



Taxonomic Status of *Drosophila pallidosa*: A Species in *statu nascendi*

B. N. Singh*

Genetics Laboratory, Department of Zoology, Institute of Science, Banaras Hindu University, Varanasi 221 005, India.

bnsinghbhu@gmail.com, bashisthsingh2004@rediffmail.com, bnsingh@bhu.ac.in

Abstract: *Drosophila pallidosa* was described as a new species by Bock and Wheeler (1972) which belongs to the *ananassae* complex of the *ananassae* subgroup of the *melanogaster* species group. It is endemic to certain islands such as South Pacific Islands of Samoa and Fiji. Initially, Futch (1966) called it as a light form of *D. ananassae*, dark, cosmopolitan and domestic species. Futch designated them as a pair of sibling species which are closely related, potentially interfertile, and sympatric species. Their isolation in natural populations is maintained by sexual isolation. *D. ananassae* and *D. pallidosa* were separated just on the basis of sexual isolation in natural populations and variation in sex comb tooth number between them. However, both the species have identical male genitalia, which is important taxonomic feature in the genus *Drosophila*. In the laboratory, they are crossable and produce fertile hybrids of both sexes and thus they lack post zygotic reproductive isolation.

Since the initial studies, a number of investigations have been carried out on this pair of sibling species pertaining to sexual isolation, morphometric traits, male genitalia, fluctuating asymmetry, hybrid fertility, productivity and mating preference, parthenogenesis, interpulse intervals, molecular phylogeny, metaphase karyotypes, allozyme and inversion polymorphisms, cuticular hydrocarbons, courtship song and nucleolus organizer region (NOR) variations. Based on these findings, the evolutionary status of *D. pallidosa* is discussed and it is suggested that it does not occupy the full status of a species rather, it is in the process of speciation. Thus, it is a species in *statu nascendi*. Based on genetic and behavioural studies, it has also been suggested that there is doubt about the status of *D. pallidosa* as a good species.

Index Terms: Sibling Species, *Drosophila ananassae*, cosmopolitan species, *Drosophila pallidosa*, endemic to Samos and Fiji Islands, *statu nascendi*.

Drosophila is a very interesting biological model which has been used in a variety of studies such as genetics, evolution,

cytogenetics, ecology, behavior, molecular biology etc. It is a genus of the family Drosophilae (class-Insecta; order-Diptera). More than 1500 species have been described so far at global level (Gupta, 2005; Brake & Bachli, 2008). If the work on *Drosophila* taxonomy continues, several thousands of species may be described in future. So far, about 150 species of *Drosophila* have been described from India (Gupta, 2005; Singh, 2015). More than 500 species have been described from Hawaiian Islands and the picture winged species provide unique opportunity for the study of evolution, cytogenetics and behaviour. Based on the behavioural studies, the direction of evolution has been discussed (Singh, 1997). Although India has rich *Drosophila* fauna harbouring about 150 species which include both new records and new species, *Drosophila ananassae*, a cosmopolitan and domestic species mainly circumtropical in distribution endowed with many genetic peculiarities, has been extensively utilized from the point of view of population, behavior and evolutionary genetics (Singh, 1996, 1998, 2000, 2010, 2018a, b, 2019; Singh & Singh, 2008)

Futch (1966) studied the speciation in South Pacific populations of *Drosophila ananassae* and reported that *D. ananassae* populations from the Islands groups in central and western Pacific ocean include light (brownish-yellow) and dark (blackish-brown) *D. ananassae* like populations found on the American Samoan Islands of Tutuila. He suggested that these forms are interesting as in spite of pigmentation differences, they are morphologically nearly identical and there is no post mating reproductive isolation but they coexist together in these islands as separate reproductively isolated units. Both these forms are sexually isolated which is demonstrated cytologically and ethologically (Futch, 1966). Later, these forms were found from other islands of Samoa Archipelago and from the islands of Fijian group. The dark and light forms show genetic isolation based mainly on cytological and ethological evidence. Bock and Wheeler (1972) described these two forms as separate species.

* Corresponding Author

The dark form is *D. ananassae* Doleschall, a polytypic widespread cosmopolitan domestic and circumtropical species, whereas, the light form as *D. pallidosa* which is localized as an endemic species known from South-Central Pacific Islands of Samoa and Fiji. There, it exists side by side with its widely distributed sibling *D. ananassae*. Futch (1973) designated them as a pair of sibling species and studied ethological differentiation of *D. ananassae* and *D. pallidosa* in Samoa. These two species were separated (Bock & Wheeler, 1972) just on the basis of ethological isolation in natural populations and differences in the number of sex comb teeth. However, both these species have an identical male genitalia which is an important taxonomic feature in the genus *Drosophila*. Further, they are crossable in the laboratory and produce fully fertile hybrids of both sexes and thus, they lack post zygotic reproductive isolation. Futch (1973) has also suggested that occasional crosses between these two species must have occurred in natural populations but such incidents must have been very rare and the fertile hybrids must have been reabsorbed in the original populations.

Since the initial studies by Futch (1966, 1973) and Bock and Wheeler (1972) on this unique pair of sibling species (Singh, 2016), a number of studies have been conducted. On the basis of genetic and behavioural studies, Schug et al. (2008) have suggested that there is doubt on the status of *D. pallidosa* as a good species. McEvey and Schiffer (2015) wrote that two experienced *Drosophila* taxonomists emphasized the remarkable morphological similarity of *D. ananassae* and *D. pallidosa*: exceedingly similar species which cannot be separated by detailed observation of genitalia of males. These observations have raised doubts about the full status of *D. pallidosa* as a separate species. It has been suggested that it is still in the process of speciation: a species in *statu nascendi* (Singh & Singh, 2017). The term *statu nascendi* was coined by Dobzhansky and Spassky (1959) for *D. paulistorum* which was considered as a cluster of species in *statu nascendi*. They studied different geographic strains of *D. paulistorum* and suggested that it is a cluster of species in *statu nascendi*, in nascent stage of speciation although different Mendelian populations were considered to be different species because of inability of sympatric populations to interbreed and exchange genes. Vishalakshi and Singh (2009) studied fluctuating asymmetry in these two species and their hybrids using different morphological traits. They found that the level of fluctuating asymmetry (FA) is similar in parental species and their hybrids of different generations in males and females. These results are interpreted in terms of developmental stability as a function of balance between the disruption of co-adapted gene complexes and the level of heterozygosity. Sexual isolation has been studied within and between the species employing different geographic strains of *D. ananassae* and *D. pallidosa* and the results have shown the existence of intra- and inter-specific

ethological isolation in these species (Vishalakshi & Singh, 2006; Singh & Singh, 2020a).

Singh and Sisodia (2013) also discussed the evolutionary relationship among different members of the *ananassae* subgroup of the *melanogaster* species group. This group contains a large number of species distributed mainly throughout Southeast Asia with some species expanding into northeastern Australia, South Pacific and Indian subcontinent and Africa. In this subgroup, three species complexes have been recognized: *ananassae*, *bipectinata* and *ercepeae* based on the morphology of male genitalia. Matsuda et al. (2009) reported a number of strains whose species affiliation was not clear. These strains were found to be very similar to *D. ananassae* and *D. pallidosa* but were incompletely reproductively isolated from these species and have distinct chromosome arrangements. Matsuda et al. (2009) classified these strains into four taxa on the basis of phenotypic traits, chromosome variations and reproductive isolation: *D. parapallidosa*, *D. pallidosa* like, *D. pallidosa* like wau, and *D. papuensis* like. The six species including *D. ananassae*, *D. pallidosa*, with four new taxa were designated as “the *ananassae* species cluster” to differentiate it from the large *ananassae* species complex (Matsuda et al. 2009).

Singh (2016) described a large number of sibling species pairs/groups in the genus *Drosophila* with their evolutionary significance. Among all the species, this pair is unique in the sense that *D. ananassae* and *D. pallidosa* are so close, morphologically similar, possessing identical male genitalia and lacking post zygotic reproductive isolation. A number of investigations have been carried out on this pair of sibling species which show the similarities and differences between them and there is evidence for reduction in the fertility of hybrid males between them (Singh & Singh, 2017, 2020b). Thus *D. pallidosa* does not occupy the full status of a species and is in the process of speciation. There is a doubt on the status of *D. pallidosa* as a good species (Schug et al. 2008) and it may be in *statu nascendi* (Singh & Singh, 2017).

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