Pemphredon austriaca (Hymenoptera: Crabronidae) and various other insect species as inhabitants of deserted galls

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KEYWORDS
Nesting behaviour, pupation sites, *Quercus*, *Rosa*, Coleoptera, Orthoptera, Symphyta, successori

Entomologische Berichten 68(5): 170-174

The marble gall caused by *Andricus kollari* on oak trees and the bedeguar gall by *Diplolepis rosae* on dog rose bushes belong to the minority of insect galls that remain on the plant after the gall wasps have emerged. The holes made by the emerging gall wasps, their inquilines and parasitoids, provide shelter to other insects, the so-called successori. The crabronid wasp *Pemphredon austriaca* prefers to breed in oak marble galls and a survey showed its presence in about half of the 22 samples gathered in the central and southern part of The Netherlands. In addition, a few other crabronids emerged from these galls, as well as some sawfly species. The latter – all belonging to the allantine subfamily – apparently exploited a gall to hibernate and pupate. Related sawfly species were reared from a few bedeguar galls. The emergence of young nymphs of two species of bush cricket showed that oak marble galls serve as oviposition substrate as well.

Introduction

A gall represents the growth reaction of a plant to attack by a particular organism; the culprit may belong to the bacteria, fungi, nematodes, mites or insects (Darlington 1968). More than 1400 different Dutch galls are treated in Docters van Leeuwen (1982). Galls caused by insects, mostly Hymenoptera and Diptera, normally provide food (the gall tissue) as well as protection to the developing larva(e).

Sexual females of *Andricus kollari* (Hartig) (Hymenoptera: Cynipidae) and their progeny cause the so-called marble galls on oak (*Quercus* sp.). As these galls are fixed to (usually two-year-old) twigs, they are remain on the tree for several years after the gall makers, their parasitoids and inquilines have left them (figure 1), thereby providing shelter or breeding space to other insects. One species in particular is associated with these galls: *Pemphredon austriaca* (Kohl) (Hymenoptera: Crabronidae), which apparently breeds exclusively in these galls (Kohl 1890, Wagner 1931, Janvier 1961, Schremmer 1985, Bitsch *et al.* 2001).

In early spring 2004, I gathered twelve galls from the lower branches of huge oak trees at Plantage Willem III, Rhenen (RD 165.4-444.1) expecting to see *P. austriaca* emerge. As they did, I started more extensive sampling in early 2005. Apart from many *P. austriaca* individuals, several other species emerged from these samples. As reports on successori of oak galls are scarce, it appears worthwhile to publish the results of this study.

Material and methods

The marble galls were gathered within arm's reach from small oak trees, or from lower branches of old trees, both in early 2005 and 2006. I paid little attention to the age of the galls, but skipped those without any emergence hole. Each sample was stored in an ordinary jam jar closed with a lid and placed in an unheated garage. Spiders seen in the jars during the first few days were removed. In general, the samples were not too dry initially, but a few drops of water were added to some jars later in spring. The jars were inspected at least weekly on Monday from mid-April onwards, and almost daily at the peak of emergence. All emerging insects were collected and preserved, but the many emerging gall wasps, and their inquilines and

1. Old marble galls on oak with emergence openings of various size. Photo: Leo Blommers.
1. Verlaten knikkergallen op eik met uitvlieggaten in diverse maten.

2. Old bedeguar gall of more than one year on dog rose, showing a number of suitable holes for successori. Photo: Leo Blommers.
2. Overjarige mosgal op hondsroos met voor successori geschikte gaten.

3. Male *Pemphredon austriaca*. Photo: Peter Koomen.
3. *Pemphredon austriaca*, ♂.

parasitoids are not treated here (see also Blommers 2005). Time of emergence was scored as week number, because deviating temperatures in the storage place should have influenced the emergence date as compared to the natural situation. The discussion of results focuses on samples of ten or more marble galls, plus a few smaller samples with noteworthy results.

In an attempt to get marble galls from other regions, I exchanged galls with Drs. Jojanneke Bijkerk (Wehe Den Hoorn, Groningen). She wanted fresh rose bedeguars caused by *Diplolepis rosae* (Linnaeus) (Hymenoptera: Cynipidae) and provided me with marble galls. So, my attention was drawn to the possibility that old bedeguar galls might provide lodgings to successori as well (figure 2). I gathered some of these from dog rose (*Rosa canina*) and stored and treated these in a similar way as the marble galls.

Results

Hymenoptera

In 2005, the crabronid *Pemphredon austriaca* (figure 3) appeared in eight out of twelve rearings of more than nine marble galls and one of less (table 1). The number of galls in all rearings amounted to 375 and these yielded 74 adult *P. austriaca*, or 19.7% of the galls being occupied. However, as one gall may yield six wasps (Peeters *et al.* 2004) or more (Janvier 1961), the number of inhabited galls should have been less than the number of emerged wasps. The data clearly shows that males emerge approximately one week earlier than the females. The delayed emergence of the first sample, collected in January, as compared to the other collected in March, indicates that temperatures in the storage were inferior to those outdoors, where most of the galls are exposed to the sun for as long as the trees are without leaves. The only other crabronid seen to emerge was a male *Passaloecus gracilis* (Curtis) (figure 4) in week 21 from the galls taken at Heidestein, Zeist.

Table 1. Emergence of *Pemphredon austriaca* from marble galls in 2005.
Tabel 1. Uitkomst van *Pemphredon austriaca* uit knikkergallen in 2005.

City, Location, Amersfoort-coordinates (Province)	Date	Nr galls	Males			Females		Nr crabonids per gall	Characteristics of the trees
			Week 19	Week 20	Week 20	Week 21	Week 22		
Rhenen, Spoorbaanweg, 168.1-441.5 (Utrecht)	18-1	16		2		5	5	0.75	High trees on top of a gully, facing home gardens
Rhenen, Kwintelooijen, 166.5-445.0 (Utrecht)	15-3	23			2			0.09	Single younger trees in grass on a parking lot
Rhenen, Kwintelooijen 165.9-445.3 (Utrecht)	15-3	49	9	2	4	5		0.41	A few bushes on a sandy southern slope
Rhenen, Kwintelooijen 165.8-444.7 (Utrecht)	15-3	19	7	6	1	1		0.79	A few small trees on a marshy plot
Bennekom, Mierenbos, 177.0-443.5 (Gelderland)	15-3	6	1					0.17	A single young tree on a large lawn within woodland
Ede, Zuid Ginkel, 179.3-449.7 (Gelderland)	16-3	21	2		1			0.14	Four bushes in wood and another four in open land
Utrecht, Rhijnauwen, 139-454 (Utrecht)	20-3	36				1		0.03	Various trees along roadside
Driebergen, Heidetuin, 148.2-452.9 (Utrecht)	21-3	36	2					0.06	Smaller trees in half-open woodland
Zeist, Heidestein, 147-454 (Utrecht)	21-3	40	2	8	5	2	1	0.45	Trees of various sizes in mainly heather
Total		246	23	18	13	14	6		
Cumulative %			56.1	100	39.4	81.8	100		

4. Male *Passaloecus gracilis*. Photo: Peter Koomen.
4. *Passaloecus gracilis*, ♂.

5. Female *Spilomena enslini*. Photo: Peter Koomen.
5. *Spilomena enslini*, ♀.

Most interesting was the appearance of the pimpline ichneumonid *Perithous speculator* Haupt (det. Kees Zwakhals); five males in week 17 and one female in week 19, in the sample from Heidestein, Zeist. This is a rare parasitoid species, only known from our country, the UK, Germany, France, Sweden and Rumania (Kees Zwakhals, personal communication) and its host was not known until now. Two other *Perithous* species are known to attack *Pemphredon* species and one of them sometimes also attacks *Passaloecus* species (Fitton 1988). Thus, *Perithous speculator* most likely attacks *Pemphredon austriaca* and/or *Passaloecus gracilis*, as both were seen in this sample.

In 2006, *P. austriaca* only appeared in three out of eleven batches of ten or more marble galls, with a total number of 298 galls (table 2). One positive sample came from near Rhenen, like most of previous year, and two from the province Noord-Brabant. No crabronid wasps emerged from the 50 galls (four samples) collected by Jojanneke Bijkerk in the northern provinces. Two other crabronid species appeared this time, both in week 21: one female *Crossocerus nigritus* (Lepeletier & Brullé) from the sample from St-Anna-Bosch, Ulvenhout. And a female *Spilomena enslini* Blüthgen (figure 5) was reared from smaller gregarious galls, possibly of *Andricus lignicola* (Hartig) (Hymenoptera: Cynipidae), on old oak trees near Kasteel Loenen, Slijk-Ewijk (Gelderland; RD 180.8-433.3).

Sawflies (Hymenoptera: Symphyta) also emerged from the marble galls. *Harpiphorus lepidus* (Klug) (Tenthredinidae: Allantinae) (figure 6) emerged twice from marble galls: a male in week 17-2005 from a handful of galls from the Mierenbos, Bennekom, and a female from 34 marble galls collected by Jojanneke Bijkerk north of Beatrixoord, Haren (Groningen; RD 235-578). This small species, the length of the adult being less than 4 mm, is monophagous on *Quercus* sp. and scarce in collections, but probably not in nature (Ad Mol, personal communication). The species is monovoltine and the fully-grown larva apparently seeks a hiding place on the tree to overwinter and pupate. The species does not make a cocoon (Lorenz & Kraus 1957).

Marble galls also offered lodging to three species of *Ametastegia* (Symphyta: Tenthredinidae: Allantinae) that do not live on oak. The dock sawfly *Ametastegia glabrata* (Fallén) emerged from two samples: a male from Coenderbosch, Nuis (Groningen; RD 216.2-573.8) and a female from Tuingoed Volts, Meeden (Groningen; RD 259-593), both collected by Jojanneke Bijkerk. One male *Ametastegia equiseti* (Fallén) (figure 7) appeared in a jar with more than 100 galls gathered along the fence around nature reserve Keistoep, Tilburg (Noord-Brabant; RD 129.5-394.6) and a female of *Ametastegia tenera* (Fallén) in another jar with 26 galls from a small tree at the Gilzerbaan, Tilburg. *Ametastegia* species are known to pupate in self-made holes above ground (Lorenz & Kraus 1957). The dock sawfly, living on various *Rumex* species, is considered a minor pest of apple and pear as the fully grown larva sometimes bores a hole into more or less ripe fruit and is found there after harvest (Alford 1984). One wonders whether the larvae also made holes in the galls; they probably used existing ones, as the galls are smooth and rather hard.

A very small female of the sawfly *Cladius pectinicornis* (Geoffroy) (figure 8) emerged from eight marble galls from a nursery at Wilhelminaoord (Drenthe; RD 206-541; leg. Jojanneke Bijkerk). This species lives on various *Rosa* species and was also reared from bedeguar galls once; one female emerged from a sample of three small galls from two wild rose bushes at Rhenen, Kwinte-

Table 2. Emergence of *Pemphredon austriaca* from marble galls in 2006.
Tabel 2. Uitkomst van *Pemphredon austriaca* uit knikkergallen in 2006.

City, Location, Amersfoort-coordinates (Province)	Date	Nr galls	Males		Females			Nr crabonids per gall	Characteristics of the trees
			Week 19	Week 20	Week 20	Week 21	Week 22		
Rhenen, Remmerden, 164.6-442.8 (Utrecht)	06-4	22	5	10		2	2	0.86	Several trees on sandy slope overlooking foreland
Ulvenhout, St-Annabos, 116.4-395.8 (Noord-Brabant)	14-4	22		2		3	5	0.45	Dense plantation of smaller trees alongside highway
Tilburg, Gilzerbaan, 127.3-393.5 (Noord-Brabant)	18-4	26	1					0.04	Small tree on shoulder between maize field and road

6. Male *Harpiphorus lepidus*. Photo: Peter Koomen.
6. *Harpiphorus lepidus*, ♂.

7. Male *Ametastegia equiseti*. Photo: Peter Koomen.
7. *Ametastegia equiseti*, ♂.

looijen. One male *Allantus cinctus* (Linnaeus), another sawfly of *Rosa* sp., emerged from three bedeguar galls from the Juffers-waard, Renkum (Gelderland; RD 179.6-442.6). Finally, one adult *Athalia ancilla* Serville should be mentioned that emerged in spring (week 16) 2006 from oak apples, i.e. the galls of *Biorhiza pallida* (Olivier) on *Quercus* sp., collected at Utrecht Rhijnauwen, same locality and date as in table 1, i.e. more than one year before.

Other insect orders

Insects other than Hymenoptera appeared in various samples as well. Newborn nymphs of both the oak bush-cricket *Meconema thalassinum* (De Geer) and the speckled bush cricket *Leptophyes punctatissima* (Bosc) appeared in several batches of marble galls. The first species emerged in the samples from Rhijnauwen (Utrecht) and in those from along the Nederrijn underneath the Grebbeberg, Rhenen (RD 169.2-440.2). I reared some to the adult stage on a diet of aphids from rose and ivy (*Hedera helix*). *Leptophyes punctatissima* appeared in the samples from Zeist and Driebergen and some of these reached the adult stage while fed with clean leaves of rose and lime (*Tilia* sp.).

Adult beetles (Coleoptera, identified by Theodoor Heijerman) emerged from few samples, suggesting they had pupated in a

8. Male *Cladius pectinicornis*. Photo: Peter Koomen.
8. *Cladius pectinicornis*, ♂.

marble gall: *Dasytes plumbeus* (Müller) (Dasytidae) in batches from Spoorbaanweg and Kwintelooijen, both Rhenen, and *Malachius bipustulatus* (Linnaeus) (Malachiidae, det. Theodoor Heijerman) from Heidetuin, Driebergen (Utrecht). In 2006, a single specimen of *Dasytes aeratus* Stephens and of *Anaspis melanopa* (Forster) (Scraptiidae) appeared in a batch of marble galls from Heveadorp (Gelderland; RD 184.4-442.7), while the sample from Remmerden Rhenen yielded one specimen of the flea beetle *Chalcoides plutus* (Latreille) (Chrysomelidae). *Rhizobius* cf. *chrysomeloides* (Herbst) (Coccinellidae) emerged once in the large sample from Keistoep, Tilburg. Finally, I have to confess that I neglected the presence of a few tiny moths, flies and hopping creatures that appeared in the pots with galls.

Discussion

More than one hundred (107) *P. austriaca* individuals were reared from a few hundred marble galls. No other *Pemphredon*-species is likewise associated with these galls of *Andricus kollari* (Kohl 1890, Wagner 1931, Merisuo & Valkeila, 1972, Bitsch *et al.* 2001, Van der Smissen 2003). I found only two reports from Italy on other nesting sites than oak galls: Grandi (1962 in Bitsch *et al.* 2001) mentions one nest in a 'cigar' (= rolled leaf) of *Bytiscus betulae* (Coleoptera: Curculionidae) near Bologna, and Merisuo and Valkeila (1972) report a few specimens reared from *Rubus* stems in Triest.

Janvier (1961) describes the biology of *P. austriaca* as gall breeder, under the name of *Pemphredon luctuosus*. Although *P. luctuosus* is presently considered a junior synonym of *Pemphredon lugubris* Fabricius (Bitsch *et al.* 2001), Janvier clearly dealt with two species as he notes that the wasps he reared from the galls of *A. kollari* from oak were 6-9 mm long (like *P. austriaca*, *vide* Bitsch *et al.* 2001), while the ones he collected nearby with a net were 10-12 mm (like *P. lugubris*). Janvier himself also expresses his doubt about the lumping of (these) species by André (1882). In fact, Berland (1925) also does not mention *P. austriaca* in any way. According to Janvier (loc. cit.), *P. austriaca* nests in old galls where the female constructs her own galleries, with up to twelve cells. The species is bivoltine near Paris, France; the first generation prepares nests in June and early July, the second from mid-August till the end of September. Schremmer (1985) noted that the species may also penetrate into fresh galls, without disturbing the *A. kollari* larva in the central chamber (figure 9). The species was rare in The Netherlands, with a single record before 1950 and not one

9. A marble gall of which the peripherical area was previously inhabited by *Pemphredon austriaca*. A single gall wasp *Andricus kollari* has developed in the central chamber. Photo: Leo Blommers.
9. Een knikkergal met oud nest van *Pemphredon austriaca* in het perifere deel. Een enkele galwesp *Andricus kollari* is in de centrale ruimte opgegroeid.

between 1950 and 1980, but with fifteen records after this period (Peeters *et al.* 2004). A look at the distribution map of the species in Peeters *et al.* (2004) indicates that all locations reported here, with the exception of Rhenen, are new. Whether the species occurs in the northern provinces is not yet clear. As marble galls can be found almost everywhere in our country, it would be worthwhile and rather easy to investigate the presence of this species in regions where it has not been reported so far.

The presence of so many successori was quite a surprise, but some are mentioned as such in the literature, like the oak bush-cricket (Kleukers *et al.* 1997). The other crabronid wasps are all so-called 'twig breeders', but do not seem to have been reported as successori in oak galls, with the exception of *Passaloecus gracilis* (Peeters *et al.* 2004). As to the sawflies, one gets the impression that especially species from the subfamily Tenthredinidae Allantinae – *Allantus, Ametastegia* and *Harpiphorus* – are well adapted to the use of old galls for hibernation and pupation.

Acknowledgements

Jojanneke Bijkerk, Theodoor Heijerman, Ad Mol and Kees Zwakhals are kindly thanked for their help.

References

Alford DV 1984. A colour atlas of fruit pests. Wolfe.
André E 1882. Species des Hyménoptères d'Europe et d'Algérie. Edmond André.
Bitsch J, Dollfuss H, Bouček Z, Schmidt K, Schmid-Egger C, Gayubo SF, Antropov AV & Barbier Y 2001. Hyménoptères Sphecidae d'Europe occidentale, Vol. 3. Faune de France 86: 1-460.
Blommers L 2005. Bewoners van eikengalnoten. Nieuwsbrief Sectie Hymenoptera, Nederlandse Entomologische Vereniging nr 22, november 2005, pp. 51-53.
Darlington A 1968. Plant galls in colour. Blanford Press.
Docters van Leeuwen WM 1982. Gallenboek. 3de druk bewerkt door AA Wiebes-Rijks & G Houtman. KNNV Uitgeverij & WJ Thieme.
Fitton MG, Shaw MR & Gauld ID 1988. Ichneumonidae: Pimplinae. Handbooks for the Identification of British Insects vol. vii part 1. Royal Entomological Society of London.
Janvier H 1961. Recherches sur les Hyménoptères nidifiantes aphidivores. II. Le genre *Pemphredon*. Annales des Sciences Naturelles (Zoologie) 12/3: 1-51.
Kleukers R, van Nieukerken E , Odé B, Willemse L & van Wingerden W 1997. Nederlandse Fauna I: De sprinkhanen en krekels van Nederland (Orthoptera). Nationaal Natuurhistorisch Museum, KNNV & EIS Nederland.
Kohl FF 1890. Zur Kenntnis der Pemphredonen. Annalen des k. k. naturhistorischen Hofmuseums Wien 5: 49-65.
Merisuo AK & Valkeila E 1972. Beiträge zur Kenntnis der paläarktischen Arten der Gattung *Pemphredon* Latreille (Hym., Sphecoidea). Annales Entomologici Fennici 38: 7-24.
Peeters TMJ, van Achterberg C, Heitmans WRB, Klein WF, Lefeber V, van Loon AJ, Mabelis AA, Nieuwenhuijsen H, Reemer M, de Rond J, Smit J, Velthuis HHW 2004. Nederlandse Fauna 6: De wespen en mieren van Nederland (Hymenoptera: Aculeata). Naturalis/KNNV/EIS-Nederland.
Van der Smissen J 2003. Zur Kenntnis der Untergattung *Cemonus* Jurine 1807 (Hymenoptera: Sphecidae, Pemphredon) mit Schlüssel zur Determination und Hinweis auf ein gemeinsames Merkmal untersuchter Schilfbewoner (Hymenoptera: Sphecidae, Pompilidae). Notes Fauniques Gembloux 52: 53-101.
Schremmer F 1985. Eine Grabwespe nistet in Eichengallen die von Gallenerreger noch bewohnt sind (Hymenoptera, Sphecidae/Cynipidae). Entomofauna 6: 397-415.
Wagner ACW 1932. Beitrag zur Kenntnis der Gattung *Pemphredon* Latr. (Hym. Crabr.). Deutsche entomologische Zeitschrift 1931: 213-233.
Ontvangen: 9 april 2008
Geaccepteerd: 18 augustus 2008

Samenvatting

***Pemphredon austriaca* (Hymenoptera: Crabronidae) en enkele andere insecten als bewoners van verlaten gallen**

De knikkergal veroorzaakt door *Andricus kollari* (Hymenoptera: Cynipidae) op eik en de mosgal veroorzaakt door *Diplolepis rosae* (Cynipidae) op roos behoren tot de gallen die niet afvallen na het uitkomen van de oorspronkelijke bewoners. Daarom kunnen ze daarna nog als schuilplaats dienen voor andere soorten, de zogenaamde successori. De graafwesp *Pemphredon austriaca* nestelt vrijwel altijd in knikkergallen en bleek aanwezig te zijn in ongeveer de helft van 22 monsters uit Midden- en Zuid-Nederland. Enkele andere graaf- en bladwespsoorten kwamen meer sporadisch uit. De bladwespen behoorden alle tot de Tenthredinidae Allantinae. Verwante bladwespsoorten werden uit enkele mosgallen van roos gekweekt. Het verschijnen van meerdere nimfen van zowel boom- als struiksprinkhaan toonde aan dat deze soorten in knikkergallen eieren leggen.

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