00-$10.75	$6.00-$12.70	$8.00-$14.00	$5.50-$13.50	$6.00-$14.50	$6.50-$16.00
Jars 5 lb.	$12.99-$19.00	$10.00-$19.50	$9.50-$17.50	$9.25-$18.00	$10.00-$21.00	$9.75-$18.00	$10.00-$19.25	$10.50-$22.00
Creamed 12 oz.	$2.50-$5.50	$2.50-$4.00	$2.49-$3.95	$2.25-$3.99	$2.50-$4.25	$1.99-$4.25	$1.75-$4.00	$2.25-$5.00
Comb 12 oz.	$3.00-$7.00	$3.50-$8.00	$2.25-$7.25	$2.50-$6.50	$2.50-$5.75	$2.50-$6.50	$2.50-$5.75	$2.75-$7.50
Round Plas. Comb	$4.00-$6.50	$3.25-$5.50	$3.50-$5.00	$3.00-$6.25	$3.25-$5.99	$3.00-$6.50	$3.25-$6.00	$3.50 $7.50
1 Gallon	$15.00-$25.00	$12.50-$26.50	$14.50-$25.00	$15.00 $25.00	$15.00-$30.00	$15.00-$27.00	$15.00-$30.00	$15.00-$30.00
60 lb.	$115.00-$160.00	$84.00-$140.00	$85.00-$120.00	$80.00-$140.00	$82.00-$140.00	$80.00-$145.00	$85.00-$140.00	$80.00-$140.00
Beeswax								
Light per lb.	$2.20-$3.50	$2.20 - $2.75	$2.20 - $3.00	$2.20 - $2.50	$2.20 - $2.50	$2.20 - $2.50	$2.20 - $2.50	$2.20 - $2.50
Dark per lb.	$2.10-$3.00	$2.10 - $2.35	$2.10 - $2.25	$2.10 - $2.25	$2.10 - $2.25	$2.10 - $2.25	$2.10 - $2.25	$2.10 - $2.25
Pollen								
Wholesale per lb.	$3.50-$6.50	$3.50-$8.00	$3.00-$6.00	$3.00 $5.00	$3.25-$6.00	$3.25-$6.00	$2.50-$6.00	$2.50-$5.50
Retail per lb.	$5.50-$15.00	$7.00-$15.00	$6.00-$15.00	$6.00-$10.00	$7.00-$15.00	$7.50 $15.50	$7.00-$12.00	$7.00-$15.00

The above prices are not meant to provide a realistic picture of prices in all states of the particular area. They are intended merely to show what a few beekeepers are receiving for their honey, beeswax and pollen and we realize prices may vary tremendously, even within individual states. The bulk prices for honey are stated per pound, delivered buyer's warehouse, containers exchanged or furnished by buyer, unless otherwise noted. Where prices are not shown, insufficient data were available.

much of the honey was darker than normal because it came from many different sources. In normal years, most of the honey in the East Central area comes from clover and alfalfa. Some of the best crops reported to us came from parts of Wisconsin, northern Illinois and Michigan. However, those beekeepers reporting better crops said much of the honey was made earlier in the spring, so colonies had to be strong or they missed the boat!

The warm dry fall allowed colonies to continue to work fall wildflowers well into October. However, by mid to late October many reporters reported their first hard frosts, which essentially ended their seasons. Some continued to feed where stores were dangerously low. Other beekeepers were wrapping their colonies to protect them from the cold winter winds. Last season below freezing weather lasted up to two months at a time without letup. Beekeepers are reporting that bee populations are rather large for this time of year and some have credited the prolonged warm fall for allowing continued brood rearing. Others have said that smaller varroa populations seem to have allowed colonies to remain strong despite below normal honey flows.

Most beekeepers finished their extracting in September. Packers and local honey buyers have been actively buying any available new crop honey due to continued low inventories in this area. Two successive years of spotty honey crops have made it tough for buyers to find large lots of honey. Therefore, many buyers have had to settle for buying smaller lots from a number of different producers. Prices at both the wholesale and retail levels remain very good.

HONEY MARKET FOR THE MONTH OF SEPTEMBER 2010

In volumes of 10,000 pounds or greater unless otherwise stated

(From OCTOBER 2010 USDA National Honey Report)

Prices paid to beekeepers for extracted, unprocessed honey in major producing states by packers, handlers & other large users, cents per pound, f.o.b. or delivered nearby, containers exchanged or returned, prompt delivery & payment unless otherwise stated.

-Report includes both new and old crop honey-

(# Some in Small Lot — +Some delayed payments or previous commitment)

California -Buckwheat extra light amber $1.44 - $1.52
Sage white $1.52 - $1.59
Dakotas - Alfalfa white $1.50 - $1.53
Alfalfa extra light amber $1.45 - $1.48
Clover white $1.50 - $1.60
Clover extra light amber $1.45 - $1.50
Florida - Palmetto light amber $1.28 - $1.30
Wildflower extra light amber $1.50
Minnesota - Clover white $1.53

Prices paid to Canadian Beekeepers for unprocessed, bulk honey by packers and importers in U. S. currency, f.o.b. shipping point, containers included unless otherwise stated. Duty and crossing charges extra. Cents per pound.

Mixed Flowers white $1.49 - $1.58

Prices paid to importers for bulk honey, duty paid, containers included, cents per pound, ex-dock or point of entry unless otherwise stated.

Argentina - Mixed Flowers white $1.54 - $1.59
Mixed Flowers extra light amber $1.54 - $1.59
Brazil - ORGANIC extra light amber $1.55
ORGANIC light amber $1.50 - $1.55
India - Mustard light amber $1.36 - $1.37

WEST CENTRAL—Honey crops were better than last year's disastrous season, according to a number of our reporters. They stress, however, that in many cases yields were still below average. Beekeepers have indicated that honey crops should be fair to good in parts of the Dakotas, Minnesota, Iowa and Missouri. We received no reports from Kansas or Nebraska, but earlier in the season some of these reporters felt that their total crops would be better than last year also. Complicating honey production this season has been the erratic weather, varying from too rainy earlier in the spring and summer followed by extremely dry conditions this fall. On the bright side, some reporters said the warm, dry fall was actually a help to them because it allowed colonies many more foraging days to work goldenrod, aster, Spanish needles and other wildflowers. This was a lifesaver for some colonies that struggled with rainy weather during much of the spring and summer seasons.

Beekeepers also fed colonies where brood nests looked light. By early November, cooler weather was settling in, so winter-feeding was also slowing down. Many beekeepers reported their first hard frosts in late October. Migratory beekeepers were preparing to move colonies to California or southern states for the winter. Here they will be fed and medicated. Later, many will be split in preparation for pollination and later honey flows in 2011. As we have mentioned for other parts of the country, varroa populations seem to be down and autumn bee populations are better than they have been for several years. Late brood rearing spurred by the mild fall is credited by some beekeepers for the better bee populations, but most do not have any good answers as to why varroa populations are down this season.

With somewhat better honey crops this season, packers have been busy making calls to beekeepers in order to rebuild their low inventories. Prices and demand have remained strong since honey supplies are still short over most of the country. At the retail level, locally produced honey is still in great demand. Beekeepers anticipate having little trouble selling the remainder of their crop during the coming holiday season.

INTERMOUNTAIN—Montana and Colorado beekeepers have had fair to good honey crops, but production is down in parts of Idaho, Nevada and Utah. Production shortfalls are varying from 80% of normal in Nevada to as low as 40% of normal in parts of Idaho. Cool, wet spring weather hurt colony foraging and brood development and then in some locations the blistering hot, dry July caused honey plants to dry up and die earlier than normal. Consequently, clover and alfalfa flows were down. Fortunately, fall weather was better, according to some of our reporters, and colonies were able to make gains from late alfalfa, knapweed, sunflowers, rabbit brush and various wildflowers.

This fall beekeepers were finishing their extracting and had begun feeding and medicating colonies in preparation for the winter season. Migratory beekeepers will be moving their bees to California or southern states to rebuild colonies in time for the 2011 pollination season. Coming into fall, beekeepers felt that their colonies were healthy and that mite levels were down. Demand for honey at both the wholesale and retail levels remains good. Prices quoted by beekeepers for wholesale bulk honey were varying from $1.40 to $1.60 for white honey and between $1.30 and $1.50 for amber grades.

WEST—Our reporters felt that their honey production was better over much of California, Oregon and Washington due to better moisture conditions and enough favorable weather during flows to allow adequate foraging. Nevertheless, some beekeepers complained that continued heavy bee losses last winter hurt their total honey production since they were not able to recoup all their losses. Also, the prolonged cool, wet spring hurt some honey flows since bees were not able to forage as much as normal. Bees continued to work scattered wildflowers, but many commercial beekeepers had already begun feeding their bees in preparation for the 2011 pollination season. Generally, colonies appear to be in fair to good condition going into fall. Beekeepers are hoping that they will not have the huge colony losses that they have had in some recent years.

Almond production in 2010 reached a record 1.65 billion pounds and world almond prices have remained fairly stable, according to Joe Traynor, Scientific Ag Co. Traynor also said that 20,000 additional acres of almonds will require bees for pollination in 2011. The continued strong demand for bees for almond pollination, coupled with the anticipated loss of Australian package bees, should cause almond pollination prices to remain stable or increase in 2011. Some almond growers are trying to economize by reducing their colony rentals from 2 colonies to 1 ½ or even 1.

Honey demand at both the wholesale and retail levels remains good for locally produced honey. As in much of the rest of the country, honey has been in short supply over the last couple of years due to short honey crops coupled with strong demand.

ARGENTINA

During October, which is the second spring month in the Southern Hemisphere, beekeepers in Argentina were expressing mixed feelings regarding their particular situations. Many of them have lost a substantial number of beehives due to starvation and inefficient varroa control during fall. However, beekeepers who were able to overwinter their colonies successfully are now enjoying a great spring with mild weather and exceptional foraging conditions for an encouraging build up prior to the major honey flows of December and January.

Migratory beekeepers were not as active this year due to much higher costs involved in the logistics of bee transportation, as well as enforcement of strict provincial regulations making it difficult to transport hives from one providence to another. The never-ending expansion of soybean acreage, coupled with the sharp decline of alfalfa and sweet clover fields, is putting tremendous pressure on beekeepers, who are only able to obtain income from honey production. Unfortunately, not only the pollination business is underdeveloped in Argentina, but paradoxically, some beekeepers even pay fruit growers to place their hives in their orchards! This upside down trade practice is counterproductive for the well being of the entire Argentine beekeeping industry.

Export prices seem to be quite firm in light of the world shortage of honey. It is not unusual for exporters to quote bulk honey at over $3,400 per metric ton. After much insistence, exporters finally admit that the demand from foreign buyers is much higher than what they can handle now. Many exporters and middlemen with huge operational expenses are having great difficulties purchasing large lots of bulk honey. Several large and traditional beekeepers went out of business during the last two years. Thus, obtaining important honey lots has become increasingly difficult and logistically very expensive. A new trend not seen in previous years is that some Argentine exporters are now opening purchasing offices in neighboring countries such as Uruguay, Brazil and Chile in a desperate effort to offset the dramatic drop in local honey production.

Total honey exports for the first nine months of 2010 were 47,263 MT equivalent to US$3,012 per MT. During the same period of 2009, Argentine honey exports were 51,078 MT equivalent to US$2,752 per MT. In other words, current shipments are 7% lower in volume, but are up 9.5% in price. For example, September 2010 exports were just 4,032 MT and sold for US$12.18 million. During 2010 Germany has imported 38% of total Argentine honey deliveries (18,324 MT), while the US remains steady with its 32% share (14,527 MT).

If this decreasing trend holds true for the remainder of the third and final quarter of 2010, then total exports for this year will barely reach 60,000 MT. The only exceptional event that might change this pessimistic scenario would be excellent honey crops in the northeastern and northwestern subtropical provinces of Argentina before the


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U.S. Honey Imports Jump in 2010

by JOHN PARKER

U.S. honey imports increased 36 percent in the first eight months of 2010 to 83,475 tons, valued at $213.9 million. If a similar pace continued through December, arrivals for calendar 2010 might reach $300 million. The average import price moved a tenth higher to $2,562 per metric ton ($1.16 per pound) in the first 8 months of 2010. Retail prices for honey in jars containing 1 pound in the summer of 2010 ranged from $3.50 to about $6.56 per pound in some major grocery stores.

The rise in quantity and value for honey imports in 2010 will be a change from the way the value was steady at $220.3 million in the two previous years. The average price for U.S. honey imports showed an upward trend from $1,189 per ton in 2005 to $2,330 per ton in 2009, and about 2,562 per ton in early 2010..

As U.S. honey output suffered from problems stemming from disease and poor overwintering, traders searched the world over to find quality honey for a reasonable price. Imports from specific countries fluctuated widely in the recent decade. Brazil, Vietnam, India, Canada, and Argentina were leading suppliers in 2009. Argentina, India and Vietnam were the leading suppliers for direct shipments in early 2010. Argentina exports over 95 percent of its honey output recently, while India exports about a fourth of its production.

Transit Trade Through Malaysia Picked Up in 2009 and Early 2010

U.S. imports of honey reported as arriving from Malaysia advanced from 4,418 tons in the first 8 months of 2009 to a peak of 11,478 tons in the comparable part of 2010. It appears that Malaysia was the leading transit trader in honey originally from China in early 2010. Malaysia was not listed by FAO as a large producer of honey in the recent two decades. While honey output in Sarawak and Sabah of Malaysia may have been larger than FAO reported for the country, it appears unlikely that this would be an answer to the tremendous increase in shipments from Malaysia to the United States recently. Honey can be transported through Burma and Thailand to Malaysia where excellent port facilities are available to load the honey on ships destined for the United States.

U.S. sources reported imports of honey from Malaysia in January-August 2010 had the lowest price of any major supplier with an average price of $1,609.86 per ton, valued at $18.5 million. That followed the doubling of U.S. honey imports from Malaysia to 9,068 tons in calendar 2009, and the delivery of only 141 tons in 2006.

Malaysia has duty-free trade with nine other countries of Southeast Asia belonging to ASEAN (Association of Southeast Asian Nations). That means honey from China (not yet a member of ASEAN) may move from one of the ASEAN countries to another easily to be delivered at a most convenient port.

Indonesian Honey Shipments to U.S. Market Up Sharply in early 2010

Indonesia has a duty-free area for dealing with world trade just south of Singapore on Batam Island. Some of the extra shipments of honey to the United States from Indonesia in recent years may have come from traders located in Batam Island. U.S. honey imports from Indonesia increased from an average of 1,152 tons annually during 2006-08 to a peak of 5,388 tons in the first 8 months of 2010, a gain of 82 percent over the comparable months of 2009.

Direct Arrivals From China Nearly Blinked Out In 2009, But Rebounded Recently

For a while China was the leading supplier during 2002-07. Concern about the quality of honey coming from China and regulations to deal with certain matters contributed to a steep decline for honey imports directly from China. (Editor's note: However, much of this Chinese honey is still finding its way to the U.S. market via transshipments through third-party countries.) Arrivals directly from China declined from a peak of 32,149 tons in 2006 to 11,252 tons by 2008 and bottomed out at 67 tons in 2009, before rebounding moderately to 1,515 tons in the first eight months of 2010.

Vietnam's Deliveries Remained Steady In Early 2010

Shipments of honey from Vietnam to U.S. ports declined from 19,378 tons to 17,439 tons in 2009. Some reports indicated than Vietnam was exporting more honey than FAO indicated it was producing. Arrivals from Vietnam slowed down in 2009 with a decline of a tenth in shipments, but a 2.4 percent rise to 12,714 tons was reported during the first eight months of 2010. U.S. imports of most items from Vietnam have a preferential tariff of 4 percent ad valorem. This has resulted in a surge for U.S. imports of manufactured goods from Vietnam recently. Vietnam also has free trade in many items with ASEAN countries.

India Bolsters Honey Output and Exports

India has interesting programs to boost exports for a wide range of products, and total exports are now well above the value of total imports. Three decades ago, India had a large trade deficit, and food aid was needed to cope with grain shortages when adverse weather reduced yields. India has almost as much good crop land as the United States. Widespread adoption of improved technology in farming resulted in sharp gains for grain yields and fruit. More farmers were able to finance projects for bees.

India moved into first place in terms of quantity among suppliers of U.S. honey imports in the first eight months of 2010, when 15,316 tons were shipped, valued at $38.6 million. India has the world's largest orchards of mangoes and has become a more important fruit producer in recent years. Keeping bees became more widespread in the recent decade, as honey output rose to over 65,000 tons. (Editor's note: Unfortunately, another reason for honey import increases from India is that some of this honey is actually Chinese honey being transshipped to the U.S. via India, according to reports.)

Supplies From Argentina Affected By Weather

Argentina had a big rebound for deliveries of honey to U.S. importers in early 2010 with shipments of 13,260 tons, valued at $41.2 million, compared with 7,737 tons in the comparable months of 2009, for a value of $23 million. Over 95 percent of the 81,000 tons of honey output in Argentina is exported, mostly to Europe.

Purchases of quality honey from Argentina by U.S. importers reached an average price of $3,100.68 per ton in early 2010. Arrivals from Argentina peaked at 28,878 tons in 2006, but were down to 10,043 tons in 2008 as adverse weather caused a reduction in output.

Canadian Deliveries Were Higher in the Past.

U.S. honey imports from Canada tumbled from a peak of $52.1 million in 2008 to $28.6 million in 2009, and rebounded 32 percent in the first eight months of 2010 to $28 million, for the 7,864 tons shipped. Convenient delivery of Canadian honey to U.S. buyers helped boost sales recently.

Brazilian Shipments Peaked in 2008, Before Declining Sharply in 2009

Imports of honey into the United States from Brazil reached a peak in 2008 of 17, 709 tons, valued at $42.5 million, before declining by 48.2 percent in early 2010. The average price for arrivals from Brazil climbed a fifth to $2,827.06 per ton in early 2010, when shipments were off nearly half to 7,390 tons.

Imports From Mexico Up in Early 2010

U.S. honey imports from Mexico doubled in the first 8 months of 2010, reaching 2,592 tons, valued at $7.9 million. Output of honey in Mexico increased in recent years as more orchards had arrangements for beekeepers. Total honey exports from Mexico averaged over 30,000 tons annually during the last four years.

Uruguay Revived Shipments in Early 2010

Imports of honey into the United States from Uruguay rebounded to 776 tons in early 2010, compared with only 19 tons in the comparable part of 2009. Arrivals of honey from Uruguay declined from 1,893 tons in 2007 to 227 tons in 2008 and then to only 50 tons in 2009. U.S. honey imports from Uruguay had reached 5,489 tons in 2005, before the steep decline followed.

Mongolia Skipped Sending Honey to U.S. Market in Early 2010

Mongolia emerged as a new source of U.S. honey imports in 2005 with the arrival of 581 tons, and shipments averaged 1,100 tons annually during 2007-09. Then no honey was reported arriving in U.S. ports from Mongolia in the first eight months of 2010. (Editor's note: Here again, this country's close proximity to China has made some U.S. beekeepers suspicious as to the honey's true country of origin.)

Consumer Demand Remains Strong

Sales of honey in grocery stores were strong in early 2010. A greater focus on health foods and rising prices for products with a lot of sugar tend to lift demand for honey. The retail price for some small containers with honey in grocery stores in the summer of 2010 usually ranged from $3.20 to about $6.75 per pound. Since the average imported price for honey in early 2010 as it arrived in large containers at U.S. ports was about $1.16 per pound, profits from preparing honey for sale in grocery stores must have been rewarding. The world market price for sugar in the summer of 2010 was about double a year earlier.

Market Share For Suppliers of Honey Imports Fluctuates

The share of U.S. honey imports from specified countries changes to some extent each year. China's joining the World Trade Organization appears to have contributed to recent trade policy. U.S. imports of honey from China increased 49.9 percent in 2006, when China accounted for a fifth of total honey imports. The steep reduction to less than 1 percent for China's share in 2009 meant a shift to greater imports from other sources.

There has been a concern about honey originally coming from China moving through ports in Vietnam. U.S. honey imports from Vietnam increased 2.4 percent in early 2010. Then came the tremendous rise in shipments of honey from Malaysia to the United States. That indicated a shift by some transit traders from moving honey originally from China through Vietnam to the Malaysian route.

Russian Honey Deliveries Far Below Earlier Levels

Russian shipments of honey to the United States peaked at 4,755 tons in 2006, but then declined a fifth to 37 tons in early 2010. Demand has increased among shoppers at new grocery stores in Russia. Investments from multinational grain traders provided Russian agriculture with modern tools to boost yields through 2009. The recent drought reduced grain yields, but rural residents continued to keep bees on their private plots.

Imports From Europe Up In Early 2010

During the first eight months of 2010, U.S. imports of honey from some European countries increased, although the quantity shipped remained comparatively small. Germany and some other EU countries provide mostly honey in consumer-ready containers. Opportunities for shipping cartons of honey in attractive jars at lower air cargo rates at certain times in the winter may enhance honey exports from some places in Europe.

U.S. imports of honey from Germany increased in early 2010 to $883,000. Germany has maintained a flourishing trade in honey in recent decades. In addition to local output, large supplies of honey are imported in drums from South America and Asia. The attractive packaging for honey processed in Germany contributes to significant exports to other EU countries and the Middle East.

Arrivals of honey from the United Kingdom soared from $54,000 in the first eight months of 2009 to $462,000 in the comparable months of 2010. Arrivals from Romania more than tripled, rising to $325,000. Imports from Austria moved up a fourth to $44,000. Shipments from Poland advanced 73 percent to $114,000 in early 2010.

The Classroom

by Jerry Hayes

Please send your questions to Jerry Hayes
Email: gwhayes54@yahoo.com

MERRY CHRISTMAS

Well, 2010 was interesting. I don't quote Scripture often but, "For nation shall rise against nation, and kingdom against kingdom: and there shall be famines, and pestilences, and earthquakes in diverse places." Matthew didn't mention the economy in the dumper, but here we are. Be grateful, have gratitude for all you have and all we have in this country and that includes *honey bees*. We have that connection to something real and amazing, regardless of what is going on around us in the world. *Merry Christmas*.

Q Warre (war rey) Hives

As a beekeeper, I am concerned about the health of our industry. I am interested in all methods of helping our industry. I have been hearing and reading about these Warre hives and the way in which they are used. Have you had any experience in seeing or hearing about these hives? If you have, what are your opinions, professional or personal?

Thank you,
Ernie Schmidt

A

First, here is my disclaimer: I have never been a full time manager of a Warre Hive full of honey bees. Here is what I think I know from having seen these in use:

1) They look like a pain in the neck.

2) Their management is based on "hands-off" beekeeping, which is not good. How does one administer pest, parasite and disease control or anything else efficiently?

3) TBH's (top bar hives) such as the sloped sided Kenyan variety are much better for individual frame manipulation than these things are since TBH's are designed to work with honey comb building biology, not against it. A square box like the Warre hive with only a top bar for the bees to build free form comb on means they attach it to the sides and the top bars of the box below.

4) Under-supering is a pain. With the entire comb attached to something (side, top, bottom), you have to lift up the upper box somehow and use piano wire to separate the comb attached to the top bars from the box above. You kill a lot of bees. Ugh. Plus, when they get tall, the weight is physically tough to deal with. My back is really not getting any stronger.

5) The only possible advantage is that the colony is forced to draw new comb. This is a good thing because it avoids reusing pesticide- or disease-contaminated comb. On the down side, it lowers your honey production since the extra comb building means less honey production. However, you can compromise by swapping out three or so frames /combs every year from a Langstroth frame style hive and get the same results without forcing ugly words to come out of your mouth when working the Warre hives.

The Warre hive was originally developed by the French beekeeper, Emile Warrė, who lived from 1876 to 1951. It is a vertical top-bar hive advocated by some beekeepers as a more natural way to keep bees.

The understanding of "bee space" was the *Holy Grail* of beekeeping. It allowed beekeeping to become easier, more efficient and enjoyable. It is the basis of all successful beekeeping. Are you sure you want to go back over 150 years into beekeeping history and re-invent the wheel?

Q Small Hive Beetle Ground Drench

There is a possibility of getting a ground drench registered in Canada for small hive beetle. This would be a Permethrin treatment, GardStar. From what you've seen in Florida, are many beekeepers using ground drenches on apiaries?

Raul Shashinski

A

Florida's soils (sand) are not structured and therefore are conducive to small hive beetle (SHB) larvae pupating in it. In most of Florida we are always just three weeks away from a drought as and rain we get simply runs through the sand and back into the aquifer. SHB larvae have to: 1) burrow 5-6 inches straight down in the sand to get to a location with sufficient moisture and stable

Small hive beetle larvae can multiply very quickly in a hive and may cause the colony to abscond.

temperatures or 2) crawl a distance to get to the margins of woods and thicker vegetation where temperatures are cooler and soil is moister.

All of that to say ground drenches do not do very well because our rains wash and dilute the Permethrin (GardStar) quickly and wash it out of the kill zone. Also, SHB larvae can crawl 100+ yards at times seeking out the cooler moister woods margins. One potentially would have to treat a large area around a colony or an apiary repeatedly to have any effect and it just isn't efficient or cost effective. Plus, most beekeepers consider a treatment like this is after the fact, when their colony has already been compromised. They are usually more interested in killing the reproductive adults in the colony. Unlike you, we have an endemic 24/7/365 population of SHB, so controlling adult infestation pressure is the goal. Winter will be your friend.

We haven't even talked about the environmental concerns, and ground water contamination, etc. My opinion is that this product should not be your first line of defense or offense Paul.

Q Science Fair Project

My name is Julia Rauchfuss. I am a senior at West Jr/Sr High School and I am doing a Science Fair project on the honey bee's foraging behavior. I have a few questions about my experiment that I was hoping you might be able to help me with. My science project is to determine whether honey bees rely more on their sense of smell or their memory to locate food sources. I am having difficulty isolating the variable in my experiment, which is the method the bees use for finding the sugar water bowl (smell, memory of bowl's previous location, and memory of bowl's appearance) from each other.

My plan for my experiment is to lay out 4 identical bowls equidistant from the beehive, one bowl will contain sugar water and the others will contain plain water. In each test, I will leave the bowls out in this formation long enough for the bees to become accustomed to the location of the sugar bowl. Then, I will switch the location of the sugar bowl with one of the other bowls and observe which bowl the bees initially go to. If the bees first go to the prior location of the sugar water bowl, then I would hypothesize that they are using some type of memory. If that is the case, I plan to perform further experiments to determine whether they are remembering the previous location of the sugar water bowl or its appearance. I know that was a very brief explanation of my experiment, but are there any apparent problems that you see in it?

Also, I have a few questions about my experiment that I was hoping you might be able to answer for me. I'm aware of the waggle dance that bees use to tell other bees where to find a food source, and that this could throw off my results if bees are using instructions to find the bowl (instead of smell or memory). But, I'm not sure exactly how to adjust my experiment to prevent the waggle dance from skewing my results or even to take advantage of this behavior. Should I stop recording results after it has become apparent that the bees have been told where to find the sugar water bowl? Will it be apparent when the bees have been told where to find the sugar water bowl?

Thank you for your time.

Julia Rauchfuss

A

Julia, I am glad that you are using the honey bee as your research platform. What I think I know from data about honey bee foraging in a field setting is this. Foraging scouts leave the colony and sample flower nectar to bring back to the colony to share with their forager-age sisters. There is a bit of competition among the returning scouts as they share information about the nectar they have brought back. The nectar will be sampled by other individuals in the colony and assessed for sugar content. More sugar means it is sweeter and may be a better energy exchange for energy expended flying out and energy being returned (sugar) to the colony for use and/or storage. In this nectar sample the nectar will have a flavor and aroma component. Through a variety of "dances", vibrations, angles and speed, which you have already read about, foragers are recruited to go in a certain direction when they leave the colony. After leaving the colony in a certain direction, they also search for aromas associated with the nectar sampled in the colony. At some point the foragers then use their visual field to do a final location and then they taste the nectar to see if it matches up with the flavor they received from the sample in the colony and *viola* they are there or not. The order may be dances, direction, aroma/scent, visual, flavor and identification. It is a multi-level search mechanism, not just dances.

For instance, if you just put out sugar water that has no "flavor or aroma", then it is difficult for the scouts to go back and "sell" the product. It has no identifying traits that can be used to direct their sisters to a location other than suggested direction and distance. Fewer foragers will go to and ultimately find the site than if there are other identifying components—pretty fascinating for an insect with a brain the size of a period on this page.

Have fun with this. I would run your research design protocol past Dr. Jamie Ellis /University of Florida for fine-tuning and explanation.

Julia Replies

Jerry, thank you! In a simple paragraph, you helped me understand what several books and articles could not. Your breakdown on the waggle dance has really helped me grasp the concept in a way that I can use to plan my experiments. And thank you for telling me about the sugar water. Dr. Ellis recommended that I use water with honey in it.

Q Beekeeping in Western Australia

Hello Jerry. I never miss an issue and your page. I am confused. Here is my question. There are thousands of beekeeper sites and millions of pages on how to keep bees. They all claim to be experts. Bah humbug! The swarm prevention issue is still the single most important factor. Keeping bees and keeping them balanced and fulfilled is essential.

Just read Kim Flottum's book, which really is very detailed. Unfortunately, he has also missed the whole point as to the center core essentials! People need to read more about animal behaviors. Temple Grandin and Cesar Millan provide such fabulous information.

Having done my reading and research, then following a logical twice-a-month structured management system and inspection routine all through spring and summer for the past 10 years, my bees do not swarm. Raising a new queen during pretty autumn days on top of the hive (above a screen), then easily finding and dispatching the old queen and placing the new queen and her brood box down to the base of the hive, preparatory to winter, is just basic common sense. (I do not have snow where I live.) No STRESS, No SWARMING, No FEAR, No CONFUSION. Lots of honey, happy bees

...and an even happier beekeeper. So many people seem to be doing it wrong. Jerry can we ever agree on a practical beekeeping regime that works for most of the people, most of the time?

Dan
Western Australia

A

Dan, I have thought about your question/observation about how, consistently and successfully, to manage honey bees. So, here goes with my admonition that an opinion is like a nose…everybody has one. I think my opinion is that we are talking about somewhat different beekeeping worlds—Australia and the United States. As such, the basics are the same, but at the same time slightly different due to the changes that have been imposed on U.S. beekeepers generally.

Beekeeping 30+ years ago was one in which the only thing we had to worry about was AFB. Honey bees basically took care of themselves. If one could learn about honey bee biology to a small degree and prevent or discourage swarming, he/she was ahead in the game. Preventing swarming, which is a key reproductive method for honey bee survival, is hard to stop.

Fast forward to tracheal mites, varroa mites, small hive beetles (SHB), honey bee viruses, African honey bees (AHB), *Nosema ceranae*, systemic agricultural pesticides, sunspots and global warming. All of these, except the last two said somewhat in jest, add in levels of change and concern with their new variables. We lost lots of beekeepers when tracheal mites were introduced. Those who adapted then had to contend with varroa mites and then we lost some more beekeepers who could not adapt. Now slowly mix in SHB, viruses, AHB, etc. and swarming takes on a less important role because if your bees are that healthy to reach swarming stage, that is great!

Most of the time U.S. commercial beekeepers are splitting colonies to make up losses, so swarming is not an issue. Then, with AHB biological introgression and this bee's propensity to send out swarms the size of a grapefruit multiple times (10-20) a year and beekeepers simply can't keep up.

If someone can successfully keep honey bees in the southern tier of states in the United States, they are excellent beekeepers—much better than I am. There are so many negative inputs and one has to know not only the biology of honey bees, but also a whole suite of pests, parasites and pathogens and so only the smartest, most committed and adaptable beekeepers survive. This is Darwinian control of beekeepers, as well as honey bees.

I think at some point in the future we can come up with Best Management Practices for honey bees that will be successful. I just don't think we are there yet.

Thanks for the great question.

Dan Follows Up

Comprehensively answered and very clever as always. We (down under in Western Australia) keep on whacking ourselves and touching as many wooden objects as possible while our luck continues to hold up with our not having to deal with European foulbrood, small hive beetle, *Apis cerana* honey bees or bee-killers like Varroa and Tracheal mites. We just have light doses of AFB and occasional Chalkbrood outbreaks.

I believe you have answered my query very well.

Recently, I was obliged to participate in a surveillance hive-monitoring program. I had to insert sticky boards and Bayvarol strips in my hives. The state apiary inspector will take out, examine and review all the sticky boards for any signs of a mite problem. I FELT SO BAD on the inside after I had done that to my special friends the bees, felt like I was doing something bad to them, they who have given so much back to me over the years and the queens that have formed great communication connections with me and demonstrated calmness and positive energy to new comers. Such balanced bees and no swarming.

Jerry, please keep up your good work answering all manner of question in the *ABJ*. You are certainly VERY MUCH APPRECIATED, even 18,000 miles away!

P.S. Western Australia is known as the wildflower state. Average yearly yield from a hive in the suburbs is about 100 kilos (220 pounds). Our casuarinas -paper bark trees flowered three times this past summer, four times in the previous year. Climate change can be weird.

Kind regards,
Dan
Wesern Australia

Q Temperate Bees In The Tropics

I'm wondering if you could shed some light on how the bees behave here in South Florida during the winter months? Does the queen slow down laying due to the *weather* and *lack of nectar* like they do in the north - or because we are tropical, does she keeps up her laying more than the north? My mentor, who has been a Massachusetts beekeeper for 35 years, isn't sure about the winter months here in south Sarasota County and we're wondering if we need to feed the bees all winter? Also, is there a list of plants that provide nectar and pollen during the winter months here in SW Florida since it is sub-tropical? Is there a list of native plants just for our zone 9, 10 that are good for bees? Also, how do you know when to feed them the sugar water mixture? Thanks again for your wonderful help to all of us!

Janice

A

Glad to be able to assist a little, Janice. Sometimes I am a little long-winded, as in my mind answers are seldom neat and tidy in the honey bee world. Bear with me a bit as I weave around your question below.

Genetically based European honey bees developed/evolved in a part of the world that had a significant most challenging season for survival….winter. These are temperate "bees" or bees that have adapted to seasons, temperature swings, daylight length changes and short, intense growing seasons as plants try to reproduce before the next winter. Some flowers produce lots of nectar to encourage quick complete pollination by insects, honey bees included, in temperate northern climates. Honey bees have adapted to collect large amounts of nectar, and have figured out how to preserve it (honey) for use during winter when there is nothing to eat and cold temperatures require more energy to keep from freezing to death. Honey is a high-energy food sought after by animals, including humans, and is the reason humans have had a close relationship to these food-storing insects for thousands of years. The beekeeping industry developed because it was agricultural food production and had individual value and societal cultural value.

European-based honey bees are valuable because they store more honey than they typically need and we can eat it, trade it and sell it. They are seasonally adjusted to respond and survive winter. In tropical/subtropical climates European genetically based honey bees do not do well "generally" year round because they have no seasonal cues as they had in temperate climates.

Brazilian beekeepers brought over African Bees in the late 1950's because the European honey bees they had were okay, but not very robust or vital because they didn't know how to biologically respond to few or weak seasonal cues. These beekeepers/entomologists thought they could breed out the defensive/aggressive characteristics. However, they didn't and we now have the environmental blunder of the 20th Century—and for us the 21st Century. We will have to see how all this works out in the long-term.

So, keeping honey bees successfully in the tropics/subtropics is a bit different. Queens are genetically programmed to take several months off in winter, but now the daylight is shorter in Florida, but not so short as to signal "winter". The temperatures are still warm, so that tells the queen she can lay and there is always something blooming. However, there is not really enough to provide suitable nectar and pollen for significant brood production. There is some of everything, but not enough for large European honey bee populations. Left alone, they are confused and stressed. Beekeepers have to feed liberally to keep the colony alive as they try to raise brood and keep large hungry populations that do not have enough natural resources to access all of the time.

Beekeepers have to monitor colonies continuously as the bees eat up stores quickly in the warm weather. Or, they do as commercial beekeepers do and use this time to split colonies and treat for varroa, waiting for January, February and March when colonies will build up again in the South Florida "spring". You still have to feed and monitor as honey bee populations increase. You have to be a good beekeeper in South Florida, as it will test your management skills. No winter cleansing there.

In the Melitto Files there has been a list of plants blooming in different regions of Florida over the last year or so. Dig out your past issues and you'll find "Management Calendars". Or, take a look at www.UFhoneybee.com and find past issues of the Melitto Files and in them will be "Management Calendars" listing possible plants in bloom.

If you have made it this far, I hope it made some sense.

Q Anise Hyssop

I am sure you are familiar with Anise Hyssop. Are there specific varieties that are best for honey bees? Do you know the amount of honey produced with an acre, for example, of hyssop?

USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. An *illustrated flora of the northern United States, Canada and the British Possessions*. 3 vols. Charles Scribner's Sons, New York. Vol. 3: 112.

A

I have read just like you have that Anise Hyssop (*Agastache foeniculum*) is a great nectar/pollen plant for honey bees—that it can support 100 colonies per acre. If that were really true, then every beekeeper would be tilling up their yards to plant it. And since they aren't, it must be 1) not true or 2) a very well kept secret. Remember the old saying that if is sounds to good to be true…?

Like all other honey plants, it is not perfect and nectar/ pollen production is variable, affected by climate, soil type, moisture, hours of sunlight, pests, diseases and competition from weeds. Many Anise Hyssop enthusiasts have found out the hard way that the plant requires a great amount of money and time to establish. It is not a matter of going out in the field with a planter and sowing 60 acres and then waiting to harvest the resulting honey. Growing a good stand of Anise Hyssop can be difficult.

However, I always encourage trying new honey plants if you have the acreage, time and money to do so. Read about the plant first and find out where it grows best and where it seems to produce the best honey crops. A great honey plant in one part of the country may be a flop in a different area. What some beekeepers do is to first find out which plants/trees grow best in their area and then they pick the best honey plants from this list.

Q Varroa Control In New Zealand

Since you worked on the research with Metarhizium, I thought you could answer a question for me. Since this fungus is being marketed for Varroa control in New Zealand, can you tell me how they solved the problems that researchers had with it here? Also, has anything been published regarding efficacy with this fungus in New Zealand?

On a completely different note, I understand that different bee dances are used for food or water sources, depending on distance from the hive. Which of the dances would be used when the hives are placed into an orchard when food is both near and far? Thanking you in advance,

Morris

A

I have heard that Dr. Mark Goodwin in New Zealand found a "different" strain of Metarhizium that was longer lived and functions well within the hive environment. If it was that great and consistent, we may have heard more about it, but I have not. Let me know if you do.

In an orchard environment many times the smell of nectar overwhelms the need for specific direction to go a certain distance since it is completely obvious where food is. It becomes a visual/olfactory exercise. Have you ever been someplace and smelled some great cooking, great perfume or a great flower aroma and can follow it to the source? You didn't need Map Quest or a GPS; you just needed your nose **first,** then your eyes **second**? Just like a honey bee.

Q Winter / Skunks

Hello, I have a question regarding my beehives. I am wondering what is the ratio of sugar to water that I should be giving to my bees for winter-feeding. In addition, I wonder how much I should be giving, if I am taking about 30 lbs. of honey from their hives. What is the sugar to water equivalent?

One more question. I live in the suburbs of Chicago and have noticed some scratch marks at the entrance of my hives. What kind of animal would eat bees?

I appreciate your time in answering my questions. I look forward to hearing from you soon.

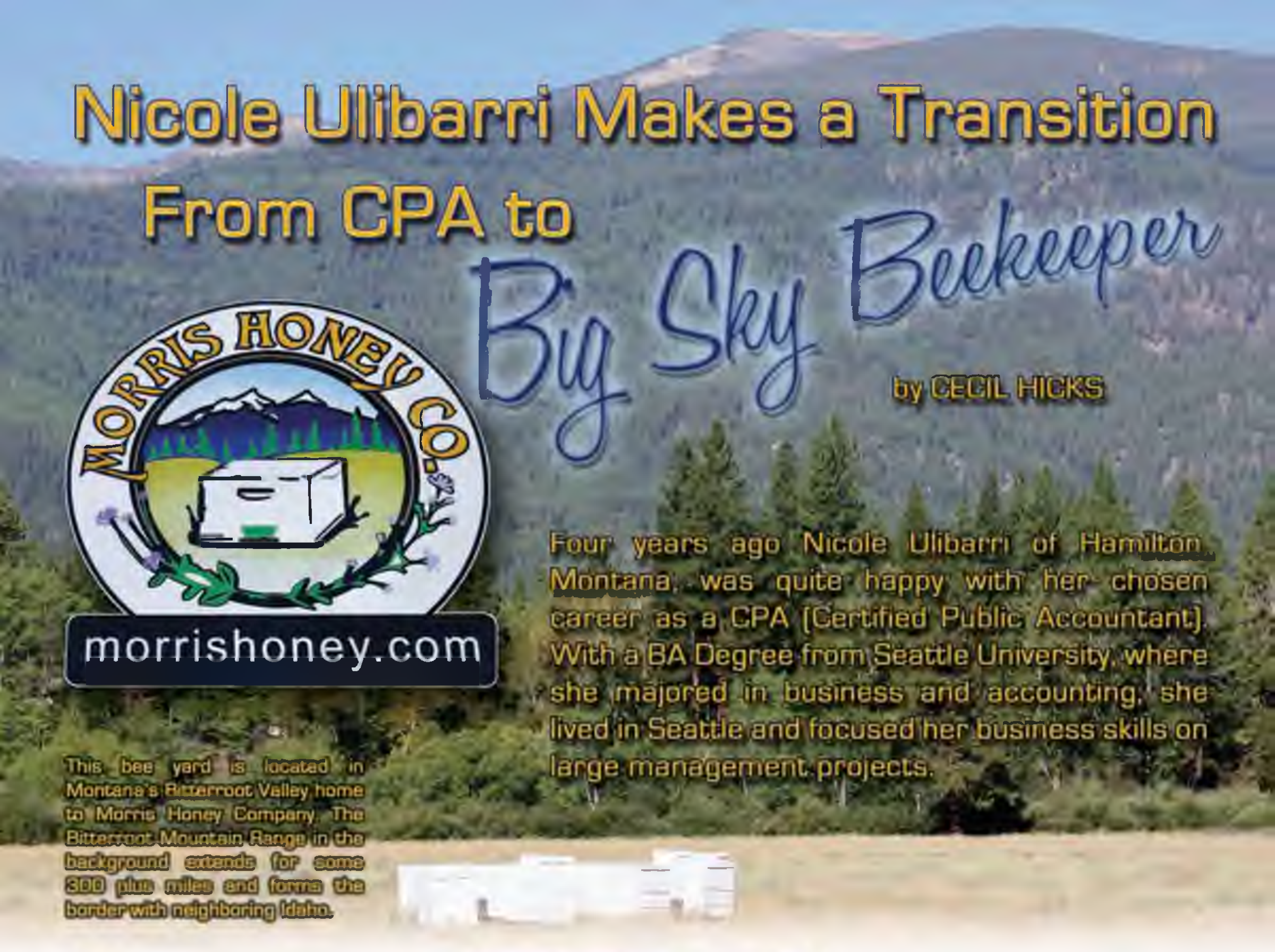
Stan

A

Stan, for your part of the country having 60+ pounds of sealed honey or stored sugar syrup replacement is the goal. If you are not at this level, a 2 parts sugar/1 part water mixture should be fed now until that minimum amount of 60 pounds is reached. To combine two parts sugar to one part water, you will need to use hot water, but be sure to let it cool before feeding it to your bees. It is getting late, Stan. Get the weight up. This may be all a waste of time, however, if varroa control was not administered in late summer or early fall, so it is your call.

Skunks scratch at the hive entrance, bees get disturbed and because it is night, they don't fly. Instead, they walk out where they are eaten—a bee buffet for the skunks!

You can discourage the skunks by adding a strip of tacks (points up) along the front entrance, some beekeepers build screen wire cages to protect the front entrances.



Nicole Ulibarri Makes a Transition From CPA to Big Sky Beekeeper

by CECIL HICKS

Four years ago Nicole Ulibarri of Hamilton, Montana, was quite happy with her chosen career as a CPA (Certified Public Accountant). With a BA Degree from Seattle University, where she majored in business and accounting, she lived in Seattle and focused her business skills on large management projects.

This bee yard is located in Montana's Bitterroot Valley home to Morris Honey Company. The Bitterroot Mountain Range in the background extends for some 300 plus miles and forms the border with neighboring Idaho.

She grew up the daughter of a large commercial beekeeper, Wayne Morris of Morris Honey Company of Hamilton, Montana, who ran some 3,000 plus beehives in the Bitterroot Valley. During her youth and on into adulthood, she had little participation in her dad's profession. Her brother, Erik, who currently works as a surety broker in Denver, had spent a couple summers when he was growing up working with his father's bees, but he too chose a different career.

Nicole's life changed drastically when her father died while on vacation just prior to Christmas of 2006. Shortly after his death she made a life-changing decision to go home to help her mother, Marilyn, decide the future of the family bee business.

Nicole said her mom, at the time, wasn't too involved with the honey business, having just recently retired from a career of her own as a local Postmaster with the U.S. Postal Service. However, after retirement, she was planning on assisting her husband in the future with honey retail sales and marketing.

Nicole explained, "Although, I'd never worked bees before, someone had to step in and take control and be in charge of the company as important decisions had to be made." Her dad had recently purchased additional bees from some regional beekeepers and had more than 3,200 colonies wintering in a Montana warehouse. There were also several part-time beekeepers on the payroll who were wondering if they were still employed and if so, what did they want them to do. Plus, her dad had already signed pollination contracts worth more than $300,000 in the almond orchards of California.


Nicole Ulibarri (l) and her mother Marilyn Morris, owners of Morris Honey Company of Hamilton, Montana, ready their honey sales display table at the start of the second annual North West Honey Fest held in September of 2010 at Stevensville, Montana.

She recalls, "In other words, it was kind of chaotic and we were in a dilemma about what direction Morris Honey Company should be taking." They'd even tried to sell the whole bee operation along with the equipment, but didn't have any takers. While still dealing with her father's passing, she made a decision to switch careers and, thus began her transition from a CPA to a commercial Big Sky beekeeper. She also had to help her mom figure out the financial situation of the company and at the same time attempt to grasp the magnitude of her father's migratory beekeeping operation.

Morris Honey Company initially began operations in Riverside, California, in the early 1940's with Wayne's dad, Walter. In 1960, Walter moved his bees to Hamilton, Montana, and yarded them in the Bitterroot Valley for the honey production season. Nicole explained that her grandfather was one of the original migratory commercial beekeepers from the state who branched out

Nicole Ulibarri (background) and her mother Marilyn Morris stand alongside their honey bottling tank at their Hamilton, Montana, bee shop. Besides selling bulk honey by the barrelful to commercial packers, they specialize in retail outlets with seven, ten and eleven ounce jars.

Commercial beekeeper Nicole Ulibarri stands inside one of her fenced bee yards in a California avocado orchard. (Photo courtesy of Nicole Ulibarri)

and began leasing bees and shipped them to California for almond pollination duties.

Walter was later joined in the bee business by his sons, Wayne and Bud. However, Bud would later get out of the beekeeping business, and it was run jointly for decades by Walter and Wayne. Nicole said Walter continued working bees well into his 90's.

With the decision made to join the family bee company, she shipped bees to California and traveled there herself and began learning the ropes from fellow beekeepers on caring, feeding, medicating and handling bees.

While it was quite a struggle and basically a "sink, or swim learning experience," she managed to survive the first year of operations in the California almonds and later the honey production season in Montana.

Later, back in Montana, they (she and her mother) were faced with rebuilding new hives, buying nucs, requeening and reviewing the costs of maintaining and figuring out her dad's complex migratory beekeeping methods. During the honey flow season it meant covering a large territory by bee truck and weekly inspection and supering of yards.

Although they searched through all his papers, records and files, they never could find a complete list with locations and names of landowners of all his numerous bee yards. While Marilyn knew where some of his yards were and they did find a few named, they concluded that he must have kept most of this list in his head as it's kind of hard to know where the "broken gate yard" was.

However, her second year in the bee business was a total disaster. Nicole recalls, "While our bees were in California between the fall and winter of 2007-2008, we lost 2,500 hives and at the same time a large outbreak of CCD had been striking numerous bee outfits."

She was in shock from the vast number of bee colonies lost as this new phenomena devastated her bee yards destroying seemingly healthy hive after healthy hive. In spite of her best efforts, she was only able to salvage about 400 hives. "This situation put our company in a very tough time," she explained.

Again, they thought about selling off all the company assets, but after strategizing, they decided instead to scale back and raise fewer bees, diversifying sales in other markets and taking the company in another direction.

Nicole stated, "We decided to evolve the company into a business that would work for both of us and looked for a balance. In other words, I didn't want to be on the road living out of a motel all the time."

(l) Scott Debnam, holding a honey super frame, and Jerry Bromenshenk, both members of Bee Alert, Inc. (a Montana bee research organization) from Missoula, gave talks and demonstrations on beginning beekeeping for visitors attending the 2010 North West Honey Fest in Stevensville. (r) Rick and Barb Molenda (r) of Western Bee Supply Company (one of the nation's largest beekeeping woodenware suppliers) out of Polson, Montana, were on hand to answer questions about beekeeping supplies at the North West Honey Fest.

(l) How sweet it is. These honey tasters on the right side of the table enjoy a small taste of honey when they visited the large tent housing Montana State Beekeepers Association (MSBA) honey tasting table during the honey fest. Beekeeping volunteers (on the left side of the table) include Nicole Ulibarri (left foreground), MSBA's president, help answer questions about the many kinds of honey present. (r) Morris Honey Company sells gift packs of honey as well as lavender flowers from their headquarters in the Bitterroot Valley in Hamilton, Montana.

Marilyn summed up her feeling about the situation at the time when she said, "We had nowhere else to go but up."

Today, Nicole runs the day-to-day bee operations. They've rebuilt their colonies up to 1,200, which is enough hives to ship out in three semi-truck loads. She plans to maintain that number as she can handle them by herself with only having to occasionally hire part time help as needed. Marilyn has taken over the bookkeeping, warehousing, extraction duties and marketing sales. Marilyn said that once they start extracting she hires two other workers.

Nicole likes to think of herself as being the outside beekeeper and her mom the inside beekeeper.

Besides selling bulk honey by the barrelful to a national honey packer, they also have local retail outlets in both Montana and California that include sales to the specialty honey market and honey sold through their web site at www.morrishoney.com.

Additional sales markets away from traditional honey outlets, include supplying honey for a Bitterroot Valley mead wine maker, Hidden Legend, and setting up colorful retail sales beehive displays at Quality Supply (a farm and ranch agriculture store) at four sites in Montana (Hamilton, Missoula, Dillon and Butte).

Morris Honey's eye-grabbing honey sales display in the Quality Supply stores has to be a blue ribbon winner. Nicole described the display as having matching colors of Morris Honey Company, which include white bee boxes sitting atop blue pallets. The display holds six and 11 ounce honey jars, three-jar 10 ounce gift packs and four-jar seven ounce gift packs. The display in the Hamilton store held a variety of orange, clover and wildflower honey.

Morris Honey Company also owns 32 acres of land near Hamilton where they've planted a field of lavender plants. Besides making honey from these flowering fields, they've found a sales market outlet in flower shops and commercial buyers have purchased their flowers for the cosmetic and essential oils industries.

Nicole said the bees did quite well in the almond orchards in California this year and hives were very strong. Because of the wet weather this past season, she changed the traditional migratory cycle established by her father. All bees stayed in California until June. In the spring, following the almond pollination season, she moved all her hives into either honey production (orange groves and wild sage), or pollination of avocado groves.

In June Nicole shipped a majority of their bees north for summer honey production with 800 colonies going to a commercial North Dakota beekeeper for the honey season. The honey from these bees would be extracted in that state. Meanwhile, she stayed in California with the remaining hives for the production of sage and buckwheat honey.

In the fall of 2010, when the honey season is finished, Morris Honey Company bee colonies will again make the return to California where they'll be inspected, gone through, medicated and fed while waiting for the almond pollination season to start.

This Morris Honey Company sign on the side of their family-owned large bee shop in Hamilton, Montana, has been their headquarters for nearly half a century.

Their bee equipment is in both Montana and California. They maintain a large 10,000 square foot honey shop/warehouse on Hamilton's main street (which is also Highway 93). They've owned this bee shop for decades and it holds an extraction room (with a 60-frame Cowen extractor), wood shop, bottling room, hot room, and a large storage area storing supers, forklifts, trucks and barrels. Marilyn said, "We've even built a one bedroom apartment in the loft over the extraction and hot room for a possible future rental income."

Nicole is a member of the Montana State Beekeepers Association (MSBA), which has a couple hundred members, of which about 50 are commercial beekeepers. She is the current president of MSBA finishing her second year term. When her father died, he was the vice president of MSBA, and she assumed his position in the organization. Then, the following year she was elected president. She is also a member of the American Beekeeping Federation.

According to state beekeeping records, the state of Montana is in the top ten in honey production in the U.S. and also the fifth leading exporter of bees for commercial crop pollination.

On Saturday, September 11, 2010 as part of National Honey Month, the town of Stevensville, Montana (located 25 miles south of Missoula in the heart of the Bitterroot Valley and a few miles from Nicole's home town of Hamilton), held its second annual Northwest Honey Fest in the town's Lewis and Clark Park. This event, honoring honey bees and beekeeping, is co-sponsored by the MSBA and the Stevensville Main Street Association.

Nicole said that Morris Honey Company was one of the main sponsors of this event and as president of MSBA, she was also responsible for helping organize the activities, requesting attendance of Montana bee industry personnel, contacting beekeepers willing to bring honey to sell, setting up tasting tables and soliciting helpers.

Nicole stands alongside one of her eye-grabbing honey sales displays located in four of Montana's Quality Supply feed and agriculture stores. She describes the display as having matching Morris Honey Company colors which consist of white bee boxes setting atop blue pallets. The display bee box fronts are actually swinging doors with enclosed storage shelves that hold additional honey jar inventories.

Some other bee industry sponsors who had displays at the honey fest in the education pavilion were Western Bee Supplies, Inc., out of Polson, Montana, and Bee Alert Inc. (bee researchers) out of Missoula, who gave well-attended demonstrations on setting up beehives and how to extract honey. This was basically a very condensed Beginning Beekeeping Course 101.

As president of MSBA, Nicole was on hand at the honey festival manning an educational booth answering beekeeping questions, selling honey and providing honey-tasting samples. Honey set on the tables for sampling included orange blossom, black sage, sweet clover, knapweed, wildflower, raspberry, sourwood and buckwheat. Nearly 3,000 visitors attended this event that celebrates the importance of honey and the beekeeping industry in our nation's culture and economy.

Besides honey sales from local Montana beekeepers, beekeeping equipment displays, arts and craft vendors were on hand along with musical entertainment. Nicole explains that it (the honey fest) was a good time to continue educating the public about the importance of honey and beekeeping to our country.

She said the one good thing that came out of the current bee industry-wide crisis concerning CCD is public awareness as more and more people realize the important role honey bees play in our food production.

As the autumn of 2010 approaches in the Bitterroot Valley of Montana, Nicole Ulibarri has finally made the transition from being a CPA and joined the ranks of other state commercial beekeepers. In her four-year journey at Morris Honey Company she has overcome the passing of her father, stepped up to numerous challenges of running a complex honey bee company, dealt with devastating CCD problems and took on the duties as president of the Montana State Beekeepers Association. All-in-all, under the circumstances, she feels pretty optimistic about the future of Morris Honey Company and her new life role as a Big Sky beekeeper.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The Traveling Beekeeper

So you want to live off the bees?

by LARRY CONNOR
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A visit with a Colorado beekeeper who left a state government position to develop his beekeeping into a full-time income.

Many beekeepers dream about leaving their job and working bees enough to justify an adequate income. Many of the people who do this have a husband, wife or partner who has a good job with benefits so the beekeeper is in a position to walk away from the 'unrewarding' position at work and follow their 'passion' as a beekeeper. This is a visit with a beekeeper from the Denver area who has done this. He is not yet where he wants to be, as are many of the readers—and is in a period of growth and transition.


One of the bee trees Kentner is moving into Langstroth equipment.

Matt Kentner is a 40-something beekeeper with a wife, Cathy, who is a music teacher. They have two daughters, aged 5 and 10. They live in a Denver suburb called Lakewood on a lot that is large enough for a horse, but already has too many bees but understanding neighbors. Plus, as you will see in the photos, the city bees are pretty well screened from view. Here is my visit to Matt Kentner of Kentner Farms (www.kentnerfarms.com).

Kentner is from Minnesota and Iowa, attended chef school in Minnesota, and worked as a baker in Steamboat Springs turning out hundreds pounds of bagels every day, plus getting time to ski and enjoy the local recreational opportunities. Then, he went to work for the State of Colorado as a computer specialist. But he walked away from that, and he and his wife are growing the beekeeping business. Early on they sat down and Cathy, the math person in the relationship, figured out how Matt could get the bees, equipment and bee truck by paying cash and not going into debt as he built up bee colonies. When I visited him he had about 75 colonies, with the goal of reaching 400. He produces primarily alfalfa honey packed into an attractive, well-designed jar and label combination that helps him earn a premium price. He recently went through the application process to sell honey through the Denver Whole Foods, a process that impressed him for the chain's passion for food quality and food safety.

My first instinct to interview Matt was when he gave me a jar of his chunk honey during two days of workshops I was doing with DenverBee.org (Denver Beekeepers Association). The jar is a 12 oz hex jar with a neatly cut chunk of honey surrounded with


Tree cut to reveal the honey comb inside. Kentner provides a bee "relocation" service.


Tool belt with two hive tools, hammer, bee brush, spare hat and other items. Note the smoker is on a hook to keep it near working distance.

Brushing the bees off the honey frames inside the super. Kentner does not use chemicals to repel the bees.

brilliant honey (he uses sweet clover for this). When I figured that he was probably the most experienced beekeeper in this new group based in Denver (beekeeping was banned there until recently), and I sensed his interest in learning, I made arrangements to visit him at his Lakewood site. There he has a storage building, but has taken over a back room of the house for his extracting room which doubles for honey storage. The room is neither large nor fancy, but it has white walls and ceiling, and is clean. Buckets of honey are stacked to the ceiling for bottling as the year goes on.

It was mid-October, and the day after my first visit, I received a call from Matt from one of his bee yards about 35 miles northeast of Denver where commercial alfalfa hay irrigation circles provide the farmers with four cuttings a year. While alfalfa hay should be cut before blooming, according to the nutritionists, the growers must be permanently late, since there is enough of a nectar flow to keep the bees on a strong flow from May to early October. Matt constantly removes honey and replaces the extracted supers. He works systematically to move the honey frame by frame, brushing the majority of the bees off the frames as he removes them. He knows to keep empty drawn comb on the colonies to increase honey production by the colonies.

Because of the low humidity of the mile-high area, the honey is often only 18 percent moisture, even when still uncapped.

Home apiary

The home apiary is tightly enclosed with a

Matt uses screws to hold the hive bodies apart, and places hardware cloth at the entrance as a mouse guard.

Plastic buckets filled with honey from alfalfa flowers.

system of shrubs and roll-up fence so bees may be brought in and removed easily. There are too many colonies in the apiary, but the neighbors are not an issue, and eventually the colonies will be put into permanent out-yard locations. There are a combination of regular hives and bee trees that need to have the bees removed.

Honey bee relocation services (If you have Honey bees living in your house, we can give them a happy home).

That is the phrase from Matt's website. One reason there are so many bees in the home apiary is the pressure Matt has on removals, bee tree salvage and capture of swarms. This combines the need for community service as an urban beekeeper with a way to charge a fee for cutouts and other bee removal fees. Matt and I did not discuss what he charges, but I have noticed that many cut-out services are charging about $100 per hour for their time, with a minimum fee of $300 to $800 per removal, depending on the local market (and that does not seem to be determined by the affluence of the residents). These fees seem entirely fair with the amount of work and equipment required for some of these jobs.

Matt with uncapper and pointing to his filled buckets of honey.

Kentner places hives on old wood pallets to keep them off the ground and out of the weeds.

Honey marketing

Honey is extracted in a small room attached to the house. You go through the garage to get into the house, so there would seem to be a natural buffer to keep bees out of the main house. The room has white walls and has a simple uncapping system and extractor. Honey is stored in clean white plastic (and food grade) buckets in the same room, and is hoarded to keep local honey sales alive. Honey is sold in a small honor display at the end of the driveway. A sign directs customers to the small case containing several one-pound and several two-pound containers of honey. Matt reminded me of my opening of *Increase Essentials*, where I wrote that I had driven many miles in the Midwest and had not seen a **Honey For Sale** sign. I admitted that that has really changed with the addition of new beekeepers such as himself. The honor honey sales provide a nice income stream every month.

The hex jars Matt uses for his chunk honey are not cheap, nor are the glass jars he uses for the liquid honey, but they are part of presenting an attractive product to the public. If he is able to get into Whole Foods, he will need to increase his output considerably. The challenge will be to produce enough of his low chemical use honey, and fill the needs of the natural foods market.

A growing part of the honey sales are on the Internet using a great website (**www.kentnerfarms.com**) where Matt was able to use some of his computer background to full

Transferring honey frames to an empty box. Using only the bee brush, Kentner moves all of his honey one box at a time to his truck.

Honor system holding honey for sale at the Kentner Farms driveway.

Inspecting honey outside Denver. The front range of the Rocky Mountains is in the distance.

Matt Kentner in one of his apiaries.

advantage. The attractive medieval painting of a three skeps and bees flying around it is the Kentner Farms branding effort, one that links the honey, the business and the beekeeper together.

Tricks

I always learn from beekeepers when I do a visit and I want to share a few things that I have seen before and one I had not seen until Matt showed me.

First, the hives in the out apiary are all screwed together, making them tight and less likely to pull apart. This will also make future repairs possible.

Second, Matt wears a tool belt with room for two styles of hive tools, a bee brush, a small hammer, a white hat for when the bees get peppery, and a few other items. Unlike me, he tends to put the tools back into the belt and not leave them around on the hives, although he admitted he likes the dry fall when he can find the items lost in the lush vegetation of spring and summer.

Third, Matt removes honey continuously during the season. The moisture content is low and he knows he needs to keep empty drawn comb on the hives in order to stimulate nectar gathering. He takes off the honey one box at time, carefully removing the bees and placing the super in the truck under a bee-proof lid. With the giant irrigation circles of alfalfa, it seems likely that there are plants in bloom for his bees to reach most of the May to October season. He notices an increase of other nectar plants in the areas where he places bees, probably due to increased pollination. For biennials and perennials this has taken several years to be fully expressed.

A combination of rolled fence and vegetation hides the hives in a suburban lot.

Compared to beekeepers who pull honey at the end of the season, Matt is stimulating his bees to gather more honey by replacing the extracted supers of drawn comb, a known foraging stimulant.

Fourth, and a new trick for me, Matt uses the bee brush to remove *bees while the combs are still in the super*. By doing this there are fewer bees in the air. Matt does not like to use chemical removal products, since he feels that they interfere with the social nature of the bees and his own social acceptability when some is on his clothing.

Fifth, Matt likes to wear shorts, a T shirt (which may be removed when the bees are agreeable), a baseball type cap, and no veil. While the veil is in the truck if the bees get peppery (and they were the day I visited), most of the season his only protection is the smoker (which he lights with a small blow-torch).

Sixth, Matt uses a hammer in two ways that I observed. First, he uses the hammer and hive tool to separate the hive bodies. There are mainly cottonwood trees in the area, and the propolis was especially effective at gluing the hive parts together. He uses the hammer to gently push the hive tool between boxes in order to get good separation.

The hammer is also at hand to nail down the plywood migratory lids he uses. Some have rabbets and other lids are cut to fit the Langstroth supers. With propolis buildup he is able to use two nails on most hives, but can tack down the ones where there are gaps. This produces a tight hive.

Medieval print Kentner Farms uses for branding products and in publicity.

For ventilation, the second hive body of each hive has a vent hole entrance. He winters in two deep hive bodies.

Fifteen minutes of fame

Matt asked that I not do a story on him since he has been in the local media because of three hives he placed on the top of the Brown Palace Hotel, one of the finest in Denver and where Presidents stay. The roof-top honey is a milestone for Denver, where bees were illegal until Marygael Meister took on the battle and started Denverbee.org. You can see photos of Matt and his roof-top hives at the hotel website; www.brownpalace.com. Click on the bumble bee logo for the story about the honeybee hive that produces honey for afternoon tea. I love the fact that few artists have had one drop of biology in their training. Let me get them into a bee yard!

Making it work

Kentner Farms will provide a new beekeeper the equipment they need. Or you can pay for his service that provides "a full years management, honey extraction, medication/ treatments and feeding. Private beekeeping lessons are available by appointment." Here are the three points Matt makes in his well designed (remember he was in computers) website:

"Customer satisfaction: if you are not 100% happy with honey, candles or anything you have purchased from us, please let us know.

Sustainability: We practice beekeeping with long-term goals in mind. This means thinking about how my children and future generations will keep bees and looking for non-chemical solutions for honey bee pests and diseases.

Local food: What can you say about this generally the closer to home the better."

I hope to keep up with Matt in the future, and report on how he is doing with all these activities.

Dr. Connor will conduct the Sixth Serious Sideliner Symposium at the Mega meeting in Galveston, Texas in early January. He will also have his book display at the meeting.


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In Honor of Lorenzo Lorraine Langstroth's 200th Birthday Dec. 25, 2010

The Father of American Beekeeping

BY ALYMER J. JONES

This story by biographer, Alymer Jones, Malden, Mass., summarizes the facts in the life of the Father of Practical Beekeeping. The real fame of Langstroth rests on his discovery of the bee space, not on his hive or equipment which led to so many patent litigations.

It would be difficult to imagine any review of apiculture that did not include a summary of the life of the greatest beekeeper of the all, Lorenzo Lorraine Langstroth. Without his discovery of the principle of the bee space as applied to the moveable frame hive, it is safe to say that beekeeping today would be far more primitive. By all means, let us review the history of this remarkable man, whose fertile imagination has meant so much to so many of us.

Langstroth was born Dec. 25, 1810 in Philadelphia, PA., of English descent, and was the second of eight children. According to his own "Reminiscences" (*Gleanings in Bee Culture* 1892-3), he was unusually interested in insects, even as a small boy. A good scholar, his father sent him to the University of Pennsylvania. At the age of 17 he went to Yale College where he made Phi Beta Kappa. Upon graduation from the college, he entered Yale Divinity School. It now became necessary for him to provide his own finances and he made his way by tutoring, often at schools for young ladies. This was a vocation he was to turn to from time to time during his life as a minister.

In 1836 Langstroth accepted his first pastorate as minister at the South Church in Andover, Mass. During the first year at Andover, he married a minister's daughter, Anne Tucker of New Haven. A son James was born to them in July 1837. Also during his sojourn in Andover, he visited the home of a friend who had some colonies of honey bees in his attic. Langstroth was so interested, he at once bought two colonies in box hives. Books were few and misleading. He felt he had to learn the natural history of the insect from his own efforts, and it is well that he came to this conclusion. At the end of two years, the young minister found himself not equal to the task of being pastor of so large a parish. Also he was subject to severe nervousness and even melancholia—an illness that was to follow him through life.

For six months the minister-amateur beekeeper taught school in Andover, and again had a nervous breakdown. In 1840 he became principal of a girl's school at Greenfield, Mass. That school building adjoins a church of which he later became pastor of the Second Congregational Church of Greenfield. On the lawn of the church stands today a tablet to Langstroth's memory, erected by the beekeepers of America. Of this church, our benefactor was pastor from 1843 to 1848 at which time the old "head trouble" incapacitated him again, and he resigned.

Langstroth had not, however, abandoned his interest in bees. As soon as he had moved there from Andover, he had acquired a log bee gum. According to his own ac-

The best known picture of Father Langstroth. It shows a benevolent face and his characteristic glance over the top of his glasses.

This is a less well known picture taken at a younger age.

count of this period:

> I learned by diligent inquiries of the best beekeepers in my vicinity, all that they could teach. But this was not much . . . About this time I was fortunate enough to get two valuable works. . . Huber . . and Bevan . . . . I soon became the happy owner of an improved Huber hive and several bar hives.

It should be explained here that Huber's hive was the so-called "leaf" hive. It was made of frames hinged together and opened like a book. It was practical only for observation, but was a great advance over anything previously known for that purpose. Bevan's bar hive was so engineered that the bees would build comb suspended from the bars and the bar of comb could be laboriously removed only by cutting it loose from the hive. Once can hardly imagine the disturbance to the colony and inconvenience to the beekeeper. Various attempts had been made to improve on this, but the best was not good. Dzierzon's hive was a bar hive with a door in back, but still required cutting.

The Reverend finally moved back to Philadelphia in 1848 and there again opened a school for young ladies. He was still engrossed in the problem of a hive that could be manipulated when he established an apiary in the attic of his Philadelphia home in that city. Soon he had an apiary in West Philadelphia about 2 miles distant. In this apiary he experimented with hives of different sizes—mostly made of stock size lumber in such widths as would be readily obtained from the lumberyard. In pondering the problem of a hive from which honey could be readily taken and the brood inspected, he gave his first attention to the covers, which, of course, were propolized down, as there was no space between them and the tops of the combs, or bars.

One certain experiment was the first step towards the modern Langstroth hive. He cut the rabbets for the Bevan hive bars 3/8ths inch deeper into the wood. Why he chose 3/8ths does not appear—if this dimension was accidental, it was a happy accident, for although larger than today's accepted bee space of 1/4 inch, give or take a 1/16th, it served to prevent propolizing and comb building. From there it was a short step—but important—to the movable frame. Langstroth's own account cannot be improved upon.

For his own complete report see Vol. 21 No. 4 page 116 *Gleanings in Bee Culture* for Feb. 15, 1893. Other references and sketches appear in his diary or journal on display at the Mann Library at Cornell.

> In the fall of 1851 I had nearly completed my application for a patent upon my improved bar hive. It will, no doubt, appear very strange to persons not familiar with the ordinary progress of inventions, that the shallow space between the tops of the bars and the board on which the receptacles for surplus honey rested, and which I proposed to make one of the leading features in my patent, did not at once suggest itself to me that uprights might be fastened to the bars, so as to give the same bee-space between the front and rear walls of the hive, and so change the slats into movable frames. But I used the shallow space above the bars, for a whole season, without ever connecting the two ideas; and then, only when it was too late to make any use of it in the apiary for that year, did the simple idea of the movable frames present itself to my mind. Returning late in the afternoon from the apiary which I had established some two miles from my city home, and pondering, how I could get rid of the disagreeable necessity of cutting the attachments of the combs from the walls of the hives, and rejecting for obvious reasons the plan of uprights, close fitting or nearly so, to these walls, the almost self-evident idea of using the same bee-space as in the shallow chamber came into my mind, and in a moment the suspended movable frames, kept at suitable distances from each other and the case containing them, came into being. Seeing by intuition, as it were, the end from the beginning, I could scarcely refrain from shouting out my "Eureka" in the open streets.

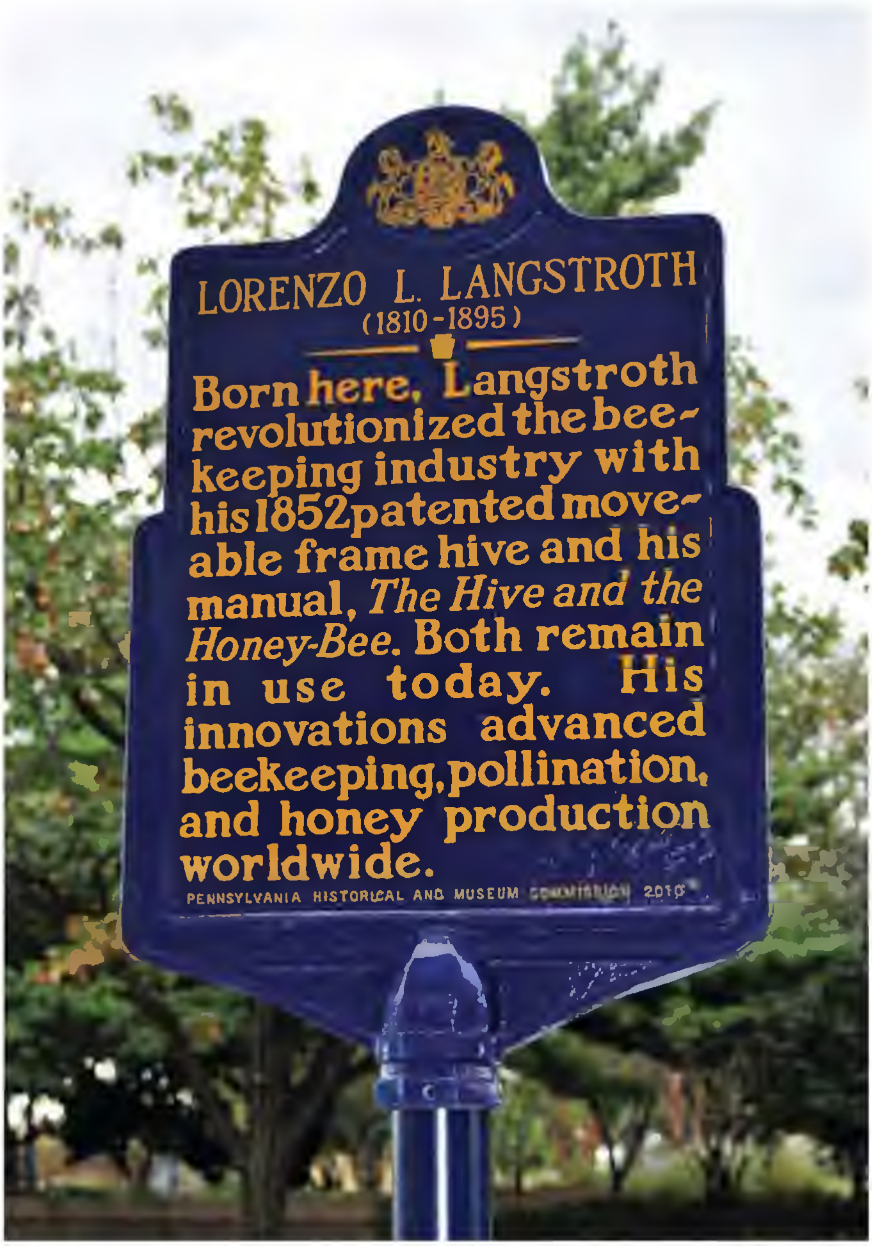
And thus on Oct. 30, 1851 modern beekeeping began.

Let us consider here the significance of the discovery of the bee space and the invention of the movable frame. Prior to the availability of a hive incorporating these features, many colonies were kept in skeps and log gums. The best colonies were destroyed when it came time to take off the honey. True, some advanced apiarians were able to induce the bees to go into a chamber and store honey in glass and/or wooden receptacles which were movable, but many, many colonies were simply destroyed. This acted as natural selection in reverse. The best were sulphured, and they bred from the mediocre. It is interesting but unrewarding to speculate on whether or not any desirable dominant genes were lost to the overall bee population in the process. Up until Langstroth's "revolution" keeping bees was hazardous and distasteful to many. Diseased colonies could now be quickly recognized and destroyed. Hive manipulation in general and queen breeding in particular got a new impetus. The invention paved the way for eventual genetic breeding. Uniting and dividing became more practical. Whole systems of swarm control were opened up. In short, all our present day systems of keeping bees became possible.

Soon after discovery of the bee space and invention of the movable frame, Langstroth became ill again, and sold his apiary in 1852. He separated from his family and moved back to Greenfield to live with relatives. His wife obtained employment as a teacher. Langstroth's idea, when he regained some equilibrium, was to go into the manufacture of his new hive, under the protection of a patent which he obtained. But under the

(r) Andover, Mass., L. L. Langstroth plaque "Erected in the centennial year of his discovery of the bee space and his invention in 1851 of the moveable frame which made modern beekeeping possible."

(below) In September 2010 an official State Historical marker of L.L. Langstroth's birthplace in Philadelphia, PA was dedicated in honor of his 200th birthday. (Photo by Bill Mondjack)



urging of friends he wrote *The Hive and Honeybee*. This became a standard work on beekeeping. It is characterized not only by clear, and at that time revolutionary, ideas on beekeeping way ahead of their time (i.e. winter ventilation, etc.) but by a splendid vocabulary and a flowering philosophical style that imparted fine lessons in morality, as well as in beekeeping. Later editions lost some of this flavor. Samuel Wagner had translated Dzierzon's German book on beekeeping into English and was all ready to publish it, but made a great personal sacrifice by abandoning his project in favor of encouraging Langstroth in his book. Wagner later established the *American Bee Journal*. Quinby came out about that time with a good book, but it was behind the times compared with *The Hive and Honeybee*. In 1853 *The Hive and Honeybee* was ready for publication and was brought out by a firm of Northampton, Mass., publishers. It met with success and went through four editions and many reprints. Eventually the rights to further revisions were acquired by the Dadants and they brought out many revisions to include foundation, extractors, smokers, and other inventions that came after Langstroth lost interest in making his own revisions. Their editions were translated into many foreign languages. Eventually, it was laid aside in favor of today's *The Hive and the Honey Bee* which is a symposium on beekeeping by the best modern experts in each phase of the study.

Although engrossed in his new book, our subject did not forget his hive, which had been patented as stated, just before his removal to Greenfield. The story of the hive, insofar as profits derived by Langstroth are concerned, is a sad one. Never a business man, and troubled by his "head trouble," he did not have the commercial acumen to exploit his invention. Friends organized a manufacturing company which sold both hives and rights to make hives on his pattern. However, infringements were common and litigation sapped what profits there were. Langstroth never did receive his just financial rewards on the hive. Thanks to the Dadants, he fared better on his book.

It was during this second residence in Greenfield that Langstroth is known to have been very friendly with W. W. Carey, a woodworking mill owner of nearby Colraine. The association was fruitful for both men. E. R. Root is authority for the statement that Carey made, under Langstroth's instruction, the first complete genuine Langstroth hive and tested it in his yard at Colraine.

In 1858 after six years this second time in Greenfield, Langstroth moved to Oxford, Ohio and his family was reunited with him. Our ex-minister took up active beekeeping, became a frequent contributor to the journals, and was active in the national beekeeping organizations. In these latter years, although he suffered some indignities, he was on the whole respected, a respect which grew as the years passed. He was particularly interested in the effort to import new honey bee races, especially the Italian. He joined with a government agent Parsons in such a project, which was successfully concluded after many narrow escapes at Flushing, Long Island about 1860. He delegated the detail work to his friend Carey. One draws the inference from Langstroth's own writings about this project that he, Parsons and Carey were the first to successfully propagate *permanently* such an importation.

Mrs. Langstroth died in 1873. His son had already passed away. His daughter and son-in-law came to live with him at this juncture. After 1874 he never had more than a few colonies. His "head trouble" became worse and in 1887 his son-in-law moved to Dayton. Langstroth died there on Oct. 6, 1895, while giving a sermon as a guest preacher in a local church.

For those who want a detailed biographical account of this great man's life, the definitive work is no doubt Florence Naile's "Life of Langstroth" Cornell University Press. Also Langstroth himself wrote his own "Reminiscences" for *Gleanings* in 1882-83, but they were never finished. At least three tablets or plaques have been erected to his memory and one garden of honey plants established—that at the Morris Arboretum at the University of PA. The tablet at Greenfield, Mass. is typical of the sentiment on all and reads in part:

> **Lorenzo Lorraine Langstroth . . . Inventor of the movable frame bee hive which made modern beekeeping possible in 1851. Scholar, Observer, Author, Friend of Mankind, this tablet is erected as acknowledgement of the debt of beekeepers of the world to his skills and unselfish leadership.**

(Reprinted from February, 1960 *American Bee Journal.*)

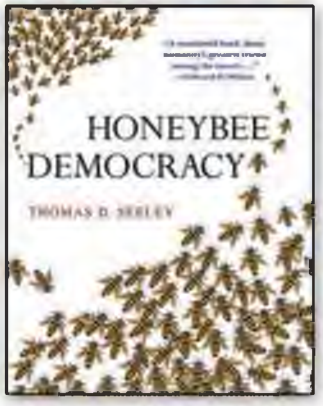
Swarm Intelligence:

How Tom Seeley Discovered Ways That Bee Colonies Make Decisions

Part I

by M.E.A. McNeil

A quest into the behavior of honey bee swarms is told in a new book destined to become a classic.



Jacket design: C. Alvarez-Gaffin

Here is one of the great stories in biology: how honey bees swarm, find nest sites, choose among them and resettle.[1] It is a hard-won tale of scientific discovery, painstakingly pieced together one bee at a time over decades and told in a wondrous new book, *Honeybee Democracy* by Thomas Seeley.[2]

Seeley, an entomologist and professor in the Department of Neurobiology and Behavior at Cornell University, is also, as our luck would have it, a gifted storyteller. He is in a lineage of honey bee researchers who approach their work as ethologists – scientists who prize field work over the lab. An originator of that perspective was Karl von Frisch, an Austrian biologist who deciphered the bee dance language in 1944, for which he was eventually awarded the Nobel Prize. His student at the Zoological Institute in Munich, Martin Lindauer, began the investigation of swarms in the 50's that Seeley has continued since 1974.

It has long been known that colonies of bees cast swarms, most often in the spring. About a third of the colony remains to rear a new queen and the old queen leaves with a swirl of some 10,000 bees, pausing to hang in a cluster before moving on to a new nest. How does this happen? No one knew.

Lindauer happened on a swarm and stopped to watch it. He saw bees dancing on the surface, much in the manner of the foragers he had been studying with von Frisch. But these bees did not have pollen loads or offer drops of nectar to other bees. What's more, they were dirty with soot or brick dust from the bombed-out city. Could the dancing bees be nest scouts reporting their finds in the way that foragers report food sources? He started to look for answers, as he'd learned from von Frisch, with a period of watching and wondering. He marked large numbers of dancing bees in a swarm with a laborious coding scheme of multiple colored dots. He observed them for days, noting the direction and distance of each dance for a dozen or more different sites until, just before departure, all the dances pointed to the same destination. He raced through the city to find nest sites mapped by the bees, and he found them; the dancers were indeed scouts.

Lindauer went on to show that the scouts make a group decision to select the optimal site. It was a pioneering discovery in behavioral biology—collective intelligence in non-human animals, greater than that of the individual. Lindauer left a "solid foundation of knowledge" that Seeley acknowledges as the genesis of his work.

Seeley was born in the second summer of Lindauer's swarm studies and grew up in upstate New York, watching and wondering in the wilderness near his home. He was "mesmerized by the intricate behaviors of the individual bees and by the peace of their great community." In college, he majored in chemistry with the thought to someday

Tom Seeley speaking on his new book *Honey Bee Democracy*, at the California Academy of Science in October, 2010. Photo: Jerry Draper

decode the pheromonal signals of the bees. During summers, he worked at the Dyce Laboratory for Honey Bee Studies at Cornell University directed by Roger A. Morse. In 1974 he began graduate studies in entomology at Harvard. His thesis advisor, Bert Hölldobler who had studied under Lindauer, had been brought to the University to introduce ethology — a seismic shift in the study of biologic science. Hölldobler, together with E.O. Wilson, described the approach as:

a thorough, loving interest in — a feel for — the organism, especially as it fits into the natural environment. Learn the species of your choice every way you can, this whole-organismic approach stipulates. Try to understand, or at the very least try to imagine, how its behavior and physiology adapt it to the real world. Then select a piece of behavior that can be separated and analyzed as though it were a bit of anatomy.[3]

"I was so incredibly lucky to start at Harvard as a graduate student, so lucky to learn to know an animal without any experimental manipulation. I didn't know that tradition until I met Hölldobler," said Seeley.[4] As his subject, he chose the mysteries raised by Lindauer's study of honey bee swarms more than 20 years before.

It made sense to begin by discovering the characteristics of a functioning natural nesting site. Following Lindauer's advice "to ask the bees themselves about this matter", he set about finding forest colonies with a newspaper ad promising "$15 or 15 pounds of honey" for a bee tree. He assembled chainsaw, steel wedges and maul and teamed up with an ex-logger to cut and dissect 21 bee nests. After cutting out the combs, he measured the cavities with sand, also assessing the openings of as many left standing.

He found that the bees did not have a preference for particular tree species. But, to his surprise, they occupied spaces a quarter to half the size of those provided by beekeepers – a volume on average the size of a deep hive body, about 45 liters (about 41 quarts).

How did this space relate to the needs of the bees? Unique among social insects that live in cold climates, bees are not dormant in winter. Their nests are heated by bees repeatedly contracting their metabolically active flight muscles, disengaged from their wings. Leaving out the pleasure of Seeley's systematic analysis, it can be summed up thus: a flying bee burns 25 times as much energy, relative to weight, as an Olympic rower – an expensive outlay of energy. But a small number of bees can heat a protected cluster with much less energy — the equivalent of a small incandescent light bulb. To retain the heat, it appeared that the bees choose a sheltered cavity of an optimum size.

To further refine the bees' criteria for nest choice, Seeley built 200 nest boxes at the woodshop in the Dyce Lab in the winter of 1975. Each box in a cluster varied in volume, opening size, orientation, draftiness, height, presence of combs. Again, the intriguing story of the process is left for the reader to enjoy in the book: What he found was that the bees prefer a small, easily guarded entrance facing south to provide a warm take-off, an entrance at the bottom of the nest, perhaps to minimize the loss of heat, and a space about the size found in bee trees, especially one with combs – anything between 30 and 60 liters. But the bees accepted otherwise optimal spaces with holes, which they promptly sealed with propolis, made from tree resin.

Seeley found that his study bees required 20 or more kilograms (44+ pounds) of honey to overwinter. He calculates a minimum nesting cavity size for the storage of that much honey to be at least 18 liters (about 16 quarts). So choosing a site that is too small, too large to heat, too exposed, or too close to the ground could be fatal. Seeley found that the bees almost always made the best pick among his boxes. "A colony achieves near-perfect accuracy when it selects its home. It is a life or death matter," he said.

On Appledore Island off the southern coast of Maine, Seeley worked in an environment without nest sites or bees, other than those he brought. "I had learned to make an artificial swarm by shaking a colony into a cage to render them homeless and then feeding them lavishly with sugar syrup to get stuffed with food like natural swarm bees," he said.[5] He'd learned from underfed swarms that went nowhere.

In an inauspicious start, he had to finesse his first swarm out of the chimney of a curmudgeon lobsterman with a shotgun next to his door. But soon Seeley was able to observe inspections of scout bees through a window in a box fitted with a window made of a special red filter, as bees don't see red light. He determined that a scout averages over half an hour in total to examine a site, inside and outside, over 10 to 30 trips. He created three-dimensional patterns of each scout's interior inspections, which show that they cover all of the surfaces, mostly in the dark, walking 60 meters (200 feet) or more, every step or short flight a measurement.

At that point, Seeley had established the bees' criteria for a nesting site and the way in which the scouts explore potential spaces. In 1975, Seeley left his work on the island without solving the mystery of how scout bees evaluate candidate nest sites. To continue, he would need to film and monitor the dancing scouts with camera equipment that was, at that time, prohibitively

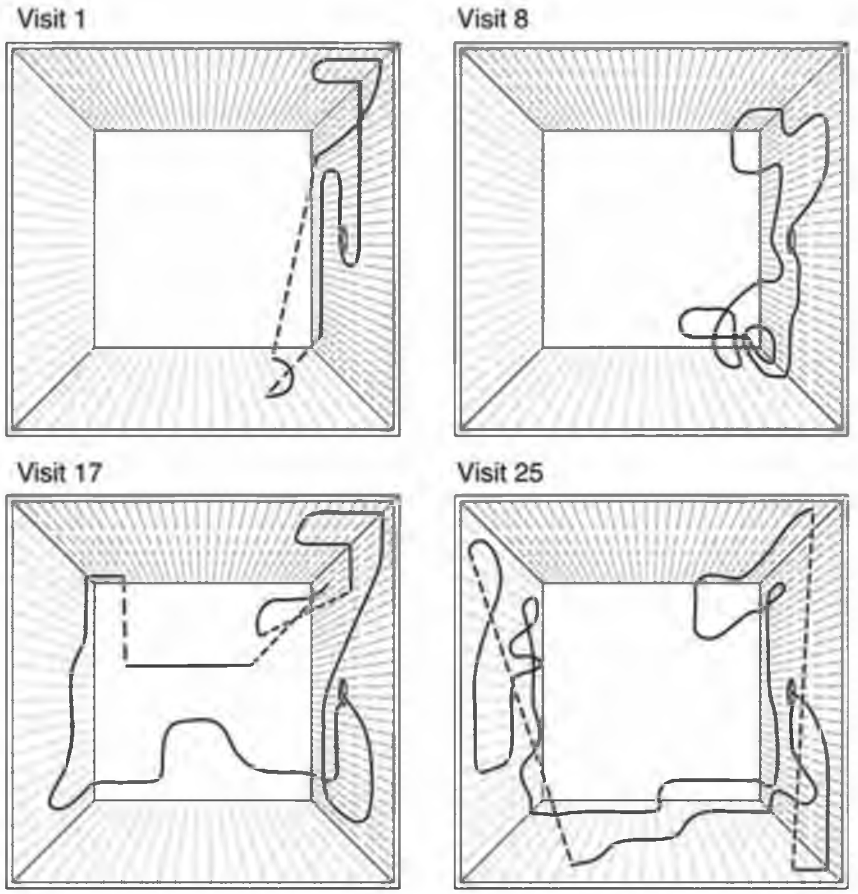
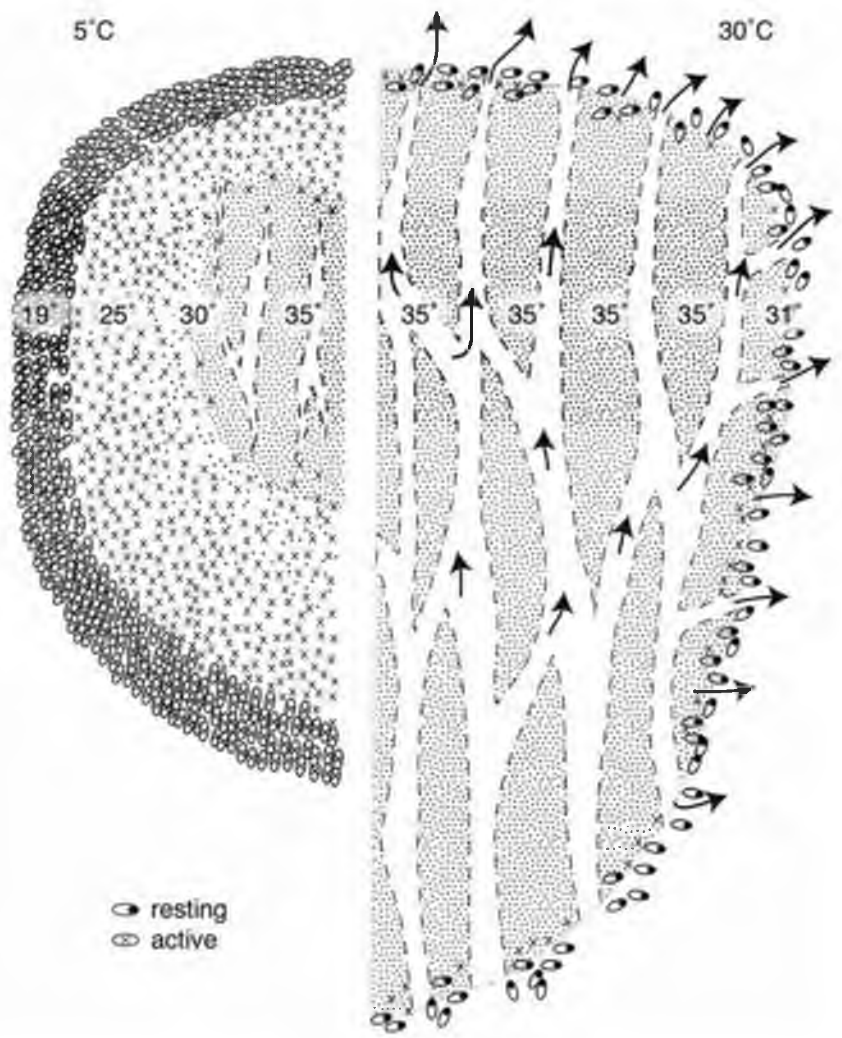


Diagram tracing four out of 25 inspections of a potential nest site by a single scout on her first trip to the box. Solid lines show where she walked, broken lines where she flew. Illustration modified from T.D.Seeley, *Scientific American*, October, 1982.



Bees in a swarm adjust for thermoregulation in low (left) and high (right) ambient temperature. Losses of heat are shown with arrows, active metabolism with crosses and resting metabolism with dots. Illustration modified from B. Heinrich, *Journal of Experimental Biology*, 1981.

It's been a long watch. Tom Seeley as a young Harvard graduate student in 1974 began work to determine how a swarm selects the best new nesting site. Photo: John G. Seeley

expensive.

Seeley left Appledore Island with a wealth of data and the marine ecologist Robin Hadlock, who became his wife. They embarked on an adventure when Seeley organized an expedition, sponsored by the National Geographic Society, to study Asian bees. His appointment to Harvard's honorary post-doctoral Society of Fellows helped support the trip and the subsequent research papers, two of which he wrote with Robin Hadlock Seeley.[6]

Honeybee Democracy recounts a hilarious story of how Seeley analyzed "chemical warfare yellow rain" reported by American intelligence; it turned out to be the yellow fecal droppings of the giant Asian bee *Apis dorsata* — thus dubbed "the KGBees".

When Seeley returned to his work with *Apis mellifera,* his interest in swarms was not abandoned but widened. He knew that the behavior of swarm scouts is but one manifestation of the bees' collective intelligence. The underlying question remained: How can an ungoverned mass of insects make complex decisions and make them well?

It has long been known that a group of animals can work together more effectively than individuals, for example, to capture prey. As Lindauer found, a group of animals can solve cognitive problems that are beyond the ability of the individuals. This phenomenon is called swarm intelligence (SI), and it is the cohesive element throughout a honey bee colony – not only in swarms.

"A colony of honey bees is a model system for studying SI…Specifically, one can describe the problem-solving abilities of the whole system (colony), characterize the behavioral properties of the system's components (bees), trace the routes of information flow between the components (signaling and cuing pathways), and manipulate the components' behavioral properties and communication processes to test their role in building swarm intelligence," wrote Seeley.

So it was not a detour but a continuation of his work, as he turned, for much of 1980 to 1995, to the question of how SI works as a honey bee colony evaluates food sources and allocates foragers. He set up experiments at the Cranberry Lake Biological Station in northern New York State. It provided a controllable research environment — just as he'd had on Appledore Island, where he could set up boxes with no other available nesting options. Cranberry Lake, deep in the Adirondack Forest, has no bees or summer forage. It was possible to control food sources and observe a range of behaviors as the study bees assessed the forage sites and managed the work force.

He saw that each forager knows only one food source at a time and dances on what he calls "a bulletin board of job opportunities for the unemployed foragers". He learned to read the waggle dance more closely, and saw that it is not the vigor of

At the woodshop at the Dyce Laboratory at Cornell, Tom Seeley built over 200 nest boxes in December of 1975. He mounted them to study swarm behavior. Photo: Tom Seeley

the dance, as was supposed, but the number of circuits it contains that is the real expression of the richness in a source.

By reading the dances, he could watch the allocation of foragers among patches of flowers and how it changed hour by hour, day by day — a mutable operation. He describes it as "like a giant amoeba". Amazingly, "There is close to optimal distribution."

Seeley, left, on a National Geographic expedition to study Asian bees, is having some fun with geneticist and molecular biologist Matt Meselson in a mountain jungle in Thailand. They had been studying the feces of the giant honey bee *Apis dorsata*, mistakenly misidentified by American intelligence as "yellow rain" chemical warfare. So the lighthearted researchers are examining giant feces – from an elephant. Photo: Pongthep Akratanakul

Seeley was tending a feeder on the first day after the bees had been confined during bad weather. When he called back to an assistant to expect the first forager to return and dance, the report back was that the bee did not dance but made a shaking signal. The researchers later identified it as a call back to action for the inactive foragers after a prolonged break.

Seeley's work with foraging behavior culminated in his 1995 book, *The Wisdom of the Hive: The Social Physiology of Honeybee Colonies.*[7] In learning how a colony works as an intelligent unit to forage, he'd garnered skills that would serve him well as he returned to the study of swarm behavior. Not the least of them was the ability to label thousands of bees for identification – less laborious than Lindauer's method only by degree.

"Both finding a home and finding food are two big problems to be solved by the bees. To find food is a question of spreading out among multiple sites; to find a home is to focus on one," he said.

But how do they narrow their choices to a single site and fly off to it in unison? Seeley spent the next 15 years understanding that phenomenon, which he calls "a nearly perfect product of evolution."[8]

Part II of this article recounts a series of ingenious experiments designed to

Seeley, right, loads hives of bees onto the Shoals Marine Laboratory boat, The Wrack, in June, 1975, the start of his first field season of swarm work on Appledore Island off the coast of Maine. "Wrack" is an old word for seaweed.

Seeley, in spring, 1976, mounting one of his nest boxes on a power pole in a study of home site preferences of the bees. He varied qualities such as volume, size of opening, direction and perforations. Photo: Tom Seeley

Herb Nelson lent his logging expertise in Seeley's summer, 1975, study of natural nests of honey bees in the forests around Ithaca, New York. Nelson is felling a mature sugar maple that was housing a vigorous colony of bees with an ideally small opening. Photo: Tom Seeley

Most summers between 1980 and 1995, Seeley studied how honey bee colonies work as a functional unit to efficiently collect their food – the subject of his book *The Wisdom of the Hive*. He is pictured at the Cranberry Lake Biology Station tending a sugar water feeder in 1994. Photo: Scott Camazine

show the bees' democratic decision-making process in choosing a home.

Footnotes

[1] Two different spellings of honey bee in this article derive from Seeley's use of the common spelling from the Oxford English Dictionary: honeybee. The *American Bee Journal* uses the spelling from the Entomological Society of America – honey bee — which specifies a true bee. In this scientific convention, the spelling of dragonfly and sawfly, for example, signify that they are not true flies. In this case, Seeley made the choice to achieve a two-word rhyming title; he optioned for poetry, since there was no need to clarify the species.

[2] Seeley, Thomas D., *Honeybee Democracy,* Princeton University Press, 2010. Quotes not otherwise identified are from the book.

[3] Hölldobler, Bert and Edward O. Wilson, *Journey to the Ants,* Harvard University Press, 1994.

[4] Phone interview, 10-23-10.

[5] Recorded interview, 10-6-10, The California Academy of Science.

[6] References for his body of published work can be found at www.nbb.cornell.edu/seeley.shtml

[7] 1995 book, *The Wisdom of the Hive: The Social Physiology of Honeybee Colonies.* Harvard University Press, Cambridge. It received the gold medal for Best Science Book, at Apimondia, 1998.

[8] Phone interview, 10-23-10.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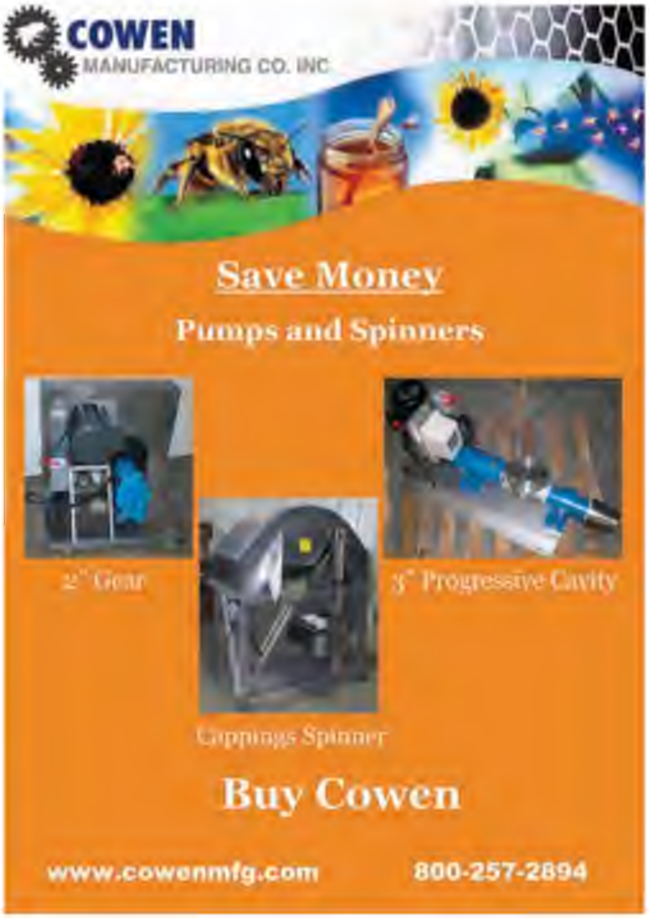
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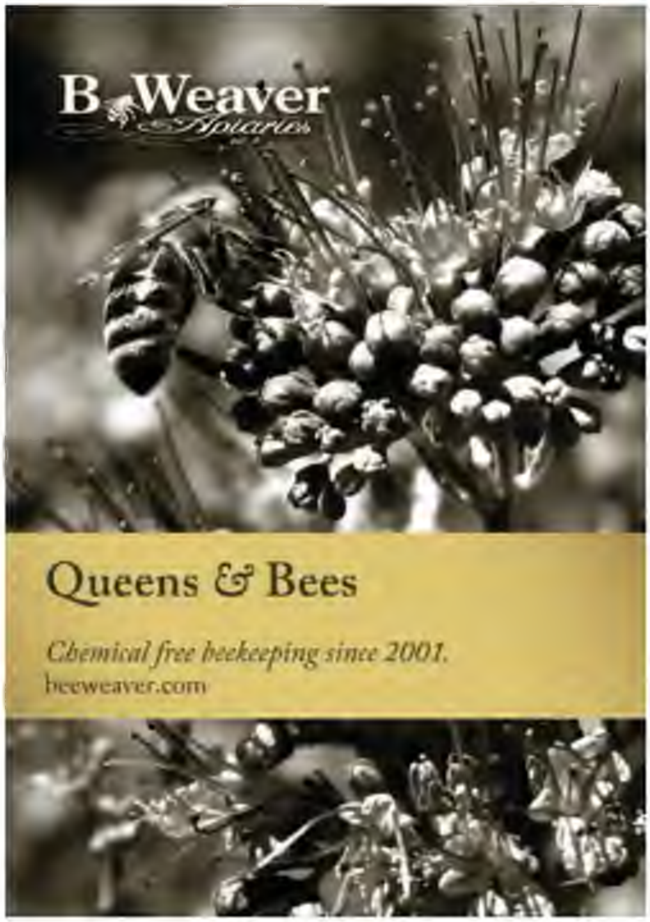
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Honey Bee Biology

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The Usurpation (Takeover) of Established Colonies by Summer Swarms in Virginia

In this article I report on a novel and important behavior displayed by honey bees in Virginia called colony usurpation, also known as colony takeover. A swarm enters the hive of an established colony and eliminates the colony's mother queen. The swarm's queen, the usurpation queen, becomes accepted as queen of the hive and begins laying her eggs. Since mated queens carry the genetic composition of the colony, colony usurpation can drastically change that with the queen replacement. I have been studying summer swarms for several seasons, and suspected usurpation, but only in the summers of 2009 and 2010 did I finally get concrete *photographic* evidence showing usurpation in Virginia.

Colony usurpation has been reported with Africanized bees usurping colonies of European ancestry in the Southwest of the United States (Schneider et al., 2004). In contrast to those bee populations, the usurpations I observed were in several of my Virginia colonies. Before and after usurpation, these colonies have a gentle temperament, even after the usurpation bees have replaced the bees of the former queen. (To make this point crystal clear about my gentle bees, here is a secret that I tell now. The way you see me in my column picture is *exactly* the way I routinely work my bees, including the usurpation colonies described in the cases below. I use nothing more than a bee smoker and a hive tool.) Furthermore, even though I currently have four usurpation colonies (and suspect several others), one would regard them as typical colonies of European ancestry, nothing special in appearance or performance. These colonies are not even nervous on the comb when they are inspected.

How my bees acquired the (presumed) genes for usurpation is unknown, but it is an important question. My colonies are not migratory, and I rarely purchase commercial queen stock. (Purchased queens were limited in number, just for some aspects of my queen introduction research, and I have not bought any for about eight years.) I rear my own queens and open mate them. I do catch (spring reproductive) swarms with bait hives, most of which originate from my apiaries. Besides the genetic pathway (if there is one) to my bees, the important point for now is this: given that the usurpation behavior is present in my relatively isolated colonies, the behavior could be found in other managed hives in nearby states. As evidence for that, I am not the only observer of usurpation in this region. While working with honey bees in North Carolina, Dr. Deborah Delaney (now an Assistant Professor at the University of Delaware) saw one usurpation swarm invade a hive and heard of at least four other usurpation swarms in North Carolina plus one in Virginia.

Quite possibly other beekeepers may have seen various "stages" of the usurpation transition process and did not realize what it was. That is perfectly understandable given the exotic nature of this behavior. Although the queen replacement seems to occur fairly quickly, I show how to recog-

Figure 1. A swarm landing by hive 41, seen from the edge of the swarm cloud. Note the lack of bees on the hive numbers and on the side corner. The clock in the digital camera records the time this photograph was taken as 3:57:37 p.m. Even though the swarm has begun to land, let the times of the other photographs be relative to this starting time.

nize and distinguish it from other colony conditions with similar symptoms. Keep in mind some of these observations are preliminary. And even to photograph them, that is, to catch the invasion of hives by swarms (or just afterwards) took a huge time commitment in the apiaries.

Case 1

On August 11, 2009 around 4:00 p.m. a small swarm (origin unknown) took flight in the research apiary behind my bee house. The swarm had been about 10 feet up in a tree. Instead of leaving, which one would expect, the swarm cloud hovered in front of a row of hives. Until the bees chose their landing site, I stayed out of the way and watched. The hives, which are my top-bar hives, were situated on a pair of studs (like a pair of rails). The swarm initially landed on this support under and close to hive number 41, housing a moderately strong queenright colony (Figure 1). The swarm did not form a typical compact cluster with festoons of calm bees. Rather the bees spread out, one layer thick, and stayed restless. I quickly stepped into the swarm cloud and caught the queen who was running about among the other bees on the support. The little cage in Figure 2 has their queen. I hung the cage there so the bees would sense their queen was with them. (The swarm had only one queen, and the bees did not ball the queen or display balling behavior on the screen of the cage.) Now I should have control over the swarm's movement, but I wanted the bees to make the next move. From experience with late summer swarms (unpublished observations), the scientific literature, and my international bee travel, I had a reasonable idea what the bees might do next. Nevertheless, it was impressive when the bees made their move.

The swarm began to invade hive 41, mostly by mass-crawling up from their initial landing location and through the closest entrance holes as seen in Figure 3. I wanted to quickly release the caged "usurpation" queen with the swarm because she would follow the crawling bees into the hive. However, I needed to distinguish her from the colony's resident queen so I could follow the events. Both queens were unmarked. Paint-marking the usurpation queen was unacceptable because new paint would introduce too much foreign odor on her. Most likely there would be an odor-mediated interaction (from pheromones) between four groups in the hive: the two queens and the bees of the usurpation swarm and resident bees. I did not want not to disturb those dynamics. So, I quickly clipped the wings of the usurpation queen. That makes her easily distinguished from the resident queen. And if she survives to establish a brood nest, she must have invaded as a mated queen (as opposed to a virgin queen because a virgin queen with clipped wings cannot survive a mating flight launched from the invaded hive). I released the queen by holding the opened cage over the entrance hole with the most bees flooding in, the lower right hole seen in Figure 4.

Figure 2. The swarm queen is caged and placed with the bees. She's in my homemade queen introduction cage. More bees have landed, but note the virtual absence of festoons, the fundamental structure of a typical swarm cluster. Only a small knot of swarm bees is noticeable on the outside of hive 41, where the hive sits on the front rail. The lower right entrance hole of the hive has no bees around it except on the alighting board. The time is 3:59:51 p.m., 2 minutes 14 seconds since Figure 1.

Figure 3. The usurpation swarm invades the hive. On the side of the hive, the bees face the front of the hive. On the front of the hive, the bees turn downward to the entrance holes. Collectively, the bees "flow" from the rail (lower right) up on the side of the hive, turn in an arc and go around the corner and down to the entrances. A stunning sight. The time is 4:07:13 p.m., 9 minutes 36 seconds, or about 10 minutes since Figure 1.

Near the end of the invasion, I opened the hive for about ten minutes, and for this particular situation, without any bee-disturbing smoke. In a routine inspection, a properly trained beekeeper can examine a colony in a top-bar hive with minimal bee disturbance. For example, there is no propolized cover to crack off that jolts a standard frame hive, and only the bees in the immediate inspection area of the top-bar hive are exposed to light and motion. In this novel situation, however, I wanted even less disturbance than that usual high standard, so no smoke (even though bees were fighting inside the hive and were apt to sting).

I found one queen ball on the hive floor right next to the entrances. I expected that

Figure 4. The front view near the end of the initial invasion. The bees are still entering the hive. Note the orientation of the ones close to the lower right entrance, their primary entry point. The time is 4:13:54 p.m., a little more than 16 minutes since Figure 1.

Figure 5. The outside of hive 41 compared to the other nearby hives with colonies of similar strength. Swarm entry is essentially complete. The queen and most of the swarm are in the hive. The time is 4:15:52 p.m., 18 minutes since Figure 1. Since this is my first observed swarm invasion with usurpation, I cannot say if invasions typically occur this quickly, but it surely can occur quickly.

and figured it immobilized the usurpation queen. It was the colony's resident (mother) queen I wanted to find. More mystery there. Deep in the brood nest, away from the entrances was another queen ball. This ball must be around the colony's resident queen. (It was, and there was only one resident queen.) So initially both queens were held in balls. The identity of the bees in these balls was unknown. There are several possible scenarios, along with how the bees were behaving in the balls, and I am researching that. As I looked through the brood nest, numerous bees were fighting, the dead falling to the hive floor. Upon finding the second queen ball, I closed the hive and took no more photographs inside the hive (see Figure 5). I did not want to keep the hive open any longer than necessary on my first completely documented colony usurpation. Superficially, the queen balls looked like others I had seen (and show below), although their use here, eliminating a colony's mother queen and replacing her with a (most-likely unrelated) foreign queen, is new and stunning. I put on my top-bar hive version of a dead bee trap, the bucket hanging off the hive front (see Figure 6) just to obtain a rough estimate of the overall worker mortality since I could not distinguish swarm bees from colony bees. More importantly, I wanted to recover any dead queens.

The next morning (August 12) at 8:00 a.m., I checked the dead bee trap. Numerous dead workers had accumulated in the trap, no queens though. At 12:00 p.m. noon when the bees were more active, foraging on a minor sumac flow, I opened the hive, again without smoke. The bees were quite nervous, but not defensive. The usurpation queen had a multilayer court of bees crowded around her. The court consisted of two layers of bees, their heads oriented to the queen, growing to three layers as more bees piled upon the others utilizing the extra room from the parted combs as I examined them.

I have occasionally seen such excessively large multilayer courts before in my queen introduction studies where I directly release (temporarily) a laying (physogastric) queen into a queen-right colony during dearth conditions. (New beekeepers please do not try that. Those queens can be killed even when returned to their home colonies.) One queen ball, which had to contain the resident queen, remained in the hive. Incredibly by 20 hours after the invasion, and probably sooner, the usurpation queen was essentially accepted and the resident queen was still being balled. The hive was only opened for about five minutes.

The next day (August 13) I decided not to open the hive, leaving the bees undisturbed, since no dead queens were in the dead bee trap. The next morning (August 14) came the conclusion for the queens. I found only one bee in the trap – the colony's original queen (see Figure 7). Later that day, I opened the hive and found the usurpation queen in the brood nest. She was treated normally by the bees in the hive, most of which had to be the resident bees (not the swarm bees). Without knowing the recent events, one would conclude that (genetically) she was (largely) responsible for the colony's characteristics (the amount of honey, brood, etc.), even though (as far as I can tell) she had nothing to do with it. Eventually, the usurpation queen established a brood nest, and her bees replaced the former queen's progeny. The usurpation colony overwintered on the former colony's honey stores. The following spring, the usurpation colony was moderately strong and did not swarm. By Aug. 21, 2010, about a year following the initial takeover, the usurpation queen still heads her colony, which is strong and has plenty of honey for the upcoming winter.

Case 2

I keep one of my top-bar hives on a scale to record weight changes (hive 8). This scale hive is by the bee house, which has old carpet around it. (Most of my research apiaries are carpeted for weed control and to see what the bees are discarding.) On the evening of July 11, 2010 in front of the scale hive, I noticed about a cup full of dead bees scattered on the carpet. No other hives in the apiary had this symptom, and I have no pesticide problems here. The scale hive housed a strong colony unlikely to be robbed, which could account for the mortality. Moreover, I saw no characteristic zigzag robber bee flight or bees fighting on the alighting board (other robbing evidence). However, the colony was still evicting dead and paralyzed bees. By mid-July forage is poor and summer swarms can occur here. I suspected usurpation.

It was becoming too dark to open the hive so I put an empty nuc box under the entrances for the night to catch the dead bees (my bucket trap cannot fit to a hive on the scale). The next day the dead bees on the carpet were gone. They must have been eaten by some night-foraging animal (which is important to know because it obscures that usurpation symptom). The nuc box contained about 25 dead bees, overnight evictions, but no queens. The colony inspection (see Figure 8) revealed one queen ball (see Figure 9) with a dark queen. From her general appearance, she could have been the resident queen. The other queen, light orange in color, had a multilayer court of bees crowded around her (see Figures 10 and 11). From Case 1 (and other observations), presumably this was the usurpation queen. The next day I found the darker queen dead in a small queen ball on the floor of the hive. (Bees will still ball a dead queen until her odor diminishes sufficiently.) The orange (presumed) usurpation queen had a normal court and looked to be the regular queen of the colony. To mark her for further study, I clipped her wings.

Practical Considerations

Currently, I do not know how common this usurpation behavior is (although as we will see in later articles I have personal evidence for a total of four usurpation queens). So far I have only observed it under dearth or marginal nectar flow conditions. Most likely genes control this behavior. Those genes could truly be rare so the behavior is rare. Or the genes could be more common, but not usually needed (expressed) unless called for by certain environmental conditions (which so far would include something like a dearth, though not necessarily limited to that.)

Under typical beekeeping conditions, the transition symptoms (swarm entry, queen balls, unusual queen court, and dead bees) will not be observed, only a new queen being treated normally. Depending on the time since the colony's former (resident) queen was last seen, usurpation could resemble a typical supersedure of the former queen. Beekeepers need to understand that unwanted queen replacement can now have two possible origins: within the hive (supersedure) and from outside of the hive (usurpation), although again the frequency of the latter is unknown. It is critically important not to over-react and blame elevated supersedure rates on usurpation. I work carefully and conservatively from the evidence. Some evidence is conclusive; other evidence is weak. Sometimes not enough evidence can be found to make a determination.

For example, if a month ago during a dearth, a (marked) queen was in the hive and now she has been replaced by an unmarked queen, based on just that, one cannot conclude usurpation. That scenario could have been just a familiar queen supersedure. If the body coloration between the two queens is very different, that is still exceedingly weak evidence to invoke usurpation. Sub-

Figure 6. The dead bee bucket trap just to estimate mortality. It will not retain all dead worker bees. Some ardent undertaker bees will remove dead bees from the trap. Dead queens are usually too heavy to lift out. Remnants of the swarm remain at the original landing site (a suspicious usurpation symptom) and on the front of the hive, but the initial invasion is well over. The time is 4:30:13 p.m., about 33 minutes since Figure 1.

Figure 7. A visual estimate of the worker mortality after the first and second nights following usurpation. On the morning after the third night, only the resident queen was in the bucket. She is on the note card.

Figure 8. Inspecting hive eight, the second usurpation case. One comb is in a holder for photography. The bees put the brood nest towards the entrance end of the hive, which is where I opened the hive. The bulk of the honey is to the rear of the hive, out of the way, quite helpful when conducting a stealthy examination of a brood nest for a multilayer court of bees around a usurpation queen or one or two queen balls.

Figure 9. Bees balling the resident queen during usurpation. It's a tight knot of bees with the queen embedded in the mass. Queen balling occurs in other situations: a queen introduction gone bad, a queen returning from a mating flight and entering the wrong hive, and other poorly understood situations. In a summer dearth, I look for queen balls, both in hives and on the ground, another reason for carpeted research apiaries.

stantial color differences between mother and daughter queens can occur. Furthermore, a queen's body color is partly dependent on the brood nest temperature during pupation, a nongenetic effect. If instead it was a week ago the beekeeper saw the old marked queen, then usurpation may be more likely. But in the prior week, the beekeeper would have had to check the *entire* colony, making sure a second queen, an unmarked daughter queen, was not in the hive with the marked queen. A pair of queens coexisting in a colony during a supersedure transition can happen. I have even had them in my observation hives. Initially finding one marked queen, something expected, and *assuming* she is the only queen in the hive is not strong enough evidence for making this kind of more precise argument for usurpation. Also, just because a late-summer or fall swarm is seen clustered near the apiary does not mean that swarm will take over a colony. If the swarm clusters on a hive, especially around or under the entrance, then I would expect usurpation. (The entry scenario may not be as quick and simple as with Case 1; I am still looking for more cases of that.)

Broader Implications

Having usurpation behavior in a temperate honey bee population has possible implications just as astounding as the observed queen replacement. Using Case 1 as a motivating example, back in the summer of 2009, that swarm could have absconded because of the marginal foraging conditions typical of August in Virginia. (It could have also been a "fall" swarm whose origins are poorly understood.) A swarm in that situation should have perished. With the usurpation trait, incredibly, that swarm hanging from nothing but a branch in August, still survived the winter. And the queens of such swarms, who possess genes (from possibly good to bad) that would have died, can now survive to reproduce those genes. (At first I wondered if the usurpation colony from Case 1 might be deficient, having absconded and in a sense failed once, but not so. It is a decent colony.)

Here is an extension of the above observations, although I do not have any data on it. While typical reproductive swarming occurs in the spring, a small amount of swarming, apparently not from absconding, which is hive abandonment, occurs in late summer and early fall. Traditionally such swarms were also doomed to die in the winter. Not necessarily so if they can usurp other colonies. Here the number of colonies with the usurpation trait could even increase (because for a particular swarm event the number of usurpation colonies could increase from one to two. The final frequency of the usurpation genes in a population of colonies could have different outcomes, a subject to be investigated with a mathematical genetics model.) In addition to the acquired honey, these fall swarms could survive the winter without ever building its own set of energy-expensive combs. With usurpation, some old assumptions fail to remain true. Here's another assumption that fails, one deeply rooted in the ecology and life history of honey bees in a temperate climate.

Much of the honey bees' life cycle is timed to getting an early start so new swarms and established colonies can store up enough honey before the winter. Brood rearing begins in the cold of late winter to jump start colony growth well before spring flowers appear. That leads to early swarm production so the new colony has more time to build combs and store honey before winter. Drone rearing begins early too so sexually mature drones are ready to mate with queens by swarm season. For generations before Langstroth revolutionized apiculture with the frame hive (in 1851), skep beekeepers prized early (and large) swarms, which made heavier honey-rich hives come fall. Even the old swarm poem warned beekeepers not to bother with late swarms. They were doomed.

A swarm of bees in May
is worth a load of hay,
A swarm of bees in June
is worth a silver spoon,
A swarm of bees in July
isn't worth a fly.

Looming over this race-against-time survival strategy is a huge assumption. One so large it's been invisible. It says that the late swarm losers must quietly perish and not invade the well-provisioned winners. Usurpation shatters this old biological rule. Instead of collecting enough winter honey before cold weather cuts off the food sup-

Figure 10. A multilayer court of bees around the (presumed) usurpation queen. It's difficult to get the bee layers in focus because of the depth, and in a few seconds they piled even higher.

Figure 11. A close-up of a multilayer court. See how the bees' heads seem to stack upon each other, a wall of faces built around the queen with only antennae projecting forward into a "repulsive" clear space.

ply, the old fundamental survival strategy of temperate climate bee populations, absconding swarms or possibly fall swarms can usurp other colonies and live off their provisions. How much the bees will use usurpation to survive (that is, how much selection there will be for this trait), is currently unknown. (There could also be selection against it.)

Besides the difficulty in getting funding to study usurpation and how it could impact our managed bees (because the behavior is so new to this area), the other problem is getting a more reliable way to observe usurpation. I have been spending a lot of time on that problem in my second home – my bee house that holds 30 observation hives. While still difficult to observe, I have managed to get usurpation to occur in a couple of observation hives. With that achievement, usurpation can be watched more closely.

In the next article, we will see some preliminary results of that work, colony usurpation—under glass—with more ground-breaking photographs.

Acknowledgments

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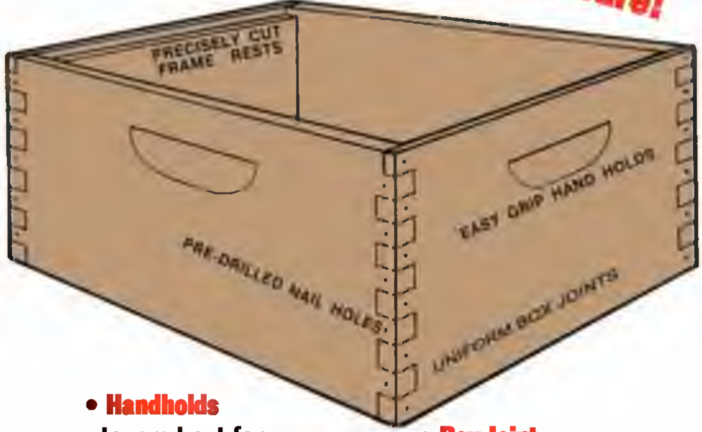

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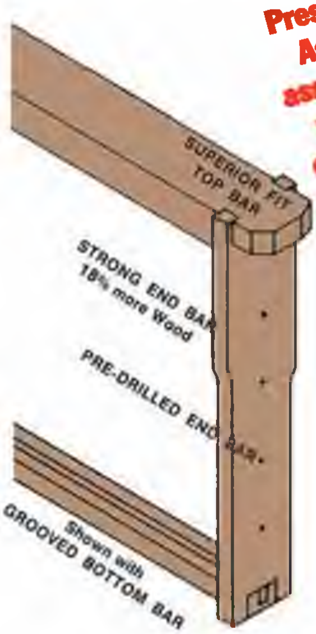

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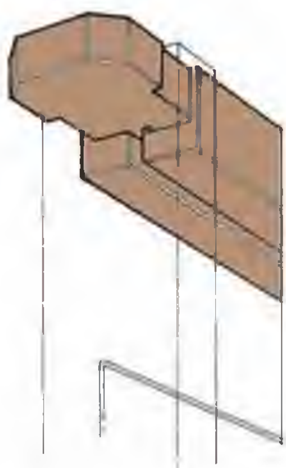

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Microsporidia: Friend, Foe (and Intriguing Creatures)

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Microsporidian disease of honey bees, variously named "Nosema disease", "nosematosis" and "nosemosis", has been known for over 100 years to cause chronic early season infections in honey bees. The only known causal agent of Nosema disease was *Nosema apis* until 1996, when another microsporidian species, *Nosema ceranae was* described from the Asian honey bee, *Apis cerana,* by Fries and colleagues. *N. ceranae* has since been found infecting populations of the European honey bee, *Apis mellifera,* around the globe. The origins of *N. ceranae* and the role these microsporidian pathogens may play in collapse of honey bee colonies is under study in laboratories worldwide. How they are transmitted and invade new colonies, and the effects on the honey bee hosts, especially when *N. apis* and *N. ceranae* interact with other diseases, parasites, pesticides and environmental stresses, is not yet well understood.

But, what exactly *are* the microsporidia? This group of pathogenic organisms first came to light in the 19th Century when they were associated with "pebrine disease" of silk worms. Louis Pasteur, credited with the first scientific studies on microsporidia during this period, wrote the 1870 classic paper *Etude sur la maladie de vers a soie* in which he described a method to control the disease. Although some early researchers noted similarities with pathogenic fungi, the lack of typical thread-like hyphae or mycelia and the unusual physical characteristics and germination "behavior" of microsporidia led to the assumption that they were an unusual group within the Protozoa. Information from the DNA sequences of several genes has, however, shown that the researchers in the early 20th Century were probably correct: Microsporidia are most closely related to organisms in the Kingdom (or Supergroup) Fungi, although where they fit in the fungal lineage is still debated.

Species in the genus *Nosema* are probably the best known of the microsporidia infecting insects because of the diseases they cause in honey bees, bumble bees, silk worms, European corn borers and other common pests and beneficial species. There are, however, over 1,300 described species of microsporidia in more than 160 genera, and approximately 700 of these species were identified from insects. Microsporidia also infect other animals and protozoons, but they do not infect plants. Although there may be some genetic relationships among microsporidia infecting different animal groups (including mammals and other vertebrates), each microsporidian species is usually only pathogenic to one host or a small number of related hosts. An example is *N. ceranae,* which infects *A. mellifera* and *A. cerana,* and while one record suggests that it can infect bumble bee species, there is no evidence that *N. ceranae* infects natural populations of species outside the family Apidae. Another bee pathogen, *Nosema bombi,* has been isolated from a large number of bumble bee species, but has not been detected in other insects.

Microsporidia are single-cell organisms and are possibly the smallest organisms with a true nucleus (eukaryotes). Mature spores measure 0.00006-0.00040 inches (1.5 - 10 microns) in length, depending on the species. The honey bee microsporidia, *N. apis* and *N. ceranae,* are about 0.00015 inches (4 microns) in length; approximately 100 spores could fit end-to-end across the period at the end of this sentence. The most common general shape of the microsporidia that infect terrestrial insects is similar to that of a jelly bean, but different species vary from kidney and spindle shapes to egg or tear shapes, to long, slender cigar-like contours. Some species isolated from aquatic organisms sport ornaments on the spore coat that are suggested to be flotation devices.

Unlike many bacteria and fungal pathogens of insects that can germinate and reproduce in the environment, at least during certain life stages, microsporidia are obligate pathogens; they can only multiply inside the cells of the host. The only stage that can survive for some time in the external environment is the infective mature spore, which is essentially a dormant stage and must be ingested by a susceptible host and invade the tissue cells of the alimentary tract to reproduce once again. Most microsporidian species reproduce only in the cytoplasm of the host's cells, but a few have been known to utilize the cell nucleus. Nuclear invasion, however, rarely occurs in infections caused by *Nosema* species.

Infective microsporidian spores contain simple but important (and interesting) structures. These organelles, which are only visible using transmission electron microscopy at a magnification of more than 5,000X, are nearly all related to invasion of host cells and reproduction. Figure 1 shows a longitudinal section of a mature spore containing a double nucleus (all true *Nosema* species have double nuclei called diplokarya; other groups may have a single nucleus), layers of membranes at the apical end of the spore called the polaroplast, a vacuole at the distal end of the spore and, most spectacularly, a polar filament that is attached at the apical end of the spore and winds like a spring around the inside spore wall. The mature spore is covered by an outer exospore formed of protein and an endospore that is composed of a protein-chitin matrix. This thick, tough spore wall protects the spore once it leaves the host cell and is exposed to environmental conditions. It is also refringent under light microscopy, causing the spores to shine in a characteristic fashion (Figure 2) and providing a diagnostic tool.

The mechanism used by microsporidia to invade the host cell is a very unusual type of "movement", particularly because there is no other known form of movement or locomotion by these organisms. When a mature spore is eaten by a susceptible host, conditions inside the gut, such as pH and ion composition, initiate germination. The polar filament everts from the apical end of the spore by turning itself inside out at a speed that allows it to puncture the gut epithelial cells of the host (see "germinating spore", Figure 3b). The posterior vacuole appears to expand during germination, pushing the contents of the spore into the tube of the polar filament for injection into the host cell.

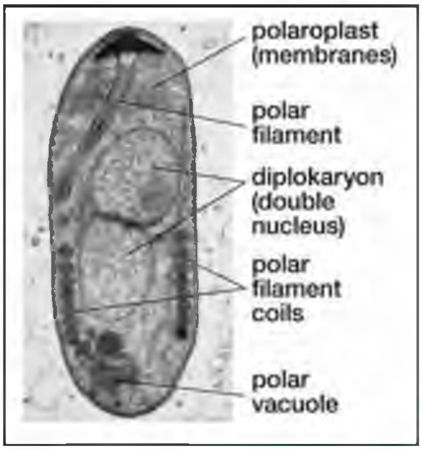

Figure 1. Major organelles inside an infective microsporidian spore. *Photo courtesy of the Society for Invertebrate Pathology.*

Figure 3 shows the life cycle of a *Nosema* microsporidium using high magnification transmission electron micrographs to illustrate the stages as they actually appear in cross section. Inside the host cell cytoplasm, the injected sporoplasm divides to form meronts. It is not known how many times the meronts divide before the pathogen "commits" to form spores, and this probably varies depending on the species. As shown in Fig. 3, most *Nosema* species initially develop in two stages in the host, primary reproduction, which serves to spread the pathogen to adjacent cells, and secondary reproduction, with mature infective spores being the final stage. Microsporidia of different species infect different tissues of their hosts. *N. ceranae* and *N. apis* are both pathogens of the midgut tissues, but other species may parasitize the fat body (a major metabolic tissue of the insect), or may be systemic, infecting all tissues, including the ovaries and testes. When gonads are infected, a microsporidian infection can often be transmitted to the next host generation via the egg. Because *N. apis* and *N. ceranae* only infect the gut tissues, there is no inter-generation transmission of these species within the eggs.

Microsporidia lack fully formed mitochondria, the energy-producing organelles of most cells. So, what do they "eat" and how do they process nutrients in order to survive, grow and reproduce in the host cell? Based on genetic studies that indicate whether an organism has the necessary mechanisms to process nutrients, the most likely source of energy uptake from the host is direct: Microsporidian vegetative forms (meronts and sporonts) appear to directly absorb adenosine triphosphate (ATP), the chemical that stores and transfers energy in cells. There is some evidence that sugars can be absorbed and processed, but most other pathways for producing cellular energy appear to be lacking. Microsporidia are thus some of the most specialized and host dependent of pathogens.

N. apis and *N. ceranae* infections are examples of the chronic nature of microsporidian disease. Some species of microsporidia are relatively virulent and all infected hosts die before they mature, but many microsporidia produce somewhat less severe effects in their hosts. Nevertheless, if a large percentage of hosts are infected, even chronic effects such as reduced mobility and egg-laying and a shorter adult lifespan can have a strong impact on the host populations. In addition, microsporidia can function synergis-

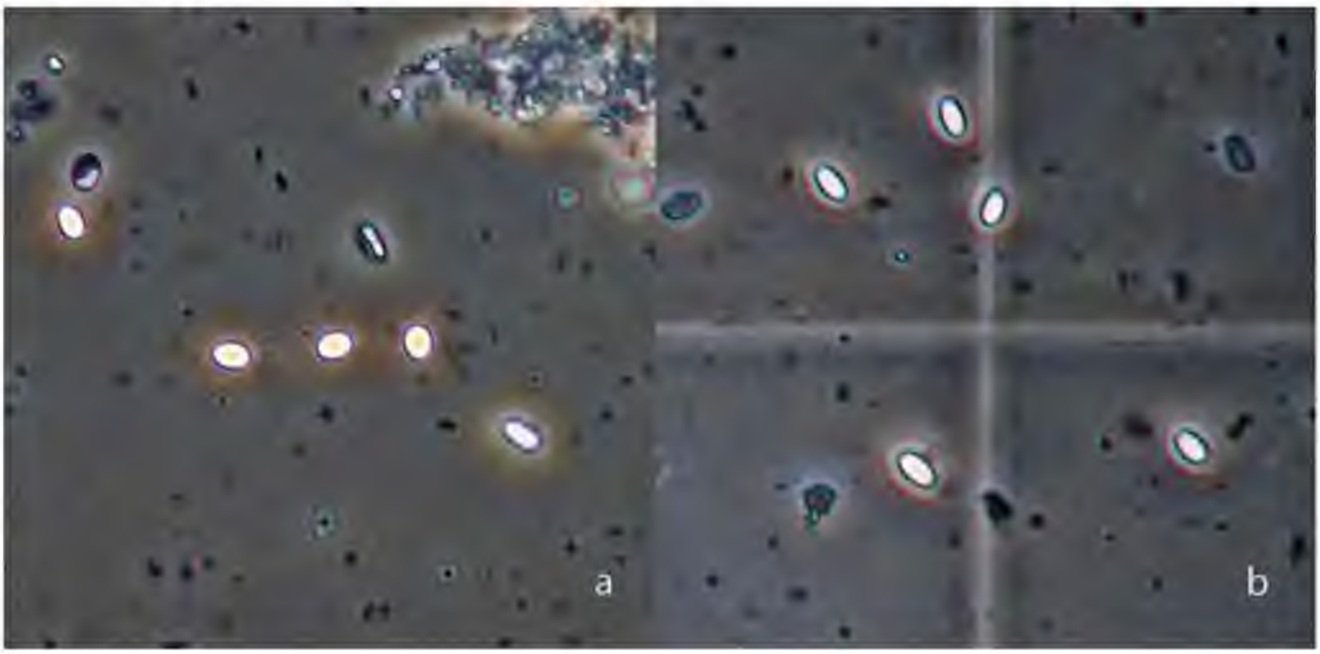

Figure 2. Mature infective spores: *Nosema apis (a)* and *Nosema ceranae (b)*, pathogens of the honey bee. *Photos by W.-F. Huang*

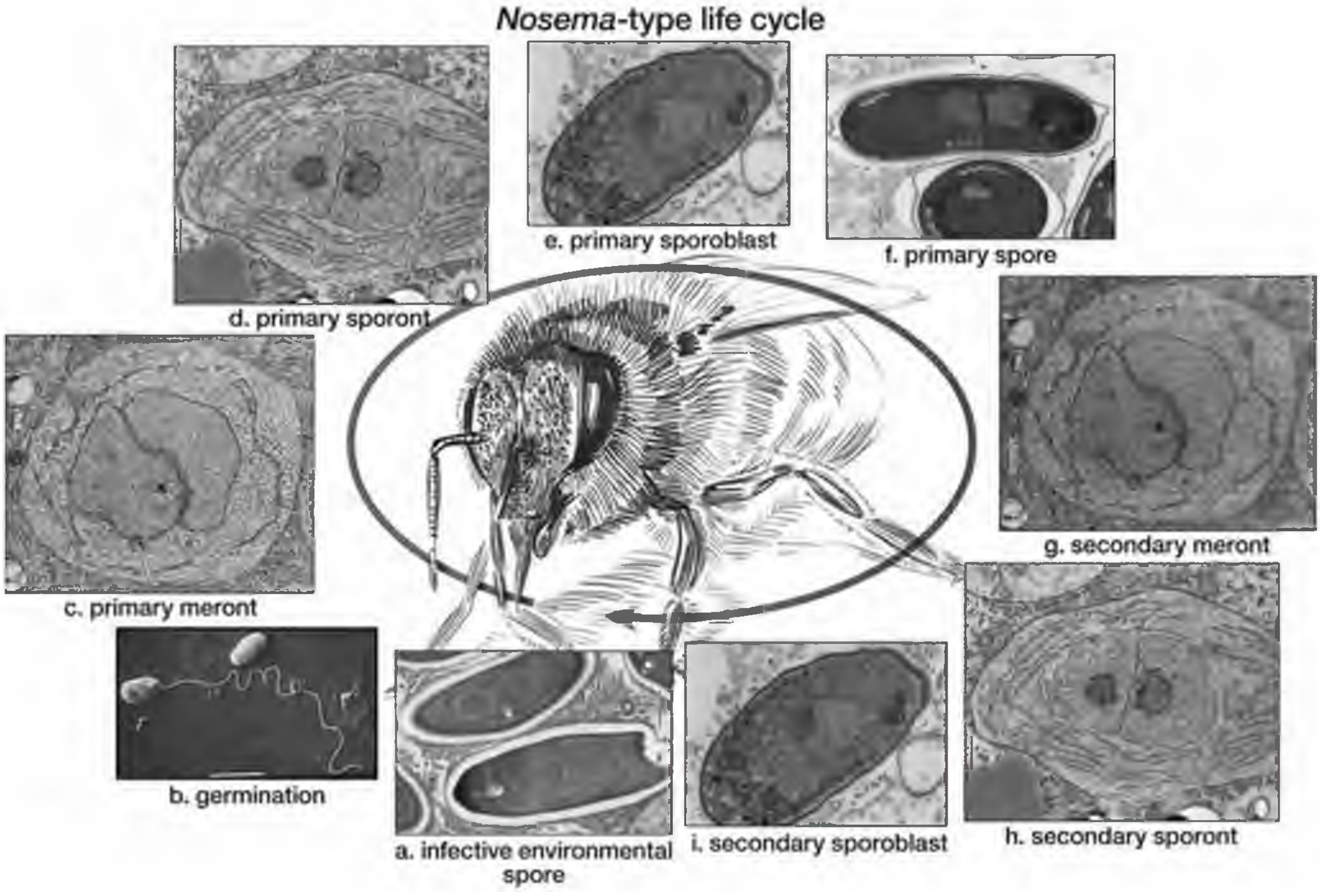

Figure 3. Typical life cycle of a microsporidium in the genus *Nosema.* Infective environmental spores (a) are eaten by a host, then germinate by extruding the polar filament and injecting the contents of the spore, the sporoplasm, into the host midgut cells (b). The primary meront (c) is the first vegetative stage and divides one or more times before spore formation begins. The sporont (d) is the first stage that is committed to form spores; it divides once to form two sporoblasts (e), which are immature spores. In this first cycle of reproduction, primary spores (f) are formed. These spores have thin walls and short polar filaments, and germinate inside the cells to infect adjacent cells. A second cycle of reproduction occurs when secondary meronts (g) develop from sporoplasms extruded from the primary spores and divide to form secondary sporonts (h). Each sporont produces two secondary sporoblasts (i), before maturing to form environmental spores (j). These spores exit the host, primarily in the feces, to infect other hosts. [*Scanning electron micrograph of germinating spore courtesy the Society for Invertebrate Pathology; transmission electron micrographs of other stages by J. Vavra, courtesy Wiley Publishing Co.; art work by K. Helms*]

tically when combined with other diseases and environmental stresses to lower the tipping point for a population "crash". Whether this is happening in honey bees as a factor in colony collapse disorder remains to be shown, but obviously any disease that has harmful effects is adding to the stress on colonies. The USDA CAP Project scientists are currently working on several aspects of the biology of *N. apis* and *N. ceranae* and their effects on honey bees, including the interactions of these microsporidia with viruses.

While obviously causing problems for management of beneficial insects, and causing disease in some mammals and immune deficient humans, microsporidia are also fascinating and unique organisms with a very specialized place in microbial ecology. These pathogens are known to be an integral part of the natural enemy complex of "outbreak" insect pests such as European corn borer, gypsy moth, spruce budworm, grasshoppers and tent caterpillars, and have been introduced as classical biological control agents of some pest species. Studies on solutions of disease problems in beneficial organisms and biological control of pest species will continue to increase our understanding of how these pathogens function in their hosts.

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Standardized Sampling Plan to Detect Varroa Density in Colonies and Apiaries

By KATIE LEE, GARY REUTER, AND MARLA SPIVAK
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***The parasitic mite,* Varroa destructor*, continues to be a major issue for beekeepers. Some consider it to be at the base of colony collapse disorder*[1]*. *Varroa *causes damage through feeding on developing bee pupae, resulting in adult bees with lower body weight*[2]*, a compromised immune system*[3]*, and a reduced life span*[4]*. *Varroa *can also spread virulent viruses*[5, 6, 7]*. Ultimately, bees exposed to *Varroa *are more vulnerable to other potentially damaging factors in the hive, like poor nutrition, pesticides, and the gut parasite,* Nosema.**

Keeping bees healthy requires beekeepers to address mite problems through management techniques such as breeding, colony manipulation, or treatment with miticides. While breeding and manipulation are the first and most important lines of defense, many beekeepers still need to use chemical treatments to keep their colonies alive. No beekeeper enjoys applying chemicals to their hive because it is expensive, time consuming, and may adversely affect bees. However, many beekeepers apply miticides once or twice a year to reduce mite infestation, often without first checking to see if the mite level is high enough to warrant treatment. Reducing treatments to only those necessary is imperative to keeping costs down, reducing hive contamination, and slowing the development of mite resistance to new miticides.

Here we describe an efficient sampling method for *Varroa*. This method will allow beekeepers to make treatment decisions based on knowledge of actual infestation levels of mites on adult bees and worker brood in an individual colony or entire apiary. Many sampling methods have been developed previously and include dislodging the mites from adult bees with alcohol, powdered sugar, or ether; monitoring the natural mite fall with a sticky board; or sampling brood with either a capping scratcher to pull out drone brood or examining individual worker pupae. These methods have typically been used to determine if mites are present or absent. If these methods are used to quantify mite levels, it is often unclear how the number of mites in the sample translates in to actual numbers of mites in a colony or apiary.

To develop an easy and standardized way of sampling adult bees for mites, we addressed two questions. First, what is the best method of sampling adult bees to determine mite infestation? Second, can the colony infestation level (i.e. mites on both adult bees and pupae) be estimated from a sample of adult bees? We chose to focus on sampling adult bees because sampling worker brood is cumbersome, sampling drone brood has wide variability, and the use of sticky boards requires two trips to the apiary, special equipment, and at least several days to get a good estimate of natural mite fall. In this article, we describe a sampling plan for beekeepers. A method suitable for researchers, with detailed sampling statistics, is published online in the *Journal of Economic Entomology*[8].

Sampling to Determine Mite Infestation of Adult Bees

To determine the most efficient way for beekeepers to sample adult bees for *Varroa*, we needed to understand the distribution of mites within a colony and an apiary. To obtain these data, we sampled a total of 954 colonies in 31 apiaries owned by five commercial migratory beekeepers. The operations were sampled in Minnesota, North Dakota, California, and Texas. The sizes of the five operations ranged from 1,000 to 20,000 colonies, and the number of colonies at sampled apiaries ranged from 24 to 84. Sampling was done in March (TX and CA) in 2006, May-June and August-September (MN and ND) in 2005, 2006, and 2007. We collected approximately 35 adult bees in alcohol from each frame in each colony and recorded the following information for each sample: date, beekeeper, yard, pallet, colony, frame location, and comb contents (e.g. open brood, sealed brood, pollen, nectar/honey, or empty). The 35-bee samples were taken back to lab, where we counted number of bees and mites in each. In 142 of the colonies, one sample of approximately 300 adult bees was taken to compare the mite infestation to the multiple 35-bee samples. We found no difference between the infestation of the large sample and the combined 35-bee samples from the same colony, indicating a single large sample is adequate to estimate adult bee infestation.

Using data from the 954 commercial colonies, we wanted to know how many adult bees needed to be sampled to accurately estimate mite infestation on all adult bees? We found that a sample size of 300 bees per colony is adequate to determine the mite infestation level of adult bees in a colony. The recommendation of sampling 300 bees confirms previous recommendations[9, 10], but this is the first time this number of bees has been associated with a precision level.

To develop an apiary level sampling plan, we used a computer program[11] to determine the number of adult bees in a colony and colonies in an apiary to sample. We first combined different numbers of the 35-bee samples within each colony to achieve different sample-unit sizes (i.e. bees to sample per colony, ranging from 35 bees to 280 bees). To estimate the infestation in an apiary, the computer program randomly selects the inputted sample-unit sizes for each apiary until it reaches the set precision for the number of colonies per apiary to sample. Thus, if 35 bees are sampled per colony, 16 colonies would need to be sampled in an apiary, and if 280 bees are sampled, only 8 colonies would need to be sampled. Since it is easier to sample more bees per colony than fewer bees from more colonies, we recommend sampling 300 bees from each of 8 colonies to estimate apiary infestation. We chose 300 bees (rather than 280) to err on the side of obtaining a better estimation.

We next determined if mites congregated on brood frames (frames with eggs, larvae, or sealed pupal cells). We found frames with brood had significantly more mites than non-brood frames, with 2.4 mites per 100 bees on frames with brood comb and 1.8 per 100 bees on frames without brood. We recommend beekeepers sample from a frame with brood.

Then, we wanted to examine how mites are spatially distributed among colonies in an apiary. We were not surprised to find that some colonies had higher mite levels than others. However, we wanted to know if direction of the hive entrance or location in an apiary (e.g. colonies on pallets at the end of a row in an apiary compared to colonies in the middle) contributed to higher mite loads. Our analyses suggested that mite levels were independent of colony direction or location.

Mite levels were sometimes highly variable among apiaries in beekeeper operations sampled at the same time of year. This means that beekeepers should make treatment decisions on an apiary-by-apiary basis and should not assume that all apiaries have similar levels of mite infestations.

Relationship Between Mites on Adult Bees and Mites in Brood

We developed a simple "correction factor" to account for the proportion of total mites in the colony that are on pupae (i.e. sealed brood) by intensively sampling brood in 62 colonies from two commercial beekeepers in MN and ND. The colonies were sampled in May-June or August-September. These are times of year when many beekeepers normally treat for *Varroa*. In each colony, we estimated the population of adult bees and sealed worker brood, and the mite infestation of adult bees and sealed worker brood. We also estimated the number of drone pupae and mite infestation on drone pupae in seven intensely sampled University of Minnesota colonies.

Drones were not included in the correction factor because the number of mites in drone brood was dwarfed by the number of mites found on adult bees or in worker pupae. In this study, an average colony had 24,500 adult bees and 14,000 worker pupae. Drone brood comprised, on average, only 3.2% of the total pupae. An average 6.8% of all mites were on drone pupae, while an average of 45.6 % were on worker pupae, and the remaining 47.7% were on adult bees. These results suggest that unless there is an abnormally high amount of drone brood in the colony, the number of mites in drone brood contribute little to the total number of mites in the colony.

We examined the relationship between the adult bee infestation and the colony infestation (density of mites on adult bees and worker pupae). We included two factors that we predicted would influence the relationship: the time of year the colony was sampled and the ratio of worker pupae to adult bees. Although both factors can affect the relationship between adult bee infestation and colony infestation, the statistics indicated only adult bees need to be sampled, and a correction factor applied, to estimate the total colony mite density. We calculated this correction factor by plotting the adult bee infestation against colony infestation (mites on adults and in brood) to find the slope of the line, which was 1.8. Thus, the number of mites on adult bees can be multiplied by 1.8 to correct for the number of mites in worker brood. To simplify and err conservatively on the side of over-estimation, we recommend using a correction factor of 2, or doubling the adult bee infestation level to estimate the mite infestation in a colony. If there is no brood, then no correction factor is needed. If there is an abnormally high amount of worker or drone brood relative to adult bees, there is a possibility the correction factor could lead to an underestimate of total mite load.

Sampling Plan Recommendations for Beekeepers

Based on our results, we provide the following recommendations for beekeepers to estimate the mite infestation level:

Colony

1. Sample 300 adult bees from one frame containing brood (i.e. eggs, larvae or pupae).
2. Use Table 1 to apply the correction factor to convert the number of mites on adult bees to the colony infestation level (i.e. total mites on adult worker bees and in worker pupae). Or divide the number of mites found in a sample of 300 bees by 3 and multiply the result by 2 to estimate colony infestation level.

Apiary

1. Sample 300 bees from one brood frame from each of 8 colonies. Sample every fifth colony in an apiary until 8 colonies are sampled. This plan is valid for apiaries with 24 to 84 colonies.
2. Use Table 1 to apply the correction factor to convert the number of mites on adult bees from 8 colonies to the apiary infestation level. Or divide the total number of mites from adult bees from 8 colonies by 12.

How to Sample Adult Bees

Counting out 300 bees for each sample is impractical, but there are a few ways to sample by volume since 300 live bees occupy about 0.42 cups or 100 ml. We realize that 0.42 cups of bees is a strange volume, however bees are small so small variations in the volume can mean large variations in the number of bees in a sample. For example, 1/3 cup averages just under 200 bees, 0.4 cups is about 275 bees, and 1/2 cup is just under 400 bees. It is important to accurately measure out the correct volume to sample 300 bees.

To make your own measuring cup, add 0.42 cups of water (1/3 cup + 1 tablespoon + 1 ¼ teaspoon) to a cup that preferably has a smaller diameter relative to height, and make a mark at the water line. Add a handle to the cup to make sampling easier. To sample, rap bees off of a brood frame into a 5 gallon bucket or plastic wash-dish container,

#Mites per 300 adult bees	Colony infestation	#Mites per 8 300 adult bee samples	Apiary infestation
1	1%	8	1%
2	1%	16	1%
3	2%	24	2%
4	3%	32	3%
5	3%	40	3%
6	4%	48	4%
7	5%	56	5%
8	5%	64	5%
9	6%	72	6%
10	7%	80	7%
11	7%	88	7%
12	8%	96	8%
13	9%	104	9%
14	9%	112	9%
15	10%	120	10%
16	11%	128	11%
17	11%	136	11%
18	12%	144	12%

Table 1. Number of mites found in a sample of 300 adult bees and the corresponding colony mite density after the correction factor is applied, and the number of mites found in eight 300 adult bee samples and the corresponding apiary mite density after the correction factor is applied.

Figure 1. Rapping a frame in a plastic wash-dish container, then using a cup that holds 0.42 cups to measure 300 adult bees.

Figure 2. Using a rectangular cup, marked inside at 0.42 cups, to measure 300 adult bees. Gently run the cup down the backs of the bees, causing them to tumble in. Rap the cup until the bees reach the 0.42 line.

then use the marked cup to scoop out 300 bees (Figure 1). Rap the cup on a hard surface to make sure the bees are at the 0.42 cup line (add or subtract bees as needed). Keep the bucket or wash-dish from becoming coated in nectar, since mites can stick to the nectar. If your cup is rectangular (such as those that come in some powdered laundry detergent boxes), then you can use the marked cup by running it gently over the backs of bees, causing them to tumble down into the cup (Figure 2). Again, be sure to measure the bees at the 0.42 line. One further sampling method is to use a device called "Gizmo" that was designed by Gary Reuter to measure 300 bees (Figure 3). Gizmo is sold by the Walter T. Kelley Beekeeping Company, or you can make your own using the plans online at the University of Minnesota Bee Lab website (www.extension.umn.edu/honeybees). The Gizmo device can be more accurate, but if you consistently measure bee at the 0.42 line, then the cup method works just as well.

Once the bees are measured, we recommend dislodging mites from the adult bees using the powdered sugar method[12] (Figure 4). It is quick, easy, and gives a adequate estimate of the mites in the sample. Dump the 300 bee sample into a jar with a size 8 hardware mesh top and add about 2 Tablespoons (or a hive tool scoop) of powdered sugar. Add more sugar if the bees don't look ghostly. Let the jar set at least one minute in the shade so the bees don't overheat, then shake vigorously for one minute into a white dish. Be sure to shake hard. Some bees may lose a leg or two, but you'll want to get as many mites off the bees as possible. After shaking, add a touch of water to the dish to dissolve the powdered sugar, and count the mites. Replace the sugar-coated bees to their colony where they will be groomed by nestmates. In areas with high humidity, the powdered sugar may not work well because the sugar clumps in the jar so that some mites are not dislodged from the bees. Dislodging mites using alcohol and then straining them is more accurate[13], but it kills the bees. If you prefer the alcohol wash, Dr. Medhat Nasr made a handy device (discussed in the *American Bee Journal*, August 2010) or you can make a strainer with size 8 hardware cloth to separate the bees and mites.

Treatment Decisions

Once you sample a colony or an apiary to determine the mite infestation level, how can you use the information to help make a treatment decision?

<u>Stationary colonies (e.g. beekeepers that keep their colonies in one location year round)</u>

Researchers have found treatment thresholds for colonies in a stationary apiary to be 10-12% colony mite infestation in autumn[14, 15, 10].

However, the threshold may be different in different regions, so these thresholds may not apply to other locations. There are many factors that can influence the density of mites a honey bee colony can tolerate, including number of neighboring colonies, length of brood rearing season, nutrition, hygienic behavior, and disease and parasite levels. We highly recommend that ALL beekeepers sample their colonies for mites in early spring and late summer, and compare mite levels with other beekeepers in the same area. It would be very beneficial for groups of beekeepers to keep records of mite levels in their regions. In this way, regional patterns could emerge and show the level of mite infestation that warrants treatment to keep colonies alive, and what level does not warrant treatment. While other factors (i.e. colony strength, presence of diseases) affect colony survival, having ongoing records of mite levels, before and after treatment, in different regions at different times of year would be extremely useful for developing regional treatment thresholds.

Figure 3. Gizmo, a device that can be used to measure 300 adult bees by volume. To operate 1) shake a frame of bees onto a piece of flashing (or cardboard, newspaper, election sign, etc.) as long as a frame and bent into a V-shape, then 2) dump the bees into the top of Gizmo. 3) There is a volume inside Gizmo that measures 300 bees. 4) Rap Gizmo onto a hard surface three times, then turn the handle to release the bees into the jar. 5) Remove the jar and screw on the mesh lid, then 6) add powdered sugar to dislodge the mites.

Figure 4. How to dislodge mites from adult bees using powdered sugar using a jar with a size 8 hardwire mesh top. 1) Add about 2 Tbsp (or a hive tool scoop) of powdered sugar to the jar, or more if the bees are not ghostly. Roll the jar to coat the bees. 2) Image of ghostly bees. 3) Let the jar set for one minute in the shade, then 4) Shake the jar hard into a dish. 5) Add a touch of water to dissolve the powdered sugar, and 6) count the mites.

Transported colonies (e.g., commercial migratory beekeepers)

There are no reported estimates of treatment thresholds for migratory beekeepers, as the thresholds will vary depending on region, season, and migratory path. However, the same principle holds that ALL migratory beekeepers should sample their apiaries for mites prior to "treatment windows," or periods of time that treatments can be safely applied. A treatment window could be in the spring before honey supers are placed on colonies, or in late summer just after the honey supers are removed. The idea is to treat ONLY if your bees will not survive until the next treatment window. Keeping records of mite levels before and after treatment, over several years, will help beekeepers understand the mite levels that colonies can tolerate before the next treatment window. A few things that could lower the treatment threshold are if a beekeeper has many colonies situated in areas dense with other beekeepers within flight range of the bees, moves and feeds colonies to stimulate continued brood rearing for much of the year, and if the bees have high virus and disease levels. There will not be a single threshold for all beekeepers. Again, monitoring colonies and keeping good records can help beekeepers to find the infestation level that requires treatment in their specific operation. Since the method to find the infestation levels is standardized, beekeepers can share their levels with each other in a meaningful way and potentially help control the mite levels in the surrounding area.

With sampling, beekeepers have the potential to decrease the use of miticides, reduce chemical contamination in the hive, and save time and money. Importantly, monitoring mite levels is an important tool in the selection of colonies with few mites for breeding. Breeding queens from colonies whose bees have lower mite levels compared to colonies around them can increase the prevalence of natural mite resistance.

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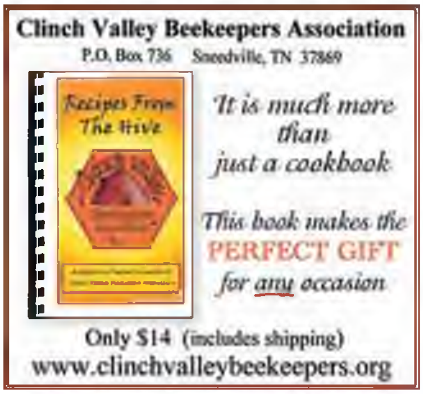

Why Supplemental Protein Feeding Can Help Reduce Colony Losses

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The interconnectedness of nutrition, worker lifespan, colony growth and survival has never been more evident. While in the past, good nutrition was necessary for colony growth and honey production, today it is essential for preventing colony losses.

We are losing more colonies now than any time in recent history. The colony deaths have been attributed to Varroa mites, diseases (e.g.,nosema), pesticides, and colony collapse disorder (CCD) whose exact cause remains elusive. Perhaps an underlying factor contributing to colony losses is inadequate nutrition. A steady supply of pollen insures the growth of colonies because it provides protein to adult bees and stimulates brood rearing. Adequate amounts of pollen also are needed to optimize worker lifespans. This is because workers in colonies with low pollen reserves transition from nest activities to foraging earlier in their adult life. How long workers live depends upon when they begin foraging. Workers that become foragers earlier in life die sooner than their nestmates that continue performing tasks in the hive. Thus, colonies with limited protein intake decline from the combination of reduced brood rearing and a shorter lifespan for adult workers. If parasitic mites and pathogens are present, the population decline can be even more severe so that the colony perishes.

In addition to affecting colony growth, nutrition (particularly protein availability) is a key component in mounting immune responses to pathogens. In honey bee colonies, protein deficiencies that affect the immune response might accelerate the spread of disease among the bees and cause pathogen levels to increase so that adult longevity and survival are reduced. Thus, what began as a nutritional deficiency could develop into colony loss from disease.

Honey bees rely on pollen for protein and for other essential nutritional requirements such lipids, sterols, vitamins, minerals and certain carbohydrates. Some digestion of pollen occurs in the midgut of the bee, but the primary means by which the nutrients from pollen are made available to the colony is its conversion to worker jelly. The conversion occurs in the paired food glands called hypopharyngeal glands (HPG) located in the frontal area of the worker's head (Fig.1). The glands are comprised of acini that produce the protein-rich worker jelly that is fed to larvae of all castes and to the adult workers and queen. Through the processing of pollen to worker jelly by nurse bees and their feeding of larvae and adults, the nutrients from the pollen are circulated throughout the colony.

Pollen is not always available to colonies, so protein supplements are fed to bees to stimulate brood rearing and prevent colony populations from declining. The supplements might not contain pollen, but instead have protein derived from sources such as soy or whey. Ideally, feeding protein supplements causes a flow of nutrients through a colony that is similar to pollen because the supplement stimulates the HPG of young bees to produce worker jelly.

Whether protein supplements are metabolized in a similar manner to pollen is not known. To answer this question, we conducted a study to compare protein levels and HPG development of worker bees fed bee-collected pollen, a protein supplement (MegaBee® patty) or sugar syrup alone without added protein (Controls). The effect of nutrition on immune response was indirectly inferred by comparing virus concentrations over time in workers fed different diets. Specifically, we examined the effects of diet on titers of deformed wing virus (DWV). This virus causes morphological deformities (i.e., stick wings) and early death in newly emerged adult bees (Fig. 2).

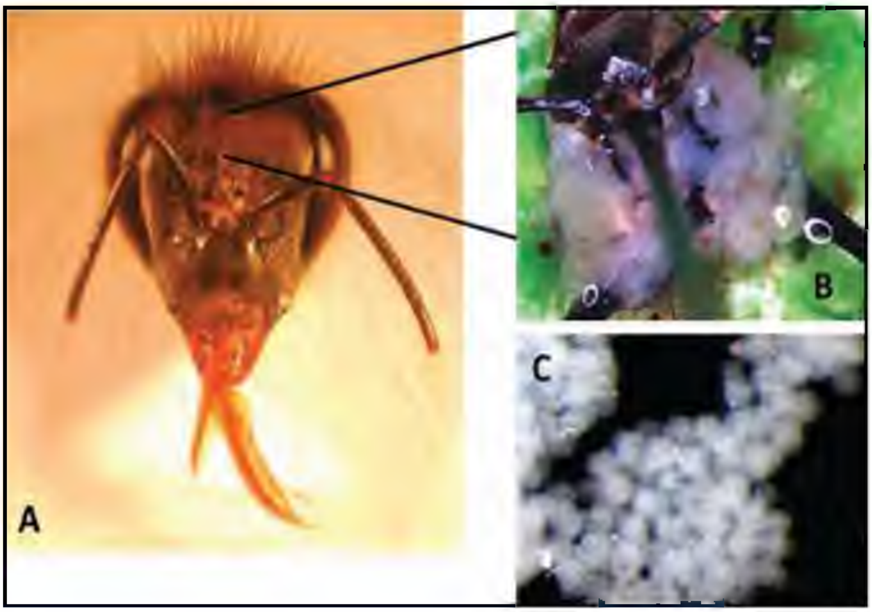

Figure 1. A. Region of the head of a worker honey bee where the hypopharyngeal glands are located. B. The glands exposed from the head. C. The individual acini that make up the hypopharyngeal glands.

DWV is one of the most widespread and prevalent viral infections of honey bees.

The study was conducted at the Carl Hayden Bee Research Center, Tucson Arizona, U.S.A. The bees used in the study were from European honey bee colonies headed by commercially produced and mated European queens. We conducted three trials, each lasting for 11 days. We began every trial by placing frames with sealed worker brood in the temperature controlled (32-34° C) environmental room at the Bee Center. When the adults emerged, they were pooled and transferred into the cages. We took a sample from the pool of newly emerged bees and used them to establish baseline measurements of protein concentration, HPG development and virus titers for the trial (Day-0 samples). Then, an average of 124 $\pm$ 2 newly emerged bees were transferred into Plexiglas cages (Fig. 3). We used five cages for each diet treatment for each trial. All bees in the cages were <24 hrs old at the start of the trial.

Bees in the cages were fed pollen patty, or the protein supplement. MegaBee® was chosen as a protein supplement because in full sized queen right colonies, it is consumed at rates that are similar to pollen patties (DeGrandi-Hoffman et al. 2008). The pollen patties we fed were made by combining Sonoran desert pollens with equal parts (by weight) of granulated sucrose,

Figure 2. Honey bee worker infected with deformed wing virus that caused stick wings.

Figure 3. Cages used for feeding worker bees pollen patty, protein supplement or sugar syrup only diets.

Drivert sugars (a mixture of equal parts of sucrose and dry fructose) and tap water. The concentration of protein in the pollen patties was similar to that of the protein supplement (pollen patty 289 ug/ml, protein supplement: 225 ug/ml). Vials with distilled water and sugar syrup also were provided to all cages.

We calculated the amount of diet consumed during the 11-day period of each trial by weighing the pollen and protein supplement patties at the beginning and end of the trial. Bees were sampled from all cages after feeding for 4, 7 and 11 days. Sampled workers were kept frozen until we measured protein concentrations in the bees, sizes of HPG, and virus titers.

In all trials, bees consumed significantly more pollen patty than protein supplement (Fig. 4). The amount of protein measured in the bees as they aged was affected by diet, age, and trial. In trial-1, the amount of protein was greater in bees fed either pollen or protein supplement compared with controls (Fig. 5). Amounts of protein in 4- and 7-day old bees were significantly higher than in day-11 bees. In trials-2 and -3, the results were similar to trial-1 in that protein amounts were highest in bees fed either pollen or protein supplement. However, the protein amounts detected in the workers fed each diet did not differ with age.

The HPG of workers that were $\leq$24 hrs. old had started to develop before we put the bees in the cages and fed them the different diet treatments. In all trials, the size of the acini decreased in control workers and increased or remained similar in size to the $\leq$24 hr old bees in those fed pollen or protein supplement (Fig. 6).

The proportion of bees where we could detect virus did not differ among diet treatments until after 7 days of feeding. At this time, the proportion of bees with virus was greater in controls compared with those fed pollen or protein supplement. Changes in DWV concentrations also were affected by the diet fed to the bees (Fig. 7). The concentration of DWV in 4-day-old bees increased from day 0 in controls and those fed protein supplement, but decreased in bees fed pollen. By day 11, the lowest concentrations of DWV were detected in bees fed pollen or protein supplement, and the highest concentrations in controls.

Our study shows that there are clear advantages to supplemental protein feeding over feeding sugar syrups alone to colonies. Protein supplements can raise protein levels in workers, develop their HPG and cause them to mount immune responses that are similar to pollen. The nutrition provided by the pollen and protein supplement appeared to influence DWV titers. Concentrations of DWV decreased dramatically over time in bees fed pollen or protein supplement compared with controls.

Interestingly, less of the protein supplement was consumed than the pollen, yet similar protein levels and HPG development occurred in bees fed either diet. A possible explanation might be that the rate of

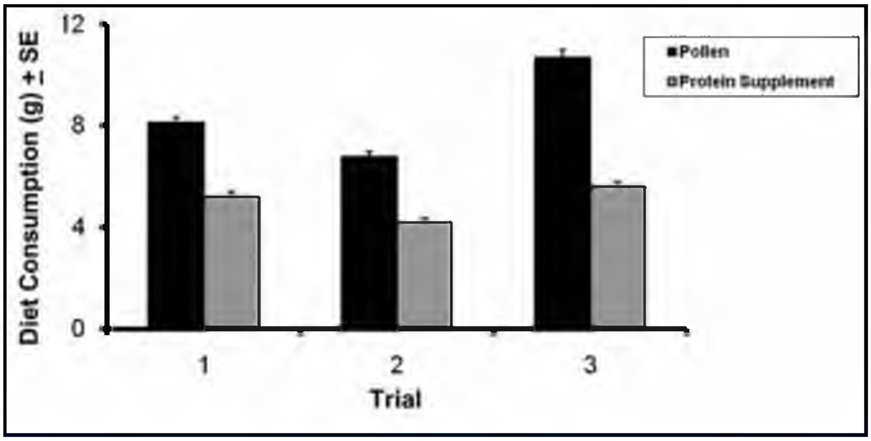

Figure 4. The average amount (grams) of pollen and protein supplement patty consumed by caged worker honey bees during an 11 day period. In each trial, bees consumed significantly more pollen than protein supplement (p<0.05).

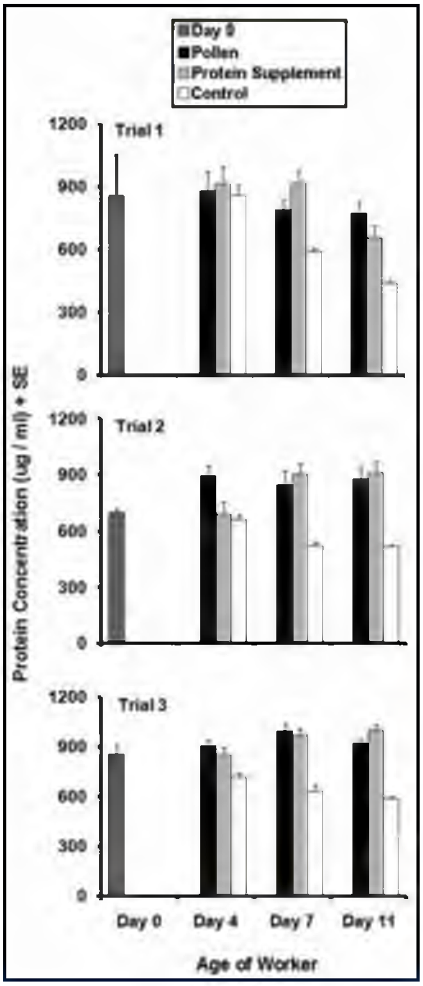

Figure 5. Average concentration of protein in the head capsules of worker honey bees of different ages fed pollen, protein supplement, or sugar syrup (Control). Protein levels were significantly lower at each age in bees fed only sugar syrup compared with those fed either pollen or protein supplement.

digestion for either diet might have been limited such that consuming more did not cause measurable increases in protein levels. This might be particularly true for pollen which is difficult to digest due to the waxy wall surrounding pollen grains. In colonies, bees store pollen in cells where it is fermented by the action of microbes and possibly pre-digested. In our study, the protein that bees were able to obtain from the pollen was solely from digestion in the gut. The ability of bees in colonies to fully digest protein supplements containing pollen might be limited so that even though bees might consume large amounts of it, after a point the increased consumption might not translate into greater nutritional benefits.

DWV levels in bees that did not receive supplemental protein increased as the bees aged and were significantly higher than in those fed either pollen or protein supplement. The specific role of protein in the activation of the immune system has been documented in humans and other animals, but relatively little is known about it in honey bees. However, we do know that alleviating protein stress in colonies by supplemental protein feeding can mitigate the effects of parasitism by Varroa mites and reduce the toxicity of some pesticides to honey bees. Our results suggest that supplemental protein feeding might slow the replication and spread of DWV. However, our study needs to be repeated in colonies before the connection between supplemental protein and changes in virus titers can be fully confirmed.

Though this study was done using caged bees, the results can provide insights into the effects of protein feeding in colonies. For instance, raising the protein levels in bees by supplemental protein feeding extends worker lifespan because it increases the period of time that they remain in the hive performing nest duties. Simulations with our mathematical models of honey bee colony population dynamics (i.e., BEEPOP and VARROAPOP) indicate that extending the lifespan of workers only a few days has dramatic effects on colony growth. Protein feeding also increases the size of HPG acini thus increasing the amount of worker jelly available to larvae and nestmates. Finally, protein feeding appears to strengthen the bees' immune response and this is essential in preventing colony losses from disease.

Honey bee populations have been declining over the past 40 years, and recently there have been huge losses of managed colonies from CCD (vanEngelsdorp et al.

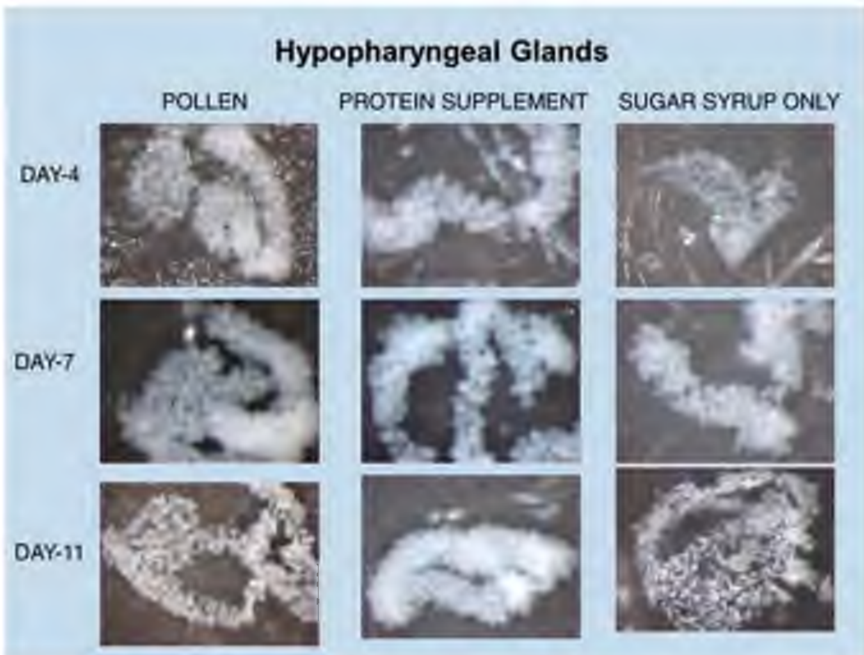

Figure 6. Sizes of acini from hypopharyngeal glands of workers that were 4, 7, or 11 days old and had been fed pollen patties, protein supplement (MegaBee®) or sugar syrup.

Figure 7. Fold-difference of deformed wing virus (DWV) in bees pre- and post- diet treatments. The virus concentrations in bees were expressed as fold difference compared to the level of virus of a calibrator. The group of 11-day-old bees fed pollen was chosen as a calibrator (indicated by a star) because they had the lowest level of DWV infection.

2007, 2008, 2009). Perhaps at the heart of many colony deaths is poor nutrition that acerbates the stress bees experience from parasitic mites, disease and environmental toxins. Management tools to reduce mite populations or reduce disease are limited and not always reliable or effective. However, one factor that can be managed effectively is colony nutrition. Our study indicates that protein supplements can closely resemble pollen in their ability to raise protein concentrations, stimulate HPG development and reduce virus titers, and therefore might be a component in management practices to reduce colony losses.

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A visit with Dr. Jerry Bromenshenk and Bee Alert Technology:

Looking at CCD, Pesticides and Landmines

Part I: Background and historical research leading to Bee Alert Technology

by **MALCOLM T. SANFORD**

THIS ARTICLE IS MADE UP OF TWO PARTS. THE FIRST SETS THE STAGE FOR THE ARTICLE, PROVIDING A BACKGROUND ON THE HISTORICAL RESEARCH THAT LED TO BEE ALERT TECHNOLOGY, INC. THE SECOND PROVIDES INFORMATION ON CURRENT RESEARCH IN CCD, VIRUSES AND LAND MINE CLEARING.

Introduction:

Many beekeepers know of or have heard about Dr. Jerry Bromenshenk at the University of Montana, recognized by his unorthodox research based on using honey bees as environmental monitors. Over the years, characterizing honey bees as "flying dust mops," Dr. Bromenshenk has carefully and convincingly shown that these insects are the most efficient organisms to use when looking for environmental air pollution. I have known him for upwards of twenty years and always found his approach to bee research robust, and refreshing.

Dr. Bromenshenk grew up on a farm in Billings, Montana. His father was the first to dabble in field corn in the region, which may have influenced his son to also become an innovator. As he was growing up, besides working on the farm toting 100 pound bales of hay, Dr. Bromenshenk also worked for a time as a seasonal naturalist in Yellowstone National Park, where he met his wife, Gail, a respected nature photographer. Thus, it seemed reasonable that I should visit them after my first visit to the Nation's first national park.

Dr. Bromenshenk picked me up in Bozeman, Montana, the nearest big city to the Park. He completed his Ph.D. there at Montana State University in 1973, and wrote his disseration on Grasshoppers and their control in range land situations.[1] He, like myself during the early 1970s, had not been involved with honey bees. Both of us, it seemed were to get "bee fever" in the course

JERRY BROMENSHENK OUTSIDE THE BEE ALERT TECHNOLOGY OFFICE, AUGUST 2010.

of our academic studies, but our careers were to take very different routes.

During the energy crisis of 1973-4,[2] Dr. Bromenshenk participated in a team looking at the effect increased coal burning (sulphur dioxide emmissions) might have on short grass prairies, along with Clancy Gordon, a well-known author and researcher at the University of Montana. Dr. Gordon was a national expert on the effects of fluoride emissions, and a witness in many legal cases and adversary hearings brought against polluters during the 1960s and '70s. He founded the University's Environmental Studies laboratory in 1963 (named for him after his death) and helped establish the Environmental Studies Graduate Program. The Clancy Gordon Environmental Scholarship is awarded each year to graduate students for use of scientific knowledge in resolving environmental problems.[3]

Since Dr. Clancy was a botanist involved in air pollution primarily. He hired Dr. Bromenshenk to look at insects. An entomologist, Dr. Bromenshenk also saw beehives everywhere in the Fort Union Coal Basin[4] ; there were about 6,000 colonies in his study area. He conducted a literature search, found a history of studies showing adverse impacts on honey bees in environmental monitoring situations, and began actively employing colonies as environmental indicators as an alternative to other techniques then being employed. Since there was limited funding for this work, he was forced to rely on beekeepers in an effort to obtain sample sites (colonies). A discussion with a commercial beekeeper, Bob Talcott, concerning grasshopper control in alfalfa seed production, resulting in a bumper honey and seed crop, converted Mr. Talcott into a valuable ally and colleague. As a consequence, Dr. Bromenshenk was able to learn honey bee colony management directly from a successful commercial beekeeper, which was to serve him well the rest of his career.

Linked up with colleagues at the University of Montana in 1974, Dr. Bromenshenk was not hired as a regular faculty member, the route most scientists take. Instead, he embarked on a 30-year career as a staff member garnering so-called "soft money". This means all his funding, including salary, was totally dependent on writing grants to study specific projects, rather than being supported by a University position. He was so successful in this endeavor that he was made Research Professor, forging a unique path to becoming recognized as a faculty member. One advantage of this continues to be that Dr. Bromenshenk can concentrate on his research and not have to contend with the distraction of teaching formal courses. Instead he has pioneered another teaching technique, training and coaching undergraduate students to actively participate in his ground-breaking research.

As a pioneer in environmental monitoring using honey bees, Dr. Bromenshenk has raised considerable awareness in this field among scientists and beekeepers. The current emphasis on this in Europe, culminating in "The Honey Bee as an Environmental Sentinel" being made the official theme for the 41st Apimondia Congress in Montpellier, France,[5] is in great part influenced by Dr. Bromenshenk's work. His initial studies in the coal fields of eastern Montana were followed by several grants from the U.S. Environmental Protection Agency to examine the effects of power plant and smelter emissions in the Seattle, Washington area on honey bee colonies. This led to other grants monitoring cleanup and remediation of superfund sites, including several U.S. Department of Energy national laboratory sites, and then U.S. Department of Defense sites, including the Aberdeen Proving Grounds in Maryland.[6] All this set the stage for further investigations, providing a path toward what has become an overall plan of action, developing ways to use "precision agriculture" in beekeeping.

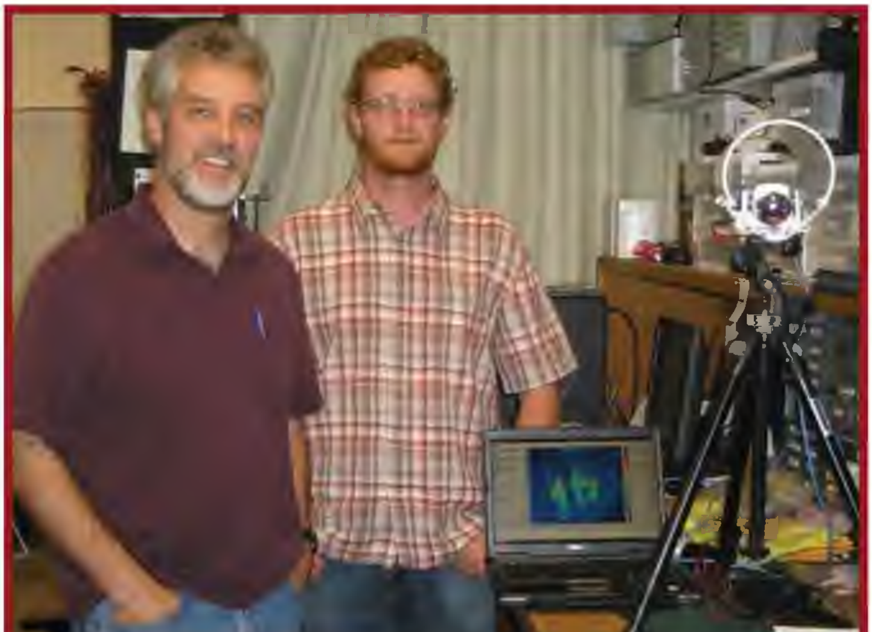
The Driving Vision:

According to Wikipedia.org, precision farming or precision agriculture is a concept relying on the existence of *in-field variability*. It requires the use of new technologies, such as global positioning systems (GPS), sensors, aerial images, and other tools used in geographic information systems (GIS) to assess and understand these variations. Collected information is used to more precisely evaluate optimum sowing density, estimate fertilizers and other input needs, and to more accurately predict crop yields. It seeks to maximize cropping potential, regardless of local soil/climate conditions, and is used to evaluate local situations for disease potential. In Dr. Bromenshenk's words, his vision is to find the beekeeping equivalent of "putting an airconditioned cab on a grain combine."

Dr. Bromenshenk's initial University of Montana research team consisted of Dr. Garon Smith, Department of Chemistry; Dr. Colin Henderson, College of Technology (COT); Dr. Vicki Watson, Environmental Studies; and a number of both undergraduate and graduate students. His web site says[7] : "All of these projects are aimed at using bees to evaluate environmental impacts as part of an ecological risk assessment. Our research involves developing and testing computerized data acquisition equipment to provide continuous, accurate, and precise field and laboratory measurements. It also includes development of computer models that simulate the responses of honey bee colonies to environmental stressors. The initial model, PC BEEPOP, [8] is a PC-based model and an expert system used for environmental risk assessments, for research, and to teach principles of apiculture, population biology, and ecotoxicology." An adaptation of PC BEEPOP is called Varroa Beepop. It continues to be available from the USDA ARS Tucson, Arizona bee laboratory.[9]

Team Bee Alert:

Most recently, Dr. Bromenshenk partnered with five other investigators to found Bee Alert Technology, Inc. Dr. Colin Henderson, oversees the statistical designs and data processing for all contracts; Robert Seccomb, a computer specialist and former graduate student, is now Chief Financial Officer; Steve Rice, who put in 14 years as Chair of the UM COT's Electronics Department and now heads the company's electronics division; Ted Etter is the electronics design engineer; and David Firth, of the UM Business School, helps guide business development. Bee Alert specializes in contract research, development of new bee-related services and equipment, and has as part of its mission a mandate to transfer technology developed at the University of Montana to the military and private sector, including beekeepers.



Dr. Joseph Shaw, director and professor of the Optical Technology Center (left) and Dr. Paul Nugent, president of NWB Sensors, Inc. (right) and their long-wave infrared (LWIR) imaging system.

THE BEE ALERT TEAM POSTER

In order to develop commercial products, it was imperative that some kind of private enterprise be developed. Thus, the entity known at Bee Alert Technology, Inc. LLC was born. The Montana Board of Regents approved establishment of the company in 2003 with the understanding that the University of Montana (UM) would receive 4 to 8 percent of the company's adjusted gross revenue. In 2005, the company's taxable income quadrupled from the previous year. The company still collaborates with the University on some projects, but works independently on many others. Bee Alert Technology, Inc. has 19 workers under contract.

In his spare time, Dr. Bromenshenk also directs the State of Montana's EPSCoR (Experimental Program to Stimulate Competitive Research) which funds energy-related work by more than a dozen faculty, as many as 30 students, and several technicians and post-doctoral investigators. This brings into focus one of his strengths as a researcher. In a recent article, he is quoted as saying, "Everything I've done in the last decade or more has been made up of teams."

I was privileged to meet some of the newest people on Dr. Bromenshenk's bee research team in Bozeman. Dr. Joseph Shaw, director and professor of the Optical Technology Center[10] and Dr. Paul Nugent, president of NWB Sensors, Inc. are working on using long-wave infrared (LWIR)[11] imaging to look at the status of beehives in the field.

The concept is to scan the hives and record the temperature by taking a picture. This can then be compared to other images, providing comparisons of bee health and/or colony strength. The camera is so sensitive that it can read the temperature of the wood surrounding the cluster. There is no reason to insert temperature probes or take the colony apart. Other possible uses include certifying colonies as "pollination units," without the need to look at individual frames of bees and brood as is the current practice. This does not work in the daytime for obvious reasons and so must be conducted at night. This technology is expected to mesh with others Dr. Bromenshenk and his team are pursuing. In particular, Dr. Shaw is involved in developing radar applications for detecting honey bees in the field, which is the focus of research dedicated to clearing land mines deployed in many of the world's battlefields.

I also met Dr. Robert Cramer of Montana State University's Department of Veterinary Molecular Biology. He is principally studying the opportunistic human fungal pathogen *Aspergillus fumigatus* (Af). His laboratory uses molecular biology, functional genomics, bioinformatics, immunology, and animal models to identify genes and biochemical pathways that allow the fungus to cause disease in immunocompromised and immunocompetent mammals, including humans.

Readers may partially recognize the name "fumigatus." *Aspergillus fumigatus* is the source of fumagillin, long used by beekeepers to treat honey bee colonies for *Nosema apis,* and now for *Nosema ceranae*. Thus, it seems reasonable for Dr. Cramer to look into Nosema control. He called Dr. Bromenshenk after seeing some publicity on the relationship to Colony Collapse Disorder CCD and Nosema, and they have been working collaboratively ever since.[12]

When I visited the Cramer lab, Dr. Bromenshenk's students were being trained to collect spores. Dr. Cramer has found *N. ceranae* spores to be much more fragile than those of *N apis*. They are easily killed by chilling and/or treating with a dilute solution of bleach (Clorox®) in water. *N apis* spores are far more robust, generally requiring fumigation by ethylene oxide (ETO) or acetic acid. Dr. Cramer says Nosema is a highly specialized organism. It works like an "inverted glove, which when it achieves entrance, injects materials through fingers that extend into the depths of the cell.

In addition, he and Dr. Bromenshenk are intensively studying the history of these organisms and their control in U.S. honey bees. Although it appears that *N. apis* is being actively replaced by *N ceranae*, recent appearance of the former in areas where it traditionally has been more prevalent suggests that in specific localities, both co-exist.

Dr. Cramer expressed surprise that fumagillin is used to treat honey bees for Nosema. It is a highly toxic substance and employed only as a last resort for human applications. His concern seems to be relevant given recent evidence that treating bees with fumagillin (Fumidil-B®) is more problematic than originally thought.[13] The reticence of regulators in most of the European Union and UK to allow fumagillin use may partly stem from this concern.

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Bromenshenk

A Discussion of the Recent Paper Linking a Virus and *Nosema cerana* to Honey Bee Colony Losses

by RANDY OLIVER
ScientificBeekeeping.com

A man walking along the street one night sees another searching for his lost keys under a street lamp and politely stops to help. After a long search, the passerby says, "Are you sure this is where you lost the keys?"

"Oh no," answers the other, "I don't know where I lost them."

"Then why are you looking only under the street lamp?

"Because the light's better here."

A recent paper, "**Iridovirus and Microsporidian Linked to Honey Bee Colony Decline**," by Dr. Jerry Bromenshenk and a team of collaborators (including the U.S. Army's Edgewood Chemical Biological Center) made national news in early October. Has the Bromenshenk team finally found another clue to the mystery of CCD by looking somewhere that others previously hadn't? I will interrupt my "Sick Bees" series in order to discuss the implications of this paper.

The Paper

I'm writing this article shortly after the release of the paper, and things are crazy! The *New York Times* ran the unfortunate, but attention-grabbing headline "**Scientists and Soldiers Solve a Bee Mystery**," which set off a flurry of excitement in a public worried about honey bees. There is gratuitous sniping from other researchers in the press, and *Fortune* magazine carried an inaccurate and libelous piece accusing Bromenshenk of being in Bayer's pocket because he didn't blame CCD on the neonicotinoid pesticides (as though the Army lab could care one whit about Bayer)! I'm incredulous that folk are getting so worked up! Science shouldn't be about personalities and politics; it should be about assessing the data and conclusions on their merits.

I want to make clear at this point that I have no dog is this fight, and am as curious as anyone to see if Bromenshenk's results will be confirmed by other investigators. I know most of the CCD researchers, and find every one of them to be top-notch scientists who really know their bees. So I am going to avoid any political commentary on the progression of CCD research.

I do recommend, that in order to appreciate the scope of the scientific effort to address CCD, that you download the CCD Action Plan (Hackett 2007), which I find to be thorough, meticulous, and impressive (although surprisingly lacking in any suggestion to use the Army lab's tools, despite its commander being on the Steering Committee). I can assure you that all researchers have diligently spent long hours doing the painstaking and tedious field and lab work necessary to figure out what is going on in the sick hives. It has been as frustrating to them as it has been to struggling beekeepers begging for answers.

What Do Bromenshenk and the Army Claim to Have Found?

Let's briefly go over the paper section by section—I assume that you've downloaded your copy (see **References**). The paper has its critics, a number of whom I have spoken with; I will attempt to address their criticisms in my analysis. Let's start with the authors' summary in the Abstract:

"We used Mass spectrometry-based proteomics (MSP) to identify and quantify thousands of proteins from healthy and collapsing bee colonies. MSP revealed two unreported RNA viruses in North American honey bees, Varroa destructor virus-1 and Kakugo virus, and identified an invertebrate iridescent virus (IIV) (*Iridoviridae*) associated with CCD colonies."

Both VDV-1 and Kakugo virus are very closely related to Deformed Wing Virus (DWV), which is ubiquitous in U.S. bees that are infested with varroa. Due to the close relationship to DWV, the identity of these two viruses will need to be confirmed by other methods. If indeed they are present, it will be a wake-up call as to just how porous our borders are to the influx of new bee pathogens!

The key (and most surprising) finding was that the team discovered the apparent widespread presence of a heretofore unreported ***iridescent virus*** in sick colonies. This finding has been strongly questioned by some—I will review the evidence shortly. Bromenshenk's next conclusion is much less controversial:

"In addition, bees in failing colonies contained not only IIV, but also *Nosema*….We conclude that the IIV/*Nosema* association may be critical in honey bee mortality linked to CCD."

The nosema has been subsequently identified as *Nosema ceranae* (Bromenshenk, pers comm). This may be an "aha!" finding, as bee health problems in a number of countries appear to have increased at about the same time as *N ceranae* was introduced, yet it has been hard to pin collapses on *N. ceranae* alone.

The Team

Bromenshenk teamed up with statistician Dr. Colin Henderson, and then enlisted the help of virologists and chemists at the Army's Edgewood lab—**this is the outfit whose job it is to identify the cause of any new diseases suffered by soldiers** (and more recently, civilians and agriculture as well). The Army team was headed by Dr. Evan Skowronski (who, due to being on the CCD steering committee properly recused himself from the actual research). The sample analyses was headed by the Army's Dr. Charles Wick, who invented the IVDS machine (his brother Dave offers IVDS sampling to beekeepers), who coordinated several additional software designers. When the team found *N. ceranae* and IIV, they recruited fungal pathologist Dr. Robert Cramer, and iridovirus experts Dr. Shan Bilimoria (who recently patented an IIV protein for use as an insecticide), and Dr. Trevor Williams (who wrote the books on iridoviruses).

The Tools

In order to grasp the significance of the Bromenshenk paper, one must understand the various methods available for confirming the presence of a pathogen in, say, a bee (Figure 1):

- **Microscopy (optical or electron)**—with which you visually look for the actual organism, as when counting nosema spores.
- **Integrated Virus Detection System (IVDS)**—this machine separates out viruses by particle size (Dave Wick has recently matched several peaks to specific bee viruses)
- **Immunological**—in which you use an antibody designed to bind with a specific virus, bacterium, or protein (ELISA or blot tests).
- **Genomics**—in which you look for the genetic sequences of specific organisms (using PCR amplification or by binding to a microarray).
- **Proteomics**—in which you look for proteins specific to each pathogen.

Each of the above methods has its strong points and drawbacks when looking for known pathogens. But how about when you are trying to discover an unknown virus? It took twenty years to nail the HIV virus that causes AIDS; and believe me, lots of researchers were looking for it! Luckily, some of the newer technologies have made great strides—in 2002, Dr. Joe DeRisi's "Virochip" identified the virus that was causing the SARS outbreak in less than 24 hours! (DeRisi, funded by Project *Apis mellifera*, is developing a microchip that should identify any bee pathogen in a sample.

It is much more difficult to identify an unknown pathogen. Realize that the study of bee pathogens has been greatly hampered by the lack of honey bee cell culture lines in which parasites could be isolated and grown. Luckily, an alternative host cell culture has recently been found for *Nosema apis* and *ceranae*, which **may** help greatly in the study of the pathology of these organisms (Gisder 2010); however, a true bee cell culture line is greatly needed, especially for viruses.

In the case of an unknown virus, the virions are so small, and in "covert" infections so sparse, that they may be entirely missed by electron microscopy. A novel virus may form a peak on IVDS, but very large viruses (such as IIV) may break up in the device. Dave Wick (pers comm) has shown me IVDS spikes that may indicate IIV.

Immunological techniques depend upon creating an exactly matching antibody, so unless the virus is closely related to the antibodies used, it won't bind. Genomic meth-

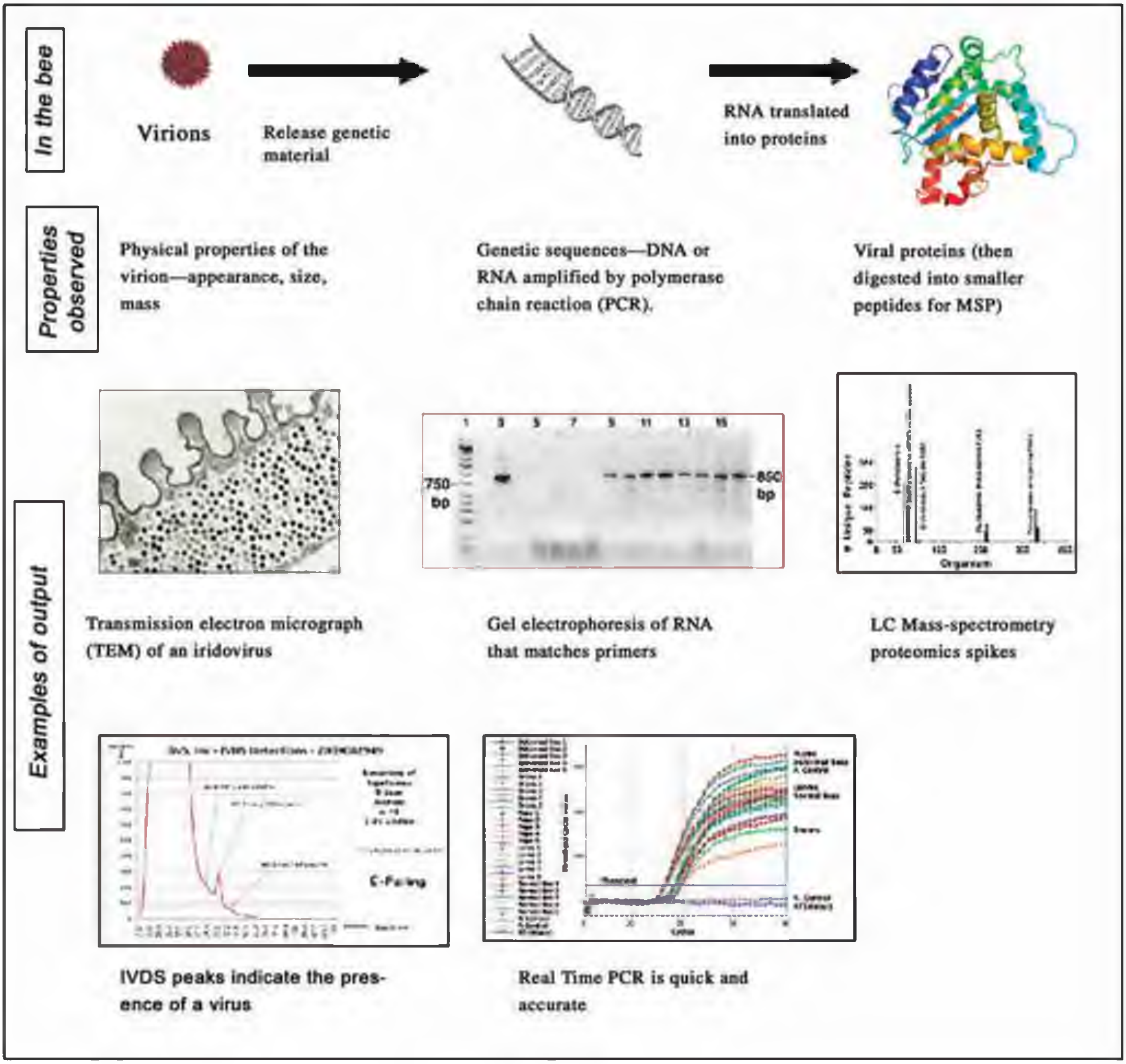

Figure 1. Different ways for identifying a virus. Please refer to my previous article about genetic transcription and translation. Each method has its advantages and disadvantages—price often being a consideration. (TEM and gel from Lapointe 2001; IVDS from Dave Wick; RT PCR from Chen 2005; MSP from Charles Wick; protein illustration from Wikipedia.)

Primer and probe specifications for real-time PCR amplification of *Nosema apis* and *N. ceranae*.

Species	Primers	Product size (bp)	Location
Nosema apis genbank: U97150	For: GCCCTCCATAATAAGAGTGTCCAC Rev: ATCTCTCATCCCAAGAGCATTGC Probe: ACTTACCATGCCAGCAGCCAGAAGA	142	4364
Nosema ceranae genbank: DQ486027	For: AAGAGTGAGACCTATCAGCTAGTTG Rev: CCGTCTCTCAGGCTCCTTCTC Probe: ACCGTTACCCGTCACAGCCTTGTT	104	218

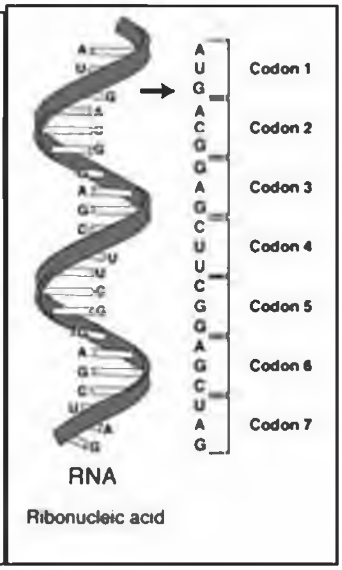

Figure 2. Typical published genetic primers. The four letters stand for the four base molecules that make up the backbone of DNA (e.g., G = guanine). Each "triplet" of bases codes for a specific amino acid. (Primers from Bourgeois (2010); codon graphic from Wikipedia.)

ods depend upon creating the right "primers" (Fig. 2) that will bind to the viral RNA or DNA. DeRisi's Virochip is imprinted with snippets of DNA from every virus ever discovered — about 22,000 different viral sequences—and ***with luck*** will bind to some part of any novel virus (however, his current chip did not find any iridovirus sequences in the Bromenshenk samples).

The key to creating such primers is to identify critical genetic sequences that are "conserved" as new viruses evolve from older viruses. Primers made from such "conserved regions" will likely hit on novel strains of that virus. Successful primers are generally posted to Genbank for use by all scientists. ***The problem with primers is that if you don't get them exactly right, the mystery virus nucleic acids may not bind to them.***

Proteomics differs from the above methods in that it looks at the final ***proteins*** that actually make up an organism (rather than the genes), and is useful for identifying traits in bees such as cold tolerance or parasite resistance. The process chemically digests all the proteins in a bee sample into smaller units called "peptides," runs them through a liquid chromatography column to separate them by size, and then gives them an electrical charge and sprays them into a device that records the "spectrum" of their atomic masses (the mass spectrometer).

The data output is mind boggling: some 26 columns wide by thousands of rows deep for each sample! A computer then matches the peptide fragment data against the full library of known peptide sequences. The more peptides that match a catalogued pathogen's "signature," the more closely the unidentified pathogen is related to it. However, there is a drawback to the method with regard to identifying pathogens that may be present at low levels—their peptides may be lost in the confusion of all the other peptides in the sample (from both the bee and all its gut bacteria).

This is where Wick's team had a brilliant idea—to combine proteomics with genomics! Still with me? Take a coffee break if necessary at this point, because understanding the next part is critical for appreciating the significance of the Army team's whiz-bang new method.

A Novel Approach

What Wick's team did was to ***download the genetic code*** for every bacterium, fungus, and virus (that had been fully sequenced as of September 2008). They then used a computer program to ***translate*** those codes into what would be the full complement of ***proteins*** for each organism, which were then "digested" by the computer into the expected peptides that would be seen in the mass spectrometer. At this point they had created a ***theoretical*** "mass spectrum" for each microorganism.

However, many peptides would be identical to those of other organisms, including the bee. So the team developed another computer program to ***discard any peptides that were not unique*** for each specific pathogen (all the bee and common pathogen peptides were "subtracted"). What was left was a "signature" of unique peptides for each microorganism. Their novel (patent pending) BACid computer program was then used to search for these microorganism signatures in any processed bee sample, and assign them by standard taxonomic classification, often right down to species and even strain (Figure 3).

The developers of the method suggested that it might "function as a strong complement to the alternative approaches of comparing microbial genomes based on DNA sequencing or microarray hybridization techniques" (Dworzanski 2006). And indeed it does, some major advantages of the method being:

•It is very rapid, and most of the work is done by computer.

•The approach allows for the detection, quantification, and classification of fungi, bacteria, and viruses ***in a single analytical pass***.

•Classification can be to strain level and is limited only by the level of precision within the proteomic and genomic databases.

•It isn't dependent upon the often tricky chemistry involved in standard genomic methods.

•Instead of using a limited number of genetic ***primers***, it uses hundred of confidently identified ***peptide sequences derived from entire genomes***.

•The signature isn't likely to be misled by single point mutations, as such changes would likely affect peptides less than they would affect primers.

This technique appears to be a major breakthrough for pathogen identification. The Army's pretty proud of it! As more bacteria, fungi, and viruses are sequenced each year, their proteomes can be added to the database, constantly improving the method. The method is explained in detail in a recent paper by the Edgewood team—Jabbour (2010).

Another of the technique's beauties is that once you process a sample, the data set can be later "mined" should any new pathogens be discovered in the future—their peptide signatures will still be in the original data. Bromenshenk has been processing bee samples to save examples of the current "state of the bee" for posterity (researchers are acutely aware of the lack historical bee specimens suitable for parasite confirmation). Future researchers could then use the archived data to see how any *new* parasites change the dynamics of bee symbionts and pathogens, or to see whether a newly-identified virus was previously present, but merely unnoticed.

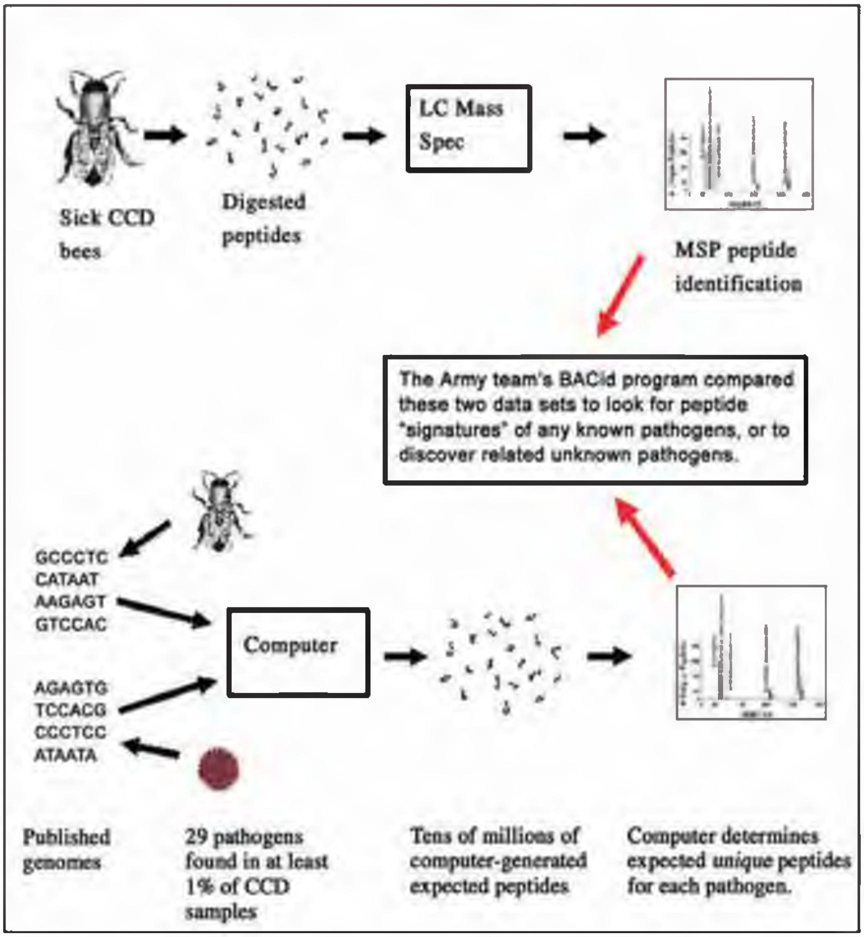

Figure 3. The upper path indicates how the Edgewood Lab processed CCD samples. The lower path is a schematic of how their novel computer program generated expected peptide sequences from the published genomes of bee pathogens, and then *subtracted any peptides that were common to either healthy bees or to multiple organisms*. This process then allowed them to look solely for the unique peptide "signature" of any specific pathogen. (Bee graphic from Kauffeld 1980).

Back to the Paper

In the Results, the authors make an amazing claim:

"MSP analysis resulted in a database of more than 3,000 identifiable peptides, representing more than 900 different species of invertebrate-associated microbes."

Nine hundred species of microbes? This is far more than all the bee symbionts and pathogens combined! The Army's explanation, soon to be released in a technical report, is that bees are essentially flying dust mops, and pick up every imaginable microorganism in the environment, albeit at very low levels. The MSP analysis is simply so dang sensitive that it picked up, for example, traces of every organism being studied in the various labs at Bromenshenk's university! MSP will even detect human skin keratin should you make the mistake of touching a bee with your bare finger when collecting the sample (Bromenshenk, pers comm).

"We narrowed the list of suspect microbes to those infecting bees and insects, 121 in all. Of these, only 29 were specific to bees or occurred in more than one percent of the colonies sampled…. Peptides were identified from nine of the approximately 20 known honey bee viruses."

The authors narrowed down their analysis to known bee pathogens, ***plus*** included any organisms that were present in more than one hive out of a hundred. They did not waste time on well known bacterial pathogens such as AFB or EFB, which had already been ruled out since they would have been readily identified by CCD investigators.

A criticism of the paper that I've heard is that the MSP could have simply misidentified normal bee peptides as erroneous indicators of IIV. This suggestion does not hold water, in my humble opinion, for two reasons:

1. The computer program (the algorithm) intentionally removed any bee peptides from consideration, and
2. The team also sampled two control groups as a check—bees from Australian packages, and from an isolated, non-migratory operation in Montana that starts fresh with packages each spring. No IIV peptides were found in either of those groups, and only a single instance of a virus (Sacbrood) was found in the Montana hives. If the MSP was misidentifying bee peptides as something else, it should have done so in the control hives as well.

The meat of the paper is in its Table 1, which shows the mean peptide count for various viruses and nosema in three groups of samples: from (1) bees from commercial apiaries sampled across the U.S. in 2006–2007, (2) bees sequentially sampled as the disorder progressed in an observation hive at Bromenshenk's lab in 2008, and (3) bees from a recurrence of CCD in Florida in 2009.

Israeli Acute Paralysis Virus (IAPV) did not occur frequently, and was more prevalent in East Coast and Australian bees. This certainly surprised me, as it was found in my own West Coast hives two years ago, and I observed the devastating effect of inoculating colonies with IAPV in my Remebee trial.

"The most prevalent viral peptides we detected were identified as invertebrate iridescent viruses (IIV)."

This claim is the lightning rod for the paper—researchers who have not found indications of IIV in their samples are, to say the least, skeptical! At this point the MSP reached its limit, since it only had in its database two complete IIV sequences—that for IIV-6, which is a common insect pathogen, and for IIV-3, which has only been found in one species of mosquito. Until more types of IIV are genetically sequenced, the computer program cannot match the peptides to the actual strain of IIV apparently present. The authors explain:

"These procedures may have identified IIV-6 as the most likely source of peptides because this is the only fully sequenced genome from the genus Iridovirus. We suspect that bees may in fact be infected by IIV-24 that is also assigned to the Iridovirus genus, which was isolated from an Asian bee…, or by a variant of IIV-6."

IIV-6 is a common insect virus which is easily cultured in wax moth larvae. I suppose that one could suspect contamination of samples from a bee brushing against an infected wax moth larva, but if you look at the average peptide counts (the $\bar{x}$ in Table 1), that explanation stretches credulity, as no actual worms were in the samples. There would also be little reason for any IIV levels from wax worms to correlate with nosema.

By the way, this is a different virus than the *Densovirus* that has plagued the wax worm bait industry. However, I was recently viewing a YouTube video of author Dr. Shan Bilimoria, which showed sick wax worms infected with IIV-6. That image immediately jolted in my memory that I had noticed similar-looking sick wax worms when I first experienced colony collapse issues in 2005. ***It stuck in my mind because I had never seen***

sick wax worms before—they were always so danged healthy! So there is the possibility that a new strain of IIV has jumped hosts, from wax worms to bees (or vice versa; I'm keeping my eye open for the recurrence of sick wax worms).

The IIV-24 that they mention is also known as Apis Iridescent Virus, and can cause serious bee mortality in the Asian bee, *Apis cerana*. Bailey, Ball & Woods (1976) state that IIV-24 "multiplied when injected into adult individuals of *Apis mellifera*, and… multiplied abundantly when injected into young pupae. These developed more slowly than pupae injected with water, but some occasionally matured into seemingly normal adults containing much virus."

So could a form of IIV-24 be the culprit? Bailey & Ball (1978) state that: "Apis iridescent virus was plentiful in each of several samples of adult individuals of *Apis cerana* from sick colonies in Kashmir and Northern India. Almost every bee, of those examined individually, was infected with the virus, which caused an easily detectable iridescence in the fat body and most other internal organs." So if the putative IIV were indeed IIV-24, you'd think that we'd easily see the iridescent color (caused by diffraction of light by the densely-packed virions). So I'm guessing that it's not IIV-24.

Just to make things interesting, I must note that vanEngelsdorp, et al (2006), when examining CCD bees under the 'scope, state that: "Crystal-like formations were observed in the thorax where muscles are located. Similar structures have been described in some viral infections; however, it is not clear if these are the same type of structures." Another odd thing is that IIV-24 is one of the few IIV's that doesn't appear to infect wax worms.

As long as we're speculating, some IIV's exhibit an orange-yellow color in heavily infected insects (Henderson 2000), which makes me wonder about the bright "corn-yellow" bee larvae that many of us are seeing in sick colonies (vanEngelsdorp, et al 2009). However, that infection appears to be controlled by treatment with oxytetracycline (personal experience), which does not support the virus hypothesis, plus iridoviruses normally do not replicate at normal broodnest temperatures. Likely just coincidence, but makes me curious.

There are also a couple of other pieces of evidence that an IIV might be involved in CCD. Dr. Mariano Higes, the Spanish *N. ceranae* researcher, found what appeared to be an IIV virion in a bee sample from a collapsing colony. Closer to home, in 1998, following unusual levels of winter mortality in the northeastern U.S., Camazine (1998) found "hexagonal, isometric particles resembling invertebrate iridoviruses" ***in the varroa mites!*** (But by the time he found them, it was too late to inspect the bees).

Since I've already crossed the speculation border, I've noticed that several CCD surveys have reported that mites were either not present, or at very low levels in collapsing colonies. The researchers generally assumed that the beekeeper had recently killed them with a miticide. But what if an iridovirus is killing the mites? Oh, this paper has sure opened a can of worms!

Still speculating, could varroa be the original or alternative host of the IIV? And further, could this be a jump of yet another parasite from *Apis cerana* to *Apis mellifera*, following varroa and *N. ceranae*, and perhaps tracheal mite, Kashmir bee virus, and who knows what else? Clearly, our bees appear to be finally picking up the entire suite of parasites from their cousins! And ***are those parasites, notably varroa,*** **N. ceranae,** ***IIV and perhaps some of the KBV/ABPV/IAPV group all co-adapted and interactive?***

Q & A

I should pause for a moment at this point, and discuss some appropriate and legitimate questions about the purported identification of an iridovirus in *Apis mellifera*, and its linkage to CCD.

Q: How could these guys find this large virus, when no one else had seen it?

A: Others may have seen it, notably Higes and Camazine, but those were isolated incidents, and only tentatively identified by appearance. The paper suggests that: **"inapparent infections by iridescent viruses may involve a low density of IIV particles in infected host cells, so without sensitive techniques such as MSP, it is not surprising that infections in CCD bee colonies were previously missed."**

The above answer is less than compelling to doubters, who are going to require additional confirmation before they will accept the finding as conclusive. One other point that must be kept in mind is ***that little analysis has been done of the "disappeared" bees*** (since they are so hard to find), so we really do not know the pathogen levels in the missing bees!

Q: How robust do they feel about their identification of IIV?

A: The Army does not go to press unless they think that they are incontrovertibly right (it's a guy thing). The authors state:

"The large number of IIV proteins that we identified, 139 in all, represent a significant fraction of the total IIV proteome…belying any criticism that our identification of IIV may be a spurious consequence of accidental matching of a few peptide fragments."

Q: How do they know that they are not simply misidentifying bee peptides as IIV peptides?

A: In the first place, their method generated the entire bee proteome, which they then "subtracted" from the results. Second, two "control" groups (Aussie bees, and "clean" Montana bees) exhibited no IIV peptides, thus supporting the authors' contention that IIV peptides are not present in uninfected bees. ***It also suggests that IIV may be related to the presence of varroa, since no IIV was found in samples from the two bee groups that weren't infested with varroa.***

Q: Could IIV have become endogenized (incorporated) into the bee genome, and the peptides thus have been generated by the bees themselves?

A: See above—no IIV peptides in the control groups. Also, the sheer number of IIV peptides observed would not be expected from expression of endogenized genes.

Q: Why didn't the team show electron microscope images of IIV virions to validate their finding?

A: I put the question to Trevor Williams, the IIV expert. His answer:

"Hello Randy – it's a good question; a picture paints a thousand words. Hopefully this issue will be resolved over the coming months and we'll get the image you're asking about. Finding virus particles in sublethally infected hosts can be extremely difficult - - maybe you remember how long it took for researchers to get a photo of HIV; this is because when the particles normally exist at a LOW DENSITY in covertly infected hosts, finding a cell with some particles inside is like looking for the proverbial needle in a haystack. Knowing which tissue to look at is an important step (one which we don't have a good handle on in the case of the bee IIV).

"Only one person has managed to observe IIV in a sublethally infected insect—a student from the Czech Republic found a low density of virus particles in some gut cells from covertly infected mayflies— but this was a serendipitous finding."

Bromenshenk's team worked on a shoestring, and electron microscopy is pricey. They didn't waste time on a likely futile search, since they weren't seeing bees with blue tissues, but this is something that the team is currently actively pursuing.

Q: Why didn't Bromenshenk get PCR or other genetic confirmation of the IIV?

A: Well, in a manner of speaking, they did! Their matches were based upon *in silica* (by computer) translation of all genetically sequenced IIV's. As far as PCR, ELISA, Southern Blot, or microarray, they are all dependent upon creating a specific primer derived from sequencing of the virus, or a very close relative. Without the proper primer, you simply won't detect the virus. Team member Dr. Robert Cramer is furiously working at sequencing the new IIV, collaborating with Williams and Bilimoria in his efforts. Indeed, he, Williams and Bilimoriaa are currently (October) testing the efficacy of an antibody to IIV-6 as a diagnostic tool. If they are successful, then any of several rapid and relatively inexpensive tests for this specific strain of IIV could be made available.

Q: Why didn't other scientists pick up IIV via genetic analysis?

A: This appears to me to be strongest scientific question of the putative IIV identification. Eaton (2007) found that all known members of the iridovirus family share quite a number of "conserved" genes. The genomists that I've spoken with feel strongly that they would have picked up the conserved genes. When this question is eventually answered, it will have great implications for the validity of the Army's method vs. metagenomics (the method used by Cox-Foster/Lipkin in the 2007 paper that indicated that IAPV was a marker for CCD).

Q: IIV peptides were present in 9 out of 13 strong colonies; how do they explain that?

A: IIV peptide counts in strong colonies were less than half of what they were in failing colonies, and IIV was present in 100% of failing or collapsed colonies. IIV's often exist in inapparent infections, in which the bees do not appear to be sick. Perhaps as long as nosema levels are low (or some other trigger is not present), IIV might not cause significant problems.

Q: Why did MSP indicate peptides from 10 species of nosema?

A: Because at the time of the analysis, *Nosema ceranae* had not yet been sequenced, so the computer matched to the closest nosemas. The Army plans to run the analysis again with the recently published genome sequence of *N. ceranae*.

Q: What the heck does the funny graph and weird statistics about "Discriminant Function Analysis" mean?

A: You're asking the wrong person, but I'll give it a shot. Discriminant function analysis (DFA) was used to determine which patterns of pathogen occurrence best discriminate between the groups Strong, Failing, and Collapsed in the 31 colonies from 2006/2007. In this case, failing and collapsed colonies tended to have high levels of IIV, plus nosema and Black Queen Cell Virus (long associated with *N. apis*; Bailey 1983); the levels of these parasites were about 80% predictive for collapse. The remaining 20% was predicted by the very low levels of Deformed Wing Virus (DWV) in failing colonies!

This result is surprising, since DWV has been strongly associated with colony collapse since shortly after the arrival of varroa. DWV titers generally go in lockstep with mite levels. Could it be that the high levels of IIV in failing colonies is killing varroa, so that they cannot transmit the virus? (that was more wild speculation). ***Or, could IIV itself suppress other viruses?*** (this appeared to be the case in Bromenshenk's observation hive). Please realize that there were only a relative handful of colonies in each group in this analysis, so I'd be careful about extrapolating these results to all instances of CCD.

The authors had a chance to later test their discriminant functions on nine colonies from the 2009 Florida collapse event—three each of strong, failing, or weak. They performed pretty well at sorting the colonies: none were classified as "healthy," and the rest were sorted fairly accurately based upon pathogen patterns.

Q: Was the virus the same in all sick colonies?

A: The authors finally looked at the similarity in occurrence of specific iridescent peptides in the three different groups of samples (2006/2007, obs. hive, Florida). ***The correlations seem surprisingly low to me if indeed a single IIV were involved in all the colonies sampled.*** However, the best correlation was between the 2007-8 East/West samples and the 2009 Florida collapse, which are likely the most representative data.

There is another aspect of IIV biology that may help to explain the diversity of IIV peptides. Williams (1998) observed: "Moreover, in all cases [of IIV infection] a marked degree of genetic heterogeneity [(differences)] was observed among the various [virus] isolates analyzed; ***identical isolates were never recovered from two different host larvae***" (emphasis mine). I find this of great interest, since DNA viruses generally have much lower mutation rates than RNA viruses. The observation that the virus is slightly different in every single individual infected insect begs for further research.

Q: What else did they do to corroborate their conclusions?

A: In another small set of data, the authors tracked the counts of IIV and nosema peptides in samples of bees from Bromenshenk's observation hive as it slowly collapsed over a period of five weeks—the counts were similar to those of failing colonies.

Finally, Cramer infected bees in cage trials with *N. ceranae* and a cultured strain of IIV-6 (he has yet to be able to isolate a pure strain of the IIV in their samples). I found the results to be supportive, but of limited significance. The purpose of such an experiment would be to fulfill Koch's Hypothesis that inoculation of healthy colonies with the two pathogens will result in CCD-like collapses, but this will be impossible until they are able to isolate the virus.

Dr. Cramer tells me that it has been problematic for him to culture the virus, since other viruses are normally present, and especially since there is no available cell culture line for honey bees in which to grow it. However, he is optimistic about the progress that he is making, and will run similar cage trials as soon as he has a pure culture.

Iridescent Viruses

Beekeepers outside of India or Pakistan have likely not heard of iridescent viruses prior to the Bromenshenk paper, so let's start with a little background on them. Luckily, Dr. Trevor Williams maintains a great website, with plenty of free downloads (see **References**), from which I've obtained most of the following information.

IIV infections are common in invertebrates, but generally occur as covert infections, with no obvious signs of disease. They only occasionally flare up into epizootics, usually when host densities are great, ***and the weather is cool and damp***.

Note that the characteristic colored iridescence in "patently infected" (dying) hosts is an unreliable indicator of infection, since low-level infections with no obvious signs of disease are much more common.

Little is known about how they actually cause disease in the host. However, these viruses have dramatic inhibitory effects upon the synthesis of DNA, RNA, and cellular proteins, and ***it is likely that they encode multiple proteins that suppress host immune responses.*** They also cause another host immune response—they *inhibit* apoptosis (cellular death) to prevent the host from clearing the infection (by sacrificing infected cells), only to later *induce* apoptosis once the cell is packed full of newly-formed virions! IIV's make our common bee viruses look like amateurs!

Another stunning observation is that: "Purely in terms of numbers, [IIV's] are among the most efficient insect viruses in turning host resources into virus particles. Around 25% of the dry weight of a dead insect may be virus." (This brings to question why CCD researchers haven't found bees full of iridovirus).

The reasons that IIV infections occasionally progress from covert to patent is poorly understood. Williams (1998) explains that the viruses "may show different grades of virulence in different individuals." Williams further observes that: "Certain [IIV's] appear to exploit multiple hosts in their natural habitat" (like maybe varroa, wax moth, yellowjackets (which also harbor KBV), or the Small Hive Beetle?).

IIV's have been tested as use for biocontrols, but have been found to have too low a rate of infectivity and slow speed of kill. However, Williams makes a chilling suggestion: "Perhaps the only real hope for the successful use of [IIV's] in insect biocontrol lies in the development of formulations that augment the infectivity of the virus (e.g., by interacting with other pathogens)" (*Nosema ceranae* and varroa come to mind).

Practical Applications

So what if the combination of IIV and *N. ceranae* is indeed what's knocking out colonies?

Nosema: You can start by making sure that nosema doesn't get out of hand. I've written extensively about *N. ceranae*, which is now the predominant species in the U.S. (Rose 2010). Fumagillin, properly applied by various methods, is a proven cure; other treatments have less data to back them up.

However, *N. ceranae* alone does not appear to always cause noticeable problems; unfortunately, there is as yet no cheap test to see whether one has IIV in their operation. However, the general biology of iridescent viruses suggests some practical implications:

Dampness: IIV's require damp conditions to efficiently transmit. This fact bolsters the common advice to avoid placing apiaries in cool, shady, damp areas. Colonies always do better in warm, sunny locations. IIV virions degrade quickly in warm, dry conditions, so dry out deadout equipment before restocking.

Temperature: For some reason, IIV replication generally appears to be favored at about 70°F, and is completely halted at temperatures above about 85°F. Note that the bees in the insulating "shell" of the winter cluster drop to about 55°F, and that even the center of the cluster may drop to near 70°F if no brood is present. This suggests that you may wish to manage your bees to maintain strong colonies that can rear a bit of brood during the winter. The problem, though, appears to have more to do with unexpected cold snaps or lack of honey stores for heat generation, than with steady cold.

Disinfection: IIV's are very sensitive to drying, UV light, and disinfectants (Nalçacıoğlu 2009). This may help to explain why CCD-affected beekeepers have observed that it is helpful to allow deadout combs to "rest" a while before restocking with bees.

Varroa: It appears that mites may vector IIV's. Keep varroa levels down!

Broodless splits: The isolated Montana operation in the study was nearly mite- and virus-free. This was apparently due to them starting with fresh packages each spring. Starting up fresh yards each season with mite-treated, broodless packages or splits might be a good idea.

Supplemental Feeding: This may sound like a platitude, but those beekeepers who maintain protein levels by feeding pollen substitutes appear to have fewer problems than those who allow their colonies to become nutritionally stressed. This observation is supported by recent research which found that protein feeding helped caged bees to resist infection by a virus (DeGrandi-Hoffman 2010).

Bee/semen import protocols: Should MSP indeed prove to be able to detect pathogens at very low levels, it could be of great utility for screening potential breeding stock for import.

Discussion

The conclusions of this paper have generated intense questioning and skepticism, which was exacerbated by the press hoopla about the mystery of CCD being "solved," which I feel is inappropriate at this point, since (replication of the identification aside) there have not yet been any infectivity studies.

The main sticking point is that the discovery is based upon "deep mining" of machine- and computer-generated data. The Army method searched for correlations between the masses of ionized peptide fragments, and computer-generated hypothetical peptide sequences—no one actually saw or physically confirmed the presence of the iridovirus. I can guarantee that the findings will be controversial until one of the above is done!

Putting doubts aside, let's assume that the team is correct, and discuss the implications of their findings. What I can say is that the results support what appears to be shaping up as a generic model for honey bee problems worldwide, both historically and in the present:

One or more viruses + nosema or varroa + chill events = sick colonies

This should come as no surprise to you if you've read the generic model for colony collapse that I published in the September issue of this journal. Allow me to quote from the CCD Action Plan: "Even if CCD is cyclic, it could be caused by a different pathogen in each case; for instance, a new pathogen could be causing significant bee loss (CCD) until the bees are able to develop resistance, at which point the problem disappears until the emergence of the next new pathogen."

Things have gone seriously downhill for beekeepers (of *Apis mellifera*) in all countries in which varroa and *Nosema ceranae* have been introduced. These two parasites appear to have rewritten the rules of virus dynamics and general colony health.

If indeed there is a previously overlooked iridovirus involved, it may help to explain some vexing questions, such as why *N. ceranae* seems sometimes to be so devastating, yet at other times relatively benign.

From a scientific bent, perhaps the most significant aspect of this paper is ***that it was the first field test of a revolutionary pathogen discovery method developed by scientists working for the U.S. Army.*** If the results are validated, it will open a new era of pathogen forensics, allowing scientists to step out of the light of the figurative streetlamp, and search more effectively in the darkness.

For this, beekeepers owe the Army a great debt of gratitude for all the free work that they've done in our behalf. Will the Army's findings be vindicated? We will find out soon enough, but I can say, the Army doesn't like to be embarrassed, so these findings would not have been released lightly.

Of considerable import is that should the team's purported discovery of a new virus in CCD colonies be confirmed, ***it would then call into question virtually all previous CCD research, since there is no way of knowing whether the purported IIV was present in the previous studies, unless the samples are reanalyzed!*** This is similar to the case of any *Nosema apis* research performed over the past decade or so—now that we've learned that *N. ceranae* invaded a number of countries unnoticed during that time. We must now question which nosema the researchers were actually working with!

Is the putative unidentified iridovirus the cause of CCD? Author Dr. Shan Bilimoria explains: "At this stage, the study is showing an association of death rates of the bees with the virus and fungus present. Our contribution to this study confirms association. But even that doesn't prove cause and effect. Not just yet" (Davis 2010).

The team is pursuing funding for the logical next steps. Bromenshenk explains: "We have a proposal pending to isolate, characterize, and then inoculate bees with the specific iridescent virus that occurs in USA bees. This is a critical step, since the virus does not appear to be any of the world's known iridescent viruses. Once we have the actual virus, we can complete the inoculation trials that are needed to test whether we've truly found the cause of CCD."

Meanwhile, the Internet is awash in "gotcha" blogs about the evil Dr. Bromenshenk. Writers who couldn't tell a beehive from a birdhouse are fueling a feeding frenzy for conspiracy buffs (for more rational views, see **Blogs**).

So will Bromenshenk and team suffer the fate of Stanley Pons, who stunned the world in 1989 with the (subsequently unreproducible) claim that he had achieved cold fusion, or will the team be vindicated by subsequent research, thus forcing their detractors to seek recipes for eating crow? Only time will tell.

Acknowledgements

As always, I must express my heartfelt gratitude to my co-researcher Peter Loren Borst. I also appreciate the time given me by the various authors of "The Paper," as well as by some of its not to be named critics.

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New Zealand Beekeeping at the Firth of Thames and the Bay of Plenty: Conversations with a Hobbyist and a New Commercial Beekeeper

by KIRSTEN TRAYNOR
photos by MICHAEL TRAYNOR

During our travels through New Zealand many kind beekeepers opened their doors and hosted us for an evening or two. They shared insights into their burgeoning industry as we enjoyed animated conversations and delicious meals together. Our spirited conversations lasted late into the evening on many occasions. Experiencing a country by being invited into the homes of locals is incomparable to trudging from one tourist hotel to another.

All our hosts surprised us with their extraordinary graciousness, their openness and their eagerness to learn and share. We can not thank them enough for making our journey so memorable. When we turned in our rental car, we were surprised to see we had traveled over 2,500 miles on the two islands.

Our journey started on the North Island, home to the majority of New Zealand's population and beekeepers. Throughout New Zealand there are currently 2,966 registered beekeepers, keeping 377,581 hives spread out over 22,448 different apiary sites.[1]

Just under two-thirds of the beekeepers (1,774) live on the North Island, which is divided into four districts for registration purposes:

- Hamilton: 2 hours south of Auckland (199 beekeepers maintaining 47,737 hives)
- Palmerston North: 2 hours north of Wellington at the southern tip of the North Island (628 beekeepers maintaining 69,520 hives)
- Tauranga: near the Bay of Plenty (307 beekeepers maintaining 73,383 hives)
- Whangarei: 2 hours north of Auckland on the northern tip of the North Island (640 beekeepers maintaining 55,324 hives)

New Zealand law, the Bisoecurity (National American Foulbrood Pest Management Strategy) Order of 1998, requires all hives to be registered. The registration database is maintained by AsureQuality.

After reading about our upcoming arrival in the *New Zealand BeeKeeper Journal*, hobby beekeepers Louise and Greg McConnell invited us to visit them at their home in Mangatarata, about an hour drive from the Auckland airport. We arrived at the turnoff to their road on a drizzly morning. Our car slowly climbed up the narrow lane and then turned off onto the dirt track. We weren't sure our car would make it on the slick, muddy road. Cattle grazed nonchalantly on the sides of the steep slope, ignoring the soft rain. Louise had warned us they lived ¾ of a mile past the cattle farm, so we decided to press on.

Through one last gate and then the narrow spit of a lane opened up into a large arc, where the McConnells recently built their home off the grid, but on top of the world. As Louise informed us, once the house was built, but before the windows were installed, the clouds simply rolled through the open window casements. From the large German made windows they installed they have a 360 degree view. To the west they can see the west coast and to the north they overlook the Firth of Thames.

The Firth of Thames bends in a majestic curve, creating a large marshy bay—an ideal spot for bird watching. Avid birders have recorded visits from over 74 species, including many rare birds. Five species of cormorant, four species of herons, a grebe, a spoonbill and a wide variety of feathered creatures have been spotted on the shores, making use of the inter-tidal mud and sand flats. Many of the birds migrate long distances from the northern hemisphere, seeking respite from cold winters.

[1] **From statistics as of Oct. 1, 2010 sent to me by Tony Roper of AsureQuality**


(l) As the drizzle let up for a moment, Michael photographed the view north from Louise and Greg McConnell's home. In the far right just below the clouds, the Firth of Thames can be seen. The dark green canopy of trees are part of protected bush land, where Louise's bees forage on Manuka flowers. (r) The view looking west from Louise and Greg McConnell's home. Beyond the first hill her hives sit along the fence line. The airstrip that first attracted them to this off-the-grid property is just out of view on the left.


(l) We pause on our drive down to the cafe to check out a colony of bees that built their home in the hillside lining the side of the road. From left to right Louise, Greg and Kirsten, the author. (r) A colony of honey bees nesting in the ground. As the rain stops, a few bees venture out. A piece of dark comb is visible from the entrance. A branch or tree root seems to support the hollow inside the soft ground.

We, on the other hand, had left the hot, dry summer of Arizona, trading sunshine for a New Zealand winter. As soon as we arrived, Louise popped the kettle on their wood burning stove and invited us to make ourselves at home.

The wood-fired stove heats their water during the colder months, as do the solar panels they installed on the roof. A small wind turbine outside provides extra electricity. They have never run out of power, though they frequently entertain family and friends. Their lovely guest bedroom has a stunning view of rolling hillsides that eventually fall away toward the sea. Just beyond the hill, hidden from view, are her 10 hives.

Louise is a veterinarian and Greg is a dairyman. Always up for adventure, Louise flies her own small, bright red two-seater plane. When she and Greg read about a piece of property for sale with its own airstrip, they decided to check it out. They both fell in love with the acreage high above the valley floor. Louise can land her plane on the small, flat grass airstrip beside the cattle pasture.

With 10 hives, Louise has a ready supply of honey to sweeten our tea. She harvests a light, creamy clover pasture honey and a dark, reddish brown Manuka from the bush—the indigenous and now protected forest—surrounding their homestead. As we sit in the living room sipping our tea, she recounts how the wasps have plagued her hives this year. With so much untouched preserve around their home, the large wasps have become a menace to her hives, darting in and robbing bees and honey. To help her hives, she has closed down the entrances to a tiny opening, but still the wasps try and attack, carrying off bees to feed their own young.

Wasps are astonishingly successful in New Zealand, because most of their natural predators are not present. Four species of stinging wasps have been introduced to the country. The most dreaded are both of European origin—the black-and-yellow German wasp *Vespula germanica* and the common wasp *Vespula vulgaris*. Both species build large nests and have infiltrated the native forests of New Zealand, consuming immense amounts of insects. Interestingly both types of wasps also collect the beech forest honeydew (which makes a delicious beech honeydew honey), stealing an important food source away from native insects and birds such as kākā and bellbirds.

As we were enjoying our tea and the freshly baked cake Louise pulled out of the oven and coated with melted chocolate, Greg returned home. At 6’2” he is a tall, but quiet man, who tends to watch and listen, taking pleasure in our banter with Louise on bees and beekeeping. We spoke about mites, which Louise first noticed in her hives last year. It seems the elevation had spared her an earlier mite infestation. Eager to learn more about combating mites organically, we suggested she might find oxalic and formic acid treatments useful, as both are permitted in New Zealand.

Since we were expected at another beekeeper’s home for the evening, the McConnells suggested we grab a small bite to eat at the cafe at the bottom of the hill, which they assured us prepared delicious pot pies and quiches. We followed them back down the windy road, trying to keep up with their four-wheel drive vehicle. As we drove back down the hill, Louise pulled over to the side of the road to show us where a hive of honey bees had made a home in the soft hillside cut away to make room for the road. The rain kept the bees from flying, but we could see the small, circular entrance where a few hardy bees were venturing out. I had never seen honey bees nest in the ground before, but the bees built a home in the mud hollow supported by tree roots.

Many cafes dot the countryside in New Zealand, providing quick homemade meals and pastries. Instead of visiting a chain restaurant, locals frequent the cafes for lunch. The one we visited was part plant nursery, part cafe. Louise confided it was tough having such a delectable place to eat nearby—as it was just a short a ride down to enjoy a cappuccino or a slice of homemade cake, she visited all too frequently.

Our conversation ebbed and flowed as we enjoyed our lunch of pumpkin and mushroom quiche. Louise wanted to learn more about the large bee losses the United States had been experiencing. We explained some of the differences in commercial beekeeping between the U.S. and New Zealand. While many commercial beekeepers in New Zealand migrate with their hives, they typically are not trucking them very long distances.

As we said our goodbyes, Louise wanted to know if we would like some honey for our journey. Never one to refuse such a tasty offer, we said we would be delighted. So Louise popped back up the hill to their home, while Greg showed us around the nursery which carried a variety of native trees. Louise brought us back a two-pound container of manuka honey and a two pound container of creamed clover honey. Although we would have enjoyed continuing our conversation, we were expected by commercial beekeeper Greg Dillon and his new wife Rosemary in Katikati overlooking the Bay of Plenty, on the eastern coast of the North Island.

Greg and Rosemary live in the center of the kiwifruit-producing area of New Zealand. As we drove to their place, we passed farm after farm blocked from view by 20 foot high living fences of trees and hedges. Apparently the kiwifruit boom of the early 1980’s spiked a demand for windbreaks. Unsheltered fruit rubbed against the vines and lost its fine hairs to friction, diminishing its value on the market. High speed winds also minimized vine growth and fruit production. New growers trying to enter the market were at a disadvantage, as they could not adequately protect their crop, spawning a race to create effective artificial windbreaks.

A right of way snakes back to the Dillon property that sits on a narrow spear of land. This peninsula-like tract juts out into a waterway where the Bay of Plenty spills in behind Matakana Island. The region produces a variety of agricultural products beyond the famous kiwifruit, including avocados,

(l) Greg Dillon and the author Kirsten Traynor stand on the back patio that overlooks the water. One of Rosemary's two cats enjoys the view from the second floor guest bedroom. (r) The storage shed houses an open air wood workshop for assembling hive bodies and a storage area for extra woodenware. The two white trucks are used for transporting the 850 hives to different orchard pollination and honey sites.

olives and citrus.

Greg is relatively new to beekeeping, having purchased the business two years ago. Previously he raised broiler chickens (or chucks as they are called in New Zealand). Wanting to start in something new, he looked for alternative businesses, including importing large composting systems from the United States that towns can install to deal with waste.

When he and Rosemary got together, they first wanted to raise free-range eggs. But as he started doing the budgets he realized the return wasn't great when you factored in the cost of replacing the hens when they stopped laying eggs. His accountant suggested Greg take a look at beekeeping, as the books he ran for another successful beekeeper looked promising.

Before buying into the business Greg met up with a friend of his, a blind beekeeper who manages an operation in Matamata, New Zealand. The picturesque green pastures and rolling hills of Matamata set the backdrop for Hobbiton and The Shire in the Lord of the Rings Trilogy.

"It was Walter's dad who had a (bee) business for sale," Greg explained, gesturing at his beekeeping employee. "So I came over and had a look and silly me, I bought it," he says with a laugh. As part of the agreement, he hired Walter to help run the business. The two have been working together for the last two years, expanding the operation from 600 hives to approximately 850.

Despite the appearance of varroa on the North Island in 2000, Greg and Walter keep their mite population in check. They lost less than 10 hives during the winter, mainly due to drone laying queens, Walter explained. He thinks the hives must have been superseded late in the season when the drone supply had dwindled, so the virgin queens couldn't mate.

Living right at the center of kiwifruit production, Greg rents out hives for kiwi pollination. Typically, growers use eight to ten hives per hectare (2.5 acres). Pollination prices fluctuate, but beekeepers can earn between $100-160 NZ per hive ($75 to 120 US, at current exchange rates). The bees only stay in the kiwifruit orchards for two weeks.

Even in the kiwi orchards, the densest monocultures in New Zealand, the bees still have access to other pollen sources, Greg speculated. The density of orchards never exceeds 2-3 square miles, he explained, leaving the bees to collect a variety of pollen. We just don't have the vast monocultures found in the United States, he said.

After kiwis, some of the bees are moved to pollinate avocados. Then, the hives are all transported to honey sites. But the distances traveled never exceed 300 to 400 km (187.5 to 250 miles), quite different from the long migrations of commercial pollination beekeepers in the States.

Most beekeepers in New Zealand harvest varietal honeys. Greg and Walter produce a light pasture honey that predominantly contains white clover. It's not as pure as the white clover they make on the South Island, Walter explains. From the hills the bees gather nectar from the native Tawari tree, which can grow up to 50 feet high and flowers in clusters of white blossoms. Tawari honey tends to be light and golden with a hint of butterscotch flavor, making it very popular with chefs for desserts. From the coastline, the bees produce Pohutukawa honey from the New Zealand Christmas Tree, *Metsiderosis excelsa*, which bursts into crimson red blooms in December—hence the common name of Christmas Tree.

Apparently, a gnarled, twisted Pohutukawa survives on a windswept cliff top at the tip of the North Island. The Maori believe it represents "the place of leaping," where the spirits of the dead begin their journey to Hawaiiki, their original homeland. The spirits hurdle off the cliff and descend into the underworld by scaling down the roots of the 800-year-old tree.

From New Zealand honeysuckle (*Knightia excelsa*), a tree that can grow up to 90' high with a trunk up to 3' in diameter, the bees make a reddish brown, malty flavored Rewarewa honey. Predominantly bird pollinated, the flowers have an unusual structure.

Working up to 850 hives, Greg and Walter stay very busy. During the spring, they try to make their rounds through all the hives in a fortnight, but sometimes the rains hold them back. They run queen excluders on all of their hives, adding on an empty honey super early in the season. If the hives build up to strong, they blow some of the surplus workers above the queen excluder into a carrier hive box to keep them from swarming. The carrier box contains several frames of honey to keep the bees calm.

After collecting surplus bees from one apiary, they transport them to the next and use the bees to bulk up weaker hives. The system keeps the hives from swarming, unless the rain stays too long and the cooped up bees start drawing queen cells. If you are in a rural industry, you know the climate rules your life, Greg said with a wry smile. We suggested they might try using an empty frame for drone comb cutting to help reduce swarming.

Unlike most American beekeepers, Greg and Walter manage their hives so the frames are parallel to the entrance instead of perpendicular. The brood box also contains a two-frame feeder that can hold 5 liters (1 and 1/3 gallon) of sugar syrup. As soon as they harvest the honey, they fill the feeder. When they return two to three weeks later, they refill the feeder.

In addition to pollination, Greg's bees produce approximately 50 kg (110 lbs) of honey per hive. The majority of the honey is sold wholesale in metal drums. The rest Rosemary packages into jars to sell at the local farmer's market. The two married recently and because of the bees, had not yet had time to get away on their honeymoon. Shortly after the beekeeping conference took place, Greg whisked her away to Europe, where they toured Italy and France.

Greg may expand the beekeeping operation in the future, but he would need to hire an extra pair of hands to help. We were surprised to learn that at the end of the beekeeping season Greg is able to sell his surplus bees to other beekeepers. Just before winter, he still earns $95 NZ ($71 US) for six frame nucs of bees that the purchasing beekeepers must then coax successfully through the winter. With many beekeepers losing their hives to varroa, they need to recoup lost colonies. And in the spring it's difficult to find any hives for sale. Although New Zealand exports packages of bees, especially to Canada, they have an import ban on all incoming bees and honey.

Many beekeepers and honey packers are worried that the honey import ban may soon be lifted, permitting Australian honey to enter the country in exchange for New Zealand apples gaining access to the Australian market. Currently the local honey market has been protected from cheap honey imports due to New Zealand's desire to eradicate American Foulbrood from its shores.

Our conversation with Greg, Rosemary and Walter continued long into the night as we shared a scrumptious meal Rosemary prepared. A traditional New Zealand Pavlova meringue topped with kiwifruits and paired with a light and refreshing fruit salad rounded out the meal. Around midnight we finally retired to the lovely guest bedroom. A stunning view over the water greeted us the next morning.

If you ever have a chance to visit New Zealand, be sure to take the time to interact with the locals. Due to our kind hosts, our travels morphed into a wonderful experience, giving us a chance to experience New Zealand from a resident's perspective. Our thanks to all the Kiwis, who so kindly opened their homes to us.

Next month, I will detail our visit to the Mossop's Honey Shop in nearby Tauranga, an enchanting destination that provides a glimpse into New Zealand beekeeping and offers an unbelievable array of honey products.

A BEE STORY FROM AFRICA

A Missouri Beekeeper Answers the Call For a "Knight in Shining Armor"

They were desperately seeking their "Knight in Shining Armor" to come to Uganda.

by GENE FOLEY

The CBS Evening News with Katie Couric and Steve Hartman, does the feature on America, "Everyone Has a Story" and Paul Harvey did his, "Rest of the Story". Since we all have a story, let me tell mine. It started with the April issue of *American Bee Journal* in the "Letters to the Editor". It was a request for the need of a qualified and experienced beekeeper, one who would take on the challenge in the Rwenzori Mountains of Uganda. Edwin Harrison is the Business Advisor for the LIDEFO, Liberty Development Foundation. He is not a beekeeper, but he knows how to ask for help in beekeeping for the people in the Village of Nakazinga and Mahago, which are in the Rwenzori Mountains. Magda, his partner, is working with the college. She has a fundraiser to help build a small college made of mud bricks, which she is doing okay with, but fund-raising is slow. I made a donation to help some; any takers?

Just a Helping Hand

Edwin stated that the villagers and farmers just wanted someone to advise them and show them a few things about beekeeping, as well to help them in their goal to be better beekeepers. He also stated that the people were afraid to work with the bees because they had no protective gear. I sent in my rėsume and listed a few short courses I had taken with Marion Ellis, Marla Spivak, and Susan Cobey. Throughout the last 12 years, I have gained knowledge in beekeeping as well as the ups and downs of beekeeping. This is how we learned, the hard way, but you get better at it over time.

Edwin said that they were desperately seeking their "Knight in Shining Armor" to come to Kasese District in Uganda and help out in their need in beekeeping. I showed up, not in shining armor, but in a white bee suit. Our club, The Joplin Area Beekeepers Association, as well as I and others, sent 19 veils, gloves, and other beekeeping items. Mann Lake gave five hive tools which the villagers loved and Dadant & Sons, Inc. has always donated nice gifts to our club for new beekeepers.

Edwin jumped on my application, and kindly asked, "When can you come?" "Not for a while," I replied. It was April and the time to requeen, make splits, move bees, and place supers. This was not the time for me to go to Uganda. With several e-mails back and forth through the Internet, plans and questions had begun to arise. Questions such as: What was I to expect? How do I dress? What foods do they eat and what about language translation? What kind of hives do they have? What do they need and so on? I knew I was stepping back in time to a village area, but needed to get an idea of how far back. I did not have in mind to change their ways, but to explain to them what may or may not work, as well as explaining the differences between the bees. I wanted to discuss how they live and the duties that bees have in their hives. This was information that these beekeepers did not

(l) "A Knight" in a white bee suit—Gene and the four advanced beekeepers, Livingston, Simion, Besinna and Sele. (r) Edwin, Gene & Magda at a crater lake in The Queen Elizabeth National Park.

(l) Gene and Isaiah, my boda-boda driver, going up the mountain. (r) Lunch break at the apiary.

have nor did they know about the drones, workers, or the queen. They did not know how long it takes for the egg to emerge from the cell, the mating of the queen and drone, the workers, and how they make honey or wax. They did not know how the workers feed the queen, feed larvae, clean house, forage and so on. They wanted to know how to split a hive and I didn't think I had gotten through to them. They needed to understand the need to split a hive and move it to another place so the worker bees would not come back to the same hive in the same yard.

The translation went through three people, sometimes four. They spoke three Ugandan languages—Lhukonzo, Luganda and English. Edwin spoke Great Britain English, Magda spoke Australian English, and I spoke American English. The only language I could really understand clearly was Australian English. It was said that I had a strong voice and that they did not understand my American English all that well either. The translation got crazy at times and funny, but we did great. I did ask Livingston and Sele about some words they use in bee talks. Here are some words translated, queen (Enzuki—Enyikams), worker bee (Enzuki—Enyikoli), drone (Enzuki—Yobulhume), honey (Obuchi), pollen (Estanjinda), nectar (Obunyunyu), brood (Ebyana) and eggs (Amata).

On My Way

Setting a schedule for my trip, I was to meet with Edwin on the 28th day of June as I was unable to leave in April. Edwin was going to be away most of June so it was set for me to leave June 26th and arrive June 28th. My schedule was to leave Tulsa, arrive in Dallas, go to London, England where there was a layover and from London to Entebbe Airport Uganda. This is where Edwin and/or Magda, his partner, were to pick me up. Magda was there with a cab driver, whom they use most of the time when in Kampala, at which point we met for the first time. Edwin was at a meeting so I met him later on at a gift shop with Magda. We had refreshments and talked some. Later that evening, we had a meal at one of their favorite places in Kampala, the capitol of Uganda, which is set close by Lake Victoria. We had to drive an hour from Entebbe to Kampala, where we stayed the night in the Aponey Hotel. It was in the middle of town, a very busy town with lots of very busy people.

The Long Bus Ride

The next day, Edwin, Magda, and I got up early to catch the bus that was to take us to Kasese, about 170 miles from Kampala. This bus was one of the large ones, like a Greyhound Bus. It stayed put until it was full and then away we went. This was about a seven-hour drive, making a lot of stops for everyone who needed to get on and off the bus. The roads had bumpers across them, five of them, 3 inches high and 15 inches wide, to slow the traffic down, which it did. What a bumpy ride, hang on!

Very Kind People in Kasese and the Mountain Area

The people were very kind. They would welcome you with a smile, a hand shake, and would say "Welcome to Uganda". These villagers are in our modern world, but not in the bee world of modern times. Uganda doesn't have the industry to employ most people, so many are self-employed and sell their goods to one another. They have skills in making and manufacturing goods and there are shops to buy most anything.

Some of their hives were Johnson hives, as well as Top Bar hives. They have a version of the Langstroth hive and removable frames, but the hives were not of standard measurement. The supers were added to the back side of the hive. In other words, the hives were 20 inches wide and 34 inches long, but they did have removable frames, which was the best part of the hive. They used a starter strip of paper with wax dribbled on it. I suggested that they melt the wax and paint it on the paper. I also had some foundation with me to cut and use as a starter. There was no way to feed the bees if needed, unless you removed some frames and set sugar syrup in the super end of the hive. The hives did not have a normal hive entrance, just bored holes. Our supers are stacked going upward and their supers had a divided board with a 4 x 6 inch queen excluder nailed on the divided board that was between the brood area and the super. There was no front entrance like the ones on ours if you needed to feed with an entrance feeder.

Their hearts were into beekeeping, but the resources, money, supplies such as lumber, foundations, queens, bees, protective clothing, and saws to make the hives were not there. They had to make do with what they had. We have it made here in America when it comes to beekeeping; we take it for granted. I was talking to Edwin and stated that in America if we needed a queen, we could just get on the phone and order one, or a super, a hive, or a foundation; you get the picture. It is just not there for them. However, they do work together as a team and they learn very quickly. They make notes as to what they do, which is something that beekeepers here need to do—keep records.

I met with the four advanced beekeepers at the office of the Liberty Development Foundation, (LIDEFO), three men, and a lady, who were very soft-spoken and kind people—Livingston, Sele, Simion, Besinna. At our first meeting we filtered honey, jarred honey, and labeled honey. The four advanced beekeepers had to walk or ride from the mountain to get to the office. Simion had an accident on his way to the office where he cut his knee, elbow, and thumb. He said that he was okay, but it looked bad to me. They don't cry over things like that as they don't have the money to do anything about it. He said that it didn't hurt much, but I had some ointment with me, so I gave it to him. He really was a very nice man. It is said that two out of three accidents are from motorbikes.

A Boda-Boda Ride-Up

Going up in the mountains to the village of Nakazinga where the apiaries are, we had our first meeting in the apiary. To get there we had to ride on a motorbike, called a *boda-boda*. It got its name when the Dictator of Congo came in and killed all white settlers. The name comes from taking people out of the country across the border to safety, so it was called boda-boda, Border-to-Border. The first day was not a very good one, as I had not been on a motorbike since I was 23, which was 51-years ago, so I just held onto the bike. The next day my driver, Isaiah, instructed me on how to hang on to him so that we both would be together and not fighting the bike all the way up. It worked. The first day we almost lost the bike. Both our feet were on the ground to hold the bike up. The trail up was not a smooth one as it had dips, ruts, and rocks in some places. We had to get off and walk a half block or more as the bike could not carry two people. The trail was too rough! There was no other way up, unless you walked. A dirt bike track looks bad when you're watching them race, but it's like a highway compared to the trails we road on.

The villagers walk all over the mountain on trails, up and down. There is only mountain water. There is no electricity and all of the houses are made of mud bricks. These mud bricks are made from clay-type soil, mixed, and put in molds, which are then laid in the sun to dry. Some buildings were made with cane poles with mud placed on both sides of the walls. No wood is used on the floors since not much wood is available to them as it is here in America. Dirt floors are common in the mountains. The people walk a lot up and down the highways, roads, and trails, three to five miles, unless they have money and may ride a boda-boda. We walked to the office from Edwin's house and it was about a mile and then to town, which was another mile. When you got tired, you just gave in and grabbed a boda-boda yourself to go home that night—cost about 3,000 to 4,000 shillings, one or two US Dollars. The cost of going up the mountains was 25,000 shillings or $12.00 USD round trip. An hour up and the drivers stayed all day with us. The ride down was coasting about all the way.

At the bee yard or apiary at the village of Nakazinga is where we opened a hive and took a look. We found the queens and I only saw one African small hive beetle; a familiar import to the United States. I brought a marker with me to mark the queens, plus a tube of *Stop That Sting* which I got from Dadant & Sons Inc., before I left on this trip. I also asked Dadant & Sons, Inc., to send a couple of catalogs so I could give them away in Uganda. The four advanced beekeepers teamed up to find and mark the queens they found, and they did a very good job with this being their first time.

The other apiary was in the village of Mahoga, another part of the mountain area where Sele and Besinna lived. Besinna lost her husband and is working bees for the honey to have extra money to live on.

A Meeting with Questions

We had our meeting with 11 other people who were interested in beekeeping, along with the other village that had 10 for a total of 21 people in all. Sele gave prayer before the meetings each day. Many questions were asked such as: "How do the bees open the cells to get to the honey?" I explained that they used their mandibles, their jaws, to remove the wax from the cells. Another question was asked, "Can you eat pollen?" "Yes", I stated. It is used for health purposes, as well as to put on your food. Another lady just could not get it as to how a queen could have so many bees.

People of Uganda have been keeping bees for a long time and do just fine. However, it will take some time for them to catch up with our modernization. The Langsthorth hives have been here since the 1850s, but they have not advanced from the Johnson hives or the Top Bar hives. They don't have any resources for getting queens and no one raises them. However, since they work with Africanized honey bees, swarms are readily available.

How Aggressive Are Their Bees?

In my opinion, I have found that the *Apis mellifera scutellata* bees may have gotten a bad name. The bees I observed had yellow stripes, and are a little smaller than our European bees here in the U.S. They are aggressive and may pursue you some 100 to 150 feet before returning to their hive. However, I have had bees follow me that far here at home. It did not appear to me that they were anymore aggressive than some bees we have here in the United States. I have opened some hives here in the US where the bees were all of over you. We call them hot hives, and some, I call hot, hot hives. I have worked with some bees with no gear on, but in my beeyard at home, I know which hive I need to suit up for.

Did I or Others Help in Anyway Being There?

Did I or other beekeepers influence the beekeepers in the Rwenzori Mountains of Kasese, Uganda, with our knowledge on beekeeping? I'm not sure, but I think it was important to be there and give them the information and knowledge they need to know about bees. We had such little time to work with the advanced beekeepers. There is no way you or anyone else could teach years of beekeeping in a day, or two weeks, but I never intended to have them change to the western ways. They have been working with bees for hundreds of years and have established their style that works for them. They are still able to make honey; it's just that they don't have the same protective gear or resources as we do.

I did comment that it would be nice if they could convert to the standard size of the Langstroth hives. I think it would benefit them as their hives are 20 inches by 35 inches, including the hive body and supers together with removable frames. The Johnson hive has a lid that is hinged and no frames or foundation, but the bees start their wax on the inner lid. So, when you lift the lid, guess what? In all their hives, the bees start foundations as they would in the wild, which can become irregular. If you give them the proper and safe gear to work bees, then I think they would do much better on their own. They are afraid to work the bees because they don't have the right bee suits and the women have open dresses and are not able to protect their legs.

What They Have and Don't Have

They don't have modern extractors and most hives don't have removable frames. The wax has no frame, so they must compress the honey out. Other equipment is not available without cost, which they are unable to afford. You need to understand that nothing is the same there as it is here. They

(l) Looking for the queen in a Langstroth hive. (r) Villagers at the apiary. Back row from left: Livingston, Besinna, Sele, Simion, Edwin, and Isaiah the boda driver.

(l) An apiary in the Nakazinga Village of the Rwenzori Mountain. (r) The honey crop.

are good at getting by with what they have, so I can't tell them to change as they're making some honey, which is all that counts. They are very kind people, religious, and hard working beekeepers. I enjoyed being with them. They work very hard and I know they will be good beekeepers. They are not loud or over jubilant; they smile and are willing to help and work together as a team. Since they don't have anything, they don't expect much.

The country is not a starving country. They are very good at gardening and have a good variety of fruits and vegetables, as well as beef, goat meat and fish, none of which is refrigerated and is hung for daily use. I think the villagers can put a master gardener to shame here, as it's their survival livelihood. Some of their crops are bananas, coffee, tea, carrots, onions, peas, beans, okra, corn, tomatoes, potatoes, eggplant, melon, and on. All of this is grown on the side of the mountain by using a hoe for cultivating, not a tiller. One of the foods that they use and eat is the Cassava root. It's used like a potato, and it's made into a dough-like substance as well. Other things are added in the dish like beans and bananas. I thought it tasted good.

Time to Depart, Going Home

The night before I was to leave, Daniel, his wife Grace, Edwin, Magda, and I had a meal at a local café. It was a great evening and get together before I left for home. The electricity goes off quite often, so we ended up finishing our meal with candlelight. I took a ride back to Kampala, where I stayed at the same Hotel Aponey, before heading to Entebee Airport to board for the USA and home. Two days after I left for home terrorists set off three bombs and killed 70 people in Kampala during an important soccer match. That was a terrible thing that happened to the people as you saw it on the television.

I enjoyed my trip and my stay with Edwin and Magda. They were very kind in letting me stay with them and helped with arrangements on items I needed while I was there. I picked up a penpal from the college, a very kind 18-year-old lady who is in her first year of college. What an experience/adventure I had and I would do it again! Best wishes and prayers to the people of Uganda, the advanced beekeepers, Livingston, Sele, Simion, and Besinna. The best to one and all in the country of Uganda.

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The Other Side of BEEKEEPING

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Family Zygophyllaceae—the Caltrop Family

Depending on the reference consulted, the Caltrop Family consists of about 26 to 30 genera and 200 to 250 species of herbs, shrubs, and rarely, trees. The family is generally distributed through the tropical regions of the world with some species in temperate regions of both the Northern and Southern Hemispheres.

Many of the family's species are halophytic or xerophytic[1]. The stems are often swollen at the nodes[2], the leaves are generally oppositely placed and pinnately[3] compound, usually without a terminal leaf, but they may rarely be simple or reduced to two leaflets. Stipules[4] are present and persistent, but often modified.

The flowers are mostly bisexual, radially symmetrical, solitary or paired. Both the sepals and the petals generally occur in 5s (rarely 4s), and usually the flowers have twice as many stamens as petals, but more rarely have 5 or 15. The stamen filaments often have scale-like appendages. The female portion of the flower is generally composed of 5 united carpels[5], (but may consist of 2-12), there is generally one stigma and the ovary is in the superior position[6]. The fruit is a usually a capsule[7] or more rarely, a drupe-like berry.

There are six genera native to the US that are for the most part found in the country's southern half. These include the genus *Guaiacum* which provides the hardest commercial woods (lignum vitae) and Creosote bush *(Larrea tridentata)*, a dominant plant in much of the desert region of southwestern US and northern Mexico.

Recognition characters: Members of the family are herbs or shrubs with oppositely placed pinnately compound leaves, often with persistent stipules. The parts of the flower (sepals, petals and stamens) come in sets of 5 (more rarely 4) or in multiples of those numbers. The stamens often have a scale-like appendage. The female part of the plant is generally made up of 5 carpels and a single style.[2, 5, 13 & 14]

creosote bush, greasewood, hediondillo

Scientific name: *Larrea tridentata*

Synonyms: *Covillea glutinosa, Covillea tridentata, Larrea divaricata, Larrea glutinosa, Larrea mexicana*

Origin: Southwestern U. S. and into Mexico.

Plant description: Creosote bush is a spreading bush that grows to a height of about 10 ft. The branches are marked with black glandular rings at the nodes. The resinous dark green to yellowish green leaves are obliquely lanceolate[8] to curved in shape and are found in pairs connected at their base. They can be up to 0.71 inches long and 0.33 inches wide, but during extreme drought are frequently smaller than this. The small, hard, shiny leaves can withstand severe desiccation.

The fruit is a globe shaped, fuzzy white, dry capsule[9] to 0.25 inches in diameter that splits into 5 hairy seeds. The style[10] is persistent in young fruits.

The plant emits an musty odor similar to that of creosote, especially when wet, as after a rain, hence the Spanish name, hediondillo, meaning stinking.[3, 5, 7, 12 & 13]

Distribution: In addition to the dry areas of southwestern United States its distribution extends into approximately central Mexico[11]. In Arizona it is found below elevations below 4500 feet[3]. Porter[13] states in California it is found at elevations under about 3300 ft[13]. It is often the dominant shrub over vast areas of desert[13].

Blooming period: John Lovell[7] reports that the species blooms to-

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1 **Halophytic: lives in salty soils; xerophytic: lives in arid habitats.**
2 **Node: The point on a stem from which a leaf originates. Sometimes the definition includes the origin of another branch.**
3 **Pinnately compound: the leaflets are distributed like the sides of a feather.**
4 **Stipules: a pair of leaf-like structures found at the base of a leaf stem.**
5 **Carpel: The main building block of the female part of a flower.**
6 **Superior position: located above the attachment point of the petals.**
7 **Capsule: a dry fruit that is composed of more than one carpel (basic female structure) and opens to release its seeds at maturity.
Drupe-like berry—Berry: a fleshy fruit derived from a single pistil; Drupe: a fleshy fruit with no means of opening to release its stony "seed" (example a peach or cherry).**
8 **Obliquely lanceolate—Lanceolate: Lance head shape, much longer than broad with the widest point before the middle of the leaf. Obliquely indicates that the two areas on either side of the midvein are not equal.**
9 **Capsule: a dry fruit that has a means of opening to release its seeds and is derived from more than one carpel (Carpel: the basic building block of the female part of the flower).**
10 **Style: The usually narrow portion of the pistil that connects the ovary to the stigma.**

Top: Creosote bush in its native habitat. The creosote bush is the front bush located just a little left of center. If you look closely you can just see the little yellow spots that are the open flowers. Photo taken in the McDowell Regional Park Area of Maricopa Co., AZ on 3/21/01.
Bottom left: Creosote bush flower. The flower is about 0.6 inches in diameter. Photo taken at the Desert Botanical Garden in Phoenix, AZ on 3/08/01.
Bottom right: Creosote bush fruits. The mature fruits are about ¼ inches in diameter. Notice the remnants of the style protruding from the center of the fruits. Photo taken at the Desert Botanical Garden on 4/13/2007.

ward the end of the mesquite flow. Pellett[12] states that it blooms in early spring. He found it blooming in February in Arizona and states that New Mexico beekeepers report that it blooms during "rather uncertain periods sometimes, more than once". Goltz[4] says that the species blooms regularly in the spring, intermittently throughout the remainder of the year, and often profusely after a summer rain. Epple[3] says that blooming periodically peaks in March to April and again in November to December. In Mexico it is said to flower in late winter and early spring[11].

[11] The key to understanding the estimated age is the word "clone". The original bush sent out underground roots that gave rise to a ring of genetically identical plants (clones) which in turn did the same thing and so on and on. If you don't like considering these clones to be among the oldest living plants, consider the analogy of a several thousand year old redwood where the inner wood has many years ago rotted away leaving only the outer layers, which are much younger than the several thousand years that we consider to be the age of the tree.

[12] ***Glabrous***: **smooth, hairless:** ***Tomentulose***: **sparsely covered with short, soft, wooly hairs.**

Importance as a honey plant: From his questionnaires, Orertel[10] using some of the synonyms provided above, found the species to be important in AZ, NM, TX and CA. From their questionnaires, Ayers and Harman[1] found the species to be of at least some importance in CA, AZ and TX and of considerable importance in NV. John Lovell[7] states that the species provides enough nectar to sustain brood rearing and to furnish a little honey. Harvey Lovell[6] claims the species' main value to the beekeeping industry is that it stimulates brood rearing. Goltz[4] states that the species is an important source of pollen and occasionally nectar; this mixture causing colony buildup when the bloom persists. According to Pellett[12] , recounting information from a J. W. Powell of Messilla Park, NM (southwestern NM), the species sometimes yields a small surplus, but that its main value is early spring buildup, and Pellett implies that this is the general situation throughout the species' range. He also claims that it yields much early pollen. Vansell and Eckert[16] state the species is "often spoken of as an important secondary source of nectar" in California and that it produces abundant quantities of pollen. Ordetx[11] claims that the species produces much nectar and pollen in Mexico.

Honey: John Lovell[7] states that the honey color is bluish-yellow. Harvey Lovell[6] also claims that the honey is bluish yellow, but is rarely obtained in surplus quantities. Ordetx[11] describes the honey as amber with a light bluish coloration.

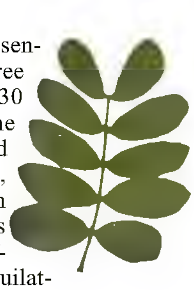
Pollen: As described above, the species apparently provides much early pollen.

Additional information: Creosote bush is thought to be among our oldest living plants. Porter[13] claims, "Clones may live to 10,000 years, longer than any other living plants known."[11] The resin from the branches mentioned above was used by Native Americans as a glue[13]. The flower buds are sometimes pickled and eaten like capers[5].

lignum-vitae, holywood lignum-vitae, holywood, tree of life

Scientific name: *Guaiacum sanctum*

Origin: Southern Florida, the Caribbean region, Mexico and further south to northern South America[5].



Plant description: *Guaiacum sanctum* is an essentially evergreen large shrub or sometimes a tree with a gnarled trunk that can reach heights of 30 ft. The twigs are light gray and enlarged at the nodes. The species has dark green compound leaves about 4 inches long with 4 to10 leaflets, each about 1 to 1.2 inches long and less than 0.8 inches wide. Leaflets are arranged in pairs (no end leaflet) and are shaped somewhat differently on either side of the central vein (inequilateral) and terminate in a small point sometimes referred as a small "tooth" to distinguish it from the more common point at the end of a leaf. This point does not show up well in the leaf image provided, partly because of the small size of the image and partly because the figure presented came from an old herbarium specimen where most of the small points had broken away from the specimen. The leaves sometimes fold together during the hottest part of the day.

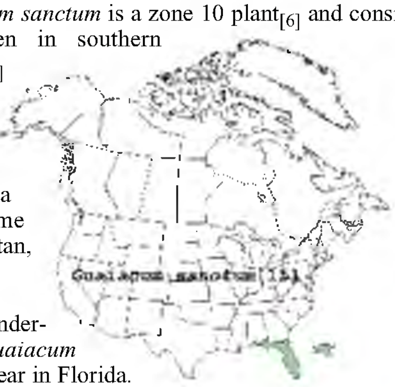
The terminal blue to purple flowers are radially symmetrical, have five petals, each less than 0.5 inches long. The fruits are greenish yellow to bright orange capsules about 0.75 inches long. The seeds are dark brown.

A sister species, *Guaiacum officinale* might also be found in southern Florida though it is generally considered an introduced species there[17]. According to Wunderlin[17], *G. sanctum* can be distin-

Top: Flowering *Guaiacum sanctum* bush. Photo taken at the Fairchild Tropical Botanic Garden in Coral Gables, FL on 3/9/2003.
Bottom left: *Guaiacum sanctum* flowers. Photo taken at the Fairchild Tropical Botanic Garden in Coral Gables, FL on 3/5/2003.
Bottom right: *Guaiacum sanctum* fruits. Photo taken at the Fairchild Tropical Botanic Garden in Coral Gables, FL on 3/9/2003.

guished from this species by its glabrous[12] petals and its usually greater than four leaflets/leaf, compared to the tomentulose petals and the usual four leaflets/leaf of *G. officinale*.[5, 9, & 17]

Distribution: *Guaiacum sanctum* is a zone 10 plant[6] and considered endangered even in southern Florida[9]. Ordetx[11] describes the more southern distribution of the species as the southern Florida Keys, the Antilles, Cuba , Puerto Rico and some parts of Mexico (Yucatan, Tabasco and Veracruz).



Blooming period: Wunderlin[17] considers *Guaiacum sanctum* to bloom all year in Florida.
The photo shown here suggests that it was blooming profusely in early March in the Miami area. I suspect that it then blooms less profusely during other times of the year.

Importance as a honey plant: Morton[8] states that the bees visit the species for nectar and references Ordetx[11] who treats *G. officinale* and *G. sanctum* together stating the former is visited by bees, and by inference, so is the latter.

While I recognize that the species is not an important honey plant in the US, I remember very clearly, however, thinking, "If I lived in southern Florida I would have one of these plants in my bee-forage garden". At the time the attractive flowers were much visited by bees and I thought the reddish fruits were also quite interesting and attractive. Admittedly, I may also have been influenced by the fact that I have always been intrigued by the greenish color of my lignum-vitae mallet and the beating it takes (see Additional Information below).

Additional Information: Lignum vitae translates into "wood of life" and reflects the old, but mistaken belief that the tree's wood exhibited powerful medicinal properties including a remedy for venereal disease. The woods of both species of *Guaiacum* are said to be the hardest of the commercial lumbers, and are self-lubricating and immune to the effects of water. For these reasons they were much used by the early shipbuilding industry for bearings, propeller shafts etc. Perhaps both the medicinal trade and the shipbuilding industry helped put the species in its endangered species status in parts of the Americas. Today the wood is used for mallets, caster wheels, and other products that require very hard woods, as well as a list of status items (pen and pencil sets, hair sticks and forks and miscellaneous other "knickknacks").

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Acknowledgement
The author is indebted to the Michigan State University Herbarium for the image of the *Guaiacum sanctum* leaves presented in this article.

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Singles and nucs available now in Florida. New queens. Call (772) 633-1134.

2000+ hive operation. Western MN east SD. Turnkey operation. East TX locations if needed. Call for all the info.–forklifts, trucks, bldgs., etc. Health reasons for sale. 888-273-2300. Cell 320-760-6769.

FOR SALE: Singles and 1 1/2 story hives for sale. 1000 available. Call for Pricing, Jon@(208) 412-1092 or Golden@(208) 250-8420. www.goldenbeeinc.com

Nucs - $96. Deep or Medium single beehives. Buckets of Honey - $130. Pollen - $300. John Pluta Milledgeville Georgia (478) 452-2337 www.georgiabees.blogspot.com

PARSONS' GOLD SOLUTION - The Only Solution For Keeping Your Honey Bees Healthy! Herbal Treatment Oil & Jelly - Bee Grooming Stimulant - Train The Bees To Do The Work - Healthy Bees Year Round. No Negative Effects On Bees, Queen, Wax or Honey. Business (419) 273-3066; Cell (419) 235-7037. www.parsonsgold-honeybees.com #33 Treatment Loaded Syringe - $11.00 plus $5.95 S/H. Checks, Money Orders, Credit Cards. Parsons' Gold Apiaries, c/o Robert B. Parsons, 2092 Twp. Rd., 195, Forest, OH 45843.

Five frame NUCS for sale mid-April through Fall. Price dependent on season and quantity of order. Minimum order of 24 NUCS. No frame trade, only return of our boxes. Call early to secure your order. FOB Lewistown PA or Dade City, FL. Please call W. Fisher Bee Farm for more information. 1-800-736-6205. Ask for Aaron.

New Beekeepers Forklift Trailers: 8000 lb. torkflex axle, 17.5/16 ply tires, hydraulic disk brakes, tilt bed, expanded metal treads. $5500.00 (269) 685-1000.

Beehives for sale: Singles and 1 & ½ on four-way pallets. Central California. Call for information. Chris (760) 417-1810.

For Sale: singles, 1 ½ stories and nucs. 4-frame nucs and 5-frame nucs available. (559) 665-1759 or (209) 769-2546.

HONEY PRICE UPDATES. Call Honey Hot Line (763)658-4193.

BROKER OF BEES AND BEE EQUIPMENT: Find out what is for sale or request a listing agreement at www.morrisweaver.com Morris Weaver Enterprises, 11625 Princess Margaret Ct., Montgomery, TX 77361-3616. Phone (936) 448-8061, Mobile (936) 825-4738. morrisweaver@comcast.net

Three and five frame nucs. New frames and queens made to order. Call Ed (239) 214-1467. jagocs@comcast.net. SW Florida.

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Essential B, lemongrass and spearmint essential oil feeding stimulant. Lower priced than the others because of lower overhead, not lower quality. $250.00 for 5 gallon bucket, $75.00 per gallon plus shipping. Contact us for more details. Jester Bee Co. Kevin@jesterbee.com, (870) 931-8700.

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400+ doubles on 4-way pallets, new queens call: (715) 347-4995.

20,000 beehives for sale. See our big ad on page 1146.

1000 5-frame Georgia nucs, April-May. Minimum order 25. $95.00. Includes good frames and wooden box. No frame exchange. Bob Binnie. (706) 982-9188.

For Sale: 300 eight-frame doubles before almonds - $225. (402) 305-0268.

California bees for sale before 2011 almond pollination. 1000+ or queen mother colonies on 4-way pallets with 2010 queen, 3-stories high 5 5/8. 3000 double sided queen mating nucs, +feed cans, also 8-frame shells and 10-frame 6 5/8 shells. Dovetail machine with hand –hold machine. Call Arrowsmith & Sons Apiaries, (530) 527-2770 or (530) 515-4522.

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(2) Food Lined Tanks. 5,000 and 3,000 gallon. Vertical tanks with bottom drains. 5,000 for $3,500 and 3,000 gallon for $2,000. All tanks sold "as is". **Contact: Howard at Glorybee Foods, Eugene, OR. (800) 456-7923.**

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Excellent clover honey in drums and light beeswax available. Mark Gilberts Apiaries, (608) 968-3500.

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Oregon raspberry or meadowfoam honey, drum lots only, F.O.B Albany, Oregon. Olsen Honey Farms (541) 926-0443.

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HONEY WANTED—Extracted or comb. LEIGHTON'S HONEY, INC., 1203 Commerce Ave. Haines City, Florida 33844. (863) 422-1773. FAX (863) 421-2299.

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BEESWAX WANTED – highest prices paid for light or dark beeswax. Contact Diana Hankins at Glorybee Foods, Inc., PO Box 2744, Eugene, OR 97402. Toll free (800) 456-7923, ext. 147.

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BEST 100% PURE FRESH ROYAL JELLY. $55.00 per kilo plus shipping. HIGHEST POTENCY. LOWEST PRICES guaranteed on larger orders. CERTIFIED TOP QUALITY. Stakich, Inc., 1155 Vaughan Rd., Bloomfield Hills, MI 48304. (248) 642-7023. Stakich@Stakich.com

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QUALITY, CLEAN, LOW MOISTURE POLLEN - $3.90/lb. Min. 10 lbs. Shipping $9.00. LOWEST PRICES guaranteed for large orders. STAKICH, INC, 1155 Vaughan Rd., Bloomfield Hills, MI 48304. Phone (248) 642-7023. Stakich@Stakich.com.

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POLLINATION

Bees wanted for the almonds. Art Harris, PO Box 82194, Bakersfield, CA 93380. (661) 444-1470.

Bee's needed for 2011 almond pollination. Prices vary based on frame strength. Send contact info to: Calpollin@live.com

Quality beehives wanted for 2011 California Almond pollination season. Call (510) 209-7006 or email denise@pollinationconnection.com

MICKEY BEE – bees for rent for 2011 almond pollination. Ask for Miguel Morales. (951) 943-7185 or (951) 833-2624.

BEES WANTED

Bees wanted for 2011 Almond Pollination, west side. 402-909-2358.

Bees wanted: Pollination 2011 Almonds. Newton Apiaries, (559) 277-8456.

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Pacific Northwest mated queens. Orders of 50 or more. Treasure Valley Idaho. Call for Pricing, Jon@(208) 412-1092. www.goldenbeeinc.com

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Experienced and interested beekeepers required to work in Australia in honey production, queen/package bee production. Long term employment and permanent residence a possibility for those wishing to make a career in Apiculture. Bio-data should be sent to: Australian Queen Bee Exporters P/L, Tel: 61-2-63683788/FAX: 61-2-63683799/Email: aqbe@bigpond.com.au

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Full-time position ND & Texas. References required. Must have clean drivers record, no drugs. Also, need winter season worker. Call Gary Mackrill (701) 984-2696.

Experienced commercial beekeeper looking for employment in California. Have class A license. Mark (386) 986-4155, Cell (386) 585- 5970 – sagetrek@msn.com

Mississippi, Alabama, Arkansas distributor wanted to sell woodenware for a major manufacturing company. 1-877-789-7526 (toll free)

Experienced commercial beekeeper needed for Somis, CA bee operation approx 1,000 colonies. Self-motivated, ability with trailer and forklift, all aspects of beekeeping. Onsite housing possible for right person, wage based on experience. Send resume with references to davidjefferson3@gmail.com

WANTED

Round Comb, Fresh good tasting **Pollen, Varietal Honey**. 800-678-1226. mstco@moonshinetrading.com

Wanted: 1 to 3 loads of bees for North Dakota white honey flow, amount depends on deal. Eric (701) 260-0815.

WANTED: GOOD STRONG BEES FOR 2011 ALMOND SEASON. We will unload semis, place bees in our contracts, and load bees back on your trucks. We have references. Contact: Brian Johnston, (719) 201-5199 or Larry Johnston (719) 469-4580.

WANTED: Honey moisture removal system. Bill (724) 226-1722.

Wanted: 4 semi-loads 2011 almond bees for April honeyflow in southwest Texas. Share crop production, 10-frame hives only. Call: R.D. Park, Jr., (210) 844-1150.

WANTED: EZYLOADER 300 CRANE. TELEPHONE: (613) 252-2389.

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The **AMERICAN BEEKEEPING FEDERATION** has many benefits to offer its members. Send for a membership packet of information today! We also offer a free Beginning Beekeeping Packet. Contact the **AMERICAN BEEKEEPING FEDERATION**, 3525 Piedmont Rd. NE, Bld. 5. Suite 300, Atlanta, GA 30305-1509, Phone (404) 760-2875, Fax 404-240-0998, or email **info@abfnet.org**.

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THE AUSTRALASIAN BEEKEEPER—Senior Beekeeping Journal of the Southern Hemisphere. Complete coverage of all beekeeping topics in one of the world's largest beekeeping countries. Published by Pender Beekeeping Supplies Pty. Ltd., PMB 19, MAITLAND, N.S.W. 2320, Australia. Annual subscription paid in advance US $95.00. Free sample copy on request.

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HONEYBEE NEWS, The Journal of the New South Wales Apiarists' Association, Inc., International Subscription AUS$50.00 (Airmail) Bank Draft, Visa or MasterCard payable to NSW AA. Published bi-monthly—For more information contact: The Editor, PO Box 352, Leichhardt NSW 2040 Australia. E-mail: **honey bee@accsoft.com.au**

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The American Bee Journal Staff would like to wish all of our readers and their families a Merry Christmas and best wishes for a healthy, happy and joyful new year!

Advertising Index

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Varroa Treatment

- Treatment is most effective when brood rearing is lowest
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- Remove strips after 42-45 days

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- Honey smells like decaying oranges
- In a severe infestation the bees may abscond from the hive

TIP: To attract the beetles, spread a small amount of Bee-Pro® patty down the center of the square then attach the strip on either side of the patty.

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$16

To Order Your Copy Go To www.BeeCulture.com

'Twas the Night Before Christmas

as misquoted
by Paula Giddings
(From December, 1978 *ABJ*)

'Twas the day before Christmas when all around the hive
Not a creature was stirring, can it still be alive?
The burlap was laid to keep the bees warm
In hopes that 'til spring they'd come to no harm.
The children were nestled all snug in the house
Television tuned in so they'd watch Mickey Mouse.
And Mama in her parka and I in my boots
Trudged out through the snow to give them a look
When out on the lawn I fell with a clatter
Ma sprang to my side to see what was the matter.
Out from beneath, her feet flew like a flash
She landed beside me with a bump and a splash.
The sun on the breast of the new-fallen snow
Made a slippery mess of the pathway below.
To the end of the porch, then down past the well
Now slipping, now sliding, then both of us fell.
We slipped down the hill, and went straight to our hive
Cracked open the lid, the bees buzzed "We're alive!"
And as we reset the lid, a few bees took flight
But glove-less and veil-less, we didn't stay for the fight.
We ran back up the hill and up past the well
To the end of the porch, neither one of us fell.
We sprang to the door, to the kids gave a shout
"Let us in! Let us in! But keep those bees out!"
And you could hear us exclaim as we dove out of sight
"Happy Christmas to all, the bees are all right!"

Best Wishes for a Merry Christmas and a Joyous and Prosperous New Year