

CHECKLIST OF THE ENDEOSTIGMATIC MITES OF THE NETHERLANDS

(ACARI: SARCOPTIFORMES: ENDEOSTIGMATA)

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Endeostigmata are a small suborder in the order Sarcoptiformes, next to the more species rich suborder Oribatida (moss mites). Endeostigmatic mites often live in rather extreme environments like dry sandy areas, deep soil layers, seashore or microbial crusts. Their body form is either globular or elongate and wormlike. This first checklist for the Netherlands contains 12 species, seven of these are new for the fauna of the Netherlands.

INTRODUCTION

The order Sarcoptiformes consists of two suborders, the Oribatida and the small order Endeostigmata. For the Oribatida a checklist for the Netherlands has already been published (Siepel et al. 2009), with several additions (Siepel & Dimmers 2010, Siepel et al. 2012, Siepel 2018). Also for the Astigmatina, currently seen as a cohort within the Oribatida, a checklist has been published (Siepel et al. 2016). This overview of the Endeostigmata completes the order Sarcoptiformes. Endeostigmata are paraphyletic, consisting of a group of families with little developed characters. For this reason, they were originally treated as primitive Prostigmata, for which Grandjean (1939) proposed the name Endeostigmata. However, two of the families studied by him, the Sphaerolichidae and Lordalychidae, are currently still seen as primitive Prostigmata. Endeostigmata are divided in four cohorts: Alycina, Nematallycina, Terpnacarina and Alicorhagiina. Only for the Nematallycina no records are known for the Netherlands. These small wormlike mites live in deep soil, a habitat rarely sampled and they may have been overlooked or not recognized as mites. Krantz & Walter (2009) provide a key to the families. Uusitalo (2010a) gives an extensive review of the Alycidae with keys to the species. For the genus *Nanorchestes*, Uusitalo (2010b) provides an overview and key of the European species. For most of the others original species descriptions are needed for a proper identification.

CHECKLIST

Class ARACHNIDA

Subclass ACARI

Order SARCOPTIFORMES

Suborder ENDEOSTIGMATA

Cohort ALYCINA

Superfamily ALYCOIDEA

Family ALYCIDAE

Alycus C.L. Koch, 1842

1 *roseus* C.L. Koch, 1842

Pachygnathus dugesi Grandjean, 1937

Alichus rostratus Trägårdh, 1909

Pachygnathus villosus sensu Thor & Willmann, 1941 nec Dugès, 1836

Utrecht Woudenberg, old hedgerow, soil sample 0-5 cm., 25.IX.1997. Gelderland Arnhem,

in garden under litter of *Taxus baccata* L., 9.IX.1965, in col. Naturalis. Elspeet, hedgerow

near cemetery, soil sample 0-5 cm., 25.IX.1997. Nunspeet, sod-cut heathland (in 1993), soil

sample 0-5 cm. 8.III.2019, col. Siepel. Epe, old hedgerow, soil sample 0-5 cm., 22.IX.1997.

Stroe, old hedgerow, soil sample 0-5 cm.,

25.IX.1997. Aperloo, old hedgerow, soil sample 0-5 cm., 25.IX.1997; Garderen, old hedgerow,

soil sample 0-5 cm., 25.IX.1997; Harskamp, old hedgerow, soil sample 0-5 cm., 25.IX.1997;

Nunspeet, old hedgerow, soil sample 0-5 cm., 25.IX.1997. Beekbergen, Nieuw Dennenlust,

pine forest floor, soil sample 0-5 cm.,

31.VII.2020. Noord-Brabant Geldrop, Stra-



Figure 1-6. Examples of endostigmatid mites, 1. *Alycus roseus*, note the segmentation on the notogaster, 2. *Laminamichaelia setigera*, note the slender chelicerae, 3. *Pachygnathus villosus*, note the chelicerae with robust basis and tapering to the end (hence the synonym 'ornithorhynchus'), 4. *Nanorchestes arboriger*, note the small size, 5. *Caenonychus pratensis*, more elongate than *Nanorchestes*, 6. *Alycorhagia fragilis*, note the robust chelicerae.

Fotos Henk Siepel.

Figuur 1-6. Voorbeelden van endostigmatid mijten, 1. *Alycus roseus*, zie de segmentatie van het notogaster, 2. *Laminamichaelia setigera*, zie de slanke cheliceren, 3. *Pachygnathus villosus*, zie de cheliceren die een brede basis hebben en naar boven toe versmallen (vandaar het synoniem 'ornithorhynchus'), 4. *Nanorchestes arboriger*, zie de geringe grootte, 5. *Caenonychus pratensis*, langgerechter dan *Nanorchestes*, 6. *Alycorhagia fragilis*, zie de robuuste cheliceren. Foto's Henk Siepel.

brechtse heide, heathland, soil sample 0-5 cm., 18.IV.2019.

Bimichaelia Sig Thor, 1902

2 sarekensis Trägårdh, 1910

Bimichaelia setigera var. *sarekensis*
Bimichaelia campylognatha Grandjean, 1942
Bimichaelia crassipalpis Halbert, 1923
Bimichaelia rectangula Willmann, 1953
Gelderland Wageningen, Oostereng, in soil, autumn 1948, De Gunst, col. Siepel.

Laminamichaelia Uusitalo, 2010

3 setigera (Berlese, 1904)

Michaelia setigera
Bimichaelia diadema Grandjean, 1939
Bimichaelia praeincisa Willmann, 1956
Gelderland Winterswijk, Kreil estate, old forest stand (*Quercus-Fagetum*), soil sample 0-5 cm., 29.I.2021, col. Siepel.

Pachygnathus Dugès, 1836

4 villosus Dugès, 1836

Pachygnathus ornithorhynchus Grandjean, 1937
Noord-Holland Amsterdam, Keizersgracht 609, 28.VIII.2020, garden, in baited trap, leg. M. Schilthuizen, col. Siepel. **Zeeland** Sas van Goes, ruderal coastal vegetation, soil sample 0-5 cm., 18.XI.2017.

Family NANORCHESTIDAE

Nanorchestes Topsent & Trouessart, 1890

5 amphibius Topsent & Trouessart, 1890

Zeeland Wolphaartsdijk, shore Veerse meer, in washed ashore seaweed, 26.IV.2019, col. Siepel.

6 arboriger (Berlese, 1904)

Monalichus arboriger Berlese, 1904
Friesland Ruigahuizen, Starnuman forest, soil sample 0-5 cm., 21.VIII.2020. **Drenthe** Taarlo, mixed moist forest stand, soil sample 0-5 cm., 19.IV.1993. Havelterberg, *Populus tremula* forest stand, soil sample 0-5 cm., 14.IX.2017. Nuilerveld, mixed moist forest stand, soil sample 0-5 cm., 14.IX.2017. **Overijssel** Denekamp,

Singraven, moist forest in moss, 31.VII.2018. Balkbrug, Ommerschans, ash forest in moss and litter, 17.II.2019. **Flevoland** Lelystad, grassland soil sample 0-5 cm., 10.XI.1997. **Zuid-Holland** Rotterdam, Kralingen, grassland, soil sample 0-5 cm., 12.XI.1997. Rijswijk, Rijswijkse bos, beech forest, in litter, 6.I.2022. **Utrecht** Woudenberg, old hedgerow, soil sample 0-5 cm., 25.IX.1997. **Gelderland** Putten, Schovenhorst, Loglife experiment, soil sample 0-5 cm., 11.II.2016, col. Siepel. Groenendaal, Deelerwoud, grassland, soil sample 0-5 cm., 20.XI.1984. Hoge Veluwe, Heiweg, grassland, soil sample 0-5 cm., 20.XI.1984. Imbos, grassland, soil sample 0-5 cm., 20.XI.1984. Bennekom, Bovenbuurt, grassland, soil sample 0-5 cm., 20.XI.1984. Wageningen, Dijkgraaf, grassland, soil sample 0-5 cm., 20.XI.1984. Loenen, old forest stand (*Quercus-Fagetum*), soil sample 0-5 cm., 5.III.1994. Hoenderloo, old forest stand (*Quercus-Fagetum*), soil sample 0-5 cm., 5.III.1994. Ugchelen, old forest stand (*Quercus-Fagetum*), soil sample 0-5 cm., 5.III.1994. Epe, old hedgerow, soil sample 0-5 cm., 22.IX.1997. Klarenbeek, old hedgerow, soil sample 0-5 cm., 22.IX.1997. Stroe, old hedgerow, soil sample 0-5 cm., 25.IX.1997. Aperloo, old hedgerow, soil sample 0-5 cm., 25.IX.1997. Elspeet, old hedgerow, soil sample 0-5 cm., 25.IX.1997. Garderen, old hedgerow, soil sample 0-5 cm., 25.IX.1997. Harskamp, old hedgerow, soil sample 0-5 cm., 25.IX.1997. Harskamp Military training area, Ossenberg, forest with *Prunus serotina*, soil sample 0-5 cm., 14.IX.2017. Nunspeet, old hedgerow, soil sample 0-5 cm., 25.IX.1997. Beekbergen, Nieuw Dennenlust, pine forest floor, soil sample 0-5 cm., 31.VII.2020. Kootwijk, small peat spot in forest, in *Sphagnum capillifolium*, 28.III.2021. Twello, old hedgerow, soil sample 0-5 cm., 22.IX.1997. Winterswijk, Kreil estate, old forest stand (*Quercus-Fagetum*), soil sample 0-5 cm., 29.I.2021. Arnhem, Johannahoeve, forest with *Prunus serotina*, soil sample 0-5 cm., 14.IX.2017. **Zeeland** Nieuwvliet, Verdrongen Zwarte polder, grassland, soil sample 0-5 cm., 19.VI.2021. **Noord-Brabant** Soerendonk, Cranendonk, grassland, soil sample 0-5 cm., 15.V.1991. Loon, mixed moist forest stand, soil sample 0-5 cm., 19.IV.1993.

Geldrop, Strabrechtse heide, heathland, soil sample 0-5 cm., 18.IV.2019.

Caenonychus Oudemans, 1902

Speleorchestes Trägårdh, 1909

7 fallax Oudemans, 1902

Zuid-Holland Rotterdam, in moss, IV.1901, col. Oudemans in col. Naturalis.

8 formicorum Trägårdh, 1909

Noord-Brabant Geldrop, Strabrechtse heide, sod-cut area with P addition, soil sample 0-5 cm., 18.IV.2019, col. Siepel.

9 pratensis Willmann, 1936

Gelderland Nunspeet, heathland sod-cut in 1994, soil sample 0-5 cm., 8.III.2019, col. Siepel. Groenendaal, Deelerwoud, grassland, soil sample 0-5 cm., 20.XI.1984. Imbos, grassland, soil sample 0-5 cm., 20.XI.1984. Harderwijk, liming exp. soil sample 0-5 cm., 19.X.2017. Wolfheze, Reijerscamp, grassland, soil sample 0-5 cm., 9.X.2019. Wolfheze, near camping Lindenhof, grassland, soil sample 0-5 cm., 9.X.2019. Tonden, grassland, soil sample 0-5 cm., 16.X.2019. Beekbergen, Nieuw Dennenlust, pine forest floor, soil sample 0-5 cm., 31.VII.2020. Geldrop, Strabrechtse heide, heathland, soil sample 0-5 cm., 15.IV.2021. Noord-Brabant Geldrop, Strabrechtse heide, heathland, soil sample 0-5 cm., 18.IV.2019.

Cohort TERPNACARINA

Superfamily TERPNACAROIDEA

Family TERPNACARIDAE

Alycosmesis Grandjean, 1939

10 palmata (Oudemans, 1904)

Sebaia palmata Oudemans, 1904

Gelderland Arnhem, in house dust, VII.1904, col. Oudemans in col. Naturalis.

Sebaia Oudemans, 1903

11 rosacea Oudemans, 1903

Gelderland Lunteren, with *Sciurus vulgaris*, 22.V.1896; Arnhem, in house dust, VII.1903, col. Oudemans in col. Naturalis.

Cohort ALICORHAGIINA

Superfamily ALICORHAGIOIDEA

Family ALICORHAGIDAE

Alicorhagia Berlese, 1910

Epistomalychus Sig Thor, 1931

12 fragilis Berlese, 1910

Willania mira Oudemans, 1931

Noord-Holland Hilversum, in rotting leaves, viii.1900. Gelderland Arnhem, in humus, 5.IV.1930, col. Oudemans in col. Naturalis. Kootwijk, small peat spot in forest, in *Sphagnum capillifolium*, 28.III.2021, col. Siepel. Groenendaal, Deelerwoud, grassland, soil sample 0-5 cm., 20.XI.1984. Hoge Veluwe, Heiweg, grassland, soil sample 0-5 cm., 20.XI.1984. Imbos, grassland, soil sample 0-5 cm., 20.XI.1984. Harskamp Military training area, Ossenbergh, forest with *Prunus serotina*, soil sample 0-5 cm., 14-IX.2017. Harderwijk, liming exp. soil sample 0-5 cm., 19.X.2017. Beekbergen, Nieuw Dennenlust, pine forest floor, soil sample 0-5 cm., 31.VII.2020; Winterswijk, Kreil estate, old forest stand (*Quercus-Fagetum*), soil sample 0-5 cm., 29.I.2021. Noord-Brabant Geldrop, Strabrechtse heide, heathland, soil sample 0-5 cm., 18.IV.2019.

FAMILY ALYCIDAE

In the Netherlands the cohort Alycina consists of two families, the Alycidae and the Nanorchestidae. Within the Alycidae four species are recorded in the Netherlands, of which *Alycus roseus* (fig. 1) is the most famous. The species was the favourite of Van der Hammen, the former curator of Acari in Naturalis Biodiversity Center in Leiden. He studied the species extensively (Van der Hammen 1969a) and proposed, based on these studies, a new classification of the Acari (Van der Hammen 1972). In *Alycus roseus* the primitive segmentation of the notogaster is still visible, which provided the link to other segmented acarids like the Oplioacarida, a primitive order in the Parasitiformes, also extensively studied by Van der Hammen (1966, 1968, 1969b, 1970, 1977). *Alycus roseus* was

also chosen as cover for the Dutch introduction to Acari (Van der Hammen 1972). *Alycus roseus* is a predator on nematodes (Walter 1988), is usually found in dry places in soil and litter and has a Holarctic distribution, but is also found in South Africa (Uusitalo 2010a).

Another species in this family is *Bimichaelia sarekensis* with one record for the Netherlands from 1948, but not published before. The species is distributed in Europe north and west of the Alps (Uusitalo 2010a). *Bimichaelia sarekensis* occurs in coniferous forest in the soil and litter. The records given by Moraza (2008) might refer to the other European species occurring south of the Alps, *B. angustana* (Berlese, 1884). Based on the long needle-like chelicerae a feeding on fungal hyphae contents seems likely, but must be confirmed for instance by measuring gut enzyme activity (Siepel & De Ruiter-Dijkman 1993).

Laminamichaelia setigera (fig. 2) is also known from only one location in the Netherlands: near Winterswijk, in the soil of a mixed beech-oak forest (Querco-Fagetum) and new to our fauna. Wood (1967) found the species in York (UK), where it is most abundant in a Festuca-Agrostis grassland, on a strongly leached brown earth of low base status. According to Uusitalo (2010a) the species has a wide range of habitats and a Palearctic distribution.

The fourth and currently last species of the Alycidae is *Pachygnathus villosus* (fig. 3). In the Netherlands found on two locations: in ruderal coastal vegetation near Sas van Goes and in a garden in the center of Amsterdam, also new to the fauna of the Netherlands. The distribution of this species is not well known. Due to a misinterpretation in the key of Thor & Willmann (1941) many erroneous identifications occurred. The genus is extensively studied by Grandjean (1936, 1937a, b, c, d). He studied and described four species: *P. dugesi* (now *Alycus roseus*), *P. trichotus* (now *Alycus trichotus* (Grandjean, 1937)), *P. ornithorhynchus* (now *P. villosus*) and

P. leucogaster (now *Amphialycus leucogaster* (Grandjean, 1937)). *Pachygnathus villosus* is known from river banks and the marine coastline (Uusitalo 2010a). The food is unknown.

FAMILY NANORCHESTIDAE

Currently five members of this family are found in the Netherlands. All of these species, except for *Caenonychus fallax* are new to the Netherlands. *Nanorchestes arboriger* (fig. 4) is the most common species and found in a variety of habitats, ranging from the bare sand in drift sand landscapes (Siepel & Nijssen 2010) to grasslands and forests. Like all Nanorchestidae it is a fluid feeder. It feeds on the liquid content of algae and maybe plant roots. The distribution could be cosmopolitan, but due to difficulties in the identification of the *Nanorchestes* species, many records might belong to other species. *Nanorchestes amphibius* is much larger than *N. arboriger*: 350 µm and 200 µm, respectively. *Nanorchestes amphibius* is found at the seashore feeding on green algae (Schuster & Schuster 1977). Recently Bolton & Bauchan (2022) synonymized *Speleorchestes* with *Caenonychus* making *Caenonychus fallax* the type species of the genus. *Caenonychus fallax* has only been found by Oudemans in moss in Rotterdam. All former records of *Speleorchestes* spec. should be evaluated to evaluate *C. fallax* next to the more commonly identified *C. pratensis* (fig. 5) and *C. formicorum*. In size *C. fallax* (275 µm) is in between *C. pratensis* (210 µm) and *C. formicorum* (350 µm), but body size in all species is rather variable. Like *Nanorchestes* the species of *Caenonychus* can also be found in very dry habitats.

Next to *Nanorchestes* also a member of the genus *Neonanorchestes* can be expected in the Netherlands, but has not been recorded yet. *Neonanorchestes* differs from *Nanorchestes* by having capitata sensillae versus hairy sensillae in *Nanorchestes* (McDaniel & Bolen 1981). *Neonanorchestes ammolutoreus* McDaniel & Bolen, 1981 has been found in Europe in inland dunes in Germany (Russell & Alberti 2010).

FAMILY TERPNACARIDAE

In the Netherlands two species are recorded, both from inside houses: *Alycosmesis palmata* and *Sebaia rosacea*. The latter is also recorded from a nest of a red squirrel *Sciurus vulgaris* Linnaeus, 1758. Mites in this family feed on solid particles (Walter & Procter 1998). The species of *Alycosmesis* are all very small (< 200 µm), while *Sebaia rosacea* measures 320 µm. The dorsal setae of *Alycosmesis* are leaf-like, those of *Sebaia* thick hairy. Due to their small size and peculiar habitats, the species are probable underrecorded.

FAMILY ALICORHAGIIDAE

The family is represented with one species: *Alicorhagia fragilis*. *Alicorhagia fragilis* (fig. 6) feeds on nematodes (Walter 1988). However, Kethley (1991) found in *Alicorhagia* spec. spores of arbuscular mycorrhizae (*Gigaspora* spec.), indicating feeding on fungi, like Díaz-Aguilar et al. (2022) found for *A. usitata* in Mexico. *Alicorhagia fragilis* is found in humus and litter of grasslands and forests. The species probably has a Holarctic distribution.

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SAMENVATTING

Naamlijst van de endeostigmate mijten van Nederland (Acari: Sarcoptiformes: Endeostigmata)

De endeostigmate mijten vormen een kleine onderorde van de Sarcoptiformes, waartoe ook de mosmijten en de astigmate mijten behoren. De meeste Endeostigmata zijn klein tot middelgroot en leven in habitats met een extreem microklimaat, meestal droog of zout. In Nederland zijn tot nu toe 12 soorten gevonden, maar door hun kleine formaat en aparte biotopen worden ze vaak over het hoofd gezien en zullen nog meer soorten kunnen worden verwacht.

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