females were fertile immediately after treatment, and fertility gradually increased over 14-16 days (HL in Figure 1).

References: Barker, J.S.F., 1994, Genetica 92:165-175; David, J.R., R. Allemand, J. van Herrewege, and Y. Cohet 1983, In: (M. Ashburner, H.L. Carson, and J.N. Thompson, Jr., eds.), *The Genetics and Biology of* Drosophila, 3d: 105-170, Academic Press, London; Markow, T.A. and E.C. Toolson 1990, In: (J.S.F. Barker, W.T. Starmer, and R.J. MacIntyre, eds.), *Ecological and Evolutionary Genetics of* Drosophila, Plenum, New York, pp. 315-331; Young, W.C., and H.H. Plough 1926, Biol. Bull. 51: 189-198.

Effect of drought stress on a natural *D. mojavensis* population.

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Stress is a major determinant of the abundance and distribution of natural populations (Hoffmann and Parsons, 1991). Populations of the cactophilic *Drosophila* are known to fluctuate throughout the year with temperature. Rainfall has a more indirect effect, as the flies depend on rots of cactus as food and oviposition sites. Here we report observations made while collecting *D. mojavensis* in San Carlos, Sonora, MX, between Jan. 6 and Jan. 12, 2000. In summary, a drought has reduced rot frequency, fly populations declined, and of the small number of *Drosophila* caught, all were very young.

Drosophila mojavensis commonly feeds in necrotic tissue of several cactus species, but most commonly organ pipe cactus (*Stenocereus thurberi*) and agria cactus (*S. gummosus*) in the Sonoran desert (Heed and Mangan, 1986). These cacti are large, reaching heights of 3-4 m, extremely drought resistant, and around San Carlos, a tourist location only a few kilometers north of Guaymas. Organ pipe is particularly abundant around San Carlos, which is also centrally located along the coast within the Sonoran desert, and as a coastal town, temperatures are predicted to be milder than in the central desert. These geographic features suggest that this region should be central for the distribution of *D. mojavensis*, and that this species should also be abundant in this region. Indeed, Dr. Markow (Univ. of Arizona) has regularly collected *D. mojavensis* from this region for many years and, except in summer, has reported a reliable population (pers. comm.). The "standard" collection technique is simply to aspirate flies directly off a rot. However, in summers, when temperatures are very high, the cactophilic *Drosophila* species are reported to be notoriously difficult to find.

Here we report an unusual decline in the population of *D. mojavensis* for the winter of 1999/2000 during what the local inhabitants noted as a 2-year stretch of very low rainfall. For perspective, the Sonoran desert is a region where rainfall is 18-25 cm a year (state climate data for Arizona, http://wrcc.sage.dri.edu/summary/climsmaz.html). Rain is concentrated in July/August, from periodic thunderstorms, with more consistent rainfall November-February, in which rainfall averages 2-3 cm per month. Although data for Mexico could not be obtained, several US stations to the north provide 1999 data for the Sonoran desert: Organ pipe National monument, Phoenix, Tucson, and Yuma. Mean rainfall was 16.5 cm for 1999, which was only 20% below normal, but missing was any rainfall preceeding collection; the last measurable accumulation had been September 24, almost four months earlier.

Anecdotally, the effect of the dry conditions was amazing. The drought effect on *D. mojavensis* was apparent the day we arrived. The cacti were dry. Columnar cacti contain numerous ridges for expansion based on the amount of water they take up and hold. Plants in the area appeared contracted, indicating low plant water content. Many young plants looked desiccated; some had dried and died. The consequence to flies is that damaged tissue predominantly dried and did not rot, a microbial process that can sometimes take down whole plants, and often complete arms of a cactus.

Likewise, diversity of other arthropods was minimal. Although in the field seven days, and collecting over banana-bait buckets at necrotic cactus, few arthropods were found. Only 2-3 additional fly species came to the baits, and more rarely an ant or beetle. Turning over rocks revealed only a handful of spiders, and more often a dead carcass than a live individual. We did not find one scorpion, a group always reliably found in the past. Of the plants, the grass was brown, leaves were brittle if retained, and only a single species had flowered, a plant resembling ocotillo, but with multiple branches above the base. These branches frequently supported a few thin red flowers, sometimes only one on the entire plant, but not a single leaf.

Collecting *D. mojavensis*: With intensive searching, a small number of cactus rots were found. Two of the most promising came from areas outside San Carlos, and these were brought back to the laboratory. No *Drosophila* reared from either. No cactus rots had flies visible on the surface, even at dusk when populations tend to peak (Krebs and Bean, 1991). Therefore, as an alternative to aspirating flies from identified rots, we prepared a bait from about 5 parts bananas and 1 part rotting cactus of organ pipe, and set the baits near cactus rots The use of the cactus adds both some of the natural attractant material, and more importantly, the natural yeasts from the cactus. No bakers or brewers yeast was added. This mixture, however, required 2-3 days to become particularly attractive: capture rates improved from 3 flies on Day 1, the evening after mixing the bait, and 2 flies the morning of Day 2, to16 on Day 2 evening and 41 on Day 4 evening. Flies came to baits, but were never observed without baits present around rots. We estimated that we caught at least 80% of all flies that entered the baits.

Stress and its consequences: The January sun raised rot temperatures 7-12 °C above ambient, a result that depended on shading, the angle of the rot surface to the sun, and less on the height from the ground (Table 1). Temperature varied in a rot, both across the width of the arm as in winter, the sun predominantly warms only the exposed side, and along the arm. Thus larvae may thermoregulate behaviorally in organ pipe cactus. For January, however, the probability of encountering a lethal heat stress is low, because 40.5 °C was the highest temperature recorded, and *D. mojavensis* larvae are not killed by a short exposure at this temperature (Krebs, 1999).

Table 1. Temperature analysis of cactus rots in early January, 2000 in San Carlos, Mexico. To determine how heat may affect populations even in the coolest time of the year, we recorded temperatures of stem tissue, both rotting and fresh, with standard liquid-mercury physiological thermometers.

Air temp in sun	Date	Rot #	Height from ground	Rot sun-side temperature	Rot shade-side temperature	Green arm sun-side
20.5°C	1/10/00	1		25.0°C	23.0°C	
		2		29.3°C	23.8°C	
		3		26.5°C	22.0°C	
26.5°C	1/11/00	4		33.4°C	29.1°C	
		5	45cm	38.3°C	27.9°C	
25.6°C		6	30cm	34.9°C	31.9°C	35.5°C
(24.6°C shade)		6	45cm	33.8°C	31.9°C	
		7		34.1°C	27.3°C	32.3°C
28.4°C	1/12/00	6	30cm	36.0°C	26.8°c	38.9°C
(27.2°C shade)		6	60cm	40.5°C	29.5°C	
		5	30cm	35.5°C	25.5°C	35.9°C
		5	45cm	37.7°C	26.4°C	25.8°C
27.1°C		7		35.7°C	29.3°C	37.1°C
28.0°C		8		34.2°C	27.3°C	
		9		37.0°C	27.5°C	

Nonetheless, these warm temperatures coupled with little rainfall, may devastate fly populations. In an area where organ pipe are incredibly numerous, necrotic tissue was rare, and even when found, it generally did not support flies. Our impression, where we caught flies, is that the rot was old.

The flies caught, however, were very young. Even after holding flies isolated in vials for almost 1 week before returning to the laboratory, only one female, of 27, laid eggs. None of the others laid until paired with a male, and, because males mature later than females, these pairs required an additional 5 days before offspring were apparent in vials. The second line of evidence of young age is that once captured, only one of the collected flies died within a month.

These observations strongly suggest that when conditions are very bad, adult life-span is short. This conclusion is paradoxical, as for a population to persist, flies must live long enough to mature, which for *D. mojavensis* males is 5-9 days at 25 °C (Markow, 1982). However, if mature flies occurred where we collected, they must respond differently to cactus baits.

The combination of a small population made up predominantly of young flies can have a severe effect on genetic variation within the population. Because in San Carlos, cactus populations are very large, the local population is not likely to disappear, but in areas where fewer organ pipe occur, Sonoran populations could be at risk.

References: Heed, W.B., and R.L. Mangan 1986, In: *The Genetics and Biology of* Drosophila, (M. Ashburner, H.L. Carson, and J.N. Thompson, jr., eds), vol. 3e: 311-345, Academic Press, NY; Hoffmann, A.A., and P.A. Parsons 1991, *Evolutionary Genetics and Environmental Stress*. Oxford Science Publ., Oxford; Krebs, R.A., 1999, Cell Stress and Chaperones 4: 243-249; Krebs, R.A., and K.L. Bean. 1991. Psyche 98: 101-109; Markow, T.A., 1982, Mating systems of cactophilic *Drosophila*. In: *The Cactus-Yeast-*Drosophila *Model System* (J.S.F. Barker and W.T. Starmer, eds.), Academic Press, Sydney, Australia, 273-287.

New host plants and host plant use for *Drosophila elegans* Bock and Wheeler, 1972.

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Introduction

The use of *Ipomoea* spp. by this species has been known for over 20 years (Okada and Carson, 1982; H. Carson, pers. comm.), but little information is available on its use of other flowers. In fact, its use of flowers outside the genus *Ipomoea* was unknown until the recent discovery that it used *Brugmansia* flowers (Sultana *et al.*, 1999). We therefore investigated which species of flowers were, and which were not, used by *D. elegans* in order to clarify the range of host-flowers used by this species. Such information is necessary for a proper understanding of *D. elegans* biology and ecology and forms part of our continuing research on this species (Hirai and Kimura, 1999; Hirai *et al.*, 1999; Kimura and Hirai, 1999).

Methods

Numerous sites were surveyed in several parts of Iriomote-jima, Japan. This subtropical island is largely covered by secondary forest and associated vegetation. However, since we wanted