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## Notes on host plant, larval features and life history of *Cephalcia hartigii* (BREMI) (Hym., Pamphiliidae)

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*Cephalcia hartigii* is a rare species whose natural history and host plant were unknown. During a field study on the web-spinning sawflies in northern Italy, 16 adults (14 males and 2 females) of this species were collected with different kinds of traps. Most of them were found on *Abies alba*. The catch of 2 mature larvae falling to the ground under a fir and the following findings of 2 typical pamphiliid larval shelters, gave evidence that *A. alba* is a host plant of *C. hartigii*. Information is given on flight period, egg laying, larval feeding and development. The main morphological characters of the mature larva are briefly described. Most of the records of *C. hartigii* reported in literature match well with the distribution pattern of *A. alba* and *A. nordmanniana*. Considering the fact that some records are not clearly referable to fir stands, the possibility that *C. hartigii* may also live on other host plants cannot be excluded.

Keywords: Web-spinning sawfly, *Abies* spp., distribution.

### INTRODUCTION

Among the European species of the *Cephalcia* PANZER, *C. hartigii* (BREMI) is considered a rare species, whose biology and host plant are unknown, as reported by BENEŠ (1976) in his revision of this genus. According to BENEŠ, its distribution pattern (central and southern Europe, North Africa and the Caucasus) and the fact that the holotype was collected on *Pinus sylvestris* L. (BREMI, 1849) suggests that the host plants are likely to be several species of *Pinus*.

Taxonomically, *C. hartigii* differs strongly from the other species of the genus, sharing morphological characters with some Nearctic species of *Cephalcia* and with the genus *Acantholyda* COSTA (BENEŠ, 1976; VAN ACHTERBERG & VAN AARTSEN, 1986). *C. hartigii* appears to be rather uniform in both morphological and colour features although its distribution pattern is discontinuous (BENEŠ, 1976).

During field work on the species of *Cephalcia* living on spruce (*Picea abies* KARST.) in a region of Northern Italy, we collected some specimens of *C. hartigii* in mixed stands of spruce and fir (*Abies alba* MILL.) (CESCATTI & BATTISTI, 1992). These records suggested further research into the biology and morphology of this interesting species.

### STUDY SITE

The study site (Mt. Paganella and Mt. Fausior) is situated between the towns of Trento and Bolzano, on the right side of the river Adige and in front of the Brenta Dolomites. This area falls between 46°09' and 46°11' North and between 13°50' and 13°56' East. The altitude of the conifer stands considered here, ranged from 950 m and 1840 m (measured from sea level) and the main exposure is N-W.

<sup>1</sup> Authors' names are in alphabetical order.

According to MAYER & HOFMANN (1969), the area is located between the climatic districts of the Outer Alps ("Randalpen") and Middle Alps ("Zwischenalpen"). The average annual rainfall varies between 900 mm and 1100 mm, with two maxima (May and November) at the lowest altitudes and a summer maximum at the highest altitudes. The annual average temperature varies from 8.1°C, for the lowest altitudes, to 4.1°C, for the highest altitudes considered.

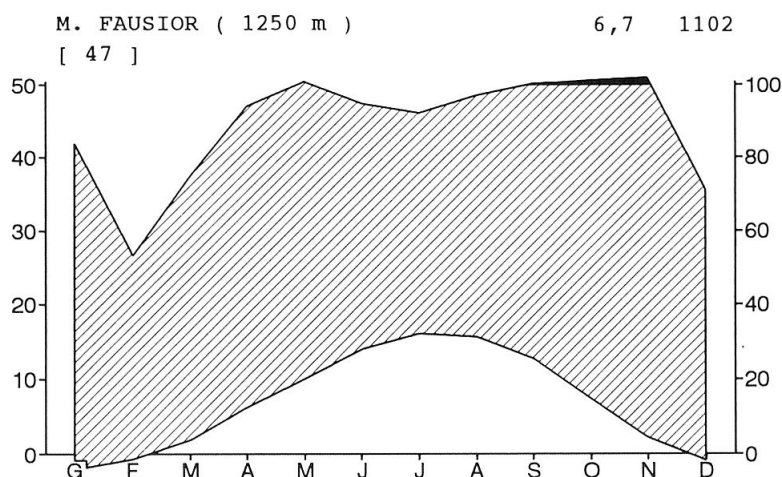


Fig. 1: Climatic diagram according to WALTER & LIETH (1960) for the study site.

The climatic diagram of the site, giving the more interesting results, is presented in Fig. 1. The geological substratum consists mainly of limestone, differentiated according to the site: limestone and marl of Jurassic and Cretaceous on the Mt. Paganella, dolomite of Triassic on Mt. Fausior. The soils are well developed and humid (brown earth type) on Mt. Paganella, thinner and drier (rendzina type) on Mt. Fausior.

The observations were made in mixed stands of *Picea abies* and *Abies alba* with a percentage for each species variable from 20% to 80%. *Abies alba* prevails in the stands of Mt. Fausior and in the lower stands of Mt. Paganella while it is less abundant outside. All the stands considered are between 90 and 110 years old and 18-25 m tall, with an average diameter of 30-35 cm at 1.3 m from the ground.

#### MATERIALS AND METHODS

The main methods of monitoring the presence of *C. hartigii* in the stands were derived from a study on the *Cephalcia* spp. of *P. abies* (CESCATTI & BATTISTI, 1992), where the techniques are described in detail. The main device used was a band coated with adhesive, which was placed around the trunk at 1.3 m from the ground in order to catch the adults climbing up the tree. A total of 230 spruces in 10 groups were, thus, sampled from in 1989, 350 spruces and 120 firs in 31 groups in 1990 and 30 firs in 1 group in 1991. Another monitoring method was based on the use of sticky yellow or transparent boards (17x22 cm), hung from branches, 1.3 m from

the ground. The sticky boards were used as follows: 40 boards in 10 sites in 1989, 15 boards in one site in 1990 .

In addition, we used a trunk trap (designed and constructed by A. ZANOCCO for *Cephalcia* spp. ), consisting of a chamber of plastic or wire 1.5 mm mesh screen, ending with a tube, in order to obtain living insects. These traps were used where *C. hartigii* had been collected by the sticky traps, for a total amount of 4 traps in 1990 and 14 traps in 1991.

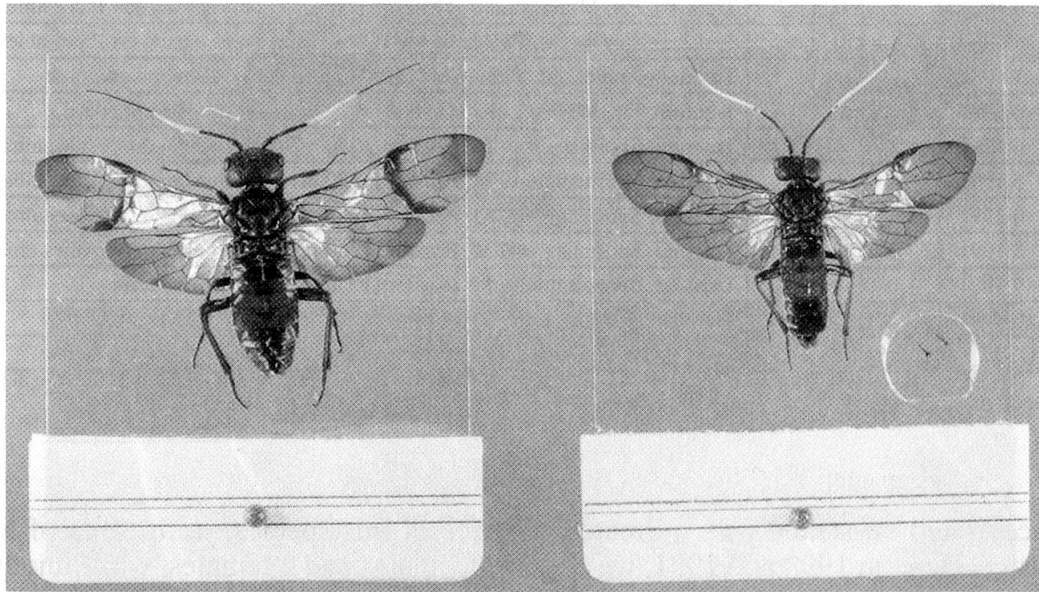


Fig. 2: Female and male of *Cephalcia hartigii* (Photo P. PAOLUCCI).

In the site where the highest number of adults was collected, in the summer of 1991, a total amount of 60 m<sup>2</sup> of plastic net was placed under the crown of 19 firs. The nets were checked every 4 days, searching for mature larvae falling from the crowns, at the end of their feeding. The only tree under which we trapped larvae of pamphiliid sawflies was cut in the autumn, its crown analysed and every track of larval activity was collected. The number and the age of the needles eaten by the larvae were evaluated for each feeding. The weight of the needles was estimated using needles of corresponding age collected from the nearest twigs.

## RESULTS AND DISCUSSION

### *Catches and host plant*

A total of 16 adults (14 males and 2 females) was collected in the 3 years of the study (Tab. 1) (Fig. 2). The first catches (6 males in 1989) were performed inadvertently during a research on the *Cephalcia* spp. of *P. abies*, only in stands mixed with *A. alba*. All the individuals were found on sticky traps where adults of *Cephal-*

*cia arvensis* PANZER or *C. abietis* (LINNAEUS) or *C. alashanica* (GUSSAKOVSKIJ) had been caught and were thought to be still living.

The absence of *Pinus* species, assumed to be the host plants of this sawfly, and the fact that we failed to find it in pure stands of spruce, led us to suppose that *A. alba* could be a host plant of *C. hartigii*. Therefore, in the following years we

Tab. 1: Catches of *Cephalcia hartigii* adults and larvae in the study site.

DATE	MM	FF	LL	LOCALITY	NOTE
16 6 1989	1	0		Trentino, Fai, M. Paganella (1150 m)	on tree band on Picea abies
23 6 1989	3	0		Trentino, Andalo, M. Paganella (1385 m)	on tree band on Picea abies
1 7 1989	2	0		Trentino, Andalo, M. Paganella (1385 m)	on yellow board
1 6 1990	1	0		Trentino, Fai, M. Paganella (1150 m)	on transparent board
19 6 1990	2	0		Trentino, Spormaggiore, M. Fausior (1250 m)	on tree band on Abies alba
18 6 1991	4	1		Trentino, Spormaggiore, M. Fausior (1250 m)	on tree band on Abies alba
22 6 1991	1	0		Trentino, Spormaggiore, M. Fausior (1250 m)	on tree band on Abies alba
1 8 1991	0	1		Trentino, Spormaggiore, M. Fausior (1250 m)	on trunk trap on Abies alba
14 9 1991			1	Trentino, Spormaggiore, M. Fausior (1250 m)	on net collector
4 10 1991			1	Trentino, Spormaggiore, M. Fausior (1250 m)	on net collector
TOTAL	14	2	2		

concentrated on stands with a greater presence of this species, in the area of Mt. Fausior. Here, in 1990 and 1991, we collected 7 males and 2 females, while another male was collected on Mt. Paganella. The females were caught by tree bands and by a trunk trap, both placed on *A. alba*. Unfortunately, the female caught by the trunk trap died before the check and, therefore, it was impossible to undertake any rearing experiments. The finding of the females induced us to search for the larvae and we collected two larvae, with some exuviae and frass, of pamphiliids in the nets placed under a fir.

The successive findings of two typical pamphiliid larval shelters and feeding remains in the crown of this fir gave us evidence that *A. alba* is a host plant of *C. hartigii*.

#### *Notes on the life history*

The flight period of *C. hartigii* occurred mainly in the second half of June. The exceptional female, collected at the beginning of August, could be explained by the longevity of the females of the genus *Cephalcia* (PSCHORN-WALCHER, 1982). In fact, this female contained very few eggs in her ovaries, probably having already laid her eggs.

The finding of the remains of an egg, near the larval shelter, suggests that the egg was laid isolated on the upper side of an old needle (shade needle), in the low-medium part of the crown (Fig. 3). The egg was partially inserted into the needle toward the apex. Two mm under the egg, around the needle, was a ring of a dark sticky substance, similar to that found in *C. arvensis* (BATTISTI & DA ROS, 1992). The larval feeding and the size of the shelter are presented in Tab. 2 and Fig. 4. The

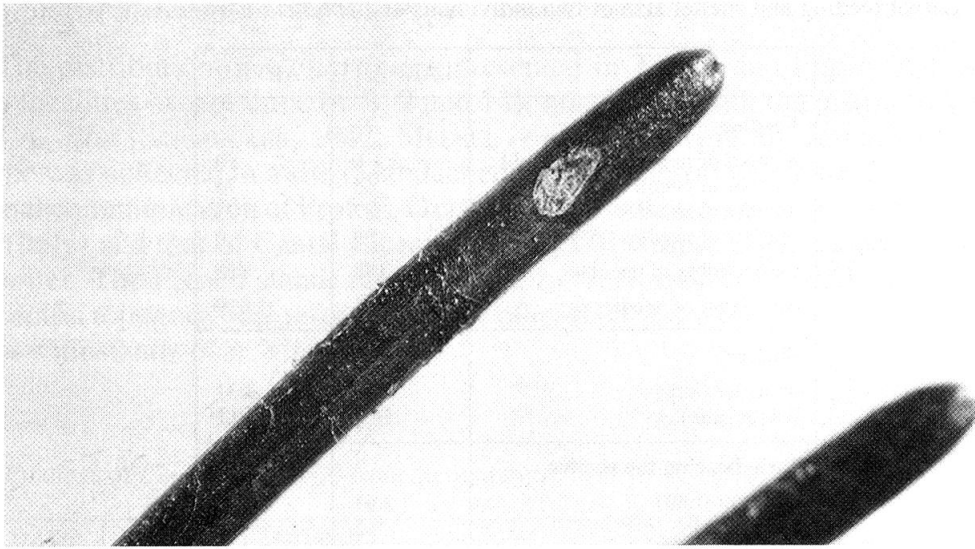


Fig. 3: A hatched egg of *Cephalcia hartigii* on a needle of *Abies alba* (Photo P. PAOLUCCI).

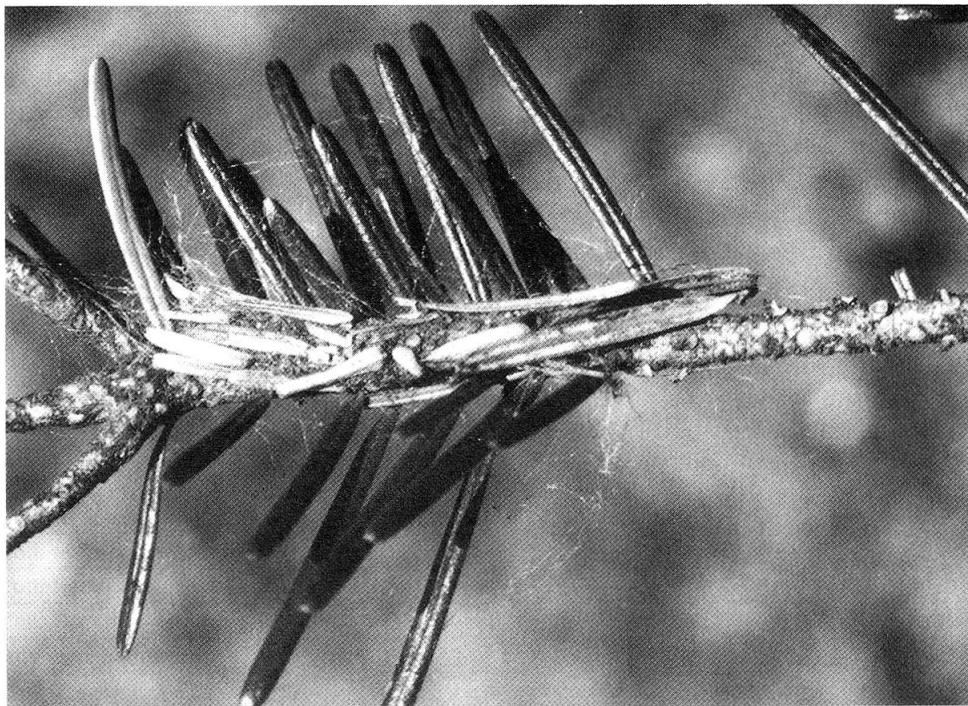


Fig. 4: A larval shelter of *Cephalcia hartigii* on a twig of *Abies alba* (Photo P. PAOLUCCI).

differences observed between the two individuals could be ascribed to the sex, males having one instar less than females in this genus. The larva feeds along the twig in front of and behind the shelter, leaving only those surrounding it. The shelter is connected to the needles by several silk threads. The larval development seems to last two months or more, the mature larvae falling to the ground in September and October.

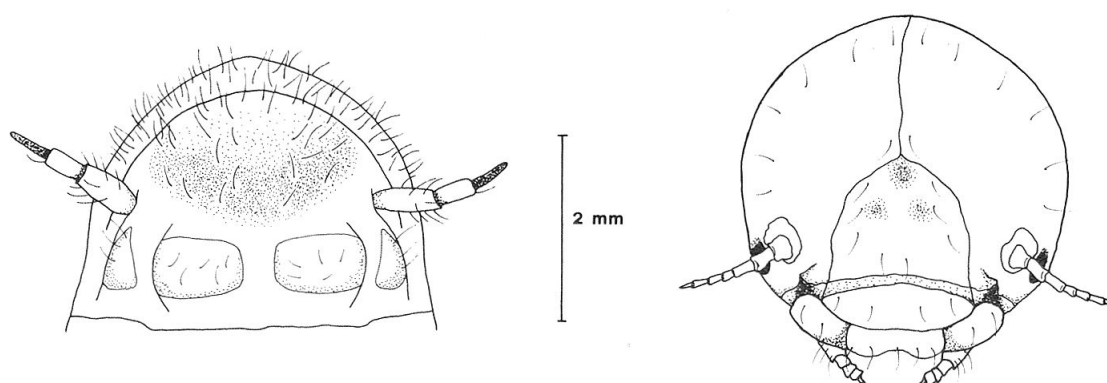
Tab. 2: Larval feeding and shelter size of two individuals of *Cephalcia hartigii*.

	LARVA 1	LARVA 2
<b>Feeding</b>		
number of needles 2-year-old	0	10
number of needles 3-year-old	45	75
number of needles 4-year-old	87	73
number of needles 5-year-old	56	0
total number of needles	188	158
dry matter of needles (g)	1.251	1.059
<b>Shelter</b>		
diameter (mm)	3.85	3.31
length (mm)	24.6	20.1
<b>Twig bearing the shelter</b>		
diameter (mm)	3.61	2.62
age (years)	5	4

### Description of the mature larva

The first finding of the mature larva of *C. hartigii* requires its morphological description for both identification needs and for taxonomic studies. According to the authors who have studied the morphology of *Cephalcia* larvae (LORENZ & KRAUS, 1957; EIDT, 1969; MARTINEK, 1988), the specific distinction of the larvae is possible only on the basis of some sclerotisation patterns of both head and abdomen, which become particularly evident in the mature larva.

The mature larva of *C. hartigii* is typical of *Cephalcia*, showing all the general features described by LORENZ & KRAUS (1957) and by EIDT (1969). Freshly-collected specimens are brown-green in colour. The sclerotisation patterns of both head and IX abdominal segment (ventral side) suggest some differences in relation to the other species described by the authors (Fig. 5). However, it was not possible to consider the intraspecific variation of *C. hartigii* and more material is needed in order to clarify this aspect.

Fig. 5: IX abdominal segment (ventral side) and head of a mature larva of *Cephalcia hartigii*.

### Geographical distribution of *C. hartigii*

The distribution of *C. hartigii* is presented in Tab. 3 and Fig. 6. All of the known localities except three (n. 8, 9 and 14), match well with the distribution pattern of *A. alba* (SCHMUCKER, 1942; MEUSEL *et al.*, 1965) (Fig. 6). In particular, the holotype was collected in a site (Mandacheregg, Swiss Jura) where the fir is present (personal communication of Prof. E. OTT, Zurich). Furthermore, the records of Lombardy (Italy) and that of Cantal Lioran (France) fall within large, natural stands of this conifer. The French stands are also used for seed crop (CTGREF, 1976). The non-specific topographical reference of the other records do not allow a precise connection with stands of *A. alba*.

Tab. 3: Findings of *Cephalcia hartigii* from the literature.

n	DATE	MM	FF	LOCALITY	STATE	LEGIT
1	24 5 1844	(1)	1	Mandacheregg, Aargau	Switzerland	J. Bremi
2	10 6 1897	1	0	C. Moravia Milkov	Czechoslovakia	J. Slaviček
3	30 5 1900	0	1	Frimb. (Frymburk, S. Bohemia ?)	Czechoslovakia	P. Kubes
4	1 6 1914	2	0	C. Moravia Milkov	Czechoslovakia	J. Slaviček
5	26 5 1931	0	1	N.E. Moravia Libhošť	Czechoslovakia	F. Gregor
6	12 6 1931	0	1	Lombardy, Valtellina, Gerola (1050)	Italy	G. Binaghi
7	26 4 1982	?		Lower Tatra, M. Dumbier (1400 m)	Czechoslovakia	A. Taeger
8	12 6 1984	?		W Caucasus, Teberda (1600 m)	Russia	J. Oehlke
9	?	1		Valley River Thana (Caucasus)	EX URSS	E. König
10	?	1	0	Vorarlberg Feldkirch	Austria	?
11	?	?		Thüringen, Ohrdruf	Germany	Schmiedeknecht
12	?	?		Thüringen, Blankenburg	Germany	Mengersen
13	?	?		Cantal Lioran	France	?
14	?	1		Tunis	Tunisia	?

n	NOTE	AUTHOR	PUBL.
1	a pair on <i>Pinus sylvestris</i> , only female caught (Holotype)	BREMI	1849
2	Coll. Moravian Museum, Brno	BENEŠ	1976
3	Coll. National Museum, Prague	BENEŠ	1976
4	Coll. Moravian Museum, Brno	BENEŠ	1976
5	Coll. National Museum, Prague	BENEŠ	1976
6	Coll. Dodero	PESARINI	1976
7	only seen, not caught	TAEGER, in litt.	1992
8	Coll. Taeger	TAEGER, in litt.	1992
9	Coll. DEI	BENEŠ	1976
10	Coll. Konow, DEI (Allotype)	ENSLIN	1917
11		SCHMIEDEKNECHT	1907
12		SCHMIEDEKNECHT	1907
13		PUTON	1883
14	Coll. Graeffe, Nat. Hist. Mus. Wien	BENEŠ	1976

One of the three records (n. 8) outside the range of *A. alba* falls within the range of *Abies nordmanniana* (STEV.) SPACH (Caucasus); the presence of mixed

stands of *A. nordmanniana* and *Picea orientalis* (L.) LINK, in the region of Teberda, is reported by SCHMIDT-VOGT (1977). Probably the other record from the Caucasus (n. 9) falls within the range of *A. nordmanniana* too, being the river Thana (= Tana) a tributary of the river Kura, not far from Tbilisi (BENEŠ, in litt. 25/2/92), but we cannot find any geographical reference to this valley.

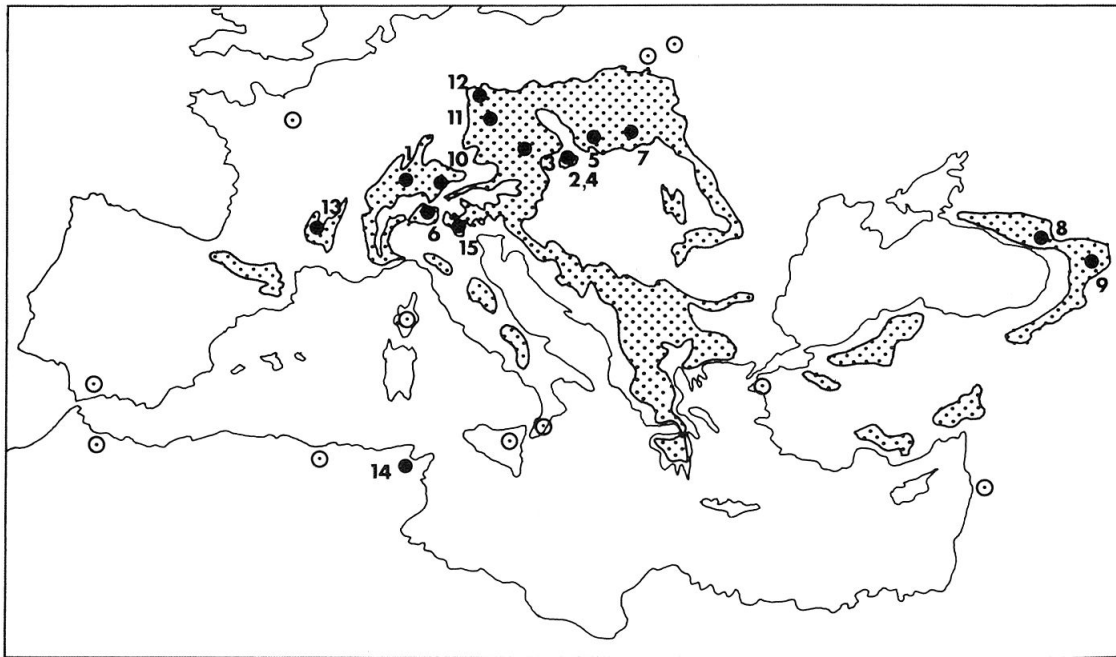


Fig. 6: Distribution of *Abies alba* according to SCHMUCKER (1942) and MEUSEL *et al.* (1965) and findings of *Cephalaria hartigii*. Numbers refer to Tab. 3 and the n. 15 shows the site of the new records.

The third record (n. 14) is attributed to "Tunis" without other information. The nearest stands of fir (*Abies numidica* DE LANNOY) are localised on the Tell Atlas (Mt. Babor, 1500/1600-2000 m a.s.l., about 1000 ha) in the coastal part of Algeria (MAYER, 1965). The lack of more precise information about this record suggests that we consider its geographic origin doubtful. *C. hartigii* is reported also for Yugoslavia by BENEŠ (1976) and VIITASARI (1982), but we could not find any more detailed reference about this record.

To our knowledge, *C. hartigii* seems to be the only species of *Cephalaria* living on *Abies* sp. in Europe; it is interesting to note that in North America there is only one species (*C. distincta* (MACGILLIVRAY)) living on *Abies balsamea* (L.) MILL. and, second in order, on *Tsuga canadensis* (L.) CARR. (EIDT, 1969).

Considering the fact that some records are not clearly referable to fir stands, we cannot exclude the possibility that *C. hartigii* may also live on other host plants. Further research should be done to clarify this aspect of the biology of *C. hartigii*.

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## ZUSAMMENFASSUNG

Zur Kenntnis der Wirtspflanze, der Larvenmerkmale und der Biologie von *Cephalcia hartigii* (BREM) (Hym., Pamphiliidae).- *Cephalcia hartigii* ist eine seltene Species, von der in Mittel- und Südeuropa, Nordafrika und vom Kaukasus berichtet wird. Ihre Biologie und Wirtspflanzen waren unbekannt. Während einer Felduntersuchung der Gespinstblattwespen in Norditalien wurden 16 Imagines (14 männlich und 2 weiblich) dieser Species mit verschiedenen Fallentypen gesammelt. Die meisten von diesen wurden an *Abies alba* gefunden. Das Ergreifen von 2 erwachsenen Larven, die auf den Boden unter einer Tanne gefallen waren, und die spätere Auffindung von 2 typischen Larvenspinsten hat uns gezeigt, daß *Abies alba* eine Wirtspflanze von *C. hartigii* ist. Es werden Ergebnisse über die Flugperiode, die Eiablage, den Larvenfraß und die Larvenentwicklung dargestellt. Die morphologische Hauptcharakteristik der erwachsenen Larve wird kurz beschrieben. Viele der bibliographischen Hinweise von *C. hartigii* stimmen gut mit der Verbreitung von *A. alba* und *A. nordmanniana* überein. Da mehrere der Hinweise nicht genau Tannenbeständen zuzuschreiben sind, ist die Möglichkeit nicht auszuschließen, daß *C. hartigii* auch an anderen Wirtspflanzen lebt.

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