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Nour El Houda Boudemagh
Laboratory of Applied Animal Biology, Department of Biology, Faculty of Sciences, Badji Mokhtar University of Annaba, Annaba, Algeria

Fatiha Bendali-Saoudi
Laboratory of Applied Animal Biology, Department of Biology, Faculty of Sciences, Badji Mokhtar University of Annaba, Annaba, Algeria

Noureddine Soltani
Laboratory of Applied Animal Biology, Department of Biology, Faculty of Sciences, Badji Mokhtar University of Annaba, Annaba, Algeria

Correspondence
Fatiha Bendali-Saoudi
Laboratory of Applied Animal Biology, Department of Biology, Faculty of Sciences, Badji Mokhtar University of Annaba, Annaba, Algeria

Morphometry of three mosquito species vectors of West Nile *Culiseta longiareolata* Macquart 1838, *Culiseta subochrea* Edwards 1921 and *Culiseta glaphyroptera* Schiner 1864 collected at Collo (Northeast Algeria)

Nour El Houda Boudemagh, Fatiha Bendali-Saoudi and Noureddine Soltani

Abstract
To identify the mosquito species competent for West Nile virus (WNV) transmission, we have proceeded to the morphometry study of three mosquito species belonging to the same genus *Culiseta* (*Culiseta* (*Allotheobaldia*) *longiareolata* Macquart 1838, *Culiseta* (*Culiseta*) *subochrea* Edwards 1921 and *Culiseta* (*Culiseta*) *glaphyroptera* Schiner 1864. These species have been harvested in the region of Collo (Northeast Algeria), which is characterized by a Mediterranean climate. Measurements of 32 structures considered important in the taxonomy of male and female adults, have been carried out. The exploitation of morphometric data of females and the statistical analysis showed significant differences concerning the width of the head, the length of the thorax, and the length of the tibia of the 3rd leg, respectively. Highly significant differences were revealed in the length of the palps and the length of tarsi of the 3rd leg. Very highly significant differences have been observed in the length of: pronotum; antennas; abdomen; wing; femur; tibia and tarsus of the 1st leg; femur; tibia and tarsus of 2nd leg; femur and tibia of 3rd leg. The width of: pronotum; antennas; palps; thorax; wing; tarsus of the 2nd leg; tarsus of the 3rd leg. For males, the statistical analysis indicated significant differences between the widths of: pronotum, femur and tarsus of the 1st leg. Highly significant differences were also noticed between the length of the abdomen and the width of the wing. Moreover, the test shows very highly significant differences concerning the length and the width of: palps; antenna; thorax; femur; tibia and tarsus of the 2nd leg; tarsus of the 3rd leg. The length of: pronotum; wing; femur; tibia and tarsus of the 1st leg; femur and tibia of the 3rd leg. On the other hand, the study of the wing parameters showed significant differences between the length and the width of the wings and the axis (Mcu-M2), (R2-Mcu). For males, significant differences between the length of the wings and the axis (R2-Mcu) were found.

Keywords: Algeria**,** Collo, Morphometry, *Culiseta*, wings

Introduction
The important place that occupy mosquitoes in the terrestrial as in aquatic fauna, and the control of diseases transmitted by their bites, makes these arthropods an important material of study for biologists [1]. In Algeria, culicidian fauna has been the subject of several studies which are particularly interested in systematic. In the region of Tebessa, several mosquito species are found; the genus of *Culiseta* is represented by two species (*Cs. longiareolata* and *Cs. annulata*) [2]. In the same region, 9 species are revealed; *Culiseta* with 3 species (*Cs. longiareolata*, *Cs. annulata* and *Cs. subochrea*) [3]. The systematic study made in the same region revealed the presence of 10 species; *Culiseta* was represented by one species (*Cs. longiareolata*) [4]. Other works has been carried out in the region of Annaba, 12 species and 7 genus are determinated; only one species belonging to the genera of *Culesita* (*Cs. glaphyroptera*) was detected [5]. In the region of El Taref, 11 species are detected: 3 species belonging to the *genus Culiseta (Cs. subochrea, Cs. annulata and Cs. moristans*) [6]. In the region of Collo, the systematic identification revealed the presence of 13 species and 5 genera: *Culiseta* with 4 species (*Cs. annulata, Cs. subochrea, Cs. glaphyroptera, Cs. longiareolata*) [7]. Only morphological characteristics are used to determine species that have medical and veterinary interest. However, the identification of twin species or sub species in the same

complex is so delicate. The biometry can be used to solve this problem. The biometrical study [2,8-9] of adults and larvae gives accuracy on systematical identification of some complexes as *Culex pipiens* and *Anopheles maculipennis*.

In this work, we have contributed to the morphometrical study of three species belonging to the same genus: *Culiseta* (*Cs. longiareolata* Aitken, 1954, *Cs. subochrea* Edwards, 1921 and *Cs. glaphyroptera* Schiner, 1864), collected from Collo (North-east, Algeria). We have measured the length and the width of 32 morphological structures: the head, the pronotum, the maxillary palps, the antennas, the thorax, the abdomen, the wings and the five tarsmer of legs. We have added to these measurements the axis (MCU-M2), (M2-R2), (R2-MCU) of the wings.

2. Materials and methods

2.1. Presentation of the study area

Collo (37°00'21" N, 6°34'21 E, Altitude: 26 m), is located in the Northeast Algeria, at 71 km from Skikda. This area is about 228, 28 km². It is limited from the North and the North-east by the Mediterranean Sea, from the West by Zitouna and from the South by Kerkera (Figure 1). This region has a Mediterranean climate; witch is principally characterized by warm, dry summers and cool, wet winters. The average annual precipitation is between 800-1400 mm/year and the average annual temperature is about 20.2 °C [7].

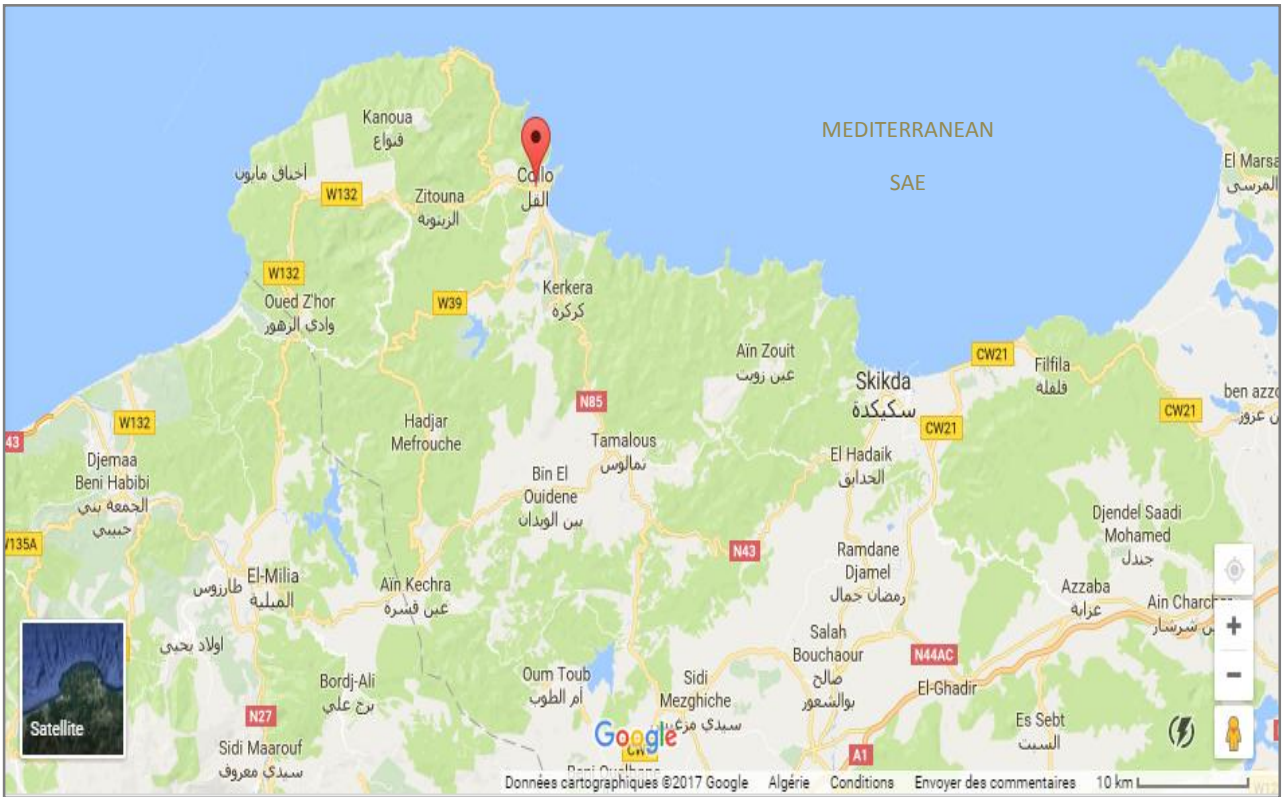

Fig 1: Geographical location of the sampling site (Collo) (Google Maps).

2.2 Biological model

Mosquitoes are insects that belong to the family of Culicidae, classified in the order of Diptera and suborder of Nematoceras. The family of Culicidae is divided into three subfamilies, the Toxorhynchitinae, the Anophelinae and the Culicinae. Most of the mosquito species belongs to the subfamily of Culicinae, which is subdivided into 11 tribes. The genus *Culiseta* is a relatively small genus including approximately 40 valid species and subspecies, which are spread over seven subgenera. The distribution of the genus *Culiseta* is almost worldwide, but largely confined to the more temperate zones of the Holarctic region. Throughout the European region, 10 species of three subgenera, *Allotheobaldia*, *Culicella*, and *Culiseta*, are recorded. In Mediterranean Africa, the genus of *Culiseta* is represented by 3 sub-genera and 6 species [10].

2.3 Sampling technique

The adults of Culicidae were collected from buildings. We were using a specific glass tube to capture the insects. When the tube was moved, the insect will fly in the bottom, one of the tube ends was closed, and the other was opened leading mosquitoes to pass to the rearing cage [8].

2.4 Mounting and conservation

Mosquitoes were taken back to the laboratory, to be killed and stored individually into Eppendorf tubes with silica gel [8]. Specimens were identified morphologically using the software of European mosquitoes [11].

2.5 Morphometry

We have measured the lengths and widths of 32 morphological structures for male and female adults (Table 1). Five criteria have been added: the length of the wing without fringe, the width of the wing of the biggest dimension and the axes (MCU-M2), (M2-R2), (R2-MCU); (Fig. 2).

Table 1: List of abbreviations of 32 morphological structures determining males and females of 3 species belonging to the genus *Culiseta*

Abbreviations	Morphological structures
h. L.	Head length
h.W.	Head width
Pa.L.	Palps length
Pa.W.	Palps width
Pr.L.	Pronotum length
Pr.W.	Pronotum
An.L.	Antennae length
An.W.	Antennae width
Th.L.	Thorax length
Th.W.	Thorax width
Wg.L.	Wing length
Wg.W.	Wing width
Ab.L.	Abdomen length
Ab.W.	Abdomen width
F. Leg 1 L.	Femur of the 1st leg length
F. Leg 1W.	Femur of the 1st leg width
T. Leg 1 L.	Tibia of the 1st leg length
T. Leg 1 W.	Tibia of the 1st leg width
Tar. Leg 1 L.	Tarsus of the 1st leg length
Tar. Leg 1W.	Tarsus of the 1st leg width
. Leg 2 L.	Femur of the 2nd leg length
F. Leg 2 W.	Femur of the 2nd leg width
T. Leg 2 L.	Tibia of the 2nd leg length
T. Leg 2 W.	Tibia of the 2nd leg width
Tar. Leg 2 L.	Tarsus of the 2nd leg length
Tar. Leg 2 W.	Tarsus of the 2nd leg width
F. Leg 3 L.	Femur of the 3rd leg length
F. Leg 3 W.	Femur of the 3rd leg width
T. Leg 3 L.	Tibia of the 3rd leg length
T. Leg 3 W.	Tibia of the 3rd leg width
Tar. Leg3 L.	Tarsus of the 3rd leg length
Tar. Leg 3 W.	Tarsus of the 3rd leg width

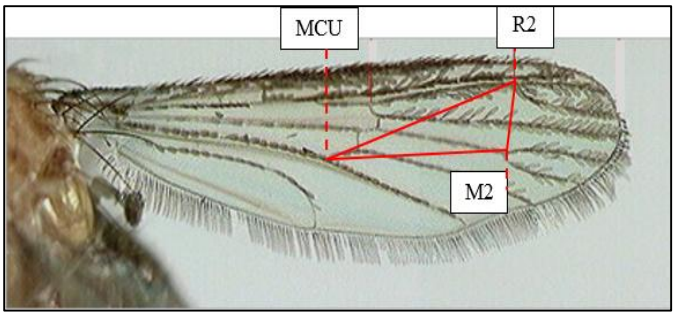

Fig 2: The axes (MCU-M2), (M2-R2), (R2-MCU) of the wing [12].

2.6 Statistical Analysis
The length and the width of each descriptor have been expressed by the mean ± standard deviation (SD), followed by the minimum and maximum values. Data were subjected to univariate (ANOVA) and multivariate (MANOVA) analyzes. All statistical analyses were performed using the MINITAB Software (Version 16, Penn State College, PA, USA) and $p<0.05$ was considered to be a statistically significant difference.

3. Results
3.1 Morphometrics
A biometrical study of three species *Cs. longiareolata*, *Cs. subochrea* and *Cs. glaphyroptera* has been performed using 32 descriptors for male and female adults. The biometrical values of the length and the width of each descriptor are represented in tables 2 and 3. The results indicate that the length of the female palps is lower than the length of the pronotum, and they are equal for the males. However, the thorax was longer than width for the both sexes. On the other hand, the biometry shows that the length of the 4th tarsomere of the first leg was equal with the 5th tarsomere and the length of the 1st tarsomere of the same leg was longer than tibia. The measurements indicate that the head and the thorax are wider than longer and the length of the abdomen is lower than width.

3.2 Statistical analysis of data
The tables 2 and 3 summarize the biometrical values of 32 descriptors considered as important in the taxonomy of males and females. The comparative study with ANOVA applied firstly on measurements of females shows significant differences in the width of the head, the length of the thorax, and also in the length of the tibia of the 3rd leg (Table1). ANOVA revealed highly significant differences in the length of the palps, the length of the tarsus of the 3rd leg. Very highly significant differences have concerned the length and the width of pronotum, antennas, wing, tarsus of the 2nd leg, the width of: palps, thorax and tarsus of the 3rd leg, the length of: abdomen, femur, tibia and tarsus of the 1st leg, femur and tibia of 2nd leg, femur and tibia of 3rd leg. For males, this test shows significant differences between the widths of: pronotum, femur and tarsus of the 1st leg. Differences are highly significant between the length of the abdomen and the width of the wing. In addition, the test shows very highly significant differences concerning the length and the width of: palps, antenna, thorax, femur, tibia and tarsus of the 2nd leg, tarsus of the 3rd leg and the length of: pronotum, wing, femur, tibia and tarsus of the 1st leg, femur and tibia of the 3rd leg (Table 3). On the other hand, the comparative study between the wing parameters of females (Table 4) shows very highly significant differences in the length and the width of the wings, and the axis (MCU-M2), (R2-MCU). For males (table 5), the differences are significant in the width of the wing and the axis (M_2-R_2). Differences are very highly significant in the length of the wings and the axis (MCU-M2), (R2-MCU).

Table 2: ANOVA. Measurements of 32 descriptors determining females of 3 species belonging to the genus *Culiseta* (N= 20; unit: µm; M.: mean; SD: standard deviation; *Cs.*: *Culiseta*)

Variables	*Cs. longiareolata*	*Cs. subochrea*	*Cs. glaphyroptera*	Statistical parameters	
	M ± SD	M ± SD	M ± SD	t_{obs}	P
h. L.	1441.3 ± 245	1443.5 ± 236.2	1395 ± 227	0.27	0.766
h.W.	1222.62 ± 180.2	1089.2 ± 145.5	1123 ± 179	3.37	0.041*
Pa.L.	1934.75 ± 285.74	502 ± 99.1	576.3 ± 97.2	5.9	0.005**
Pa.W.	229.33 ± 55.33	158.5 ± 42	164.1 ± 47	14.05	<0.001***
Pr.L.	6610.1 ± 812.1	4649.4 ± 453.3	4793 ± 457	66.72	< 0.001***
Pr.W.	237.14 ± 55.7	173.4 ± 42.4	190.2 ± 38.1	10.30	< 0.001***
An.L.	5200.8 ± 683.7	4653.2 ± 239	4623 ± 384	9.43	< 0.001***
An.W.	63.2 ± 17.52	103 ± 20.5	82.1 ± 15.3	24.2	< 0.001***
Th.L.	4496.43 ± 358.6	3974.3 ± 1344.2	3700 ± 659	4.14	0.021*
Th.W.	3893.64 ± 310.3	3234 ± 563.2	3260 ± 438.4	13.82	< 0.001***
Wg.L.	12254.6 ± 1326	9431.3 ± 1479.1	10032 ± 2164	15.4	< 0.001***
Wg.W.	3432.9 ± 535.92	2227 ± 350	2290.2 ± 345.1	52.3	< 0.001***
Ab.L.	10327 ± 1620.92	7576 ± 1598	6369 ± 1232	36.85	< 0.001***
Ab.W.	1452.7 ± 399.83	1520 ± 353	1391.3 ± 237.5	0.73	0.487
F. Leg 1 L.	6677.6 ± 817.18	4718.5 ± 657	4655 ± 412	62.50	< 0.001***
F. Leg 1W.	309.6 ± 95.15	289.1 ± 58	291 ± 60	0.48	0.621 N.S
T. Leg 1 L.	7558 ± 840.54	5347 ± 622	5274 ± 497	75.5	< 0.001***
T. Leg 1 W.	239.3 ± 51.8	231.3 ± 66	231.3 ± 54	0.13	0.879
Tar. Leg 1 L.	8829.6 ± 1716.94	8970.7 ± 1731.5	6374 ± 484.34	27.81	< 0.001***
Tar. Leg 1W.	186.44 ± 26.9	158.52 ± 19.34	157. 8 ± 13.8	0.9	0.420
F. Leg 2 L.	7742.6 ± 810	5333.9 ± 650	4942 ± 571	98.24	< 0.001***
F. Leg 2 W.	299.62 ± 50.02	283.5 ± 68	267 ± 75	1.3	0.286
T. Leg 2 L.	8172.1 ± 775.7	5888 ± 585.2	5504 ± 500	104.6	< 0.001***
T. Leg 2 W.	232.2 ± 41.53	224 ± 745	231.3 ± 49.3	0.13	0.878
Tar. Leg 2 L.	11249.24 ± 1888.82	10662.2 ± 1891.2	8561.44 ± 1064	136.6	< 0.001***
Tar. Leg 2 W.	194.6 ± 12.3	158 ± 19.11	152.3 ± 17.1	101.4	< 0.001***
F. Leg 3 L.	8292.8 ± 899.44	5334 ± 639	5185 ± 479	126.22	< 0.001***
F. Leg 3 W.	284.71 ± 40.81	283.5 ± 57.1	289.1 ± 48.2	0.06	0.941
T. Leg 3 L.	8939 ± 666.8	5888 ± 706.3	5599 ± 484	201.14	< 0.001***
T. Leg 3 W.	264.83 ± 51.7	224 ± 70	227.5 ± 40	3.15	0.051*
Tar. Leg3 L.	14053.03 ± 1378.3	13527 ± 1851	9750.7 ± 1517.5	6.85	0.002**
Tar. Leg 3 W.	196 ± 12.9	152.2 ± 7.03	149.2 ± 14.2	80.4	< 0.001***

*: $p<0.05$; **: $p<0.01$; ***: $p<0.001$

Table 3: ANOVA. Measurements of 32 descriptors determining males of 3 species belonging to the genus *Culiseta* **(**N= 20; unit: µm; M.: mean; SD: standard deviation; *Cs.*: *Culiseta*)

Variables	*Cs. longiareolata*	*Cs. subochrea*	*Cs. glaphyroptera*	Statistical parameters	
	M ± SD	M ± SD	M ± SD	t_{obs}	P
h. L.	1181.44 ± 131.81	1093.3 ± 206.5	1262.9 ± 228.3	1.74	0.193 N.S
h.W.	1069.3 ± 111.15	969.42 ± 64.25	943.2 ± 169.2	1.74	0.193 N.S
Pa.L.	6443.25 ± 642.5	5030.3 ± 966.5	5089.5 ± 474.4	14	< 0.001***
Pa.W.	240 ± 45.35	167.0 ± 29.7	175.84 ± 18.2	13.05	< 0.001***
Pr.L.	6805.35 ± 575.14	4691.0 ± 635.3	4742.43 ± 428.8	59.03	< 0.001***
Pr.W.	179.63 ± 35.2	140 ± 28.5	202.5 ± 29.3	4.25	0.023*
An.L.	5296.6 ± 575.14	4340.9 ± 310.4	4449.34 ± 667.5	10.6	< 0.001***
An.W.	58.93 ± 14.03	102.3 ± 18.4	79.93 ± 14.1	22.91	< 0.001***
Th.L.	3922.04 ± 432.9	3150.6 ± 356.2	3181.7 ± 336.9	14.33	< 0.001***
Th.W.	3748.8 ± 491.14	2639 ± 554.9	2925.4 ± 274.8	18.63	< 0.001***
Wg.L.	11416.8 ± 970.11	8627.9 ± 2274.8	9431.6 ± 1390.9	11.24	< 0.001***
Wg.W.	2659 ± 454.02	2025 ± 344	2925.4 ± 298.7	5.85	0.007**
Ab.L.	8477.4 ± 1208	7297.6 ± 1699	2429.83 ± 853.7	5.7	0.008**
Ab.W.	1060.03 ± 150.6	1271 ± 665.5	6634.1 ± 227.6	2.11	0.138 N.S
F. Leg 1 L.	7600.6 ± 1327	4254.7 ± 712.5	1294.84 ± 485.8	39.3	< 0.001***
F. Leg 1W.	257.73 ± 33.30	247.7 ± 68.3	4119 ± 56.4	3.62	0.039*
T. Leg 1 L.	8165 ± 613.4	5008.7 ± 542.6	202.5 ± 491.8	140.75	< 0.001***
T. Leg 1 W.	237.14 ± 55.11	220.8 ± 55.2	4582.6 ± 42.3	1.17	0.325 N.S
Tar. Leg 1 L.	9575.1 ± 1904	8762.6 ± 1479.2	6149.2 ± 926.8	28.73	< 0.001***
Tar. Leg 1W.	175.93 ± 12.6	155.11 ± 13.4	154.52 ± 16.83	4.64	0.017*
F. Leg 2 L.	8090.45 ± 952.7	4147 ± 777.2	5035.5 ± 745.7	251.11	< 0.001***
F. Leg 2 W.	270.51 ± 40.55	253.1 ± 28.5	250.44 ± 98	581.5	< 0.001***
T. Leg 2 L.	8669.1 ± 884.4	4734 ± 414.6	5179.4 ± 928.1	349.8	< 0.001***

T. Leg 2 W.	245 ± 53.9	210 ± 74.9	239.8 ± 67.6	400.53	< 0.001***
Tar. Leg 2 L.	11600 ± 2136	8412.5 ± 1373.3	6149.8 ± 672.6	55.08	< 0.001***
Tar. Leg 2 W.	186.44 ± 19.92	154.03 ± 10.8	154.52 ± 14.1	25.37	< 0.001***
F. Leg 3 L.	8644.25 ± 777.72	5062.6 ± 795.5	4689.14 ± 293.5	115.2	< 0.001***
F. Leg 3 W.	256.31 ± 55	280.1 ± 42.7	271.78 ± 55.8	0.61	0.552 N.S
T. Leg 3 L.	8921.15 ± 816.14	5789.6 ± 996	5035.5 ± 284.9	83.92	< 0.001***
T. Leg 3 W.	235.72 ± 46.16	221 ± 55.2	234.46 ± 46.8	0.23	0.775
Tar. Leg3 L.	12942 ± 2224.58	13216.54 ± 1627.3	9667.35 ± 1374.5	50.04	< 0.001***
Tar. Leg 3 W.	186.73 ± 22.41	142.18 ± 10.06	142.2 ± 16.7	44.44	< 0.001***

*: $p<0.05$; **: $p<0.01$; ***: $p<0.001$

Table 4: ANOVA. Measurements of the five parameters determining the female wings of 3 species belonging to the genus *Culiseta* (M± SD in µm; N: number; min V: minimal value; max V: maximal value; *Cs: Culiseta*)

Variables	M ± SD (V min - V max)			Statistical parameters	
	***Cs. Longiareolata* (N=65)**	***Cs. Subochrea* (N=24)**	***Cs. Glaphyroptera* (N=40)**	t_{obs}	P
Length	11321 ± 1110 (10579-13801)	9435.34 ± 676.91 (8579-10630)	9463.9 ± 1004.7 (8579-11190)	47.2	< 0.001***
Width	3167 ± 249 (1136-3308)	2471.12 ± 90.2 (2312.6-2611)	2541.1 ± 290.3 (2349.9-3170.5)	78.45	< 0.001***
MCU-M2	2821 ± 224 (1022.4-1235.4)	2556.6 ± 163.9 (2349.9-2834.8)	2739.7 ± 367.2 (2424.5-3543.5)	19.21	< 0.001***
M2-R2	868 ± 68 (284-369.2)	907,63 ± 89.13 (776-1081.7)	866.3 ± 147.9 (671.4-1007.1)	1.40	0.256 N.S
R2-MCU	83143 ± 212 (1136-1363.2)	2419.83 ± 410.3 (2014.4-3095.9)	2418.9 ± 304.7 (2051.5-3170.5)	48.30	< 0.001***

*: $p<0.05$; **: $p<0.01$; ***: $p<0.001$

Table 5: ANOVA. Measurements of the five parameters determining the male wings of 3 species belonging to the genus *Culiseta* ((M± SD in µm; N: number; min V: minimal value; max V: maximal value; *Cs: Culiseta*).

Variables	M ± SD (V min - V max)			Statistical Parameters	
	***Cs. Longiareolata* (N=20)**	***Cs. Subochrea* (N=7)**	***Cs. Glaphyroptera* (N=7)**	t_{obs}	P
Length	9993 ± 723 (8765.5-10817)	8733.5 ± 134 (8579-9138.5)	9101.2 ± 138.5 (8952-9325)	15	< 0.001***
Width	2275 ± 99 (2088.8-2387.2)	2296.6±50.2 (2238-2424.5)	2365.9 ± 18.3 (2349.9-2387.2)	3.05	0.062*
MCU-M2	2665 ± 230 (2238-2872.1)	2328.6 ± 60.9 (2238-2424.5)	2754.9 ± 59.4 (2685.6-2834.8)	11.11	< 0.001***
M2-R2	740 ± 52 (634.1-820.6)	809.9 ± 73.1 (746-932.5)	714.03 ± 36.5 (671.4-746)	5.22	0.011*
R2-MCU	3101 ± 216 (2685.6-3282)	1987.5 ± 73.1 (1865-2051.5)	2738.9 ± 50.2 (2685.6-2797.5)	447.23	< 0.001***

*: $p<0.05$; **: $p<0.01$; ***: $p<0.001$

MANOVA applied to 32 biometrical descriptors reveals significant differences between all measurements of female adults (Table 6), and very highly significant differences for the lengths and widths of male adults (Tables 7, 8). However, the differences are very highly significant between all the wing parameters for the both sexes (Tables 9, 10).

Table 6: Results of MANOVA applied to 32 measurements determining females of 3 species belonging to the genus *Culiseta.*

Test	Value of test	F	P
Wilks'	0.00030	45.89	< 0.001***
Lawley-Hotelling	124.61	48.67	< 0.001***
Pillai's	1.96	43.20	< 0.001***

Table 7: Results of MANOVA applied to the lengths of 32 measurements determining males of 3 species belonging to the genus *Culiseta.*

Test	Value of test	F	P
Wilks'	0.00153	24.599	< 0.001***
Lawley-Hotelling	76. 67	35.938	< 0.001***
Pillai's	1.88	16.639	< 0.001***

Table 8: Results of MANOVA applied to the widths of 32 measurements determining males of 3 species belonging to the genus *Culiseta.*

Test	Value of test	F	P
Wilks'	0.00081	34.06	< 0.001***
Lawley-Hotelling	106.33	49.84	< 0.001***
Pillai's	1.911	23.06	< 0.001***

Table 9: Results of MANOVA applied to the five wing parameters determining females of 3 species belonging to the genus *Culiseta.*

Test	Value of test	F	P
Wilks'	0.08481	25.798	< 0.001***
Lawley-Hotelling	7.46552	38.821	< 0.001***
Pillai's	1.19719	16.106	< 0.001***

Table 10: Results of MANOVA applied to the five wing parameters determining males of 3 species belonging to the genus *Culiseta.*

Test	Value of test	F	P
Wilks'	0.015	38.258	< 0.001***
Lawley-Hotelling	24.11	62.695	< 0.001***
Pillai's	1.60	22.434	< 0.001***

4. Discussion

Our study has devoted to the biometrical description of 32 morphological structures, concerning male and female adults of three species belonging to the same genus *Culiseta*. These species were collected from a Mediterranean climate region (Collo). The statistical comparison of males and females showed significant, highly significant and very highly significant differences. This analysis confirms the morphometrical study made on females and male adults of *Cx. Pipiens,* collected at two different ecosystems: Annaba known by damp Mediterranean climate and Oum El Bouaghi characterized by semiarid climate [8]. However, the morphometrical analysis of some mosquito species of medical (*Cx. pipiens, Aedes caspius, Cx. perexigus* and *Cx. theileri*) or veterinary (*Cs. longiareolata* and *Cs. annulata*) interest found in the region of Tebessa, revealed a significant increase of the body volume and a decrease in the body weight [9]. The body volume of mosquitoes can influence some parameters such as the blood volume consumption, the degree of its use in the metabolic ways and the number of eggs in maturation [9]. Moreover, our comparative study conducted on the wing axis of females showed very highly significant differences in the length, the width of the wing and the axis (MCU-M2), (R2-MCU). For males, the differences between the length of the wing and the axis (R2-MCU) were significant. Some studies concerned the length of wings of different species of mosquitoes (genus *Aedes*, *Culex*) [13-17]. The moquito *Anopheles maculipennis* with short wings is considered as vectors of Malaria while the mosquitoes with long wings not being vectors [18]. Similarly, the biometry of wings was used to determine the sex of *Cx. Pipiens* [19]. Other works confirm that the differences in the lengths of the wing were due to genotypic differences and not to environmental conditions [17]. On the other hand, the length of the wings was included as a criterion for identification of adults of *Anopheles maculipennis* [20]. Other results showed that strains of *Aedes albopictus* and *Aedes triseriatus* mosquitoes, of different geographical origins, have a similar length of wings [21].

5. Conclusion

The morphometrical comparison between 3 species belonging to the same genus *Culiseta*, have concerned 32 descriptors in male and female adults. The results showed significant, highly significant and very highly significant differences. In addition, the analysis of wing parameters showed very significant differences in the both sexes. These differences have proved that we can take the length of the wing as a measure of the total size of the body of adults: *Cs. longiareolata* is a mosquito with "long wings", while *Cs. subochrea* and *Cs. glaphyroptera* are mosquitoes with short wings. Moreover, *Cs. longiareolata* is the species that present the highest values. The highest values were also observed in females compared to males in all species studied. These values will be used later as a reference in the evaluation of the effectiveness of methods used to survey of population.

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7. References

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