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Scientific note

A scientific note on the distribution of Africanized honey bees and *Varroa destructor* in feral honey bee populations in California

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Feral honey bees (*Apis mellifera* L.) must establish their colonies relatively close to water in hot, arid environments because foraging honey bee workers must collect and ferry water from sites located within a few kilometers of their hives (Visscher et al., 1996; Atmowidjojo et al., 1997). In the deserts of the southwestern United States, hundreds of artificial water sources (guzzlers) have been developed to provide water for bighorn sheep (*Ovis canadensis*) and other wildlife (Rosenstock et al., 1999). We used these water sources as sampling stations for characterizing changes in the genetic diversity of feral honey bee populations during the introduction and spread of *Varroa destructor* Anderson & Trueman and Africanized honey bees into southern California.

From June to September of 1995 to 1997, we collected honey bee workers as they were imbibing water from three guzzlers in Anza-Borrego Desert State Park (ABDSP) and two guzzlers in the Mojave National Preserve (MNP). All of these sites were located >10 km from managed colonies. Bee-lining techniques were used to estimate the minimum number of colonies collecting water at that source because different flight vectors represented honey bees traveling to and from different colonies (Wenner et al., 1992). The rugged mountainous terrain prevented us from locating most of the colonies since we frequently lost sight of flight paths as honey bees flew across canyons. We collected honey bees from all of the colonies that we located in ABDSP, including those that occupied Nasanov-baited swarm traps placed in 1995 and 1996. We did not place any swarm traps or locate any colonies in MNP.

Pooled collections of honey bees from each guzzler or colony were placed in 70% ETOH and later examined for the presence of *V. destructor* mites. Individual honey bees were analyzed to determine their mitochondrial DNA haplotypes (Nielsen et al., 1999, 2000) and assigned to one of four racial groups: Eastern European (*A. m. ligustica, A. m. carnica, A. m. caucasica*), Western European (*A. m. mellifera*), Egyptian (*A. m. lamarckii*), and African (*A. m. scutellata*). This approach did not provide information on paternity or potential hybridization, but it did link each honey bee to a particular maternal line of descent (i.e. Africanized honey bees are descendants of *A. m. scutellata*).

A diverse assemblage consisting of Eastern European, Western European, and Egyptian honey bees was present at all of the guzzlers sampled in 1995 in both ABDSP and MNP (Tab. I). An evaluation of flight vectors, coupled with mtDNA analysis, showed that at least three different colonies were using each of the guzzlers. Africanized honey bees were first identified in ABDSP in the summer of 1996, and they were present at the three ABDSP guzzlers sampled in 1997 (Tab. I). Since Africanized honey bees were not detected at guzzlers, captured swarms ($n = 10$), or feral colonies ($n = 5$) in 1995, the colonization front apparently reached ABDSP during 1995 and 1996. In contrast, Africanized honey bees had not colonized the study areas located to the north in MNP by 1997.

Hundreds of honey bee workers were typically at guzzlers during our collections in 1995, and 30 honey bees could be collected in a few minutes. In fact, the presence of large numbers of honey bees significantly altered the behavior of bighorn sheep attempting to drink water from a guzzler monitored by remote videography in ABDSP (Boyce et al., in press). The population of feral honey bees in ABDSP apparently declined after the summer of 1995. During the subsequent autumn, winter, and spring, no swarms were captured in Nasanov-baited traps ($n = 20$) placed around the water sites, and all of the previously identified feral colonies died. In 1996 and 1997 far fewer worker honey bees were present at the guzzlers in ABDSP, and it often took several hours to collect 20–30 honey bees.

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Table I. Distribution of *Apis mellifera* mitotypes and *Varroa destructor* mites among foraging honey bee workers collected at water sources (guzzlers) in southern California deserts from 1995–1997.

Site (number tested)	*Apis mellifera* mitotype %				*Varroa destructor* mites/bees
	Eastern European[a]	Western European[b]	Egyptian[c]	African[d]	
ABDSP - 33 05″ - 33 20″ N latitude					
Blue Spring 1995 (n = 30)	3.3	90.0	6.7	0.0	6/109
Blue Spring 1996 (n = 20)	5.0	85.0	10.0	0.0	0/20
Blue Spring 1997 (n = 30)	13.3	66.7	0.0	20.0	0/30
Nolina 1995 (n = 30)	30.0	63.3	6.7	0.0	4/266
Nolina 1996 (n = 30)	0.0	100.0	0.0	0.0	0/30
Nolina 1997 (n = 30)	0.0	96.7	0.0	3.3	0/30
Pinyon Wash 1995 (n = 30)	6.7	73.3	20.0	0.0	4/265
Pinyon Wash 1996 (n = 20)	5.0	30.0	10.0	55.0	1/32
Pinyon Wash 1997 (n = 30)	10.0	26.7	3.3	60.0	0/30
MNP - 35 05″-35 06″ N latitude					
North Tank 1995 (n = 30)	40.0	13.3	46.7	0.0	0/173
North Tank 1997 (n = 30)	3.3	13.3	83.4	0.0	0/30
Kerr 1995 (n = 30)	6.7	20.0	73.3	0.0	0/91
Kerr 1997 (n = 30)	13.3	3.3	83.4	0.0	0/30

[a] Includes *A. m. ligustica, A. m. carnica, A. m. caucasica.* [b] Includes *A. m. mellifera.* [c] *A. m. lamarckii.* [d] *A. m. scutellata.*

Although feral populations may decline for a number of reasons, a likely cause of the decline in ABDSP after 1995 was the widespread presence of *V. destructor* mites. Infestations of this mite were identified in pooled collections of honey bees from all of the guzzlers (Tab. I) and in all of the feral colonies (n = 5) and swarms (n = 10) examined in ABDSP during the summer of 1995. Our method of sampling (pooled collections of honey bees) prevented us from calculating the prevalence and intensity of infestation, but it is clear that mites were ubiquitous in the feral honey bee population in ABDSP by 1995. In contrast, mites were not found in our collections from MNP in either 1995 or 1997.

V. destructor mites may have impacted feral honey bees in ABDSP and elsewhere (Kraus and Page, 1995), but it is unlikely that they will eliminate feral populations. A substantial and genetically diverse population of feral honey bees was present prior to the introduction of *V. destructor* mites and Africanized honey bees, and resistant genotypes will likely become more prevalent in feral populations over time. However, it remains to be seen whether all four races (Eastern European, Western European, Egyptian, and African) will persist in the deserts of southern California, or if feral populations of honey bees will become less racially diverse due to the introduction of *V. destructor* and Africanized honey bees.

Note scientifique sur la répartition des abeilles africanisées et de *Varroa destructor* dans les populations sauvages d'abeilles en Californie.

Eine wissenschaftliche Notiz zur Verteilung von aafrikanisierten Honigbienen und *Varroa destructor* in der wildlebenden Population Afrikanisierter Honigbienen Kaliforniens.

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