The Danish Species of *Drosophila* (Dipt.)

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Introduction.

Since the appearance of Sturtevant's monograph in 1921 the North American *Drosophila* fauna has been the subject of intensive taxonomic and faunistic investigation by a great number of workers (for a general survey, see Patterson and Stone 1952), and later on similar investigations have been made in other parts of the world. Outstanding among these investigations of faunas outside North America are the studies of the Brazilian fauna (Dobzhansky & Pavan 1943, Pavan & da Cunha 1947, Pavan 1950). The immediate aim of these taxonomic and faunistic researches has most often been to make it possible to use the natural populations of *Drosophila* to investigate certain aspects of Population Genetics.

In the late forties similar taxonomic, faunistic, and ecological investigations based on extensive collectings were initiated in Europe. Burla's excellent pioneer work (1948, 1951) on the Swiss *Drosophila* fauna has since been followed by valuable investigations in Spain, Portugal, and France (Hadorn et al. 1952), the Netherlands (Lever et al. 1951, Sobels & Lever 1954), England (Collin 1952), Scotland (Basden 1954), Finland (Hackman 1954), and Western Germany (Herting 1955).

The aim of the work on the Danish *Drosophila* species presented in this paper has partly been to bring forth further evidences on the distribution of the genus *Drosophila* in Europe and partly to obtain sufficient information on the taxonomy and ecology of the Danish *Drosophila* populations to make these possible tools for future genetical research.

So far the Danish *Drosophila* species have been treated only by three authors. In 1844 Stæger, in a short paper in Danish, described a Danish *Drosophila* species, *Drosophila confusa* as new to science and he recorded *Drosophila fenestrarum* Fallén from Denmark. Three years later, in 1847, Zetterstedt mentioned all the Danish *Drosophila* species so far known which amounted to nine *(phalerata* being regarded as a variety of *transversa)*, a knowledge due mainly to Stæger's diligent collectings now kept in the Zoological Museum, Copenhagen. Since Zetterstedt's publication, which is now more than a century old, no paper dealing with the Danish *Drosophila* fauna as a whole has been published. However, Lemche in 1949 found *Drosophila busckii* as a contaminant of milk bottles thus making a total of eleven species recorded from Denmark (table 1). The species identified as *D. graminum* Fallén by Fallén (1823) and by Zetterstedt (1847) has since been shown to comprise two distinct species which are now regarded as belonging to two different but closely related genera, *Scaptomyza* Hardy and *Parascaptomyza* Duda (Duda 1935). The present author has found that the same situation applies also to the specimens labelled *D. graminum* Fall. in Stæger's collection on which Zetterstedt based his statements on the Danish *Drosophila* species. It may be added here that both *Scaptomyza graminum* and *Parascaptomyza disticha* have been caught by the present author also. As regards *Drosophila flava* Fallén which is listed at the bottom of table 1 some doubt exists about the meaning of this name. According to Collin (1953) *D. flava* Fall. is a *Drosophila* species belonging to the *Fenestrarum* group, a statement Collin founds on an examination of coll. Fallén in Stockholm. The present author's examination of the specimens labelled *D. flava* in coll. Stæger showed, however, that these specimens do certainly not belong to the genus *Drosophila* as this genus is defined today.

They represent without any doubt a species of *Scaptomyza*; actually they are very much like *S. flaveola* Meigen as this species is described by Collin. Whatever Fallén's and Zetterstedt's original use of the name *D. flava* may have been, we can be pretty sure that the *D. flava* mentioned as Danish by Zetterstedt, who had his information from Stæger, was not a *Drosophila*. Only nine *Drosophila* species were therefore recorded from Denmark at the initiation of the present investigation. It ought to be mentioned, however, that the author's examination of W. Lundbeck's collection of *Drosophilidae* (see below) revealed that this collection contained Danish specimens of *D. melanogaster* Meig. and *D. deflexa* Duda, both collected and correctly determined by Lundbeck.

Materials and Methods.

The present records are based on material originating from two sources. A certain amount of faunistic information has been obtained by a study of W. Lundbeck's collection of *Drosophilidae* in the Zoological Museum of Copenhagen. From about the beginning of this century until his death in 1941 Lundbeck was mainly occupied in working on his great monograph: "Diptera Danica". During this work he built up what was then the most extensive Danish collection of *Drosophilidae*. But unfortunately Lundbeck died without having published anything on the *Drosophilidae*. The author has examined Lundbeck's collection and has found that it contains the following seven correctly determined *Drosophila* species: 1. *D. funebris* Fabr., 2. *D. transversa* Fall., 3. *D. fenestrarum* Fall., 4. *D. melanogaster* Meig., 5. *D. phalerata* Meig., 6. *D. deflexa* Duda, and 7. *D. confusa* Stæger. This last species was actually labelled *D. vibrissina* Duda but this is but an invalid synonym of *D. confusa*. Furthermore Lundbeck has labelled several specimens "D. obscura Fall.". The majority of these spe-

cimens were actually *D. subobscura* Collin, though a few were *D. obscura* Fall. s. str. A single specimen of *D. testacea* v. Roser was labelled *D. histrio* Meig.?. Finally three undetermined specimens turned out to be the very rare *D. picta* Zett.

The other and much greater part of the material on which this report is based has been obtained through the present author's own collecting. The collecting was mainly done in the summer of 1953 and 1954 though some *Drosophila* were collected during the colder months.

In the outdoor localities the flies were attracted by exposed fermenting banana bait as described by Patterson (1943). Ripe and overripe bananas were mashed by a meat-grinder and activated dry-yeast was added to the mass. After a lapse of about twenty-four hours the baits were exposed in open cans of about 10 liter capacity. One half to one kilo of bait was put into each can. In the first collecting year six cans were used, in the second year the number of cans was increased to twenty-five. The cans were emptied of flies by covering them with an entomological net fitted to the size of the cans.

It was impractical to expose banana bait indoors and so the flies were collected indoors by sweeping.

The flies trapped on bait were as a rule etherized immediately after the capture and determined with a binocular microscope in the field. In doubtful cases the specimens were transferred to culture vials with standard *Drosophila* medium and they were then identified later on in the laboratory. In a number of cases it was necessary to make preparations of the male genitalia to be sure of correct identification. A number of *D. obscura* strains, suspected to be *D. bifasciata*, were established and test-crossed (see below).

A total of 15,922 *Drosophila* specimens were collected and determined during the two years. Table 2 shows the number of each species collected.

In order to find out the distribution of the species in different habitats every locality visited was referred to as one of the following five types of habitat. The classification of localities was always done before the collecting was begun.

1. *Woods:* This comprises all localities more than 100 meters inside the edge of either broadleaf or coniferous woods.

2. *Edge of Woods:* This comprises all localities in the outer 100 meter zone of woods. Actually most habitats in category 1 were situated much more than 100 meters inside the edge of the woods and most of the habitats in category 2 were situated in the outer 10 meter zone of the woods. The species of trees in woods visited were recorded but in most cases there were no significant difference in the composition of the *Drosophila* faunas in the different kinds of woods.

3. *Small Tree-Groups:* This comprises small groups of trees surrounded by land without any trees. As a theoretical upper limit for the magnitude of these groups a maximum diameter of 100 meter was chosen. Actually all the tree groups investigated were considerably smaller.

4. *Domestic Habitats Out-of-Doors:* This comprises orchards, gardens, yards, etc., in other words all habitats with a purely cultivated flora or those very near human habitation.

5. *Indoor Habitats:* This comprises rooms such as kitchens, dining-rooms, and cellars in houses and greenhouses. Fruit stores for newly imported fruits and other localities where foreign species were apt to be found were avoided.

For each species and for each type of habitat "the relative population density" and "the percentage-occurrence" were calculated. "The relative population density" for a species in a given type of habitat (such as "Woods") is the total number of specimens of the species

caught as percentage of the total of all *Drosophila* specimens caught in that type of habitat. "The percentage-occurrence" of a given species in a given type of habitat is the number of localities in that type of habitat in which the species was present as a percentage of the total number of localities of this type visited. The relative population densities and the percentages-occurrence are shown in table 3 and 4. The author is aware of the fact that the two above mentioned statistics tend to be correlated. As this correlation, however, is never complete some information is gained by considering both statistics. When, for example, a species shows both a high percentage-occurrence and a high population density this testifies that the species has large populations almost everywhere in that type of habitat (see for example *D. subobscura* in "Woods"), whereas a high percentage-occurrence together with a low population density indicates that the species occurs often in the type of habitat but that its populations there are most often very small (as for example *D. funebris* in "Woods"). The characterization of the ecological distributions of the species given in section 4 is based partly on the statistics discussed here and partly on additional notes made during the collecting.

Taxonomical Remarks and Keys.

The terminology used in this section is that generally accepted in the modern taxonomic literature on *Drosophila*. For a full account of this terminology which in most details agrees with that used by other dipterists, the reader is referred to the papers of Sturtevant (1921, 1942), Burla (1951), or Freire-Maia & Pavan (1950).

Among the Danish *Drosophilidae* the three genera *Parascaptomyza* Duda 1924, *Scaptomyza* Hardy 1843, and *Drosophila* Fallén 1823 are easily recognized by possessing the following complex of characters:

1) Eyes at least centrally with a short pile.
2) Postvertical bristles well developed, convergent, and crossed.
3) Three orbital bristles: foremost a proclinate (lower) orbital, backwards a posterior reclinate (upper) orbital, and between these and nearest to the lower an anterior reclinate (middle) orbital. The latter is always conspicuously shorter than the other two. The lower orbital may be as long as the upper one but usually it is shorter.
4) Two pairs of dorsocentral bristles. In *D. funebris, D. hydei,* and in the *Fenestrarum* group of *Drosophila* one or two pairs of acrostichal hairs placed in front of, and in the same rows as, the dorsocentral bristles may be somewhat lengthened.

The above three genera can be separated by means of the following key:

1. Only two rows of acrostichal hairs between the rows of the dorsocentrals. (The rows have to be counted just in front of the anterior pair of dorsocentrals). *Parascaptomyza* Duda 1924.
   More than two rows of acrostichal hairs ..... 2.
2. Six or eight rows of acrostichal hairs ..... *Drosophila* Fallén 1823, p. p.
   Only four rows of acrostichal hairs ..... 3.
3. The middle of the three sternopleural bristles longer than the anterior one ..... *Drosophila* Fallén 1823, p. p. (*Fenestrarum* group)
   The middle of the three sternopleural bristles shorter than the anterior one ..... *Scaptomyza* Hardy 1843.

The genus *Parascaptomyza* Duda comprises only one species, *P. disticha* Duda 1924 which is common in Denmark though it has never been recorded from this country before. It is known from the following localities: Jylland: Sjørring (Aug. 1906, Lundbeck); Brøns (July, 1953, O. F.); Linnerup (Aug. 1953, O. F.); Hattenæs (Aug. 1953, O. F.). The Islands: Fanø (Aug. 1953, O. F.); Lohals, Langeland (July, 1913, Lundbeck); Tangeskov, Fyn

(July, 1953, O. F.); Engestofte, Lolland (July, 1953, O. F.); Egebæksvang, Sjælland (July, 1915, Lundbeck); Tystrup, Sj. (July, 1953, O. F.); Allindelille, Sj. (Sept. 1953, O. F.); several localities in the environs of Copenhagen, Sj. (May—Oct., Lundbeck); Rø, Bornholm (July 1889, H. J. Hansen, coll. Lundbeck).

The genus *Scaptomyza* Hardy 1843 is made up of several European species and it has representatives in North America too. The relation between the European and the North American species is not clear and the definitions of the genus seem also to differ in the two parts of the world. A recent revision of the European species has been carried out by Collin (1953). The author's material of this genus has not yet been worked out in detail but it definitely includes *S. graminum* which was mentioned already by Zetterstedt and which is most probably very common all over the country.

The genus *Drosophila* Fallén includes more than 600 species from all parts of the world. The species hitherto found in Denmark may be determined by means of the following key. The determination of the members of the *Obscura* group is specially difficult and requires some practice. A biometrical study of the morphological characters used in the taxonomy of this group has recently been published by Dyson-Hudson (1954). This paper may be a valuable help in the determination.

Key to the Danish Species of the Genus *Drosophila*.

1. Only four rows of acrostichal hairs between the dorsocentral rows just in front of the anterior pair of dorsocentrals. Three sternopleural bristles, the middle one the longest. No carina ..... *Fenestratum* group 2.
   Six or eight rows of acrostichal hairs. Two or three sternopleural bristles. If three then the middle one is always conspicuously shorter than the anterior ..... 3.
2. Primary forceps in the males very big, broadest ventrally. The ovipositor plate with a row of small teeth, all of the same size .... *D. fenestrarum* Fall.

The primary forceps smaller, but still prominent, pointed ventrally. The ovipositor plate with 5 to 7 teeth, two of which are obviously longer and stouter than the others.. ..... *D. forcipata* Collin.

3. A pair of slender bristles, about three times the length of the acrostichal hairs, are situated on mesonotum between the dorsocentral rows in front of the transversal suture (see fig. 1). The colour of the mesonotum varies from purely yellow to red brown. Abdomen yellow, with two rows of black spots. Wings unclouded..... *D. testacea* v. Roser.
Without a pair of slender bristles on mesonotum in the above position..... 4.

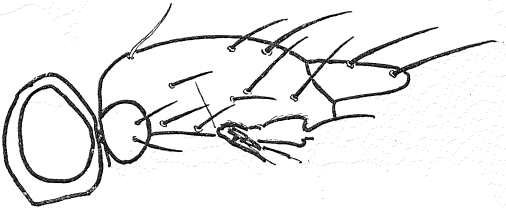

Fig. 1. Head, mesonotum, and scutellum of *D. testacea*, to illustrate the position and form of the presutural bristle which is shown in white.

4. Mesonotum gray, in living specimens with a greenish tinge. Almost all the bristles and hairs on mesonotum are inserted on a dark brown or black spot ..... *D. hydei* Sturtevant.
Mesonotum yellow, red brown, brown, or black. No special colour around the bases of the mesonotal bristles and hairs. 5.
5. Mesonotum yellow, occasionally with a dark pattern..... 6.
Mesonotum red brown, brown, or black, occasionally with a more or less distinct pattern..... 14.
6. The first femur on the inner side with a row of about 10 small, pointed, black spines. The wings clouded apically and on the posterior transversal vein. Abdomen yellow with two big, dull, black triangles on each tergite..... ..... *D. immigrans* Sturtevant.
No row of spines on the inner side of the first femur.... 7.
7. Mesonotum yellow with five black longitudinal stripes, of which the middle unpaired stripe is branched into two posteriorly. The yellow pleura also with two to three dark stripes. Wings unclouded, third and fourth longitudinal veins slightly divergent. Preapical bristles missing on first and second tibiae ..... *D. busckii* Coq.

Mesonotum without five distinct stripes, often without any pattern at all. Preapicals on all three pairs of tibiae..... 8.

8. Third and fourth longitudinal veins in the wings strongly divergent. Pleura with two brown longitudinal stripes, the upper stripe running just below the wing, the lower one crossing the upper third of the sternopleural sclerite.... ..... *D. picta* Zett.
Third and fourth longitudinal wing veins parallel or convergent. Pleura without stripes ..... 9.

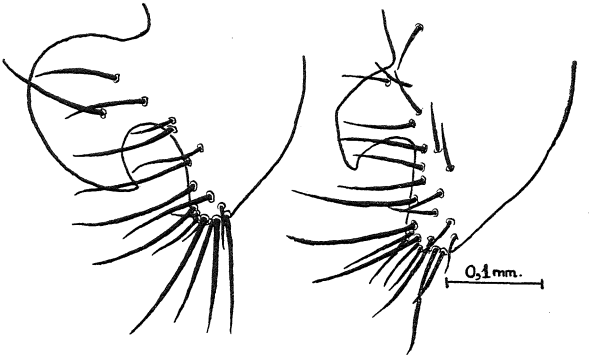

Fig. 2. Lower part of genital arch of *D. simulans* and *D. melanogaster*. The shape of the primary processes is the best distinguishing mark between these two species.

9. The yellow abdominal tergites with a black band along their posterior margins. These bands are never interrupted in the median line, on the contrary they are most often broadest there. Fifth and sixth tergites in the male all black. Males with sex combs. These consists of about ten strong black bristles of equal size placed in a row on the first metatarsus ..... *Melanogaster* group. 10.
The posterior bands on the tergites, at least on the four most anterior tergites, interrupted in the median line so that these tergites have each one or two pairs of black spots..... 11.

10. Males: the genital arch with a hook shaped process (see fig. 2). Both sexes: width of cheeks (measured vertically from the lowest point of the eye to the margin of the cheek) about one sixth of the greatest diameter of the eye.

Maxillary palps most often with three stouter bristles on their distal half..... *D. melanogaster* Meig.
Males: genital arch with a clamshell shaped process (see fig. 2). Both sexes: width of cheeks less than one sixth of the greatest diameter of the eyes. Maxillary palps most often with only two stouter bristles on their distal half.. ..... *D. simulans* Sturtevant.

11. Wings completely unclouded. Apical bristle on middle tibia exceptionally large. Large species ..... *D. confusa* Stæger.
Wings clouded on the two transversal veins. Medium sized species ..... *Quinaria* group. 12.

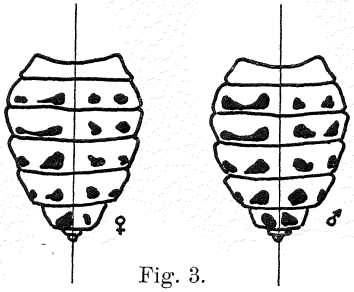

Fig. 3.

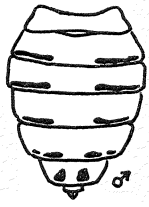

Fig. 4.

Fig. 3. Abdominal pattern of *D. transversa*, male and female. Left side from a specimen with strongly developed spots, right side from a specimen with normally developed spots.

Fig. 4. The abdominal pattern of *D. limbata*. This species does not show any conspicuous sexual dimorphism.

12. The black bands on the posterior margins of the abdominal tergites interrupted both in the median line and laterally, thus each tergite has four black spots (see fig. 3). Eyes coral red. Second oral bristle at least half the length of the first ..... *D. transversa* Fall.
The posterior bands on the tergites interrupted only in the median line. The eyes more dingy red ..... 13.
13. The median interruption of the posterior bands just as broad as the lateral spots left. These spots are only thin, faintly coloured lines along the margin of the tergites (see fig. 4). Second oral bristle longer than one half the length of the first..... *D. limbata* v. Roser.
The median interruption narrower than the lateral spots which have the shape of quadrangles whose anterior margins are more or less concave (see fig. 5). Second oral

bristle shorter than one half the length of the first .....
..... *D. phalerata* Meig.

14. Lower part of carina bulbously swollen. A pair of small, inconspicuous prescutellar bristles present. A small, distinct bristle on propleuron. The tip of the abdomen in living specimens withdrawn so that the genitalia most often are invisible. Yellow wings which are relatively very short..
..... *D. deflexa* Duda.
Carina nose-shaped, never bulbous. No prescutellars nor a propleural bristle. The external genitalia usually well exposed and easily visible in living specimens..... 15.

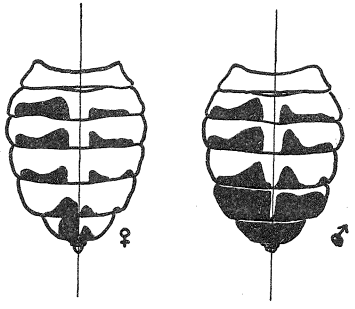

Fig. 5. The abdominal pattern of *D. phalerata,* male and female. Left side from a specimen with strongly developed spots, right side from a specimen with a weak development of the pattern.

15. Six rows of acrostichal hairs. Mesonotum grayish black. Posterior transversal vein intensely clouded. Carina with a longitudinal groove. Abdomen dark brown to black without any lighter markings ..... *D. littoralis* Meig.
Eight rows of acrostichal hairs. Posterior transversal vein unclouded (a trace of clouding may occasionally occur in *D. tristis*). Carina unsulcate..... 16.
16. Mesonotum light red brown. Two to three acrostichal hairs in the dorsocentral rows in front of the anterior pair of dorsocentrals, longer than the other acrostichal hairs. Three sternopleural bristles. Arista with 10—12 branches. Abdomen black, but with a yellow band along the anterior margin of each of at least the four first tergites. Yellow band broadest in the median line. Males without sex combs on the forelegs. Body length: 3—4 mm ..... *D. funebris* Fabr.

Mesonotum brown, black, or black with brown stripes. No prolonged acrostichal hairs. Only two sternopleural bristles. Arista with 7—9 branches. Abdominal tergites black without anterior bands. Males with two sex combs on each foreleg. Body length: 2—3 mm. ..... *Obscura* group. 17.

17. Males ..... 18.
Females ..... 22.

18. Wings strongly clouded anterior to a line running from the middle of the second costal section to the apical end of the third longitudinal vein. Palps with two equally long bristles. Proximal sex comb with 9—12 teeth, distal with 8—11. Distal sex comb inserted almost parallel to the second tarsal segment, proximal comb slightly skewly inserted on the first tarsal segment. The length of first tarsal segment divided by the length of second tarsal segment gives about 1.1 ..... *D. tristis* Fall.
Wings unclouded or only faintly clouded around the distal end of second longitudinal vein. Palps most often with only one strong bristle; if two bristles then of equal length.. 19.

19. Proximal sex comb with 4—6 teeth, distal sex comb with 3—5 teeth, arranged in an irregular row running at an angle to the length of the tarsus. Mesonotum dark brown without any pattern. First tarsal segment divided by second tarsal segment gives 1.4—1.9..... *D. silvestris* Basden.
Both sex combs with at least 6 teeth. With or without colour pattern on mesonotum ..... 20.

20. Mesonotum with longitudinal stripes. Sex combs short, their length about one fourth of the length of the tarsal segments on which they are inserted. Proximal sex comb with 6—10 teeth, distal with 6—8 teeth. Palps observed from the side triangular in shape. One strong terminal bristle on the palps, often also a considerably smaller subterminal bristle present. First tarsal segment divided by second tarsal segment gives more than 1.4..... *D. obscura* Fall.
Mesonotum without any pattern. Sex combs very long. Proximal comb with at least 7, distal with at least 8 teeth. Palps observed from the side club-shaped. First tarsal segment divided by second tarsal segment less than 1.3 .... 21.

21. Third costal section with heavy bristles on its basal $^1/_2$—$^4/_5$. Sex combs inserted parallel to the tarsal segments, considerably longer than $^1/_2$ of these segments. Proximal comb with 10—15, distal with 9—13 teeth. Second tarsal segment clearly shorter than the first. Forceps with 6—8 primary teeth ..... *D. subobscura* Collin.

Third costal section with heavy bristles on its basal $^2/_5$—$^1/_2$. Sex combs not completely parallel to the tarsal segments, about half as long as these. Proximal sex comb with 7—10, distal with 8—10 teeth. First tarsal segment hardly longer than second. Forceps with 7—10 primary teeth..... ..... *D. ambigua* Pomini.

22. Palps with two equally strong bristles. Mesonotum with two unclear longitudinal stripes. Ovipositor plate narrow and very pointed. Abdominal tergites black, without any light spots ..... *D. tristis* Fall.
Most often only one bristle on the palps. If two bristles occur, then the subterminal bristle is shorter than half the length of the terminal, or the subterminal bristle is $^3/_4$—$^1/_2$ the length of the terminal but in this case the lateral areas of the abdominal tergites show light spots ..... 23.

23. Mesonotum with distinct, longitudinal stripes. Fourth, fifth, and sixth tergites laterally with a more or less distinct yellow spot. Occasionally these spots are very faint, and rarely they are missing entirely. Ovipositor plate with one long bristle, approximately as long as the maximal breadth of the plate. Eyes dark red ..... *D. obscura* Fall.
Mesonotum without pattern. If a trace of a mesonotal colour pattern occurs, then the tergites are without any light spots and the bristle on the ovipositor plate is very short. Eyes bright red ..... 24.

24. Fourth, fifth, and sixth tergites laterally with a distinct white spot which may often occur also on the third tergite. Ovipositor plate with two long divergent bristles..... ..... *D. silvestris* Basden.
No spots on the tergites. Only one ovipositor bristle and this is short..... 25.

25. Third costal section with heavy bristles on basal $^1/_2$—$^4/_5$. Palps only with one long bristle but often with some small hairs in the subterminal position. The teeth of the ovipositor plate short and stout, all of the same size. Ovipositor bristle only about twice as long as the teeth..... ..... *D. subobscura* Collin.
Third costal section with heavy bristles on basal $^3/_5$—$^1/_2$, Palps very often with a subterminal bristle also, about half the length of the terminal bristle. The 4 to 5 most terminal teeth on the ovipositor plate longer and stouter than the rest. Ovipositor bristle about three times as long as the longest teeth ..... *D. ambigua* Pomini.

Records of the Danish *Drosophila* species.

In the following are recorded the Danish *Drosophila* species listed in systematical order (see table 5). Under each species the *Synonyms* occurring in the more recent literature are mentioned first. For synonyms older than Duda's monograph (1935) the reader is referred to this work. Secondly references are given to recent *Complete*

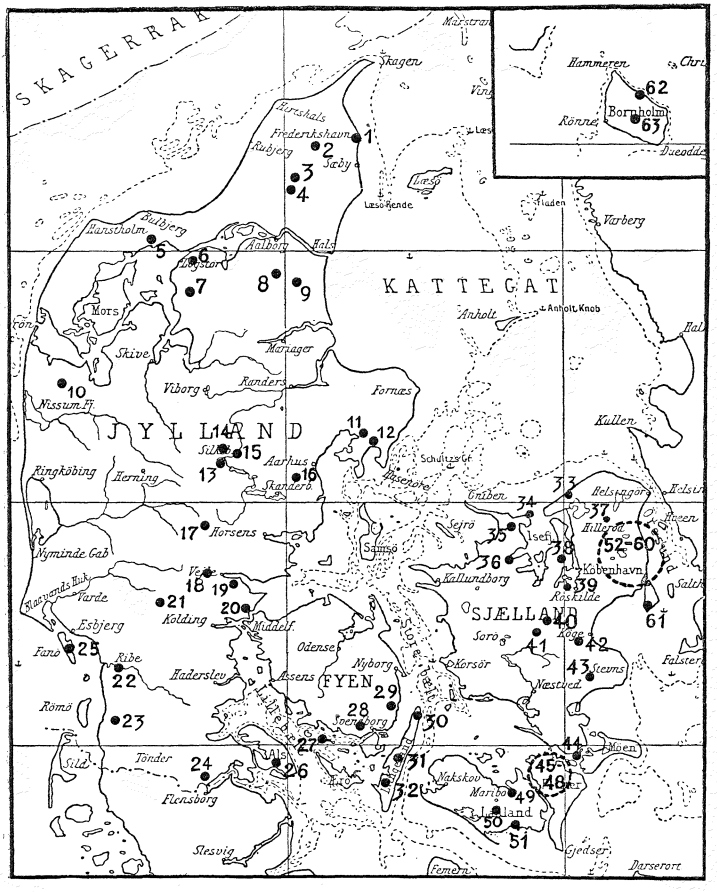

Fig. 6. Map of Denmark Proper, showing the localities mentioned in the text. List of localities see p. 264.

Jylland:
Brøndum (Mr. B. Christensen) 6
Brøns* 23
Estrup* 21
Fredericia (Lemche 1949) .. 20
Frederikshavn (Mr. B. Christensen) 1
Hattenæs* 15
Hulknøse (Mr. B. Christensen) 4
Jerslev skov (Mr. B. Christensen) 3
Kalø hestehave* 11
Klosterhede plantage* 10
Kollund* 24
Linnerup* 17
Mols Laboratory* 12
Munkebjerg* 19
Naaege* 14
Østerild plantage* 5
Overlade (Mr. B. Christensen) 7
Ribe* 22
Rold skov* 8
Silkeborg* 13
Sjørring (*Coll.* Lundbeck) .. 9
Stilling* 16
Tolne skov* 2
Vingsted* 18

The Islands:
Als: Sønderskov* 26
Amager: Kongelunden* 61
Bjørnø (*Coll.* Lundbeck) 27
Bornholm: Almindingen* .. 63
— : Rø (H. J. Hansen) 62
Bogø (*Coll.* Lundbeck) 44
Falster: Nørre Alslev skov* 45
— : Orehoved* 46
— : Orenæs skov* 47
— : Resle skov* 48
Fanø: Fuglekøjen and Statsplantagen* 25
Fyn: Skovbo* 28
— : Tangeskov* 29
Langeland: Aasø* 31
— : Faarevejle* 32
— : Lohals (*Coll.* Lundbeck) 30
Lolland: Engestofte* 50
— : Nysted (*Coll.* Lundbeck) 51
— : Saxkøbing (Lemche 1949) 49
Sjælland: Allindelille* 40
— : Boserup (*Coll.* Lundbeck) 39
— : Charlottenlund skov* 52
— : Egesbæksvang (*Coll.* Lundbeck) . 53
— : Ermelunden (*Coll.* Lundbeck) 54
— : Frederiksberg* .. 55
— : Geels skov* 56
— : Hillerød (Lemche 1949) 37
— : Holbæk (Lemche 1949) 36
— : Hørsholm (S. L. Tuxen) 57
— : Lellinge* 42
— : Liseleje* 33
— : Lyngby (*Coll.* Lundbeck) 58
— : Nykøbing (Lemche 1949) 35
— : Østerbro* 59
— : Ringsted (Lemche 1949) 41
— : Rørvig* 34
— : Skuldelev (Mr. P. Eriksen) 38
— : Tystrup* 43
— : Utterslev* 60

*) Localities in which the author has collected.

Descriptions of the species. An account of the *Occurrence in Denmark* then follows. The localities mentioned under this heading are shown on the map in figure 6. After a brief account of the *Distribution* based on recent literature, aspects of ecology are discussed under the heading *Biological Notes.*

1. **Drosophila deflexa** Duda 1924.

New to Denmark.

Synonym: According to Herting (1953) *D. guyénoti* Burla 1948 is an invalid synonym of this species.

A complete description has been given by Burla (1948, 1951, under the heading: *D. guyénoti*).

Occurrence in Denmark: 1) The Zoological Museum collection: *The Islands:* Bogø (5 specimens, July 1917, Lundbeck). 2) The author's collection: *Jylland:* Kollund (July 1953); Estrup, Vingsted, and Stilling (Aug. 1953); Mols Laboratory and Kalø (July 1954). *The Islands:* Sønderskov, Als; Skovbo and Tangeskov, Fyn; Faarevejle, Langeland; and Engestofte, Lolland (July 1953); Almindingen, Bornholm (July 1954).

D. deflexa is not known from Jylland north of Kalø nor from Sjælland. The lack of the species among the flies collected from Jylland may be due to the fact that the weather was very unfavourable when the collecting was done. It is more difficult to understand why this species was not collected from Allindelille on Sjælland where 1204 specimens of *Drosophila* were collected in September 1953 and 3117 specimens were collected in June 1954. Taking into account the records from Fyn, Langeland, Lolland, and Bogø it is very unlikely that *D. deflexa* should not occur on Sjælland.

Distribution: Europe from Northern Spain (Hadorn *et al.* 1952) to Scotland and Eire (Basden 1952), Poland and Hungaria (Duda 1935).

Biological Notes: This species has been caught

in Denmark most often in woods but it has also been found in small groups of very few trees whereas it seems to avoid human habitations. The relative population density is low in all types of habitats, reaching its minimum in "Woods" but the absolute population density in this type of habitats is probably not less than in the other two wild habitats where other species have less dense populations.

In the territory of the Mols Laboratory thirty *Drosophila* specimens were taken on a bleeding oak (*Quercus robur*) in July 1954. Twenty-eight of these were *D. deflexa* (14 ♀♀ + 14 ♂♂), the two remaining were a male *D. subobscura* and a female *D. tristis* respectively. The sap was highly fermented and there was a conspicuous white mass of yeast in the wound. *D. deflexa* then seems to be a sap feeder. Though very little is known about the biology of the species of the subgenus *Pholadoris* to which *D. deflexa* belongs, it is stated by Patterson & Stone (1952) that the type species *D. victoria* is a sap feeder too.

Near the above mentioned oak eighty-eight *Drosophila* specimens were trapped in the same time interval on ordinary banana bait. The composition of this sample was strikingly different from that of the sample caught at the sap. The trapped flies comprised only three specimens of *D. deflexa*. The dominating species was *D. phalerata* (52 specimens), followed by *D. subobscura* (19). It is evident that at least one of the two population samples is highly biased. It seems most probable to the author to assume that both samples are somewhat biased; it is at least difficult to exclude the possibility that the ordinary bait sample gives an underestimate of the population density of *D. deflexa*. Hadorn *et al.* (1952) have demonstrated that *D. deflexa* is attracted more efficiently by banana bait than by any other bait tried (apple, blackberry, and a mixture of various fruits naturally occur-

ring in the area). My observation indicates that *D. deflexa* may be more numerous than proved by samples trapped even on banana bait.

2. **Drosophila busckii** Coquillet 1901.

Complete descriptions have been published by Patterson (1943) in English and by Burla (1951) in German.

Occurrence in Denmark: 1) Lemche (1949) recorded this species from Copenhagen and the following provincial towns: Nykøbing, Holbæk, Hillerød, and Ringsted (all on Sjælland), Fredericia (Jylland), and Saxkøbing (Lolland). 2) The author's collection: *Jylland:* Kollund (July 1953). *The Islands:* Sønderskov, Als; and Engestofte, Lolland (July 1953).

Distribution: *D. busckii* is a very widely distributed, cosmopolitan species, recorded from all parts of the world. It has been found in all European countries recently investigated. The most northern records are from Scotland (Basden 1954), Norway, probably the southern part (Sturtevant 1921), and Finland (Hackman 1954).

Biological Notes: *D. busckii* is a synanthropous species found most abundantly in the neighbourhood of houses. At least in Northern Europe it seems to be mainly an indoor species (Basden 1954, Sobels *et al.* 1954). The few specimens collected by the author were all caught outdoors. The population on Als (July 1953) could be traced back to a pigsty. The two other catches were also taken in the neighbourhood of farms but it was not possible to locate the center of population density.

3. **Drosophila melanogaster** Meigen 1830.

New to Denmark.

Complete descriptions have been given by Patterson (1943) in English and by Burla (1951) in German.

Occurrence in Denmark: 1) Z. M. collection: Several specimens collected in Copenhagen and in the environs of this city in the first decade of this century

(Lundbeck). 2) Author's collection: *Jylland:* Ribe, Vingsted, Munkebjerg, Silkeborg, Hattenæs, Naaege, and Stilling (Aug. 1953); the Mols Laboratory, and Rold skov (July 1954). *The Islands:* Sønderskov, Als; Faarevejle and Aasø, Langeland; Engestofte, Lolland; Orenæs skov and Resle skov, Falster; Tystrup and Hørsholm, Sjælland (July 1953); Orehoved, Falster (July 1953, Febr. 1954); Allindelille, Sjælland (Sept. 1953, June 1954); several localities in the city of Copenhagen (June 1953 to June 1954).

Distribution: A cosmopolitan species known from all European countries recently investigated.

Biological Notes: This species is synanthropous. In Denmark it reaches its highest population densities indoors where favourable breeding conditions are available, and in gardens, orchards, etc. *D. melanogaster* was, nevertheless, caught in many woods at rather long distances from human habitations but then always in extremely low densities. It can be trapped indoors all the year round.

4. **Drosophila simulans** Sturtevant 1921.

New to Denmark.

Complete descriptions have been published by Patterson (1943) in English and by Burla (1951) in German.

Occurrence in Denmark: Author's collection: *Jylland:* A single female has been caught together with several specimens of *D. melanogaster* in August 1953 at Hattenæs in the neighbourhood of a house. *The Islands:* Three males have been been trapped together with 21 male *D. melanogaster* and 16 females which were a mixture of the two species in a small garden in the city of Copenhagen (June 1954). Some specimens were reared from decomposing bananas collected in the spring 1951 on a ship unloading its cargo of bananas from the Canary Islands in the harbour of Copenhagen. This may be re-

garded as a direct evidence for the suggestion often made that *D. simulans* is continually introduced into Northern Europe from the warmer parts of the world.

Distribution: Worldwide. The number of specimens caught in Europe is small though the species is recorded from Portugal and France (Hadorn *et al.* 1952), Switzerland (Burla 1951), the Netherlands (Sobels *et al.* 1954), and Great Britain (Basden 1952).

Biological Notes: As demonstrated by Patterson (1943) this species is more thermophilous than *D. melanogaster*. In agreement with this statement *D. simulans* occurs very sparsely outdoors in Northern Europe. Though it may be rather numerous in natural habitats in the southern parts of its distribution, *D. simulans* is exclusively synanthropous in the more northern ranges of its distribution. Basden (1954) caught 315 specimens in fruit stores in Edinburgh but only three specimens outdoors in a garden. The Dutch and the Danish specimens were also caught in gardens.

5. **Drosophila obscura** Fallén 1823.

Complete descriptions have been published by Pomini (1940) in Italian and by Burla (1951) in German.

Occurrence in Denmark: 1) Previous records: Zetterstedt (1847), no details of locality mentioned. The specimen kept in Z. M. 2) Z. M. collection: Copenhagen (1 ♀ Aug. 1904, 1 ♀ Aug. 1923, Lundbeck). 3) Author's collection: *Jylland:* Kollund, Brøns, and Hulknøse (July 1953); Stilling, Hattenæs, Silkeborg, Linnerup, Munkebjerg, Vingsted, Estrup, and Fanø (Aug. 1953); Tolne skov, Østerild plantage, Rold skov, and Kalø hestehave (July 1954); Mols Laboratory (May and July 1954). *The Islands:* Sønderskov, Als; Skovbo and Tangeskov, Fyn; Aasø and Faarevejle, Langeland; Engestofte, Lolland; and Resle skov, Falster (July 1953); Orenæs skov, Falster (July and Oct. 1953); Allindelille, Sjælland (Sept. 1953 and June

1954); Geels skov and Utterslev, Sj. (Apr. 1953); Charlottenlund skov, Sj. (April and May 1953); Frederiksberg, Copenhagen (Apr., May, June, and Sept. 1953, May and June 1954); Østerbro, Copenhagen (June 1953); Kongelunden, Amager (Apr. 1953); Almindingen, Bornholm (June 1954).

Distribution: Europe. Known from Sweden (Zetterstedt 1847); Finland (Hackman 1954); England, Scotland, Eire (Basden 1952, 1954; Collin 1952); Holland (Lever *et al.* 1951); Germany (Duda 1935; Herting 1955); Switzerland (Burla 1951); Austria (Mainx *et al.* 1953); France, Spain, Portugal (Hadorn *et al.* 1952); and Italy (Buzzati-Traverso 1941). Duda states that this species occurs also in North America; it has, however, been demonstrated by Frolowa *et al.* (1929) that the American "*D. obscura* Fall.", mentioned by Sturtevant (1921), is another species, namely *D. pseudoobscura* Frolowa.

Biological Notes: *D. obscura* is very common all over Denmark. It occurs most constantly in woods where it quite often is the dominant *Drosophila* species. However, it is not strictly limited to wild habitats but is frequently found in rather dense populations near human habitation. For example it was found in several localities in the city of Copenhagen.

Remarks on the non-occurrence of *D. bifasciata* Pomini in Denmark.

Drosophila bifasciata Pomini is morphologically very similar to *D. obscura* Fallén but according to the literature available at the initiation of the present work (Pomini 1940; Burla 1951) females of *D. bifasciata* should differ from those of *D. obscura* by lacking yellow spots on the tergites. The males differ from the males of *D. obscura* only in a few quantitative traits, for example by having on the average a somewhat greater number of teeth in the sex combs, but the ranges of variation given in the literature overlap considerably. Attention was therefore concentrated on the females but it soon became obvious that the yellow spots on the tergites of the *D. obscura* females were not so clearcut as appeared from the existing descriptions of this species. On the contrary, a con-

tinuous variation from very big spots to no spots at all was observed, a fact which has also been recognized by Herting (1954, personal communication) and Basden (1954). Twenty-four strains originating each from one *D. obscura*-like female without any trace of spots were then established. Already in the first generation females which unquestionably showed yellow spots appeared in all the cultures. Test crosses to a *D. obscura* strain established earlier yielded progenies which were normal both as regards number, viability, and morphology. *D. bifasciata* has then not been found in Denmark yet, but it was demonstrated that the lack of yellow spots on the tergites is unsufficient to distinguish it from *D. obscura*.

6. **Drosophila silvestris** Basden 1954.

New to Denmark.

Synonym: This species was recognized already by Burla (1951) who mentioned it under the preliminary name *obscura-X*.

A complete description has been given by Basden (1954).

Occurrence in Denmark: Author's collection: *Jylland:* Kollund (July 1953); Estrup, Vingsted, and Munkebjerg (Aug. 1953); Mols Laboratory, Rold skov, Tolne skov, and Østerild plantage (July 1954). *The Islands:* Fuglekøjen, Fanø (Aug. 1953); Orenæs, Falster; Engestofte, Lolland; Faarevejle, Langeland; Skovbo and Tangeskov, Fyn (July 1953); Allindelille, Sjælland; Almindingen, Bornholm (June 1954).

Distribution: Northern Europe. Demonstrated in Switzerland (Burla 1951), Great Britain (Basden 1952, 1954), the Netherlands (Sobels *et al.* 1954), and Northwestern Germany (Herting 1953, personal communication). The recorded population densities indicate an Atlantic distribution.

Biological Notes: *D. silvestris* has been caught by the author in woodlands only. The highest relative population density, which was only a little less than 3 %, was found inside woods. The density was much less on the edge of the woods and the species was never taken outside woods.

7. **Drosophila tristis** Fallén 1823.

Synonym: Duda (1935) has suggested that *D. spurca* Zett. 1847 is a synonym of *D. tristis* Fall. This has been confirmed by Frydenberg (1955).

Complete descriptions have been given by Pomini (1940) in Italian and by Burla (1951) in German.

Occurrence in Denmark: 1) Previous records: Zetterstedt (1847), no exact date nor locality was given. The specimen is kept in Z. M. as type of *spurca* Zett. 2) Author's collection: *Jylland:* Kollund (July 1953); Mols Laboratory (May and July 1954); Tolne skov (July 1954). *The Islands:* Sønderskov, Als; and Skovbo, Fyn (July 1953); Allindelille, Sjælland (June 1954).

Distribution: Europe. The most southern localities are Pavia, Italy (Pomini 1940) and Northern Spain (Hadorn *et al.* 1952), the most northern localities are Scotland (Basden 1954) and Upland, Sweden (Zetterstedt 1847).

Biological Notes: The few Danish specimens collected indicate a low population density which is in agreement with the statements of most authors. Sobels *et al.* (1954) have recently recorded a dense population in the Netherlands. All Danish specimens were caught in woods and groves.

8. **Drosophila ambigua** Pomini 1940.

New to Denmark.

Complete descriptions have been given by Pomini (1940) in Italian and by Burla (1951) in German.

Occurrence in Denmark: Author's collection: *The Islands*: Utterslev, Sjælland (Apr. 1953); Frederiksberg, Sjælland (June and Sept. 1953, Apr., May, and June 1954); Østerbro, Copenhagen (June 1953).

Distribution: Europe. Known from Italy (Pomini 1940); Switzerland (Burla 1951); Spain, Portugal, and France (Hadorn *et al.* 1952); Austria (Mainx *et al.* 1953); the Netherlands (Lever *et al.* 1951), and Great Britain (Basden 1952).

Biological Notes: In the author's collectings this species appeared only in Copenhagen and the near environs of this city and always in the close neighbourhood of houses. Thus *D. ambigua* may be regarded as a mainly domestic species in Denmark. According to Hadorn *et al. D. ambigua* is a typical wild species on the Iberian peninsula.

9. **Drosophila subobscura** Collin 1936.

New to Denmark.

Complete descriptions have been given by Pomini (1940) in Italian and by Burla (1951) in German.

Occurrence in Denmark: 1) The Z. M. collection: Several specimens collected by Lundbeck have been reared from gooseberries at Lyngby, Sjælland (Oct. 1923). 2) Author's collection: *Jylland*: Frederikshavn, Hulknøse, Brøns, and Kollund (July 1953); Stilling, Naaege, Hattenæs, Silkeborg, Linnerup, Munkebjerg, Vingsted, Estrup, and Ribe (Aug. 1953); Tolne skov, Østerild plantage, Rold skov, and Kalø hestehave (July 1954); Klosterhede plantage (Aug. 1954); Mols Laboratory (March, Apr., May, and July 1954). *The Islands*: Fanø; Skovbo and Tangeskov, Fyn; Faarevejle and Aasø, Langeland; Engestofte, Lolland; Orehoved, Resle skov, and Nørre Alslev skov, Falster; Lellinge and Tystrup, Sjælland (July 1953); Orenæs skov, Falster (July and Oct. 1953); Kongelunden, Amager; and Geels skov, Sjælland (Apr. 1953); Allindelille, Sjælland (Sept. 1953, June 1954); Liseleje, Sj. (Apr. 1954); Charlottenlund skov, Sj. (May and June 1953); Østerbro, Copenhagen (June 1953); Frederiksberg, Copenhagen (June and Sept. 1953, June 1954); Almindingen, Bornholm (June 1954).

Distribution: *D. subobscura* is known from all European countries recently investigated, and it has been demonstrated also in Libanon (Pipkin 1952), Syria, and on the coasts of the Black and Caspian Seas (Buzzati-Traverso 1955).

Biological Notes: *D. subobscura* is the most common *Drosophila* species in Denmark, just as it seems to be in most European countries. It was taken in all out-of-door habitats, the population density being high almost everywhere. Accordingly it is the species which most often dominates the populations. It was caught only once indoors, namely in a greenhouse.

10. **Drosophila transversa** Fallén 1823.

A complete description has been given by Burla (1951).

Occurrence in Denmark: 1) Previous records: Zetterstedt (1847), no date nor exact locality is mentioned. The specimens kept in Z. M. labelled Frederiksberg, Stæger. 2) Z. M. collection: Boserup, Sjælland (Jan. 1916 in *Morchella esculenta*, Lundbeck). 3) Author's collection: *Jylland*: Tolne skov, Østerild plantage, Rold skov, Klosterhede plantage, and Kalø hestehave (July 1954); Mols Laboratory (Apr., May, and July 1954); Hattenæs, Linnerup, and Vingsted (Aug. 1953); Kollund (July 1953). *The Islands*: Tangeskov, Fyn; and Engestofte, Lolland (July 1953); Allindelille, Sjælland (Sept. 1953 and June 1954); Rørvig, Sj. (Sept. 1953, reared from an undetermined toadstool); Skuldelev, Sj. (June 1954, reared from a *Polyporus* species); Frederiksberg, Sj. (June 1953, June 1954); Almindingen, Bornholm (June 1954).

Distribution: This species is widely distributed over the Holarctic region. In Europe it has recently been recorded from Northern Spain, France (Hadorn *et al.* 1952), the Netherlands (Lever *et al.* 1951), Switzerland (Burla 1951), Great Britain (Basden 1952), and Finland (Hackman 1954). The species has been recorded from Japan (Kikkawa *et al.* 1938) and from China (Tan *et al.* 1949) and it occurs also in Eastern and Middle U. S. A. For all the author knows the conspecificity between the Nearctic and the Palearctic *D. transversa* has never been proved experimentally.

Biological Notes: *D. transversa* is a typical fungus-feeder. The population density has been found to be rather low all over Denmark. The species seems less strictly confined to woods and forests than the following species and than the species of the *Obscura* group. *D. transversa* seems to prefer more open localities such as moors with a few scattered trees and bushes.

11. **Drosophila phalerata** Meigen 1830.

A complete description has been published by Burla (1951).

Occurrence in Denmark: 1) Previous records: Zetterstedt (1847) lists the species without exact locality as variety of *D. transversa*. The specimens are kept in Z. M., coll. Stæger. 2) Author's collection: *Jylland*: Kollund skov, Brøns, and Overlade (July 1953); Ribe, Estrup, Vingsted, Munkebjerg, Silkeborg, Hattenæs, and Stilling (Aug. 1953); Mols Laboratory (May and July 1954); Kalø hestehave, Rold skov, Tolne skov, and Østerild plantage (July 1954); Klosterhede plantage (Aug. 1954). *The Islands*: Fuglekøjen, Fanø (Aug. 1953); Orenæs skov, Falster (July and Oct. 1953); Resle skov, Falster; Engestofte, Lolland; Faarevejle, and Aasø, Langeland; Tangeskov, and Skovbo, Fyn; Sønderskov, Als; and Lellinge, Sjælland (July 1953); Allindelille, Sj. (Sept. 1953 and June 1954); Hareskov, Sj. (Sept. 1953, reared from an undetermined toadstool); Skuldelev mose, Sj. (June 1954, reared from a *Polyporus* species); Almindingen, Bornholm (June 1954).

Distribution: *D. phalerata* is widely distributed throughout Europe where it has been found in Spain, Portugal, France (Hadorn *et al.* 1952), Switzerland (Burla 1951), Germany (Duda 1935, Herting 1954, pers. comm.), Russia (Balkaschina *et al.* 1935), the Netherlands (Lever *et al.* 1951), Great Britain (Basden 1952), and Finland (Hackman 1954).

Biological Notes: *D. phalerata* which is regarded as a fungus-feeder is very common all over Denmark.

It occurs most constantly and with highest density inside woods where it quite often is the dominant *Drosophila* species. It seems to avoid open areas and the neighbourhood of human habitations more strongly than *D. transversa* does.

12. **Drosophila limbata** v. Roser 1840.

New to Denmark.

A complete description has been given by Burla (1951).

Occurrence in Denmark: Author's collection: *The Islands*: Allindelille, Sjælland (Sept. 1954, 1 ♀ + 3 ♂♂); Orenæs skov, Falster (Oct. 1953, 1 ♂).

Distribution: *D. limbata* is widely distributed over the European Continent. Duda (1935) records it from Germany, France, Hungary, Austria, and Russia. More recently this species has been caught in Switzerland (Burla 1951), the Netherlands (Lever *et al.* 1951), Northern Spain, France (Hadorn *et al.* 1952), Finland (Hackman 1954), and Western Germany (Herting 1954, pers. comm.).

Biological Notes: *D. limbata* seems everywhere to have very low population densities. Duda designates it "much more seldom than *D. transversa*" and the more recent authors agree to this statement. The five specimens caught by the author were trapped in mixed woods on a bait consisting partly of bananas and partly of fungi naturally occurring in the localities.

13. **Drosophila littoralis** Meigen 1830.

New to Denmark.

Complete descriptions have been given by Burla (1951) in German and by Patterson (1952) in English.

Occurrence in Denmark: Author's collection: *The Islands*: Sønderskov, Als; Tangeskov, Fyn; Engestofte, Lolland; Orenæs skov, Falster; and Tystrup, Sjælland (July 1953); Allindelille, Sj. (Sept. 1953 and June 1954).

Distribution: Widespread in Europe. Recorded

from Portugal, Spain (Hadorn *et al.* 1952), France (Duda 1935, Hadorn *et al.* 1952), Northern Italy (Patterson 1952), Austria (Patterson 1952), Switzerland (Burla 1951), Eastern and Western Germany (Duda 1935, Herting 1954, pers. comm.), the Netherlands (Sobels *et al.* 1954), Scotland (Basden 1954), and Finland (Hackman 1954). A closely related form, *D. imeretensis* Sokolov has been recorded from Georgian SSR by Sokolov (1948). *D. imeretensis* may well be only a geographical strain of *D. littoralis* (Patterson 1952).

Biological Notes: The connection between *D. littoralis* and fresh waters mentioned by Burla (1951) has been confirmed by the author's collectings. The specimens recorded above from Tangeskov and Tystrup were trapped on open lands quite near small ponds surrounded by a few bushes and low trees. The specimens from Engestofte were caught in a forest on the shore of a lake and the Allindelille specimens were trapped mainly around the bogs of the wood. An attempt to find the larvae in decaying wood, especially in *Salix*, in Allindelille proved unsuccessful.

14. **Drosophila testacea** v. Roser 1840.

New to Denmark.

Complete description has been given by Burla (1951).

Occurrence in Denmark: 1) Z. M. collection: Ermelunden, Sjælland (1 ♂, Sept. 1914, Lundbeck). 2) Author's collection: *Jylland*: Munkebjerg (Aug. 1953); Tolne skov, Østerild plantage, and Rold skov (July 1954). *The Islands*: Skovbo, Fyn (July 1953); Allindelille, Sjælland (Sept. 1953 and June 1954); Charlottenlund skov, Sj.; and Frederiksberg, Sj. (June 1953); Almindingen, Bornholm (June 1954).

Distribution: Europe and Eastern North America. European records from Northern Spain (Hadorn *et al.* 1952), France (Duda 1935, Hadorn *et al.* 1952), the Nether-

lands (Sobels *et al.* 1954), Germany (Duda 1935, Herting 1954, pers. comm.), Finland (Hackman 1954), and England (Basden 1952, Collin 1952).

Biological Notes: As found most commonly in other European countries, this species seems to be rather infrequent also in Denmark.

15. **Drosophila funebris** Fabricius 1787.

Complete descriptions have been given by Burla (1951) in German and by Patterson (1943) in English.

Occurrence in Denmark: 1) Previous records: Zetterstedt (1847), the specimens kept in Z. M. labelled Frederiksberg, Stæger, and Lemche (1949). 2) Z. M. collection: A great number of specimens from Copenhagen and the environs of this city. 3) Author's collection: *Jylland*: Hulknøse, Jerslev, Brøndum, Brøns, and Kollund (July 1953); Stilling, Hattenæs, Silkeborg, Linnerup, Munkebjerg, and Ribe (Aug. 1953); Tolne skov, and Rold skov (July 1954). *The Islands*: Sønderskov, Als; Skovbo, Fyn; Aasø, Langeland; and Engestofte storskov, Lolland (July 1953); Allindelille, Sjælland (Sept. 1953 and June 1954); Almindingen, Bornholm (June 1954). Besides more than 400 specimens collected mainly indoors in several localities in the city of Copenhagen.

Distribution: Worldwide. Recorded by all recent investigators in Europe. The only *Drosophila* species so far known from Greenland (Vibe 1950) and Iceland (Nielsen, Ringdahl & Tuxen 1954).

Biological Notes: This species is typically a domestic species in Denmark. Though only about 10 % of the total number of *Drosophila* specimens collected by the author were caught in Copenhagen, more than 75 % of the *D. funebris* specimens collected were taken in this city. However, as demonstrated by the above records the species can very often be met in wild habitats also but there it occurs always with an extremely low density.

16. **Drosophila hydei** Sturtevant 1921.

New to Denmark.

Synonyms: According to Wharton (1944) *Drosophila setosa* Dobzhansky & Pavan 1943 is identical with *D. hydei*. *D. repleta* as described by Duda (1924, 1935) comprises both *D. repleta* and *D. hydei*.

Complete descriptions have been given by Patterson (1943) in English and by Burla (1951) in German.

Occurrence in Denmark: Author's collection: *Jylland*: Østerild plantage, and Rold skov (July 1954); Linnerup, Silkeborg, and Munkebjerg (Aug. 1953); Kollund (July 1953). *The Islands*: Sønderskov, Als; Tangeskov, Fyn; Faarevejle, Langeland; and Orehoved, Falster (July 1953); Frederiksberg, Sjælland (June 1953).

Distribution: Cosmopolitan. This species has often been mixed up with *D. repleta* by European authors and the records are, therefore, frequently unreliable. So far as is known to the author *D. hydei* has been demonstrated with certainty in the following European countries: Italy (Stone 1942), France (Hadorn *et al.* 1952), Switzerland (Burla 1951), Western Germany (Herting 1954, pers. comm,), the Netherlands (Lever *et al.* 1951), England (Basden 1952), and Scotland (Basden 1954).

Biological Notes: *D. hydei* is a domestic species all over the world. In the author's collectings the species was accordingly met frequently in the neighbourhood of houses. The few records farer away from houses, as for example in Rold skov and Østerild plantage, were all due to a single individual.

17. **Drosophila immigrans** Sturtevant 1921.

New to Denmark.

Complete descriptions have been given by Patterson (1943) in English and by Burla (1951) in German.

Occurrence in Denmark: Author's collection: *Jylland*: Brøns (July 1953); Ribe, Estrup, Vingsted, Munkebjerg, and Stilling (Aug. 1953); Mols Laboratory, Kalø

hestehave, and Rold skov (July 1954). *The Islands*: Skovbo, Fyn; and Sønderskov, Als (July 1953); Allindelille, Sjælland (Sept. 1953 and June 1954); Hareskov, Sj. (Sept. 1953); Frederiksberg, Sj. (June 1954); Almindingen, Bornholm (June 1954).

Distribution: Cosmopolitan. In his investigation of the Swiss fauna Burla (1951) found only very few specimens of *D. immigrans* north of the Alps. He considered these few individuals as recently introduced from the south and unlikely to establish themselves. So he regarded *D. immigrans* as restricted to the Mediterranean region in Europe. It was, therefore, somewhat surprising to find so many as 584 specimens of this species in Denmark, where it was trapped mainly in wild habitats. In Kalø hestehave *D. immigrans* was actually the dominating species in July 1954 and it reached a considerable population density also in Allindelille in June the same year. Herting (1955) has found *D. immigrans* dominant in some woods in Westfalen in spring time. There is then no reason anymore to regard *D. immigrans* as restricted to Southern Europe.

Biological Notes: *D. immigrans* is commonly regarded as a domestic species. It seems, however, as though it is able to establish rather stable and sometimes very dense populations in wild habitats in Denmark.

18. **Drosophila confusa** Stæger 1844.

Synonyms: An examination by the author has shown that *D. vibrissina* Duda 1924 and *D. grischuna* Burla 1950 are invalid synonyms of *D. confusa*. Details on this problem are to be published shortly.

Occurrence in Denmark: 1) The type series in coll. Stæger is from Denmark but no further locality is given on the labels. 2) Author's collection: The species has not been caught in *Jylland*. *The Islands*: Charlottenlund skov, Sjælland (April and May 1953); Allindelille, Sj. (June 1954); Sønderskov, Als (July 1953).

Distribution: *D. confusa* is known from Sweden (Zetterstedt 1847), Austria (Schiner 1864), Russia (Balkaschina *et al.* 1935, recorded as *D. vibrissina*), Spain, France (Hadorn *et al.* 1952, recorded as *D. grischuna*), Switzerland (Burla 1950, the description of *D. grischuna*). Duda (1935) using the synonym *D. vibrissina* recorded the species from Hungary and Eastern Germany. By the courtesy of Prof. W. Hennig, Deutsches Entomologisches Institut, Berlin, the author has been able to examine some of Duda's Hungarian specimens from the type series of *D. vibrissina*. Mr. E. B. Basden, Edinburgh, has kindly informed the author that the species occurs in England and by the courtesy of Mr. R. L. Coe, British Museum, the author has had the opportunity of examining several specimens from England. The species then appears to be widely distributed throughout Europe.

Biological Notes: The Danish specimens were caught exclusively in woods. Probably the species is confined to this type of habitat. *D. confusa* is most probably a fungus-feeder as several specimens in the collection of British Museum had been reared from toadstools.

19. **Drosophila picta** Zetterstedt 1847.

Synonyms: According to Frydenberg (1955) *D. macularis* Villeneuve 1921 is an invalid synonym of this species.

Complete descriptions have been given by Duda (1935, under the name *D. macularis*) in German and by Frydenberg (1955) in English.

Occurrence in Denmark: The Z. M. collection: The type specimen which Zetterstedt loaned from Stæger for the purpose of describing still remains in coll. Stæger. The type is without any doubt from Denmark, probably from Sjælland, but no exact locality is given either by Zetterstedt in the description or by Stæger on the label. Three undetermined specimens reared by Lundbeck from burreeds (*Sparganium*) collected on the island Bjørnø in August 1923 turned out to be *D. picta* Zett. Not a single spe-

cimen of this species was caught by the present author.

Distribution: Villeneuve (1921) recorded the species from two localities in France: Blain (Loire inférieure) and Rambouillet. According to Duda (1935) three specimens have been taken by Oldenberg in the environs of Berlin, Germany, and Duda himself has caught the species in Silesia (now Slask, Poland). Recently *D. picta* has been recorded from four localities in the Netherlands (Sobels *et al.* 1954). The species is then widely distributed in Northern Europe though it apparently always occurs with small population densities.

Biological Notes: Both Duda and Sobels *et al.* point out that the *D. picta* caught by them were all taken in localities where reed *(Phragmites communis)* was the dominant plant species. It is an equally striking fact that the species has been reared twice from bur-reed *(Sparganium)*. These two plant species undoubtedly indicate the sort of localities where to look for this rare *Drosophila* species.

20. **Drosophila fenestrarum** Fallén 1823.

Complete descriptions have been published by Duda (1935) and Burla (1951) both in German but attention is called also to Collin's (1952) and Basden's (1954) papers which mention the characters in which *D. fenestrarum* differs from the two closely related species *D. forcipata* Collin and *D. acuminata* Collin.

Occurrence in Denmark: 1) Previous Danish records: Stæger (1844) and Zetterstedt (1847); the specimens kept in Z. M. 2) The Z. M. collection: *The Islands*: Geels skov, Sjælland (May 1909, Lundbeck); Ermelunden, Sj. (June 1906, May 1918, Oct. 1923, and May 1924, Lundbeck); Nysted, Lolland (July 1923, Lundbeck). 3) Author's collection: *Jylland*: Mols Laboratory (March 1954). *The Islands*: Fanø (Aug. 1953, 1 ♀); Orenæs, Falster (July 1953, 1 ♂); Allindelille, Sjælland (Sept. 1953, 1 ♂).

Distribution: Portugal (Hadorn *et al.* 1952), Switzerland (Burla 1951), Germany (Duda 1935, Herting, pers.

comm. 1954), the Netherlands (Sobels *et al.* 1954), England (Collin 1952), Scotland (Basden 1954), Sweden (Fallén 1823, Zetterstedt 1847), and Finland (Hackman 1954).

Biological Notes: The small number collected by the author indicates rather the inefficiency of the banana bait method for this species than a low population density. It is the author's impression that this species has a preference for habitats with less dense vegetation than that of woods.

21. **Drosophila forcipata** Collin 1952.

New to Denmark.

Complete description has been given by Collin (1952).

Occurrence in Denmark: 1) The Z. M. collection: Without locality among the specimens of *D. fenestrarum* in coll. Stæger. 2) Author's collection: Only a single individual (♂) of this species has been recognized among the *Fenestrarum* group specimens collected. It was caught at "Gyveldal" in the territory of the Mols Laboratory April 1, 1954. The separation from *D. fenestrarum* was based on the structure of the genitalia.

Distribution: This species which has only recently been separated from *D. fenestrarum* is recorded from Great Britain by Collin (1952). It is quite common in Westfalen, Germany (Herting 1955).

Comparison of the Danish Fauna with the Faunas of Other European Countries.

The Danish *Drosophila* species have been systematically arranged in table 5 in accordance with the modern taxonomy of the genus initiated by Sturtevant (1942). It appears from the table that four of the existing nine subgenera of the genus occur in Denmark. To this may be added the *Fenestrarum* group which undoubtedly constitutes a new subgenus.

In Denmark as elsewhere more species belong to the subgenus *Drosophila* than to any other subgenus. There are ten species of the subgenus *Drosophila* in Denmark, eight of these belong to known species groups but *D. confusa* and *D. picta* for the time being remain unassigned to a species group. The subgenus *Sophophora* has in Denmark two species groups, the richest of which is the *Obscura* group that is represented by five species. The *Melanogaster* group is represented by two cosmopolitan species only. The subgenera *Pholadoris* and *Dorsilopha* have one Danish species each.

Disregarding the domestic species *D. busckii, D. melanogaster, D. simulans, D. funebris, D. hydei,* and *D. immigrans,* which are all cosmopolitan, the Danish fauna is characterized by the dominance, both in number of species and in number of specimens, by the *Obscura* and the *Quinaria* groups. Another zoogeographically important trait of the fauna is the presence of two species of the *Fenestrarum* group which is unknown outside Europe. Of minor interest in the fauna are the subgenus *Pholadoris* and the *Virilis* and *Testacea* groups and the unassigned species *D. confusa* and *D. picta.*

Patterson and Stone (1952) estimated a total of 89 known species of *Drosophila* for the Palearctic region. This is a revision of the estimate of 92 species by Patterson and Wheeler (1949) who published a complete list of the known species. The *Drosophila* fauna of the Palearctic region is known mainly from investigations in Europe and in Eastern Asia (Japan and China). The fauna in between these two parts of the region is almost unknown. Europe and Eastern Asia have very few indigenous species in common. Europe is dominated by the species of the *Obscura* and the *Quinaria* groups which are very rare in Eastern Asia. But Eastern Asia is dominated by many indigenous species of the *Melanogaster* and the *Immigrans* groups which in Europe are repre-

sented only by domestic and cosmopolitan species. Furthermore the European fauna differs from that of Eastern Asia by the occurrence of the subgenus *Pholadoris,* of the *Fenestrarum* group, and of the species *D. confusa* and *D picta.* Eastern Asia on the other hand has species of the *Robusta* and the *Bizonata* groups which do not occur in Europe at all.

Due to this clear difference in the composition of species in the two known parts of the Palearctic region, it seems practical to treat the two faunas separately, at least until more knowledge of the fauna of the central parts of the region is available.

In the following we shall therefore concentrate on the European fauna only in order to place the Danish fauna on a proper background. Patterson and Wheeler's list of the European species contains many names which are regarded as synonyms by European dipterists. And since their list was published new species have been added to the fauna and other synonyms have been revealed. A better estimate of the total number of European species of *Drosophila* can be obtained by starting with Duda's valuable monograph (1935) and correcting its records in accordance with later literature. Table 6 shows this revision from which it appears that a total of 43 species of *Drosophila* is known from Europe. Seven of these species have been recorded by Duda only (some of Duda's identifications of Finnish species have been confirmed by Hackman 1954).

Table 7 lists the remaining 36 species and shows their occurrence in the eight European countries recently investigated. The table also shows the total numbers of species known from these countries. These numbers vary from sixteen in Portugal to twenty-nine in Switzerland. The differences are due partly to real differences in the number of species in these countries and partly to differences in collecting activities. The latter plays a greater

rôle with the domestic species and with accidentally introduced species. This is because certain investigators (for example in France, Spain, and Portugal) have concentrated their collecting activity only on natural habitats. But others (for example in Scotland and in the Netherlands) have also collected in localities (such as fruit-stores near wharves) where rare domestic species and accidentally introduced foreign species are apt to be found. If we therefore from the numbers given in table 7 subtract a) the six common domestic species, *D. melanogaster, D. funebris, D. busckii, D. immigrans, D. simulans,* and *D. hydei* (which all occur in Denmark), b) the domestic *D. repleta* which in Europe is restricted to the southern parts, and c) the three accidentally introduced species, *D. buzzatii, D. ananassae,* and *D. polychaeta,* we are left with the numbers of indigenous species given in table 8.

It can be seen from this table that a total of twenty-six indigenous species of *Drosophila* is known from the whole of Europe. These species are marked by an asterisk in table 7.

As regards the number of species in each country there can be little doubt that the numbers given for Portugal, Spain, and France are less complete than those given for the other five countries in the table. This is a consequence of the fact that the collectings in these three countries were made in one month only and that fewer flies were collected than in the other countries.

The numbers of species in the five other countries agree well with the common experience from other parts of the world that the number of species decreases with increasing latitude. The Danish fauna occupies an intermediary position between the richer German and Dutch faunas (18 and 19 species respectively) and the poorer Scotch fauna (12 species), suggesting that the number of species found in Denmark is a reliable estimate. Future investigations will probably only reveal a few more indigenous species in Denmark.

Acknowledgements.

The following colleagues have in different ways given the author valuable advise and assistance: Mr. E. B. Basden, of the Institute of Animal Genetics, Edinburgh; Dr. Hans Burla, Mr. F. Finsinger, Prof. Dr. E. Hadorn, and Dr. E. Stumm-Zollinger, all the University of Zürich, Switzerland; Dr. B. Herting, of Münster University, Westf., Germany; Prof. Dr. J. Lever, of Amsterdam University, Holland; Mr. Bent Christensen, Mr. P. Eriksen, Mr. E. Nøstvik, Prof. Dr. R. Spärck, Dr. S. L. Tuxen, and Prof. Dr. Mogens Westergaard, all of the University of Copenhagen; Dr. H. M. Thamdrup and Dr. C. Overgaard Nielsen, of Aarhus University. It is a pleasure to express the most sincere appreciation to all these persons without whose help this work would not have been possible. A/S "Kirkebye's Bananer", Copenhagen, has kindly supplied the author with bananas without charge and the author owes much to the helpful cooperation of Mr. Uldahl of this company. Parts of the manuscript were prepared in the "Departamento de Biologia Geral", University of São Paulo, Brazil, while the author held a fellowship from this university, supplemented with a Rockefeller travelling grant. Dr. L. C. Birch, of Sydney University, Australia, has kindly checked the English of the manuscript.

Table 1. The *Drosophila* Species Hitherto Recorded From Denmark.

Recorded as:	Recorded by:	Present name:
1. *D. confusa* Stæger 1844	Stæger 1844 Zetterstedt 1847	*D. confusa* Stæger
2. *D. fenestrarum* Fallén 1823	Stæger 1844 Zetterstedt 1847	*D. fenestrarum* Fallén
3. *D. obscura* Fallén 1823	Zetterstedt 1847	*D. obcura* Fallén s. str.
4. *D. spurca* Zetterstedt 1847	Zetterstedt 1847	*D. tristis* Fallén
5. *D. transversa* Fallén 1823	Zetterstedt 1847	*D. transversa* Fallén
6. *D. transversa* Fallén (= *phalerata* Meigen 1830)	Zetterstedt 1847	*D. phalerata* Meigen
7. *D. funebris* Fabricius 1787	Zetterstedt 1847 Lemche 1949	*D. funebris* Fabricius
8. *D. picta* Zetterstedt 1847	Zetterstedt 1847 Frydenberg 1955	*D. picta* Zettersted
9. *D. busckii* Coquillet 1901	Lemche 1949	*D. busckii* Coquillet
10. *D. graminum* Fallén 1823	Zetterstedt 1847	*Scaptomyza graminum* Fallén
11. *D. flava* Fallén 1823	Zetterstedt 1847	*Parascaptomyza disticha* Duda ?

Table 2. The Numbers of *Drosophila* Collected from Denmark April 1953 to August 1954.

	♀♀	♂♂	Total		♀♀	♂♂	Total
1. *D. deflexa**	50	54	104	11. *D. phalerata*	1142	2086	3228
2. *D. busckii*	6	7	13	12. *D. limbata**	1	4	5
3. *D. melanogaster*	548	520	1068	13. *D. littoralis**	36	35	71
4. *D. simulans**	1	3	4	14. *D. testacea**	6	10	16
mel. and *sim.*	16	—	16	15. *D. funebris*	271	279	550
5. *D. obscura*	840	1204	2044	16. *D. hydei**	11	9	20
6. *D. silvestris**	132	162	294	17. *D. immigrans**	318	266	584
7. *D. tristis*	7	9	16	18. *D. confusa*	7	14	21
8. *D. ambigua**	130	204	334	19. *D. picta*	0	0	0
9. *D. subobscura**	1923	5447	7370	20. *D. fenestrarum*	17	27	44
10. *D. transversa*	61	58	119	21. *D. forcipata**	0	1	1
*: New to Denmark.				Total:	5523	10399	15922

Table 3. The Relative Population Densities in the Five Types of Habitats.

Species	Woods	Edge of Woods	Tree-Groups	Domestic Habitats Out-of-Doors	Indoor Habitats
D. deflexa	0,4	0,9	0,9	—	—
D. busckii	0,0	0,2	—	0,2	—
D. melanogaster	0,2	1,2	6,4	34,2	25,5
D. simulans	—	0,0	—	0,2	—
D. obscura	14,5	11,4	2,0	18,7	—
D. silvestris	2,8	1,3	0,1	—	—
D. tristis	0,1	0,1	0,1	—	—
D. ambigua	—	—	—	17,8	—
D. subobscura	50,5	56,0	57,3	22,3	3,8
D. transversa	0,4	0,6	5,8	0,2	—
D. phalerata	28,0	16,0	19,4	0,2	—
D. limbata	0,1	—	—	—	—
D. littoralis	0,3	1,0	0,1	0,5	—
D. testacea	0,2	0,0	—	0,1	—
D. funebris	0,4	0,5	0,8	5,2	70,6
D. hydei	0,1	0,1	0,8	0,2	—
D. immigrans	2,0	10,4	1,2	0,5	0,2
D. confusa	0,2	0,2	—	—	—
D. picta	—	—	—	—	—
D. fenestrarum	0,0	0,0	4,8	—	—
D. forcipata	—	—	0,1	—	—
Total number of specimens collected in the habitat	8583	3751	846	1877	635

0,0 means that the species has been caught in the habitat but that it occurred with a density less than 0,05 %.

— means that the species has not been caught in the habitat at all.

Table 4. The Percentages-Occurrence in the Five Types of Habitats.

Species	Woods	Edge of Woods	Tree-Groups	Domestic Habitats Out-of-Doors	Indoor Habitats
D. deflexa	29	23	15	—	—
D. busckii	7	10	—	5	—
D. melanogaster	25	43	23	80	55
D. simulans	—	3	—	5	—
D. obscura	89	83	38	65	—
D. silvestris	57	27	8	—	—
D. tristis	18	10	8	—	—
D. ambigua	—	—	—	60	—
D. subobscura	93	97	100	75	9
D. transversa	39	37	77	10	—
D. phalerata	86	63	38	5	—
D. limbata	7	—	—	—	—
D. littoralis	25	10	8	5	—
D. testacea	36	3	—	5	—
D. funebris	43	33	8	70	55
D. hydei	14	10	15	15	—
D. immigrans	39	27	23	15	9
D. confusa	11	13	—	—	—
D. picta	—	—	—	—	—
D. fenestrarum	7	3	23	—	—
D. forcipata	—	—	8	—	—
Total number of localities of each ecological type	28	30	13	20	11

Table 5. The Twenty-One Danish *Drosophila* Species Systematically Arranged.

Subgenus	Species Group	Species
Pholadoris Sturtevant 1942		*D. deflexa* Duda 1924
Dorsilopha Sturtevant 1942		*D. busckii* Coquillet 1901
Sophophora Sturtevant 1939.	*Melanogaster* group.	*D. melanogaster* Meigen 1830
		D. simulans Sturtevant 1919
	Obscura group	*D. obscura* Fallén 1823
		D. silvestris Basden 1954
		D. tristis Fallén 1823
		D. ambigua Pomini 1940
		D. subobscura Collin 1936

(**Table 5** continued)

Drosophila		
Sturtevant 1939...	*Quinaria* group	*D. transversa* Fallén 1823
		D. phalerata Meigen 1830
		D. limbata v. Roser 1840
	Virilis group	*D. littoralis* Meigen 1860
	Testacea group	*D. testacea* v. Roser 1840
	Funebris group	*D. funebris* Fabricius 1787
	Repleta group	*D. hydei* Sturtevant 1921
	Immigrans group ...	*D. immigrans* Sturtevant 1921
	Unassigned species..	*D. confusa* Stæger 1844
		D. picta Zetterstedt 1847
Unassigned group	*Fenestrarum* group..	*D. fenestrarum* Fallén 1823
		D. forcipata Collin 1952

Table 6. The Number of *Drosophila* Species Known from Europe.

Duda (1935) recorded		28
to this has been added		
by Collin (1936).....	*D. subobscura* n. sp.....	1
by Pomini (1940)	*D. tristis* Fall.	
	D. ambigua n. sp.	
	D. bifasciata n. sp.....	3
by Buzzati-Traverso (1948)..	*D. buzzatii* Wheeler.....	1
by Burla (1948)	*D. hydei* Sturtevant	
	D. alpina n. sp.	
	D. simulans Sturtevant	
	D. helvetica n. sp.....	4
by Burla & Gloor (1952)....	*D. tsigana* n. sp.....	1
by Collin (1952).....	*D. forcipata* n. sp.	
	D. acuminata n. sp.....	2
by Sobels *et al.* (1954).....	*D. polychaeta* Patterson & Wheeler.	1
by Basden (1954).....	*D. ananassae* Doleschall	
	D. silvestris n. sp.....	2
Total number of European *Drosophila* species		43

Table 7. List of the Thirty-Six Species of *Drosophila* Recently Found in Europe. Their Occurrence in Eight Countries is Indicated.

	Portugal	Spain	France	Switzerland	Western Germany	The Netherlands	Scotland	Denmark
*D. rufifrons**	+	+	+	+	+	+	o	o
*D. deflexa**	o	+	+	+	+	+	+	+
D. busckii	+	+	+	+	+	+	+	+
D. melanogaster	+	+	+	+	+	+	+	+
D. simulans	+	+	+	+	o	+	+	+
D. ananassae	o	o	o	o	o	o	+	o
*D. obscura**	+	+	+	+	+	+	+	+
*D. tristis**	o	+	+	+	+	+	+	+
*D. bifasciata**	+	+	+	+	o	+	o	o
*D. silvestris**	o	o	o	+	+	+	+	+
*D. ambigua**	+	+	+	+	o	+	+	+
*D. subobscura**	+	+	+	+	+	+	+	+
*D. helvetica**	o	+	+	+	+	+	o	o
*D. alpina**	o	o	o	+	o	o	o	o
*D. transversa**	o	+	+	+	+	+	+	+
*D. phalerata**	+	+	+	+	+	+	+	+
*D. limbata**	o	+	+	+	+	+	o	+
*D. kuntzei**	o	+	+	+	+	+	o	o
*D. littoralis**	o	+	+	+	+	+	+	+
*D. unimaculata**	o	o	o	+	+	o	o	o
*D. testacea**	o	+	+	+	+	+	o	+
D. funebris	+	+	+	+	+	+	+	+
D. repleta	+	o	o	+	+	o	o	o
D. hydei	o	o	+	+	+	+	+	+
D. buzzatii	+	o	o	o	o	o	o	o
*D. tsigana**	+	o	+	o	o	o	o	o
D. polychaeta	o	o	o	o	o	+	+	o
D. immigrans	o	+	+	+	+	+	+	+
*D. picta**	o	o	o	o	o	+	o	+
*D. confusa**	o	+	+	+	o	o	o	+
*D. fenestrarum**	+	o	o	+	+	+	+	+
*D. forcipata**	o	o	o	o	+	o	+	+
*D. acuminata**	o	o	o	o	o	o	o	o
*D. histrio**	o	+	+	+	+	+	o	o
*D. cameraria**	+	+	+	+	+	+	+	o
*D. nigrosparsa**	o	o	o	+	o	o	o	o
Total number of species.	16	22	24	29	24	26	19	21

+: known from the country. o: not recorded from the country.
* Species marked by an asterisk are regarded indigenous in Europe.

Table 8. The Total Number of Indigenous *Drosophila* Species Known from Eight European Countries Recently Investigated.

Portugal	10
Spain	17
France	18
Switzerland	22
Germany	18
The Netherlands	19
Denmark	15
Scotland	12
Europe	26

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