crosses southern Shikoku and has not changed for several decades, suggesting the severe competition between the two closely related species. Prior to the present study, in Shikoku, *D. takahashii* had been reported only from Kochi prefecture, south of Ehime, and had not been recorded in Ehime prefecture. It is extremely difficult to distinguish females of *D. takahashii* and *D. lutescens*, but based on male abundances, these two species occur at a 1:2 ratio in Uwajima and Matsuno, the two localities at which *D. takahashii* has been found in Ehime (Table 1). Further studies on distribution and seasonal change are needed for newly immigrant species of *D. takahashii*, as well as two colonizing species, *D. simulans* and *D. albomicans*, in nature.

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References: Asada, N., 1988, Zoological Science 5: 915-918; Fuyama, Y., and M. Watada 1981, Zoological Magazine 90: 62-68; Kawanishi, M., and T. K. Watanabe 1977, Jpn. J. Ecol. 27: 279-283; Kawanishi, M., and W. H. Lee 1978, Jpn. J. Ecol. 28: 231-235; Kitagawa, O., 1991, *Evolution of Populations*. Tokyo University Press, Tokyo (in Japanese); Kitagawa, O., K. I. Wakahama, Y. Fuyama, Y. Shimada, E. Takanashi, M. Hatsumi, M. Uwabo, and Y. Mita 1982, Jpn. J. Genet. 57: 113-141; McKenzie, J. A., and P. A. Parsons 1972, Oecologia 10: 373-388; McKenzie, J. A., and P. A. Parsons 1974, Aust. J. Zool. 22: 175-187; Mikasa, K., 1991, J. Arts Sci. Meikai Univ. 3: 8-18; Okada, T., 1956, *Systematic Study of* Drosophilidae *and Allied Families of Japan*. Gihodo, Tokyo; Ohsako, T., T. Aotsuka, and O. Kitagawa 1994, Jpn. J. Genet. 69: 183-194; Parsons, P. A., 1983, *The Evolutionary Biology of Colonizing Species*. Cambridge Univ. Press, Cambridge; Shiino, T., 1993, *Invasion of the Japan Mainland by* Drosophila albomicans. Ph.D. thesis, Tokyo Metropolitan University; Watada, M., Y. N. Tobari, and S. Ohba 1986a, Jpn. J. Genet. 61: 253-269; Watada, M., S. Ohba, and Y. N. Tobari 1986b, Jpn. J. Genet. 61: 469-480; Watada, M., Y. Inoue, and T. K. Watanabe 1986c, Zoological Science 3: 873-883; Watada, M., and M. Itoh 1999, Dros. Inf. Serv. 82: 50-53; Watanabe, T. K., and M. Kawanishi 1976, Proc. Jpn. Acad. 52: 191-194; Watanabe, T. K., and M. Kawanishi 1978, Zoological Magazine 87: 109-116; Watanabe, T. K., Y. Inoue, and M. Watada 1984, Jpn. J. Genet. 59: 225-235.

Metaphase karyotypes of *Drosophila guayllabambe* and *Drosophila novemaristata* (*repleta* group, *hydei* subgroup).

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The cytogenetic and molecular analysis can contribute valuable information when species that are closely related are studied, helping thus, toward the knowledge of its phylogenetic relations. Here we present the karyotypes of *D. guayllabambe* (Rafael and Arcos, 1988) and *D. novemaristata* (Dobzhansky and Pavan, 1943), sibling species which have been incorporated in the *hydei* subgroup, *bifurca* complex, based on their morphological characteristics.

D. guayllabambe and *D. novemaristata* are endemic species of the Andes. *D. novemaristata* has been found in four regions of Perú: Ancash, Ayacucho, Lima and Junín (Dobzhansky and Pavan, 1943; Vázquez and Pilares, 1987), while *D. guayllabambe* has been registered in five provinces of Ecuador: Imbabura, Pichincha, Tunguragua, Chimborazo and Loja (Rafael and Arcos, 2000). The two species have never been found to grow together.

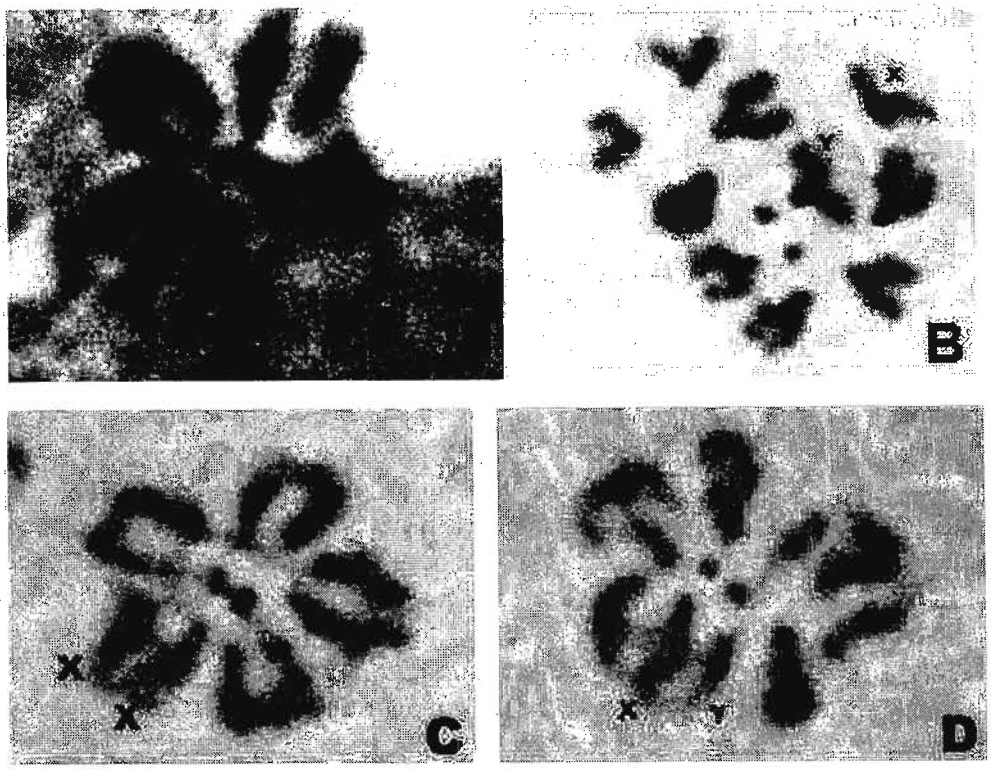

Figure 1. Metaphasic karyotypes of *D. guayllabambe*: A, Female; B, Male; and *D. novemaristata*: C, Female; D, Male. 400×.

The knowledge of the karyotype of *D. novemaristata* is very limited, and the only thing that has been learned refers to diagrams carried out from metaphasic preparations where no particular characteristics have been pointed out (Dobzhansky and Pavan, 1943; Suyo and Pilares, 1987). There is more precise data in reference to the karyotype of *D. guayllabambe* (Rivera, 1989) which even shows variations within and between populations.

The plates were prepared according to the methods proposed by the University of Texas (1970).

The karyotype of *D. guayllabambe* would be: chromosomic number 2n = 12. It is composed of five pairs of autosomes: 3 pairs of telocentric chromosomes, 1 pair of acrocentrics and 1 pair of very small rods (metacentrics) or dots (telocentrics) which can vary within and between populations. The sexual chromosomes X are telocentric, and in the male the Y chromosome is submetacentric, and slightly smaller than X (Figure 1, A and B).

The karyotype of *D. novemaristata* (Figure 1, C and D) is basically the same as *D. guayllabambe*. As a unique particularity, we may note that the variation in the shape of the dot chromosomes has been observed even within the same individual; these data agree with the changes in size of the corresponding polytene chromosome (Morán, not published).

References: Dobzhansky, Th., and C. Pavan 1943, Biol. Geral 4:7-72; Morán, T., Unpublished data; Rafael, V., and G. Arcos 1988, Evolución Biológica 2:167-176; Rafael, V., G. Arcos, and L. Arcos Terán 2000a, Rev. P.U.C.E. No. 65:130-155; Rivera, M., 1989, Estudio de cromosomas mitóticos de 3 especies del género *Drosophila*: *D. guayllabambe*, *D.* nigrohydei y *D.* hydei; y sus relaciones filogenéticas. Tesis de Licenciatura. Pontificia Universidad Católica del

Ecuador; Suyo, M., and L. Pilares 1987, Rev. Per. Ent. 30:61-64; Vásquez, J., and L. Pilares 1987, Personal communication; U. Texas 1970, Methods of Chromosome Preparations, Department of Zoology, The University of Texas at Austin. Austin, USA.

Allozyme evidence for sex-linkage in the phosphoglucomutase gene in *Drosophila pachea.*

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Introduction

There is little published information on genetic variability of *Drosophila pachea* Patterson and Wheeler, a cactophilic species endemic to the Sonoran Desert of North America (Heed, 1978). Rockwood-Sluss *et al.* (1973) surveyed a total of four polymorphic loci that coded for esterase (two loci), malate dehydrogenase, and acid phosphatase and found a high degree of genetic similarity in different populations from throughout the geographic range of the species.

For the past several years we have been conducting a comprehensive ecological and population genetic study of cactophilic *Drosophila* (*D. pachea, D. mojavensis, D. nigrospiracula* and *D. mettleri*) from northwestern Mexico. In the course of this work it was discovered that allozyme patterns for phosphoglucomutase (PGM; EC 5.4.2.2) were unequally distributed among males and females of *D. pachea.* Here we offer evidence that the *Pgm* locus is sex-linked in *D. pachea* (a member of the *nannoptera* species group), but not sex-linked in *D. nigrospiracula* Patterson and Wheeler (a member of the *repleta* species group).

Methods

Adult flies of *D. pachea* were collected from four different sites in northwestern Mexico (San Carlos and Bahía Kino, Sonora; Mulegé and San Ignacio, Baja California Sur [BCS]) in association with necrotic tissue of their specific host cactus, senita (*Lophocereus schottii*). Adults of *D. nigrospiracula* were collected from necrotic tissue of their host cactus, cardón (*Pachycereus pringlei*) near La Paz and Mulegé, BCS, and Guaymas, Sonora. Flies (175 *D. pachea* and 162 *D. nigrospiracula*) were aspirated directly from their feeding sites into vials and taken to the laboratory in Guaymas where they were sorted by sex. Whole flies were homogenized in approximately two volumes of Tris buffer (Cleland *et al.*, 1996) and then centrifuged for 5 min at 10,000 *g*. The supernatants were transferred to paper wicks that were then inserted into 12.5% starch gels. Horizontal electrophoresis was carried out at 4°C in a buffer system of 40 mM citrate adjusted to pH 6.0 with N-(3-aminopropyl)morpholine (diluted 1:20 in the gel). After electrophoresis, the gel was sliced horizontally into thin sections that were stained for enzyme activity using standard recipes (Murphy *et al.*, 1990). The most common electromorph produced by the *Pgm* locus was used as a reference and was designated as *100. Allozymes were assigned numbers corresponding to their relative migration from the origin compared to the reference.

Chi-square tests were used to test genotypes of the polymorphic *Pgm* locus for deviation from Hardy-Weinberg equilibrium. Heterozygosity was determined by direct count.