The Acroceridae (Diptera) of The Netherlands

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Abstract: A review is presented of the Acroceridae of The Netherlands. The current Dutch list contains 8 species of the family, of which *Acrocera sanguinea*, *Ogcodes fumatus*, and *O. reginae* are newly recorded for the fauna. *Paracrocera manevali*, previously reported from The Netherlands, has been deleted from the list. Distribution maps based on material examined are given for all species occurring in The Netherlands. A lectotype is designated for *Acrocera borealis*; study of the lectotype revealed that it is a female of *P. orbiculus* and the synonymy of *P. borealis* under *P. orbiculus* is established. Reticence considering the taxonomic status of other species names is expressed. A single male of *O. fumatus* was reared from a subadult female of *Pardosa lugubris*, which represents a new host record for this acrocerid.

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Introduction

The recent rearing of a male of *Ogcodes fumatus* (Erichson) by the second author and the preparation of a new checklist of the Diptera occurring in The Netherlands induced this review of the Dutch records of Acroceridae. In general, Acroceridae are seldom captured in the field and records are therefore scant. In his checklist of Dutch Diptera, De Meijere (1939) recorded three species, viz. *Oncodes gibbosus* (Linnaeus), *O. zonatus* Erichson, and *Paracrocera orbiculus* (Fabricius). Theowald (1954) reported *Oncodes varius* Latreille as a species new to the fauna. Van der Goot (1963) published a key to the then known four Dutch species of Acroceridae, summarizing the localities of capture from specimens studied and literature records. Van Aartsen (1997) added *Acrocera trigramma* Loew and *Paracrocera manevali* Séguy to the Dutch list. In the present paper the published records are reviewed and checked against material in Dutch collections. As a result of this study we are able to report the occurrence of *Acrocera sanguinea* Meigen, *Ogcodes fumatus*, and *O. reginae* (Trojan) as new to the Dutch fauna. *Paracrocera manevali* has to be deleted from the Dutch list, resulting in a total of 8 species of Acroceridae known from The Netherlands. The numbers of species of Acroceridae recorded from countries adjacent to The Netherlands are: Belgium: four (De Bruyn, 1991), Germany: 11 (Schumann, 1999; but see the section on taxonomy), and Great Britain: three (Chandler, 1998). The following collections with Dutch Acroceridae were studied in the course of this project (abbreviations given in parentheses): Nationaal Museum voor Natuurlijke Historie Naturalis, Leiden (NNM), Wageningen Universiteit (WU), Zoölogisch Museum, Amsterdam (ZMAN), and the private collections of Bob van Aartsen, 't Harde (BvA), Laurens van der Leij, 's-Hertogenbosch (LvdL), Wouter van Steenis, Utrecht (WvS), Bastiaan Wakkie, Amsterdam (BW), and Theo Zeegers, Enschede (ThZ).

Biology

Although adult Acroceridae usually are seldom encountered in Northwest Europe, some mass aggregations have been observed. In England, Edwards (1983) recorded mating clusters of *Paracrocera orbiculus* on the tips of dead elder twigs, a swarm of this species flying about a group of elder leaves, and many individuals of both sexes perched under termi-

Fig. 1. Eggs of *Ogcodes gibbosus* (Linnaeus) on a stem of *Equisetum fluviatile* L. (photo A. P. Noordam).

nal leaflets. Edwards (1984) observed several clusters of *P. orbiculus*, primarily consisting of males, on fence posts along a stretch of about two hundred meters. A mass occurrence of *Ogcodes reginae* in a *Molinia* vegetation has been observed in the province of Noord Brabant in The Netherlands (Van der Leij, 1999; as *O. varius*). According to the literature, females of certain species tend to congregate during oviposition, a phenomenon which is corroborated by some of the Dutch captures of *Ogcodes gibbosus* (see under that species, below). Upon copulation, females deposit their eggs on dead twigs or branches (*Ogcodes*) or on stems of grasses (*Acrocera*). A single female may lay up to 5000 eggs. Figure 1 illustrates a stem of *Equisetum fluviatile* L. covered with eggs of *O. gibbosus* (material deposited in ZMAN).

Primarily based on Schlinger (1987), the following information can be given on the biology of immature Acroceridae. Larvae of Acroceridae are obligatory internal parasitoids of true spiders (Araneae) and show hypermetamorphosis, i.e. the successive larval stages have a strikingly different morphology. Usually a single parasitoid developes within a host specimen, but records are available of two or more larvae reaching maturity in a single spider. As the eggs are not deposited on the host, the first stage larvae must actively locate their victim. The first instar larvae are of the planidial type, i.e. they are flattened and free-living. The first instar larvae move about by crawling, looping, or jumping. It is generally recorded that once a spider makes contact with a planidial larva, the larva sticks to one of its legs and climbs upward until it reaches the dorsal base of the spiders abdomen. This spot is unattainable for the spider's preening legs. Here it cuts a hole and enters the abdomen where it ends up in the booklung area. In a position where it is able to breathe outside air, the larva goes into a phase of diapause which lasts from five to nine months. The next two larval stages are rather little-known. A dif-

ferent strategy was recently observed during laboratory experiments by Overgaard Nielsen et al. (1999), who studied larvae of *Paracrocera orbiculus* invading *Pardosa prativaga* (Koch). Here the planidial larvae attached themselves to the legs of the spiders, especially to the tibiae and femora, by cutting a small hole through the integument. The spiders tried to remove the ectoparasitic larvae, but often failed to kill them all. After about a week the surviving larvae moulted and a small and flexible second instar larva entered the host through the attachment hole made by the first instar larva, leaving the entrance hole plugged by the exuviae. The fourth and final larval stage lasts only up to two days in the northern European Acroceridae. During this stage the larva voraciously feeds on the internal tissues of the spider and eventually emerges from the host. *Ogcodes* larvae emerge in the area of the epigastric furrow, *Acrocera* larvae leave the host through the abdominal dorsum. About 24 hours before the acrocerid larva leaves its host, it apparently induces the spider to spin a small web reminiscent of a moulting web. The spider will never use the web as it dies shortly after completing it, but the parasitoid occupies the web in order to pupate in a protective enveloppe. The adult fly emerges about two to three weeks after pupation; adults live up to six weeks. Rearing records indicate that specific host-parasitoid relationships are rare.

Host spectrum

Schlinger (1987) gave a world list of all known hosts of Acroceridae. On this list 22 of a total of about 100 spider families are represented. Small spider species with an adult size of less than 3 mm are lacking, apparently because they do not offer enough nutriment for a parasitoid acrocerid to complete its development. Schlinger's host list is dominated by hunting spiders, mostly Lycosidae and Salticidae. The web building Agelenidae and Amaurobiidae are well represented, especially in the New World, but other webbuilders are nearly absent. The dominance of hunting spiders and scarcity of webbuilders must be the consequence of the active search for a host by the first instar larva of the Acroceridae; active search is hardly possible along sticky spider snares. The webbuilders on Schlinger's list frequently come into contact with the substrate (e.g. *Zygiella* in its retreat), or have the horizontal agelenoid web type. The last category seems to be primarily parasitized by specialized New World acrocerids dropping their eggs on these dense horizontal mats. Surprisingly, there are no records of acrocerid parasitism in the Linyphiidae, which is by far the most species-rich spider family in the temperate regions. Linyphiidae are on average rather small, but they make horizontal mats, while many linyphiids have frequent contact with the substrate, and some have even evolved into hunting spiders and abandoned webbuilding altogether.

Hints for finding parasitized spiders

Several authors noticed the unchanged behaviour of the victim spider till the very end, when it begins to build a web in which the acrocerid pupa will be suspended. Parasitism in webbuilding spiders can perhaps be diagnosed by disorders in the web many days before the death of the spider. For Agelenidae, Cady et al. (1993) mentioned "poorly structured webs" which are not maintained. Holl et al. (1983) described one parasitized specimen of the orb web builder *Zygiella x-notata* (Clerck), of which the web consisted of only a few snares without an orb structure. However, this spider was detected only three hours before it started spinning the ultimate moulting web mentioned above.

In parasitized hunting spiders the retarded development can be a useful clue for detection. In the rearing of the Dutch specimen of *Ogcodes fumatus* by the second author, the parasitized spider was the most retarded of a group of 25 specimens of *Pardosa lugubris* (Walckenaer) collected simultaneously as subadults and kept alive in order to record the courtship. Dr D. Cordes (pers. comm.) had a similar experience when rearing his only acrocerid thus far. From a series of immature

Alopecosa barbipes (Sundevall) all spiders minus one reached the adult stage at the time the single acrocerid larva pupated. Looking for immature hunting spiders at a moment when most specimens of the species have reached adulthood could prove to be a fruitful strategy to collect parasitized spiders.

Taxonomy

The recent literature recognizes 37 species and 9 genera of Acroceridae occurring in Europe (Nartshuk, 1988; Weinberg & Bächli, 1997). Whereas the genera seem to be well-established, the taxonomic status of certain species appears to be rather debatable. Judging from the occurrence of intermediate forms, some taxa appear to represent extremities of a continuum rather than discrete biological entities. It is, however, beyond the scope of this paper to discuss the taxonomy of the western Palaearctic Acroceridae in detail, as such a study preferably should involve the examination of all available types and collection material from this area (see also Weinberg & Bächli, 1984). We confine ourselves to a few short remarks.

Acrocera Meigen

The fact that the Dutch material of *Acrocera sanguinea* and *A. trigramma* is represented by a female and a male specimen respectively corroborates the observation of Weinberg & Bächli (1997) that specimens of these taxa always seem to belong to one sex only. It supports their suggestion that we actually are dealing here with a single, sexually dimorphic species. More information on the sex of other material of both *A. sanguinea* and *A. trigramma* is needed before the synonymy can be definitively established. Until then, we provisionally accept both taxa as valid species.

Ogcodes Latreille

In the genus *Ogcodes* several species rouse the suggestion that perhaps two names are in use to denote a single biological species. Candidates for a possible synonymy are *O. fumatus* and *O. pallipes*, and *O. reginae* and *O. varius*.

The reared specimen of what we provisionally identify as *O. fumatus* has slightly infuscated wings, but agrees in every other aspect with our Palaearctic material of *O. pallipes*. The comparison of a larger material, including the types, will be necessary to satisfactorily establish this possible synonymy.

Among the Dutch material identified as *O. varius*, some specimens are rather dark. These specimens have a black scutellum bordered by an obscured yellowish hind margin and rather broad dark anterior margins of the abdominal tergites. In some cases, the dark anterior margins of the tergites occupy more than the basal half of the tergites. The specimens are in between typical *O. varius* (yellow scutellum with dark triangular spot at the base; dark anterior margins of abdominal tergites occupying at most basal quarter of tergites) and *O. reginae* (entirely black scutellum; dark anterior margins of abdominal tergites occupying about four-fifth of tergites). It is also remarkable that all Dutch material of *O. reginae* are females, while all specimens identified as *O. varius* are males. A preferably substantial number of specimens of both forms, including the types, should be studied before a final decission on the synonymy can be made.

For the time being, we accept *Ogcodes fumatus*, *O. pallipes*, *O. reginae* and *O. varius* as distinct species.

Paracrocera Mik

The Dutch material of *Paracrocera orbiculus* shows an extreme form of variability in the venation of the wings and in the colouration of the body. This agrees with the findings of Nartshuk (1982) who distinguished no less then ten different colour forms of *P. orbiculus* in the Saint Petersburg area only! Nartshuk observed that local specimens with a black scutellum always were females. This led her to suggest that the type material of *P. borealis* (Zetterstedt), which according to its original description has an entirely black thorax, actually represents female material of *P. orbicu-*

lus. To check this, we examined the type material of *P. borealis* preserved in the Museum of Zoology of Lund University. The extant type material consists of a single specimen; Zetterstedt (1838) did not state the number of specimens from which he described *borealis*. The type is labelled as follows: a small black label referring to Zetterstedt's 1832 trip to Lycksele and Åsele Lappmarks (Michelsen, 1985), and the written labels "A. borealis / Åsele." "Lectotypus / Acrocera / borealis. Zett / 1838 / design. 1993 / H. Andersson" "Registrerad / 1999 / ArtDatabanken / Ragner Hall" "ZML 1999 / 309" "Paracrocera / orbiculus Fabricius / H. de Jong det. 1999". The specimen is pinned and staged on a strip of synthetic material. It has a black thorax with brownish postpronotal lobes and postalar calli, while the somewhat deflated abdomen is black in ground colour with extensive brownish parts on tergites two to four, and yellowish markings on tergites three and four. Its overall condition is good. The protruding terminalia with the long cerci clearly show that it is a female, thus confirming Nartshuk's inference. As the colourpattern of the specimen falls within that of *P. orbiculus* and no distinguishing structural characters were found, we conclude that *borealis* is conspecific with *P. orbiculus*. According to Dr R. Danielsson (pers. comm.) the remaining *Paracrocera* material in the Zetterstedt collection of Lund University was identified by Dr H. Andersson as *P. orbiculus*, which supports our conclusion regarding the synonymy. As Andersson's lectotype determination was not published, we herewith fix the lectotype status of the type specimen of *A. borealis*.

Other Palaearctic taxa that are currently regarded as distinct species of *Paracrocera* could well represent synonyms of *P. orbiculus*. Majer (1977) introduced *P. kaszabi* based on a single male holotype, with a "(w)ell visible, big hypopygium". However, according to the illustration accompanying the description, the holotype is clearly a female. The same probably goes for *P. manevali* Séguy, which was described in four lines (Séguy, 1926) and should be characterized by its large protruding genitalia. Our suggestion is that the type of *P. manevali* also is a female of *P. orbiculus*. Another possible candidate for synonymy under *P. orbiculus* is *P. minuscula* Séguy, which should differ from *P. orbiculus* by the colour of the last tarsomere only (Séguy, 1934). As we had no access to the type material of these taxa, a definite decision must be postponed to another occasion.

The synonymy of *Acrocera globula* (Panzer) under *P. orbiculus* as discussed by Chvála (1980b) is accepted here. Both taxa are listed as distinct species in the recent German checklist (Schumann, 1999; as *Paracrocera globula* and *P. orbicula*, respectively). Conform Chandler (1998), the species is referred to as *Paracrocera orbiculus* in the present paper.

Identification

Identification of the northwestern European Acroceridae can be completed most satisfactorily with the combined aid of the keys by Chvála (1980a, 1980b), Sack (1936), and Weinberg & Bächli (1997). Chvála (1980a) gives the most complete key to the European species of *Ogcodes*.

The Dutch records

Below a list is given of the Dutch and reportedly Dutch species of Acroceridae. Going through the material in the Dutch collections it appeared that quite a number of specimens were identified incorrectly, and we therefore restrict the distributional data on the maps to specimens we have examined ourselves. It should be noticed that most records of Acroceridae in The Netherlands are from the diluvial higher grounds of the country.

Acrocera sanguinea Meigen

Material examined: 1♀, Ewijk, vi.1966, J. Pijfers leg. (ZMAN).

The specimen was placed among the material under the drawer label for *Paracrocera orbiculus*. *Acrocera sanguinea* is a new addition

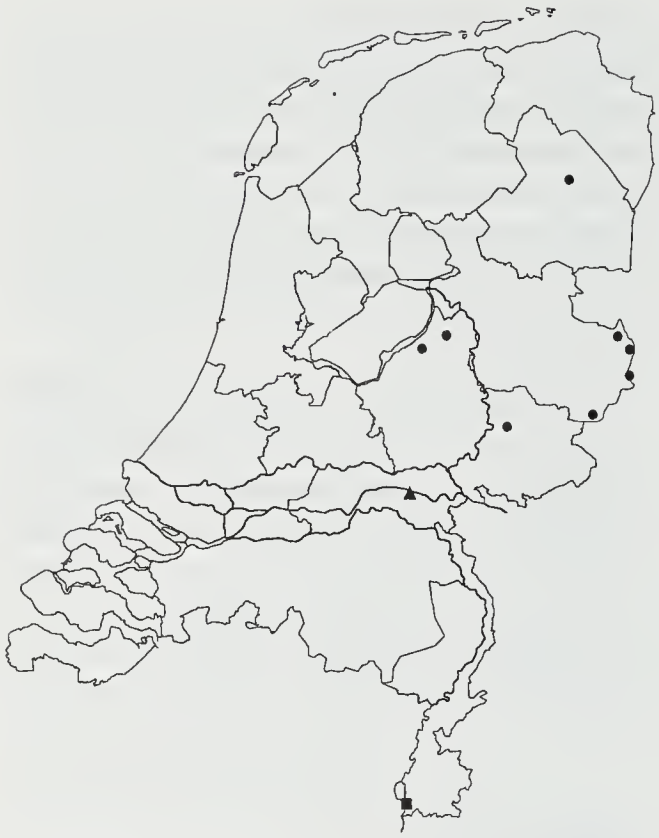

Fig. 2. Distribution of *Acrocera sanguinea* Meigen (triangle), *A. trigramma* Loew (square), and *Paracrocera orbiculus* (Fabricius) (circle) in The Netherlands.

to the Dutch list. The locality where the specimen was captured is indicated in figure 2.

Acrocera trigramma Loew

Material examined: 1♂, St. Pietersberg, 16.vii.1992, B. van Aartsen leg. (BvA).

Based on the above specimen, *A. trigramma* was reported as new to the Dutch fauna by Van Aartsen (1997). Thus far it is the only recorded material of *A. trigramma* from The Netherlands. The locality is given in figure 2.

Ogcodes fumatus (Erichson)

Material examined: 1♂, Heeze, Strabrechtse Heide, 11.iv.1999, A. P. & S. A. Noordam leg. Ex *Pardosa lugubris* subadult ♀; pupated ± 25.iv.1999; emerged 7.v.1999 (ZMAN).

A single male of this species was reared by the second author from a subadult female of *Pardosa lugubris* s.str. The locality where the host spider was taken lies at the edge of a mixed forest mainly consisting of *Pinus* and *Betula* with an undergrowth of *Molinia*. The spider was kept indoors individually in a petridish. A day before emergence of the larva from the spider's abdomen, the spider constructed a web on the periphery of the petridish; web-construction is an anomalous action for a subadult prey-hunting lycosid spider. Upon completing the web, the spider died and the acrocerid larva left the spider's body and pupated within the web on about 25 April 1999 (fig. 3). The adult emerged on 7 May 1999 (fig. 4).

Combining the host records published by Chvála (1980b) and Schlinger (1987), the following host list for *O. fumatus* can be given: *Zygiella x-notata* (Araneidae), *Oxyopes lineatus* Latreille (Oxyopidae), *Misumena vatia* (Clerck), and *Thomisus onustus* Walckenaer (both Thomisidae). The association of *O. fumatus* with *Pardosa lugubris* represents a new host record, and the first of this species with a lycosid spider. *O. fumatus* is a new addition to the Dutch fauna. The locality where the host spider was captured is given in figure 5.

Ogcodes gibbosus (Linnaeus)

Material examined: 1♀, Driebergen, 1.vii.1972, B. van Aartsen leg. (BvA); 1♂, Wageningen, 8.ix.1949; 1♂, Wageningen, Binnenveld, half vi.1954; 1♂, Ede, Bennekommer Meent, 3.vii.1955; 1♂, 2♀, Bennekomse Meent, 8.vii.1956 (all R. H. Cobben leg.; all WU); 1♂, Roermond, 1827, Latiers leg.; 6♀, Wageningen, vii.34, Kluyver leg.; 1♂, Kotten, 3.vii.1952, P. Loof leg.; 3♀, Leersumse Veld, vii.1954, M. F. Mörzer Bruyns leg. (all ZMAN).

Fig. 3. *Ogcodes fumatus* (Erichson), pupa on wall of petridish (photo A. P. Noordam).

Fig. 4. *Ogcodes fumatus* (Erichson), ♂ (photo A. P. Noordam).

Associated with the specimens in the Zoölogisch Museum Amsterdam originating from Wageningen (six females) and Leersumse Veld (three females) are stems of *Equisetum* covered with a black layer consisting of eggs (fig. 1). A few glass mounts with first stage larvae reared from the eggs collected at Wageningen are kept with the adults. De Meijere (1935a, 1935b) referred to the egg-covered *Equisetum* stems from Wageningen and shortly noted the thin black larvae that hatched from the eggs. The larvae were standing upright and moved like bloodsuckers, but also made short jumps. The findings of several females in association with their eggs support the observation referred to above that females of certain Acroceridae congregate during oviposition. The material from Groesbeek and Empe mentioned by Van der Goot (1963) could not be traced; the specimen of *O. gibbosus* from Doesburg listed by Van der Goot (1963) actually is a specimen of *O. zonatus* (see below). The known distribution of *O. gibbosus* in The Netherlands is given in figure 5.

Ogcodes reginae (Trojan)

Material examined: 6♀, de Hamert, Heerenven, 2.viii. 1978, H. Strijbosch leg. (BvA); 1♀, Stiphout, Geneindse Heide, Kikkerven, 3.ix.1989, J. Wasser leg. (LvdL); 1♀, Beegden, 24.vii.1955, R. H. Cobben leg. (WU); 2♀, Winterswijk, 22-31.vii.1951, P. d. W. leg. (ZMAN).

The specimens in the Zoölogisch Museum Amsterdam were placed under the drawer label for *Ogcodes varius*. They represent the material which Theowald (1954) referred to when introducing *O. varius* as a species new to the Dutch fauna. According to Theowald, the material was captured on 22 to 31 July 1951 at Winterswijk by P. de Wolf; Theowald did not state the number of specimens involved or their sex. Van der Goot (1963) referred to a single specimen of *O. varius* taken near Winterswijk in the period 22 to 31 July 1951 without mentioning its sex. Re-examination of the specimens in the Zoölogisch Museum Amsterdam revealed that both belong to *O. reginae*. *Ogcodes reginae* is a new addition to the Dutch list; its known distribution is given in figure 5.

Ogcodes varius Latreille

Material examined: 2♂, Beegden, 24.vii.1955, R. H. Cobben leg. (WU); 2♂, Winterswijk, Wooldse Veen, 26.vii.1996, W. van Steenis & L. Lankreijer leg. (WvS); 1♂, Wooldse Veen, 26.vii.1996, B. Wakkie leg. (BW).

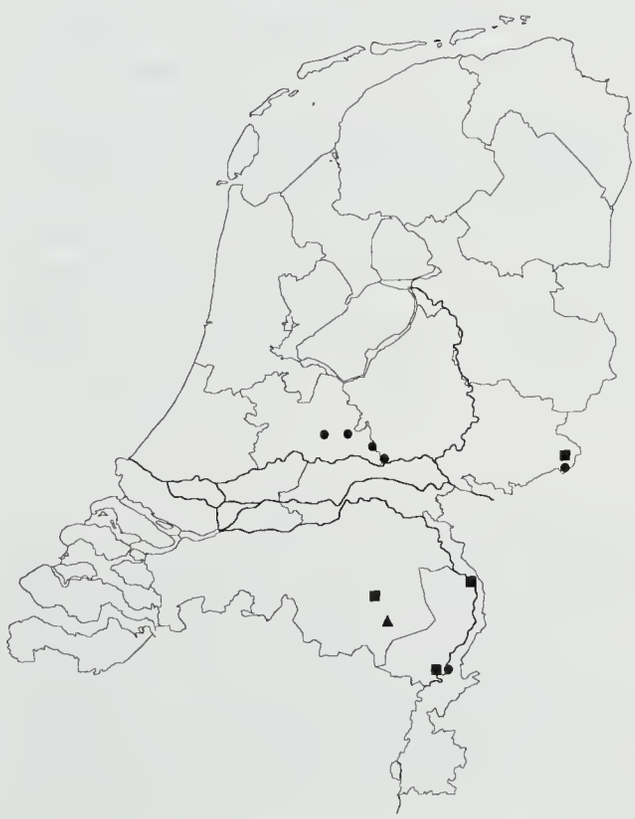

Fig. 5. Distribution of *Ogcodes fumatus* (Erichson) (triangle), *O. gibbosus* (Linnaeus) (circle) and *O. reginae* (Trojan) (square) in The Netherlands.

The above specimens prove that *Ogcodes varius* actually occurs in The Netherlands; the localities are given in figure 6.

Ogcodes zonatus Erichson

Material examined: 1♀, Maastricht, 2.viii.1973, B. van Aartsen leg. (BvA); 1♂, Nieuwkoop, 30.vi.1945 (NNM); 2♂, 1♀, Herkenbosch, 22.vii.1955, R. H. Cobben leg. (WU); 1♂, Laag Soeren, vi, Everts leg.; 1♀, Doesburg, Summer 1900 (both ZMAN).

Van der Goot (1963) mentioned literature records from Bunde, Laag Soeren, Winterswijk, Assen, Doesburg, and added Nieuwkoop as a new locality. According to Van der Goot, the material from the first four localities had been lost, while he considered the specimen from Doesburg *O. gibbosus*. The specimen from Laag Soeren still is available in the Zoölogisch Museum Amsterdam, the specimen from Doesburg is *O. zonatus*. The distribution of *O. zonatus* in The Netherlands is given in figure 6.

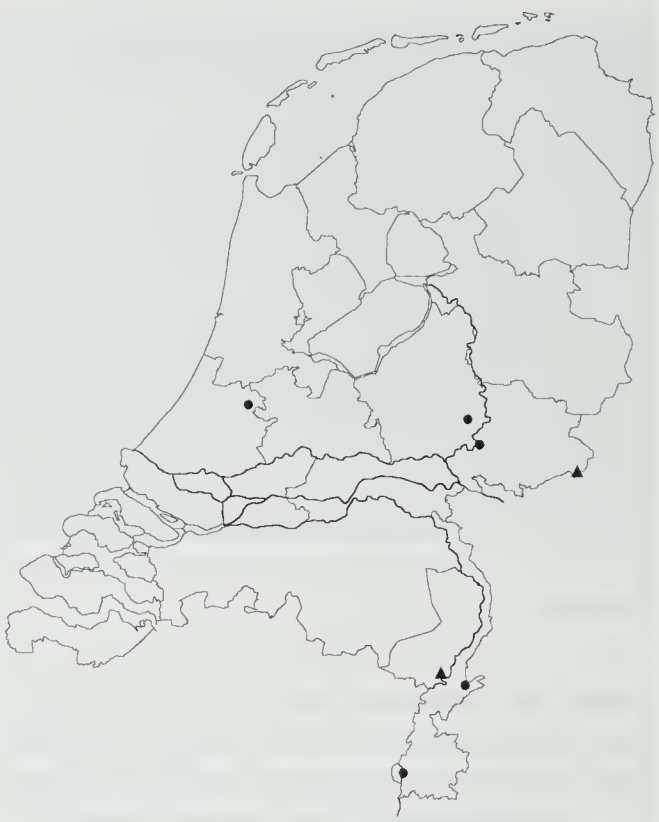

Fig. 6. Distribution of *Ogcodes varius* Latreille (triangle) and *O. zonatus* Erichson (circle) in The Netherlands.

Paracrocera manevali Séguy

Van Aartsen (1997) listed this species as new to the Dutch fauna based on two females reportedly captured on 15 July 1994 in de Dellen near Epe in the province of Gelderland. Re-examination of this material (actually captured by Van Aartsen on 15 July and 5 August 1994) proved that it belongs to *P. orbiculus* (see there), and *P. manevali* has to be deleted from the Dutch list.

Paracrocera orbiculus (Fabricius)

Material examined: 1♂, Nunspeet, 17.vii.1977; 1♀, Epe, de Dellen, 15.vii.1994; 1♀, Epe, de Dellen, 5.viii.1994; 1♀, Papenvoort, 26.vii.1998 (all B. van Aartsen leg.; all BvA); 1♀, Vorden, 24.vii.1936, Valck Lucassen leg. (NNM); 1♂, Buurser Zand, 9.vi.1990, H. J. Prijs leg.; 1♀, Losser, Hengelerheurne, 6.vii.1994, T. Zeegers leg. (both ThZ); 3♀, Denekamp, 22.vii.1906, J. C. H. de Meijere leg.; 1♀, Lattrop, 22.vii.1991, V. S. van der Goot leg. (all ZMAN).

The specimen from Empe mentioned by Van der Goot (1963) could not be traced. The distribution of *P. orbiculus* in The Netherlands is given in figure 2.

Checklist of the Dutch Acroceridae

Acrocera Meigen, 1803
- *sanguinea* Meigen, 1804
- *trigramma* Loew, 1845

Ogcodes Latreille, 1796
- *fumatus* (Erichson, 1846)
- *gibbosus* (Linnaeus, 1758)
- *reginae* (Trojan, 1956)
- = *varius* auct. nec Latreille, 1812
- *varius* Latreille, 1812
- *zonatus* Erichson, 1840

Paracrocera Mik, 1886
- *orbiculus* (Fabricius, 1787)
- = *manevali* auct. ?nec Séguy, 1926 (misidentification)

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