Bulletin de la Société entomologique de France, **122** (1), 2017 : 75-82.

The complex of the pale green lacewing *Chrysopa pallens* (Rambur, 1838) *sensu lato* (Neuropterida, Chrysopidae)

by Michel Canard[1] & Dominique Thierry[2]

[1] 47 chemin Flou-de-Rious, F – 31400 Toulouse <michel.canard@wanadoo.fr>
[2] 12 rue Martin-Luther-King, F – 49000 Angers <dominique.thierry@wanadoo.fr>

(Accepté le 17.XII.2016)

Abstract. – The outline of the male distal abdominal sternites and of the claws of the green lacewing *Chrysopa pallens* (Rambur, 1838) were compared to that of the sibling species *C. gibeauxi* (Leraut, 1989). In addition, a possible synonymy of *C. gibeauxi* with the far-eastern Asian species *C. septemmaculata* Tsukaguchi, 1995, was investigated but not retained for the benefit of vicariant taxa status.

Résumé. – **Le complexe de la Chrysope pâle *Chrysopa pallens* (Rambur, 1838) *sensu lato* (Neuroptera, Chrysopidae)**. La silhouette des derniers sternites abdominaux et des griffes de *Chrysopa pallens* (Rambur, 1838) est comparée à celle de l'espèce jumelle *Chrysopa gibeauxi* (Leraut, 1989). En outre, la possible synonymie de *C. gibeauxi* avec l'espèce d'Extrême-Orient *C. septemmaculata* Tsukaguchi, 1995, est envisagée mais non retenue en faveur du statut de vicariant.

Keywords. – *Chrysopa gibeauxi*, *C. septemmaculata*, sibling species, disjunct distributions, vicariance.

The complex of the sibling species of the green lacewing *Chrysopa pallens* (Rambur, 1838) *sensu lato* includes about twelve species described between 1838 and the end of the XIXth century. Only *Chrysopa gibeauxi* (Leraut, 1989) appeared more recently in this cohort. The relevant describers (Brauer, Burmeister, McLachlan, Rambur, Wesmael) concerned by the green lacewings occurring in the temperate Palaearctic ecozone, founded most often their diagnosis upon the head ornamentation to define various forms and/or species and subspecies. But, as McLachlan (1886) wisely noted, the inter-population variation is sometimes rather high. This is a cause of the confusion within the complex. That is why it would be useful to take other characters into account to discriminate the true taxa more rationally.

The two species *Chrysopa pallens* and *C. gibeauxi* were considered a single species since their synonymy asserted by Aspöck *et al.* (2001). However, the later was re-instated as a valid taxon by Tillier *et al.* (2014). These two nice green lacewings are well separated by many characters successively given in the former publication and also by Devetak *et al.* (2015). In the present note, we give further elements not appearing in the previous texts, namely the ordering of the distal abdominal segments (terminalia) of the male and the outline of the claws, to improve their separation within the complex.

In order to clarify the *C. pallens* complex, another question remains: is the far-eastern green lacewing *Chrysopa septemmaculata* Tsukaguchi, 1995, a valid species within? In a noteworthy book on Asian green lacewings, Tsukaguchi (1995) described this new species he qualified as very close to *C. pallens*.

Overview of the complex. – Beyond the steps leading to the subfamily Chrysopinae and the genus *Chrysopa*, we found several characters bounding *C. pallens* (syn. *C. septempunctata* Wesmael, 1841) *sensu lato* in the usual identification keys [Aspöck *et al.* (1980) for Europe *sensu lato*, Dorokhova (1987) for ex-USSR, Hölzel (1967) for Middle East, Kis *et al.* (1970) for Romania, Mazel *et al.* (2006) for France, Monserrat (2016) for the Iberian Peninsula,

PLANT (1997) for Great Britain, SAN MARTIN (2004) for Belgium, TSUKAGUCHI (1995) for the Far-Eastern Asia, ZELENÝ (1971) for Central Europe]. They are:

– large size, *i.e.* the wing span ≥ 30 mm;
– ground colour green, pale green or bluish green;
– head with black markings, most often 7;
– one interantennal simple black spot and epicranium spotless;
– second antennal article (pedicel) green, the same colour as the first article or sometimes lightly ringed of brown;
– cross veinlets in the costal area of the forewing black, the first being black or green;
– no basicostal brown spot on the forewing;
– abdomen ventrally green;
– gonocristae largely distributed on the 9th sternite.

MATERIAL AND METHODS

The insects on which our observations are based come from various sites:

– *Chrysopa pallens*: 3 ♂ and 2 ♀, France, Rochecorbon (Indre-et-Loire), 28.VII.1986 and during summer 1987 (*R. Cloupeau*); 2 ♀ France, Comps (Drôme), 10.VII.2007 (*D. Thierry*); 1 ♀, Spain, Valencia, 28.VII.1987 (*D. Thierry*); several individuals, Slovenia (*D. Devetak*); 1 ♂, Japan, Honshu, Mozuume, Sakai-shi, Osaka-fu, Honshu, 28.VII.1988 (*S. Tsukaguchi*).

– *Chrysopa septemmaculata*: 2 paratypes (♂ and ♀) kindly loaned by the author-describer, Japan, Hokkaido, Sounkyo, Kamikawa and Nukabira, Tokachi, VII.1974 and VIII.1975.

– *Chrysopa gibeauxi*: 1 ♂, Slovenia, Maribor, 4.VII.1975 (*D. Devetak* leg. and det.); 3 ♂ and 7 ♀, Slovenia, Dravograd, Carinthia, 4.VII.1975 (*D. Devetak*); 1 ♂, Serbia, National Park Tara: Jezero Zaovine (*D. Devetak*); 1 ♀, Poland, Zverziniec, 350 m, Roztocze National Park, 12.VII.2013 (*D. Thierry*).

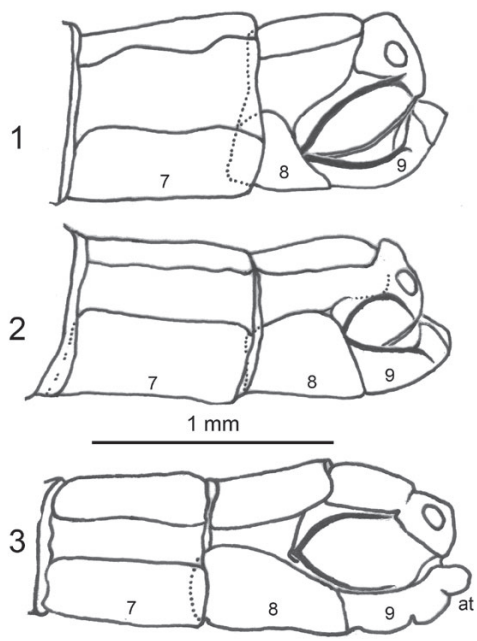

Fig. 1-3. – *Chrysopa spp.*, side view of the distal part of the male abdomen. – **1**, *C. pallens* (Rambur). – **2**, *C. septemmaculata* Tsukaguchi. – **3**, *C. gibeauxi* (Leraut). (1-2 after TSUKAGUCHI, 1995).

To appraise the outline of the claws, some peculiar reference marks must be located, namely the claw apex A, the more deep-set hollow point of the claw indentation B, the distal tip of the basal dilation C and the midpoint of the base of the claw D. The angle ABD is called the tilting and the angle ABC, the opening of the claw. An index of indentation depth I is the ratio: length of BC / length of BA (see THIERRY *et al.*, 1998).

The photographs were taken with a camera Toupcap, Actinacmos Sensor, Hangzhou, China, and a trinocular microscope Zoom Pro, Escalquens, France. Except special mention, the photographs were pictured by D. Thierry.

RESULTS

Cutting the species. – When scrutinizing the apical abdominal segments of the male, *i.e.* 8th and 9th segments, one may observe notable differences in their contour.

– In *Chrysopa pallens*, the 8th sternite is triangular in side view, shorter than the 9th sternite, the ratio length of sternite 8 / length of sternite 9 (including the fused apical tubercle) (fig. 1) is R ≅ 0.56-0.77. The apodemes show a ventral branch turned upwards at a right angle in its terminal part (fig. 1). This arrangement appeared clearly for instance in the figures 1 and 4 of Principi (1949: 317, 320), in the figure 130 of Kis *et al.* (1970: 272) as well as in the figure 67 of Tsukaguchi (1995: 176). Such an ordering of the terminalia is the most common pattern in *Chrysopa spp*.

– In *C. gibeauxi* (fig. 3), the ordering of the terminalia is of the same basic type as observed in *C. septemmaculata*. But the 8th and the 9th segments (+ apical tubercle) are much more longer and approximately of the same length so that R ≅ 1, depending on the degree of invagination of the 9th sternite into the 8th. The apodemes are regularly curved (dorsal) and straight (ventral). The apical tubercle is large and bears a small "lip".

– In *C. septemmaculata*, the 8th sternite is trapezoid-shaped, wide, longer than the 9th, so that R ≃ 1.14. The ventral apodeme is slender and turned down, as shown in the figure 68 of Tsukaguchi (1995: 174) (fig. 2). Such an aspect of the terminalia is unusual amongst the *Chrysopa spp*., appearing for instance in *Chrysopa walkeri* McLachlan, 1893.

The claws show different outlines.

– In *Chrysopa pallens* they are not very inclined, the tilting T is close to a right-angle T ≃ 92° (88-94) (n = 4), the indentation depth I ≃ 0.73, the opening O ≃ 24° (fig. 4).

– In *C. gibeauxi* (n = 10), the claws are little more inclined T ≃ 104°, their indentation is small (I ≃ 0.47), the opening O ≃ 25° (fig. 6).

– In *C. septemmaculata*, the only specimen drawn in fig. 5 shows in first view a shape very similar to that of *C. pallens*, with T = 98°, O = 24°, but the indentation is shorter (I = 0.48).

Synonymy? – *Chrysopa gibeauxi* and *C. septemmaculata* have a lot of characters in common which might suggest they are synonymous:

– the cephalic ornation constituted of 7 deeply black marks;

– the colour of the palpi, more or less deeply and darkly pigmented with brown to blackish-brown from 3rd to terminal segment of Pmx1 *vs* mainly testaceous in *C. pallens* (http://xespok.net/arthropoda) (fig. 10-11);

– the black colour of the first cross veinlet *vs* green in *C. pallens*, and of all others in the costal area up to the pterostigma (fig. 7-9);

– the gradates black in the both fore and hind wings (fig. 7-9);

– strong and black short hairs on the pronotum, on legs (see Tillier *et al*., 2014: figures 4-5, 11) and on the distal part of the abdomen (see Tillier *et al.*, 2014: figures 12, 14);

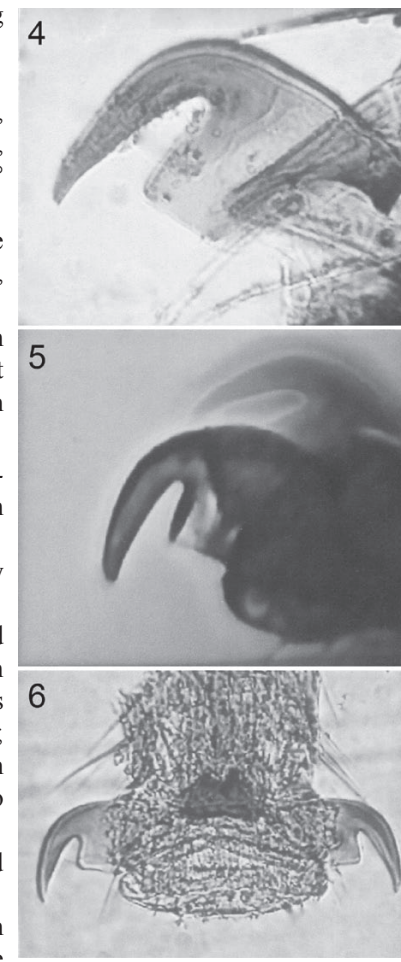

Fig. 4-6. – *Chrysopa spp.*, outline of claw. – **4**, *C. pallens* (Rambur). – **5**, *C. septemmaculata* Tsukaguchi. – **6**, *C. gibeauxi* (Leraut).

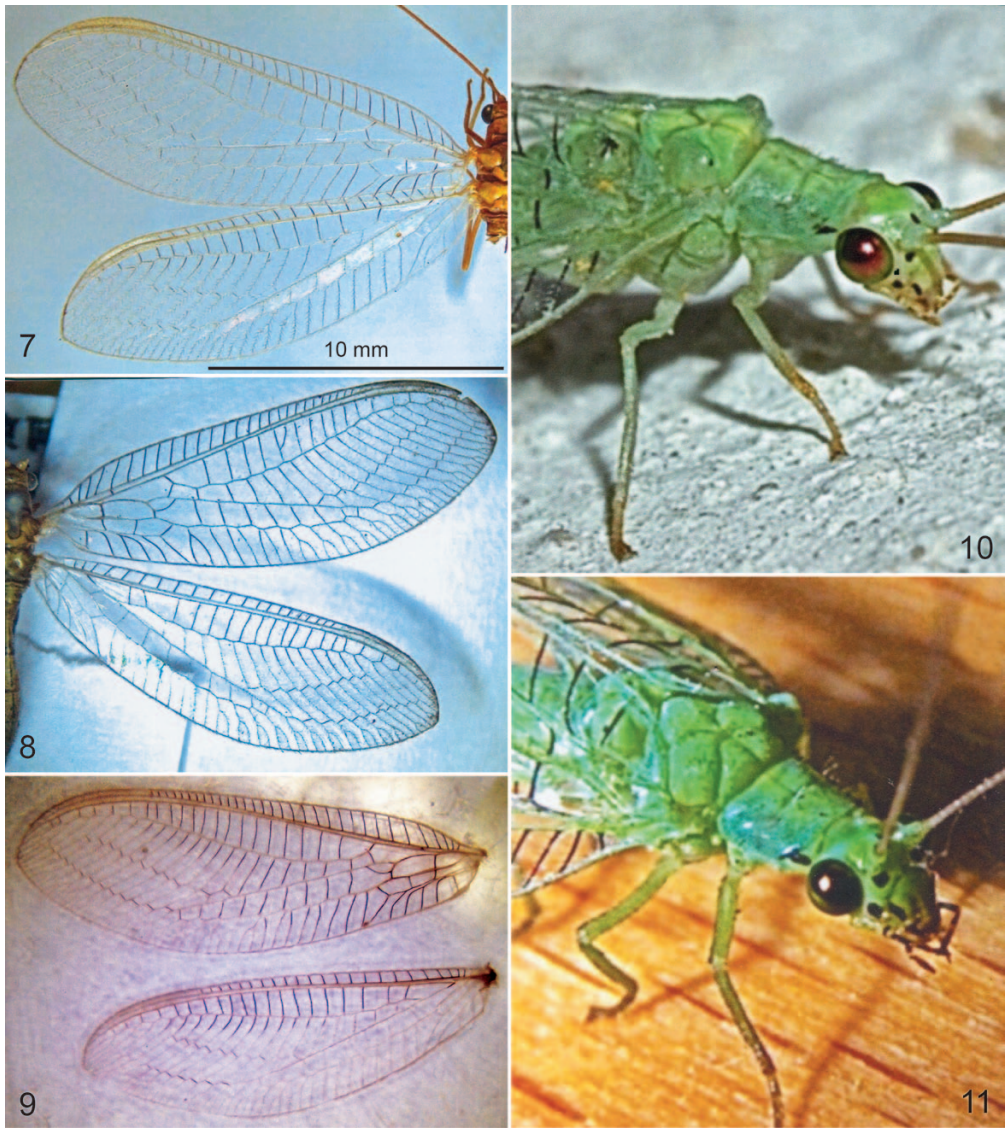

Fig. 7-11. – *Chrysopa spp.*, morphological details. – **7-9**, Wings: **7**, *C. pallens* (Rambur); **8**, *C. septemmaculata* Tsukaguchi; **9**, *C. gibeauxi* (Leraut). – **10-11**, Palpi: **10**, *C. pallens*; **11**, *C. gibeauxi.* (after George Shuklin, http://wikimedia.org).

– the regularly curved entoprocessus in male internal genitalia (fig. 12) *vs* angular in *C. pallens*;

– the gonocristae well-developed in the median part.

Beyond these unobtrusive traits, the peculiar fitting up of the male terminalia constitutes a strong sign of their close relationships.

Despite these general convergences, some details differ, such as the green colour of the subcosta in all wings of *C. septemmaculata vs* blackened in its proximal part in *C. gibeauxi*, especially visible in the hind wing (fig. 7-9).

Are they synonymous as initially expected? Or are they subspecies in a more or less continuous distribution? We consider rather they are vicariant forms in disjunct montane habitats

of both western and far-eastern temperate Palaearctic regions; the range between the two respective distributions (fig. 13-14) is large enough to isolate the two sibling taxa, acting as an efficient geographical barrier preventing any genetic exchange.

So, we propose to keep for the taxon *Chrysopa septemmaculata* Tsukaguchi, 1995, the status of valid species. Indeed, further studies on adults and the examination of pre-imaginal stages, eggs and larvae, would be later of interest to ascertain the present opinion.

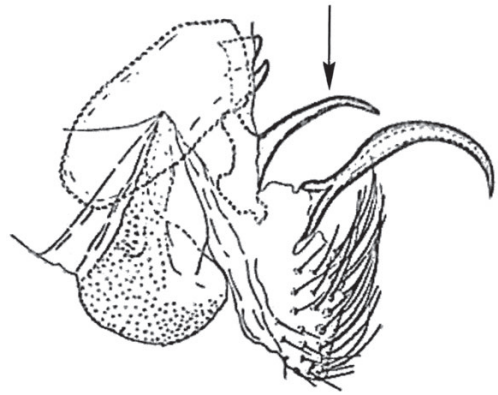

Fig. 12. – *Chrysopa septemmaculata* Tsukaguchi, male internal genitalia (after Tsukaguchi, 1995); the arrow indicates the entoprocessus.

In other respects, as mentioned in the paper of Tillier *et al.* (2014), the Polish scientists E. Warchalowska-Śliwa and E. Palik (from Krakow, Poland), collected in North Korea between 24.VII and 14.VIII.1989 (at light?) 8 individuals, identified by R. Dobosz (from Bytom, Poland) as true *C. gibeauxi*. They were a little different from the typical form, bearing meso- and metanotum together with the dorsal and lateral parts of the abdomen furnished with bright white hairs as *C. pallens* does. However, because we did not see any voucher specimen — all deposited in the collection of the Bytom museum — a steady analysis of this sample was not yet appraised.

Bio-ecological characters. – *Chrysopa pallens* is common and ubiquitous, occurring widely in the whole temperate Palaearctic ecozone. It extends in longitude from the Iberian Peninsula, even the Canary Islands where it was probably introduced by human agricultural activity (Monserrat, 2016), to far-eastern Asia: China, Korea and Japan; latitudinally, from the Scandinavian countries to North-Africa (Morocco, Tunisia), Israel, Iran and Cambodia. It seems associated to deciduous trees and may also been found into the shrub strate in the field (Zelený, 1984) and in gardens and orchards (Killington, 1937). It is multivoltine everywhere, regulated by photoperiod (Grimal & Canard, 1991; Volkovich, 1998). Adults own scent glands which make the species a stinking lacewing. The egg laying is of the grouped type (batches) (see Díaz-Aranda *et al*., 2001: fig. 4.19.C).

Chrysopa septemmaculata occurs on the eastern coast of the Japanese island of Hokkaido and was suspected to be present in the Russian far-eastern island of Sakhalin. It was also recorded in the Russian counties of Amur and Primoryie (http://sznm.sbras.ru/insecta/neuroptera.htm) (fig. 13). It is rare everywhere and occurs in montane habitats. According to Tsukaguchi (1995), it never cohabits with *C. pallens*. Adults are active in July and August. The ability to emit any stercoral fumes is not known, nor is the egg laying disposition.

Chrysopa gibeauxi was first considered a west-European inhabitant because only known from the western slope of the Alps and in the Massif Central (France). It was then believed rare and mountain/continental dweller associated with conifers. Since the recent revisions, its known range became much broader, including Poland, western Russia (St-Petersburg district), Slovenia, Croatia, Serbia (National Park Tara) and Austria (National Park Geseäuse, Obersteiermark) (Wagner *et al.,* 2016) (fig. 14). Mostly collected in July and August, but also and less frequently in May, June or September, showing so a possible bivoltinism. It emits bad scent when disturbed as we (DT) could smell on the specimen caught near by the Ukrainian border. No information is known about egg laying modality.

Fig. 13-14. – *Chrysopa spp.*, distribution. – **13**, *C. septemmaculata* Tsukaguchi. – **14**, *C. gibeauxi* (Leraut); in Poland, several sites (© http://d-maps.com).

Acknowledgements. – We are glad to thank warmly Dr Shigehiko Tsukaguchi, Osaka, Japan, and Pr Dušan Devetak, Maribor, Slovenia, for the loan of specimens without which this paper could not be written; thanks also to Samuel Danflous, Mauressac (Haute-Garonne) who rendered the draft more fluent to readers.

References

Aspöck H., Aspöck U. & Hölzel H. (unter Mitarbeit von Rausch H.), 1980. – *Die Neuropteren Europas*. *Eine Zusammenfassende Darstellung des Systematik, Ökologie und Chorologie der Neuropteroidea (Megaloptera, Raphidioptera, Planipennia) Europas.* Krefeld : Goecke & Evers, 2 volumes, 495 and 355 p.

Aspöck H., Hölzel H. & Aspöck U., 2001. – Komentierter Katalog der Neuropterida (Insecta: Raphidioptera, Megaloptera, Neuroptera) der Westpaläarktis. *Denisia,* **2** : 1-606.

Devetak D., Jakšić P., Koren T. & Ivanjnšič D., 2015. – Two sibling green lacewing species, *Chrysopa pallens* and *Chrysopa gibeauxi* (Insecta: Neuroptera: Chrysopidae) in Slovenia and western Balkan countries. *Annales, Series Historia Naturalis,* **25** (1) : 47-54.

Díaz-Aranda L.M., Monserrat V. J. & Tauber C. A., 2001. – Recognition of early stages of Chrysopidae (p. 60-74). *In* : McEwen P. K., New T. R. & Whittington A. E. (eds), *Lacewings in the Crop Environment*. Cambridge University Press.

Dorokhova G. I., 1987. – [Ostryad Neuroptera-Setchatokrl'e – *In*: *Opredelitel' Nasekomikh Evropeiskoi Chasti SSR. Tom IV. Shestaia Chast'. Bol' shkrylye, Verblyudki, Setchakokrylye, Skorpionovoye Mukhi Rucheinki*]. In Russian, Medvedev G. S. (ed.), Leningrad Izdatel'stvo Nauka, Zoologicheskii Institut, Leningrad, SSSR, **4** (6) : 36-72. English translation, 1998: Order Neuroptera-Lacewings. *Keys to the Insects of the European Part of the USSR.* 40-98. New Delhi : Amerind Publishing Co Pvt. Ld.

Grimal A. & Canard M., 1991. – Modalités du développement de *Chrysopa pallens* (Rambur) (Neuroptera, Chrysopidae) au laboratoire. *Neuroptera International,* **6** [1990] : 107-115.

Hölzel H., 1967. – Die Neuropteren Vorderasiens II. Chrysopidae. *Beiträge zur Naturkundlichen Forschung in Südwestdeutschland,* **26** : 19-45.

Killington F. J., 1937. – *A Monograph of the British Neuroptera*. **2**. London : Ray Soc, 306 p., 14 pl..

Kis B., Nagler C. & Mândru C., 1970. – *Fauna Republicii Socialiste România. Insecta Neuroptera (Planipennia)*. Bucharest : Academiei Republicii Socialiste România, 345 p.

Mazel R., Canard M. & Thierry D., 2006. – Clés synoptiques des Chrysopidae de France (Neuroptera). *Revue de l'Association roussillonnaise d'Entomologie,* **15** : 29-45.

McLachlan R., 1886. – On some points of variation in *Chrysopa septempunctata* Wesm. *Entomologist's Monthly Magazine,* **23** : 36-38.

Monserrat V. J., 2016. – Los crisópidos de la Península ibérica y Baleares (Insecta, Neuropterida, Neuroptera, Chrysopidae). *Graellsia,* **72** (1) : 1-143.

Plant C. W., 1997. – *A Key to the Adults of British Lacewings and their Allies.* UK : Field Studies Council, 91 p.

Principi M. M., 1949. – Contributi allo studio dei neurotteri italiani. – VIII. Morfologia, anatomia e funzionamento degli apparati genitali nel gen. *Chrysopa* Leach (*Chrysopa septempunctata* Wesm. e *Ch. formosa* Brauer). *Bolletino dell'Istituto di Entomologia della Università di Bologna,* **17** : 316-362.

San Martin G., 2004. – *Clé de détermination des Chrysopidae de Belgique*. Wavre : Jeunes & Nature, 42 p.

Schneider W. G., 1851. – *Symbolae ad Monographiam Generis Chrysopae Leach*. Vratislaviae, 178 p.

Thierry D., Cloupeau R., Jarry M. & Canard M., 1998. – Discrimination of the West-Palaearctic *Chrysoperla* Steinmann species of the *carnea* Stephens group by means of claw morphology (Neuroptera, Chrysopidae). *Acta Zoologica Fennica,* **209** : 255-262.

Tillier P., Thierry D., Dobosz R. & Canard M., 2014. – *Chrysopa gibeauxi* (Leraut, 1989): reinstatement as valid species and remarks on its distribution (Neuropterida, Chrysopidae). *Bulletin de la Société entomologique de* France*,* **119** (4) : 521-528.

Tsukaguchi S., 1995. — *Chrysopidae of Japan (Neuroptera, Chrysopidae)*. Osaka : private print, 223 p.

Volkovich T., 1998. – Environmental control of seasonal cycles in green lacewings (Neuroptera, Chrysopidae) from the forest-steppe zone of Russia. *Acta Zoologica Fennica,* **209** : 263-275.

Wagner H. C., Komposch C., Aurenhammer S., Degasperi G., Korn R., Frei B., Volkmer J., Heimburg H., Ivenz D., Rief A., Wiesmair B., Zechmeister T., Schneider M., Dejaco T., Netzberger R., Kirchmair G.,

Gunczy L. W., Zweidick O., Paill W., Schwarz M., Pfeifer J., Arthofer P., Holzer E., Borovsky R., Huber E., Platz A., Papenberg E., Schied J., Rausch H. R., Graf W., Muster C., Gunczy J., Fuchs P., Pichler G. A., Allspach A., Pass T., Teischinger G., Wiesinger G. & Kreiner D., 2016. – Bericht über das zweite ÖEG-Insektencamp: 1019 Wirbellose Tierarten aus dem Nationalpark Gesäuse (Obersteiermark). *Entomologica Austriaca,* **23** : 207-260.

Zelený J., 1971. – Green lacewings of Czechoslovakia (Neuroptera, Chrysopidae). *Acta Entomologica Bohemoslovaca,* **68** : 167-184.

—— 1984. – Chrysopid occurrence in West-Palearctic temperate forests and derived biotopes (p. 151-160). *In* : Canard M., Séméria Y. & New T. R. (eds), *Biology of Chrysopidae*. The Hague : Dr W. Junk, x + 294 p.