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Feeding rates of *Drosophila mojavensis sonorensis* on native and non-native hosts.

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Drosophila mojavensis is a cactophilic fly species endemic to North American deserts (Heed, 1978). The species utilizes the necrotic tissues or "rots" of cacti during the flies' life stages and occurs as four geographically isolated subspecies (Heed, 1982; Pfeiler *et al.*, 2009). It is hypothesized that *D. mojavensis* originated in Baja California on *Stenocereus gummosus* (agria cactus) after an isolation event from *D. arizonae* (Ruiz, 1990). A northward migration is thought to have established the subspecies *D. m. wrigleyi* on Santa Catalina Island and *D. m. mojavensis* in the Mojave Desert (Pfeiler *et al.*, 2009). Because agria does not grow at these localities, the subspecies have to utilize *Opuntia littoralis* (prickly pear) and *Ferrocactus acanthodes* (barrel), respectively, in these areas. The subspecies in Baja California remained on agria and is designated as *D. m. baja*.

Furthermore, it is thought that an expansion event of the original population created the fourth subspecies, *D. m. sonorensis*, in the Sonoran Desert on mainland Mexico. This movement came with a final host shift to organ pipe cactus (*Stenocereus thurberi*). While the subspecies utilize their host plants in similar fashions, each necrotic rot environment has a distinct chemical profile (Kircher, 1982). Because there is little evidence of gene flow between the populations (Pfeiler *et al.*, 2009), we would expect to see adaptation of each subspecies to their specific cactus host. This adaptation should be evident in larval feeding behavior as *Drosophila* larvae exhibit a large number of gustatory receptors (Voshall and Stocker, 2007). Here I report the larval feeding rates of the Sonoran Desert subspecies, *D. m. sonorensis*, on its native host, organ pipe, and the native host of *D. m. wrigleyi*, prickly pear. Host specialization is predicted to produce higher feeding rates on the native host.

Materials and Methods

Sample collection and creation of necrotic tissues

Drosophila mojavensis sonorensis flies were collected at Organ Pipe National Monument Park in 2007 and maintained as isofemale lines on standard banana food until their use in these experiments.

The artificial cactus necroses of *S. thurberi* and *O. littoralis* were created using standard protocol of autoclaved cactus incubated at 25°C for approximately 5 weeks using the bacteria *Pectobacterium cacticada* and the following yeast species: *Pichia cactophila*, *P. amethionina*, *Candida sonorensis*, *C. ingens*, and *Sporopachydermia cereana* (Matzkin *et al.*, 2006).

Experimental design

First instar larvae were used to minimize the potential effects of prior food exposure. Each larva was gently transferred with a brush to a new Petri dish containing a thin layer of the test medium and was allowed to acclimate for two minutes. The number of mouthpart contractions per larva was counted for two minutes as described by Green *et al.* (1983). A total of 100 *D. m. sonorensis* larvae were tested on their native host, organ pipe, and 100 more on the non-native host, prickly pear. Larvae with mouthpart contractions less than 5 were excluded, and mean feeding rates were compared by a one-way ANOVA using JMP software.

Results

Mean feeding rates were significantly different on the two cactus types (Table 1). Mouthpart contractions of *D. m. sonorensis* exhibited a higher average in two minutes on the native cactus, organ pipe, than on prickly pear, non-native host ($p = 0.02$, DF 192).

Table 1. *D. m. sonorensis* mean number of larval mouthpart contractions per two minutes.

Cactus	$\bar{\chi}$ ± SE (n)
S. thurberi (native)	155 ± 5.70 (95)
O. littoralis (non-native)	135 ± 5.79 (98)

Discussion

The higher feeding rates on the native host, organ pipe, support the hypothesis that *D. m. sonorensis* exhibits an adaptation and specialization in the rot environment of its host cactus. This result suggests that larvae will perform best when reared on their native host versus a novel cactus. Other performance indicators (recruitment,

resulting adult mass, etc.) should be affected in a similar fashion. Results from Bono and Markow (2009) showed that *D. mojavensis* individuals collected from organ pipe had faster emergence times when eggs were oviposited on their host cactus versus the novel cactus, cina. As well, transcriptional differences are also evident and have revealed candidate genes in the adaptation process (Matzkin, 2002 a,b), such as *adh* and *GstD1*.

Taste is one plausible explanation for how *Drosophila* larvae may develop a host preference. The ratio of gustatory to odorant receptors in larvae is larger than in adults, suggesting that taste is more important during the larval stages (Voshall and Stocker, 2007). This may result from the limited mobility of larvae to disperse effectively from their oviposition site (Schoonhoven, 2005). Furthermore, the toxins present in the necrotic tissues of cacti vary greatly (Kircher, 1982), which should force fly species to specialize on one cactus and develop mechanisms, such as a taste preference, to determine their host efficiently. Future taste studies on *Drosophila* prove to be interesting as tests reveal that some flies may share a more similar taste profile to human-preferred sweeteners than some mammals (Gold *et al.*, 2008).

In conclusion, further exploration of the larval feeding rates and taste preferences in *D. mojavensis* is needed. The species has become an important model system for speciation studies (Bono and Markow, 2009), and a better understanding of the ecology is fundamental to enhancing research. I propose that a complete reciprocal study of the feeding rates exhibited by the four subspecies on their cacti hosts will yield promising results in understanding the ecological divergence and adaptation of organisms.

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VII Symposium on Ecology, Genetics and Evolution of *Drosophila*

The Symposium on Ecology, Genetics and Evolution of *Drosophila* has been organized every two years since 1999 and traditionally brings together the Brazilian community of Drosophilidae researchers, as well as researchers of other countries, dealing with a broad range of issues. The event was initially idealized by Dr. Jean David from the National Center of Scientific Research (CNRS) in France, and the first edition was held in Rio de Janeiro, Brazil, in 1999, organized by Dr. Blanche Christine Bitner-Mathé. Since then, the Symposium on Ecology, Genetics and Evolution of *Drosophila* has been attended also by researchers from other countries of South America, North America, and Europe.

The subsequent events also occurred in Brazil: