ORIBATID MITES IN DIFFERENT FOREST TYPES IN THE NETHERLANDS (ACARI: ORIBATIDA)

Andrei Zaitsev & Matty Berg

Oribatid mites are small, heavily armoured animals with four pairs of legs. Although they are found mainly in soil, many species have also been observed in the tree canopy, in moss and lichens, in caves, between bird feathers, in ant nests and even under water. The ecology and occurrence of oribatid mites in the Netherlands is not very well known. In 2000 the authors sampled 47 forest sites all over the Netherlands. In total 144 oribatid mite species were collected, of which 16 species are new to the Dutch fauna. For all species a location map is presented.

INTRODUCTION

The oribatid mite fauna of the Netherlands has been explored for more than a century. The first species list was published by Oudemans (1896), containing about 60 species. He continued to work on the systematics of oribatids and updated his first list in 1902. Van der Hammen (1952) brought it up to date to a total of 162 species. From the fifties most research was devoted to the ecology of oribatid mites, mainly by soil ecologists. This activity has resulted in many new species for the Dutch fauna and the checklist by Van der Hammen is now under revision. Currently 274 species are known to occur in the Netherlands (Siepel et al. in prep.).

In Western Europe the highest diversity of oribatid mites is normally observed in forest habitats. This common ecosystem has not been systematically surveyed on the composition of its soil fauna. Therefore, the authors have sampled, from March to September 2000, oribatid mites, springtails, terrestrial isopods and myriapods in different forest types, all over the country. The aim of the project was to assess the diversity in various forest types and analyse patterns and trends in diversity of soil fauna. With the results it should be possible to indicate forest types with the highest diversity of soil microarthropods.

In this paper we focus on the distribution patterns of the oribatid mites. For each species a basic location map is presented. The species richness of the different forest types is illustrated. Additional information on the ecology of the species will be published elsewhere.

FOREST LOCATIONS

In total 47 sites were sampled (table 1, fig. 1, 2), more or less regularly distributed over the Netherlands. It mostly concerned semi-natural forests, both old forests and newly formed, and two forest plantations, 'Roggebotzand' near Dronten and 'het Amsterdamse Bos' at Amsterdam. The sites were chosen using the forest classification by Van der Werf (1991). In this book 33 different types of forest are described, ranging from wet, nutrient-rich willow forests to dry, nutrient-poor lichen pine forests, covering a range of geological formations, soil types, nutrient status, and moisture levels (table 2). Not all forest types were sampled. Some have disappeared due to disturbances, e.g. eutrophication, fragmentation or severe thinning. Some of the rare types were too small or could not be visited, as they were closed for the public.

At every site five soil samples, 10 cm in diameter and 6 cm deep, were taken with a soil corer. The samples were taken close to each other in a representative and homogeneous part of the forest, away from the forest edge. Samples were stored in

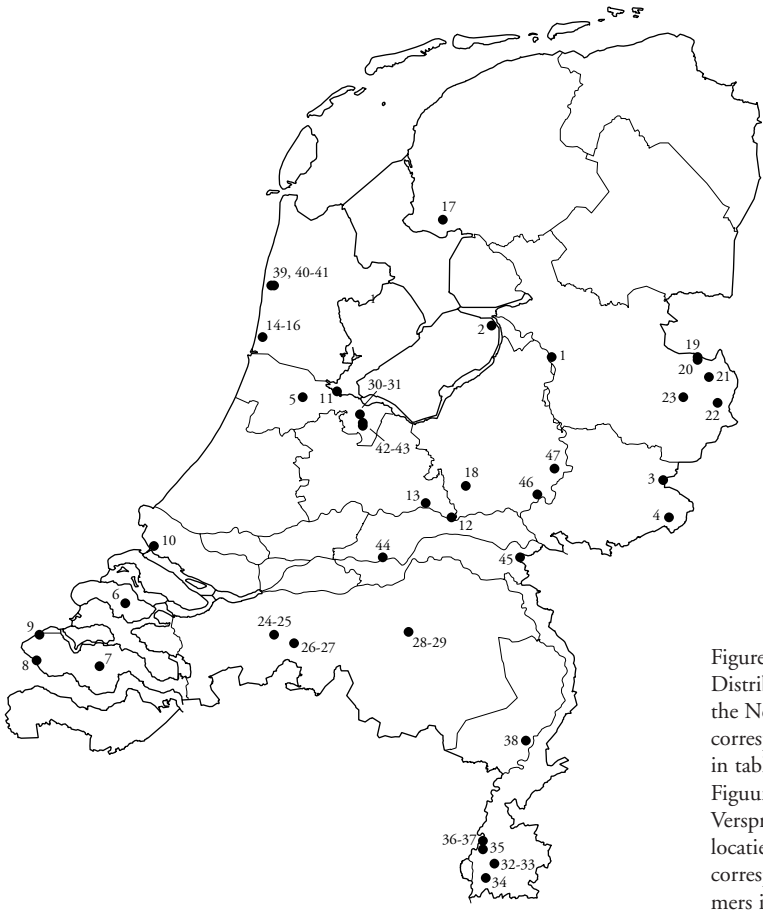

Figure 1
Distribution of the sampled sites in the Netherlands. The numbers correspond with the site numbers in table 1.
Figuur 1
Verspreiding van de bemonsterde locaties in Nederland. De nummers corresponderen met de locatienummers in tabel 1.

Figure 2
Site Bekendelle (nr. 4). Photo M. Berg.
Figuur 2
Locatie Bekendelle (nr. 4). Foto M. Berg.

Table 1 ▶
List of sampled sites.
Tabel 1
Lijst met bemonsterde locaties.

Site	Forest name	Community	Province	x-coor.	y-coor.	date of visit
1	Boerwetering	Windesheim	OV	204	496	06.II.2000
2	Roggebotzand	Dronten	FL	183	507	01.III.2000
3	Zwilbroek	Eibergen	GL	243	453	16.III.1999
4	Bekendelle	Winterswijk	GL	245	440	16.III.1999
5	Amsterdamse Bos	Amsterdam	NH	117	182	15.VIII.2000
6	Schuddebeurs	Brouwershaven	ZL	055	410	08.III.2000
7	Landlust, Heinkenszand	Borssele	ZL	046	388	08.III.2000
8	Zeereep	Zoutelande	ZL	024	390	08.III.2000
9	Manteling van Walcheren	Domburg	ZL	025	399	08.III.2000
10	Quackjeswater	Westvoorne	ZH	065	430	08.III.2000
11	Dijk IJsselmeer	Diemen	NH	129	484	19.III.2000
12	Grebbeberg	Rhenen	GL	169	440	04.IV.2000
13	Bovenpolder	Amerongen	UT	160	445	04.IV.2000
14	Berenweide, NH-duinreservaat	Heemskerk	NH	103	503	12.IV.2000
15	Berenweide, NH-duinreservaat	Heemskerk	NH	103	503	12.IV.2000
16	Berenweide, NH-duinreservaat	Heemskerk	NH	103	503	12.IV.2000
17	Starnuman bosschen	Gaasterland	FR	166	544	24.IV.2000
18	Edesche bos	Ede	GL	174	451	25.IV.2000
19	Moosbeek, Hezingen	Tubbergen	OV	255	496	26.IV.2000
20	Weersink	Tubbergen	OV	255	495	26.IV.2000
21	Agelerbroek	Ootmarsum	OV	259	489	26.IV.2000
22	Boerskotten	Oldenzaal	OV	262	480	26.IV.2000
23	Molenven	Saasveld	OV	250	482	26.IV.2000
24	Liesbos	Prinsenbeek	NB	107	399	24.V.2000
25	Liesbos	Prinsenbeek	NB	107	399	24.V.2000
26	Ulvenhoutse bos	Nieuw Ginniken	NB	114	396	24.V.2000
27	Ulvenhoutse bos	Nieuw Ginniken	NB	114	396	24.V.2000
28	De Geelders	St Oedenrode	NB	154	400	24.V.2000
29	De Geelders	St Oedenrode	NB	154	400	24.V.2000
30	Naardermeer	Naarden	NH	137	476	29.V.2000
31	Naardermeer	Naarden	NH	137	476	29.V.2000
32	Berschheide	Berg en Terblijt	LI	184	319	01.VI.2000
33	Berschheide	Berg en Terblijt	LI	184	319	01.VI.2000
34	Riesenberg	Gronsveld	LI	181	314	01.VI.2000
35	Bunderbos	Geulle	LI	180	324	02.VI.2000
36	Catsop	Elsloo	LI	180	327	02.VI.2000
37	Catsop	Elsloo	LI	180	327	02.VI.2000
38	Leudal	Heythuysen	LI	195	362	02.VI.2000
39	Bergerbosch, NH-duinreservaat	Bergen	NH	107	521	04.VII.2000
40	Guurtjeslaan, NH-duinreservaat	Bergen	NH	106	521	04.VII.2000
41	Guurtjeslaan, NH-duinreservaat	Bergen	NH	106	521	04.VII.2000
42	Spanderswoud	Hilversum	NH	138	473	09.VII.2000
43	Spanderswoud	Hilversum	NH	138	472	09.VII.2000
44	Uiterwaarde	Waardenburg	GL	145	426	28.VIII.2000
45	Duivelsberg	Ubbergen	GL	193	426	28.VIII.2000
46	Rhedensche heide	Rheden	GL	199	448	28.VIII.2000
47	Leusveld	Brummen	GL	205	457	28.VIII.2000

Nr	Dutch name	Latin name	Sites
1	Korstmossen-Dennenbos	Cladonio-Pinetum sylvestris	39
2	Kussentjesmos-Dennenbos	Leucobryo-Pinetum	NS
3	Kraaihei-Dennenbos	Empetro-Pinetum	16
4	Kraaihei-Berkenbos	Empetro-Betuletum	3
5	Berkenbroek	Periclumeno-Betuletumpubescenti-carpaticae	NS
6	Droog Berken-Zomereikenbos	Betulo-Quercetum roboris	13
7	Vochtig Berken-Zomereikenbos	Betulo-Quercetum roboris subassociatie molinietosum	17, 23,28
8	Droog Wintereiken-Beukenbos	Betulo-Quercetum roboris droge subassociatie	14,45
9	Vochtig Wintereiken-Beukenbos	Fago-Quercetum petraeae subassociatie molinietosum	19, 22, 24, 25
10	Elzen-Eikenbos	Lysimachio-Quercetum	NS
11	Duin-Eikenbos	Convallario-Quercetum dunense	9, 15
12	Veldbies-Beukenbos	Luzulo-Fagetum	NS
13	Gierstgras-Beukenbos	Milio-Fagetum	NS
14	Parelgras-Beukenbos	Melico-Fagetum	18
15	Kalk-Beukenbos	Carici (albae)-Fagetum	NS
16	Esdoorn-Essenbos	Aceri-Fraxinetum	32
17	Gewoon Eiken-Haagbeukenbos	Stellario-Carpinetum rijke subassociaties	4, 29, 35
18	Kamperfoelierijk Eiken-Haagbeukenbos	Stellario-Carpinetum subassociatie periclymenetosum	34
19	Duin-Berkenbos	Crataego-Betuletum	10
20	Abelen-Iepenbos	Violo odoratae-Ulmetum	6, 8, 12
21	Droog Essen-Iepenbos	Fraxino-Ulmetum droge subassociaties	7
22	Elzenrijk Essen-Iepenbos	Fraxino-Ulmetum subassociatie alnetosum	NS
23	Vogelkers-Essenbos	Pruno-Fraxinetum	27, 33
24	Bosmuur-Elzenbos	Stellario-Alnetum glutinosae	NS
25	Elzenbronbos	Chrysoplenio oppositifolii-Alnetum	NS
26	Essenbronbos	Carici remotae-Fraxinetum	36
27	Ruigt-Elzenbos	Filipendulo-Alnetum	26
28	Kalk-Elzenbroek	Cirsio-Alnetum	NS
29	Gewoon-Elzenbroek	Carici elongatae-Alnetum	21
30	Moerasvaren-Elzenbroek	Thelypterido-Alnetum	30
31	Berken-Elzenbroek	Alno-Betuletum pubescentis	31
32	Koningsvaren-Elzenbroek	Carici laevigatae-Alnetum	38
33	Schietwilgenbos	Salicetum albae	11, 44
34	Intermediary types		1, 5, 2, 20, 37, 40, 41, 42, 43, 46, 47

Table 2
List of the sampled forest types (names of the forest types according to Van der Werf (1991)).
Tabel 2
Lijst met de bemonsterde bostypen (namen van de bostypen volgens Van der Werf (1991)).

Species	Family	Site number
Liochthonius hystricinus (Forsslund, 1942)	Brachychthoniidae	23, 27
Hoplophthiracarus pavidus (Berlese, 1913)	Phthiracaridae	9
Phthiracarus crinitus (C.L. Koch, 1841)	Phthiracaridae	44
Euphthiracarus monodactylus (Willmann, 1919)	Euphthiracaridae	4
Trimalaconothrus novus (Sellnick, 1921)	Malaconothridae	3
Nellacarus septentrionalis Kunst, 1963	Microzetidae	5, 13
Liacarus nitens (Gervais, 1844)	Liacaridae	32
Carabodes minusculus Berlese, 1923	Carabodidae	39
Tectocepheus cuspidentatus Knulle, 1954	Tectocepheidae	28, 29, 34
Berniniella serratirostris Golosova, 1970	Oppiidae	3
Quadroppia bellula Luxton, 1987	Oppiidae	26, 28, 32, 45
Quadroppia michaeli Mahunka, 1977	Oppiidae	24, 26, 28, 43
Suctobelbella hammeri (Krivolutsky, 1966)	Suctobelbidae	3, 21, 28, 39
Suctobelbella perforata (Strenzke, 1950)	Suctobelbidae	26
Eupelops torulosus (C.L. Koch, 1836)	Phenopelopidae	41, 46
Oribatella berlesei (Michael, 1898)	Oribatellidae	35, 38, 45

Table 3
Oribatid mite species new for the fauna of the Netherlands, with site numbers.
Tabel 3
Mosmijten nieuw voor de fauna van Nederland, met locatienummers.

a cool box and transported to the lab. The specimens were extracted the same day with a Tullgren extractor (using a temperature/moisture gradient) for a period of three weeks.

THE SPECIES

In total 144 oribatid mite species have been collected. Figure 3-146 show the location maps of all species. According to information kindly provided by Henk Siepel, 16 of the species are to be considered new for the fauna of the Netherlands (table 3). Some of these species have already been mentioned in literature, but up to now no collected material was available to check these records. The systematics and nomenclature of oribatid mites in table 3 and the maps are in accordance to Krivolutsky et al. (1995).
The most interesting among the newly found oribatid mite species is *Nellacarus septentrionalis* Kunst, 1963, the first representative of the family Microzetidae in postglacial areas of Europe. Another species, from the genus *Brachychthonius,* is very similar to *B. gracilis*, and is known only from Japan. The first author is currently investigating its taxonomic status.
The new species were mainly found in the eastern and southern part of the country. Forest with more than two new species were a moist rather nutrient-poor Betulo-Quercetum roboris subassociation molinietosum at Geelders (4 species), a dry nutrient-poor Empetro-Pinetum located at Zwilbroek (3 species) and a moist and moderate nutrient-rich Filipendulo-Alnetum forest located at Ulvenhout (3 species) (table 3).
A reference collection is made of all collected mites. The new species for our fauna are stored in the reference collection of the Vrije Universiteit, together with all other species. Two unidentified species are now under investigation by the first author and are in his private collection. A part of the species is also stored in the private collection

of H. Siepel. The specimen of *Suctobelbella hammerae* has been sent to H. Siepel to check the identification.

SPECIES RICHNESS

The lowest number of species collected per five samples, 14 species only, was in forest type 21, a dry Fraxino-Ulmetum forest near Borssele (fig. 147), with a very thin litter layer. Of the forest types that were sampled only once, forest type 4, a nutrient poor and dry Empetro-Pinetum forest near Zwilbroek, had the highest species richness, 49 species in total. Some forest types were sampled more than once. In general they showed a higher number of species per forest type due to the greater number of samples taken.
Of the forest types that were sampled at two sites, type 8, a dry Betulo-Quercetum roboris forest (Heemskerk en Ubbergen), showed the highest diversity with 60 species in 10 samples. Two forest types were sampled at three sites. In forest type 17, a medium nutrient rich Stellario-Carpinetum forest (Winterswijk, Boxtel, Geulle), 73 species were found. Sites with a high number of oribatid mite species have one characteristic in common; they all have a rather thick litter layer. Most species of oribatid mites feed on bacteria, fungi, algae, moss or dead organic matter. The thicker the litter layer the more abundant their food sources. At the sites with the lowest species numbers the litter layer was rather thin or almost absent when we took our samples. This is a common phenomenon in these forests in summer, where a litter layer is lacking due to decomposition of leaves that have fallen in autumn.
The obtained species lists per site and location maps for each species are not complete. Every site was visited only once and not more than five samples were taken. For a full investigation of the oribatid mite community composition one should sample for at least three consecutive years, three times annually, with ten samples per sample period. However, some general patterns in oribatid species distribution can already be observed from these preliminary results. In the near future we are planning to add literature records to the maps to obtain more precise distribution maps.

ACKNOWLEDGEMENTS

The authors are indebted to Dr. D.A. Krivolutsky (Moscow State University, Moscow) for checking the identification of some of the species. We are thankful to Dr. H. Siepel (Alterra, Wageningen) for additional information on the oribatid mite fauna of the Netherlands. Special thanks to Dr. Nico M. van Straalen (Vrije Universiteit, Amsterdam) for financial support of the project.

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Figure 3-146 ▶
Occurrence of the oribatid mite species in 47 forest sites in the Netherlands.
Figuur 3-146
Voorkomen van de mosmijten op 47 boslocaties in Nederland.

- ∘ sample sites / onderzochte locaties
- • species found / soort aangetroffen

3 Achipteria coleoptrata
(Linnaeus, 1758)

4 Achipteria nitens (Nicolet, 1855)

5 Acrogalumna longipluma
(Berlese, 1904)

6 Adoristes ovatus
(C.L. Koch, 1839)

7 Amerus troisii (Berlese, 1883)

8 Autogneta longilamellata
(Michael, 1885)

9 Autogneta willmanni
(Dyrdowska, 1929)

10 Banksinoma lanceolata
(Michael, 1885)

11 Belba corynopus
(Hermann, 1804)

12 Belba pseudocorynopus
Markel, 1960

13 Belba spec.

14 Berniniella serratirostris
Golosova, 1970

15 Brachychthonius berlesei
Willmann, 1928

16 Brachychthonius cricoides
Weis-Fogh, 1948

17 Camisia segnis (Hermann, 1804)

18 Camisia spinifer
(C.L. Koch, 1835)

19 Carabodes coriaceus
C.L. Koch, 1835

20 Carabodes femoralis
(Nicolet, 1855)

21 Carabodes labyrinthicus
(Michael, 1879)

22 Carabodes minusculus
Berlese, 1923

23 Cepheus cepheiformis
(Nicolet, 1855)

24 Cepheus dentatus
(Michael, 1888)

25 Ceratoppia bipilis
(Hermann, 1804)

26 Ceratozetes gracilis
(Michael, 1884)

27 Ceratozetes mediocris
Berlese, 1908

28 Chamobates borealis
(Tragardh, 1902)

29 Chamobates cuspidatus
(Michael, 1884)

30 Chamobates schuetzi
(Oudemans, 1902)

31 Conchogneta delacarlica
(Forsslund, 1947)

32 Cultroribula bicultrata
(Berlese, 1905)

33 Cymbaeremaeus cymba
(Nicolet, 1855)

34 Damaeobelba minutissima
(Sellnick, 1920)

35 Damaeus onustrus
C.L. Koch, 1840

36 Diapterobates humeralis
(Hermann, 1804)

37 Dometorina plantivaga
Berlese, 1896

38 Eniochthonius minutissimus
(Berlese, 1903)

39 Eupelops acromios
(Hermann, 1804)

40 Eupelops occultus
(C.L. Koch, 1836)

41 Eupelops plicatus
(C.L. Koch, 1835)

42 Eupelops torulosus
(C.L. Koch, 1836)

43 Euphthiracarus monodactylus
(Willmann, 1919)

44 Euzetes globulus (Nicolet, 1855)

45 Fuscozetes fuscipes
(C.L. Koch, 1844)

46 Galumna alata (Hermann, 1804)

47 Galumna lanceata
Oudemans, 1900

48 Galumna obvia (Berlese, 1914)

49 Gustavia microcephala (Nicolet, 1855)

50 Hemileius initialis (Berlese, 1908)

51 Hermannia gibba (C.L. Koch, 1839)

52 Hermanniella granulata (Nicolet, 1855)

53 Hoplophthiracarus pavidus (Berlese, 1913)

54 Humerobates rostrolamellatus Grandjean, 1936

55 Hypochthonius rufulus C.L. Koch, 1835

56 Hypodamaeus riparius (Nicolet, 1855)

57 Hypodeoppia sigma
Strenzke, 1951

58 Liacarus nitens (Gervais, 1844)

59 Liacarus subterraneus
(C.L. Koch, 1841)

60 Liebstadia similis
(Michael, 1888)

61 Liochthonius alpestris
(Forsslund, 1958)

62 Liochthonius brevis
(Michael, 1888)

63 Liochthonius evansi
(Forsslund, 1958)

64 Liochthonius hystricinus
(Forsslund, 1942)

65 Liochthonius perfusorius
Moritz, 1976

66 Liochthonius sellnicki
(Thor, 1930)

67 Liochthonius strenzkei
Forsslund, 1963

68 Liochthonius tuxeni
(Forsslund, 1957)

69 Machuella draconis
Hammer, 1961

70 Malaconothrus mollisetosus
Hammer, 1952

71 Malaconothrus processus
Van der Hammen, 1952

72 Malaconothrus punctulatus
Van der Hammen, 1952

73 Medioppia media
Michelcic, 1956

74 Medioppia subpectinata
(Oudemans, 1901)

75 Micreremus brevipes
(Michael, 1888)

76 Microppia minus (Paoli, 1908)

77 Microtritia minima
(Berlese, 1904)

78 Minunthozetes semirufus
(C.L. Koch, 1841)

79 Nanhermannia comitalis
Berlese, 1916

80 Nanhermannia coronata
Berlese, 1913

81 Nanhermannia nana
(Nicolet, 1855)

82 Nanhermannia pectinata
Strenzke, 1953

83 Nanhermannia sellnicki
Forsslund, 1958

84 Nellacarus serpentrionalis
Kunst, 1963

85 Nothrus anauniensis
Canestrini et Fanzago, 1876

86 Nothrus biciliatus
C.L. Koch, 1841

87 Nothrus palustris
C.L. Koch, 1839

88 Nothrus silvestris Nicolet, 1855

89 Odontocepheus elongatus
(Michael, 1879)

90 Ophidiotrichus tectus
(Michael, 1884)

91 Oppia minuta
Sellnick, 1928

92 Oppia neerlandica
(Oudemans, 1900)

93 Oppia ornata (Oudemans, 1900)

94 Oppiella nova
(Oudemans, 1902)

95 Oribatella berlesei
(Michael, 1898)

96 Oribatella calcarata
(C.L. Koch, 1835)

97 Oribatula tibialis (Nicolet, 1855)

98 Oribella paoli Oudemans, 1913

99 Palaeacarus hystricinus
Tragardh, 1932

100 Parachipteria punctata
(Nicolet, 1855)

101 Paradamaeus clavipes
(Hermann, 1804)

102 Phthiracarus crenophilus
(Willmann, 1951)

103 Phthiracarus crinitus
(C.L. Koch, 1841)

104 Phthiracarus ferrugineus
(C.L. Koch, 1841)

105 Phthiracarus nitens
(Nicolet, 1855)

106 Phthiracarus tardus
Forsslund, 1956

107 Phthiracarus testudineus
(C.L. Koch, 1841)

108 Platynothrus peltifer
(C.L. Koch, 1839)

109 Protoribates capucinus
(Berlese, 1908)

110 Punctoribates punctum
(C.L. Koch, 1839)

111 Punctoribates sellnicki
(Willmann, 1928)

112 Quadroppia bellula
Luxton, 1987

113 Quadroppia michaeli
Mahunka, 1977

114 Quadroppia quadricarinata
(Michael, 1885)

115 Rhysotritia ardua
(C.L. Koch, 1841)

116 Rhysotritia duplicata
(Grandjean, 1953)

117 Scheloribates laevigatus
(C.L. Koch, 1835)

118 Sellnickochthonius hungaricus
(Balogh, 1943)

119 Sellnickochthonius immaculatus
(Forsslund, 1942)

120 Sellnickochthonius zelawaiensis (Sellnick, 1928)

121 Spatiodamaeus verticillipes (Nicolet, 1855)

122 Steganacarus striculus (C.L. Koch, 1836)

123 Steganacarus anomalus (Berlese, 1883)

124 Steganacarus magnus (Nicolet, 1855)

125 Suctobelbella acutidens (Forsslund, 1941)

126 Suctobelbella acutidens ssp. lobata (Strenzke, 1950)

127 Suctobelbella alloenasuta Moritz, 1971

128 Suctobelbella falcata (Forsslund, 1941)

129 Suctobelbella forsslundi (Strenzke, 1950)

130 Suctobelbella hammeri (Krivolutsky, 1966)

131 Suctobelbella longirostris (Forsslund, 1941)

132 Suctobelbella palustris (Forsslund, 1953)

133 Suctobelbella perforata (Strenzke, 1950)

134 Suctobelbella sarekensis (Forsslund, 1941)

135 Suctobelbella similis (Forsslund, 1941)

136 Suctobelbella subcornigera (Forsslund, 1941)

137 Suctobelbella subtrigona (Oudemans, 1900)

138 Suctobelbella vera
(Moritz, 1964)

139 Synchthonius crenulatus
(Jacot, 1938)

140 Tectocepheus cuspidentatus
Knulle, 1954

141 Tectocepheus velatus
(Michael, 1880)

142 Trimalaconothrus novus
(Sellnick, 1921)

143 Tritegeus bisulcatus
(Grandjean, 1953)

144 Xenillus clypeator
Desvoidy, 1839

145 Xenillus tegeocranus
(Hermann, 1804)

146 Zygoribatula exilis
(Nicolet, 1855)

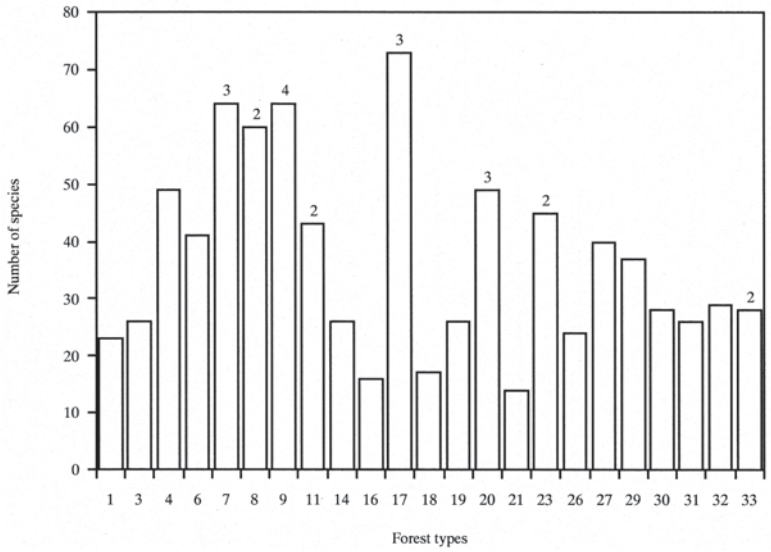

Figure 147
Number of species for each forest type. Numbering of the forest types is according to table 2. Numbers above the columns refer to the number of sites sampled.
Figuur 147
Aantal soorten per bostype. De nummering van de bostypen is volgens tabel 2. De nummers boven de kolommen geven het aantal bemonsterde locaties.

SAMENVATTING

Mosmijten in verschillende bostypen in Nederland (Acari: Oribatida)
In 2000 werd de bodemfauna van 47 bossen bemonsterd (tabel 1), verdeeld over 23 bostypen (tabel 2). In totaal werden 144 soorten mosmijten gevonden, waarvan er 16 nieuw zijn voor de Nederlandse fauna. Van elke soort wordt een locatiekaart getoond. In figuur 147 wordt de verdeling van de soorten over de bostypen geïllustreerd.

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