

Variation in some scoliid wasps of the French Mediterranean coast (Hymenoptera: Scoliidae)

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Abstract: Six species of Scoliidae, many of them collected in large quantities in the vicinity of Salins d'Hyères (Var, France), and in Argelès-sur-Mer (Pyrénées Orientales), were studied. The *haemorrhoidalis*-form of *Megascolia flavifrons* showed an explosive expansion in Salins d'Hyères and not in Argelès. Male *Scolia hirta* var. *unifasciata* as well as many males intermediate between *unifasciata* and *bifasciata* have been found. In Salins d'Hyères *Scolia fuciformis* is much more abundant than hitherto described. The colour pattern of *Colpa interrupta* is strongly variable. A male of *Colpa quinquecincta* with an incomplete separation of cubital cells 2 and 3, as well as females with three cubital cells are described.

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Introduction

Six species of Scoliidae: *Megascolia flavifrons*, *Scolia hirta*, *S. fuciformis*, *S. sexmaculata*, *Colpa interrupta* and *C. quinquecincta* have been collected, mainly during the months of July of 1982 to 1986, in the south of France, east of Toulon, near Salins d'Hyères, and recently also in the vicinity of Argelès-sur-Mer. For Salins d'Hyères the above mentioned species probably represent the complete scoliid-fauna, for Argelès this cannot be said with certainty.

The most extensively studied wasp is *Megascolia flavifrons* (fig. 1), of which the *haemorrhoidalis*-form (fig. 2) has been found

in Salins d'Hyères, for the first time in 1982 (Piek, 1986). For a recent review of nomenclature see Hamon (in press).

Megascolia flavifrons (Fabricius, 1775) (figs. 1-4, tables 1-2)

This is Europe's largest wasp, found in France in the mediterranean area and in Landes (fig. 1). The wasp is very abundant in the Provence, Languedoc and Roussillon. It was generally assumed that the forma typica was restricted to the Languedoc, the Provence and Corse, and that the red-brown haired *M. flavifrons hae-*



Fig. 1. Females of *Megascolia flavifrons* on artichoke in the vicinity of Salins d'Hyères.

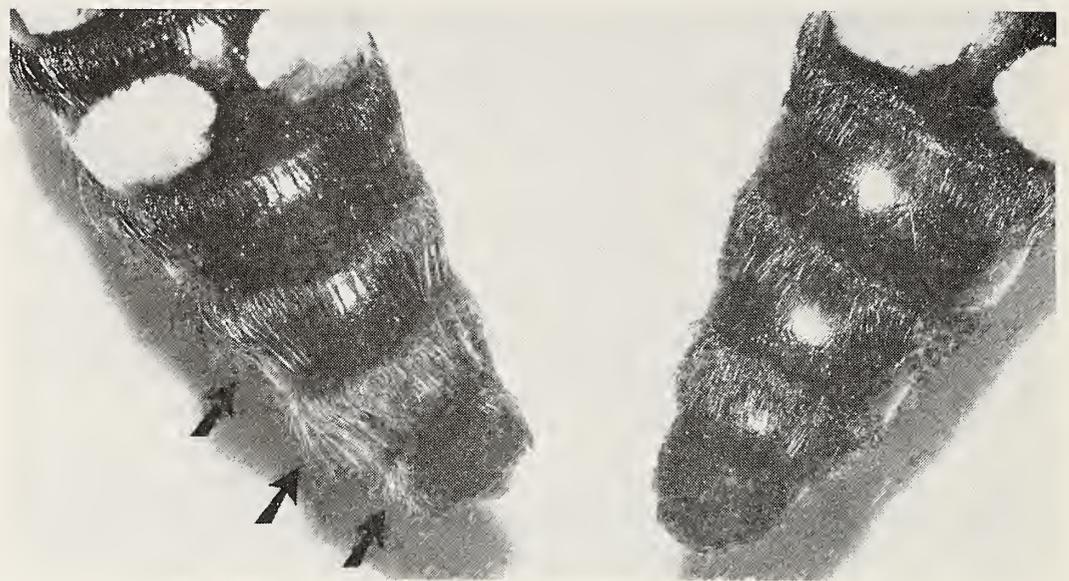


Fig. 2. Part of the gaster of *Megascolia flavifrons* from Salins d'Hyères. Left: forma *haemorrhoidalis*; right: forma typica. Arrows point to the red brown setae. Photograph taken with yellow (3X) filter.

morrhoidalis (Fabricius, 1787) was only found in the adjacent areas of Landes and the Balkans. However, the presence at low frequency of the *haemorrhoidalis* form has been described for the Provence too (Piek, 1986). Moreover, one specimen of *M. f. haemorrhoidalis* has been reported from Montpellier in the Languedoc (Berland, 1925), and a series of twelve males from Agay (Var, France) in the collection of the British Museum (Natural History) includes a single male, collected in June 1930, showing brown red setae on the tergites 5, 6 and 7.

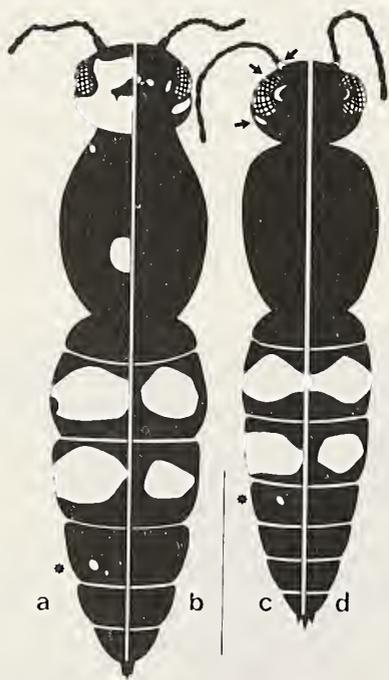


Fig. 3. Colour patterns of the integument of *Megascolia flavifrons*. Examples of the most (a) and least (b) coloured female, and most (c) and least (d) coloured male. Arrows point to yellow spots at the male head. Asterisks indicate the occasional yellow spots at T₄. (Bar 1 cm)

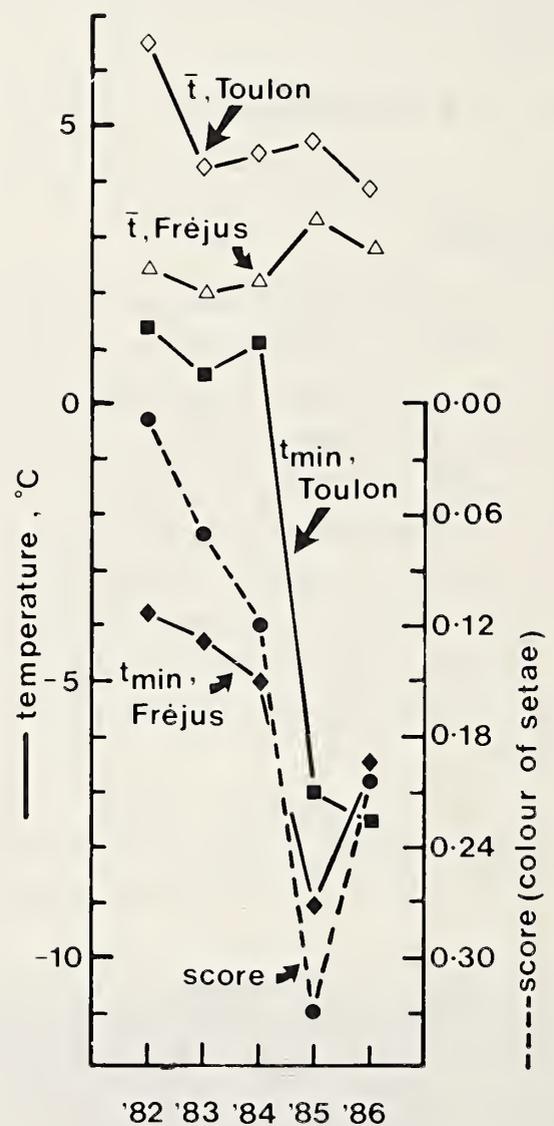


Fig. 4. Plot of the average and the minimum temperatures of the coldest months recorded at Toulon (Var, France) and Fréjus (Var, France), for five subsequent years, and the reversed scoring points (according to table 2) for the colouring of setae of female *Megascolia flavifrons* collected in the same years. Note the remarkable coincidence of the decrease in minimum temperatures and the increase in colouration of setae. [Temperatures from: Résumé mensuel du temps en France. Ministère des transports. Published by Direction de la météorologie, 77 rue de Sèvres-92106 Boulogne-Billancourt Cédex, France.]

Table 1. Evaluation of colour patterns of females of *Megascolia flavifrons*

Integument	Setae		
<i>Head</i>			
Spots on subvertex (frons) and vertex (behind the eye)	0	Completely black	0
About half the vertex and subvertex dark-yellow	1	Red setae on vertex	1
Vertex and subvertex nearly completely dark-yellow	2		
<i>Thorax</i>			
Completely black	0	Completely black	0
Small or hardly visible dark-yellow spots on scutellum	1	Red setae on the posterior margin of the pronotum	1
Large spots on scutellum	2		
Also spots on the pronotum	3		
<i>Gaster</i>			
Spots on T ₂ and T ₃	0	Completely black	0
Band or just fused spots on T ₂ and spots on T ₃	1	Red setae on T ₅ and/or T ₆	1
Bands on T ₂ and T ₃	2	Red setae on T ₄ -T ₆	1
Bands on T ₂ , band or spots on T ₃ , and small spot(s) on T ₄	3	Red setae on T ₃ - T ₆	3

Table 2. Colour patterns of integument and setae of females of *M. flavifrons* from Salins d'Hyères and Argelès-sur-Mer (1986*), according to the scoring system of table 1. n = number of observations; \bar{x} = mean of scores; SEM = standard error of the mean. Note the explosive increase in colouring of the abdominal setae in Salins d'Hyères, and the differences in colouring of the integument between Salins d'Hyères and Argelès.

	Head			Thorax		Gaster	
	n	\bar{x}	SEM	\bar{x}	SEM	\bar{x}	SEM
<i>Integument:</i>							
1982	75	1.69	0.07	1.25	0.08	0.61	0.08
1983	86	1.72	0.06	1.04 ¹	0.06	0.42	0.07
1984	101	1.73	0.05	1.03 ¹	0.08	0.55	0.05
1985	101	1.63	0.06	1.30	0.06	0.75	0.06
1986	128	1.88	0.03	1.47	0.06	0.74	0.06
1986*	66	2.00 ²	0.02	1.67	0.08	1.35 ²	0.10
<i>Setae:</i>							
1982	75	0.00	—	0.00	—	0.01	0.01
1983	86	0.00	—	0.01	—	0.07	0.04
1984	101	0.00	—	0.01	0.01	0.12	0.04
1985	101	0.00	—	0.01	0.01	0.33 ²	0.07
1986	128	0.00	—	0.06	0.02	0.20	0.04
1986*	66	0.00	—	0.00 ³	—	0.00 ⁴	—

1, significantly different from the other years ($p = 0.05$); 2, significantly different from all preceding values; 3, significantly different from the preceding value; 4, significantly different from the two preceding values.

As well as differences in the colour of the setae, this species shows marked differences in colouring of the integument. The female of *M. flavifrons* is a black wasp with the dorsal part of the head dark orange-yellow, which often has two spots of the same colour on the scutellum, and four yellow spots on the second and third gastral tergites. The males show only very small spots on the head and no spots on the thorax (fig. 3).

Table 1 gives the evaluation of colour patterns of *M. flavifrons* females in a scoring system. Table 2 gives the scores of the colour patterns of females of *M. flavifrons* collected in July from 1982 to 1986, and evaluated according to the system described in table 1. Significant differences are present in colouring of the thorax between wasps collected in 1982, 1985 and 1986 on the one hand and in 1983 and 1984 on the other hand. The colour score of

gastral setae of wasps from Salins d'Hyères also shows large variation during the years of observation: the score of 1985 being significantly different from all preceding years.

The presence, at low frequencies, of the *haemorrhoidalis* form suggests that both this form and the forma typica may be based on less than absolute difference in allelic frequencies (Piek, 1986). However, a sudden appearance of the red-brown setae, not earlier reported for the Provence, might also have external causes. Since the years under observation are characterized by severe winters, a number of temperature parameters were compared with scores of table 2. A striking coincidence was seen when the scoring of colouring of setae was plotted reversely against the years of observation, together with the minimum temperatures recorded for two adjacent places, Toulon and Fréjus (fig. 4). Arguments against the idea that the relatively cold winters may have caused the presence of the *haemorrhoidalis* form in the Provence are (1) no coloured setae have been found in Argelès after a comparable cold winter in 1986, (2) no observations of the forma typica are known from Landes, also not after mild winters.

Males have been observed at a much lower number. In Salins d'Hyères twelve out of sixteen were black-haired and four had small areas of red-brown setae at the gastral apex. As far as the limited number of observations on

males may allow statistical treatment, no differences can be observed between the years of observation.

Scolia hirta (Schrank, 1781)

(fig. 5)

This wasp is distributed over southern Europe: Spain, Italy, the Balkan, France (south of Paris), as well as in eastern Germany, Poland and Russia. The northern border of distribution probably coincides with the July-isotherm of 18 °C (Betrem, 1961). *S. hirta* shows a remarkable variation in colour pattern (fig. 5).

Vogrin (1915) has described three variations, in the range from a beginning of separation within the T₂ band to a complete lack of colouring on T₂. Since, according to Betrem (1935) the last form is present in Corse and Italy, and is seldom seen in the Donau-region and the south of France, he considered this form as a subspecies *unifasciata* Cyrillo, 1787 (Betrem & Chester Bradley, 1964).

In Salins d'Hyères the author has found in 1986 two out of twenty males with a reduced band on T₂ (fig. 5e) and a single male with a completely black T₂ (fig. 5f). In Argelès he has collected in the same year thirty males including a single male with a reduced band on T₂ and seven males with a completely black T₂. Moreover, two males with a reduced band on T₃ and a more or less normal band on T₂ (fig. 5d) have been found in the latter area. All females collected in 1986 in both areas as well as the females collected in four preceding years were bifasciate (fig. 5a). Only two females showed separation on the band on T₃ into two large spots (fig. 5b).

Females with only one band (on T₃), present in the collections of the Institute of Taxonomic Zoology, (Amsterdam), and of the British Museum, all originate from Corse, Malta, Sardina and Sicilia. However, *unifasciata* forms present in these collections and originating from the Iberian peninsula or from continental France (Provence), all are male. Moreover, Bernard (1935) has described a single male *S. hirta* var. *unifasciata* Cyrillo, 1787, collected

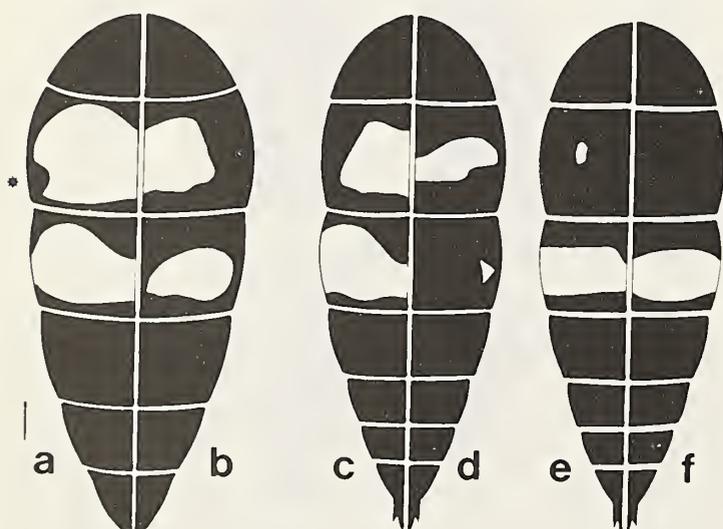


Fig. 5. Colour patterns of *Scolia hirta*, female (a,b) and male (c-f). The often described typical inflexion of the yellow spot at T₂ of the female (asterisks) is not always present. The colour patterns of the males are very variable: (f) represents the *unifasciata* form. (Bar 1 mm)

in June in St Raphael (about 50 km east of Salins d'Hyères).

Since the male *unifasciata* form as well as male *bifasciata* intermediate forms are present in the south of France and these males are present in one and the same area, there is no reason to distinguish a subspecies *unifasciata*. As the *unifasciata* factor might be sex-linked at the French continent and the Iberian peninsula, and obviously not in Corse and Sardinia, it is uncertain whether the colour variations found in these two area are comparable.

***Scolia fuciformis* (Scopoli, 1786)**
(fig. 6)

Although Berland (1925) described this species to be not common, and Bernard (1935) mentioned only a single female collected near St Aygulf and Villepey (about 50 km east of Salins d'Hyères), this species is now very abundant in the latter area. In 1976, for example, I collected more than 200 of these wasps in one week from an area of about one hectare camping site (Le Pansard, La Londe les Maures). In July the females were flying close to the ground, and digged in the late afternoon for

finding a sleeping site. I have found them often at a depth of about 20 cm, but never with a beetle larva. Oviposition might occur later in the summer.

Possibly due to the fact that Berland (1925) only knew four males and one female, he described the colour pattern to be rather constant, which is not true (fig. 6). The males show more variation than the females.

***Scolia sexmaculata* (O. F. Müller, 1766)**
(fig. 7)

According to Betrem (1936) the form which is normally found in France is *S. sexmaculata* var. *quadripunctata* Fabricius, 1775. This form is characterized by four pale-yellow spots on the tergites 2 and 3 (fig. 7c). The spots on the head (scape and inner rim of the eye) are variable (figs. 7a, b, arrows). Often a small spot is present on tergite 4 (fig. 7d) (*S. sexmaculata* var. *sixpunctata* Rossi, 1792). According to Betrem (1935), this latter variety is found everywhere in southern Europe, and probably all colour forms are present everywhere this species is found in France (Hamon, personal communication).



Fig. 6. Colour patterns of *Scolia fuciformis*. Examples of most (a) and least (b) coloured female, and most (c) and least (d) coloured male. Note the spots sometimes visible at the vertex of the female, and the spots sometimes present at the pronotum and scapulae of the male (arrows). (Bar 1 mm)

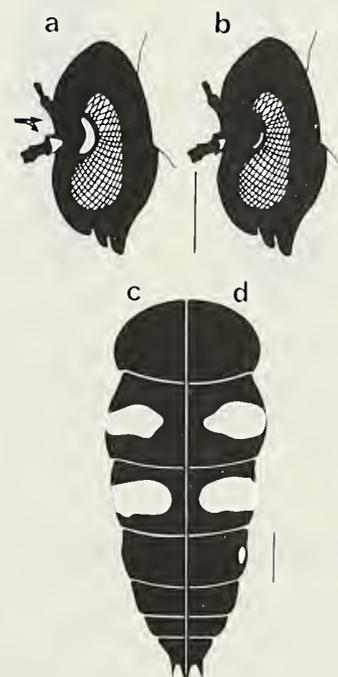


Fig. 7. Colour patterns of *Scolia sexmaculata*. Examples of most (a) and least (b) coloured head: c, normal pattern of *S. sexmaculata* var. *quadripunctata*, which has pale-yellow spots; d, example of *S. sexmaculata* var. *sixpunctata*. (Bars 1 mm)

***Colpa interrupta* (Fabricius, 1782)**
(fig. 8)

The genus *Colpa* is represented in the south of France by two species, *interrupta* (Fabricius, 1782) and *quinquecincta* (Fabricius, 1793). These two members of the subfamily of Campsomerinae have been earlier classified in the genus *Elis*. It is believed that all members of this genus paralyse larvae of Scarabaeidae (Kurzewski, 1963), as has been also described for the genus *Scolia*. Campsomerinae, the Old World species in particular, are characterized by such a marked sexual dimorphism that it is sometimes very difficult to establish which males and females belong together (Betrem, 1967). Fig. 8 shows the range of colour pattern of both females and males of *C. interrupta*. Females are yellow, males are pale-yellow. Especially the females belong to the most variably coloured Scoliidae of the south of France.



Fig. 8. Colour patterns of *Colpa interrupta*. Examples of most (a) and least (b) coloured female, and most (c) and least (d) coloured male. Females are yellow, males are pale-yellow. (Bar 1 cm)

***Colpa quinquecincta* (Fabricius, 1793)**
(figs. 9-10)

This species is abundant in the second half of July and in August. The female is not coloured, otherwise than by white hairs on all segments of the gaster. The male has a somewhat variable pale-yellow colour (fig. 9).

In the time that *C. quinquecincta* and



Fig. 9. Colour patterns of males of *Colpa quinquecincta*. Examples of most (a) and least (b) colouring. Note the spots on pronotum (open asterisk), mesonotum (black arrow), scutellum (open arrow) and on the legs (black asterisk). (Bar 1 cm)

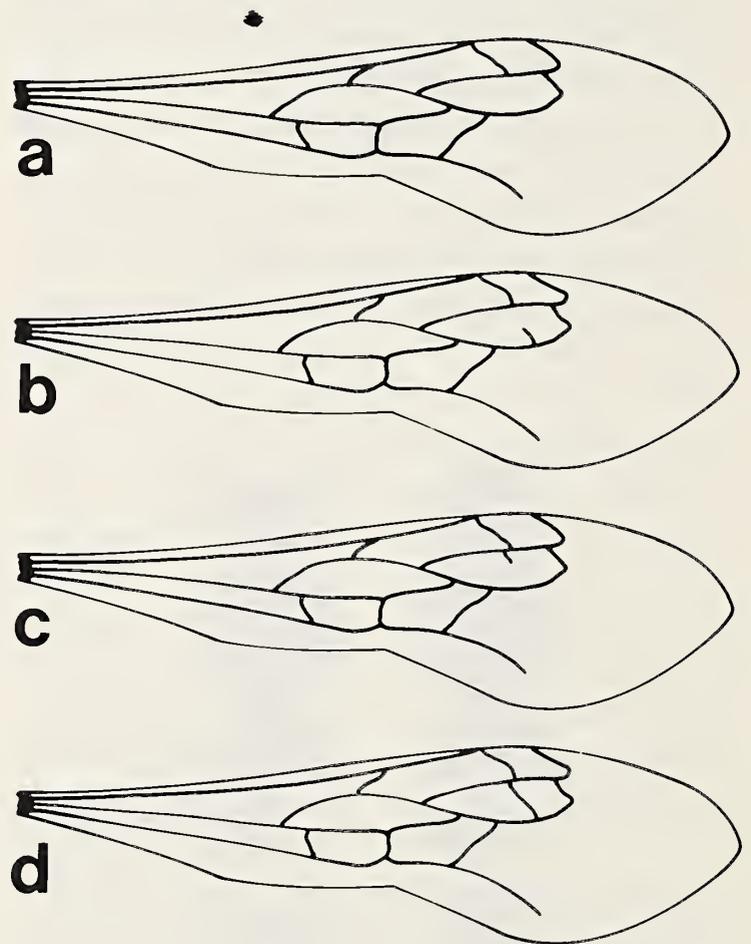


Fig. 10. Variation of wing nerves of *Colpa quinquecincta*. Frequencies of the types are as follows ("ab" means one wing of type "a", the other one of type "b"). ♀♀ : aa = 18, ab = 23, ad = 3, bb = 58, bd = 21, cd = 1, dd = 11; ♂♂ : cd = 1, dd = 64.

C. interrupta were attributed to *Elis*, this genus was subdivided into *Dielis* Saussure & Sichel, 1863, and *Trielis* Saussure, 1883 (Be-

trem, 1962a, b). This division was based on the presence of two, respectively three cubital cells. According to Berland (1925) *Colpa (Trielis) quinquecincta* forms an exception in that the male has three cubital cells, and the female two. This species was considered to belong to the genus *Trielis*.

However, the limited material collected near Salins d'Hyères shows a single male with an incomplete separation between the second and third cubital cell (fig. 10b). A larger amount of females collected in Argèles showed that it is not true that females of *C. quinquecincta* always have only two cubital cells. From 135 females only 18 had two wings with two cubital cells (fig. 10) and 117 wasps showed at least at one wing a partial separation into cubital cells 2 and 3. Only 11 wasps were found to have a complete separation of the cubital cells 2 and 3 at both wings.

A comparable reduction from three to two cubital cells has been described for the Middle-American species *Triscolia fervida* Burmeister (Micha, 1927). Evidently, this character is of no use for a generic subdivision.

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