# South Carolina Hive Instrumentation Project: 2013

## A statewide, real time, online hive monitoring system.

## Sponsored by the South Carolina Beekeepers Association

Project Manager: Bobby Dunn, Papa's Produce, Spartanburg Beekeepers

Project Engineer: Paul Vonk, Center for Honey Bee Research

**Grant Proposal**

***Abstract:*** *Scale Hives, each consisting of a computer, digital scale and other sensors, will be used to measure hive weight, temperature and humidity in the coastal plain, Piedmont and mountains of South Carolina. The hive computer samples the scale and sensors every five minutes and provides real time access to the data via the internet. By determining the beginning, end, and quantity of nectar flows, bee keepers will be better able to tell when to add and remove supers, when to move hives and where to locate hives to maximize honey production. Data will be provided to NASA's Honey Bee Net for climate and land use research. The network of scale hives will provide a platform to conduct additional experiments. Depending on the final cost of production and the number of participating Associations, up to 10 scale hives will be strategically located in order to give the best data coverage for the state. This is the first phase of a multi year project to place scale hives with as many local beekeeper associations as possible.*

**Background:** The use of scale hives to determine nectar flows is well established. In the 1970s, NASA established Honey Bee Net[1], consisting of volunteers who manually measure and record hive weights once a day. The information of plant/pollinator interaction is used to correlate satellite imagery with what is happening on the ground. NASA's data reveals that in the northeast, the nectar flows are now occurring 30 days earlier than in the '70s, i.e. they have shifted approximately one week per decade. Advances in technology have enabled automated data collection, real time analysis, remote administration and access to the data, and have greatly reduced the costs.

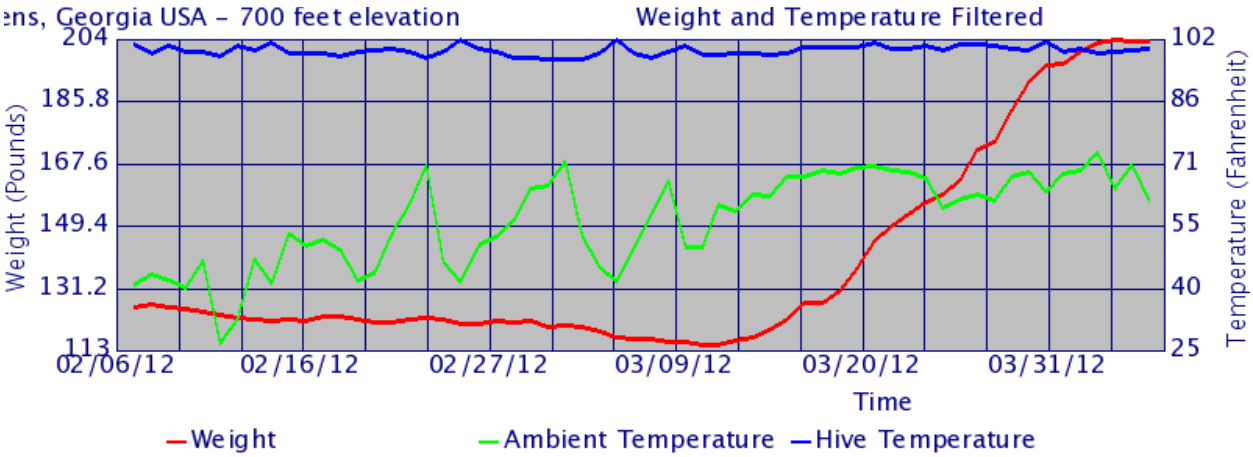


*Illustration 1: Graph of weight gain during spring nectar flow. Note that there was a 90 lb gain in the last three weeks in March.*

**Goals:**

1. Help South Carolina beekeepers better manage their hives, e.g. when to add and remove supers, when to move hives and where to locate hives to maximize honey production.

2. Provide South Carolina beekeepers with tools to conduct further research.

3. Gather baseline and historical data that shows the annual variations in the timing of nectar flows.

4. Generate interest in beekeeping and attract students to Science, Technology, Engineering and Math (STEM) by displaying the collected data on each participating Associations' website and working with teachers to use the data in the classroom.

5. Assist NASA in land use and climate research by providing data to Honey Bee Net (http://honeybeenet.gsfc.nasa.gov) and to make South Carolina beekeepers more aware of information that is available there.

6. Participate in a national bee research database by forwarding the data to http://www.hivetool.org.

**Proposal:** Phase I. Working with local beekeeping associations, up to 10 scale hives will be located across South Carolina in key locations on the coastal plain, the Piedmont and in the mountains. These locations will be selected based on different flora, elevation, climate and land use. They will be located where there is already power and internet access to minimize costs.

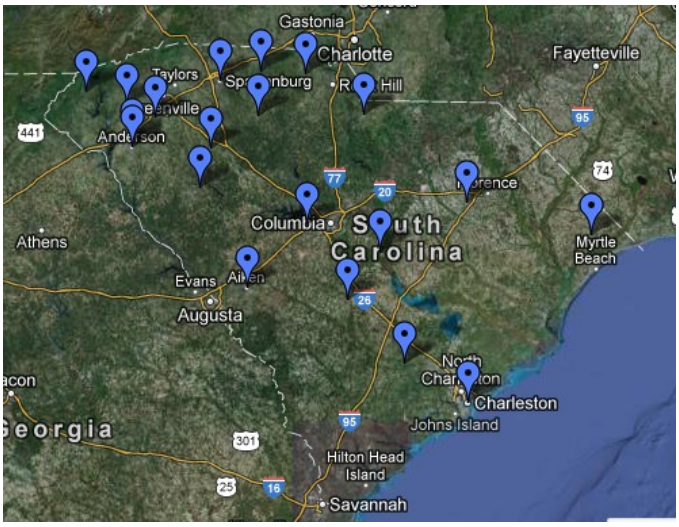


*Illustration 2: Possible locations of scale hives in South Carolina based on beekeeping associations.*

The hardware will consist of an industrial electronic scale repackaged in a metal frame that fits a hive super, two temperature and humidity probes (one inside the hive and one outside), and a Raspberry Pi computer[2] to log and transmit the data. Free Open Source Software[3] (FOSS) based on the Linux[4] operating system and developed by the open source project HiveTool[5] will be used.

Twelve hive instrumentation packages (10 for installation and 2 spares) will be assembled for approximately $350 each. See Appendix A. Equipment Cost for a detailed cost breakdown.

The remainder of the $5000 grant (approximately $800) will be reserved for shipping expense to distribute the units or travel expense for delivery and installation. Any funds not used will be returned after completion of the project. All equipment purchased with this grant will remain the property of the South Carolina Beekeepers Association and will be so marked. Additional equipment used for internet connection or solar power supplies will remain the property of the association that provided it.

Upon completion of Phase I, a report detailing the project's status, successes and failures, shall be submitted to the South Carolina Beekeepers Association. Included in the report shall be recommendations for extending the project another year.

Phase II.

After reviewing the project's status and recommendations and feedback from members, beekeepers, educators, and scientists, the South Carolina Beekeepers Association may decide to fund Phase II. Possible goals include increasing the number of instrumentation hives from 10 to 19 (one for each local association), adding additional sensors (microphone, camera) and hardware upgrades.

**Critical Dates:**

1 February 28, 2013: Submit final grant request to Kerry Owen.

2. March 2013 - NC/SC state meeting. Information and status of the project will be presented by Kerry Owen.

3. July 2013 - SC state meeting. Paul Vonk, author of HiveTool will speak about the equipment, observations, and conduct a workshop on installation and maintenance.

4. July 2014 - Presentation of the Hive Scale Grant project data & accomplishments.

**Development Team:**

A group of educators and professionals are developing a working prototype of a Hive Scale to be placed at multiple locations throughout the state of South Carolina and used in STEM programs. The group currently consists of the following people:

Bobby Dunn, Project Manager, Papa's Produce
Paul Vonk, Project Engineer, Center for Honey Bee Research and Hivetool.org
Carl Chesick, Center for Honey Bee Research
Dr. Jennifer Leavey, Georgia Tech. bees.gatech.edu
John London, ME, manufacturing and tool making
Woody Malott, head of the Science Dept, Rabun Gap-Nacoochee School
Roger Williams, IT/networking, liaison to the Baltimore Co. Schools STEM program

**Contact Information:**

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## Appendix A. Equipment Cost

| | Description | cost each item | cost per scale hive | project cost for instrumentation |
|---|---|---|---|---|
| 1 | Scale | $175.00 | $175.00 | $2,100.00 |
| 1 | Computer | $60.00 | $60.00 | $720.00 |
| 1 | Enclosure | $25.00 | $25.00 | $300.00 |
| 1 | 100' Ethernet Cable | $15.00 | $15.00 | $180.00 |
| 1 | 7 port usb hub (Belkin) | $15.00 | $15.00 | $180.00 |
| 1 | RS232 to USB Adapter | $7.00 | $7.00 | $84.00 |
| 2 | Temperature/Humidity sensors (TEMperHUM) | $22.00 | $44.00 | $528.00 |
| 1 | 6 AA Batteries | $9.00 | $9.00 | $108.00 |
| | TOTAL | | $350.00 | $4,200.00 |

## Appendix B. South Carolina Local Beekeeping Association Locations

Aiken
Anderson
Charleston
Cherokee
Edisto
Horry
Wateree
Lakelands
Lancaster
Laurens
Low Country
Mid State
Oconee
Pee Dee
Pickens
Piedmont
Spartanburg
Union
York

1 http://honeybeenet.gsfc.nasa.gov/
2 http://www.raspberrypi.org/faqs
3 http://en.wikipedia.org/wiki/Free_and_open_source_software
4 http://en.wikipedia.org/wiki/Linux
5 http://hivetool.org/