

# Harlan G. Hall

Associate Professor



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## Contact

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(100% Research)

## Education

- B.S., Louisiana State University (Zoology), 1969
- Ph.D., University of California (Genetics), 1978

## Relevant Employment History

- Associate Professor (1992-present) U. of Florida
- Assistant Professor (1986-1992) U. of Florida
- Staff Scientist (1980-1986) Lawrence Berkeley Laboratory
- Postdoctoral Fellow (1979-1980) Scripps Institution of Oceanography
- Postgraduate Researcher (1977-1978) U. of California, Davis
- Research Assistant (1976-1977) U. of California, Berkeley
- Teaching Assistant U. of California, Berkeley (1972-1975)
- Lab Assistant (1971) USDA-ARS, Biological Weed Control, Albany, CA
- Technician GS-5 (1968-1969) GS-4 (1967-1968) Assistant (1966-1967)
- USDA-ARS, Bee Breeding Investigations, Baton Rouge, LA
- Lab Assistant - Bee Biology (Summer 1965) U. of California, Davis

## Research Responsibilities

- DNA markers (RFLPs, detected with cloned probes) are being used to distinguish honeybee subspecies, specifically African and European bees.
- Methods based on the polymerase chain reaction (PCR) are being employed to facilitate testing of the RFLP markers, which will enhance research efforts, regulatory identification, and stock certification.
- The DNA markers are being used to follow African bee population expansion in the New World and their interaction with the resident European bees. Hybridization patterns in populations and characteristics of known hybrids are being studied, which may point to mechanisms that limit hybridization, which, in turn, may affect control programs. The DNA markers will be used to study honeybee genome organization.

## Teaching Responsibilities

Teaching the developmental genetics (emphasis on Drosophila) section of Principles of Genetics (PCB 5065).

## Accomplishments

### Finding DNA markers and simplifying tests:

- Members of my research group and I have found several cloned honeybee nuclear DNA probes that reveal polymorphic loci with alleles specific to groups of African, east and west European subspecies of honeybees.
- I developed a more rapid method to identify honeybee mitochondrial DNA (mtDNA) using the PCR, and we have simplified the test further by sequence-specific amplification with primers carrying different fluorescent labels.
- We have made several RFLPs, detected with probes, analyzable with the PCR.
- We found several useful RAPD DNA markers.

### Studying African bee population dynamics with the DNA markers:

- Using mtDNA, we demonstrated that New World feral African bees were comprised of unbroken African matriline. This finding was confirmed by a later study of many more samples, facilitated by our new PCR test.
- With mtDNA and nuclear DNA markers specific to east European bees, I showed that, in the tropics, gene flow between feral African colonies and managed European colonies was asymmetric in favor of African bees. European matriline in apiaries became extremely Africanized after backcrossing with African drones, but, in turn, did not become part of the feral African population. These studies disproved previous assumptions that African paternal introgression into European apiaries was a primary mechanism of African bee spread. Feral African matriline were found to hybridize to a small extent with European males as the expanding African population encountered managed European bees, but the hybrids appeared not to persist as the African population became established. We found an allele specific to west European bees, that has been retained in the feral African population at about a 20 to 30% level.

Studying known hybrids: I speculated that factors, other than tropical environmental selection, perhaps related to metabolism, might limit hybrid survival. In collaboration with J. Harrison, Arizona State Univ., we found that African bees had higher metabolic capacities than European bees. Hybrids had capacities equal to or lower than their European parents. This apparent negative heterosis may have contributed to the retention of the African bee genotype in the neotropics.

## **Grants and Contracts (Total \$328,100 over last 5 years):**

PI - USDA Competitive Research Grant, Plant Stress Program, Entomology and Nematology, 1986-1987, 1987-1989, 1989-1991, 1991-1994, 1994-1996; University of Florida Interdisciplinary Center for Biotechnology Research (ICBR) 1987; Florida State Beekeepers Association 1988; US-AID 1990-1991, 1991-1992

## **Career Publications**

- Chapters in books: 3
- Refereed Papers: 17
- Miscellaneous papers: 4

## **Selected Publications**

- Hall, H.G. 1986. DNA Differences Found between Africanized and European Honeybees. *Proc. Natl. Acad. Sci. U.S.A.* 83:4874-4877.
- Hall, H.G. 1988. Characterization of the African Honeybee Genotype by DNA Restriction Fragments. In: Needham, G.R., Page, R.E., Delfinado-Baker, M. and Bowman, C.E. (eds) *Africanized Honey Bees and Bee Mites*. Ellis Horwood, Chichester. Pages 287-293.
- Hall, H.G. and Muralidharan, K. 1989. Evidence from Mitochondrial DNA that African Honeybees Spread as Continuous Maternal Lineages. *Nature* 339:211-213.
- Hall, H.G. 1990. Parental Analysis of Introgressive Hybridization between African and European Honeybees Using Nuclear DNA RFLPs. *Genetics* 125:611-621.
- Hall, H.G. 1991. Genetic Characterization of Honey Bees through DNA Analysis. In: Spivak, M., Breed, M.D. and Fletcher, D.J.C. (eds) *The African Honey Bee*. Westview Press. Pages 45-73.
- Hall, H.G. and Smith, D.R. 1991. Distinguishing African and European Honey Bee Matrilines Using Amplified Mitochondrial DNA. *Proc. Natl. Acad. Sci. U.S.A.* 88:4548-4552.
- Hall, H.G. 1992. Processes of New World African Honeybee Spread Revealed by DNA studies. *Florida Entomologist* 75:51-59.
- Hall, H.G. 1992. Further Characterization of Nuclear DNA RFLP Markers that Distinguish African and European Honeybees. *Archives of Insect Biochemistry and Physiology* 19:163-175.
- Hall, H.G. and McMichael, M.A. 1992. European Honey Bee (*Apis mellifera* L.) (Hymenoptera: Apidae) Colonies at High Elevations in Costa Rica Tested for African DNA Markers. *Bee Science* 2:25-32.
- Hall, H.G. 1992. Suspected African Honeybee Colonies in Florida Tested for Identifying DNA Markers. *Florida Entomologist* 75:257-266.
- Harrison, J.F. and Hall, H.G. 1993. African-European Honeybee Hybrids Have Low Non-Intermediate Metabolic Capacities. *Nature* 363:258-260.