# A karyotype study of seven species of the Drosophila quinaria section(Diptera, Drosophilidae) from erstern Siberia and the Russian Far East

北海道教育大学紀要（第２部Ｂ）第47巻　第２号
Journal of Hokkaido University of Education (Section IIB) Vol. 47, No. 2

平成９年２月
February, 1997

# A Karyotype Study of Seven Species of the *Drosophila quinaria* Section (Diptera, Drosophilidae) from Eastern Siberia and the Russian Far East

Hide-aki WATABE, Hongwei CHEN* and Nikolai N. VINOKUROV**

Biological Laboratory, Sapporo Campus, Hokkaido University of Education, Sapporo 002
*Department of Biology, Shenyang Teacher's College, Shenyang 110034, China
**Department of Entomology, Yakutsk Institute of Biology, Russian Academy of Sciences, Yakutsk, Yakutia 677891, Russia

# 東シベリアおよび極東ロシア産ホシショウジョウバエ区７種の核型

渡部　英昭・陳　宏偉*・ニコライ・ビノクロフ**

002　北海道教育大学札幌校生物学教室
*110034 中華人民共和国瀋陽師範学院生物系
**677891 ロシア科学アカデミー・ヤクーツク生物学研究所昆虫学部門

## Abstract

Karyotypes of 7 species of the *Drosophila quinaria* Section which had been collected from Eastern Siberia and the Russian Far East were studied using the ganglion cell-Giemsa staining method. Two species of the *testacea* group, *Drosophila testacea* and *D. orientacea*, possess a diploid number of 8 chromosomes, consisting of 2 pairs of metacentric autosomes, 1 pair of acrocentric sex chromosomes and 1 pair of microchromosomes. B chromosomes are observed with high frequencies in two geographic strains of *D. testacea*. The metaphase plates of five species, *D. rellima, D. transversa transversa, D. limbata, D. nigromaculata* and *D. funebris*, show the same number of chromosomes, 2n=12 (5R + 1D).

## Introduction

Chromosomal studies have provided us with invaluable evidence, in the consideration of the phylogeny and evolution of drosophilid flies.

Eastern Siberia is an important territory for tracing the evolutionary process of temperate species distributed in the Nearctic region, because most of them might have derived from the Old World via Beringia (Throckmorton, 1975). Until the end of 1980', however, our knowledge of drosophilid flies was extremely limited in Russia, especially its eastern and northern areas. Since 1992, we have made an extensive study on the drosophilid fauna of Eastern Siberia (Toda *et al.*, 1996), and Sidorenko (1990a, b, 1993, etc.) has done the same in the Russian Far East. We have also made cytological studies of drosophilid flies distributed in Eastern Siberia and the Russian Far East, and we report here on karyotypes of seven

species belonging to the *Drosophila quinaria* Section.

## Materials and Methods

All adult flies were collected in June and July from 1993 to 1995, by insect nets and fermenting malt traps (Lakovaara *et al.*, 1969), and the females were allowed to oviposit in glass vials with malt-yeast-sucrose-cornmeal medium. We put a cultivated yellow mushroom, *Pleurotus cornucopiae* var. *citrunopileatus*, on the surface of *Drosophila* food, for the rearing of mycophagous species, *D. testacea* von Roser, 1840 and *D. orientacea* Grimaldi, James & Jaenike, 1992. The species used and their collection data are given in Table 1, together with the results of the karyotype observations.

Preparations of mitotic chromosomes were made with neuroblast of the 3rd instar larvae treated with 0.1 mg/ml of colchicine solution, stained with 4% Giemsa solution and then air-dried. More than 50 metaphase plates were observed in each species.

**Table 1.** Karyotypes of seven species of the *Drosophila quinaria* Section from Eastern Siberia and the Russian Far East, and their collection localities.

| Species-group / Species | Metaphase chromosomes[1] 2n | karyotype | sex chromosome | Collection localities[2] |
|---|---|---|---|---|
| *testacea* group | | | | |
| *D. testacea* | 8 | 2V, 1R, 1D | X : R, Y : J | YK, OL, NG |
| *D. orientacea* | 8 | 2V, 1R, 1D | X : R, Y : V | VL, US |
| *quinaria* group | | | | |
| *D. rellima* | 12 | 5R, 1D | X : R, Y : V | YK, VH, RS |
| *D. transversa* | 12 | 5R, 1D | X : R, Y : J | YK, OL, VH, RS |
| *D. limbata* | 12 | 5R, 1D | X : R, Y : J | US |
| *D. nigromaculata* | 12 | 5R, 1D | X : R, Y : V | VL, US |
| *funebris* group | | | | |
| *D. funebris* | 12 | 5R, 1D | X : R, Y : V | YK, OL, VH |

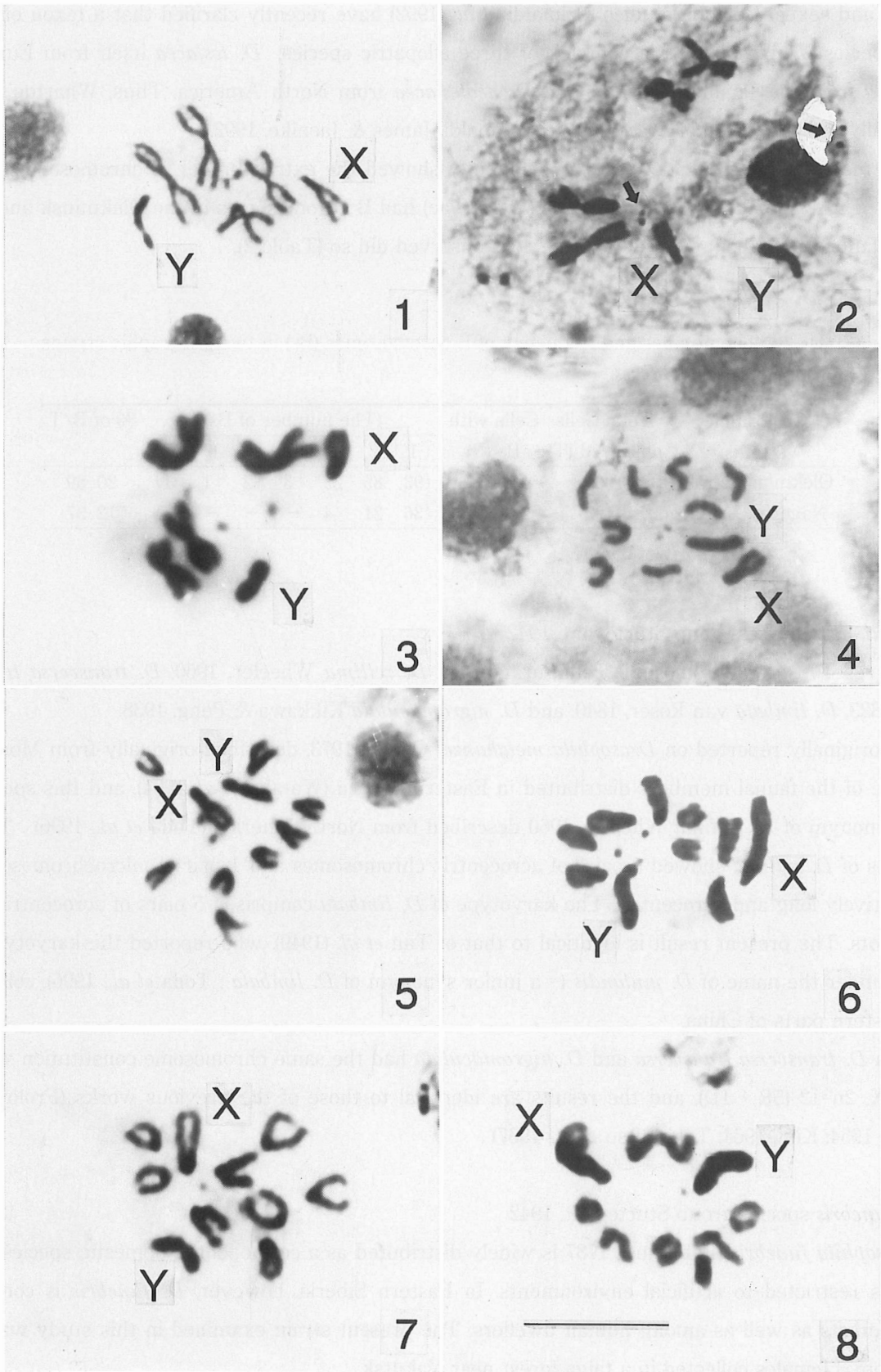
1) Abbreviations of chromosomes: R, acrocentrics; V, metacentrics; J, submeta- or subtelocentrics; D, microchromosomes.
2) YK (Yakutsk), OL (Olekminsk), VH (Verkhoyansk), RS (Rosomakha), NG (Nagornyi) in Eastern Siberia. VL (Vladivostok), US (Ussuri Nature Reserve) in the Russian Far East.

## Results and Discussion

1. The *testacea* species-group Sturtevant, 1942

Figures 1 and 3 show metaphase configurations of *Drosophila testacea* and *D. orientacea*, respectively. Both species possess the same number of chromosomes, 2n=8, consisting of two pairs of metacentric (V-shaped) autosomes, one pair of microchromosomes (dots) and sex chromosomes. X chromosomes are acrocentric (rod-shaped). Y is submetacentric in *D. testacea* and metacentric in *D. orientacea*.

The karyotype of "*D. testacea*", 2n=8 (1V + 2R + 1D), has already been studied by Wharton (1943), who used a geographic strain of "*D. testacea*" collected at Wooster, Ohio, U. S. A. Based on morphological com-




**Figs. 1-8.** Karyotypes of seven species of the *Drosophila quinaria* Section collected in Eastern Siberia (ES) and the Russian Far East (FE). 1, 2: *D. testacea* from Olekminsk, ES. 3: *D. orientacea* from Vladivostok, FE. 4. *D.rellima* from Verkhoyansk, ES. 5: *D. transversa transversa* from Yakutsk, ES. 6. *D. limbata* from Ussurian Nature Reserve, FE. 7. *D. nigromaculata* from Vladivostok, FE. 8. *D. funebris* collected in a taiga forest near Yakutsk, ES. Arrows in Fig. 2 indicate B chromosomes. Bar= 10 $\mu$m.

parisons and sexual isolation studies, Grimaldi *et al.* (1992) have recently clarified that a taxon of the Holarctic species "*D. testacea* " is a complex of three allopatric species: *D. testacea* itself from Eurasia, *D. orientacea* from the Japanese Islands, and *D. neotestacea* from North America. Thus, Wharton's results are actually the karyotype of *D. neotestacea* Grimaldi, James & Jaenike, 1992.

The metaphase plates of *D. testacea* frequently showed the extra number of chromosomes, B chromosomes (Fig. 2). About 60% of individuals (3rd larvae) had B chromosomes in the Olekminsk and Nagornyi populations, and about 10 to 20% of the cells observed did so (Table 2).

**Table 2.** The number and frequency of B chromosomes (Bs) in two geographic strains of *Drosophila testaces.*

| Geographic strains | Total Cells observed (T) | Cells with Bs (B) | (The number of Bs) | | | | | | | % of B/T |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | (1 | 2 | 3 | 4 | 5 | 6 | 7) | |
| Olekminsk strain | 1039 | 215 | (93 | 85 | 23 | 3 | 2 | 1 | 1) | 20.69 |
| Nagornyi strain | 493 | 61 | (36 | 21 | 4 | − | − | − | −) | 12.37 |

2. The *quinaria* species-group Sturtevant, 1942

Figures 4-7 show chromosome configurations of *D. rellima* Wheeler, 1960, *D. transversa transversa* Fallen, 1823, *D. limbata* van Roser, 1840, and *D. nigromaculata* Kikkawa & Peng, 1938.

We originally reported on *Drosophila metakunzei* Okada, 1973, described originally from Mongolia as to be one of the faunal members distributed in Eastern Siberia (Watabe *et al*, 1994), and this species is a junior synonym of *D. rellima* Wheeler, 1960 described from North America (Toda *et al.*, 1996) . The ganglion cells of *D. rellima* showed 5 pairs of acrocentric chromosomes and 1 pair of microchromosomes. Its X is relatively long and acrocentric. The karyotype of *D. limbata* comprised 5 pairs of acrocentrics and 1 pair of dots. The present result is identical to that of Tan *et al.* (1949), who reported the karyotype of *D. limbata* under the name of *D. mutandis* (= a junior synonym of *D. limbata* ; Toda *et al.*, 1996), collected in southwestern parts of China.

Both *D. transversa transversa* and *D. nigromaculata* had the same chromosome constitution with rod-shaped X, 2n=12 (5R + 1D), and the results are identical to those of the previous works (Frolova, 1926; Momma, 1954; Kim, 1964; Tokumitsu *et al.*, 1967) .

3. The *funebris* species-group Sturtevant, 1942

*Drosophila funebris* (Fabricius), 1787 is widely distributed as a cosmopolitan domestic species, and its habitat is restricted to artificial environments. In Eastern Siberia, however, *D. funebris* is common in natural forests as well as among human dwellers. The present strain examined in this study was established from 3 females collected in a taiga forest near Yakutsk.

The metaphase plates have 5 pairs of rod-shaped chromosomes and 1 pair of microchromosomes (Fig. 8), which is identical to the results of Metz (1914). Its X is acrocentric with a large area of heterochromatin around centromere, and Y is relatively long and metecentric.

At last, we have found in the present study that *D. orientacea* is also distributed in eastern parts of Eurasia, and will in future report on the geographic range of distribution of two sibling species, *D. testacea* and *D. orientacea* in another article.

## Acknowledgements

We wish to express our cordial thanks to the following persons for heir kind help in the field study: Prof. N. G. Solomonov (Yakutsk Institute of Biology), Prof. B. I. Ivanov (Yakutsk Institute of Biology), Prof. M. J. Toda (Hokkaido University), and Dr. V. S. Sidorenko (Institute of Biology and Pedology, Vladivostok). This work was supported by Grants-in-Aid for Overseas Scientific Study from Ministry of Education, Science , Sports and Culture, Japan (Nos. 04041014, 07041078) to Prof. M. Fukuda (Hokkaido University).

## References

Bächli, G., and M. T. R., Rocha-Pite, 1981. Drosophilidae of the Palearctic region. In Ashuburner, M., H. L. Carson, and J. N. Thompson Jr. (eds.), The Genetics and Biology of *Drosophila*, 3a: 167-196. Academic Press, London.

*Frolova, S. L., 1926. Normale und polyploide Chromosomengarnituren bei einigen *Drosophila*-Arten. Z. Zellforsch., 3: 682-694.

Grimaldi, D., A. C. James and J. Jaenike, 1992. Systematics and modes of reproductive isolation in the Holarctic *Drosophila testacea* species-group (Diptera: Drosophilidae). Ann. Entomol. Soc. Amer., 85:671-685.

Kim, K. W., 1965. Chromosomal studies of Korean *Drosophila* species. *Drosophila* Inf. Serv., 40: 69.

Lakovaara, S., W. Hackman, and K. Vepsalainen, 1969. A malt bait in trapping drosophilids. *Drosophila* Inf. Serv., 44: 128.

Metz,C. W., 1914. Chromosome studies in the Diptera. I. A preliminary survey of five different types of chromosome groups in the genus *Drosophila*. J. Exp. Zool., 17: 45-49.

Momma, E., 1956. *Drosophila* survey of Hokkaido. II. Chromosomes of seven wild species. J. Fac. Sci., Hokkaido Univ. Ser. VI. Zool., 12: 200-208.

Sidorenko, V. S., 1990a. The review of the palearctic drosophilid flies of the subgenus *Stegana* Mg. (Diptera, Drosophilidae) with description of new species from Soviet Far East. News of Insects Systematics of Soviet Far East 1990: 126-128. (In Russian)

——, 1990b. To the knowledge of drosophilid flies of the genus *Mycodrosophila* Oldenberg (Diptera, Drosophilidae) from Primorye Territory. News of Insects Systematics of Soviet Far East 1990: 129-132. (In Russian)

——, 1993. Tribe Drosophilini of the Asian part of the USSR (Diptera, Drosophilidae). Entomofauna,14: 253-268.

Tan, C. C., T. C. Hsu and T. C. Sheng, 1949. Known *Drosophila* species in China with descriptions of twelve new species. Univ. Texas Publ. , No. 4920: 196-206.

Throckmorton, L. H., 1975. The phylogeny, ecology and geography of *Drosophila*. In King, R. C. (ed.), Handbook of Genetics, 3: 421-469. Plenum Publ., New York.

Toda, M. J., V. S. Sidorenko, H. Watabe, K. K. Sergey and N. N. Vinokurov, 1996. A revision of the Drosophilidae (Diptera) in East Siberia and Russia Far East: Taxonomy and biogeography. Zool. Sci., 13: 455-477.

Tokumitsu, T., T. Shima and A. Kaneko., 1967. *Drosophila* Survey of Hokkaido. XXIII. A karyotype study in seven species of the *quinaria* and *robusta* groups. Jpn. J. Genet., 42: 2789-282.

Watabe, H., M. J. Toda and N. N. Vinokurov, 1994. A preliminary report on the drosophilid fauna of Sakha SSR, the East Siberia. *Drosophila* Inf. Serv., 75: 145-147.

Wharton, L. T., 1943. An analysis of the metaphase and salivary chromosome morphology within the genus *Drosophila*. Univ. Texas Publ., No. 6205: 119-134.

(*Indirect citation).