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Activity of *Apis mellifera* (Hymenoptera: Apidae) and some spiders (Araneidae) during the 1991 total solar eclipse in Costa Rica

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**Resumen:** El eclipse solar del 11 de julio de 1991 en Costa Rica afectó la actividad de *Apis m. mellifera* y el comportamiento de construcción de telas de arañas. El comportamiento de las abejas no fue afectado durante las fases previas al eclipse y sí durante la fase de oscuridad total. La mayoría de las abejas inició el vuelo de regreso al nido 5-7 minutos antes de iniciarse la fase de oscuridad total. El número mínimo de abejas se obtuvo a las 14:10 hr cuando finalizó el período de oscuridad total. A partir de ese momento aumentaron rápidamente la luminosidad y la temperatura, así como el número de abejas en los sitios de alimentación. En el período de oscuridad total, nueve de diez arañas (cuatro géneros) desmantelaron sus telas, como hacen normalmente al anochecer.

**Key words:** Solar eclipse, honeybee activity, spider web construction.

There are few reports about the cause-effect relationships between solar eclipses and organisms. It is known that most plankton shows a direct ascending reaction to the solar light decrease, similar to high onset (Backaus *et al.* 1965). Other authors, however, have not observed such movement (Franceschini *et al.* 1970). Observers reported that many birds stopped flying and perched during the 1991 solar eclipse in Costa Rica (A. Wille and R. Rojas, pers. com.). Similarly, the leaves of certain legumes adopted the nocturnal posture (C.E. Valerio, pers. com.). This paper informs about the effects of the eclipse (July 11 1991, Costa Rica) on the activity of foraging honey bees (*Apis m. mellifera*) and on the behaviour of four species of spider.

**Honey bees:** The numbers of honey bee workers visiting dishes with sugar syrup were counted from the start of the eclipse (12:38 hr) through its final phase (15:13 hr). The eclipse lasted 2h and 35 min, approximately (Minsky 1991) and the total phase was 5 min and 50s long.

The bee colonies were located in Sto. Tomás, Sto. Domingo, Heredia (1200 m altitude) where the total dark phase started at 14:05 hr. The bees were trained to begin visit the feeding places at 6:00 hr. The feeders were located in an straight line north to south 10, 20, 30 and 40 m from the location of the colonies. Thus the bees were already accustomed to the feeding places well before the start of the eclipse.

The counting of bees at the feeding places was done from 10:20 hr to 11:20 hr; during this period only one teaspoon of honey was used in each feeder, in order to understand the way the bees visited the feeders. Ten minutes before the eclipse (12:25 hr), two spoons of honey were placed in each feeder every five minutes, until 14:00 hr. This was done to keep a significant number of honey bees visiting the feeders.

In the morning (before the eclipse) at maximum visitation the honey was consumed in 10 min. The number of bees decreased progressively and reached almost zero one hour later.

The flying and feeding behavior of the bees was not visibly affected during the first phases of the eclipse, that is between 13:34 hr (when the eclipse was 50%) and 13:51 hr (75% eclipse).

The maximum amount of bee visits was observed 5 min before total darkness (13:55 hr) with a mean of 100 bees per feeding place. The phase of total darkness started at 14:05 hr and was preceded by a drastic reduction of light and temperature from 13:58 hr (Fig. 1). Most of the bees flew back to the colonies between 5 and 7 min before the start of the total dark phase; only a few bees remained in the feeding dishes, some of them moving under the dishes as if searching protection. These bees stopped flying at 14:01 hr. The minimum number of bees was observed at 14:10 hr when the phase of total darkness finished. After this time the light and temperature rose and the number of visiting bees increased again.

Since no honey was located in the feeding places after the total darkness phase finished, it is assumed that the bees remembered the feeding places after the occurrence of the eclipse.

Von Frish (1967) showed that honey bees use the sun as a navigation reference and suggested that the sun is recognized by the bees as an ultraviolet disk. However, the bees are able to perform the communicating dance and to orient themselves during dark days when the sun or blue skies are not distinguishable (Dyer and Gould 1981). However it is known that *Apis dorsata* (the giant bee) fly during the night when the moon is quite brilliant (Dyer 1984). The daily activity of the tropical bees may be affected by various factors, among them the seasons (Roubik 1984, Appanah 1986), daytime temperature (Ihering 1903, Nogueira-Neto 1970), environmental humidity (Fowler 1979, 1970), and nectar secretion by flowers (Roubik 1989).

The dramatic decrease of honey collecting activity during the eclipse is completely different from those observed in other studies under normal conditions. Therefore, we conclude that the collecting behavior of the bee forager was drastically affected by the scarcity of light and the absence of the sun as a point of reference to provide orientation in their flights back and forth from their nests.

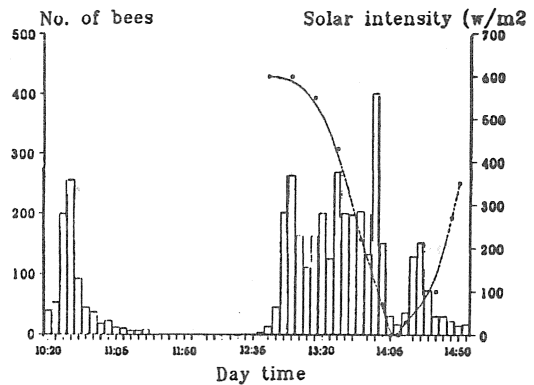


Fig. 1. Activity of bees (bars) before, during and after the solar eclipse (curve; solar activity) of July 11, 1991, in Costa Rica. Plotting based on the total number of individuals in each feeding station (per count).

**Effect of the eclipse on spiders:** In nature the spider webs are sometimes destroyed by the wind and rain, but then the spider rebuilds them (Foelix 1982). It is also known that some spiders entirely or partially destroy their webs when the evening darkness arrives (W. Eberhard pers. com.).

Ten spider webs (belonging to four subgenera) were observed and marked before the solar eclipse. Six webs belonged to *Leucage mariana* two to *Gasteracantha cancriformis*, one to *Micrathena sexiposa* and one to *Cyclosa* sp. *Leucage* spiders usually build several webs a day, while those of *Gasteracantha*, *Micrathena* and *Cyclosa* eliminate the webs during the night (W. Eberhard, pers. com.).

During the eclipse phase of total darkness, nine of the ten spiders removed web threads, except the supporting ones. After the darkness phase the spiders rebuilt the webs and which were completed by 15:30 hr, one and a half hour after the end of the total dark phase.

Not all the spiders rebuilt the webs at the same time, and nevertheless there was much variation: half an hour after the end of total darkness, one had finished the web, four had initiated reconstruction and four had not.

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