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Variation of the siphonal characters in sympatric populations of *Aedes caspius* (Pallas, 1771) and *Aedes dorsalis* (Meigen, 1830)

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Introduction

An investigation of sympatric populations of *Aedes caspius* and *Ae. dorsalis* is of taxonomic interest in that it may provide further information on the status of *Ae. dorsalis* as a species. It is also of epidemiological significance as *Ae. caspius* is a vector of Tahyna virus and *Ae. dorsalis* a vector of CE, WEE and SLE viruses. From an evolutionary aspect such a survey may provide an insight into adaptive mechanisms responsible for the divergence of populations, speciation, and generic and morphological differentiation.

The respiratory siphon, a process of the eighth abdominal segment, is a valuable diagnostic character for distinguishing subfamilies, genera and species within the family Culicidae. *Ae. caspius* and *Ae. dorsalis* larvae are characterised by siphonal setae (1-S) inserted at a distance of 1/2-2/3 of the siphonal length.

The aim of this paper is to establish differences in the characters of the respiratory siphon of 4th instar larvae in sympatric populations of *Ae. caspius* and *Ae. dorsalis* in Northern Yugoslavia.

Material and methods

Third and fourth instar larvae of sympatric populations of *Ae. caspius and Ae. dorsalis* were collected from a salt water pool in Rusanda (45°31' N; 17°59' E) in the surroundings of Zrenjanin (Yugoslavia). Larvae were reared separately under simulated natural conditions in water from Rusanda salt lake and maintained at 16-18 °C. After eclosion, exuviae of 4th instar larvae were preserved in 70% ethanol to be examined for the siphonal characters. The characters analysed (Fig. 1) included the number of pecten spines (PT - right and left sides), the number of branches of the siphonal seta (1-S), the siphonal length index[1] ($LI^1=L_3/L_1$), the siphonal length index[2] ($LI^2=L_3/L_2$), the siphonal index ($SI=L_1/W$), the width index ($WI=W_1/W_2$), the area index ($AI=A/L_1$) and the perimetric index ($PI = P/L_1$). Morphometric analyses were computed by the Jandel Scientific Java 1989 image system. The data were statistically processed using SPSS/PC+ Version 4.0.

Results and discussion

Highly significant differences in the number of the pecten spines from both left and right sides of the siphon of 4th instar larvae were registered when *Ae. caspius* ($x = 20.66$) and *Ae. dorsalis* ($x = 18.07$) were compared ($P \leq 0.001$). In contrast, no significant differences were recorded in left (*Ae. caspius*: $x = 20.72$; *Ae. dorsalis*: $x = 17.95$) and right sides (*Ae. caspius*: $x = 20.60$; *Ae. dorsalis*: $x = 18.20$) within populations of the same species (Table 1). Analysis of the number of branches in the siphonal seta (*Ae. caspius*: 4-7; *Ae. dorsalis*: 3-7) showed overlapping values in the populations studied (*Ae. caspius* $x = 5.02$; *Ae. dorsalis*: $x = 4.80$; $P \leq 0.078$).

According to Marshall (1938), the number of branches in the siphonal seta of *Ae. caspius* ranges from 5 to 7 and in *Ae. dorsalis* from 3 to 6, while the number of pecten spines ranges from 20 to 26 in *Ae. caspius* and 14 to 21 in *Ae. dorsalis*. Richards (1956) found greater variability of the pecten, the number of spines ranging from 16 to 26 in *Ae. caspius* and 14 to 22 in *Ae. dorsalis*, which is in close agreement with Gutsevich *et al.* (1974) who found 17-26 pecten spines in *Ae. caspius* (as *Ae. caspius caspius*) and 14-23 pecten spines in *Ae. dorsalis* (as *Ae. caspius dorsalis*). The same authors registered 5-10 branches of the siphonal seta in *Ae. caspius* and 3-8 in *Ae. dorsalis*. Similar results were obtained in a morphological analysis of larvae of sympatric populations in France (Lambert *et al.*, 1990); the number of branches of the siphonal seta ranging from 5 to 10 in *Ae. caspius* and 3-6 in *Ae. dorsalis*, while the number of pecten spines was 16 -26 in *Ae. caspius* and 15-24 in *Ae. dorsalis*.

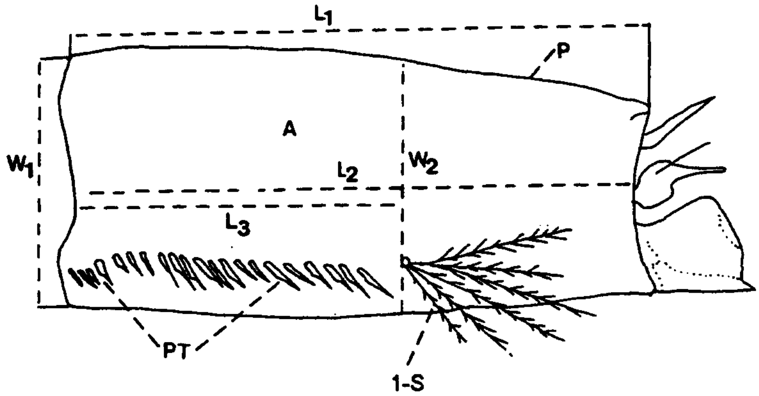

Figure 1. Siphon of 4th instar larva of *Ae. caspius* to show the number of pecten spines, PT; number of branches of siphonal seta, 1-S; siphonal length index^{1,} $LI^1 = L_3/L_1$; siphonal length index^{2,} $LI^2 = L_3/L_2$; siphonal index, $SI = L_1/W_1$; width index, $WI = W_1/W_2$; area index, $AI = A/L_1$; and perimetric index, $PI = P/L_1$.

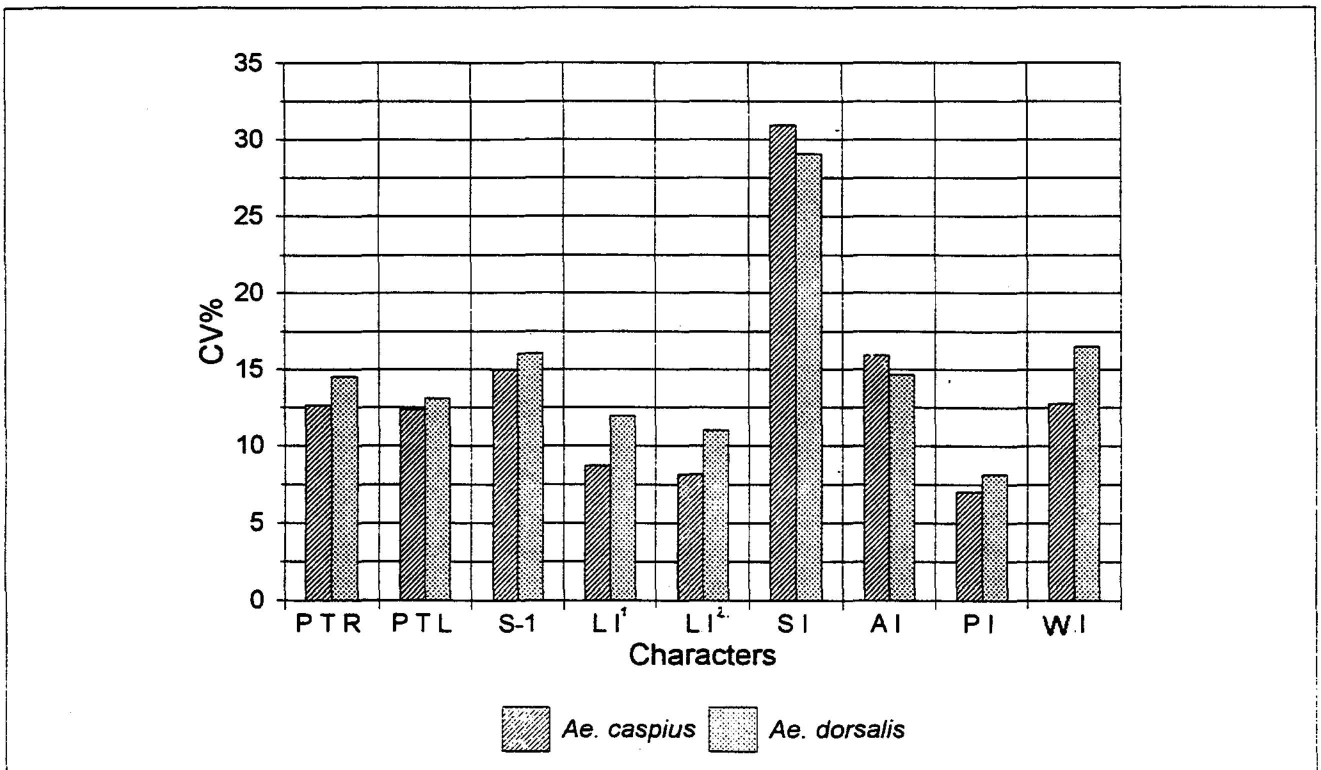

Figure 2. Coefficient of variation (CV) of the siphonal characters: number of pecten spines: PT - right (PTR) and left (PTL) side; number of branches of siphonal seta, 1-S; siphonal length indices, LI^1, LI^2; siphonal index, SI; area index, AI; perimetric index, PI; width index, WI) in *Ae. caspius* and *Ae. dorsalis*.

Character		*Ae. caspius*		*Ae. dorsalis*	
P T		Right side	Left side	Right side	Left side
	$\bar{x}\pm S_{\bar{x}}$	20.60±2.50	20.72±2.40	18.20±0.30	17.95±0.27
	σ	2.60	2.56	2.64	2.35
	min.-max.	14-27	14-28	14-25	13-25
	95 Pct	20.11-21.10	20.24-21.21	17.60-18.80	17.41-18.48
	n	108	110	75	76
1-S	$\bar{x}\pm S_{\bar{x}}$	5.02±0.08		4.80±0.09	
	σ	0.75		0.77	
	min.-max.	4-7		3-7	
	95 Pct	4.86-5.18		4.61-4.99	
	n	90		61	

Table 1. Variation in the number of pecten spines (PT) and number of branches of siphonal seta (1-S) in the populations of *Ae. caspius* and *Ae. dorsalis.*

Character		*Ae. caspius*	*Ae. dorsalis*
L I ^{1}	$\bar{x}\pm S_{\bar{x}}$	0.586±0.006	0.494±0.008
	σ	0.051	0.059
	min.-max.	0.475-0.756	0.337-0.718
	95 Pct	0.571-0.599	0.479-0.509
	n	66	61
L I ^{2}	$\bar{x}\pm S_{\bar{x}}$	0.599±0.006	0.517-0.007
	σ	0.019	0.057
	min.-max.	0.517-0.765	0.339-0.664
	95 Pct	0.587-0.612	0.503-0.532
	n	65	61
S I	$\bar{x}\pm S_{\bar{x}}$	2.445±0.093	2.571±0.094
	σ	0.756	0.748
	min.-max.	0.959-5.396	1.418-4.918
	95 Pct	2.259-2.631	2.383-2.759
	n	66	63
A I	$\bar{x}\pm S_{\bar{x}}$	5.278±0.131	5.285±0.099
	σ	0.840	0.774
	min.-max.	3.796-7.027	3.381-6.724
	95 Pct	5.013-5.543	5.087-5.484
	n	41	61
P I	$\bar{x}\pm S_{\bar{x}}$	2.816±0.024	2.799±0.029
	σ	0.197	0.229
	min.-max.	2.373-3.208	2.406-3.914
	95 Pct	2.768-2.865	2.741-2.858
	n	66	61
W I	$\bar{x}\pm S_{\bar{x}}$	1.043±0.017	1.121±0.024
	σ	0.133	0.185
	min.-max.	0.601-1.442	0.850-1.996
	95 Pct	1.010-1.075	1.073-1.169
	n	65	60

Table 2. Variation in siphonal length indices (LI^1, LI^2), siphonal index (SI) area index (AI), perimetric index (PI), and width index (WI) in the populations of *Ae. caspius* and *Ae. dorsalis.*

Wood (1976) and Ivnitsky *et al.* (1984) have indicated that the number of pecten spines has an adaptive significance under adverse conditions in populations of *Ae. aegypti* and *Ae. caspius* respectively. Ivnitsky *et al.* (1984) recorded a correlation between environmental conditions, diet in particular, and the morphological parameters of the respiratory siphon. Larvae of a laboratory population of *Ae. caspius* feeding upon periphyton possessed a smaller number of pecten spines than those feeding on filtered plankton. In addition to the differences in pecten spine number, dissimilarity in phototaxis between the populations was recorded. Larvae having a greater number of spines (filtration feeding) were characterised by more expressed positive phototaxis than those with a smaller number of spines (feeding on bottom periphyton). The same author indicated faster development of larvae with a greater number of pecten spines compared to those having a smaller number, and showed that this phenomenon is not sex-related.

Intrapopulation variability of the siphonal index (SI), siphonal length indices (LI^1, LI^2), width index (WI), area index (AI), and perimetric index (PI) was statistically evaluated (Table 2). Significant differences (ANOVA and t-test) in mean values of both siphonal length indices (LI^1: $P \leq 0.001$; LI^2: $P \leq 0.001$) and width index (WI: $P \leq 0.007$) between the populations of the two species were established. Analysis of LI^1 frequency distribution showed that 90% of *Ae. caspius* had a siphonal length index^1 greater than 0.525, while in 84% of specimens of *Ae. dorsalis* it was less than 0.540. Marshall (1938) found that the siphonal index in *Ae caspius* ranged from 1.8 to 2.3 and that of *Ae. dorsalis* from 1.9 to 2.9. According to Lambert *et al.* (1990), these values range from 1.46 to 1.86 in *Ae. caspius* and from 1.48 to 2.13 in *Ae. dorsalis,* while the data reported by Gutsevich *et al.* (1974) ranged from 1.8 to 2.6 for *Ae. caspius* (as *Ae. caspius caspius*) and 2.5 to 3.0 for *Ae. dorsalis* (as *Ae. caspius dorsalis*). Data on the siphonal length index obtained for *Ae. caspius* ranged from 0.47 to 0.62 (Lambert *et al.*, 1990,), 0.55 to 0.62 (Marshall, 1938), and 0.51 to 0.62 (Richards, 1956), while those for *Ae.dorsalis* ranged from 0.39 to 0.55 (Lambert *et al.*, 1990), 0.43 to 0.54 (Marshall, 1938) and 0.43 to 0.56 (Richards, 1956).

The variation coefficient, being a relative parameter of variability, indicates a higher intrapopulation variability of *Ae. caspius* in all analysed characters except the siphonal index and area index, when compared to *Ae. dorsalis.* Variation coefficients show that the highest (siphonal index) and the lowest (perimetric index) values were recorded in populations of both *Ae. caspius* and *Ae dorsalis* (Fig. 2).

Determination of individuals using the morphological characteristics of siphon was not feasible. The recorded extremes may possibly lead to individual ranking at species level. Clear distinctions within the 95% probability range, between sympatric populations of *Ae. caspius* and *Ae. dorsalis* are evident in characters such as length indices (LI^1 and LI^2) and width index (WI) (Tables 1 and 2). The differences found between the species under consideration at this locality are meaningful only at population level and have weak diagnostic significance.

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