II. NEW SPECIES IN THE QUINARIA GROUP OF THE SUBGENUS DROSOPHILA

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INTRODUCTION

Sturtevant (1939) has pointed out the desirability of constructing a scheme of classification of Drosophila species indicating their degree of genetic relationship and has divided the genus into three subgenera. It has, moreover, been recognized that within a subgenus there occur further subdivisions into "groups" of closely related species and subspecies. Several taxonomic and genetic papers emphasizing the species group have been published recently (see Sturtevant and Dobzhansky 1936; Stalker and Spencer 1939; Sturtevant 1940; Patterson, Stone, and Griffen 1940; and Patterson and Crow 1940). This procedure calls attention to those forms which may be expected to offer the most favorable material for studies in experimental evolution.

The group to which attention is here called contains the following described species: D. transversa Fallén, guttifera Walker, quinaria Loew, and deflecta Malloch. Descriptions of six new forms are added: D. munda, subquinaria, occidentalis, suboccidentalis, palustris, and subpalustris. As all of these species have been kept in culture through several generations, series of specimens of each have been sent to the United States National Museum, Washington, D.C. Each is designated as a paratype series with no one individual selected as the type.

It is not our purpose herewith to present a full account of the biology of the group. However, for the convenience of any who may care to work with these species we include a brief statement.

Ecologically the group may be designated as "fungus feeders." Sturtevant (1921) in his description of transversa states that, "this species breeds on various kinds of fleshy fungi, where it is usually to be found in great numbers, along with D. putrida Sturtevant." The author has made many collections of transversa from fleshy fungi. Patterson (written communication) reports that Mainland and Wheeler found both suboccidentalis and subquinaria feeding on a fungus of the genus Coprinus. While fungus feeding is typical other food habits have been evolved. Sturtevant (1921) indicates that quinaria is a fruit-feeder, and that it is frequently found about tomato plants and on windfall apples. A summary of our collection records in Ohio taken under a great variety of conditions, using yeasted banana bait, indicates a probable sex dimorphism in food preferences in this species. Between three and four times as many females as males were captured from banana traps. However, in collecting specimens directly from tomato and potato plants no such disparity of sexes appeared. Where quinaria were quite abundant in a large tomato patch relatively few were drawn to banana traps. This indicates more restricted feeding habits than in many other species.

Both palustris and subpalustris have been taken in considerable numbers in a large swamp area, the Killbuck Bottoms, Wayne County, Ohio. Wild larvae of the former were found feeding on decaying leaf stalks

of the broad-leaved arrowhead, Sagittaria latifolia, and adults were reared out from this material. Sturtevant (1921) reports that guttifera is a fungus feeder. It would seem probable that there has been an evolution from such a form as transversa, feeding on fleshy fungi in upland wooded areas, through quinaria in moister wooded areas to swamp inhabiting forms such as palustris, deflecta, and subpalustris living on decaying water plants. With gradual drying of swamp areas such a food habit might in turn evolve into leaf-mining.

Cytologically most of the species in this group have six chromosome pairs, a pair of long rods, four pairs of medium rods, and a pair of dots. However, variations occur such as the two pairs of V's, pair of rods, and pair of dots in quinaria and munda, the satellites on the X's of suboccidentalis and the V-shaped Y of subquinaria.

Occidentalis and suboccidentalis have been crossed. Palustris and subpalustris will also hybridize. In the latter case some strains are much more compatible than others in interspecies crosses, as evidenced by a large series of crosses attempted from stocks originating from different wild pairs. It seems probable that other interspecific crosses may be found in this group.

None of the species has been used extensively for genetic study. However, the author has found one or more mutant types in palustris, subpalustris, munda and transversa. In the latter a javelin-like recessive mutant is frequent in wild stocks from diverse localities, a case similar to light in repleta, net in immigrans, and bobbed in hydei.

Geographically transversa and quinaria occupy the eastern United States, and are replaced westwards by subquinaria, munda, occidentalis and suboccidentalis. Whether the transversa of the eastern United States is actually the same species as the European transversa described by Fallén can only be determined by comparison of living stocks. The swamp forms have only been recorded in the eastern United States, with guttifera much more abundant in the southeast than in the northeast. The food habits of all members of the group are probably such as to lead to the establishment of small discontinuous colonies or populations, a condition favorable to rapid evolution.

All of the species known in this group have been cultured in the laboratory except deflecta. The usual procedure for culturing Drosophila species may be followed with these precautions. Temperature should be kept at 23 C or below (possibly below 21 C for occidentalis and suboccidentalis). Food should have a rather soft texture as young larvae of these species do not burrow readily into firm food cakes on which many Drosophila thrive. Aging of parent flies with one or two transfers to fresh food is advantageous. As some of the species are "cataleptic" it is well to add paper to culture vessels to absorb excess moisture and to avoid miring of the flies in food medium.

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Description of New Species

Drosophila munda, sp. nov.

External characters of imagines.

♂. Arista with about 10 branches; 3 below terminal fork. Antennae dull yellowish brown, third joint darker. Front light brown. Middle orbital 1/3 anterior and 1/5 posterior. Second oral bristle 4/5 first. Palpus yellow, two or three prominent bristles. Carina flat, broad below, narrow above. Face light brown. Cheek light brown; greatest width about 1/5 greatest diameter of eye. Eye dull red; heavy yellow pile; large and round.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Sterno-index about .7. Anterior dorsocentrals about 3/4 posterior; no enlarged hairs anterior to dorsocentrals. Presutural bristles absent. Mesonotum light brown, shiny. Scutellum light brown, shiny. Legs light brown. Apical bristles on first and second tibiae; preapicals on all three. A few short, recurved hairs on median side of fore-tarsus.

Abdomen shiny yellow; a dark brown apical band on tergites 2, 3, and 4, interrupted in mid-dorsal line and reaching 2/3 distance to lateral margin of tergite; two large, dark brown triangular spots on tergite 5; tergite 6 dark brown.

Wings clear; posterior crossveins with narrow, black clouds. Costal index about 3.5; 4th vein index about 1.9; 5x index about 1.1; 4c index about .8. Two prominent bristles at apex of first costal section; third costal section with heavy bristles on its basal 3/5.

Length body 2.7 mm. (in live specimen); wings 2.7 mm.

♀. Last abdominal tergite lighter in color than in male.

Length body 3.0 mm.; wings 3.0 mm.

Internal characters of imagines.

Testes lemon yellow, spiral, with about 2 proximal heavy gyres to coil reversal point; from there 1 heavy and 9 or 10 thin outer or distal gyres.

Spermathecae elongated dome-shaped, chitinized. Ventral receptacle thin spiral of about 65 coils.

Other characteristics, relationship, and distribution.

Eggs.—About .45 mm. long; 3 filaments, 2 thin lateral and 1 slightly longer, thick median.

Puparia.—Light brown. Each anterior spiracle with about 12 branches; horn-index about 17.

Chromosomes.—Metaphase plate shows a pair of rods, 2 pairs of V's and a pair of dots.

Relationship.—Belongs to the quinaria group of the sub-genus Drosophila.

Distribution.—This species was first collected at Cave Creek, Chiricahua Mountains, Arizona, in September, 1940. Other collections have

been made in Tombstone Canyon, Mule Mountains, Arizona; top of Chiricahua Mountains, Arizona; Sonita, Arizona; Ramsey Canyon, Huachuca Mountains, Arizona; Mangus Canyon, near Silver City, New Mexico; Whitewater Creek, Black Mountains in Gila National Forest, New Mexico; Bonita River, Sacramento Mountains, New Mexico. Collections were made by G. B. Mainland, R. P. Wagner, and M. R. Wheeler, University of Texas.

Drosophila subquinaria, sp. nov.

External characters of imagines.

♂. Arista with about 9 branches; 2 or 3 below terminal fork. Antennae yellow. Front light brown. Middle orbital 1/3 anterior and 1/6 posterior. Second oral bristle 4/5 first. Palpus light yellow; two or three medium bristles. Carina flat to slightly sulcate, narrow above, broad below. Face yellow. Cheek yellow; greatest width about 1/4 greatest diameter of eye. Eye red; short yellow pile; medium size and round.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Sterno-index about .7. Anterior dorsocentrals about 3/4 posterior; no enlarged hairs anterior to dorsocentrals. Presutural bristles absent. Mesonotum light brown, shiny. Scutellum light brown, shiny. Legs yellow. Apical bristles on first and second tibiae; preapicals on all three. In all about 6 or 7 very short, recurved hairs on median side of foretarsus.

Abdomen yellow; tergites 2, 3, 4, 5 with 4 prominent black spots on each; 2 large black spots on tergite 6; spots tend to be triangular, but may be somewhat united; narrow, dark lateral margins on each tergite.

Wings clear; anterior and posterior crossveins with wide black clouds. Costal index about 2.9; 4th vein index about 1.75; 5x index about 1.0; 4c index about .91. Large upper and smaller lower bristle at apex of first costal section; third costal section with heavy bristles on its basal 3/5.

Length body 2.8 mm. (in live specimen); wings 2.8 mm.

♀. Abdominal tergites 2, 3, 4, 5, 6 with 4 prominent black spots on each; also narrow, dark lateral margins on each tergite; spots may be somewhat united. Length body 3.0 mm.; wings 3.0 mm.

Internal characters of imagines.

Testes bright lemon yellow, spiral, with 3 heavy inner gyres and about 8 thin outer gyres.

Spermathecae dome-shaped, chitinized. Ventral receptacle thin irregular spiral of about 25 coils.

Other characteristics, relationship, and distribution.

Eggs.—About .54 mm. long; 3 filaments, 2 thin lateral and 1 slightly longer and thicker median.

Puparia.—Light brown. Each anterior spiracle with 8 short branches which are not outwardly reflexed; horn-index about 20.

Chromosomes.—Metaphase plate shows a pair of long rods, the X's, 4 pairs of medium rods, and a pair of dots; in the male a V-shaped Y.

Relationship.—Belongs to the quinaria group of the subgenus Drosophila; nearly related to *D. quinaria.*

Distribution.—This species was first collected at Manitou Springs, Colorado, in July, 1941. Other collections have been made at Estes Park, Colorado; Grand Teton National Park, Wyoming; Iron Creek, Yellowstone, Wyoming; Madison River, Yellowstone, Wyoming; Big Cottonwood Canyon, Utah. Collections were made by G. B. Mainland and M. R. Wheeler, University of Texas.

Comparison with D. quinaria.

D. quinaria, with which this species might be confused, differs from D. subquinaria in having a slightly larger body size; eye pile longer; abdominal spots smaller and less likely to fuse together; eye slightly flattened along lower posterior margin; second oral ⅔ length of first; a double row of long recurved hairs on medial side of male fore-tarsus, at least 12 to 15 of these all longer than thickness of tarsus; clouds on apex of second, third, and fourth veins; and a larger egg.

Drosophila occidentalis, sp. nov.

External characters of imagines.

♂. Arista with about 9 branches; 3 below terminal fork. Antenna brown. Front brown. Middle orbital ⅓ anterior and ⅕ posterior. Second oral bristle ⅘ first. Palpus yellow; two prominent bristles. Carina rounded, broad below, narrow above. Face light brown. Cheek light brown; greatest width about ¼ greatest diameter of eye. Eye red; sparse yellow pile; round and medium size.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Sterno-index about .7. Anterior dorsocentrals about ¾ posterior; no enlarged hairs anterior to dorsocentrals. Presutural bristles absent. Mesonotum light brown, shiny. Scutellum light brown, shiny. Legs light brown. Apical bristles on first and second tibiae; preapicals on all three. About 9 short (not as long as tarsal thickness) recurved hairs on median side of fore-tarsus.

Abdomen shiny yellow; a dark brown apical band on tergites 2, 3, and 4, narrowly interrupted in mid-dorsal line and reaching ⅔ distance to lateral margin of tergite; tergites 5 and 6 almost solidly dark brown or black, with a very narrow light band in mid-dorsal line.

Wings clear; anterior and posterior crossveins with wide black clouds. Costal index about 3.0; 4th vein index about 1.8; 5x index about 1.2; 4c index about .9. Two prominent bristles at apex of first costal section; third costal section with heavy bristles on its basal ⅔.

Length body 2.8 mm. (in live specimen); wings 2.8 mm.

♀. Abdomen shiny yellow; a dark brown apical band on tergites 2, 3, 4, and 5 narrowly interrupted in mid-dorsal line and reaching ⅔ distance to lateral margin of tergite; band on tergite 5 tending to break into 2 parts on either side; dark brown area not interrupted in mid-dorsal line in tergites 6 and 7. Length body 3.0 mm.; wings 3.0 mm.

Internal characters of imagines.

Testes light orange yellow, spiral, with about 2 proximal heavy gyres to coil reversal point; from there 2 heavy gyres and about 8 thin outer or distal coils.

Spermathecae elongated dome-shaped, chitinized. Ventral receptacle thin spiral of about 50 coils.

Other characteristics, relationship, and distribution.

Eggs.—About .45 mm. long; 3 filaments, 2 thin lateral and 1 slightly longer, thick median.

Puparia.—Light brown. Each anterior spiracle with about 10 branches; horn-index about 25.

Chromosomes.—Metaphase plate shows a pair of long rods, 4 pairs of medium rods, and a pair of dots.

Relationship.—Belongs to the quinaria group of the sub-genus Drosophila.

Distribution.—This species was collected by Th. Dobzhansky at Monterey, and Mt. San Jacinto, California.

Drosophila suboccidentalis, sp. nov.

External characters of imagines.

♂. Arista with about 9 branches; 3 below terminal fork. Antennae brown. Front brown. Middle orbital ⅓ anterior and ⅕ posterior. Second oral bristle ⅘ first. Palpus yellow; two prominent bristles. Carina rounded, broad below, narrow above. Face light brown. Cheek brown; greatest width about ¼ greatest diameter of eye. Eye red; sparse yellow pile; round and medium size.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Sterno-index about .7. Anterior dorsocentrals about ¾ posterior; no enlarged hairs anterior to dorsocentrals. Presutural bristles absent. Mesonotum light brown, shiny. Scutellum light brown, shiny. Legs light brown. Apical bristles on first and second tibiae; preapicals on all three. About 9 long (longer than tarsal thickness) recurved hairs on median side of fore-tarsus.

Abdomen shiny yellow; a dark brown apical band on tergites 2, 3, 4, and 5 narrowly interrupted in mid-dorsal line and reaching ⅔ of distance to lateral margin of tergite.

Wings clear; anterior and posterior crossveins with wide black clouds. Costal index about 3.0; 4th vein index about 1.8; 5x index about 1.2; 4c

index about .9. Two prominent bristles at apex of first costal section; third costal section with heavy bristles on its basal ⅔.

Length body 2.8 mm. (in live specimen); wings 2.8 mm.

♀. Abdomen shiny yellow; a dark brown apical band on tergites 2, 3, 4, and 5 narrowly interrupted in mid-dorsal line and reaching ⅔ distance to lateral margin of tergite; band on tergite 5 tending to break into 2 parts on either side; dark brown area not interrupted in mid-dorsal line in tergites 6 and 7. Length body 3.0 mm.; wings 3.0 mm.

Internal characters of imagines.

Testes salmon, spiral, with about 2⅓ heavy inner gyres to coil reversal point; from there 1 heavy gyre and about 7 thin outer or distal coils.

Spermathecae elongated cap-shaped, chitinized. Ventral receptacle thin spiral of about 60 coils.

Other characteristics, relationship, and distribution.

Eggs.—About .45 mm. long; 3 filaments, 2 thin lateral and 1 slightly longer, thick median.

Puparia.—Light brown. Each anterior spiracle with about 10 branches; horn-index about 25.

Chromosomes.—Metaphase plate shows a pair of rods with dot-like element attached at end of each (these rods are the X's), 4 pairs of medium rods, and a pair of dots. In male the Y is a long rod, the one X showing the satellite.

Relationship.—Belongs to the quinaria group of the sub-genus Drosophila, and closely related to *D. occidentalis*, with which it can be crossed.

Distribution.—This species was first collected by A. H. Sturtevant at Jackson, Wyoming, in July, 1940. Other collections were made by G. B. Mainland and M. R. Wheeler at Manitou Springs, Colorado; Estes Park, Colorado; Black Hills, 11 miles from Custer, South Dakota; Jackson's Canyon, 13 miles southwest of Casper, Wyoming; Grand Teton National Park, Wyoming; Iron Creek, Yellowstone, Wyoming; Madison River, Yellowstone, Wyoming; Pocatello, Idaho; Wasatch Range, 3 miles west of Liberty, Utah; Tushar Mountains, 5 miles west of Junction, Utah; and Ogden River near Ogden, Utah.

Comparison with D. occidentalis.

In general the abdomen of the male is considerably darker in D. occidentalis, due to more extensive pigmentation of tergites 5 and 6. The median break in the apical band on tergite 5 is much more extensive in suboccidentalis. The testis color of occidentalis is orange yellow; that of suboccidentalis is salmon. The best distinguishing character is the fore-tarsus of the male. In occidentalis the medially directed hairs are shorter than the thickness of the tarsus, while in suboccidentalis they are considerably longer than the thickness of the fore-tarsus.

Drosophila palustris, sp. nov.

External characters of imagines.

♂. Arista with about 9 branches; 2 or 3 below terminal fork. Antennae light brown, third joint darker. Front light brown. Middle orbital ⅓ anterior and ¼ posterior. Second oral bristle ⅔ first. Palpus yellow; one prominent bristle. Carina flat, narrow above, broad below. Face light yellow. Cheek brownish yellow; slightly darker spot under lowest point of eye; greatest width about ¼ greatest diameter of eye. Eye red; posterior lower margin flat, making eye slightly pointed below; short yellow pile.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent. Sterno-index about .7. Anterior dorsocentrals about ⅗ posterior; no enlarged hairs anterior to dorsocentrals. Presutural bristles absent. Mesonotum shining yellowish brown, with 3 lighter stripes, a median and 2 lateral, just inside the dorsocentral rows. Scutellum yellowish brown, darker at apex. Legs light yellow. Apical bristles on first and second tibiae; preapicals on all three. 5 to 7 thin, very short recurved hairs on median side of fore-tarsus.

Abdomen shining dark brownish gray; 3 broad light yellow stripes running the length of the abdomen, one mid-dorsal and 2 lateral; the edge of each tergite just lateral to lateral yellow stripes is tipped with black; yellow stripes narrowed posteriorly.

Wings brown; dark clouds at apex of L 2, 3, 4. Crossveins clouded; on posterior crossvein cloud heavier at ends of vein. Posterior crossvein slightly sigmoid. Costal index about 3.1; 4th vein index about 1.5; 5x index about .7; 4c index about .8. Two prominent bristles at apex of first costal section; third costal section with heavy bristles on its basal ½.

Length body 2.8 mm. (in live specimen); wings 2.9 mm.

♀. Length body 3.0 mm.; wings 3.1 mm.

Internal characters of imagines.

Testes bright yellowish orange, spiral, with about 2 heavy proximal gyres to coil reversal point; from there one heavy and 6 or 7 thin outer or distal gyres.

Spermathecae cap-shaped, chitinized. Ventral receptacle thin spiral of about 60 coils.

Other characteristics, relationship, and distribution.

Eggs.—About .60 mm. long; 3 filaments, 2 thin lateral, and 1 slightly longer, thicker median.

Puparia.—Golden brown. Each anterior spiracle with about 14 branches; horn-index about 8.

Chromosomes.—Metaphase plate shows a pair of long rods, 4 pairs of medium rods and a pair of dots.

Relationship.—Belongs to the quinaria group of the sub-genus Drosophila.

Distribution.—Collections have been made from Killbuck Bottoms, Wayne County, Ohio; near Overton, Wayne County, Ohio; Odell's Lake, Holmes County, Ohio by Harrison Stalker and the author; Rochester, New York by Harrison Stalker; Morristown, New Jersey by A. H. Sturtevant; and Chain Bridge, Virginia, by J. R. Malloch. Specimens of this species are in collection of Illinois Natural History Survey from Illinois.

Note.—This species was first described by J. R. Malloch under the name Drosophila lativittata. However, this name is to be rejected as a homonym as the same author had used it in a prior description of an Australian species of Drosophila (see Malloch, J. R., 1923. Proc. Linn. Soc. N. S. Wales, 48:618). We are therefore proposing as a substitute the name palustris and publishing a fuller description.

Drosophila subpalustris, sp. nov.

External characters of imagines.

♂. Arista with about 10 branches; 2 or 3 below terminal fork. Antennae light brown, third joint darker. Front light brown. Middle orbital ⅓ anterior and ¼ posterior. Second oral bristle ½ first. Palpus yellow; one prominent bristle. Carina flat, narrow above, broad below. Face light yellow. Cheek shining brownish yellow; slightly darker spot under eye; greatest width about ⅕ greatest diameter of eye. Eye dark red; lozenge shaped, lower portion ending in blunt point; short yellow pile.

Acrostichal hairs in 6 rows; no prescutellars. Anterior scutellars divergent; posterior scutellars tend to be erect. Sterno-index about .8. Anterior dorsocentrals about ¾ posterior; no enlarged hairs anterior to dorsocentrals. Presutural bristles absent. Mesonotum shining yellowish brown, with 3 lighter stripes, a median and 2 lateral, just inside the dorsocentral rows. Scutellum brown, darker toward apex. Legs light yellow. Apical bristles on first and second tibiae; preapicals on all three. About 9 or 10 long recurved hairs on median side of fore-tarsus.

Abdomen shining dark brownish gray; 3 broad light yellow stripes running the length of the abdomen, one mid-dorsal and 2 lateral; the edge of each tergite just lateral to lateral yellow stripes is tipped with black; yellow stripes narrowed posteriorly.

Wings smoky gray-brown; heavy dark clouds at apex of L 2, 3, 4, and 5, on anterior crossvein and at both ends of posterior crossvein. Posterior crossvein distinctly sigmoid. Costal index about 3.0; 4th vein index about 1.1; 5x index about .7; 4c index about .8. Two prominent bristles at apex of first costal section; third costal section with heavy bristles on its basal ½.

Length body 2.9 mm. (in live specimen); wings 3.0 mm.

♀. Length body 3.1 mm.; wings 3.2 mm.

Internal characters of imagines.

Testes light yellow, spiral, with about 2 proximal heavy inner gyres to coil reversal point; from there one heavy and about 7 outer or distal light coils.

Spermathecae cap-shaped, chitinized. Ventral receptacle thin relatively short spiral of about 35 coils.

Other characteristics, relationship, and distribution.

Eggs.—About .65 mm. long; 3 filaments, 2 thin lateral, and 1 slightly longer, thicker median.

Puparia.—Golden brown. Each anterior spiracle with about 14 branches; horn-index about 5.5.

Chromosomes.—Metaphase plate shows a pair of long rods, 4 pairs of medium rods and a pair of dots.

Relationship.—Belongs to the quinaria group of the subgenus Drosophila, and closely related to *D. palustris* with which it can be crossed.

Distribution.—This species was first collected in the Killbuck Bottoms, Wayne County, Ohio, by Harrison Stalker and the author in July, 1939. Subsequent collections in 1940 and 1941 have been made from the same region. It has also been taken at Odell's Lake, Holmes County, Ohio.

Comparison with D. palustris.

Drosophila subpalustris differs from D. palustris in darker wings with much heavier clouds, and a distinctly sigmoid posterior crossvein; egg filaments thinner; eye darker in color; more lozenge shaped; pupal horns longer; testes lighter yellow; mesonotum and abdomen slightly darker; long recurved hairs on fore-tarsus.

The species seems also closely related to D. deflecta Malloch.

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