The distinction between the females of *Hydrophorus albiceps* Frey and *H. magnicornis* Frey (Dipt., Dolichopodidae)

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In 1915 Richard Frey described the two species *Hydrophorus albiceps* and *H. magnicornis* together with 7 other new species of the genus (one of which as a variety) from Finland (Frey 1915). For the first time in the genus the male copulatory organ was used for diagnostic purposes. Frey presented a key to the Finnish species known at the time but gave little guidance to the determination of the females. He compared each of the two species with *H. borealis* Lw but seems not to have observed that they hold an exceptional position in relation to both this species and all other North European species with two-spotted wings, their front coxae being black-haired. This fact was revealed by Becker (1917), who also tried to separate them by the colour of the epistoma and the body length. These distinguishing characters can, however, hardly be maintained. Parent (1938) bluntly states, »Je ne vois aucun caractére permettant de distinguer les femelles de ces deux espéces». Later the matter has been discussed by Storå (1955), who also holds the opinion that the females can hardly be separated with certainty. He proposes, however, as a possibility that the *H. magnicornis* female has the ventral hairiness of the front femora shorter than the *H. albiceps* female in analogy with the condition among the males.

The material at my disposal has been collected in the following regions:

	H. albiceps		*H. magnicornis*	
	♂♂	♀♀	♂♂	♀♀
Halland	3	9		
Småland		1		
Värmland	2	6		
Hälsingland	1			
Norrbotten	8	6	31	31
Lappland	9	5	25	21
Norway			1	1
Finland	17	29	14	18
Total	40	56	71	71

Of this material 45 specimens were kindly lent to me by Mr. Ragnar Storå, Jakobstad, Finland, and 4 specimens by Dr. Richard G:son Dahl, Hälsing-

borg, to both of whom I beg to offer my thanks. Another 33 specimens were lent to me from the Entomological Department, Zoological Institute, Helsinki, to the custos of which, Dr. Walter Hackman, I also wish to express my gratitude.

At the first comparison between females identified with any degree of certainty (females from the South of Sweden belong, e.g., to *H. albiceps* as *H. magnicornis* does not occur in this region) and between males of the two species I found three characters deserving a closer examination.

Character I: the length of the acrostichal bristles. The longest presutural bristle was measured. The measurement was performed in a Leitz Greenough binocular microscope at a magnification of 50 times by means of an eyepiece micrometer (1 centimeter graduated into twentieths of millimeters). Regard was taken to the curvature of the bristle only in such cases when the very tip of the bristle was strongly bent. Then the length of the bristle with the tip imaginarily staightened out was estimated. The values are given in microns (μ). The accuracy of the measurements will be approximately ±5 μ. One source of error is, of course, afforded by the fact that sometimes the originally longest bristle may be broken or even missing.

Character 2: the length of the ventral hairiness of the front femora. The measurements were performed by the same method as those of character 1. They were made somewhat postero-ventrally and perpendicularly to the outline of the hairiness (*i.e.* they do not represent the length of any single hair). This character was not studied in the males as in them it is obviously a secondary sex character.

Character 3: The colour of the propleural hairiness. The infusion of dark—black hairs in the tuft of hairs around the propleural bristle was graduated in the following way:

0 purely white
1 a tinge of [brownish] yellow
2 distinctly brownish yellow but no truly dark hair
3 some few dark hairs
4 a quite evident infusion of black hairs
5 several stiff and bristly black hairs

The frequencies of the values for the characters 1 and 2 are presented in histograms (Figs. 1 and 2). Character 3 showed the following distribution:

	H. albiceps		*H. magnicornis*	
	♂♂	♀♀	♂♂	♀♀
0	15	24		
1	9	16		1
2	7	12		1
3	9	3	11	20
4		1	48	32
5			12	17
Total	40	56	71	71

The males were identified by their secondary sex characters and genitalia. The identification of the females, though, was definitely settled afterwards in accordance with the measured values. The correctness of these identifications could be checked later by means of a newly discovered and absolute character (se further below!).

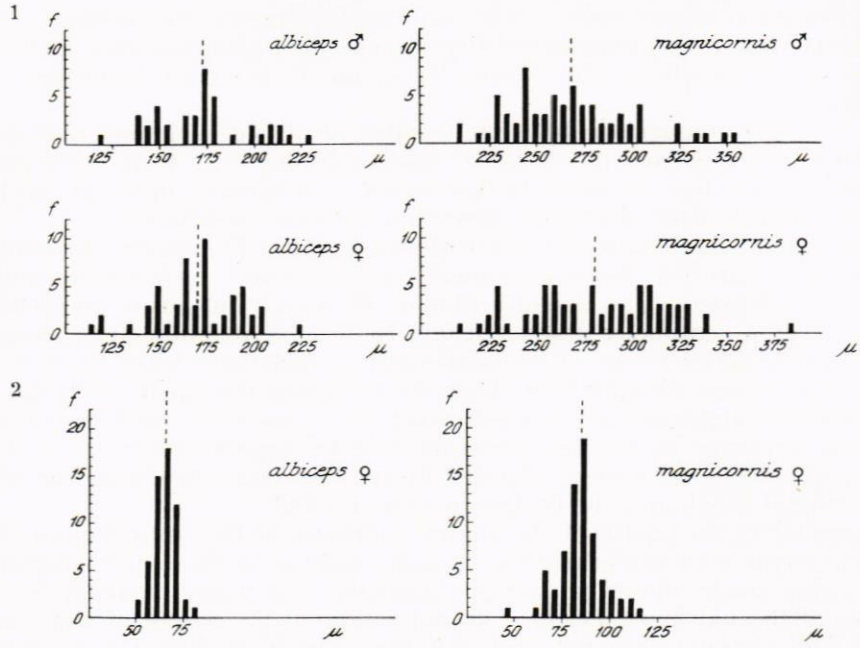


Fig. 1. Length of acrostichal bristles (character 1). The vertical axis gives the frequencies (f). The arithmetic mean ($\bar{x}$) is marked by a broken line.

Fig. 2. Length of the ventral hairiness of the front femora in the females (character 2).

The statistical treatment of the material included the calculation of the arithmetic mean ($\bar{x}$), the standard deviation (s) and the standard error ($s_{\bar{x}}$). Objections can, of course, be made to the treatment of character 3, the graduation of which is inevitably arbitrary, the intervals not being irrefutably equivalent. The calculations gave the following values:

	H. albiceps		*H. magnicornis*	
character 1	♂♂	♀♀	♂♂	♀♀
range	125—235	120—230	210—355	210—385
$\bar{x}$	179.00	176.18	268.00	282.43
s	25.475	22.688	32.195	35.864
$s_{\bar{x}}$	4.028	3.059	3.848	4.286
character 2				
range		50—80		45—115
$\bar{x}$		63.75		83.59
s		6.124		11.990
$s_{\bar{x}}$		0.818		1.423
character 3				
range	0—3	0—4	3—5	1—5
$\bar{x}$	1.25	0.95	4.01	3.89
s	1.192	1.015	0.575	0.837
$s_{\bar{x}}$	0.191	0.136	0.068	0.099

To prove the applicability of the characters the following argumentation was pursued. Between the males of the two species there are distinct differences in both characters 1 and 3 (P***). If the female material can be divided into two groups with the same distribution as the males in regard to these characters, it can be presumed that these groups represent a correct segregation of the material into species. Such a segregation of the females was performed according to the range of variation established for the males. If an analysis of the difference in each character and species separately between the males and the corresponding group of females does not give significant values, there can be regarded to be a reasonable probability that the segregation is correct. The t-distribution was calculated by use of the formula $t=\frac{\bar{x}_1-\bar{x}_2}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}}$:

H. albiceps, character 1, ♂♂—♀♀: P<0.6
H. magnicornis, character 1, ♂♂—♀♀: P*<0.02
H. albiceps, character 3, ♂♂—♀♀: P<0.3
H. magnicornis, character 3, ♂♂—♀♀: P<0.4

The significant difference found for character 1 in *H. magnicornis* can possibly be explained by a correlation with e. g. body length, the females being somewhat larger. This hypothesis has, however, not been tested as is would require a renewed measuring of the whole material. Yet the probable difference between the sexes is negligible in comparison with that between the species. It has thus been shown that probably the segregation is substantially correct and that the two characters seem to have the same applicability for females as for males. The above argumentation applies, of course, only to characters, the variation of which is not sex-associated (as is e.g. that of character 2 in the present case).

As some overlapping exists in all the three characters, troublesome borderline cases will occur in a certain frequency during the identification work. It is then necessary to rely on at least two characters which are not to any great extent genetically linked to each other. This requirement I regard as fulfilled, if a correlation test does not reveal a significant correlation. It is here naturally not intended to analyse the relative location in the chromosomes of the responsible genes but only to find taxonomic characters varying on the whole independently of each other. The coefficient of correlation (r) was calculated for the characters 1 and 3 (both sexes) as well as for 1 and 2 (females). The significance of the acquired values was tested by means of the formula $t=r\sqrt{\frac{n-2}{1-r^2}}$:

characters 1 and 3

H. albiceps, ♂♂ r=0.12 P<0.5
H. albiceps, ♀♀ r=0.20 P<0.2
H. magnicornis, ♂♂ r=0.08 P<0.6
H. magnicornis, ♀♀ r=0.13 P<0.3

characters 1 and 2

H. albiceps, ♀♀ r=0.38 P**<0.01
H. magnicornis, ♀♀ r=0.46 P***<0.001

Between the characters 1 and 3 there is thus in no case a significant correlation. Consequently, if during the examination of a doubtful specimen these

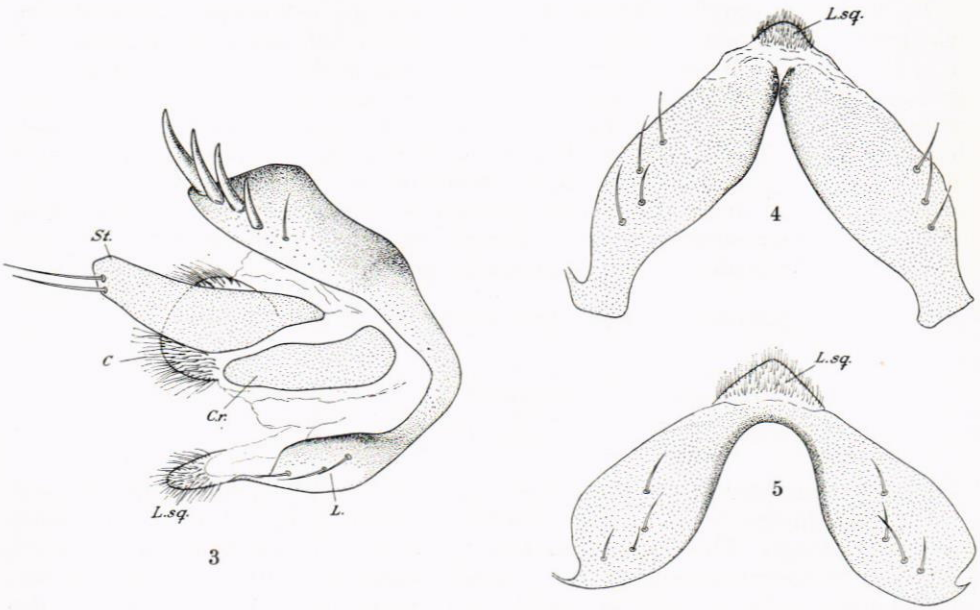
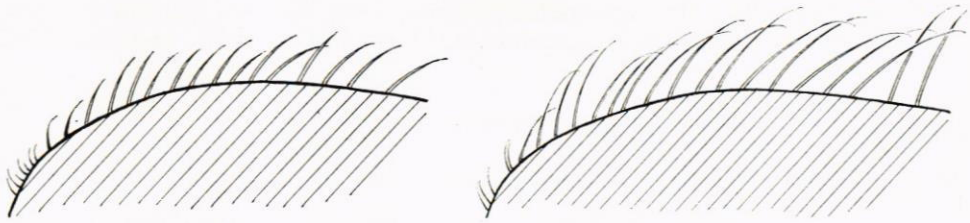


Fig. 3. Oviscapt of *Hydrophorus magnicornis* Frey, right lateral view. C=cercus; C. r.= cercal rod; L=lobus; L. sq.=lobular squama; St=stylus.

Figs. 4—5. Lobus, ventral view. L. sq.=lobular squama. Fig. 4. *Hydrophorus albiceps* Frey. Fig. 5. *Hydrophorus magnicornis* Frey.

two characters indicate the same species, they can be assumed to do so genetically independently of each other, a state of things that renders the indication stronger. The good positive correlation found in the test of the characters 1 and 2 signifies on the contrary that, in combination with character 1, character 2 is of a smaller indicating value than character 3. Moreover, character 2 is the one that is the most difficult to measure or estimate. For those reasons less importance should be attached to it than to the other two.

The discovery of a new and absolute distinguishing character for the females of the two species later afforded an opportunity of checking in a definitive way the correctness of the segregation, even in the most doubtful borderline cases. The difference consists in the shape of a sclerite of the oviscapt. This part of the body seems never before in the family to have been used for diagnostic purposes. The first comparative study of the oviscapt of the Dolichopodidae is that of Buchmann (1961), who showed that there may be marked differences in this organ between closely related species, figuring and describing the oviscapt of 25 *Dolichopus* species and one representative each of the genera *Hercostomus, Chrysotus,* and *Sciapus.* For a general description of the organ I refer to Buchmann and here use his terminology. As a divergence from his descriptions I shall only point out that the cerci, which in his species are more or less fused to the ring-shaped sclerite, the median ventral part of which he calls the lobus, in *Hydrophorus*



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Figs. 6—7. Presutural acrostichal bristles, left lateral view of the front dorsal part of the thorax. Fig. 6. *Hydrophorus albiceps* Frey. Fig. 7. *Hydrophorus magnicornis* Frey.

are attached proximally to a pair of free rod-like sclerites, which I refer to as cercal rods (Fig. 3). They probably correspond to two likewise rod-like and strongly sclerotised areas, which in *Dolichopus* without any marked delimitation connect the weakly sclerotised and hairy cerci with the anterolateral corners of the lobus. The decisive distinguishing character referred to above is the form of the median incision at the front edge of the lobus. This incision is narrow and acute-angled in *H. albiceps* (Fig. 4), broad and curving in *H. magnicornis* (Fig. 5). For practical reasons this character has been examined on only a limited portion of my material but it confirmed the segregation based on the characters 1—3 even in those instances that I regarded as doubtful borderline cases. A preliminary investigation of 12 other species of the genus (*H. alpinus* Wahlb., *H. balticus* Meig., *H. bipunctatus* Lehm., *H. borealis* Lw, *H. callosoma* Frey, *H. forcipatus* Frey, *H. litoreus* Fall., *H. micans* Frey, *H. nebulosus* Fall., *H. norvegicus* Ringd., *H. pilipes* Frey, and *H. praecox* Lehm.) has shown that even in other cases the lobus offers good distinguishing characters between otherwise very similar species.

As a summing up the following survey of the differences between the females of the two species can be given:

H. albiceps Frey	*H. magnicornis* Frey
Propleural hairiness as a rule purely white.	Propleural hairiness with as a rule a quite evident infusion of black hairs.
Acrostichal bistles short (120—230 μ) and stiff (Fig. 6).	Acrostichal bristles long (210—385 μ), usually weak and more or less bent at the tip (Fig. 7).
Ventral hairiness of the front femora short (—80 μ).	Ventral hairiness of the front femora longer (—115 μ). The state of things is thus quite contrary to what was presumed by Storå (*l. c.*).
Median incision at the front edge of the lobus narrow and acute-angled (Fig. 4).	Median incision at the front edge of the lobus broad and curving (Fig. 5).

To a trained eye the acrostichal bristles, even without measuring, and the propleural hairiness are, as a rule, sufficient for a reliable identification.

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