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A revision of the *tumiditarsus* group of the subgenus *Drosophila* and its relation to the genus *Zaprionus*.

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Both molecular and morphological analyses have confirmed the paraphyly of the genus *Drosophila*, being defined mainly upon non-derived traits (Ashburner *et al.*, 2005). However, many attempts were made to establish groups of species and radiations of groups and to assign other drosophilid genera to them (*e.g.*, Throckmorton, 1975). Nonetheless, species groups were usually arbitrarily defined with no general taxonomical criterion, resulting in some groups including only one species as well as others encompassing more than 150 species. An example is the *tumiditarsus* species group to which a single Oriental species, *Drosophila repletoides*, belongs. The phylogenetic positioning of this species, and thus of this group, had a very long debatable history. At times, it was considered a member of the *virilis-repleta* radiation, at others of the *immigrans-Hirtodrosophila* radiation (see list of synonyms below). A recent molecular phylogenetic study of the *virilis-repleta* radiation (Tatarenkov and Ayala, 2001) using alpha-methyldopa-hypersensitive protein (*amd*) and dopa-decarboxylase (Ddc) genes discarded *D. repletoides* from the analysis due to its high degree of divergence from other species groups. Unfortunately, the same workers did not include the species in a later work using both genes aiming to analyze the phylogenetic relationships among genera of the subgenus *Drosophila* (Tatarenkov *et al.*, 2001). More recently, the species was used in a molecular phylogeny study of the Drosophilidae based on the *Amyrel* gene (Da Lage *et al.*, 2006). According to their results, *D. repletoides* was placed within the *immigrans-Hirtodrosophila* radiation, close to the genus *Zaprionus*, with a Bayesian posterior probability of 96%. The genus *Zaprionus* has long been considered a member of the *D. immigrans* group (Throckmorton, 1975). In order to test the relation of *Zaprionus* to both *D. immigrans* and *D. repletoides*, I used the three sequences available on the GenBank for the latter species (*i.e.*, *amd*, *Ddc,* and *Amyrel*) in a four-taxon analysis, taking the genus *Hirtodrosophila* (an ancient subgenus of *Drosophila*) as an outgroup. As shown in Figure 1, the result obtained from the *Amyrel* gene was further confirmed from the combined analysis: *D. repletoides* is more related to *Zaprionus*, than is *D. immigrans*, although very distant to be included within it.

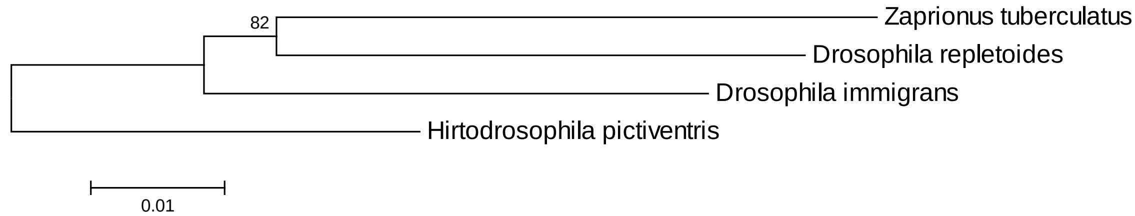

Figure 1. Neighbor-joining (NJ) phylogenetic tree inferred from 1217 amino acid sequences of 3 concatenated genes (AMD, DDC and AMYREL) for 4 species of the *immigrans-Hirtodrosophila* radiation. The number above the node connecting *Zaprionus* to *D. repletoides* represents the bootstrap value after 1000 iterations.

This result prompted me to morphologically revise both *D. repletoides* and the genus *Zaprionus* (especially species belonging to the Oriental subgenus *Anaprionus*). Although *D. repletoides* has a longitudinally striped thorax, which is the most diagnostic feature of the genus *Zaprionus*, it differs greatly from the latter by the thoracic stripes being blackish in color with the median one bifid posteriorly (silvery-white and straight in *Zaprionus*), by bearing 8 rows of acrostichal hairs (6 in *Zaprionus*), having a minute anterior reclinate orbital and no prescutellars (both well-developed in *Zaprionus*), and by having the phallus apically bifid (fused with a characteristic ruff in *Zaprionus*). Figure 2 shows the difference in thoracic ornamentation among *D. repletoides*, a member of the Oriental subgenus *Anaprionus* of *Zaprionus* with the subgeneric characteristic of the presence of a median stripe (*Z. bogoriensis*) and a member of the Afrotropical subgenus *Zaprionus s. str.* with the subgeneric characteristic of the absence of the median stripe (*Z. tuberculatus*).

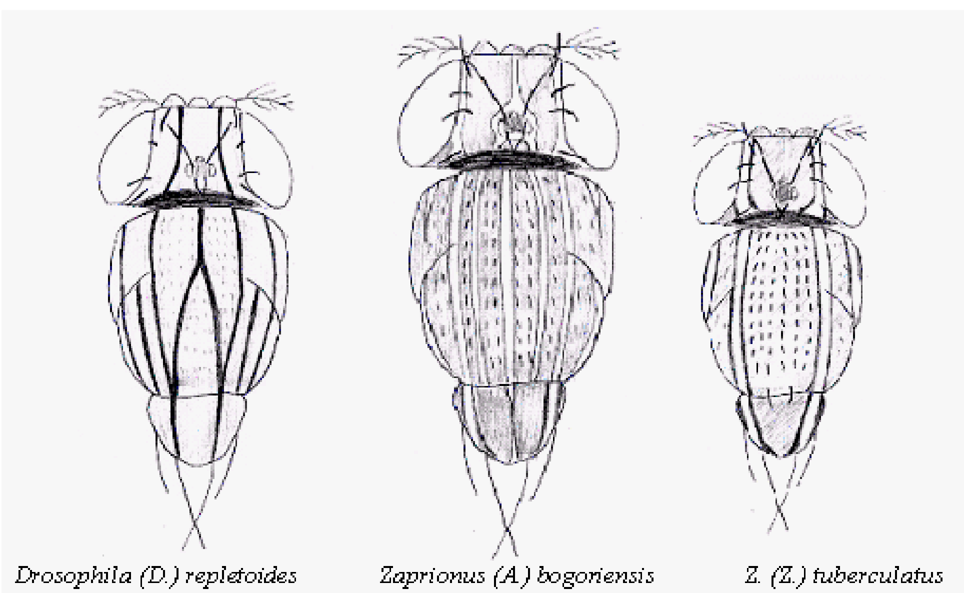

Figure 2. A compare-ison of frons and thoracic ornamentation among *Drosophila repletoides*, *Zaprionus bogoriensis* and *Z. tuberculatus* showing the difference in color and bifurcation of the longitudinal stripes. (Note also the disposition of orbital bristles, the number of rows of acrostichal hairs, and the presence or absence of the prescutellar bristles). Drawings are scaled to the relative sizes of species.

Nonetheless, 3 species classified within the Oriental subgenus *Anaprionus* (Bäechli, 1999-2006) share the same thoracic ornamentation as *D. repletoides*, as well as all the above characteristics distinguishing it from *Zaprionus*. Those are *Z. multistriatus* Duda (1923), *Z. flavofasciatus* Takada *et al.* (1979) and *Z. cercociliaris* Gupta and Gupta (1991). Their position within the genus *Zaprionus* is no longer justified and they have to be placed in the genus *Drosophila* within the *tumiditarsus* group. In fact, the first two species were first described as *Drosophila* species.

In addition, the widespread *Z. (Anaprionus) bogoriensis* Mainx (1958) should also change its name. This species had a long history of synonyms (see below) of which the oldest is *Z. multistriatus* Sturtevant (1927), preoccupied by *Z. multistriatus* Duda (1923). Since Duda's species is now incorporated into *Drosophila* according to this study, the synonym problem disappears, and *Z. bogoriensis* should recover its older name of *Z. multistriatus* Sturtevant.

In conclusion, the major nomenclatural changes I made in this paper can be summarized as follows:

Genus *Drosophila* Fallén, 1823, Diptera sveciae. Geomyzides: 4
Subgenus *Drosophila* Fallén
- ***tumiditarsus* group** Clayton and Wheeler, 1975, In: King, R. C. (ed.), Handbook of Genetics 3: 490
  - ***D. cercociliaris*** Gupta and Gupta, 1991, Proc. zool. Soc., Calcutta 44: 119 **comb. nov.**
  - ***D. flavofasciata*** Takada, Beppu and Toda, 1979, J. Fac. gen. Educ., Sapporo Univ. 14: 122 **nomen protectum**
  - ***D. multistriata*** Duda, 1923, Annls hist.-nat. Mus. natn. Hung. 20: 57 **nomen protectum**
    - syn. *lineata* de Meijere, 1911, Tijd. Ent. 54: 420 (*Stegana*: preocc.)
  - ***D. repletoides*** Hsu, 1943, Kwangsi Agric. 4: 162
    - syn. *tumiditarsus* Tan *et al.*, 1949, Univ. Texas Publs 4920: 205
    - syn. *hayashii* Okada, 1953, Zool. Mag. Tokyo 62: 285
    - syn. *chinoi* Okada, 1956, Syst. Study of Drosophilidae and Allied Families of Japan, 162

Genus *Zaprionus* Coquillett, 1901, Proc. U. S. natn. Mus. 23: 31
Subgenus *Anaprionus* Okada, 1990, Jpn. J. Ent. 58: 154
  - ***Z. multistriatus*** Sturtevant, 1927, Philipp. J. Sci. 32: 365 **nomen protectum**
    - syn. *bogoriensis* Mainx, 1958, Zool. Anz. 161: 126
    - syn. *argentostriata* Bock, 1966, Univ. Qld. Pap., Dep. Zool. 2: 273 (*Drosophila*)

The taxonomic status of the four species of the *tumiditarsus* group remains to be determined in light of more detailed molecular, morphological and behavioral analyses.

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Drosophila collection in Baja California, México: New records for four species.

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Drosophila flies were collected on the Baja California Peninsula in January 2001 in 39 stations covering 22.94°N, 109.99°W to 31.66°N, 116.53°W. *Drosophila* were obtained from natural cactus rots and artificial baits of cardón *Pachycereus pringlei*, senita *Lophocereus schottii*, agria *Stenocereus gummosus,* organ pipe *Stenocereus thurberi,* prickly pear *Opuntia engelmanni,* and banana. For artificial baits, about 20 kilograms of fresh cactus tissue was cut in small cubes, placed in a 10 gallon container cover with water, and inoculated with natural rot liquid. Then, almost 300 grams of prepared rotten tissue was placed in a two-liter green soda container and local vegetation was added for perching purposes. Baits were recovered after a 3-10 day period, flies were sorted on site, and isofemale lines were set up. Specimen identities were confirmed at the University of Arizona, either by external morphology, genitalia morphology, polytene chromosomes squashes, and/or molecular analysis by the author. A total of 5251 *Drosophila* flies in 17 species were collected from 25 rotten cacti plants, 95 baits in 39 localities. Table 1 shows the species and numbers collected by state. *Drosophila* flies were more abundant at the south of Baja Peninsula during collection time. Percentage of species composition per bait type is presented in Table 2. In general, prickly pear baits were not attractive for *Drosophila* flies; only ten individuals were collected over eight baits.

Table 1. Species collected by state in Baja California Peninsula, January 2001.

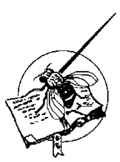
Species	Baja North	Baja South	Total
D. mojavensis	90	1424	1514
D. pachea	219	664	883
D. aldrichi	124	671	795
D. mettleri	218	347	565
D. simulans	57	441	498
D. nigrospiracula	4	356	360
D. pseudoobscura	124	104	228
D. arizonae	1	116	117
D. hydei	35	55	90
D. busckii	83	1	84
D. spenceri	0	70	70
D. repleta	0	14	14
D. eremophila	0	13	13
D. azteca	0	8	8
D. mainlandi	0	6	6
D. melanogaster	1	3	4
D. mathisi	1	1	2

Upon request, the author can provide specific collection data such as flies per bait, locality, and sex of the sample. According to the book by Markow and O'Grady (2006), four species, *D. azteca*, *D. mathisi*, *D. pseudoobscura, D. spenceri*, are new records in Baja California peninsula.

Table 2. Percentage species composition per bait type in Baja California collection, January 2001. Data presented by column.

Species		Banana	Agria	Cardon	Senita	Organ pipe
	Total baits	11	28	23	21	10
	Total flies	566	1055	1022	630	374
D. mojavensis		24.9%	33.6%	29.2%	4.9%	26.5%
D. aldrichi		6.5%	24.8%	19.7%	15.9%	35.0%
D. pachea		----	1.2%	2.5%	54.1%	8.3%
D. mettleri		7.2%	4.6%	16.0%	12.5%	11.0%
D. simulans		17.8%	21.0%	11.8%	3.5%	6.4%
D. nigrospiracula		0.7%	2.4%	7.8%	8.4%	5.9%
D. pseudoobscura		14.5%	4.5%	7.4%	0.3%	4.5%
D. arizonae		3.0%	1.2%	1.7%	0.2%	1.3%
D. hydei		4.9%	4.5%	1.0%	----	0.8%
D. busckii		13.3%	0.8%	----	0.2%	----
D. spenceri		2.8%	0.5%	2.0%	----	0.3%
D. repleta		1.1%	0.8%	----	----	----
D. eremophila		1.4%	----	----	----	----
D. azteca		1.2%	----	0.1%	----	----
D. mainlandi		----	----	0.6%	----	----
D. melanogaster		0.4%	----	0.2%	----	----
D. mathisi		0.2%	0.1%	----	----	----

References: Markow, T.A., and P.M. O'Grady 2006, Drosophila, *A Guide to Species Identification and Use*. Academic Press.



Drosophila carbonaria: **reproductive notes and a new recipe to rearing it in laboratory.**

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Drosophila carbonaria Patterson and Wheeler 1942 is a single species in the carbonaria group (Sturtevant, 1942) within the subgenus *Drosophila*. This species is found in the Sonoran and Chihuahan Deserts of the Southwestern United States and Mexico. In nature, *D. carbonaria* are associated with the sap fluxes of mesquite trees (*Prosopis* spp.), and occasionally, windfall citrus fruits (Patterson, 1943). It is extremely rare to collect *D. carbonaria* on banana baits even when these baits were close to the mesquite trees (Pers. obs.). Recently, *D. carbonaria* has been introduced in the Hawaiian archipelago along with its host (Wagner, *et al.*, 1990). Nevertheless, Hawaiian collections of *D. carbonaria* were associated to the sap fluxes of monkeypod trees *Samanea saman* (O'Grady, *et al.,* 2002).

Mesquite fluxes have the lowest nitrogen and phosphorus content of several described *Drosophila* host, including the cactus hosts of Sonoran desert *Drosophila* (Jaenike and Markow 2003). Thus, *D. carbonaria* likely has adopted specialized strategies to survive on its nutrient poor diet. Indeed, of 21 yeast species isolated from both mesquite and *D. carbonaria* flies, three of then were unique to this *Drosophila*-plant association (Ganter *et al.,* 1986). The paucity of research on the