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## Notes on *Polistes sulcifer* ZIMMERMANN 1930 in Croatia (Hymenoptera, Vespidae)

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**Abstract:** Distribution, biology and variability of socially parasitic paper wasp *Polistes sulcifer* ZIMMERMANN 1930 in Croatia are discussed. Seven new localities are added to its known distribution: two from Croatian Natural History museum collection, and five presented by unusually large number of specimens collected in August 1999, in southern Velebit mountain: 12 females and 222 males.

**Keywords:** *Polistes, sulcifer*, social parasite, biogeography, variability.

### Introduction

*Polistes sulcifer* ZIMMERMANN 1930 is one of the three known species of socially parasitic paper wasps, formerly placed in the subgenus *Sulcopolistes* BLÜTHGEN 1938, and subsequently raised to full generic status (BLÜTHGEN 1943). More recently, CARPENTER (1996 etc.) and many other authors, rejected the separate status of *Sulcopolistes*, and restored all the species to the only European genus, *Polistes*.

Social parasites exhibit interesting nesting behavior: they do not construct nest of their own, but usurp already built nest of *Polistes* species with hatched workers. After usurpation, in which resident queen is removed, workers continue to feed larvae, but the brood is progressively replaced by a parasite species.

Likewise many other parasitic species, abundance of *P. sulcifer* populations is usually low, possibly due to varying number of host nests available for usurpation. Biogeographical information is therefore poor, and any new record of this species is important.

Species is reported from many southern and central European countries (ZIMMERMANN 1930; BLÜTHGEN 1943, 1961; TOBIAS 1978; GAYUBO 1979; GUSENLEITNER 1981; etc.). In Croatia, VOGRIN (1955), CETKOVIĆ (1985, 1996b) and CETKOVIĆ & RADOVIĆ (1996) reported it from few localities, following ZIMMERMANN's (1930) record in species description.

All *Polistes* species are very variable (ZIMMERMANN 1930, 1931; GUIGLIA 1972; POLASEK 1997), sometimes with „characteristic“ features of two, or even more species occurring in a single specimen. Taxonomic criteria for delimiting species of *Polistes* are uncertain, as seen in the case of *P. gallicus*-complex, where few taxa are largely confused (CETKOVIĆ 1996b; CETKOVIĆ & RADOVIĆ 1996). Therefore, the variability pattern and range of variation of relevant characters are important in study of these species.

## Material and methods

Specimens from Croatian Natural History Museum (CNHM), and from collection Polasek (CP) were examined. Altogether, there were 240 specimens: 6 in CNHM, 234 in CP; specimens in CNHM are pinned, while most of material in CP is deposited in ethanol, with only a sample of specimens being dried and pinned. All specimens in CP were collected at several localities in southern Velebit mountain, ranging from the sea level (Starigrad-Paklenica), up to the second highest peak in southern Velebit Mt (Sveto brdo). Distribution map is based on investigated specimens and literature citations, when these were considered reliable.

**Material examined:** Pecine, 25.9.1884., leg.?, 1♂; Kalnik 4.8.1917., leg. ? 1♂; Sljeme (1035 m), 8.1953., leg. ? 1♂ (specimen determined and cited as *P. semenowi* by Vogrin); Velebit Mt (1600 m), 08.08.1977., leg. Perovic F. 1♂; Obli Vir, Blace 08.08.1996., leg./det. Perovic F. 1♀; Vosac, Biokovo Mt, 20.07.1996., leg./det. Perovic F. 1♂ (all in CNHM); Velebit, Ivine vodice (1250 m): 9♀, 166♂♂; Vlaski grad (1350 m): 3♀, 37♂♂; Sveto brdo (1750 m): 14♂♂; Mala Paklenica - Šv. Jakov (800 m): 2♂♂; Starigrad-Paklenica: 3♂♂ (collected: 01-04.08.1999, all in CP).

Variability of examined specimens was studied only on specimens from CP. The range of size variability of the collected specimens is given, as fore wing length measured from the tegula to most distal point of the wing.

## Results and Discussion

Currently, *P. sulcifer* is the only positively reported parasitic species of *Polistes* in Croatia (three species occur in Europe: *P. semenowi* MORAWITZ 1889, *P. sulcifer* ZIMMERMANN 1930, and *P. atrimandibularis* ZIMMERMANN 1930). I examined specimens from CNHM reported as *P. semenowi* by VOGRIN (1955), but they are actually *P. sulcifer*, as established also by CETKOVIC (1996a, 1996b). VOGRIN's error occurred since he was using BERLAND (1928), in which only *P. gallicus* (= *P. dominulus*) and *P. semenowi* are mentioned in determination key, so he had determined this specimen incorrect.

BLÜTHGEN (1943) reported *P. semenowi* from "Dalmatien", but whether it was only a literature quote, or new specimen(s) he examined remains uncertain. Similar citation by GUIGLIA (1972) could be just referring to BLÜTHGEN (1943), and therefore, the presence of *P. semenowi* in Croatia is considered doubtful.

ZIMMERMANN (1930) was the first who reported *P. sulcifer* in Croatia. Specimens are in Mus. Vienna, mentioned in his description of the species. VOGRIN (1955), CETKOVIC (1985, 1996b) and CETKOVIC & RADOVIC (1996) reported the occurrence of *P. sulcifer* in Croatia, based on specimens in CNHM collection, and those newly collected by A. Cetkovic. Altogether, they reported 9 localities from which this species was collected; ZIMMERMANN'S (1930) record "Istrien" is imprecise as a locality and therefore not included here.

Now seven new localities are added: two represented by two specimens from CNHM collection, and five represented by unusually large number of specimens, collected in southern Velebit mountain: 12 females and 222 males, collected during the period of only four days. Together with previous specimens, a comprehensive distribution map is given in Fig. 1.



Fig. 1: Distribution of *Polistes sulcifer* in Croatia.

Likewise many parasites, this species usually has low population abundances. Occasionally, there may occur periods of population outbreaks, due to the favorable conditions in certain seasons. Regarding the large number of specimens I collected from several locations, I believe that the season of 1999 was particularly favourable for this species in Croatia. A less marked seasonal outbreak of a population of *P. sulcifer* at Stara planina Mt. (Serbia) was recorded by CETKOVIC (1996b).

As listed before, females were collected up to 1350 m (Vlaski grad), while males were found up to even 1750 m (Sveto brdo). Similarly to other vespids, males may occur at much higher altitudes than females (CETKOVIC 1985, 1996a), and often on pointed objects such as poles. Scattered specimens of all *Polistes* species can be found high above their altitudinal limits, and therefore only multiple records, or the nest records are sure indicators of species occurrence.

In Croatia, this species is recorded more frequently at higher locations than at lower ones, and oftenly at the maritime areas (see in Fig. 1); however, as pointed by CETKOVIC (1996b) and CETKOVIC & RADOVIC (1996), currently its distribution can not be explained by any of the biogeographical models proposed for other species of European social wasps. Interestingly, in 4 years of intensive collecting of *Polistes* species, I found no specimen of *P. sulcifer* in Virovitica, in Panonian basin, although it's reported hosts, *P. dominulus* (CHRIST 1791) is very frequently collected there.

At the locality Ivine vodice, I found five nests of nonparasitic species *P. biglumis* (LINNAEUS 1758) and observed them for some time. At one nest I observed a male of *P. sulcifer*, in a dominant behavioral position towards *P. biglumis* worker. After catching both specimens, I took the entire nest, expecting that it would be infested, but only 6 ♀♀ and 4 ♂♂ of *P. biglumis* emerged from the nest.

I found no usurped nest of *P. biglumis*, but there were also only few noticed specimens of reported host species (*P. dominulus*) at all locations. Altogether, I collected only 4 ♂♂ of *P. dominulus*, with no ♀♀ noticed. All these facts might support CETKOVIC's (1996a, 1996b) hypothetical proposal that, in this part of *P. sulcifer* range, *P. biglumis* could be its alternative host.

I collected most of ♀♀ while feeding on *Cirsium eriophorum* (Vlaski grad), *Cirsium arvense* (Ivine vodice), or on flowers of various Umbelliferae species. ♂♂ were collected on same plants, but also on *Eryngium amethystinum* (Starigrad-Paklenica), and on stones as well. ♂♂ were showing territorial behavior, protecting the flower they were sitting on. Sometimes they would even attack the approaching hand, rather than escaping. Species occurs from June to September (specimens from CNHM), but most of specimens were collected in the beginning and middle of August.

### Variability

All *Polistes* species are rather variable, with geographical variability often overlapping with the intra- and interspecific one. Sometimes, key features proposed for distinguishing two or more species are mixed in a single specimen. Therefore, the range and pattern of variability, as well as the relative frequency of certain states are important in species discrimination.

Main feature for separating parasitic from nonparasitic species is mandibular furrow (present only in parasites). Also, in parasitic species ♀♀ have much larger and wider head, seen in profile.

Main feature for separation of *P. sulcifer* from other parasitic species is the form of the mandibular furrow: in *P. sulcifer* it is very distinct, with well marked edges (in ♀♀, the anterior edge is about twice as high as the posterior one) and with flattened bottom. In other two species edges are more similar and the bottom rounded.

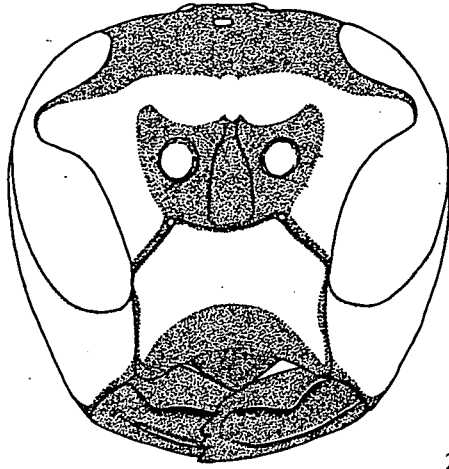
### Females

♀♀ are relatively less variable, when compared with some other species (such as *P. dominulus*). Features that are most variable are color patterns of clypeus, malar space, sternite 6 and mesoscutum. The color of malar space and sternite 6 are the features often used for the identification of European *Polistes* in females.

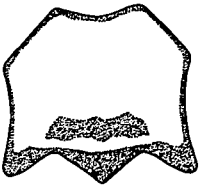
♀ head is shown in Fig. 2a. Clypeus is usually with broad black band on its base (Fig. 2a), and the range of variation includes: clypeus with small black transversely elongate spot (Fig. 2b), with two stripes connecting this spot with the lower edge of clypeus (Fig. 2c), with only a yellow spot remaining on black lower half of the clypeus (Fig. 2d), up to very dark form, with more than half clypeal surface entirely black (Fig. 2e).

In *P. sulcifer* ♀♀ malar space is mainly yellow colored, with large yellow stripe along the hind margin of the eye, extending up to reach the dorsal stripe on temporae: in 8 examined specimens these stripes are separated, while in 4 specimens stripes are fused, with only the narrowing of yellow coloration denotes the place of fusion. In two specimens with fused stripes, these are so large that cover most of the malar space, with only black remaining as narrow area behind them.

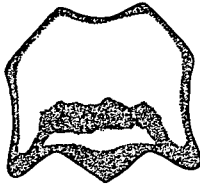
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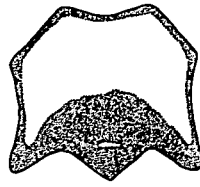
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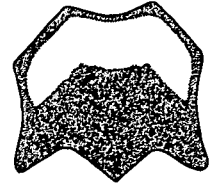
2b



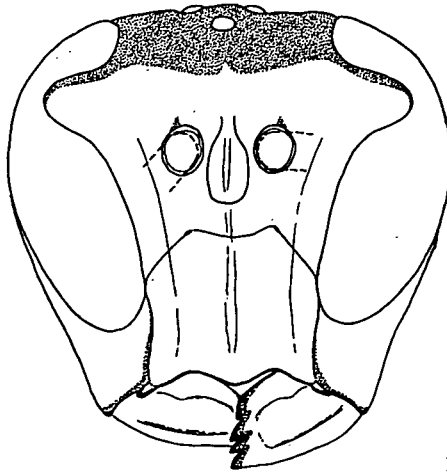
2c



2d



2e



3

**Fig. 2:** *Polistes sulcifer*, female: a) head, frontal view, b-e): color variability of clypeus.  
**Fig. 3:** *Polistes sulcifer*, male: head, frontal view.

Color pattern of sternite 6 is similar to that in very yellow colored members of *P. gallicus*-complex: with a yellow spot on each side of a sternite, one-third as long as sternite length, or reduced to two tiny yellow spots (7 specimens); or with fused spots, so that only one, medially narrowed yellow marking exist (5 specimens). In one specimen this fused marking is so reduced that only reddish area is present at the tip of terminal sternite, without any yellow coloration.

Mesoscutum is either entirely black (7 ♀ ♀), or with two yellow spots (5 ♀ ♀).

Variability of fore wing length: 10.4 - 13.8 mm (mean 12.7±0.9).

### Males

♂♂ are more variable, with more extensively yellow coloration on the body, but the patterns of color variation are less characteristic for a particular species. Interestingly, in 7 males coloration of stripes is whitish or even white, instead of yellow; for a moment I considered that these specimens might be *P. semenowi*, since they appeared much unlike others. ♂ head is shown in Fig. 3.

Mesoscutum coloration is often variable in all European *Polistes* species, but nevertheless, some authors use it as possible key separator for *P. sulcifer* vs. *P. semenowi* (BLÜTHGEN 1943). In 179 examined specimens mesoscutum is entirely black, while in 43 (19,4 %) it is marked with yellow: in 39 with two yellow spots, while in 4 with only one spot (1 with left sided, and 3 with right sided one).

Coloration pattern of lower parts of the thorax in *P. sulcifer* ♂♂ is similar to that in *P. dominulus*: it is not mainly yellow colored (such as in *P. nimpha* and *P. biglumis*, and some other species), but with just few yellow spots, sometimes reduced only to markings on fore and mid coxae. Coloration of coxae is commonly used key separator between parasitic species, by many authors; STARR & LUCHETTI (1993) use it as a crucial feature in *P. sulcifer* vs. *P. semenowi* key couplet. In most specimens I investigated, coxae are marked with yellow; in only few specimens, yellow spot is very reduced, to only small spot(s) on fore coxae, while mid and hind coxae are entirely black. Only two specimens have all coxae entirely black, thus looking just like *P. semenowi*, but other features (mandibular furrow, clypeal dimensions) determine that they are *P. sulcifer*.

Variability of fore wing length: 9.8 - 14.0 mm (mean 12.1±0.8).

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### Resumé

*Polistes sulcifer* ZIMMERMANN 1930 is the only parasitic paper wasp positively reported from Croatia. Specimens mentioned as *P. semenowi* by VOGRIN (1955) are actually *P. sulcifer*, while

BLÜTHGEN's (1943) report of *P. semenowi* from "Dalmatien", probably followed by GUIGLIA (1972), is dubious. There are no records of *P. atrimandibularis* ZIMMERMANN 1930, but regarding its distribution in neighboring countries, this species is to be expected in Croatia as well.

Distribution map for *P. sulcifer* is supplemented by seven new localities. Maximal altitude recorded is 1750 m for males (Sveto brdo), while females were collected up to 1350 m (Vlaski grad).

There is no obvious explanation for unusually large number of collected specimens in 1999 at southern Velebit, but certain population oscillations of this species have been reported before.

The pattern of variability place this species amongst the less variable *Polistes* species, with only few coloration features often varying: clypeus, malar space, sternite 6 and mesoscutum in females and coxae and mesoscutum in males. Some coloration features which were proposed as possible key separators for males were proven unsatisfactory, since few examined specimens would be keyed down to the other species (*P. semenowi*).

### Zusammenfassung

Die Verbreitung, Biologie und Variabilität der sozialparasitischen Wespe *Polistes sulcifer* ZIMMERMANN 1930 wurde für Kroatien diskutiert. Zur bisher bekannten Verbreitung kamen als Ergänzung sieben weitere Fundorte hinzu.

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