

Culicoides (Diptera, Ceratopogonidae) from Cyprus

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ABSTRACT.

During an investigation of the epidemiology of blue tongue virus disease of sheep in Cyprus from 1970 to 1973, light traps were used to establish the presence of biting midges. Twenty-six species of Culicoides are recorded for the first time from the island; of these, two are potential vectors of blue tongue virus.

RÉSUMÉ.

Au cours d'une enquête épidémiologique sur la maladie à virus « Blue tongue », à Chypre de 1970 à 1973, nous avons utilisé des pièges lumineux pour établir la présence de Culicoides. Vingt-six espèces de Culicoides sont rapportées pour la première fois pour la faune de l'île; parmi celles-ci, deux sont des vecteurs potentiels du virus « Blue tongue ».

1. INTRODUCTION.

Blue tongue virus disease of sheep has been known to occur in Cyprus for many years (GAMBLES, 1949). In 1970, a team from the Animal Virus Research Institute commenced a programme of research on the disease in the island. Since species of *Culicoides* are known to be involved in the transmission of the disease both in Southern Africa (DU TOIT, 1944) and in the U.S.A. (FOSTER *et al.*, 1963, 1968) one of the initial steps of the investigation was to establish the presence of potential vectors; this report concerns studies made during 1970 to 1972. There appear to be no previously published records of *Culicoides* from Cyprus.

Most of the recorded outbreaks of blue tongue have occurred in the period October to December. From discussion with Veterinary Officers in Cyprus it appeared that outbreaks were most frequently seen in the south-eastern part of the island, in the low-lying area between Famagusta and Larnaca. For this reason many of the localities sampled are within this area. The terrain here

is a slightly undulating coastal plain, rather rocky in parts but intensively cultivated in others. There are few streams, and these dry up early in the summer. Irrigation from artesian wells is widespread and under these conditions the main crops are citrus, salad crops such as cucumbers and tomatoes, potatoes, lucerne and colocasias where the fields can be flooded regularly. Numbers of sheep are grazed all over the area, and at night are herded into sheep folds either outside or within the villages. There are also few cattle, some used as draft animals and some for milk production; the latter are kept indoors, within the villages. To the west the country is more mountainous, and the catching stations at Platres and Troodos were at approximately 3,500 ft. and 5,500 ft. respectively.

2. METHODS AND LOCALITIES.

Most midges were taken in light traps consisting of a 125-watt mercury vapour lamp mounted over a six-inch 'Ventaxia' fan, the entrance to each trap being screened with $\frac{1}{4}$ inch wire mesh to exclude larger insects: power was provided from a small portable generator. Trapped insects were blown into jars containing either methylated spirit or weak detergent solution; in the latter case the catch was subsequently preserved in 5-10% formalin. Other midges were taken from Robinson-type moth traps belonging to the Ministry of Agriculture, Cyprus, and situated at various points on the island. Records from these traps are denoted by the letter 'A' in parentheses after the locality.

For study, a single wing of each midge was mounted in either Euparal or balsam; the remainder of the midge was treated with 5-10% potassium hydroxide at 100 °C. for 10 minutes, cleared in absolute alcohol-phenol and mounted in phenol-balsam. In general, midges which had been preserved in formalin required treatment with the stronger alkali to ensure that they were properly macerated. All measurements were made using a Leitz microscope eyepiece, calibrated with a stage micrometer, and were converted to millimetres or microns as appropriate. Antennal ratio is the sum of the lengths of the last five

TABLE 1. — Antennal sensilla of *Cyprus Culicoides*.

Species	N ^o *	3	4	5	6	7	8	9	10	11	12	13	14	15	Total		
															Max.	Min.	Mean ± S.E.
agathensis	15	7.2	1.0	1.0	1.1	1.0	1.3	1.1	1.7	0.9	1.0	1.0	4.7	0.9	31	18	23.9 ± 0.93
azerbaidzhanicus	10	3.2	0.9	1.0	1.2	1.0	1.9	1.6	2.0	0	0	0	0	0	15	10	12.8 ± 0.44
badooshensis	2	2.9	0	0	0.6	0.7	0.9	0.9	1.0	1.0	1.0	1.0	2.0	0	13	10	11.9 ± 0.51
cataneii	20	5.6	0.9	1.1	0.1	1.0	0.8	1.0	0.3	1.0	1.0	1.0	1.9	1.0	22	15	17.7 ± 0.43
circumscriptus	16	5.8	2.3	2.1	2.2	1.9	1.8	1.6	1.1	0.9	1.0	1.6	3.8	0	31	23	26.1 ± 0.80
citrinellus	8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.9	0	0	0	0	0	9	8	8.9 ± 0.12
coluzzii	23	2.5	0	1.1	0.1	1.1	2.0	1.3	2.2	0	0	0	0	0	14	8	10.3 ± 0.33
kirovabadicus	2	6.0	2.5	2.0	2.0	2.0	2.0	2.0	0.5	1.0	1.0	1.0	5.0	0	28	26	27.0
lailae	13	4.7	1.6	1.5	1.5	1.5	1.1	1.0	0.8	1.0	1.0	1.3	3.1	0.1	22	18	20.3 ± 0.40
langeroni	10	2.9	1.0	1.0	1.0	0	0.1	0.1	0	1.0	1.0	1.0	2.2	0	12	11	11.3 ± 0.15
longipennis	4	2.7	0	1.0	0	1.0	2.0	1.0	2.0	0	0	0	0	0	10	9	9.7 ± 0.25
maritimus	20	5.4	1.1	1.2	1.2	1.1	1.1	1.1	1.2	1.0	0.9	1.1	4.7	0.05	27	19	21.3 ± 0.49
newsteadi	9	3.8	0	0	0	0	0	0	1.0	1.0	1.0	1.0	2.0	0	12	11	11.8 ± 0.15
obsoletus	3	3.0	0	0	0	0	0	0	0	1.0	1.0	1.0	1.0	2.0	9		9.0
pallidipennis	11	2.5	0	0	0	0	0	0	0	0	1.0	1.0	1.0	1.0	7	6	6.5 ± 0.17
parroti	2	1.0	0	0	0	0	2.0	2.0	2.0	0	0	0	0	0	7	7	7.0
pulicaris	2	4.0	0	0	0	0	0	0	0	1.0	1.5	1.5	3.0	2.0	13		13.0
pumilus	2	3.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0	0	0	0	0	10	10	10.0
punctatus	2	3.5	0	0	0	0	0	0	0	1.0	1.0	1.0	2.0	2.5	12	10	11.0
puncticollis	6	1.0	0	0	0	0	1.8	1.8	2.0	0	0	0	0	0	7	6	6.7 ± 0.21
schultzei	3	2.7	0	0	0	0	1.0	2.0	2.3	0	0	0	0	0	8		8.0
shaklawensis	8	9.9	0	0	0	0	0	0	0	1.0	1.1	1.1	3.0	1.0	18	16	17.1 ± 0.23
submaritimus	3	3.7	1.7	1.7	1.0	1.0	1.0	1.3	1.7	1.0	1.0	1.0	4.3	0	23	18	20.3 ± 1.45
sp. near tauricus	13	2.0	1.0	1.0	1.0	1.0	1.2	1.0	2.0	0	0	0	0	0	11	10	10.2 ± 0.10

(*) Number of antennae measured.

TABLE 2. — Antennal ratios of *Cyprus Culicoides*.

SPECIES	N ^o *	MAX.	MIN.	MEAN ± S.E.
agathensis	15	1.57	1.36	1.46 ± 0.01
azerbaidzhanicus	9	1.18	1.06	1.12 ± 0.01
badooshensis	7	1.09	1.06	1.07 ± 0.005
cataneii	18	1.43	1.23	1.33 ± 0.01
circumscriptus	16	1.46	1.33	1.39 ± 0.01
citrinellus	8	1.02	0.94	0.98 ± 0.009
coluzzii	14	1.42	1.22	1.31 ± 0.01
kirovabadicus	2	1.45	1.46	1.45
lailae	8	1.05	0.97	0.99 ± 0.02
langeroni	10	1.19	1.07	1.13 ± 0.01
longipennis	4	1.37	1.28	1.34 ± 0.04
maritimus	10	1.50	1.25	1.38 ± 0.02
newsteadi	9	1.06	1.01	1.03 ± 0.01
obsoletus	4	1.20	1.07	1.14 ± 0.03
pallidipennis	10	1.19	1.08	1.14 ± 0.03
parroti	2	0.96	0.96	0.96
pulicaris	2	0.97	0.95	0.96
pumilus	2	1.13	1.11	1.12
punctatus	2	1.15	1.08	1.11
puncticollis	6	0.90	0.76	0.82 ± 0.02
schultzei	3	1.11	1.04	1.07 ± 0.02
shaklawensis	8	1.18	1.10	1.13 ± 0.01
submaritimus	3	1.47	1.40	1.43 ± 0.02
sp. near tauricus	8	1.00	0.93	0.96 ± 0.008

* Number of antennae measured.

segments of the flagellum divided by the sum of the lengths of the preceding eight. Designations of wing veins and cells follow those of CAMPBELL and PELHAM-CLINTON (1960).

The localities at which catches were made, with their latitudes and longitudes to the nearest second, are:

Akanthou (33°55'E., 35°2'N.); Athalassa (33°24'E., 35°8'N.); Ayia Napa (34°0'E., 34°59'N.); Kiti (33°34'E., 34°50'N.); Kormakiti (33°01'E., 35°20'N.); Lapathos (33°49'E., 35°16'N.); Liopetri (33°53'E., 35°00'N.); Livadhia (33°38'E., 34°57'N.); Morphou (32°59'E., 35°12'N.); Panagra (33°04'E., 35°20'N.); Paphos (32°25'E., 34°45'N.); Paralimni (33°59'E., 35°02'N.); Phrenaros (33°55'E., 35°02'N.); Platres (32°52'N., 34°53'N.); Pyroi (33°29'E., 35°04'N.); Salamis (33°54'E., 35°11'N.); Sotira (33°57'E., 35°01'N.); Troodos (32°53'E., 34°55'N.); Vasilias (33°07'E., 35°20'N.); Yialousa (34°11'E., 35°22'N.); Zakaki (33°00'E., 34°39'N.).

3. NOTES ON THE SPECIES TAKEN.

Over 15,000 specimens were examined. Catches of midges from Athalassa were made during all months of the year; records from Troodos refer to June only. Catches from other localities were made mostly during March to May and September to December. Details of distribution of sensilla on the antennae of females and antennal ratios are given in Table 1 and 2.

3.1. *C. agathensis* Callot, Kremer and Rioux.

A series has been taken of both sexes from Athalassa, Liopetri, Paralimni, Salamis and Yialousa (A). The species has been recorded from the south of France and from Morocco.

3.2. *C. azerbaijanicus* Dzhanfarov.

A number of both sexes have been taken from Athalassa and Panagra. The wings are almost unmarked, but the species may be separated from other species with unmarked wings by the male terminalia and by the distribution of antennal sensilla in the female. The antennal ratio agrees with the figure given by KREMER *et al.* (1971) for North African specimens. It has previously been recorded from southern Russia and from Morocco.

3.3. *C. badooshensis* Khalaf.

Four females have been taken, from Liopetri and Paphos. It is known from Iraq, Israel and from Morocco and probably occurs more widely in Cyprus than these records suggest.

3.4. *C. cataneii* Clastrier.

This common and widespread species was taken from traps in Athalassa, Ayia Napa, Kormakiti, Liopetri, Panagra, Paphos, Pyroi, Salamis and Sotira. It was described from Algeria (CLASTRIER, 1957) and has also been recorded from Italy (KREMER, 1965) and Israel (CALLOT *et al.*, 1969).

3.5. *C. circumscriptus* Kieffer.

This species has been taken in almost all the localities so far sampled; it is a common and widespread midge. Differences in the numbers of sensilla on the female antennae between North European and Mediterranean specimens have been noted by CALLOT, KREMER and COLUZZI (1965); the Cyprus specimens agree with the figures given by these authors for specimens from the Mediterranean area. Ten blood-fed specimens from Athalassa all had nucleated red blood corpuscles in the mid-gut. The species occurs throughout Europe, North Africa and the Middle East.

3.6. *C. citrinellus* Kieffer.

Four male specimens, two from Athalassa and two from Salamis, with plain unmarked wings and terminalia

corresponding to Kieffer's original description have been identified as this species. The females are very similar to *C. azerbaijanicus*, but differ in being rather larger and paler, in having the third segment of the palp less swollen, and in having only single sensilla on antennal segments 8 and 9. *C. citrinellus* is known from Algeria and France. Most of the females taken have contained fully developed eggs, although none has been seen with any trace of blood in the gut.

3.7. *C. coluzzii* Callot, Kremer and Bailly-Choumara.

Recorded in fair numbers from Athalassa, Liopetri and Panagra. The wing markings vary considerably in both extent and distinctiveness; the male terminalia agree with the figure given by CALLOT *et al.* (1970). The species has been taken in Italy, Tunisia and Morocco.

3.8. *C. kirovabadicus* Dzhanfarov.

Two specimens only have been taken of this species; a female from Salamis and a male from Athalassa. The milky white appearance of the wing together with the clearly defined dark spot on the cross-vein, and no other very distinct markings, make the species easy to recognise among alcohol-preserved material. The male terminalia are similar in all respects to those of *C. circumscriptus*. The antennal ratios and distribution of sensilla on the two antennae of the single female are as shown in Tables 1 and 2. I have also seen two males and three females of this species which were collected from emergence traps in Israel by Mr. Y. Braverman, and which correspond exactly with the Cyprus specimens. It is otherwise known only from Kirovabad in Azerbaijan.

3.9. *C. lailae* Khalaf.

This species has been taken from Athalassa, Liopetri, Pyroi and Salamis. The two pale spots on the wing are variable in intensity and size and in some specimens are almost absent, even when the wing is viewed by dark field illumination. From their descriptions *C. kurekts-haicus* (DZHAFAROV, 1962) and *C. conicus* (REMM and ZHOGOLEV, 1968) would appear to be synonymous with this species. It has thus been recorded from southern Russia, Iraq, Iran and Morocco.

3.10. *C. langeroni* Kieffer.

A series of both male and female midges taken at Panagra, having unmarked wings, agree exactly with KREMER'S (1961) redescription of *C. langeroni*. The

description of *C. judaeae* MACFIE (1933), together with the figure of the terminalia, suggests that this species is synonymous with *C. langeroni*. This was confirmed by examination of two slide-mounted specimens of *C. judaeae* in the British Museum (Natural History) collection, both of which are labelled 'type' support this. One specimen, a female, resembles *langeroni* in appearance and the distribution of sensilla on the antennae is 3, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 2, 0. The other specimen, a male, is identical to *langeroni*. The distribution of the species is Algeria, Tunisia, Morocco (BAILLY-CHOUMARA *et al.*, 1970), Palestine and Russia (GUTSEVITCH, 1966).

3.11. *C. longipennis* Khalaf.

Two females and two males of this species have so far been identified, from Athalassa, Liopetri and Troodos. It was described from Iraq and has also been recorded from France and Italy.

3.12. *C. maritimus* var. *paucisensillatus* Callot, Kremer and Rioux.

A large series of midges closely resembling *C. maritimus* Kieffer in wing markings and in the form of the male terminalia has been taken from Athalassa, Lapathos (A), Liopetri, Paphos (A), Paralimni, Phrenaros, Salamis, Sotira and Zakaki (A). The distribution of sensilla on the antennae is as shown in Table 1. In only one case did the terminal segment of the antennae bear a sensillum and they thus correspond to the variety *paucisensillatus* Callot, Kremer and Rioux (1963). The variety has been recorded from Morocco and the Camargue area of France.

3.13. *C. newsteadi* Austen.

This is another widespread species in Cyprus, having been taken at Akanthou (A), Athalassa, Kiti (A), Kormakiti (A), Lapathos (A), Liopetri, Livadhia, Morphou (A), Paphos, Pyroi, Sotira, Vasilias (A), Yialousa (A) and Sakaki (A). It is a member of the *pulicaris* complex of species, and is considered by BAILLY-CHOUMARA *et al.*, (1970) to be synonymous with *C. halophilus* Kieffer. A comparison of a series of British *C. halophilus* with Cyprus *C. newsteadi* revealed only minor differences between the two; notably that the wings of the British examples were more heavily and more diffusely marked than the Cyprus specimens. However no constant differences were found and I am inclined to agree with the above authors and with EDWARDS' (1939) suggestion that the two may be forms of the same species. In this case, the name *C. halophilus* Kieffer 1924 must fall to *C. newsteadi* Austen 1921 in accordance with the law of priority, but possibly the

name *halophilus* Kieffer could be retained for the more heavily marked northern form of the species.

3.14. *C. obsoletus* Meigen.

A series of both sexes were taken at Athalassa, Paphos, Platres and Troodos, and a single female at each of Sotira and Vasilias (A). The male terminalia are identical to those of typical European *C. obsoletus*. The species has been recorded also from Israel (CALLOT, KREMER and BRAVERMAN, 1969), Morocco (BAILLY-CHOUMARA *et al.*, 1970) and from Algeria (CLASTRIER, 1957).

3.15. *C. pallidipennis* Carter, Ingram and Macfie.

This midge has been taken in catches from Athalassa, Liopetri, Panagra, Pyroi, Salamis and Sotira; particularly at Liopetri and Sotira it has been the dominant species in many of the light-trap catches. It is probably widespread in association with sheep. Its distribution outside Cyprus includes the whole of the Middle East and Africa.

3.16. *C. parroti* Kieffer.

A single female has been taken at Athalassa. It is known from Europe, Algeria, Turkey and Russia.

3.17. *C. praetermissus* Carter, Ingram and Macfie.

A single male only has been taken, from Sotira. The wings and terminalia of this specimen correspond exactly to the original description and to the descriptions of KHAMALA (1968) and KHAMALA and KETTLE (1971). *C. praetermissus* has been recorded from Egypt and from East and West Africa.

3.18. *C. pulicaris* Linnaeus.

Two female midges with wing markings closely resembling *C. pulicaris* var. *setosinervis* Kieffer were taken, one at Paphos (A) and one at Sotira: the hour-glass marking near the tip of the wing is shaped like a figure 8, and the markings are much reduced in extent compared with typical European specimens of the species. A series of females has recently been taken at Platres and Troodos, and both sexes at Athalassa.

3.19. *C. pumilus* Winnertz.

Two males and a female of this species were taken from Troodos. The two males differ from each other in

that one has a distinct central body on the aedeagus, as in the figure given by KREMER (1965): this central body is absent in the second specimen, where the aedeagus is a simple arch. *C. pumilus* is known from Europe, Russia and Morocco.

3.20. *C. punctatus* Meigen.

Two females were taken at Liopetri; the wing markings are reduced in extent as in the two *C. pulicaris*, but there is a very definite pale spot at the ends of each of veins M1, M2 and M3/4.

3.21. *C. puncticollis* Becker.

Recorded from Liopetri, Pyroi, Salamis, Sotira and Vasilia (A), but not usually in large numbers. The species occurs throughout the Middle East and North Africa.

3.22. *C. schultzei* Enderlein.

Two males and three females of this species were taken, from Liopetri and Sotira. They appear identical to specimens from Israel, but since KREMER (BAILLY-CHOUMARA *et al.*, 1970) has suggested that a complex of species may be present in the Mediterranean-North Africa area, the exact determination of these specimens must be suspect.

A fourth female specimen from Liopetri, not included in the tables, has an extra well defined pale spot just below and proximal to the pale costal spot beyond the second radial cell; in the other specimens there is only one spot below and distal to the second radial pale spot. The antennal ratio of this specimen is 1.23; the sensilla are distributed on the antenna as in typical *schultzei*. The distribution of *C. schultzei* includes the Middle East and Northern, Western and East Africa; MURADOV (1965) records it as a severe animal-biter in Turkmenia.

3.23. *C. scoticus* Downes and Kettle.

A series of males was taken, together with males of *C. obsoletus* and females belonging to the *obsoletus* group, from Platres and Troodos. I have been unable to separate the females: the appearance of the 3rd segment of the palp has been the only character suggested for separating these two species but this varies so much that it is of doubtful value. The terminalia of the males are quite distinctive. *C. scoticus* is known from Europe and Russia.

3.24. *C. shaklawensis* Khalaf.

Four females were taken at Paphos during October 1972; they are identical to specimens in the British Museum. The species was described from Iraq and is presumably Middle Eastern in its distribution.

3.25. *C. submaritimus* Dzhafarov.

Among the series of *C. maritimus* are several specimens which in their wing markings closely approach *C. submaritimus*, in that the pale spot at the apex of cell R5 is larger than that in M1 and is produced towards the pale spot beyond the second radial cell. Such specimens have been taken at Athalassa, Salamis and Zakaki (A). In the series of well over a hundred individuals examined it is possible to grade the specimens from typical *maritimus* through intermediates to typical *submaritimus*, although males tend to resemble *submaritimus* and females *maritimus*.

3.26. Sp. *indet.* near *C. tauricus* Gutsevich.

A series of thirteen females and three males of a species with unmarked wings was taken at Pyroi. In alcohol the mesonotum appears uniformly dark brown; slide-mounted females have three very characteristic spermathecae resembling those of *C. tauricus*. The female palpi bear a partially divided sensory pit, as in GUTSEVICH's figure (GUTSEVICH, 1959, p. 677; captions to Fig. 3 and 4 transposed); sensilla are present on segments 3 to 9 inclusive of the antennae. The male terminalia show certain constant differences to those of *C. tauricus*. The dorsal and ventral roots of the basistyle are strongly chitinised and appear as though they originate from a single stem, as in *C. flavidus* Dzhafarov (1959); the dorsal root is almost foot-shaped, while the ventral root is simple. The membrane is not spiculate and the aedeagus bears a definite median process. The parameres are simple banana-shaped structures. *C. tauricus* is known only from Russia. *C. saevus*, recorded from Russia and from North Africa, also has three spermathecae but according to KREMER (1965) has sensilla on antennal segments 3 and 7-10 only. The male of *saevus* has the ventral root of the basistyle footshaped.

4. DISCUSSION.

The twenty-six species noted above may well be no more than a small fraction of the total number of species on the island of Cyprus, particularly as some habitats—notably the mountain ranges towards the west and the

west coast—have not been adequately sampled. However, those so far taken demonstrate links with both the European and African faunas. Thus, *C. circumscriptus* ranges throughout Europe and the Middle East, while *C. schultzei* ranges through Africa, the Middle East and towards Southern Russia, but is not found in Europe. *C. praetermissus* is an African species, while *C. puncticollis* forms a link between the European *C. riethi* and *C. nubeculosus* and the African *C. cornutus*. *C. scoticus* and *C. pulicaris* are typical European species.

The presence of one proven vector and one potential vector of blue tongue virus has been established. *C. pallidipennis* is a vector of the virus in South Africa (DU TOIT, 1944) and it is reasonable to assume that the Cyprus strain of this species is also capable of transmitting the virus. *C. puncticollis* must also be suspect as a vector since it is closely related to *C. variipennis*, a vector in the U.S.A. (FOSTER *et al.*, 1968). Both these species will probably take blood meals from sheep and cattle in Cyprus, although further work is needed to establish this; *C. pallidipennis* has been recorded as feeding on sheep and cattle in Israel (BRAVERMAN *et al.*, 1971). Members of the *pulicaris* group are known to bite cattle and sheep in Europe (CAMPBELL and PELHAM-CLINTON, 1960) and *newsteadi*, *pulicaris* and *punctatus* must be suspect as possibly being involved in virus transmission in Cyprus until they can be decisively eliminated. *C. schultzei* bites farm animals and asses (MURADOV, 1965) although nothing is known of its ability to transmit virus. None of the *Culicoides* taken have been noted to bite man in the field; the presence of nucleated red blood corpuscles in blood-fed *C. cataneii* and *C. circumscriptus* suggest that they may bite birds. However, numerous lizards and frogs were present in the vicinity of the trap in which the blood-fed insects were taken and the source of blood may have been reptiles or amphibia.

The catching stations are too scattered on the island to allow of more than tentative guesses at the true habitats of the various species. *C. pallidipennis*, *C. newsteadi* and *C. puncticollis* seem to occur wherever domestic livestock are found. *C. cataneii* and *C. circumscriptus* are probably found throughout the island. *C. lailae* and *C. coluzzii* seem to occur generally at lower stations. *C. pallidipennis* has been taken most frequently during the autumn months, while *C. agathensis* is most abundant during the spring.

5. SUMMARY.

An account is given of twenty-six species of *Culicoides* captured in Cyprus during the period 1970-1972. The species taken were *agathensis*, *azerbaidzhanicus*, *badooshensis*, *cataneii*, *circumscriptus*, *citrinellus*, *coluzzii*, *kirovabadicus*, *lailae*, *langeroni*, *longipennis*, *maritimus*, *newsteadi*,

obsoletus, *pallidipennis*, *parroti*, *praetermissus*, *pulicaris*, *pumilus*, *punctatus*, *puncticollis*, *schultzei*, *scoticus*, *shaklawensis*, *submaritimus*, and sp. near *tauricus*. Of these, two—*pallidipennis* and *puncticollis*—deserve attention as potential vectors of blue tongue virus of sheep, and attention should be given to possible involvement of other members of the *pulicaris* group in transmission of this disease.

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