The larvae of North European Colymbetes Clairville (Coleoptera, Dytiscidae)

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Nilsson, A. N. & Cuppen, J. G. M.: The larvae of North European *Colymbetes* Clairville (Coleoptera, Dytiscidae). [De nordeuropeiska *Colymbetes*-arternas larver (Coleoptera, Dytiscidae).] – Ent. Tidskr. 109: 87–96. Umeå, Sweden 1988. ISSN 0013-886x.

In North Europe, the dytiscid genus *Colymbetes* Clairville includes the four species: *C. dolabratus* (Paykull), *C. fuscus* (Linnaeus), *C. paykulli* Erichson, and *C. striatus* (Linnaeus). Earlier treatments of larvae of this genus are confusing as the larvae described as *C. paykulli* were misidentified. Based on material mainly from northern Sweden and the Netherlands we present an illustrated identification key to all four species and all larval instars. Phenological data from different latitudes are presented and the life cycles of the studied species are discussed.

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Introduction

North European *Colymbetes* Clairville includes the four species: *C. dolabratus* (Paykull), *C. fuscus* (Linnaeus), *C. paykulli* Erichson, and *C. striatus* (Linnaeus). Galewski (1964, 1968) described all larval instars of all four species and provided keys to their identification. Galewski's (1968) key to third-instar larvae was also reproduced by Nilsson (1982). However, the larvae of this genus are very difficult to identify to species as larvae of all species are very similar and highly variable in most characters. After the study of many larvae, mainly from northern Sweden and the Netherlands, we have come to the conclusion that Galewski's (1964) description of *C. paykulli* is based on larvae that belong to *C. striatus*. Consequently, the true larva of *C. paykulli* is undescribed, a fact that explains much of the difficulty experienced when identifying larvae to species as the keys given by Galewski (1964, 1968) and Nilsson (1982) are useless for the separation of larvae of *C. striatus* and *C. paykulli*. As the distribution of these two common species show a large overlap, problems are severe. Further, the key characters used by Galewski (1968) are mainly gradual and often difficult to use unambiguously.

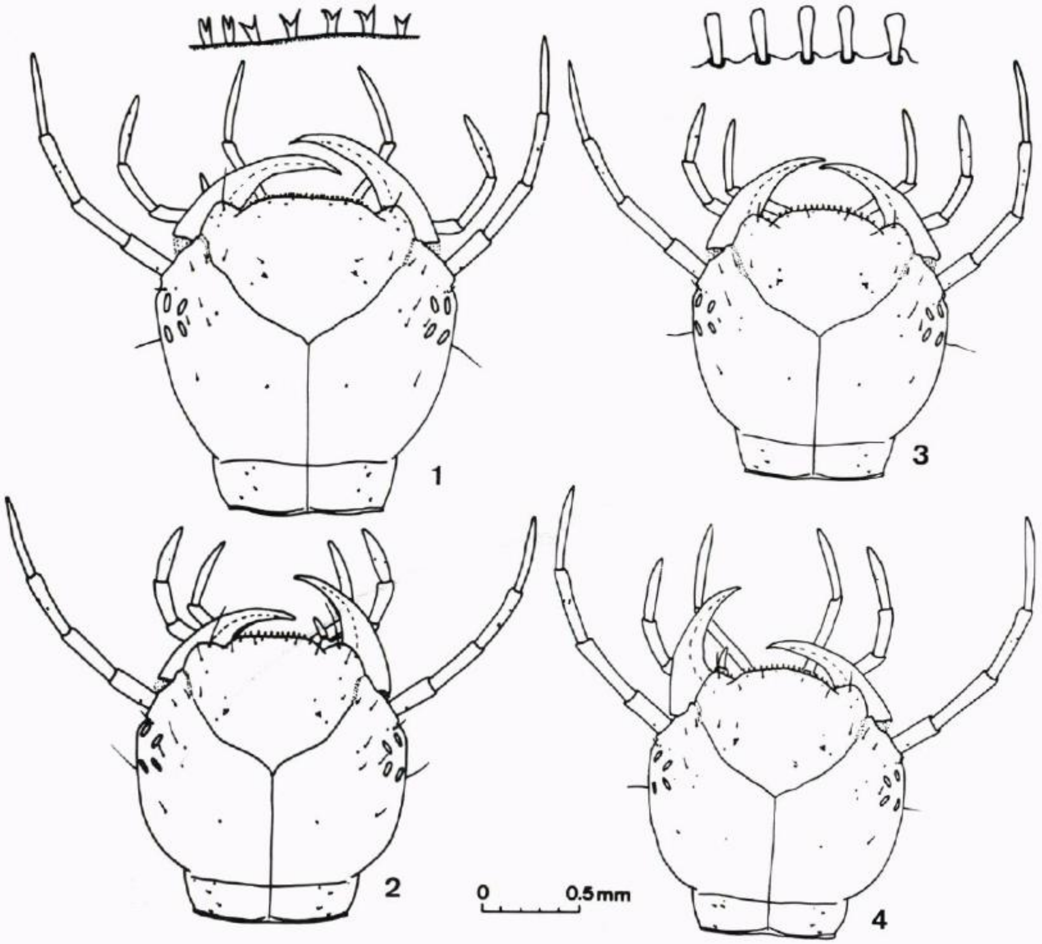
Galewski (1967) also described the pupa of *C. paykulli*. However, as the identity of his material was based on the examination of larval exuviae, it probably represents *C. striatus*. Further, Falkenström who had collected this material had identified it as *C. striatus*.

The main purpose of this paper is to enable the identification of larvae of all instars of the North European species of *Colymbetes*. Some observations on phenology and life history are presented also.

Methods and material

Dissected larvae were mounted in Euparal on glass slides or studied in alcohol with a Wild M11 transmission microscope or a Wild M5 stereomicroscope, both provided with a drawing tube and a micrometer eyepiece. Measurements and abbreviations are used as in Nilsson (1987). The nomenclature of leg sensilla follows Nilsson (1987).

Larvae of *C. dolabratus*, *C. paykulli* and *C. striatus* were collected from several localities in northern Sweden. Additional larvae of *C. dolabratus* were from Greenland and northernmost Norway. Besides a single third-instar larva from the Baltic Island of Gotland and one or two larvae of each instar from England, all *C. fuscus* larvae were from the Netherlands.



Figs 1–4. *Colymbetes*, first-instar larva, head, dorsal aspect. – 1. *C. paykulli* Er., with marginal clypeolabral setae magnified. – 2. *C. fuscus* (L.). – 3. *C. striatus* (L.), with marginal clypeolabral setae magnified. – 4. *C. dolabratus* (Payk.).

The identity of the larva of *C. paykulli* is based on several cases of co-occurrence of larvae and adults in a region where *C. striatus* is the only other species of the genus. As the description of the larva of *C. striatus* given by Galewski (1964) was based partly on larvae reared from eggs laid in captivity, their identity must be regarded as certain. The identity of the larvae of the other three species is based on Galewski's (1964, 1968) descriptions in combination with co-occurrence of larvae and adults, partly with species in allopatry.

The studied material is deposited in the collections of the authors.

General remarks

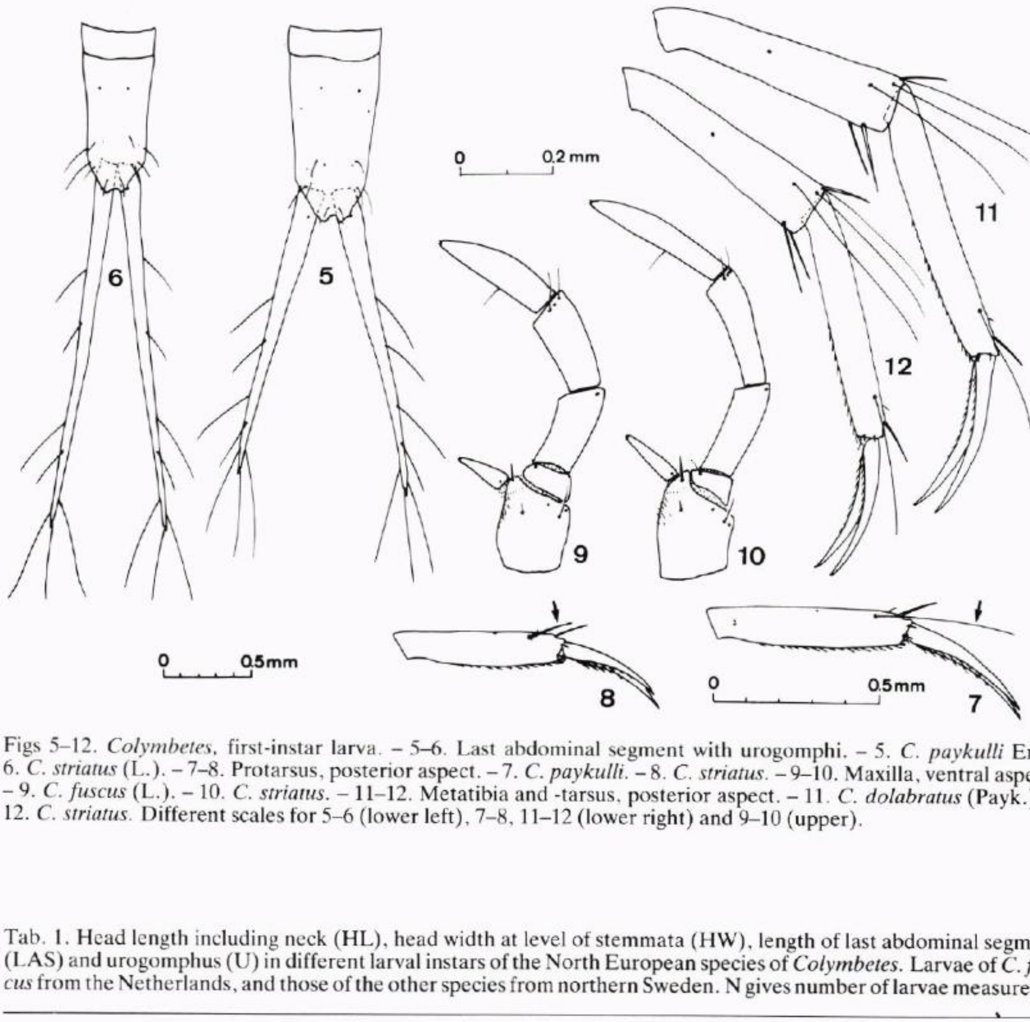
For a general description of *Colymbetes* larvae we refer to Galewski (1964). The similarity with the larvae of *Rhantus* (s.str.) Dejean is striking. The separating characters given earlier (Nilsson 1987) are useful, but the number of PD femoral setae in the two later instars should be used with some caution as variation in *Colymbetes* is considerable.

The primary leg setation of *Colymbetes* larvae shows a few constant differences from that of *Rhantus*. Besides the lack of additional tarsal setae and the spiniform shape of the upper PDi seta on all femora in *Colymbetes* mentioned earlier (Nilsson 1987), also the tibiae lack the additional setae present in AV and PV series in *Rhantus*. The secondary setal series on the legs are the same in both genera, and as variation in setal numbers is considerable, these characters have a low diagnostic value.

In the first-instar larvae, the bifurcate shape of the marginal clypeolabral setae in *C. paykulli* is characteristic, and evidently apotypic. Otherwise most diagnostic characters within the genus are gradual. The general similarity in larval morphology among the *Colymbetes* species makes a separate description of the *C. paykulli* larva unnecessary. The characters that separate it from the other species are illustrated and given in the key. Further, some important measurements are listed in Tab. 1.

Key to larvae of North European Colymbetes

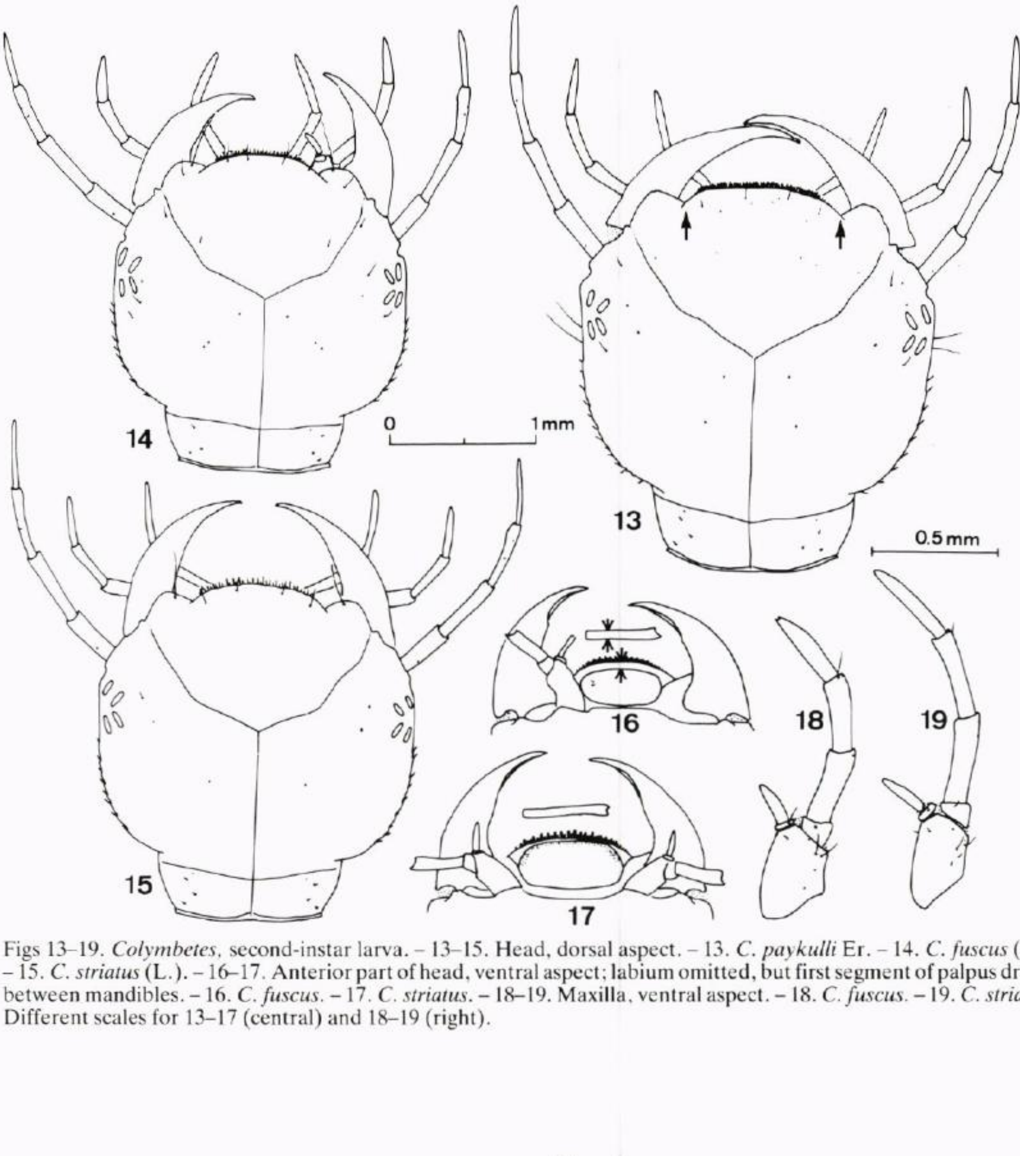
1. Frontoclypeus with pair of small hatching tubercles (Figs 1–4). Urogomphus with seven primary setae only (Figs 5–6). Legs without secondary PD setal fringes (**First instar**). 2
- Frontoclypeus without hatching tubercles (Figs 13–15). Urogomphus with numerous secondary setae (Figs 20–21). Legs with secondary PD setal fringes. 5
2. Anterior clypeolabral margin inside lateral angles more or less straight, and with 25–30 short and bifurcate lamelliform setae (Fig. 1). Urogomphus short, U/LAS 1.7–2.0 (Fig. 5). Protarsal seta no. 7 as long as tarsal claws (Fig. 7). Head width at stemmata 1.5–1.6 mm. .... *paykulli*
- Straight or curved anterior clypeolabral margin inside lateral angles with 13–20 long and apically rounded lamelliform setae (Figs 2–4). Urogomphus long, U/LAS 2.2–2.7 (Fig. 6). Protarsal seta no. 7 in most specimens much shorter than tarsal claws (Fig. 8). Head width 1.4 mm or less 3
3. Maxillary palpus short, apical segment about 5× as long as broad (Fig. 9); apical segment of galea about as long as apical width of first segment of maxillary palpus (Fig. 9). .... *fuscus*
- Maxillary palpus long, apical segment at least 5.5× as long as broad (Fig. 10); apical segment of galea evidently longer than apical width of first segment of maxillary palpus (Fig. 10). 4
4. Each tarsus evidently longer than tibia, ratio between tarsal and tibial length 1.06–1.10 (Fig. 11, measured along dorsal margin). Lateral outline of head rather abruptly narrowed posteriorly to neck (Fig. 4). .... *dolabratus*
- Each tarsus of about same length as tibia, ratio between tarsal and tibial length 1.01–1.03 (Fig. 12). Lateral outline of head evenly narrowed posteriorly to neck (Fig. 3). .... *striatus*
5. Abdominal segments 1–6 with non-functional, closed, obsolete spiracles (**Second instar**) 6
- Abdominal segments 1–6 with functional, distinct spiracles present laterally on each tergum (**Third instar**) 9
6. Anterior clypeolabral margin inside lateral angles more than 2× as long as antennomere 2 (Fig. 13). Head width at stemmata 2.4–2.6 mm. Urogomphus short, U/LAS 1.3–1.5 (Fig. 20). Metatibia with 1–2 secondary P spines (Fig. 22) .... *paykulli*
- Anterior clypeolabral margin inside lateral angles less than 2× as long as antennomere 2 (Figs 14–15). Head width at stemmata 2.2 mm or less. Urogomphus long, U/LAS 1.6 or more (Fig. 21). Metatibia in most specimens without secondary P spines (Fig. 23) 7
7. Anterior clypeolabral margin in ventral view about as broad as width of first segment of labial palpus (Fig. 16). Palpi thicker, apical segment of maxillary palpus less than 5× as long as broad (Fig. 18). Protarsus with 3–4 secondary AV spines .... *fuscus*
- Anterior clypeolabral margin in ventral view distinctly narrower than width of first segment of labial palpus (Fig. 17). Palpi slender, apical segment of maxillary palpus about 6× as long as broad (Fig. 19). Protarsus with 5 or more secondary AV spines 8
8. Urogomphus longer, U/LAS 2.0–2.2. Outer margin of urogomphus with 4–10 spiniform, yellow setae dispersed along entire length together with numerous black setae. Legs slender, width of metatarsus at level of primary spine no. 2 subequal to or narrower than length of spine (Fig. 24) .... *dolabratus*
- Urogomphus shorter, U/LAS 1.6–1.8. Outer margin of urogomphus with 0–3 spiniform setae in basal half together with numerous black setae. Legs less slender, width of metatarsus at level of primary spine no. 2 exceeding length of spine (Fig. 25) .... *striatus*
9. Inner margin of mandible with weak median tooth (Fig. 26). Anterior clypeolabral margin in ventral view thicker than width of first segment of labial palpus (Fig. 16) .... *fuscus*
- Inner margin of mandible without median tooth (Figs 27–28). Anterior clypeolabral margin in ventral view narrower than width of first segment of labial palpus (Fig. 17) 10
10. Anterior clypeolabral margin long, inside lateral angles 2.4–2.5× as long as antennomere 2 (Fig. 27). Head with at stemmata 3.4–3.7 mm, lateral outline subparallel (Fig. 27). Metatibia in most specimens with 1–3 secondary P spines (Fig. 22). Urogomphus with 45–50 setae along outer margin (Fig. 29) .... *paykulli*
- Anterior clypeolabral margin short, inside lateral angles 1.9–2.2× as long as antennomere 2 (Fig. 28). Head width at stemmata 3.3 mm or less; lateral outline often converging anteriorly (Fig. 28). Metatibia without secondary P spines. Urogomphus with 35 or less setae along outer margin (Figs 30–31) 11
11. Larva larger, head width at stemmata 3.2–3.3



Figs 5–12. *Colymbetes*, first-instar larva. – 5–6. Last abdominal segment with urogomphi. – 5. *C. paykulli* Er. – 6. *C. striatus* (L.). – 7–8. Protarsus, posterior aspect. – 7. *C. paykulli*. – 8. *C. striatus*. – 9–10. Maxilla, ventral aspect. – 9. *C. fuscus* (L.). – 10. *C. striatus*. – 11–12. Metatibia and -tarsus, posterior aspect. – 11. *C. dolabratus* (Payk.). – 12. *C. striatus*. Different scales for 5–6 (lower left), 7–8, 11–12 (lower right) and 9–10 (upper).

Tab. 1. Head length including neck (HL), head width at level of stemmata (HW), length of last abdominal segment (LAS) and urogomphus (U) in different larval instars of the North European species of *Colymbetes*. Larvae of *C. fuscus* from the Netherlands, and those of the other species from northern Sweden. N gives number of larvae measured.

Instar and species	N	HL		HW		LAS		U	
		x̄	SD	x̄	SD	x̄	SD	x̄	SD
First instar									
dolabratus	5	1.30	.06	1.28	.04	.65	.04	2.01	.10
fuscus	11	1.22	.08	1.19	.07	.64	.03	1.70	.17
paykulli	9	1.56	.05	1.54	.03	.89	.05	1.72	.10
striatus	8	1.30	.05	1.26	.06	.72	.05	1.94	.17
Second instar									
dolabratus	8	2.02	.06	1.93	.03	1.33	.05	2.89	.09
fuscus	7	2.11	.08	2.01	.06	1.50	.07	2.72	.27
paykulli	7	2.53	.06	2.50	.08	1.83	.10	2.56	.19
striatus	10	2.13	.10	2.01	.08	1.62	.05	2.66	.11
Third instar									
dolabratus	7	2.93	.15	2.80	.11	2.36	.17	3.52	.22
fuscus	4	3.31	.18	3.19	.15	2.62	.15	3.80	.33
paykulli	6	3.71	.21	3.61	.16	3.00	.14	3.44	.29
striatus	11	3.42	.11	3.24	.08	2.94	.16	3.29	.22



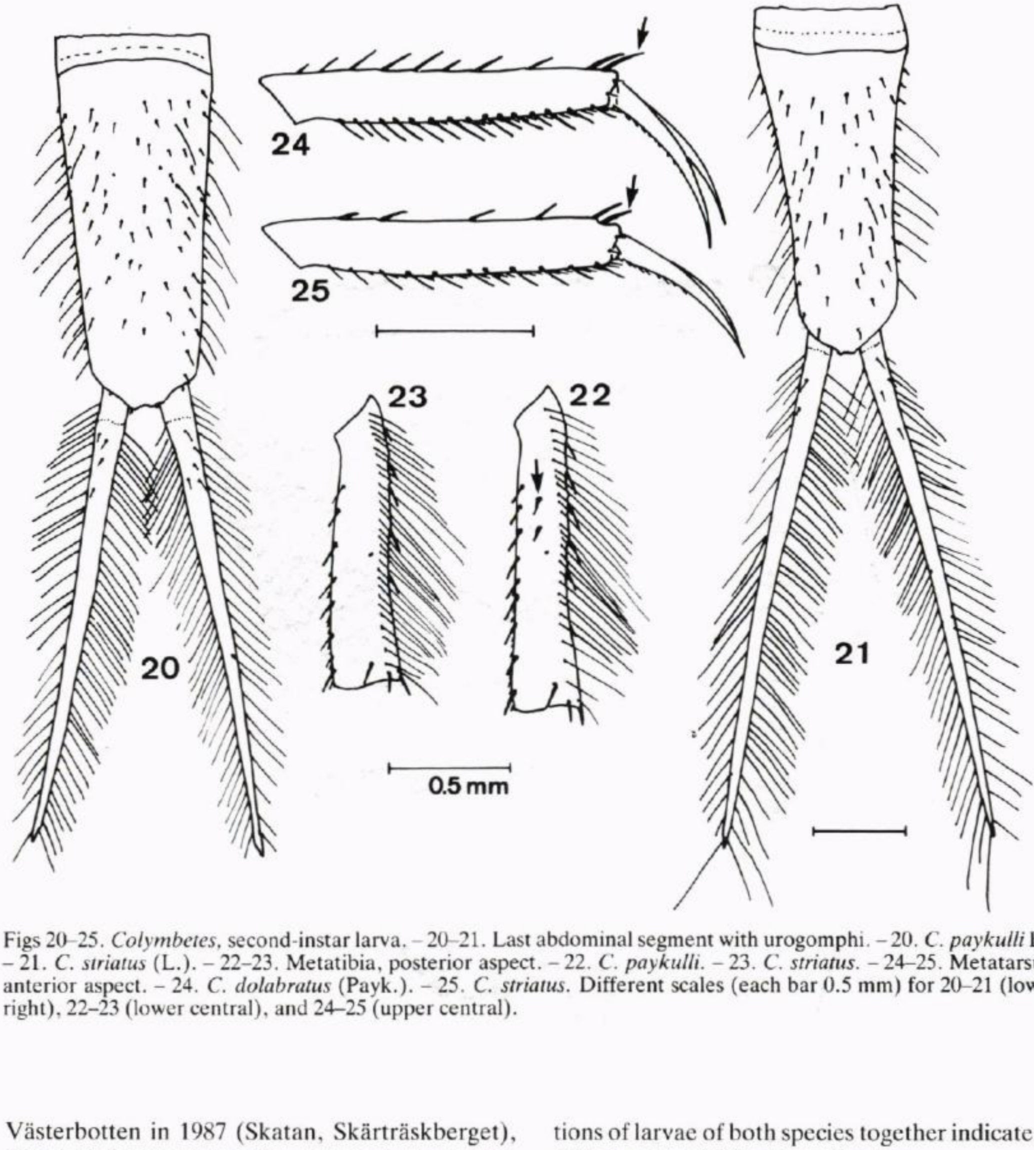
Figs 13–19. *Colymbetes*, second-instar larva. – 13–15. Head, dorsal aspect. – 13. *C. paykulli* Er. – 14. *C. fuscus* (L.). – 15. *C. striatus* (L.). – 16–17. Anterior part of head, ventral aspect; labium omitted, but first segment of palpus drawn between mandibles. – 16. *C. fuscus*. – 17. *C. striatus*. – 18–19. Maxilla, ventral aspect. – 18. *C. fuscus*. – 19. *C. striatus*. Different scales for 13–17 (central) and 18–19 (right).

mm. Head ventrally brownish with distinct yellow spots. Outer margin of urogomphus in most specimens with 3 or less spiniform, yellow setae (Fig. 30). Temporal spines evidently shorter than secondary D spines of protibia and -tarsus .... *striatus*

– Larva smaller, head width at stemmata 2.9 mm or less. Head ventrally testaceous, without distinct colour-pattern. Outer margin of urogomphus in most specimens with 4 or more spiniform, yellow setae (Fig. 31). Temporal spines, at least basally, of about same length as secondary D spines of protibia and -tarsus .... *dolabratus*

Phenology

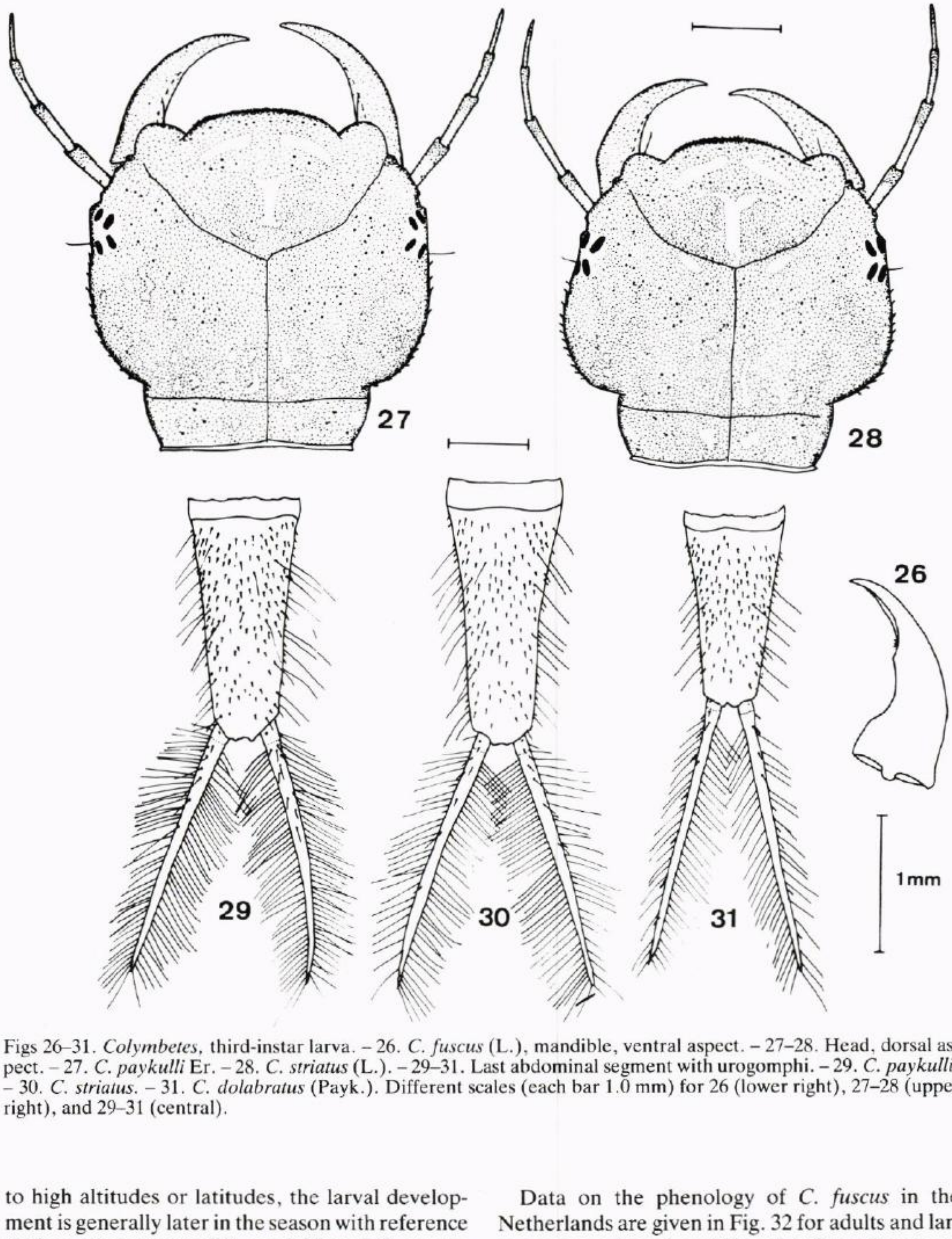
In northern Sweden, larvae of *C. paykulli* were collected from May to July with most records in June. The earliest record is 8 May 1979 when all three instars were taken together in a bog ditch near Umeå (VB). Generally, instars I and II appear from late May to early June, and instar III from early June to early July. Deviations from this pattern are caused by regional and interannual differences in spring development. Results from a detailed study of a seasonal fen in the province



Figs 20–25. *Colymbetes*, second-instar larva. – 20–21. Last abdominal segment with urogomphi. – 20. *C. paykulli* Er. – 21. *C. striatus* (L.). – 22–23. Metatibia, posterior aspect. – 22. *C. paykulli*. – 23. *C. striatus*. – 24–25. Metatarsus, anterior aspect. – 24. *C. dolabratus* (Payk.). – 25. *C. striatus*. Different scales (each bar 0.5 mm) for 20–21 (lower right), 22–23 (lower central), and 24–25 (upper central).

Västerbotten in 1987 (Skatan, Skärträskberget), based on handnet samples collected at approximately ten day intervals during the ice-free season (late April to October), are shown in Tab. 2. As this summer was very rainy, water was present during the whole summer. Larvae were present only from 31 May to 26 June. The seasonal occurrence of larvae of *C. striatus* at the same site (Tab. 2) is very similar to that of *C. paykulli*, with larvae present from 7 to 16 June. Data on *C. striatus* from other northern Swedish localities reveal no important differences with respect to larval phenology when compared to *C. paykulli*. Frequent observations of larvae of both species together indicate no difference in distribution of instars.

Data on *C. dolabratus* are more scarce, with the first two instars collected 20 June 1987 at Ammarnäs (LY) and 8 July 1983 at Tjallingenjaure (ÅS, 920 m ASL). Near Abisko (TO), two instar II larvae were collected 28 July 1983, and at Padjelanta (LU) they were collected 13 and 18 July at altitudes of 680 and 580 m ASL respectively. Records of instar III are from late June to late July. These observations are consistent with the data from Finnish Lapland presented by Eriksson (1972). As *C. dolabratus* is more or less confined



Figs 26–31. *Colymbetes*, third-instar larva. – 26. *C. fuscus* (L.), mandible, ventral aspect. – 27–28. Head, dorsal aspect. – 27. *C. paykulli* Er. – 28. *C. striatus* (L.). – 29–31. Last abdominal segment with urogomphi. – 29. *C. paykulli*. – 30. *C. striatus*. – 31. *C. dolabratus* (Payk.). Different scales (each bar 1.0 mm) for 26 (lower right), 27–28 (upper right), and 29–31 (central).

to high altitudes or latitudes, the larval development is generally later in the season with reference to the main pattern of *C. paykulli* and *C. striatus* described above. However, at Ammarnäs *C. dolabratus* and *C. paykulli* both had larvae of the first two instars on 20 June.

Data on the phenology of *C. fuscus* in the Netherlands are given in Fig. 32 for adults and larvae and are based on 223 and 118 specimens respectively. All data for the years 1974 to 1987 are pooled; samples were spread over the whole country. Adult specimens have been observed

Tab. 2. Seasonal occurrence of larvae of *Colymbetes paykulli*, *C. striatus*, and *Rhantus suturellus* in a seasonal fen in northern Sweden (VB: Skatan, Skärträskberget) in 1987. About every ten days five handnet samples were taken from late April to October. Water temperature was measured 5 cm below the surface at noon. Larval instars 1–3 are given as L1–3.

Species and instar		May 31	June 7	16	26	July 5
C. paykulli	L1	+	–	+	–	–
	L2	+	+	+	+	–
	L3	–	+	–	+	–
C. striatus	L1	–	+	–	–	–
	L2	–	+	–	–	–
	L3	–	+	+	–	–
R. suturellus	L1	–	+	–	+	+
	L2	–	+	+	+	+
	L3	–	–	–	+	+
Water temp.	°C	14.0	20.6	13.5	14.2	16.2

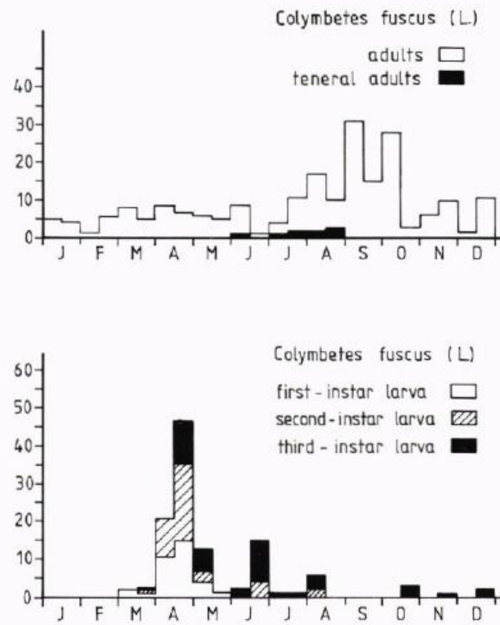


Fig. 32. Seasonal distribution of records of adults (top) and larvae (bottom) of *Colymbetes fuscus* (L.) in the Netherlands. Pooled data from 1974 to 1987 covering the whole country given in fortnightly intervals.

throughout the year with an obvious peak in abundance from August to the first half of October (Fig. 32). The small gap at the end of June and the beginning of July is remarkable for this is a period when much sampling has been done. Also the relatively high number of specimens in winter, when sampling intensity in comparison with March and April was low, is remarkable. Teneral adult specimens have been found in June and mainly July and August, though numbers are low.

Compared with the adults, larvae of *C. fuscus* have been found only during a limited period of the year (Fig. 32): instar I larvae have been found from March to May; instar II from April to the end of June; and instar III from the second half of April to early August. There are also a few observations of third instar larvae from the second half of October to December. The main larval period, however, lasts from April to June. The data for the Netherlands are in accordance with the observations of Galewski (1964) in Poland and Balfour-Browne (1950) in England. In France, however, Bertrand (1928) found larvae throughout the year, but mainly in autumn and winter.

Life history

Both Galewski (1964) and James (1970) suggested that the life cycle of *Colymbetes* is univoltine, with larval development in spring or early summer and overwintering adults only. Generally, this interpretation is corroborated by data on larval and adult phenology of *C. fuscus* in the Netherlands (Fig. 32). Here, teneral adults were observed from June to August, and the death of the foregoing generation is indicated by the few specimens collected in late June and early July (Fig. 32). The occurrence of larvae in October to December (Fig. 32) suggests a flexibility of the life cycle, and probably egg-laying starts already in autumn but is most intense in early spring. Further south, as in France, the larval development is mainly passed in autumn and winter, followed by pupation in spring (Bertrand 1928).

The data from northern Sweden on *C. dolabratus*, *C. paykulli* and *C. striatus* largely agree with *C. fuscus* in the Netherlands except that breeding and larval development are about two months later in the season. However, the longer winter at higher latitudes in combination with the temporary character of most breeding pools could make a univoltine life cycle impossible. Most often, the breeding pools are dry at the time of adult emergence, and pools are subsequently filled with water at most for a very short period in autumn when food is scarce (Nilsson 1986b). In this situation it is difficult to understand how the adults manage to feed and mate before they breed in early spring next year. Most probably, as suggested by James (1970) and Galewski (1971), emerging adults migrate to more permanent waters where they stay during winter. Following this ecological strategy, they belong to the "non-wintering spring migrants" of Wiggins et al. (1980). It should be emphasized, that the data at hand from northern Sweden cannot reject the possibility of a semivoltine life cycle. This pattern would emerge if the new adult generations stay in or near the pools where they have developed. In this case they probably would have to feed and mate their first spring, and delay their egg deposition to the following spring. A semivoltine life cycle seems necessary for *C. dolabratus* as in the arctic adults have been collected in pools of water on pack ice (Zimmerman 1981).

In order to establish the voltinism displayed by *Colymbetes* species at different latitudes, more attention must be payed to ovarian development and egg-laying behaviour.

Observations of *C. paykulli* and *C. striatus* in northern Sweden indicate that the larvae feed mainly on the larvae and pupae of *Aedes* mosquitoes. At the time of emergence of the *Colymbetes* larvae, the *Aedes* larvae have generally reached their third or fourth instar, and the larvae of the egg-overwintering *Agabus* species, the other important exploiters of this prey, are about ready for pupation. Galewski (1964) noted that in Poland the larval development of the genera *Colymbetes* and *Rhantus* was separated in time, with that of *Rhantus* later in the season. This is also generally the case in the Netherlands (Cuppen, unpublished). However, in northern Sweden, the species *R. suturellus* (Harris) often co-exists with *C. paykulli* and/or *C. striatus*. In this case the larval development of the two genera shows a considerable overlap, and in the pond referred to in Tab. 2, larvae of *R. suturellus* occurred from 6 June and onwards.

Nilsson (1986b) stated that in a seasonal pond, the larvae of *C. paykulli* fed mainly on mayfly larvae. However, when re-examined these larvae include both *C. paykulli* and, predominantly, *C. striatus*. Feeding experiments indicated that mosquito larvae and mayfly larvae are consumed at equal rates when served together (Söderström & Nilsson 1987).

Acknowledgements: We thank Ms L. Bondestad and Mr V. Jussila, Umeå, for valuable help in obtaining young larvae of *C. dolabratus*. Ms E. Engblom and Mr P.-E. Lingdell, Tyresö, provided us with larvae of *C. dolabratus* from northern Sweden and Greenland. Mr R. Carr, Maidstone, and Dr G. N. Foster, Prestwick, kindly sent us larvae of *C. fuscus* from England. Dr D. J. Larson, St. John's, helped us improve the manuscript.

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Sammanfattning

De fyra nordeuropeiska *Colymbetes*-arternas larver har tidigare ej kunnat artbestämmas m h a tillgänglig litteratur. Speciellt har larven till *C. paykulli* Erichson varit okänd. I denna uppsats ges en bestämningstabell till alla fyra arternas tre larvstadier, och flera nya karaktärer presenteras. Vidare redovisas arternas fenologi i norra Sverige och Nederländerna. Arternas livscykler diskuteras. Ytterligare studier är nödvändiga för att avgöra om och under vilka förhållanden livscykeln är ett- eller två-årig.

Recension

Lucht, W. H. 1987. *Die Käfer Mitteleuropas. Katalog*. Goecke & Evers Verlag, Krefeld. ISBN 3-87263-035-0. 342 s. Pris 112 DEM.

Denna centraleuropeiska skalbaggskatalog är utgiven som ett tilläggsband till det tyska bestämningsverket "Die Käfer Mitteleuropas" (DKM). Katalogen följer också den systematik och nomenklatur som använts i DKM till punkt och pricka. Detta är i min mening en stor svaghet, då det medför att denna del av katalogen är starkt föråldrad. I förordet anges att särskilda tilläggsband skall komma att behandla de nödvändiga korrigeringarna av nomenklatur och systematik.

Samtliga i katalogen upptagna familjer, släkten och arter har försetts med egna sifferkoder med tanke på databehandling. I detta system, vilket beskrivs ingående i förordet, får varje art en sifferkombination som representerar familj, släkte och art. Med tanke på stabiliteten hos denna "Numeroklatur" har den utformats så att nya arter kan tillföras, namn kan ändras osv. I jämförelse med de bokstavskoder som används i svenska kataloger kan det tyska systemet här ge en fördel då sifferkoderna är oberoende av artnamnen. Faran är väl bara att systemet blir alltför komplicerat när väl alla nödvändiga ändringar gjorts.

I katalogen ges den artvisa utbredningen som förekomst i Tyskland och angränsande områden i de fyra väderstrecken. Det norra området innefattar Danmark och Sydsverige (= Sk–Ds), vilka behandlas var för sig. Den något lustiga avgränsningen av Sydsverige sägs följa nordgränsen av den eurosibiriska, sommargröna lövskogszonen.

För att få ett mått på tillförlitligheten på utbredningsuppgifterna vad gäller Sydsverige har jag närmare granskat familjen Dytiscidae. Det med DKM identiska arturvalet leder ibland till inkonsekvenser. T ex finns *Colymbetes dolabratus* med – trots att ju arten saknas i det innefattade området. Istället saknas i katalogen *Laccophilus stroehmi* som ju faktiskt förekommer i Bohuslän och därmed i Sydsverige. Arter vilka i ett område endast har påträffats före 1910 har markerats med –, övriga med +. För vår del innebär detta att markeringen för *Hydroporus brevis* skall ändras från + till –. En annan miss är att *H. glabriusculus* ej markerats för Sydsverige, där den dock påträffats i sex av de innefattade landskapen. Till sist borde även *Agabus didymus* markerats som funnen i Sydsverige före 1910 då den beskrevs av Paykull härifrån som *Dytiscus vitreus*.

Luchts katalog är en trevligt utformad sammanställning över Centraleuropas skalbaggsarter vars användbarhet dock starkt begränsas av den föråldrade nomenklaturen och systematiken.

Anders Nilsson

Upprop

Förra året startade SNF och Fältbiologerna ett projekt som går ut på att inventera samtliga rätvingearter i Sverige och på att närmare undersöka och analysera biotopvalet hos några arter som förekommer med små isolerade populationer. Vi vill nu gärna ha in uppgifter om observationer för följande arter: *Chrysocraon dispar, Leptophyes punctatissima, Metrioptera roeseli, Gryllotalpa gryllotalpa, Psophus stridulus, Sphingonotus caerulans* och *Meconema thalassinum*. Vi önskar också få kontakt med entomologer som arbetat med rätvingar och som har samlingar eller lokaluppgifter om andra arter.

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