

Survivor Stock

A growing number of small-scale beekeepers are joining forces to select for better bees

by M.E.A. McNeil

Hope has sprouted like dandelions in a grassroots movement to breed survivor stock honey bees across the country — burgeoning from only five years ago, when an article series in *The American Bee Journal* found only a few projects.¹ That is not to say that the grail of the ideal bee is a new pursuit. In the 19th century, the replacement of the nasty black German bee (*Apis mellifera mellifera*) with Italians (*A.m. ligustica*) was like tulip mania. An archived press clipping marked 1937-40 from the predecessor lab to the USDA-ARS said “They have just begun to bring forth their super-bee.”²

If it seems like an endless beginning, it is because the introduction of Varroa and tracheal mites changed the game. Breeding bees against mites was, at first, not known to be possible, and acaricides were widely used against varroa. It took the costly work of some exploring souls to revive old research, observe and demonstrate the feasibility of selecting for survival traits.³ Hygienic behavior was bred at the University of Minnesota Spivak Lab, and Russian bees, which evolved with Varroa, were imported by the USDA Baton Rouge lab, which also developed VSH (Varroa Sensitive Hygiene) stock that removes mites.

Now an additional goal, to develop locally adapted bees, has been taken on by an increasing number of small-scale beekeepers. Bees shipped from one geographic region to another can have problems acclimatizing, according to Debbie Delaney, a bee researcher at the University of Delaware. “People need to select for their area.” But, “I think there is confusion about what defines survivor stock. If bees are in a tree, people are thinking that it is survivor stock, but we don’t really know. It’s best to monitor for important traits.”

Every year Delaney acquires as much locally developed stock as possible: “I weed it out. Work by Seeley, Tarpy, and Mattila all show that diversity is key.” Washington State University bee breeder Sue Cobey also

stresses the importance of genetic variation, citing the example of disease resistance, where some bees, even in the same colony, can be badly infected and others uninfected.

Cobey has been breeding bees for over thirty years. Her experience has taught her that selecting for a single trait, such as hygienic behavior, can be done in as few as five years, but “developing mite resistant bees is a much more difficult and complex task.” She says that most successful survivor stock breeders have some or all of the following advantages: queen rearing; a broodless period that suspends mite reproduction (brought about by hard winters, swarming, splitting, caging queens or

behavior); pesticide-free foraging areas; selection for hygienic and VSH traits; control of drone selection by instrumental insemination or isolated breeding areas; genetic diversity; careful record keeping; and, she emphasizes, dedication.

Because the number of breeding projects has soared, the purview of this article will be a sampling of group or cooperative programs. All involved are looking for bees better able to cope, but the diversity of means to that end invokes the old joke: two beekeepers, three opinions. How they are going about it ranges from a live-and-let-die approach to controlled monitoring and IPM.

South African bee researcher Mike Allsopp said, “Beekeepers in South Africa just chose not to treat for varroa, with the result that we very rapidly eliminated the susceptible stock from our population... but to translate that to continent-wide programmes will be difficult — mostly because it is an all-or-nothing choice. Everyone has to go for the live-and-let-die, or else it cannot work.”⁴

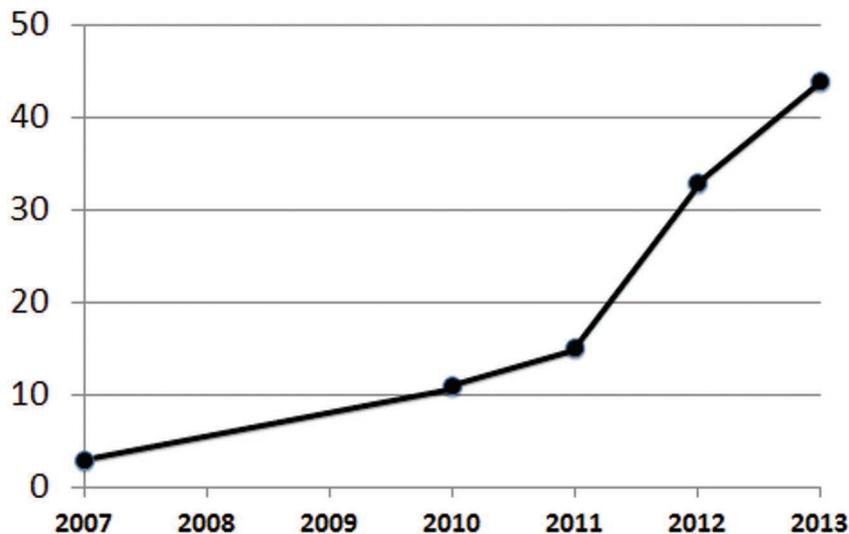
Not everyone here has made that choice — a choice that was not clear to make; American beekeeping is quite different from South Africa, by subspecies and management requirements. But acaricides long used in hives to control mites have been shown to be harmful to bees and absorbed by pollen and wax, so some small-scale beekeepers have opted to withdraw chemical treatments and select stock from survivors.

Commercial beekeeper John Miller calls attention to the fact that mite and disease-laden bees from a failing colony abscond, infecting others. His concern is that many novice beekeepers do not have the skill to control such contagion, and he likens it to allowing a dying chicken flock to spread avian flu. Cobey says it is critical to monitor carefully, use controls when needed, and re-queen susceptible colonies. University of Minnesota entomologist Marla Spivak agrees that IPM is a good approach, observing that live-and-let-die “might not be the



Meghan Milbrath works with the Northern Bee Network, a Minnesota consortium. A Kickstarter campaign raised \$5,000 to provide networking, education, a queen/drone exchange program and local stock. Photo by Andrew Potter.

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Greg Hunt's lab at Purdue University has bred for a grooming trait nicknamed "ankle biter" bees. The Heartland Honey Bee Breeders Cooperative has met there to start a yearly "insemination event" to breed and exchange stocks. They are now blind testing the Purdue stock against some without the trait. *Graph courtesy of Greg Hunt.*

best way. You don't know why they survived, and you can get down to a genetic bottleneck." She suggests that a better plan is to select for relevant traits — such as hygienic behavior, grooming, conservation of resources, seasonal shut-down.

A clear advantage to small-scale group projects is that they tend to be run by experienced beekeepers. Projects vary in management and organization — from individually led programs to consortiums and

those in cooperative efforts with university researchers.

Michigan

The Northern Bee Network functions as a communication center for Michigan survivor stock breeders, with a goal of increasing distribution of local bees. It is organized by Meghan Milbrath, who has worked as a bee researcher and now sells nucs and teaches



Bonnie and Gary Morse started breeding local bees as Bonnie Bee and Company with the support of Marin County beekeepers, who provided selected stock from diverse microclimates. *Photo by Melanie Kirby.*

classes. She considered the lessons of now-disbanded projects in choosing to narrow the function of a network to providing sources for education and local stock across the state. "Beekeepers are independent, and a lot of people are doing a good job of local breeding," she said.

The group raised \$5,000 in a Kickstarter campaign to begin last January, and now has a mailing list of 500. Informal exchanges of selected queens and drone frames are coordinated, as well as some shared expenses, such as shipping of Buckfast queens from Canada. The site also connects beginners with mentors: There are no stipulations for such arrangements: some are free, some paid, some trade for splits.

The website (<http://northernbeenet-work.com/>) profiles each breeder, including selection criteria and treatments. "I don't want to make the rules," said Milbrath, "But we require transparency. If I am buying a queen, I need to know how the bees have been managed." Network providers are smaller-scale beekeepers with fewer than 100 hives. "All are either treatment-free or moving toward treatment-free," using IPM, with the objective to develop hardy Northern localized stock.

Virginia

The Sustainable Honeybee Program (SHP), at the foot of the Blue Ridge Mountains in the northwest corner of Virginia is run by Billy Davis, who started keeping bees in 1947.⁵ He said, of dwindling colonies and clubs, "Somebody has to fix this mess."

SHP is a non-profit with the purpose of breeding and providing bee clubs in the surrounding area with local survivor stock — "hygienic, gentle, reliable producers that have a natural inclination to overwinter." Educational programs, developed by Davis, are offered through The Virginia Teaching Consortium. Of the non-salaried board of four, three, including Davis, are Master Beekeepers.

Davis has bred bees for 16 years in an isolated apiary, bringing in instrumentally inseminated hygienic queens five years ago. He now has a crew of interns who keep careful lineage records as queens are produced in nucs from six breeders — one of which is four years old. "We do rudimentary research — a lot of observed performance," he said: liquid nitrogen testing for hygienic behavior, infra-red readings every 15 days outside hives to record the size of the cluster. "We look for frugal, thrifty bees" to overwinter. "We have worked severely on behavior"; his crew can work shirtless in a quiet bee yard. "We have slowly brought the bees to the point where the whole population is above 80% hygienic." Apart from the loss of 24 colonies to a bear, their winter loss was 3% — two of 66 nucs.

"We highly support IPM beekeeping. We don't have to follow the commercial model or follow a 'natural' method that leads us down the primrose path to do nothing ex-

cept kill bees. However, we have not treated a colony for anything since 2005.”

They have given up trying to produce queens on a large scale, having bred 380 in one season: “It burned out our guys,” said Davis. The project provides nucs to clubs in the surrounding area. For each, they ask a \$250 donation to support their all-volunteer work.

Marin County, California

For years, a group of Marin County beekeepers discussed the possibility of a local survivor stock project. To that end, Cynthia Perry organized the Split Squad, which has successfully paired donors of splits with recipients as a means of supporting local adaptation. Some of the parent stock is three to four years old. Recipients bring their own nuc boxes, pay donors \$75, agree not to treat and share a split the next year. The all-volunteer group distributes about 20 splits a year.

A full-on breeding program, beyond occasional, informal queen swaps, proved too time-consuming for the part-time Marin beekeepers. Bonnie and Gary Morse took on the task professionally as Bonnie Bee and Company, in cooperation with sup-



Bonnie and Gary Morse, in Marin, are observing traits in the best overwintering bees, such as the drone culling behavior shown here – seen when drones are mite infested. This colony cleaned itself up from April to June in this way. Photo by Bonnie Morse



The logo for the non-profit survivor stock breeding consortium in Virginia.



Billy Davis of The Sustainable Honey Bee Program in Virginia checks a queen mother colony with intern Richard Whitlow observing. Photo by Sean Robertson

portive beekeepers. From the best colonies across the widely varied microclimates of the County, frames with eggs or splits to use as cell builders were donated. The Morses started with 20 colonies in four apiaries and now, in three years, have 120 colonies in 14 apiaries, managed with IPM.

“We have really struggled with evaluation,” said Bonnie Morse. “If we are selecting for one or two qualities we may not recognize other traits.” That being said, they are identifying three behaviors in more successful colonies: broodless periods, drone culling, and the uncapping of pupae characteristic of hygienic or VSH behavior.

Their observation of broodless periods, not triggered by dearth or supersedure, suggests a means of mite control. To examine the phenomenon they have set up an experimental apiary at the Romberg Center of San Francisco State University in Tiburon. “There seems to be better survival with those colonies. It defies all logic. For us, 9 out of 10 colonies that went broodless survived the winter, compared to 3 out of 10 that did not,” said Morse. By managing bees “through pre-varroa understanding – adding a frame of brood or attempting to requeen — we may be discouraging bees to do it on their own,” she said.

Over three years, their nuc sales have risen from 50 to 150. All are returned to the climate zones within the County of their parent stock. “It is a popularly held notion that it is important, although I don’t know how important it is,” she said.

In their work toward the common goal, the Morses also work with clients to make increases to share. “What’s exciting about Marin is what all the beekeepers are doing — learning to do splits, raise queens. We now have 74.7% locally sourced bees. As

a community we might be able to hit isolation” — in an area of over 800 square miles. “I’m encouraged,” said Morse.

Colorado

“5280”, the Denver survivor stock rearing group, is named for the elevation of the city — a pertinent element in the failure of many package bees brought in from dissimilar climates. The organizer, Marygael Meister, a chemist and microbiologist, describes herself as a “down board thinker” — a chess term that refers to planning well ahead. Her first move to address the problem was to start educational programs on bee behavior and breeding. Her next was to draw 23 names from the roster of over 300 from the Denver Bee Association and fund equipment for each. She created two management groups: with and without foundation. Participants were required to survey the dominant forage for four radii up to two miles from their apiaries — a requirement that acknowledges the need for an acre of season-long forage to feed a colony.⁶

With the goal of breeding stock that would withstand Denver winters, colonies were managed with IPM. Progeny was reared by grafting and queens set out to mate in a concentrated area of feral *A.m. mellifera* — which appear to be adapted survivors of the early European imports. Despite the loss of a precious apiary of Washington State University stock by an entomophobe with a can of Raid, 12 of 23 colonies overwintered.

“We are all on the same page,” said Meister. Breeding is done from queens of known origin that test highly hygienic with liquid nitrogen and are strong propolis producers. Members now keep 16 hives at an



(l) Dwight Wells, president of Heartland Honey Bee Breeders Cooperative, came from Ohio for the group’s “insemination event” at Purdue University in Indiana. He displays cells from instrumentally inseminated queens. (r) Queens brought to Purdue by members of the Heartland Honey Bee Breeders Cooperative were inseminated with genetics from a mixture of selected drones. Photos by Dan O’Hanlon.

urban farm and 18 on the rooftop of the five-star Brown Palace Hotel, where they extract their honey. They meet for speakers monthly in the hotel’s rooftop room overlooking the city as well as gathering for applied learning. The hotel makes a bourbon and a beer with the honey and has events centered on the bees. “There is a lot of enthusiasm,” she said.

Pennsylvania

The Pennsylvania Queen Project is described by chair Jeff Berta as “a loose group of like-minded IPM/treatment-free beekeepers across the state” supported by the expertise of the Penn State University Center for Pollinator Research (CPR).⁷

“People would say let’s exchange, but it never happened,” said Berta, who decided to organize more formally with co-chair Mark Gingrich. He has received three grants from NESARE to cover equipment, queen cells, and field assessments for mite resistant stock. An open mating program for secluded yards in five locations across the state was formulated under entomologist Christina Grozinger of CPR. To begin, over 200 Russian, Carniolan and Ontario Buckfast queen cells were introduced for mating with local survivor stock drones. A scoring system for colony strength was devised by Berta: he correlates numbers of frames with brood and honey with mite counts in a statistical table. The group next decided to take the best scoring colonies that survived the third winter for instrumental insemination (II). They plan to select again to create more II queens and widely disperse the daughters to the participants — a group of seven, soon to be 12, established beekeepers.

Berta, a commercial horticulturist, has not treated his bees for over a decade. But with this project, “The goal is chemical-free, but we’re not there yet. We lost a lot; if we hadn’t been so stubborn about chemical-free breeding, we would still have this valuable breeding stock.” He points out that

each breeder queen is worth thousands of dollars of grant money, hours of work and hundreds of driving miles — making IPM a viable alternative for moving forward.

With the intent of getting a lot of people involved, they are recruiting new beekeepers to do testing. Sharing the successful genetics the group develops is part of the goal. Although the progeny is sold through project members, university classes and bee clubs are free to graft from the select larvae, and there will be a queen exchange at a yearly picnic.

Midwest

The Heartland Honey Bee Breeders Cooperative (HHBB) includes members from Illinois, Indiana, Kentucky, Michigan, Missouri, Ohio, Tennessee, Virginia and West Virginia. Their mutual goal is “to develop a gentle, productive, disease-resistant, northern queen.” They plan a yearly “insemina-



Ginger Davis fishes for drones in a congregation area at Purdue University. Professor Greg Hunt has bred bees there with strong grooming behavior. Photo by Dan O’Hanlon.

tion event” at Purdue University in Indiana under entomology Professor Greg Hunt, whose expertise is in behavioral genetics.

Representatives of four state survivor stock projects met for the first such event last June, bringing the best of their stock from over 1000 colonies: Dwight Wells, president of HHBB, Ohio; Dan O’Hanlon, West Virginia; Dave Shenefield, Indiana; and Jeff Berta, Pennsylvania. “In this group, all the states are in the same biotope,” said Berta. “We all have similar long, erratic winters. We do our evaluations a little differently, but everyone’s goal is non-treatment with IPM as the last resort. We hope to create mite-resistant, not mite-proof bees.”

At the meeting, 74 queens from the HHBB breeding programs were instrumentally inseminated — some with drones from Purdue mite-grooming stock, some from VSH stock. Hunt welcomes the cooperation: Breeding “is very labor intensive. There is not enough economic incentive and not enough academic incentive to produce resistant stocks.”

His lab started breeding for mite resistance in 1997, using mostly survivor stock and a few colonies from USDA selection programs. He found a need for selection for mite-grooming behavior as a complementary trait to VSH in bees — which he’d concluded were the two most important behavioral traits. Because groomed mites are chewed by bees, his stock has been called Indiana Leg Chewers, or Ankle Biters. From 2007-13 the average proportion of chewed mites in the stock went from 3% to 44%, and may be higher now.⁸

To blind test this trait, the Hunt Lab is giving two queens to HHBB members and others — with and without the grooming trait, marked with different colors. Participants agree to introduce each into an equal size queenless split, not treat, and provide evaluation of each queen at the end of the season when the mite-biter is identified.

“I think if we can combine these two traits, we will have bees we don’t need to

treat for mites,” said Hunt. “But you have to keep selecting. I am excited to disperse the work among the bee breeders. I want to distribute as much stock and training as possible. We would like to have the Midwest beekeeping community try the queens that we are selecting for high mite-grooming ability and winter hardiness.”

O’Hanlon edits the group’s quarterly newsletter and invites free subscriptions at HHBCCoop@gmail.com.

New Mexico

The Southwest Survivor Queen Bee Project, having morphed into the Rocky Mountain Survivor Queen Project, is in transition into a geographically wider pollinator institute. The plan is to develop programming that can be accessible to beekeepers nationwide — via webinars, newsletter, and field days — to gain “consilience” — the principle that independent, unrelated sources can advantageously converge.

Melanie Kirby and Mark Spitzig of Zia Queen Bee Company founded the project some seven years ago, having bred survivor stock for the last decade in climate zones from desert to tundra. Their initial project focused on propagating stock from the widely varied microclimates in New Mexico. Subsequently, survivor queens from breeders across the country, from Oregon and Colorado, to Maryland, Vermont and Pennsylvania have been exchanged and tested by the couple to enhance genetic diversity. They have created a survivor queen breeding and rearing manual.

A series of grants from Western Sustainable Agriculture Research Education and the New Mexico Department of Agriculture helped fund the New Mexico Pollinator Lecture Series, providing instruction and additional expertise for the breeding projects. The 2013 speakers were research entomologist Tom Seeley of Cornell and Juliana Rangel of Texas A&M.

In the meantime, Kirby and Spitzig are breeding from four-year-old queens that Spitzig calls their “longevibees” — kept in a remote canyon with feral survivor stock. Rangel has sampled dozens of the colonies for her research, an example of the cross-pollination that the new institute hopes to foster.

The Future

Impetus for these local coalitions has been provided by many long-time individual survivor stock breeders: for example, Kirby and Spitzig traveled to Marin to help launch the Morses, who also went to Vermont to learn from Kirk Webster — a breeder of untreated stock for over a decade. “It’s still in its beginning stages” said Webster. “Each one has to work out their own method for their circumstances and goals, which are often quite different.”

“It will take some time to see adaptation to local environments,” said Delaney. “The genetics get diluted so quickly. It is a



Some ringleaders for the “insemination event” at Purdue University with the Heartland Honey Bee Breeders Cooperative: Professor Greg Hunt, Dwight Wells, Jeff Berta and Sam Moehlet. Photo by Dan O’Hanlon.

double-edged sword — to maintain diversity and select for particular characteristics. Breeding is hard.”

UC Davis Extension Apiarist Elina Niño said, “The limiting factors are time and money. Smaller programs might be the ones that come up with good stock that could be used by large commercial beekeepers.”

Sue Cobey’s dream five years ago was for small-scale beekeepers to organize breeding in geographically specific groups. That dream is becoming a reality, with even more such efforts coalescing than those sampled in this article. Cobey’s larger dream is for these groups to be connected through a national support program that could help evaluate, select and even breed.

From the vantage of three decades of ex-

perience, recently retired UC Davis Extension Apiarist Eric Mussen said, “Over time I think there will be local bees that are better adapted.”

With thanks for interviews from: Jeff Berta, Sue Cobey, Billy Davis, Debby Delaney, Christine Grozinger, Greg Hunt, Melanie Kirby, Maryael Meister, Meghan Milbrath, Bonnie Morse, Mark Spitzig, Marla Spivak and Kirk Webster, as well as information generously provided by Mike Allsopp, John Miller and Cynthia Perry.

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Endnotes

- 1 **McNeil, M.E.A. (2009).** Next Up the Survivors, Parts I & II, *The American Bee Journal*, v 149, no 3, March 251-55 and v 149, no 4, April 353-58.
- 2 **McNeil, M.E.A. (2012).** Happy Birthday to the USDA and Land Grant Colleges, *Bee Culture*, December, 65-72.
- 3 Initial work was done at Ohio State. John Kefuss did early breeding against mites.
- 4 The bees in South Africa are *A.m. scutellata* and *A.m. capensis*. European genetics have all but disappeared, according to Allsopp.
- 5 Several videos by Billy Davis are available on YouTube.
- 6 Forage requirement: Eric Mussen, retired UC Davis Extension Apiarist.
- 7 Penn State Center for Pollinator Research, <http://ento.psu.edu/pollinators>.
- 8 **Andino, G.K., Hunt, G.J. (2010).** A scientific note on a new assay to measure honeybee mite-grooming behavior, *Apidologie*, DOI 10 1007/s13592-011-0004-1.



Krispin Givens helped instrumentally inseminate queens brought from across the Midwest to Purdue in a cooperative project among breeders to produce survivor stock. Photo by Dan O’Hanlon.