the medium (Table 3). This difference appears to arise from a probably-spurious reduction in development time when 250μM urea solution was used to hydrate the medium, although a Tukey test failed to isolate this development time from that found for other treatments.

Discussion: Urea has been previously identified as being produced by *Drosophila* larvae (Botella *et al.,* 1985) but the highest concentrations found in those experiments were higher, by about a factor of ten, than the concentrations of urea found in the current experiments. These higher concentrations of urea were probably caused by the higher densities of larvae used in those experiments (*c.f.,* 140 larvae/ml of medium with a maximum of 5/ml in this experiment) and that the experimenters utilised a method of 'larval stop', retaining larvae in the medium for an extended period. However, given these differences, the highest urea concentrations found in this study were still comparable with the lower values obtained by Botella *et al.* (1985).

Botella *et al.* (1985) suggested that urea could have a negative effect on the performance of *D. melanogaster.* However, the concentrations used to produce these responses seemed unrealistically high (0.03M to 0.2M) compared to the concentrations found in conditioned medium by those authors and in experiments carried out here. With the exception of the 0.1M treatment used for *D. melanogaster,* all the concentrations used in our experiment are below those of Botella *et al.* The negative response which *D. melanogaster* displayed to urea at the concentrations they used was linear for development time, a response occurring even at their lowest urea concentration (Botella *et al.,* 1985). The extension of the development time at 0.1M in this study is in accordance with those findings. Apart from the differences in urea concentrations used, there is another problem comparing the current work with that of Botella *et al.* caused by their method of 'larval stop' (Mensua and Moya, 1983). This produced larvae-to-adult development times of 23-35 days at 18°C (*c.f.,* 15 to 17 days for larval and pupal period of *D. melanogaster* at 18°C given in Ashburner and Thompson, 1978). It is possible that the effects of urea identified by Botella *et al.* (1985) are to be found only in the very specific conditions of their study.

It appears that urea can potentially have a deleterious effect on the performance of *Drosophila* larvae. However, these effects only occur at concentrations higher than those found even in contrived high density situations. It seems likely, therefore, that this substance would not occur at sufficiently high concentrations to affect *Drosophila* populations in nature.

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Norry, Fabian M.,* **and Juan C. Vilardi**. Laboratorio de Genética de Poblaciones, Departamento de Ciencias Biológicas, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires 1428 Buenos Aires, Argentina. Wing asymmetry and chromosome inversions in *Drosophila buzzatii.*

Abstract: The possible relationship between developmental stability and inversion karyotypes of the second chromosome was examined in the cactophilic fly *Drosophila buzzatii.* The results indicate that developmental stability, as indexed in terms of fluctuating asymmetry of wing length, does not differ among karyotypes in wild-reared flies. Thus, developmental stability is apparently independent of both possible factors: (i) heterozygosity at the karyotypic level of variation, and (ii) any possible genetic coadaptation attributable to these chromosome inversions.

Introduction: Developmental homeostasis is the overall ability of individuals to cope with genetic and environmental stress (Lerner, 1954; Palmer and Strobeck, 1986; Parsons, 1990). In bilaterally symmetrical organisms, this ability may be indexed in terms of fluctuating asymmetry (FA) - side-wise random deviations from perfect bilateral symmetry (Van Valen, 1962). Inbreeding depression has often been thought to be causally associated with low levels of developmental stability (Lerner, 1954; Waddington, 1960, 1966). However, Fowler and Whitlock (1994) demonstrated that FA of sternopleural bristles is not a reliable measure of the degree of inbreeding in experimental populations of *Drosophila melanogaster.* Thus, although the FA level may be a reliable index of developmental stability, the genetic basis of FA remains unclear.

Two well-known hypotheses about the cause of genetic variation in developmental stability are heterozygosity and genetic coadaptation. While the isozyme heterozygosity has been examined with respect to FA in a wide variety of

species (see Palmer and Strobeck, 1986, for a review), chromosome inversions in *Drosophila* were largely unexplored in relation to FA. Here, we compare the level of FA (in wing length) among inversion karyotypes (genotypes) in wild-reared flies of the cactophilic species *Drosophila buzzatii*.

Table 1. Asymmetry of the wing length is given for karyotypes of the second chromosome in wild-reared *D. buzzatii* flies. Values (in mm x 10^3) are given for data pooled across sexes. Statistics are also shown for data pooled within homokaryotypes (Homo-k) as well as heterokaryotypes (Hetero-k). N is the sample size.

	Karyotypes						
Statistics	j / st	j / j	jz3 / st	jz3 / j	jz3 / jz3	Homo-k	Hetero-k
N	27	105	17	104	20	125	148
Mean	4.02	3.84	5.47	5.66	4.65	3.97	5.34
SD	6.92	7.06	7.63	8.38	8.85	7.34	8.03

Material and Methods: A population breeding on *Opuntia vulgaris* at Arroyo Escobar (34°4' S; 58°7' W), Buenos Aires (Argentina), was sampled for this study. This population is polymorphic for inversions on the second chromosome, namely *standard* (st), j, jz^3 and jq^7 (Hasson *et al.*, 1991). During April 1 to 15, 1991, wild-reared flies were collected from rotting cladodes of *Opuntia vulgaris*, as described in Norry *et al.* (1995a). These flies were immediately sexed, placed in vials with culture medium and individually crossed with flies of a homokaryotypic stock as described in Norry *et al.* (1995a). The cytological analysis of eight larvae of the progeny from each cross allowed us to infer the karyotype of the wild parent. Only karyotypic classes with sample sizes larger than 17 individuals were analyzed.

Wing length was scored as the distance from anterior crossvein to distal tip of vein III (see Norry *et al.*, 1995b). Both wings were measured on a microscope slide at 100× magnification, using a Wild M-20 compound microscope. Asymmetry scores were obtained by subtracting the measurement of the left side from that of the right side.

Results and Conclusions: No sexual dimorphism in FA of wing length was detected by the Mann-Whitney test (MEAN $RANK_{MALES}$ = 137; MEAN $RANK_{FEMALES}$ = 135; P = 0.87). The results are therefore reported for data pooled across sexes. Summary statistics for wing asymmetry in wild flies are given for each examined karyotype in Table 1. Among karyotypes, no significant variation in FA was detected by the non-parametric Kruskal-Wallis test (H = 3.14; P = 0.54). Nor was there evidence of karyotypic variation in FA when data were pooled within homo- and hetero-karyotypic classes (both karyotypic classes were compared using the Mann-Whitney test: MEAN $RANK_{homo\text{-}k}$ = 142; MEAN $RANK_{hetero\text{-}k}$ = 131; P = 0.23).

These results suggest that the inversion polymorphism is adaptively independent of developmental stability, as no significant variation in FA was detected among karyotypes. We conclude that developmental stability (as indexed by wing asymmetry) is independent of: (i) heterozygosity at the karyotypic level of chromosomal variation, and (ii) any possible genetic coadaptation attributable to these chromosome inversions.

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Hodge, Simon [1], **and Paul Mitchell**[2]. [1]Department of Entomology and Animal Ecology, P.O. Box 84, Lincoln University, Canterbury, New Zealand; [2]Division of Biology, Staffordshire University, College Road, Stoke-on-Trent, ST4 2DE, UK. The effect of resource quantity and water content, and atmospheric humidity, on the interaction between *Drosophila hydei* and *D. melanogaster*.

Introduction: It has long been known that the form taken by the interaction between two species can be influenced by the abiotic environment (*e.g.*, Park, 1954). Many environmental variables have been found to affect interactions between drosophilids, including; temperature (*e.g.*, Moore, 1952; Ayala 1966), age of resource (Merrel, 1951; Miller, 1954; Mitchell and Arthur, 1990), light intensity (Moth and Barker, 1976; but see Arthur, 1986), ethanol concentration (Arthur, 1980) and amount of resource (Arthur, 1986).

This study investigated how the amount of resource presented to the larvae, the resource water content and the atmospheric humidity affected the interaction between *D. melanogaster* and *D. hydei*. All these factors are associated with resource desiccation, which is known to affect the performance and behaviour of these two species (Arthur, 1996;