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ECOLOGY AND DISTRIBUTION OF DUTCH LACEHOPPERS (HEMIPTERA: FULGOROMORPHA: CIXIIDAE)

Marco de Haas & Kees den Bieman

The Cixiidae are a medium-sized homopteran family, with over 140 European species. Nine species were known to exist in the Netherlands. Two new species are reported here: *Cixius dubius* and *Trigonocranus emmeae*. *Cixius dubius* was collected in 1952 in Gerendal and Cannerbos and was then identified as *C. stigmaticus*. *Trigonocranus emmeae* was collected for the first time in the Netherlands at the Sint Pietersberg in 2017. Information about the distribution, phenology and ecology of the Dutch cixiid fauna is presented.

INTRODUCTION

The name lacehopper and the Dutch name glasvleugelcicaden both refer to its transparent wings (fig. 1). Within the suborder Fulgoromorpha, lacehoppers (Cixiidae) are the second largest family with over 140 species in Europe (Jach & Hoch 2013). In the Netherlands, nine species were known (Den Bieman et al. 2011), two additional species are here reported for the first time. The number of species in northern and western Europe is limited, but is much higher in the south and east.

In 2017, the collections of the larger Dutch natural history museums and a few private collections

were examined and digitized. Next to that additional fieldwork was carried out and the cixiid data of the website Waarneming.nl were critically analysed and incorporated in the data set.

In the collection of Naturalis Biodiversity Center, six specimens of the species *Cixius dubius* have been found, which is a new species for the Dutch fauna. During fieldwork, the interesting species *Trigonocranus emmeae* was collected for the first time in the Netherlands, at a parking area on the Sint Pietersberg. In addition, *Myndus musivus* has been rediscovered after 98 years in the vicinity of Bunde.



Figure 1. *Trigonocranus emmeae*, Auerbach (Bavaria, Germany), 5.vii.2009, leg. Herbert Nickel. One of the two new species for the Netherlands. Photo Gernot Kunz.
Figuur 1. *Trigonocranus emmeae*, Auerbach (Beieren, Duitsland), 5.vii.2009, leg. Herbert Nickel. Een van de twee nieuwe soorten voor Nederland. Foto Gernot Kunz.

There are only a few publications on the Dutch Cixiidae. De Graaf & Snellen van Vollenhoven (1853) published the first checklist of the Dutch plant- and leafhoppers and mentioned *Cixius cunicularius* (Linnaeus, 1767), *C. nervosus* (Linnaeus, 1758) and *Tachycixius pilosus* (Olivier, 1791) (as *Cixia contaminata* Germar, 1818). In the second checklist (De Graaf et al. 1862) *Cixius albicinctus* Germar, 1818 is added, but this is a synonym for *T. pilosus*. Fokker (1891) reported *C. distinguendus* Kirschbaum, 1868 (as *C. brachycranus* Scott, 1870) and *Cixius pinicola* Fieber, 1876 (is *Tachycixius venustus* (Germar, 1830)) as new species for the Dutch fauna. The latter is a Mediterranean species which does not occur in central and western Europe. Dutch specimens of this species were not found in the collections and it is omitted from later fauna lists. Therefore, *Tachycixius venustus* is not considered to be a Dutch species. In part thirteen of the fauna of the Netherlands (Blöte 1943), Blöte reported a total of seven species: *Oliarus leporinus* (Linnaeus, 1761) (now *Pentastiridius leporinus* (Linnaeus, 1761)), *Cixius simplex* (Herrich-Schäffer, 1835), *C. stigmaticus* (Germar, 1818), *C. vitripennis* Kirschbaum, 1868 (synonym for *C. simplex*) and *Myndus musivus* (Germar, 1825) as new species. In an attached description Blöte mentioned some differences between *C. simplex* and *C. vitripennis*, but no details are presented on the genitalia. In the Dutch collections no specimens labeled *C. vitripennis* were found, and this name is not included in later lists. Cobben & Gravesteyn (1958) reported *C. similis* for the first time, which raises the total number of Dutch species to nine. In the fauna lists of Gravesteyn (1974) and Den Bieman et al. (2011) no changes in the cixiid fauna were included.

IDENTIFICATION

Lacehoppers are easily recognised by their hyaline wings and the three or five keels on the mesonotum. Planthoppers (Delphacidae), which also have hyaline wings, are distinguishable by the spur on the apex of their hind tibia. The adults of all Dutch Cixiidae can be identified with Biedermann

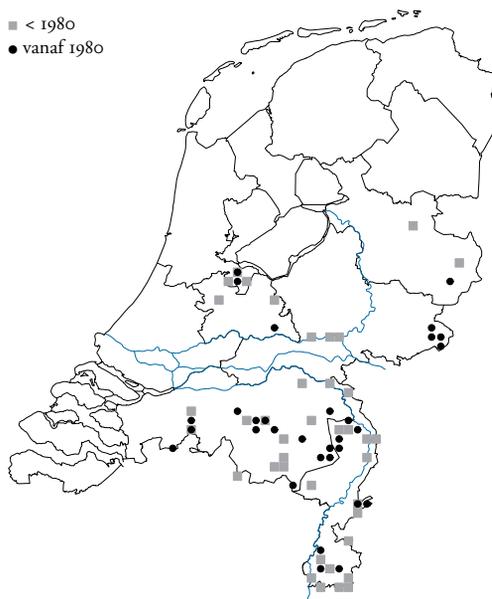


Figure 2. Records of *Cixius cunicularius* in the Netherlands. Figuur 2. Vindplaatsen van *Cixius cunicularius* in Nederland.

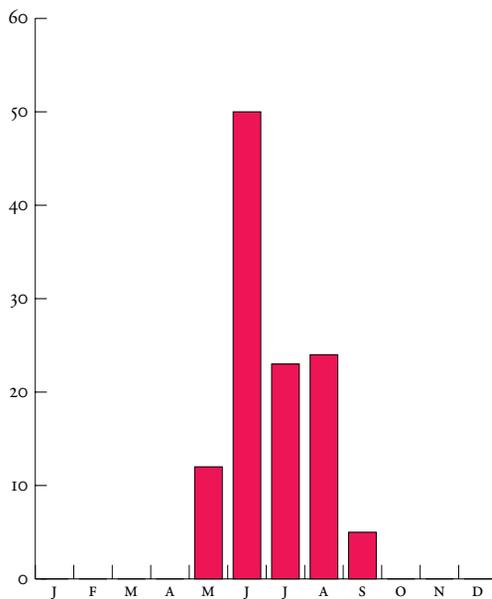


Figure 3. Phenology of adult *Cixius cunicularius* in the Netherlands. Figuur 3. Fenologie van volwassen *Cixius cunicularius* in Nederland.

& Niedringhaus (2004). The following species can only be identified after studying the genitalia: *C. dubius*, *C. similis*, *C. simplex* and *C. stigmaticus*. Within the genus *Cixius* these species can be recognized by the completely black frons and clypeus. In the case of *C. distinguendus* it is recommended to compare the shape of the head with reference material or to study the male genitalia. Little is known about species specific differences in the morphology of female genitalia (Holzinger et al. 2002).

The Dutch genera can be recognized easily in the field. In the Netherlands only the genus *Cixius* has more than one species, of which only *C. nervosus* and *C. cunicularius* can be reliably identified in the field.

Dutch Cixiidae can only be identified up to the genus level in the nymphal stage. The nymphal stages of many *Cixius* species are unknown (Stöckmann et al. 2013).

BIOLOGY

Little is known on the biology of the European Cixiidae species. Kirby (1992) described the ecology of some rare cixiids from Great Britain, Nickel (2003) did the same for the German species. The occurrence of species is probably determined by ecological bottlenecks affecting the nymphs (Holzinger et al. 2002).

Nymphs

The nymphal biology and nymphal stages of the economically important species *Hyalesthes obsoletus* have been described in detail (Cargnus et al. 2012). This species occurs in surrounding countries of the Netherlands. Nymphs of most other lacehoppers are rarely found, mostly because nymphs live in the soil or the litter layer where they suck on plant roots. Probably, nymphs also feed on soil fungi (Holzinger et al. 2002). This cryptic lifestyle is the main reason why there is not much known on the biology of the nymphs of most species. It has been suggested that the occurrence of Cixiidae species is mainly determined

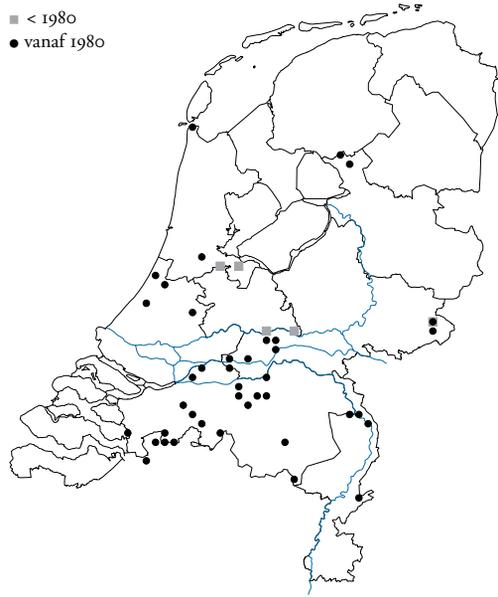


Figure 4. Records of *Cixius distinguendus* in the Netherlands.
 Figuur 4. Vindplaatsen van *Cixius distinguendus* in Nederland.

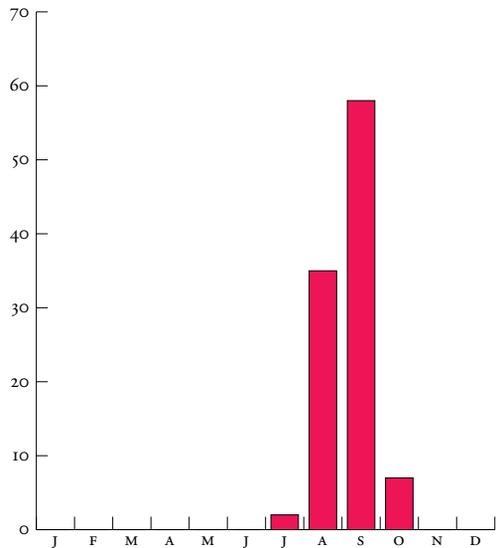


Figure 5. Phenology of adult *Cixius distinguendus* in the Netherlands.
 Figuur 5. Fenologie van volwassen *Cixius distinguendus* in Nederland.



Figure 6. *Cixius dubius*, Perchtoldsdorfer Heide (Oostenrijk), 1.VI.2007. Photo Gernot Kunz.
 Figuur 6. *Cixius dubius*, Perchtoldsdorfer Heide (Oostenrijk), 1.VI.2007. Foto Gernot Kunz.

by the ecological requirements of the nymphs, like the occurrence of host plants, soil structure, soil moisture and soil chemical parameters (Holzinger et al. 2002, Nickel et al. 2002). In the Netherlands Cixiidae hibernate in the nymphal stage in the soil, the adults emerging from the end of April onwards. Nymphs are sometimes found under tree stumps, rocks, mosses or in ant colonies. For most species little is known about the hostplants of the nymphs.

During fieldwork some nymphs of the species *Trichonocranus emmeae* were found a few centimeters under mosses and stones. Some nymphs were found near ants, although, no direct contact between nymphs and ants was observed.

Adults

Adult lacehoppers are relatively rarely found due to their low numbers and their hidden lifestyle. Like most plant- and leafhoppers, Cixiidae are phloem feeders, phloem sugar flows have a high nutritional value. They feed mainly on shrubs and trees (Nickel et al. 2002). Although most species are polyphagous, some species are oligophagous or monophagous. For example, adults of *Myndus musivus* lives only on narrow-leaved willows and adult *Pentastiridius leporinus* are mostly found on grasses, primarily on reed.

Symbiosis

Nymphs and adults excrete the surplus sugars from the phloem which, for some species, leads to a symbiosis between ants and cixiids. Ants feed on the excreted sugars and defend the lacehoppers against predators (Lőrinczi 2012). This symbiosis was only recorded once for adult lacehoppers (Holzinger 2009b), but is more commonly documented for nymphs (Myers 1929, Holzinger et al. 2002).

Enemies

Nymphal cixiids are parasitized by Embolemidae from the genus *Embolemus* Westwood, 1833 (Varrone & Olmi 2012). Leafhopper wasps (Dryinidae) are known to parasitize Auchenorrhyncha, species of the genus *Dryinus* parasitize Cixiidae (De Rond 2004). Parasitized nymphs can be recognized by the dryinid thylacium, a grey sac which contains the larvae. This thylacium protrudes from the body of the plant- or leafhopper. In contrast to Embolemidae and Dryinidae, the larvae of big-headed flies (Pipunculidae) develop inside the plant- or leafhopper (Rafael & Skevington 2010).

Economic importance

The number of economically important cixiid species is limited. In Europe, *Hyalesthes obsoletus* Signoret, 1865 is the most harmful species (Holz-



Figure 7. Records of *Cixius dubius* in the Netherlands.
 Figuur 7. Vindplaatsen van *Cixius dubius* in Nederland.

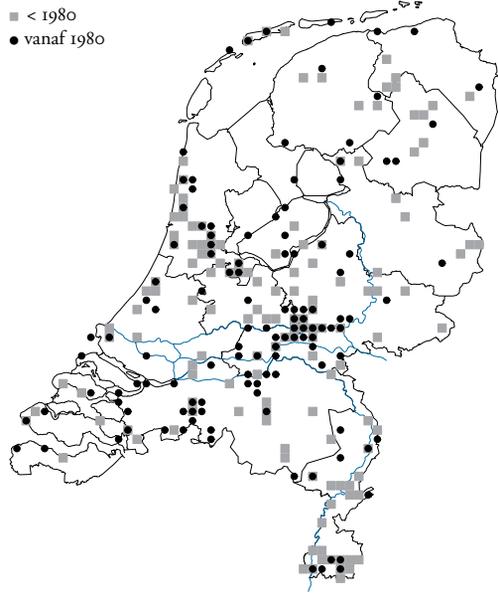


Figure 8. Records of *Cixius nervosus* in the Netherlands.
 Figuur 8. Vindplaatsen van *Cixius nervosus* in Nederland.

inger et al. 2002). This species transfers viruses to, amongst others, potatoes, grapes and tomatoes. The species is known to exist in Germany, southern Belgium and further southward. This species was not found during our field work in Limburg (the southern part of the Netherlands) on locations where the host plants, mainly field bindweed *Convolvulus arvensis* and common nettle *Urtica dioica*, were found.

Pentastiridius leporinus has been reported as a vector of the Syndrome ‘Basses richesses’ on sugar beets in France (Bressan et al. 2009). This species also occurs in the Netherlands, mainly in very humid biotopes in the provinces of Noord- and Zuid-Holland.

MATERIAL

The Cixiidae collection of Naturalis Biodiversity Center, which includes the collections of the former Zoölogical Museum Amsterdam and the

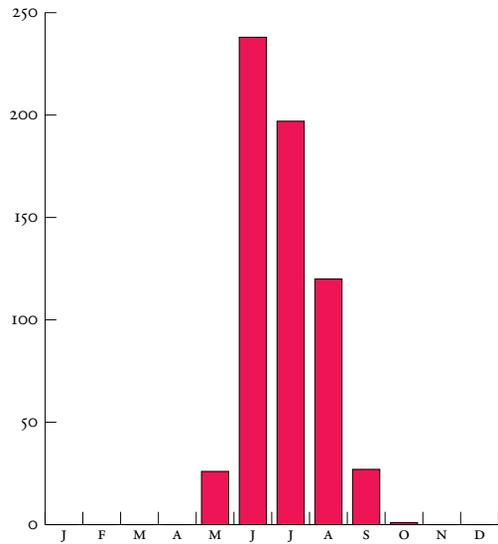


Figure 9. Phenology of adult *Cixius nervosus* in the Netherlands.
 Figuur 9. Fenologie van volwassen *Cixius nervosus* in Nederland.

department Entomology of the Wageningen University, was completely reviewed. Also the collection of the Nature History Museum Fryslân was examined and the Nature History Museum Brabant shared its data. In addition, the private collections and the data sets of Ad Mol, Kees den Bieman, Roel van Klink and Vincent Kalkman have been used. Finally, all observations which could be validated from Waarneming.nl are included in this article. In 2017 these data sources were supplemented by fieldwork.

SPECIES

Cixius Latreille, 1804

In Europe the genus *Cixius* is represented by about 50 species, of which 15 species occur in central Europe (Holzinger et al. 2003). Seven species occur in the Netherlands. The taxonomic status of several species is unclear. In the Netherlands this applies to *Cixius nervosus* (n nominate morph) and its variety *C. nervosus var. longispinus* Wagner, 1955. The genus differs from the related genus *Tachycixius* due to the absence of tubercles at the apical margin of the forewings. Both genera can be distinguished from the other Dutch genera by the combination of the following characteristics: three keels on the mesonotum, the vertex which is broader than long and the presence of 1-3 apical spines at the hind tibia.

Cixius cunicularius (Linnaeus, 1767)

Distribution *Cixius cunicularius* is an uncommon species which is mainly found in Limburg and Noord-Brabant (fig. 2). In addition, this species is known to exist only at a few locations in the provinces of Gelderland, Utrecht and Overijssel and around lake Naardermeer in the province of Noord-Holland. The species may also be found in the province of Drenthe. Because the species often occurs in low densities, it can easily be overlooked. The status of *C. cunicularius* is not clear, the number of observations before and after 1980 is almost equal. It is not often collected at the



Figure 10. Records of *Cixius similis* in the Netherlands.
 Figuur 10. Vindplaatsen van *Cixius similis* in Nederland.

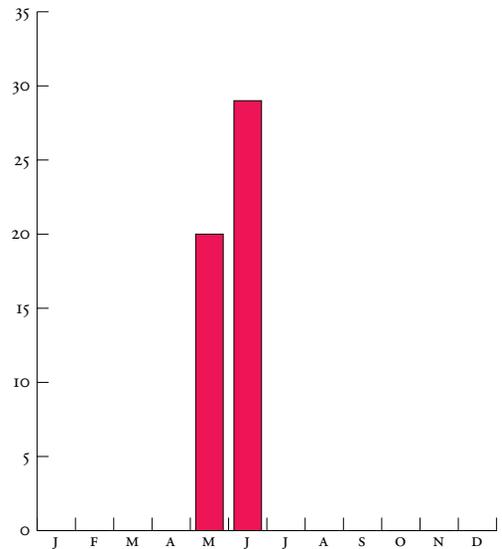


Figure 11. Phenology of adult *Cixius similis* in the Netherlands.
 Figuur 11. Fenologie van volwassen *Cixius similis* in Nederland.



Figure 12. Records of *Cixius simplex* in the Netherlands.
 Figuur 12. Vindplaatsen van *Cixius simplex* Nederland.



Figure 13. Records of *Cixius stigmaticus* in the Netherlands.
 Figuur 13. Vindplaatsen van *Cixius stigmaticus* Nederland.

same locality for several years. *Cixius cunicularius* occurs throughout western, central and eastern Europe, with the exception of Spain. Furthermore, this species is also present in the Near East and the East Palaearctic area (Jach & Hoch 2013). **Ecology** Mainly found in moist deciduous forests, often in the vicinity of streams and canals. In addition, the species is sometimes found around ponds and in peatlands, if there are deciduous trees nearby. Adults are found on deciduous trees such as *Alnus*, *Betula*, *Corylus*, *Salix*, *Ulmus* and others (pers. obs. Kees den Bieman & Marco de Haas, Nickel 2003).

Phenology Adults are found from May to the beginning of September, with a peak in June (fig. 3). This indicates that there is only one generation per year, as described for Germany (Nickel 2003) and Austria (Holzinger 2009a).

***Cixius distinguendus* Kirschbaum, 1868**

Distribution *Cixius distinguendus* seems to have increased considerably in recent decades (fig. 4).

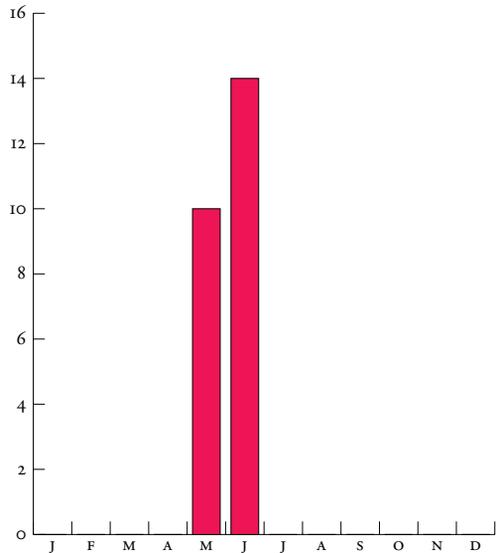


Figure 14. Phenology of adult *Cixius stigmaticus* in the Netherlands.
 Figuur 14. Fenologie van volwassen *Cixius stigmaticus* in Nederland.

Only 10 observations were recorded before 1980, since 1980 55 observations were noted. While fairly common in the southern provinces, the number of observations from northern parts of the Netherlands is low. The species has not been found in the northern provinces Groningen and Friesland, probably due to less intense collecting activities. The species is known from central and western Europe and also occurs in the East Palaearctic area (Jach & Hoch 2013, Van Stalle 1987).

Ecology This species can be found in various, but mainly moist, biotopes on woody plants. This varies from young pines on dry, sandy grounds to willows in flood plains. Mostly, this species is found in forests and along forest edges on various shrubs and young trees such as *Betula*, *Fagus*, *Pinus*, *Picea*, *Salix* and *Quercus* (pers. obs. Kees den Bieman & Marco de Haas, Nickel 2003).

Phenology A late species, adults are collected from July until October, with the majority of the observations in August and September (fig. 5). As in Germany and Austria, only one generation per year occurs (Nickel 2003, Holzinger 2009a).

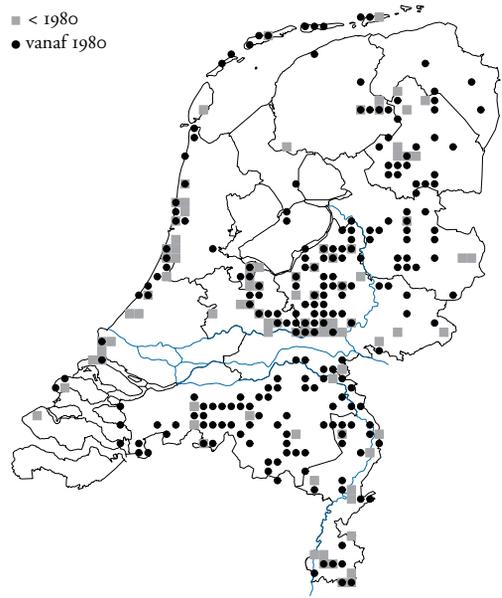


Figure 15. Records of *Tachycixius pilosus* in the Netherlands.
 Figuur 15. Vindplaatsen van *Tachycixius pilosus* in Nederland.

***Cixius dubius* Wagner, 1939**

New for the Netherlands

Limburg Neercanne, Cannerbos, 19.v.1952, 1 ♂, 3 ♀, col. Naturalis; Gerendal, 20.v.1952, 2 ♂, col. Naturalis.

Distribution The only six Dutch specimens of this species (fig. 6) were collected in 1952 in the Gerendal and Cannerbos, in the southern part of the province of Limburg (fig. 7). These were at the time identified as *Cixius stigmaticus*. These records probably form the northwestern boundary of the range. *Cixius dubius* has a limited European distribution: Belgium, Germany, Czech Republic, Slovakia, Switzerland, Austria, Italy and former Yugoslavia (Jach & Hoch 2013). In Germany the species mainly occurs in the southern states (Holzinger et al. 2003, Kunz et al. 2011).

Ecology Although information about the Dutch specimens is missing, it is likely that the specimens

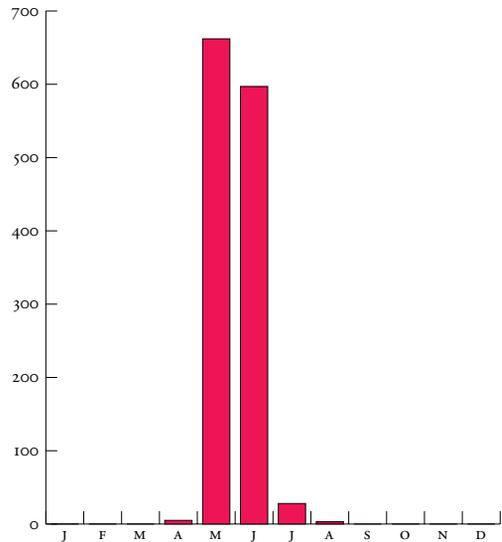


Figure 16. Phenology of adult *Tachycixius pilosus* in the Netherlands.

Figuur 16. Fenologie van volwassen *Tachycixius pilosus* in Nederland.

were collected in one of the deciduous forests in the Gerendal. Also the Cannerbos is a deciduous forest. In Germany, this species is found in closed and open deciduous and coniferous forests on, among others, *Corylus* and *Quercus* (Nickel 2003). **Phenology** The Dutch specimens were collected in May. In Germany, adults are found from the beginning of May to the end of June and there is one generation per year (Nickel 2003).

***Cixius nervosus* (Linnaeus, 1758)**

Distribution *Cixius nervosus* is the most widespread Cixiidae in the Netherlands (fig. 8). The species is known from almost all over Europe (Jach & Hoch 2013). *Cixius nervosus var. longispinus* also occurs in the Netherlands, but is found less often than the nominate morph. In Germany, the nominate morph and *Cixius nervosus var. longispinus* do not differ in distribution or ecology (Holzinger et al. 2003, Nickel 2003). Not enough information is known to make a statement on the situation in the Netherlands.

Ecology This species is found in a wide range of biotopes. Often in humid biotopes, in forest and forest edges, on deciduous trees. However, this species can also be found on solitary trees in very dry heathlands, in old fruit orchards, on trees along roadsides and in gardens. Adults are found on deciduous trees and shrubs such as *Acer*, *Alnus*, *Betula*, *Carpinus*, *Corylus*, *Fraxinus*, *Malus*, *Populus*, *Rhamnus*, *Tamarix*, *Tilia* and *Salix*, but most common on *Quercus* (pers. obs. Kees den Bieman & Marco de Haas, Nickel 2003).

Phenology Adults are found from May until October with a peak in June and July (fig. 9). The Dutch records clearly indicate only one generation per year.

***Cixius similis* Kirschbaum, 1868**

Distribution A rare species in the Netherlands that occurs in peat and very wet heathlands (fig. 10). It is only known from a few records in Drenthe, Gelderland, Noord-Brabant and Limburg. Its rarity can be explained by the rarity



Figure 17. Records of *Pentastiridius leporinus* in the Netherlands.
 Figuur 17. Vindplaatsen van *Pentastiridius leporinus* in Nederland.

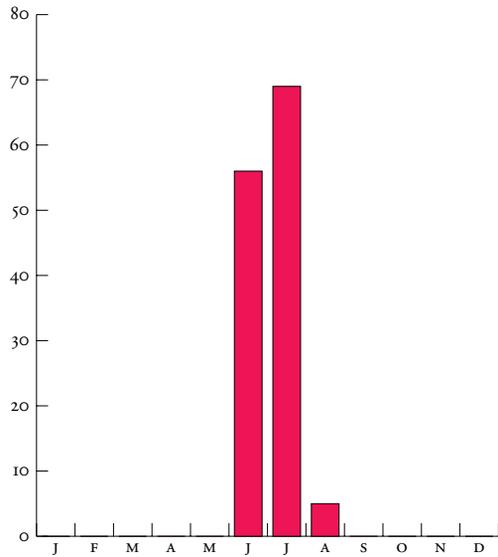


Figure 18. Phenology of adult *Pentastiridius leporinus* in the Netherlands.
 Figuur 18. Fenologie van volwassen *Pentastiridius leporinus* in Nederland.



Figure 19. *Myndus musivus*, Sisteron (Alpes de Haute Provence, France). Photo Gernot Kunz.

Figuur 19. *Myndus musivus*, Sisteron (Alpes de Haute Provence, Frankrijk). Foto Gernot Kunz.

of the habitat. Probably the species can be found at more places by sampling suitable locations.

Cixius similis occurs in a large part of western, central and eastern Europe and is largely absent in the Mediterranean region (Jach & Hoch 2013).

Ecology Adults are often found on low, woody plants, such as *Betula pubescens*, *Vaccinium myrtillus*, *V. uliginosum* and *Pinus*, and on grasses such as *Molinia caerulea* on peaty soils like intermediate bogs and wet heathlands (Dutch data, Nickel 2003).

Phenology In the Netherlands adults were only found in May and June (fig. 11). In Germany, adults are found from May to August (Nickel 2003). This species is univoltine.

Cixius simplex (Herrich-Schäffer, 1835)

Distribution *Cixius simplex* is a very rare species in the Netherlands, known from only four old specimens in the collection of Naturalis: Arnhem (1872, 1905 and one specimen without a date on the label) and Bussum (1895) (fig. 12). The species occurs in most of Europe, but is not found in Scandinavia and northeastern Europe (Jach & Hoch 2013). This species may have disappeared from the Netherlands.

Ecology Little is known about the habitat requirements of this species. Adults are found on

woody plants in forest edges, but also in the herb layer in moist locations (Nickel 2003).

Phenology Found in the Netherlands in September. In Germany, adults are found between June and October. This species has one generation per year (Nickel 2003).

Cixius stigmaticus (Germar, 1818)

Distribution *Cixius stigmaticus* is a rare species, known from the provinces of Limburg, Noord-Brabant, Gelderland, Overijssel, Drenthe and Friesland (fig. 13). The species is not found in the western parts of the Netherlands. In Germany, the species probably has declined since 1970 (Nickel 2003). Probably, the same applies to the Netherlands as only five records exist since 1980.

Cixius stigmaticus occurs in large parts of western, central and eastern Europe, with the notable exception of Great Britain and Ireland (Jach & Hoch 2013).

Ecology This species can be found in dry to moist forests and forest edges, on several deciduous trees and shrubs, such as *Alnus*, *Betula*, *Rubus*, *Salix* and *Quercus* (Nickel 2003).

Phenology Dutch specimens were collected in May and June (fig. 14). In Germany there is one generation per year, with adults from May to July (Nickel 2003).

Tachycixius Wagner, 1939

Tachycixius has a Palaearctic distribution and counts 24 species (Holzinger 2000). Of these, 20 occur in Europe, of which three are found in central Europe (Holzinger et al. 2003). In the Netherlands one species occurs: *Tachycixius pilosus*. The genus is distinguished from the related genus *Cixius* by the presence of tubercles at the apical margin of the forewings.

Tachycixius pilosus (Olivier, 1791)

Distribution *Tachycixius pilosus* is a common species on sandy soils in the Netherlands (fig. 15). In spring it can be the most common leaf- and planthopper species on grasses, shrubs and trees in (pine) forests. The species is mostly found in forests on inland sandy soils. In addition, the species can be found in the sea dunes. There are a few records outside the large sandy areas in the east of the Netherlands. *Tachycixius pilosus* occurs in a large part of Europe with the exception of some eastern Mediterranean countries (Jach & Hoch 2013).

Ecology The species is mostly found in deciduous forests and sometimes in coniferous forests, but can also be found in parks, gardens and on solitary trees. *Quercus robur* and *Sorbus aucuparia* seem to be favorite host plant. On sandy soils the species can also easily be collected from *Vaccinium myrtillus*. In open pine forests it is often found on the grass *Deschampsia flexuosa*. Possibly the nymphs of this species feed on the roots of this grass. In the dunes this species can be found on *Hippophae rhamnoides* (Dutch data).

Phenology Adults are found from the end of April to the beginning of July (fig. 16). In May the species is sometimes found in high numbers. This phenology indicates the occurrence of a single generation per year.

Pentastiridius Kirschbaum, 1868

Pentastiridius is represented by only four species in Europe, three of which occur in central Europe (Holzinger et al. 2003). One species, *Pentastiridius leporinus*, occurs in the Netherlands. The genus

■ < 1980
● vanaf 1980



Figure 20. Records of *Myndus musivus* in the Netherlands. Figuur 20. Vindplaatsen van *Myndus musivus* in Nederland.

differs from other Dutch genera by the five, rather than three, keels on the mesonotum.

Pentastiridius leporinus (Linnaeus, 1761)

Distribution *Pentastiridius leporinus* is a rare species, found in the provinces of Zuid-Holland, Noord-Holland, Flevoland, Overijssel, Utrecht, Gelderland and Noord-Brabant (fig. 17). Locally, the species can be common. A population can be restricted to an area of several hundred square meters, not occurring in an apparently similar habitat neighboring that area. This was observed in the population of the Oostzanerveld, Noord-Holland (see also Kirby 1992). The species occurs almost all over Europe, in the Near East and the East Palaearctic area (Jach & Hoch 2013).

Ecology The species occurs in wet areas, mainly in (brackish) lowland areas, but also along streams. It is mainly collected from reed *Phragmites australis* but is also reported from *Carex*, *Scirpus*



Figure 21. Geul river entering the river Maas, at the left willows with *Myndus musivus* (Limburg), 5.vii.2017. Photo Marco de Haas. Figuur 21. Uitstroom van de Geul in de Maas met links het wilgenstruweel met *Myndus musivus* (Limburg) 5.vii.2017. Foto Marco de Haas.

and *Eriophorum* (Nickel 2003). It is notable that in eastern France the species is associated with the transmission of the bacterial plant disease ‘Basses richesses’ in sugar beet (Bressan et al. 2009). A sugar beet field is a completely different biotope than the low moor marshes in which the species is found in the Netherlands. In eastern France nymphs have been found both on the roots of wheat and sugar beet. In September, the 2nd and 3rd nymphal stages were found at a depth of 15-20 cm in sugar beet fields. In the spring the 3rd to 5th nymphal stages live at a depth of 5-10 cm in the root zone of wheat. In this region, wheat is planted after sugar beet harvest. It is suggested that adult *P. leporinus* migrate from wheat to sugar beet fields in June-July. If this is a fact, *P. leporinus* has adapted to the rotation of the harvest (Bressan et al. 2009).

Phenology Adults are found from June until the beginning of August (fig. 18). There is only one generation a year in the Netherlands, as well as in Germany and Austria (Holzinger 2009a, Nickel 2003).

Myndus Stål, 1862

Myndus is a monotypic genus with only one species in Europe: *Myndus musivus* (Holzinger et al. 2003). The genus can be recognized by the

vertex which is clearly longer than wide and the brown spots on the forewing.

Myndus musivus (Germar, 1825)

Distribution *Myndus musivus* (fig. 19) is a rare species which was found in one location in the Netherlands (fig. 20). Mac Gillavry discovered the species in 1919 for the first time. It was found during an excursion along the right bank of the Maas, just above the confluence of the Geul and the Maas (Mac Gillavry 1920). In 2017, the species was rediscovered at nearly the same spot on a narrow-leaved willow along the southern shore of the Geul. Probably the species can be found in other areas, with gravel or sandbanks, flowing waters and narrow-leaved willows. *Myndus musivus* is found in central, southeastern and eastern Europe. In the Netherlands the species reaches the northwestern boundary of its range (Jach & Hoch 2013).

Ecology The species is found on narrow-leaved willows such as *Salix viminalis* and *S. triandra* along natural rivers and streams with sand or gravel banks (Holzinger et al. 2003). At the Dutch location, the species was found on willows which stood directly on the shore of the Geul, mainly on the overhanging branches (fig. 21).



Figure 22. Locality of *Trigonocranus emmeae*, Sint-Pietersberg: Châlet d'n Observant (Limburg), 4.VIII.2017. Photo Kees den Bieman.

Figuur 22. Vindplaats van *Trigonocranus emmeae*, Sint-Pietersberg: Châlet d'n Observant (Limburg), 4.VIII.2017. Foto Kees den Bieman.



Figure 23. Locality of *Trigonocranus emmeae*, Sint-Pietersberg: Châlet d'n Observant (Limburg), 4.VIII.2017. Photo Kees den Bieman.

Figuur 23. Vindplaats van *Trigonocranus emmeae*, Sint-Pietersberg: Châlet d'n Observant (Limburg), 4.VIII.2017. Foto Kees den Bieman.

The species did not appear on willows that were several meters from the shore. In Germany, the species has declined, presumably as a result of the canalization of streams and rivers (Nickel 2003).

Phenology In the Netherlands, adults were found twice in July. In Germany it is a univoltine species with adults from June to August (Nickel 2003).

Trigonocranus Fieber, 1875

Trigonocranus is a monotypic genus with a Palaearctic distribution (Holzinger et al. 2003). The only species, *Trigonocranus emmeae*, is rare and little is known about its ecology. It is the smallest cixiid in the Netherlands.

Trigonocranus emmeae Fieber, 1876

New for the Netherlands

Limburg Sint Pietersberg, on a parking area at Châlet d'n Observant, under stones and moss, AC 176.2-314.I, 27.VII.2017, 1 brachypterous ♂, 5 macropterous ♀ and nymphs, leg. & col. M.C. de Haas; same locality, 4.VIII.2017, 3 macropterous ♀, leg. & col. C.F.M. den Bieman.

Distribution In 2017 the first population of *Trigonocranus emmeae* (fig. 1) was found on a stony slope at a parking area next to the restaurant Châlet d'n Observant on the Sint Pietersberg (fig. 24). Perhaps other populations could be discovered in quarries and along stony railroads in the province of Limburg. All over its range it is a rare species with a disjunct distribution. In our neighboring countries there are observations from Belgium (pers. comm. Jean-Yves Baugnée), Germany (Nickel 2003), Luxemburg (Niedringhaus et al. 2010) and the United Kingdom (Kirby 1992). *Trigonocranus emmeae* occurs in major parts of western and central Europe and some countries in southeastern Europe (Jach & Hoch 2013).

Ecology Little is known about the ecology of *T. emmae*. It is the only Dutch Cixiidae with macropterous and brachypterous individuals. The brachypterous individuals are unpigmented and have reduced eyes. Nymphs and brachypterous adults live underground, in upper soil layers or in litter. Most observations in other countries are based on macropterous, flying individuals (Nickel 2003). The species is mostly recorded in warm

biotopes with an incomplete vegetation coverage. Not much is known on the hostplants. At a site in southern Germany, the species was found on the roots and the lower stem parts of field bindweed *Convolvulus arvensis* (Hoch et al. 2013). This plant was not occurring at the Dutch site. Adults and nymphs were found under moss at about 2 cm depth, near several herbs and near roots which were covered with a wax-like material. The population is located on a small slope consisting of calcareous debris, covered with herbs and some planted trees. Moss covered most of the soil (fig. 22-23).

Phenology In the Netherlands, the species was found at the end of July and the beginning of August. In Germany, the species is observed from May to the beginning of August. This phenology indicates the existence of one generation per year (Nickel 2003).

CONCLUSIONS

With eleven species, the Dutch Cixiidae fauna is rather small, despite the recent discovery of two species. Two species (*C. dubius* and *C. simplex*) may have already disappeared from the Netherlands. The Cixiidae fauna of neighboring countries is not much richer with eleven species in Belgium (Van Stalle 1987, pers. comm. Jean-Yves Baugnée), twelve in Luxembourg (Niedringhaus et al. 2010), twelve in Great Britain (Wilson et al. 2015) and twenty in Germany (Biedermann & Niedringhaus 2004). Based on this information, the following species are expected to exist in our country: *Cixius wagneri* China, 1942, *Cixius sticticus* Rey, 1891, *Reptalus panzeri* (Löw, 1883) and *Hyalesthus obsoletus* Signoret, 1865.

All Dutch Cixiidae species have a single generation per year and the nymphs hibernate. The information about habitat preferences is mainly based on records of adult individuals. Adults are found in a wide range of trees and shrubs and seem to be polyphagous. However, nearly nothing is known on the hostplant preference of the underground living nymphs.



Figure 24. Records of *Trigonocranus emmeae* in the Netherlands.

Figuur 24. Vindplaatsen van *Trigonocranus emmeae* in Nederland.

The discovery of *Trigonocranus emmeae* is notable. It is one of the most northern sites of a species that seems to be rare all over its distribution area. Because of that, the protection of the site in Limburg deserves attention. Recently, this species was collected for the first time in Sweden's utmost southern province in 2011 (Gillerfors 2011).

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SAMENVATTING

Ecologie en verspreiding van de Nederlandse glasvleugelcicaden (Hemiptera: Fulgoromorpha: Cixiidae)

De Cixiidae (glasvleugelcicaden) vormen een middelgrote cicadenfamilie, met in Europa ruim 140 soorten. Voor het eerst sinds Cobben & Gravstein (1958) kunnen twee soorten als nieuw voor Nederland gemeld worden: *Cixius dubius* en *Trigonocranus emmeae*. *Cixius dubius* is in 1952 verzameld in het Gerendal en het Cannerbos, maar is destijds foutief in de collectie opgenomen als *Cixius stigmaticus*. *Trigonocranus emmeae* is in 2017 voor het eerst in Nederland aangetroffen op de Sint Pietersberg. *Myndus musivus* is na bijna 100 jaar herontdekt op vrijwel op dezelfde vindplaats in Zuid-Limburg als de eerste (en enige) waarneming van Mac Gillavry in 1919. Op basis van een uitgebreide studie van het beschikbare collectiemateriaal en meldingen op Waarneming.nl wordt per soort de verspreiding en fenologie aangegeven. Ecologische gegevens op basis van eigen waarnemingen en literatuuronderzoek worden samengevat. Door de verborgen ondergrondse levenswijze van de nimfen is maar beperkte ecologische informatie over de Nederlandse Cixiidae beschikbaar.

Van de huidige elf Nederlandse Cixiidae soorten zijn er inmiddels mogelijk twee al weer uit ons land verdwenen: *Cixius dubius* en *C. simplex*. Deze twee soorten zijn sinds respectievelijk 1952 en 1905 niet meer in ons land verzameld. Echter het voorbeeld van *Myndus musivus* laat zien dat Cixiidae na een lange tijd weer herontdekt kunnen worden. Dit is mede het gevolg van de geringe verzamelintensiteit van cicaden in ons land.

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