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Dytiscid Beetles in Greenland, with Description of the Three Larval Stages of Hydroporus melanocephalus (Marsham, 1802)

by **P.C. Jeppesen**

Abstract: Only two dytiscid beetles (*Coleoptera: Dytiscidae)* occur in Greenland: *Hydroporus melanocephalus* (Marsham, 1802) and *Colymbetes dolabratus* (Paykull, 1798). The known Greenlandic distribution is mapped for each species. The three instars of the larvae of *H. melanocephalus* are described. The length/width ratio of the head capsule is the most effective way to separate the three instars. The mouthparts, legs and urogomphi are figured. A bifid type of seta is found on the legs. A pair of sensory setae with unknown function are found on the underside of the clypeus.

Key words: Coleoptera Dytiscidae – Greenland – *Hydroporus melanocephalus* – larval stages – morphology.

Introduction

Only two species of *Dytiscidae (Coleoptera)* are known from Greenland, *Hydroporus melanocephalus* (Marsham, 1802) and *Colymbetes dolabratus* (Paykull, 1798). As can be seen by the synonyms of *Hydroporus melanocephalus* in HENRIKSEN & LUNDBECK (1917: 488), there has been confusion or errors in their determination.

According to FABRICIUS (1780), SCHIØDTE (1857) and LUNDBECK (1891), the Greenlanders distinguished between both species of water beetles. They called the large species (*C. dolabratus*) "Mingok" and the small species (*H. melanocephalus*) "the babies of Mingok". The Greenlanders were afraid of the beetles because they believed that they "could swallow them and (the beetles could) thereafter come down to the stomach with the drinking water and they therefore were dangerous because they eat the gut so that one can die from it" (LUNDBECK, 1891: 125, translated from Danish). In this myth there is a parallel to the beliefs of laymen of ancient Europe concerning the larger water beetles. To protect oneself from the water beetles the Greenlanders drank whale oil (also called train oil after the Danish word tran).

Greenlanders explained that they could rid the water of water beetles by collecting amphipods (*Gammarus locusta* Linne, 1758) and introducing them into the infested lakes. There would then be a war between

the water beetles and the amphipods in which the beetles and the amphipods would kill each other, with the result that the water beetles would be removed.

Greenlanders called the larvae of *C. dolabratus* "Pamiortok". They did not associate the imagines with the larvae and they could not believe that a larva could become a Mingok.

The Greenlanders were so familiar with the water beetles that they called a small lake near the town of Holsteinborg "Mingordunguak" which means "the lake of the water beetles" (LUNDBECK, 1891: 129). This lake is still known for its abundance of water beetles although it has recently become polluted.

Materials and methods

We originally tried to collect larvae using hand nets and casting nets in the near shore vegetation and in the water column. But this was unsuccessful. It was then discovered that the larvae occurred on the surface of submerged rocks or on the bottom (2–25 cm depth), and were collected individually using very small nets. Most specimens were killed and preserved in 70–80% ethanol, the remainder were fixed in formalin before being transferred to 80% ethanol.

The drawings were made from dissections stained in aqueous methyl green, lignin pink, or safranin, and mounted in euparal.

The measurements of the head capsule, abdominal segments, and total length were made with a screw micrometer mounted on a Leitz stereomicroscope. Measurements of mouthparts and legs were made from drawings.

The SEM pictures were made after preparing the animals with carbon and gold.

The statistics are made on a Texas Instruments calculator TI 59. The formulas are for the mean: $\overline{X} = \frac{\Sigma X}{N}$ and for correlationd coefficient: $r = \frac{ms_x}{s_y}$ (x = measurements, N = number of measurements, m = slope, s = standard deviation).

Dytiscidae in Greenland

As far as is known, *H. melanocephalus* is a circumpolar species that occurs in North America, Geenland, northren and Central Europe,

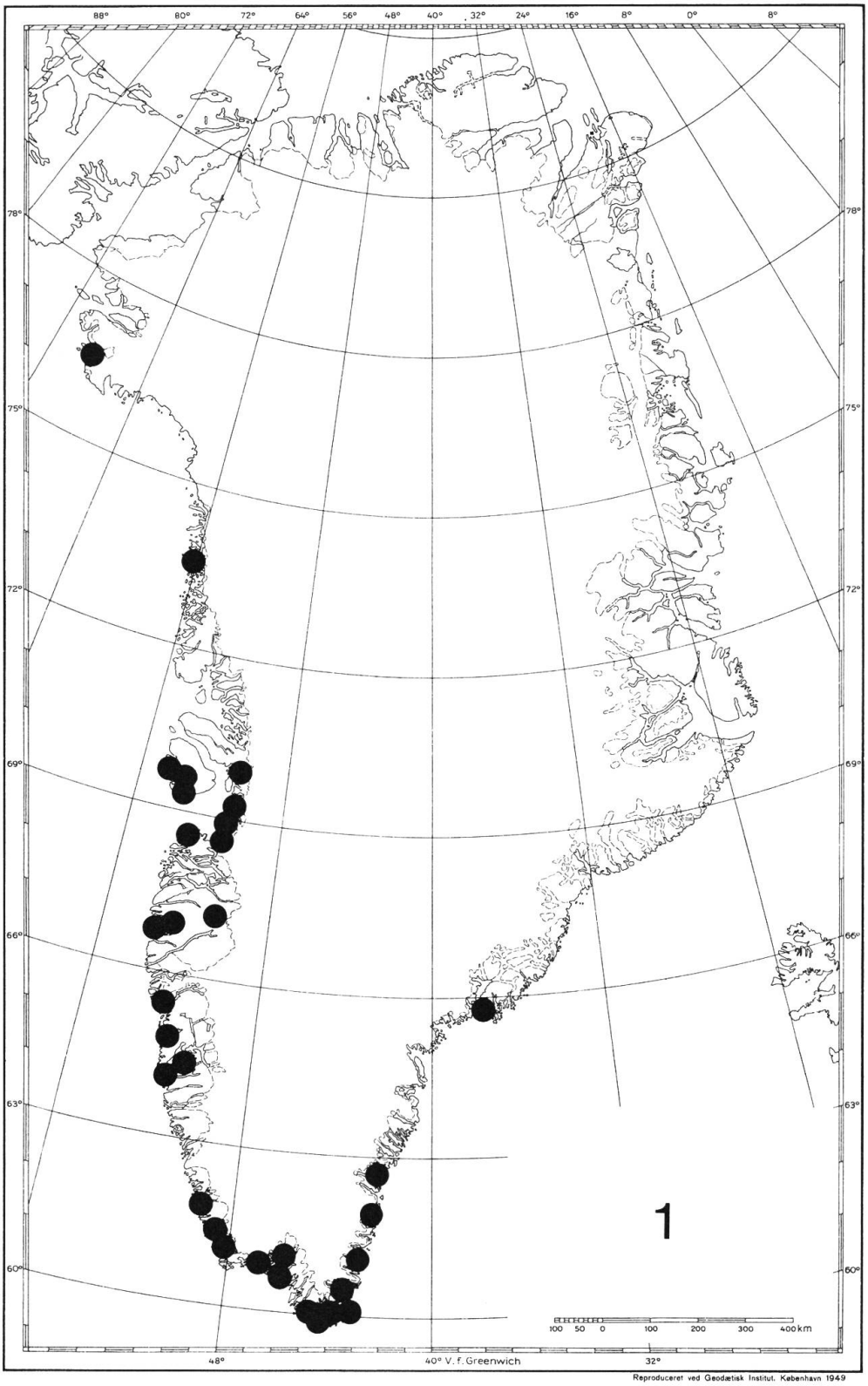


Fig. 1: Distribution of *Hydroporus melanocephalus* (Marsham, 1802) in Greenland.

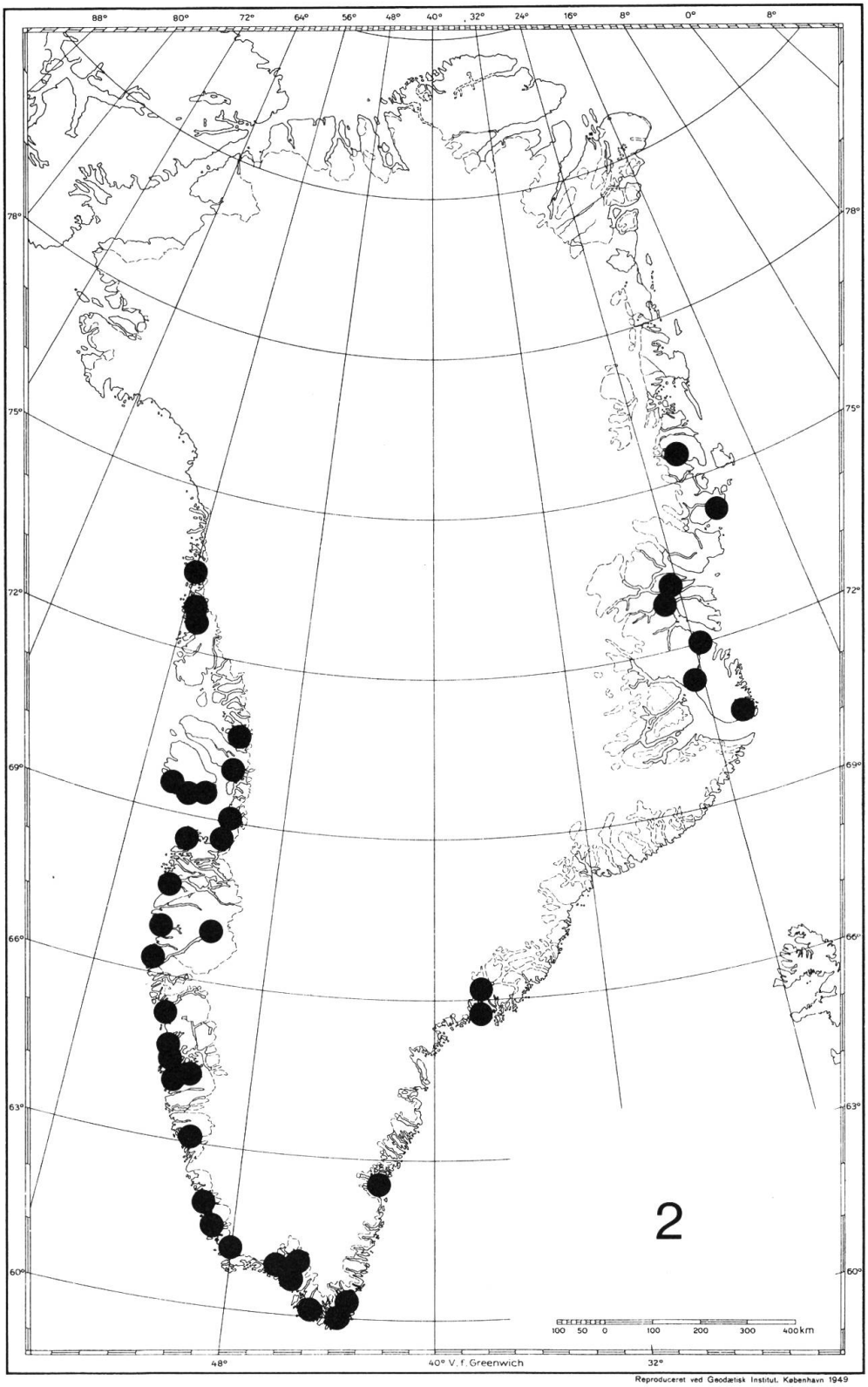


Fig. 2: Distribution of *Colymbetes dolabratus* (Paykull, 1798) in Greenland.

northern and central zones of European USSR and Siberia (FRANCISCOLO, 1979 and ZAITSEV, 1953). *Colymbetes dolabratus* is also circumpolar, but more northernly distributed than *H. melanocephalus*. It occurs in North America, Greenland, northern Europe, northern USSR including Siberia (BRINCK, 1940 and ZAITSEV, 1953).

Freshwater habitats have been sampled in all of ice-free Greenland (RØEN, 1968) but dytiscids have only been found in the southern part. *Hydroporus melanocephalus* is recorded from Kap Farvel in the south, and north to 76°35'N in the district of Thule; however, on the east coast it is recorded north only to 65°35'N, in the district of Angmagsalik (Fig 1). By contrast, *C. dolabratus* (Fig 2) has been recorded up to 73°20'N in the district of Upernavik on the west coast but has been reported as far north as 75°28'N in the northeast coast area on the east coast (RØEN, 1963 and HENRIKSEN, 1939).

Subfossils of parts of *H. melanocephalus* have been found in the bottoms of five lakes down to 342 cm but not below this (bottom samples down to 359 cm) in South Greenland. The samples were C-14 dated and the ages ranged between 8600 and 2100 years. Remains of *C. dolabratus* were found in two of the lakes down to 192 cm and wer dated to 2900 and 3900 years (RØEN, 1975).

Biology of water beetles in Greenland

Larvae and imagines of *C. dolabratus* are found during the summer in bodies of wate ranging from lakes to small rock pools (with or without vegetation), however, in the winter the imagines are found only in lakes that do not freeze completely, i. e., lakes deeper than 3 m. The imagines of *H. melanocephalus* are found in the same habitats as *C. dolabratus,* while there are no records of the larvae from large lakes.

Collection dates from different years show that first-instar larvae were captured on 5 and 16 July, second-instar larvae were taken from 26 June to 12 August, and third-instar larvae from 25 June to 16 August. These data indicate that the larvae may be able to overwinter not only as imagines but also as third and second instars.

RØEN (1963) observed that during the winter, imagines of *C. dolabratus,* come to the surface to replenish their respiratory air bubble if there is a hole in the ice, and similar behaviour is likely for *H. melanocephalus*. Furthermore, *H. melanocephalus* can be collected near homothermal springs throughout the year (KRISTENSEN, personal com-

munication). According to RØEN (1963), *C. dolabratus* can tolerate ten months without direct access to atmospheric air and food. Ten months is exactly the time the lakes are covered with ice as far north as 74°N. A constant population farther north of this limit in Greenland is not expected for *C. dolabratus*.

The prey taken by imagines of *H. melanocephalus* includes small crustaceans (RØEN, 1971), like *Daphnia* (personal observation). I have never seen larvae feeding; however, their diet probably includes crustaceans and rotifers (RØEN, personal communication), because there are apparently no other animals of the appropriate size in some of these small pools. Some of the smallest rockpools contain no detectable food items except small algae and *H. melanocephalus* larvae; what do the larvae, which have extraoral digestion, feed on in such a pool? I have observed one larva (killed in alcohol) with strings of green algae between the mandibles and the clypeus, but these may have grabbed by the larva when it was placed in the fixative.

Larvae

The pupae and the larval stages of *C. dolabratus* have been described by GALEWSKI (1967 and 1968, respectively).

What later proved to be the third-stage larva of *H. melanocephalus* was first described by MEINERT (1901, as *H. atriceps*, based on a single specimen). The same specimen was later mentioned by BERTRAND (1928 and 1931), who also referred it to *H. melanocephalus*. HENRIKSEN (1930) gave a key to six species of *Hydroporus* larvae, including *H. melanocephalus*. A figure of the head has recently been published by NILSSON (1982). As there is only one species of *Hydroporus* in Greenland, the *Hydroporus* larvae found there must be *H. melanocephalus*.

Hydroporus melanocephalus (Marsham) Figs 1, 3–26.

Description:

Total length (without cerci): 2.2–5.8 mm (N = 43). Colour: yellow to greyish brown or brown. Length of head capsule: 0.45–0.98 mm (N = 130). Width of head capsule: 0.31–0.78 mm (N = 130). Antennal segment 2 slightly shorter than segment 3 (Figs 5–7). Clypeus protruded frontally, broad and short, distal part shorter than proximal part and without lateral notches.

Legs without swimming hairs.

Abdominal segment 8 about twice as long as segment 7. 1st segment of urogomphi longer than abdominal segment 8. Urogomphi with 7 primary hairs; first segment with two of the three primary hairs attached basally.

Separating the stages:

All three larval instars are present in the material.

The total length (cerci not included) was measured for 43 of the 133 available larvae. Length varied from 2.2 mm to 5.8 mm, but it was not possible to separate the three larval stages by use of body length alone.

Table 1 clearly shows that the ratio between length and width of the head capsule provides a good means of separating the three larval stages. The table demonstrates, however, that there is no correlation between length and width of the head capsule within the three larval stages. The material is apparently not normally distributed.

Instar	No. of spec.	Length (mm)			Width (mm)			Correlation index
		min	max	mean	min	max	mean	
1	15	0.45	0.58	0.50	0.31	0.49	0.43	0.56
2	40	0.59	0.75	0.67	0.51	0.63	0.57	0.51
3	75	0.76	0.98	0.88	0.72	0.87	0.78	0.53

Tab. 1: Measurements of head capsule (in mm).

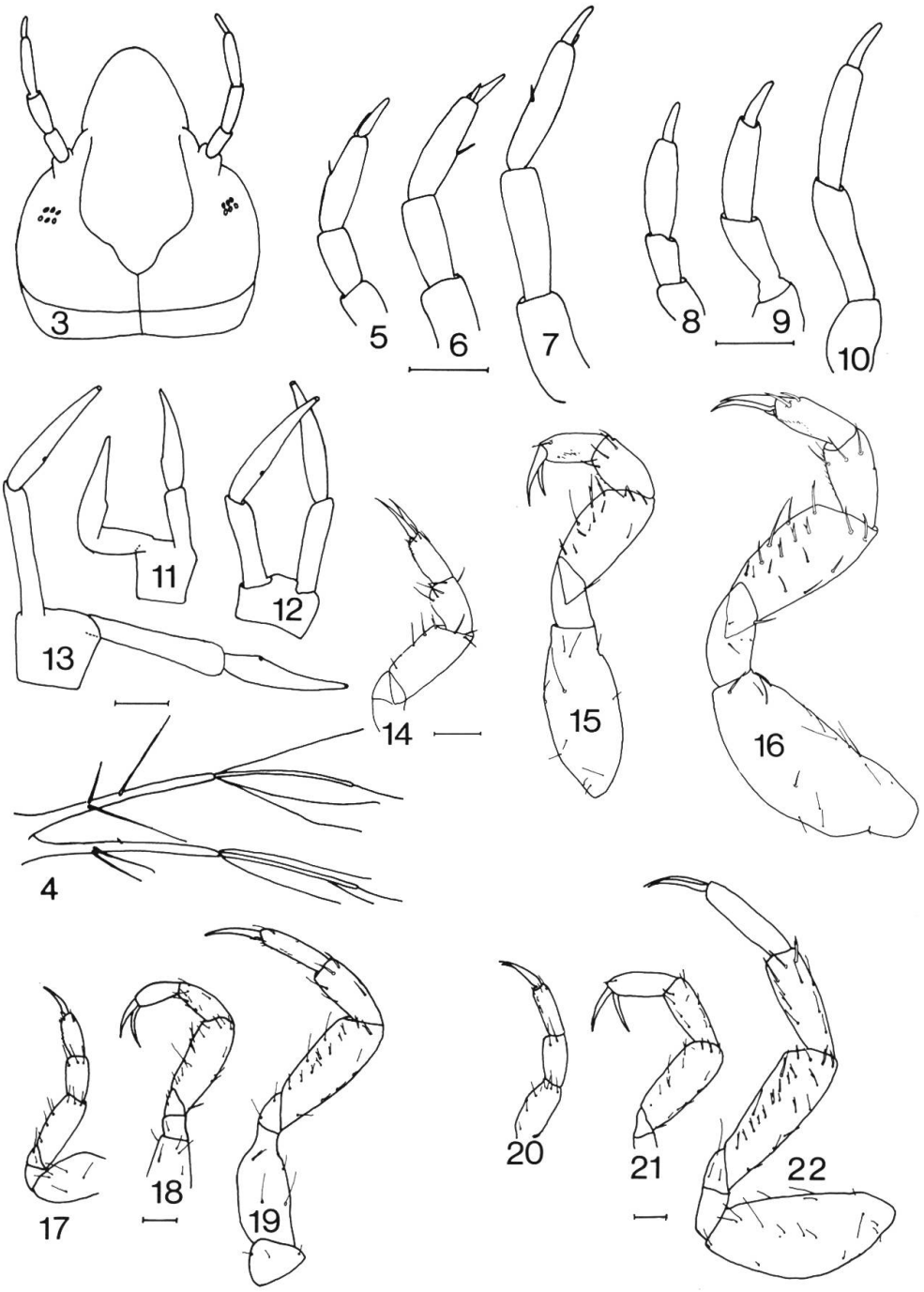
The three larval stages can be identified by the calculated length and width of the head capsule. The following measurements are based on 133 individuals with no overlap:

length: 1st instar $\leqslant$ 0.58 mm $<$ 2nd instar $\leqslant$ 0.75 mm $<$ 3rd instar
width: 1st instar $\leqslant$ 0.50 mm $<$ 2nd instar $\leqslant$ 0.67 mm $<$ 3rd instar

Each eye has 6 ommatidia of equal size. The distance between the ommatidia varies.

The clypeus (Figs 3 and 23) in *H. melanocephalus* forms a nasale. A row of small teeth best seen by SEM, is present on the edge of clypeus. The mandibles and the small teeth work together to hold the food. A pair of sensory setae are placed close to the edge; their function is unknown, but they may be chemoreceptors.

The antennae have four moveable segments. The apical (fourth) segment is the same length in all three instars (Figs 5–7) and has been



Figs 3–22: *Hydroporus melanocephalus* (Marsham, 1802). Bars 0.1 mm: 3, Head of third instar. Length of head 0.89. 4, Urogomphi of third instar. 5–7. Antennae: 5, First instar. 6, Second instar. 7, Third instar. 8–10. Maxillary palps: 8, First instar. 9, Second instar. 10, Third instar. 11–13. Labium: 11, First instar. 12, Second instar. 13, Third instar. 14–16. Fore legs: 14, Right leg of first instar. 15, Right leg of second instar. 16, Right leg of third instar. 17–19. Middle legs: 17, Left leg of first instar. 18, Right leg of second instar. 19, Right leg of third instar. 20–22. Hind legs: 20, Right leg of first instar. 21, Left leg of second instar. 22, Right leg of third instar.

given the value of 1 in Table 2. As can be seen, the relative lengths of the four antennal segments can be used to identify the larval stages. As it is difficult to see the limits of the proximal segments their measurements are given in parentheses.

Instar	Antennal segments			
	1	2	3	4
1	(0.8)	1.5	2.2	1
2	(1.3)	1.9	2.7	1
3	(2.3)	2.9	3.2	1

Tab. 2: Relative lengths of antennal segments.

The three segments of the maxillary palps (Figs 8–10) also differ from stage to stage and support the above separation of the three instars (Tab. 3). The apical segment is given the value of 1.

Instar	Palp segments		
	1	2	3
1	1.3	2.3	1
2	1.6	1.9	1
3	2.3	2.3	1

Tab. 3: Relative lengths of palp segments.

The labium (Figs 11–13) consists of a mentum and a pair of two-segmented palps. The first (proximal) segment has the same thickness in all three instars. Also the relative mesurements of the labium support the separation of the instars (Tab. 4).

The legs are of the normal hydradephagan type, with the femur as the longest segment. All the legs are slender walking legs of similar shape with two claws (Figs 14–22). The legs are sparsely covered with setae of various kinds. The setation tends to increase from first to third instar as well as posteriorly in each larva, so that also the differences in setation can be used to support the above separation of instars.

The relative measurements of the segments of the legs (Tab. 5), with the claws valued at 1, is not a good character for separating the instars, but perhaps these measurements can be used to separate this species from other species of *Hydroporus*.

The most obvious form of seta on the legs is a bifid type, easy to find in the third and second instar, but hard to recognize in the first instar without use of SEM (Fig. 24). On the surface of the legs there may be

Instar	A	B	C	D
1	5.0	3.0	3.0	1
2	6.8	4.5	4.0	1
3	6.8	6.8	4.5	1

Tab. 4: Relative measurements of the labium. A = length of the apical segment, B = length of the proximal segment, C = width of mentum, D = width of proximal segment valued at 1.

Legs	Instar	Claw	Tarsus	Tibia	Femur
Fore	1	1	1.2	1.3	2.1
	2	1	1.3	1.9	2.5
	3	1	1.5	1.8	2.8
Middle	1	1	1.0	1.0	1.8
	2	1	1.2	1.3	2.6
	3	1	1.1	1.1	2.5
Hind	1	1	1.0	1.1	1.8
	2	1	1.3	1.3	2.7
	3	1	1.3	1.5	2.3

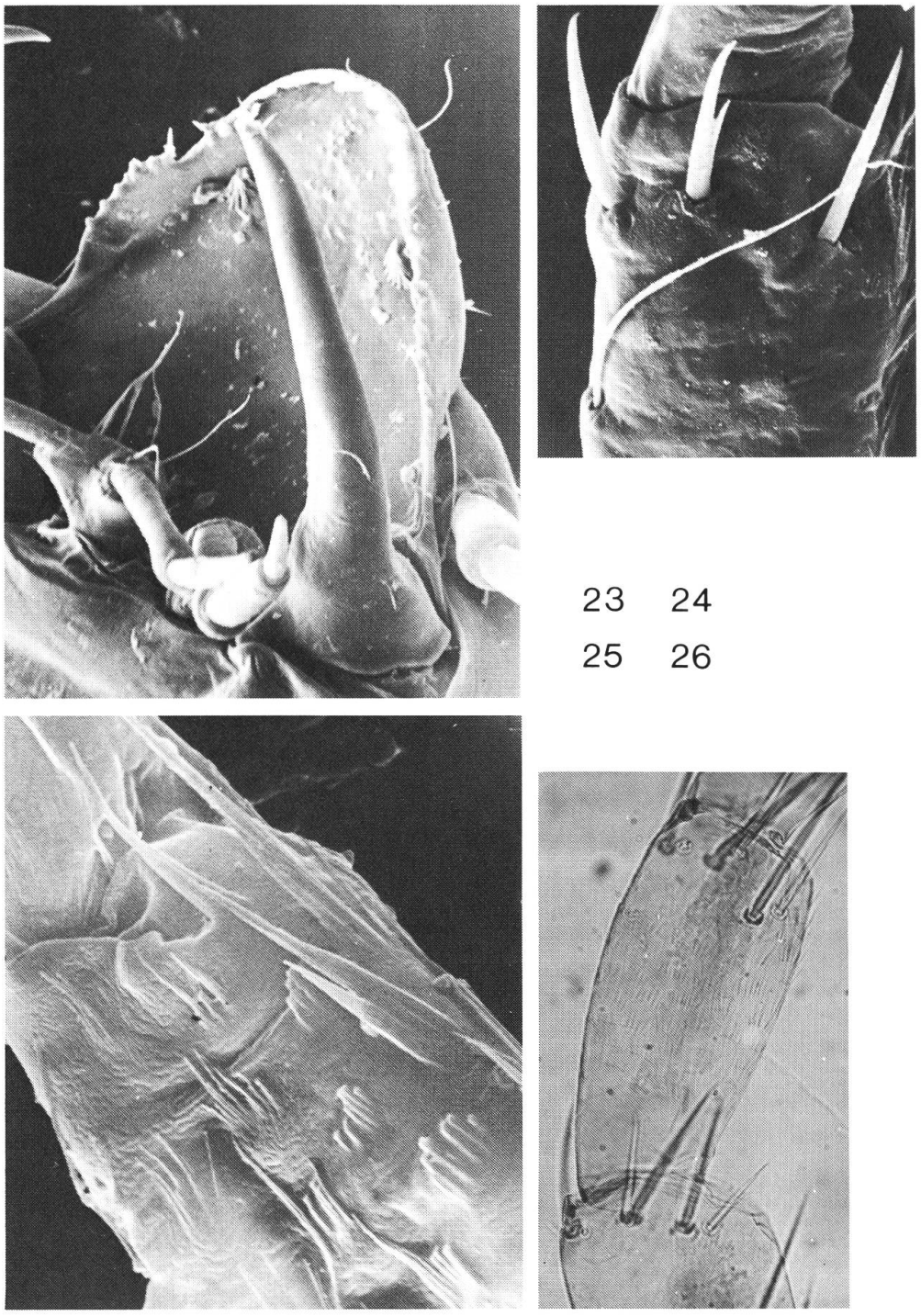
Tab. 5: Relative lengths of leg segments.

flat bundles of small setae (Fig. 25) that form structural lines (Fig. 26).

As can be seen from Table 6, the lengths of abdominal segments 7 and 8 and of the urogomphi can also be used to separate the three larval stages.

As the length of the siphon depends on the angle at which it is seen, and the larvae are so small that it is difficult to arrange them in the exact same position, I have instead measured the ventral and dorsal sides of the last abdominal segment. The length of the siphon is then defined as the difference between the length of the dorsal and ventral measurements, which is independent of the angle of viewing the siphon.

The urogomphi consist of two segments with 7 primary setae and no secondary setae (Fig. 4); first segment with two of the three primary hairs attached basally (Tab. 6).



Figs 23–26: *Hydroporus melanocephalus* (Marsham, 1802): 23, Clypeus seen from beneath. 24, Bifid setae on the metatibia of a third instar. 25, Mesotibia of first instar. 26, Metatibia of first instar.

	Abdominal segment 8 dorsal				Abdominal segment 7			
Instar	min	max	mean	N	min	max	mean	N
1	0.21	0.25	0.22	8	0.09	0.14	0.11	6
2	0.35	0.38	0.37	10	0.17	0.32	0.24	8
3	0.53	0.63	0.56	10	0.26	0.36	0.30	11
	ventral				**Urogomphi**			
1	0.13	0.15	0.14	8	0.88	0.98	0.92	10
2	0.23	0.26	0.25	10	1.11	1.35	1.22	10
3	0.38	0.44	0.41	10	1.43	1.68	1.52	9

Tab. 6: Actual length (mm) of abdominal segments 7 and 8 and of the urogomphi.

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