

ZOOLOGICAL DIVERSITY

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1. INTRODUCTION

An exhaustive inventory or overview of the Belgian fauna does not exist to date. The works of LAMEERE (1895, 1900) ‘Manuel de la Faune de Belgique’, and MAITLAND (1897) ‘Prodrome de la Faune des Pays-Bas et de Belgique’, have the merit to be the first and only initiatives, but they are incomplete and largely outdated.

In comparison with the series published in adjacent countries, e.g. ‘Synopses of the British Fauna’, ‘Nederlandse Fauna’, ‘Faune de France’, ‘Wetenschappelijke Mededelingen van de Koninklijke Nederlandse Natuurhistorische Vereniging’, no overview series is running on the Belgian fauna. There was however a good impulse by the ‘Faune de Belgique’ starting with the publication of POLL (1947) on marine fishes. Unfortunately, only eleven issues appeared, the last one on the beetle family Elateridae (JEUNIAUX 1996).

Data on zoological diversity in Belgium are therefore incomplete, scattered or unavailable. This chapter draws on information directly provided by experts to present an overview of faunal groups observed or expected in Belgium.

2. METHODS

In 1998, the authors developed a questionnaire to investigate the Belgian zoological diversity, based on the one created by KRIKKEN and KOOMEN (Naturalis, Leiden). After a first consultation round within the Royal Belgian Institute of Natural Sciences, the questionnaire was sent to selected Belgian experts in other research institutions, universities, nature associations, etc. If no Belgian expert could be identified for a target group, the questionnaire was sent to experts in neighbouring countries or even to specialists worldwide.

During the inquiry, held from end 1998 to mid 2002, 316 questionnaires were returned, of which 194 were completed by Belgian experts and 122 by foreign specialists. The information gathered via these questionnaires forms the basis for the assessment of the faunal groups. These data were completed by literature and collection information, as well as by personal communications. For groups without questionnaire response, a literature or collection study was conducted.

Additional information was also gathered and checked from websites such as the ‘European Register of Marine Species’ (ERMS, <http://erms.biol.soton.ac.uk>), the ‘North East Atlantic Taxa’ (NEAT, <http://www.tmbi.gu.se/libdb/taxon/taxa.html>), the ‘Integrated Taxonomic Information System’ (ITIS, <http://sis.agr.gc.ca/pls/itisca/taxaget>), the ‘Insect Identification and Natural History’ site (<http://entomology.unl.edu/lgh/insectid/>), and from numerous scientific websites focusing on one or more faunal subgroups.

3. DESCRIPTION

This chapter does not present a complete hierarchical system. Taxa are discussed if occurring or expected in Belgium. Phyla are listed following MARGULIS & SCHWARTZ (1998), with some minor changes. Small phyla are treated as a whole, while large ones are subdivided.

Each faunal taxon present or expected in Belgium is described as follows:

- scientific name followed by English, Dutch, French and German vernacular names;
- brief general description of the taxon with emphasis on morphological, ecological and distributional aspects, and the number of species worldwide (in few cases the fossil record is also mentioned);
- information source(s);
- knowledge on and, if available, state of the art of the taxon in Belgium (number of observed and expected species, state of knowledge, information on collection(s), trends, threats, alien species, geographical species richness, etc.); for poorly known groups, species numbers of adjacent countries are presented, when available;
- references and further reading with a focus on synoptical publications for Belgium and/or neighbouring countries; however, the aim was not to obtain an exhaustive enumeration of all the references in relation to the taxon dealt with; references used for the description (Belgian and worldwide situation) of several taxa are grouped at the end of the chapter under 'general references and further reading'.

This chapter does not pretend to be exhaustive or completely up-to-date. Any reader who should notice missing information is welcome to contact the authors, as this will contribute to elaborate an increasingly complete picture of the Belgian fauna.

4. SYNOPSIS OF THE BELGIAN FAUNA

PROTOZOA - PROTOZOANS

(OERDIEREN, PROTOZOËN - PROTOZOAIRES - URTHIERE, PROTOZOEN)



Single-celled eukaryotic organisms, feeding heterotrophically and exhibiting diverse motility mechanisms (pseudopodia, flagella, cilia, etc.); most abundant eukaryotic organisms in the world in terms of numbers and biomass; of major importance as consumers of bacteria and as parasites and symbionts of animals and plants; some are responsible for the contamination of water, others contribute to the fertility of soils; the Protozoa is an extremely diverse group for which numerous classifications have been developed over time according to very divergent views on its phylogeny; ca. 40,000 living species described; guesstimates for the total number of living species worldwide range from more than 100,000 to a multiple of this number.

Questionnaire completed by Johan DE JONCKHEERE (Scientific Institute of Public Health).



Few overviews of Belgian species exist. Obviously, our knowledge of this group is very poor and even a very rough estimate of the expected number of Belgian protozoan species is simply impossible. Only some subgroups, genera or species, often of medical, veterinary, pharmaceutical or economical interest, are or have been studied. Most

of the few laboratories in Belgium involved in Protozoa are specialised in tropical diseases or in ecological research. Representatives of this group are present in all aquatic and terrestrial habitats occurring as free-living forms, symbionts, commensals or parasites. An example of a representative collection is the 'Culture Collection of Algae and Protozoa' which is the longest established of the world's major protistan service culture collections (CCAP, <http://www.ife.ac.uk/ccap>). It holds over 2,000 strains of algae and protozoans. All protozoans and freshwater algae are kept at the Centre for Ecology and Hydrology (CEH), Windermere, England. The remaining part is managed by the Dunstaffnage Marine Laboratory (DML), Scotland. Another collection is the Protistology Collection of the 'American Tissue Culture Collection' (ATCC, <http://www.atcc.org>), based in Manassas, Virginia.

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Data were gathered via questionnaire, literature and personal communications on taxa of the following phyla. Even more than for metazoans, the texts on protozoans must be seen as a first impulse towards a more complete picture of this group in Belgium. The classification hereafter follows MARGULIS et al. (1990), with some minor changes.

RHIZOPODA (SARCODINA) - AMOEBOID PROTOZOANS

(NAAKTE en GESCHAALDE AMOEBEN - RHIZOPODES - WURZELFÜSSLER und TESTACEEN)



Probably the largest protozoan phylum; unicellular organisms moving and capturing food by means of pseudopods; most Rhizopoda are free-living, others are parasitic (*Entamoeba histolytica* causing some forms of amoebic dysentery); reproduce asexually by cell division or sexually by meiosis and the production of haploid gametes, followed by fusion of gametes and the formation of zygotes; include the naked forms (amoebas) and forms with perforated shells; a few thousand living species known worldwide.

Questionnaires completed by †Didier CHARDEZ (Gembloux Agricultural University) on the Thecamoebidae, by Peter WEEKERS (Ghent University) on the genera *Acanthamoeba* and *Hartmannella* and by Johan DE JONCKHEERE (Scientific Institute of Public Health) on the pathogenic *Acanthamoeba*. Text completed with data from the literature.



Of the 60 species listed in his contribution on the Rhizopoda, DE SAEDELEER (1934) only mentions Belgian locations for 35 of them. It is unclear whether the 25 other species were also found in our country. An overview of the Rhizopoda species recorded in Belgium until the 1950s, with bibliographic references, is published by VAN OYE (1948, 1956). He lists 164 species mainly belonging to the genera *Amoeba*, *Arcella*, *Diffflugia*, *Euglypha* and *Nebela*.

Later, 280 species, 95 varieties and 20 forms of Thecamoebidae or testate amoebae have been recorded (CHARDEZ 1987, with partial species list). In this number are included the taxa found in the following habitats: fresh water, soil, mosses, ferns, lichens, rhizosphere and the supralittoral mesopsammon. Information on other terrestrial habitats and the marine environment is not known to us. Taxonomic knowledge of the Thecamoebidae is moderate. A representative collection is managed by the Gembloux Agricultural University. The species number is increasing, not only because of an intensification of sampling and research, but also because of the restoration of some habitats and the decrease of desiccation. Middle Belgium, the Hautes Fagnes and the Belgian Lorraine show the highest species richness. Ecologically, the highest diversity is found in stagnant freshwater and terrestrial habitats.

The number of observed and expected species of *Acanthamoeba* and *Hartmannella* in Belgium is unknown, among others because of the cosmopolitan feature of these organisms. A global list can be found in SLEIGH (1985). General identification keys are provided in PAGE (1983, 1988), SIEMENSMA (1987) and PAGE & SIEMENSMA (1991). Taxonomic knowledge is poor. Ecologically, the highest species richness is found in the terrestrial environment, followed by, in decreasing order of richness, stagnant fresh water, the marine environment and running fresh water. Some occur as symbionts or parasites of animals and plants. A few are human pathogens. DE JONCKHEERE investigates the occurrence of pathogenic *Acanthamoeba* spp. in natural, man-made (e.g. pools, fish farms) and thermally polluted water systems.

Based on samples from the Belgian marine waters, KUFFERATH (1952) described four new species of Amoebidae: *Amoeba ostendensis*, *A. hostilis*, *A. placida* and *Rhizophidium lynghyae*. He did not mention how many species of this family are known or expected in Belgium. The number of *Psalteriomonas* and *Lyromonas* spp. in Belgium is unknown. Only two species have been described so far: *Psalteriomonas lanterna* and *Lyromonas vulgaris* (BROERS *et al.* 1990, BROERS *et al.* 1993). Both are occurring in the anaerobic bottom layer of freshwater ponds. SIEMENSMA (1987) lists 67 Gymnameobia spp. found in Dutch freshwater systems. There is no expert in Belgium able to identify species. Taxonomic knowledge of amoeboid protozoans in Belgium is very poor.

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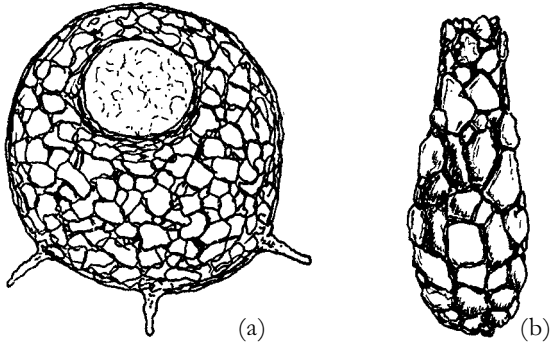
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Tests of two species of Thecamoebidae observed in Belgium: (a) *Centropyxis aculeata* and (b) *Diffflugia linearis* (drawings by D. CHARDEZ, courtesy of M. HEUSCHEN and the Gembloux Agricultural University).

The phylum MYXOZOA, formerly assigned to the Protozoa, has been transferred to the Metazoa following recent research, and is discussed there.

ZOOMASTIGINA (ZOOMASTIGOPHORA) - ZOOFLAGELLATES or FLAGELLATED PROTOZOA (ZOÖFLAGELLATEN - ZOOFLEGELLÉS - ZOOFLAGELLATEN)



Free-living, symbiotic or parasitic protozoans with one or more whip-like flagella; in freshwater and marine environments; feed by absorbing organic molecules from the surrounding medium or engulf prey by phagocytosis; reproduction by binary or multiple fission, sexual processes unconfirmed; most live as solitary cells, some form colonies; some have pseudopodia besides flagella; an example of a symbiont is the zooflagellate living in the gut of termites where it digests cellulose; an example of a parasite is *Trypanosoma gambiense*, which causes African sleeping sickness; very rough guesstimate: 4,000 living species worldwide.

Questionnaire completed by Johan DE JONCKHEERE (Scientific Institute of Public Health) on the pathogenic *Naegleria*. Additional information from literature.



Specimens of this group seem to be studied mainly incidentally during ecological or health-related studies. DE JONCKHEERE investigates the occurrence of pathogenic *Naegleria* spp. in natural, man-made (e.g. pools, fish farms) and thermally polluted water systems.

In addition to diatoms, dinoflagellates, Chrysophyceae, Xanthophyceae, Euglenophyceae, etc., CONRAD & KUFFERATH (1954) list 41 'zooflagellate' spp. from brackish water habitats near Lilloo. Most of the genera cited, e.g. *Bodo*, *Monosiga*, *Tetramitus*, are classified within the Zoomastigina by MARGULIS *et al.* (1990). KUFFERATH (1952) describes one new species of

Rhizomastigina from Belgium, but it is unclear whether this taxon (still) belongs to the Zoomastigina, and if yes, under what name. SCHOUTEDEN (1905) and NEALE ELLIS (1929) mention some Choanoflagellata from adjacent areas.

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ACTINOPODA - ACTINOPOD PROTOZOANS



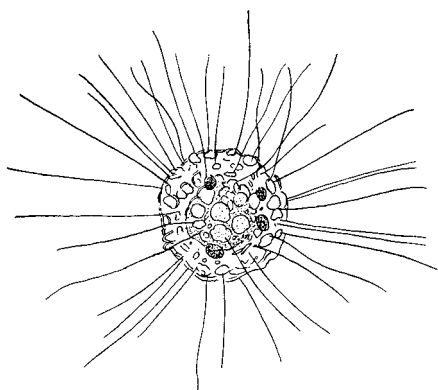
Free-living protozoans with stiffened pseudopodia, called actinopoda, used for locomotion and food trapping; shells made of silica; locomotion via rolling is achieved through lengthening and shortening of the axopodia by assembly and disassembly of the microtubule core of the axopod; containing two major classes: the Heliozoa or heliozoans (zonnediertjes - héliozoaires - Sontentierchen), mainly living in fresh water but also present in the marine environment, and the Radiolaria or radiolarians (straaldiertjes, radiolariën - radiolaires - Straltierchen, Radiolarien), which are mainly marine planktonic organisms; ca. 180 living heliozoan species as well as 4,100 living and almost 7,600 fossil radiolarian species have been recorded worldwide.

No questionnaire has been completed.



KUFFERATH (1952) lists 20 Heliozoa species, three of them new for science, from Belgian marine waters and the Sluice dock in Ostend. In 1950, the same author reported on one radiolarian from the mouth of the Scheldt. No studies on the Belgian freshwater fauna are known to us. SIEMENSMA (1981) recorded 46 Heliozoa species in Dutch

freshwater systems. Given the proximity of the study area and the often wide distribution of the species, most of them are (or were) probably also present in Belgium. The optimal environment for Heliozoa species is shallow, clear, oxygen-rich fresh water with much vegetation. Only two species were found on riverbank plants of heavily polluted waters. Obviously, this entire phylum is very poorly studied in Belgium.



2

Actinosphaerium portuum, a new heliozoan species described by KUFFERATH in 1952 from the southern part of the North Sea. Body diameter is 30 μm , while the fine, radiant pseudopodia can reach 40 μm (from KUFFERATH 1952, © RBINS).

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CILIOPHORA - CILIATES or CILIATED PROTOZOANS

(TRILHAARDIERTJES, WIMPERDIERTJES - CILIÉS, CILIOPHORES - WIMPERTIERCHEN)



Cell body covered with cilia; nucleus differentiated into macro- and micronucleus; free-living in freshwater and marine environments; feed on bacteria or algae; although ciliates typically reproduce asexually, they also exchange genetic information via conjugation; taxon includes the slipper-shaped paramecium and the trumpet-shaped stentor; Suctorina are sessile ciliates that suck out the protoplasm of their prey through tentacles; opinions about the worldwide ciliate species diversity are very divergent: B.J. FINLAY (Centre for Ecology and Hydrology, Windermere) states that ciliate species have a cosmopolitan distribution and that almost all species (ca. 3,000) have been described; W. FOISSNER (University of Salzburg) contests this hypothesis and thinks the total species number of Ciliophora is approximately a tenfold of it.

Main information provided by Jeroen VAN WICHELEN (Ghent University). Questionnaires completed by †Didier CHARDEZ (Gembloux Agricultural University) and Ilse HAMELS (Ghent University) on the Ciliophora in general and by Eric HOCHBERG (Santa Barbara Museum of Natural History) on the Opalinopsidae. Additional information from the literature.



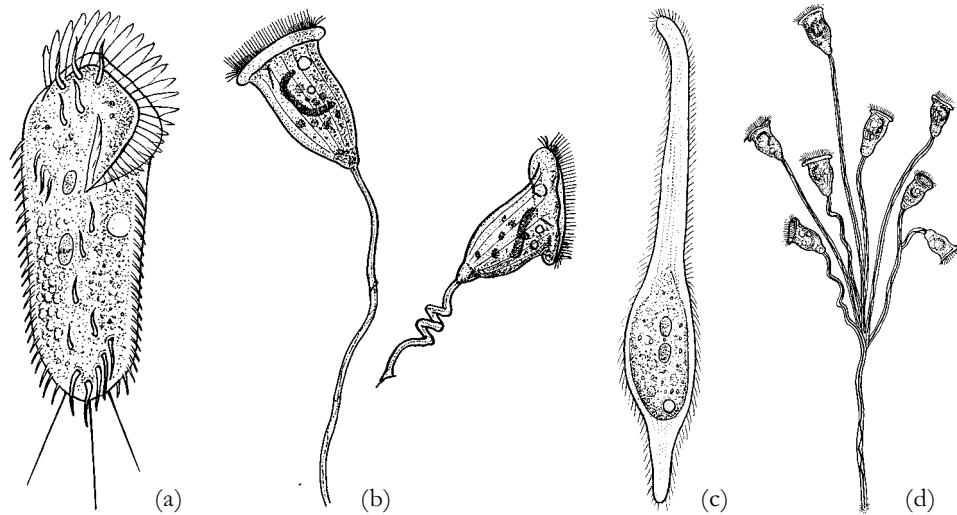
Although this taxon seems to be the 'best' known protozoan phylum in our country, taxonomic knowledge is poor and no representative collection could be identified. A catalogue of the Belgian Ciliophora, following sampling of different lakes, ponds, ditches, rivers, brooks, lichens, mosses, ferns and soils, is published by CHARDEZ (1987) and contains ca. 250 species. VAN WICHELEN *et al.* (2002) studied the Flemish lakes and found 135 taxa out of which 90 species could be identified. Next to the free-living species, some ciliates occur as symbionts and commensals of mainly fishes and as parasites of cephalopods, crustaceans, fishes and amphibians. The interstitial marine and brackish water ciliates have only been studied ecologically. It is obvious that Belgian marine waters and some terrestrial habitats are poorly studied or not at all from a taxonomic point of view. Other problems are the often obsolete descriptions of Belgian species, the high number of synonyms and, more fundamentally, the species concept which is difficult to apply to these organisms. Nevertheless, since 1950, the species number has increased because of research intensification and probably introductions.

Opalinopsidae or apostome ciliates are parasites of cephalopods and crustaceans. So far, no species have been recorded in Belgian marine waters, but four or five are expected based on host-parasite relationships. Taxonomic knowledge is obviously very poor and a Belgian expert could not be identified. A European species list can be found in HOCHBERG (1990). Representative collections are present in the Santa Barbara Museum of Natural History and the Muséum d'Histoire Naturelle of Geneva.

KUFFERATH (1950) lists 16 species of Tintinnidae, of which 6 are new to science, from the Belgian marine waters. Because of taxonomic uncertainty and changing classification, it is unclear how many species of this family really occur.

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3

Four ciliate species occurring in Belgium: (a) *Stylonichia mytilus*, (b) *Vorticella nebulifera*, (c) *Litonotus anser* and (d) *Carchesium polypinum* (drawings by D. CHARDEZ, courtesy of M. HEUSCHEN and the Gembloux Agricultural University).

GRANULORETICULOSA



Phylum almost entirely consisting of the Class Foraminifera or foraminifers, foraminiferids (foraminiferen - foraminifères - Foraminiferen); possessing hard parts in the form of tests (or shells), composed of organic matter reinforced with sand or calcium carbonate, and granular, reticulose pseudopodia; shell consisting of one or more chambers; among the most abundant, diverse and widely distributed protists in the oceans playing a significant role in food webs; mostly benthic, some are planktonic; length ranging from 100 μm to ca. 10 cm (*Nummulites* spp.); feed on organic molecules, bacteria, diatoms, other single-celled phytoplankton and even small animals such as copepods; mineralised shells of Foraminifera preserve a record of ocean chemical properties useful for evolutionary, paleobiological and geochemical analysis of global environmental change; to date, 3,620 genera and ca. 60,000 species, of which ca. 4,000 recent species, have been described; fossil record of Foraminifera dates back to more than 550 million years ago.

Information from literature, completed by personal communications of Pieter LAGA (Geological Survey of Belgium), Herman HOOYBERGHS (KUL) and Stefan REVETS (RBINS).



CUSHMAN (1949) lists 128 species and subspecies (this includes recent and subrecent forms) based on the study of bottom samples from the Belgian marine waters. He notes that the samples are characterised by a considerable number of Cretaceous specimens and the occasional presence of Tertiary ones. In adjacent areas, MURRAY (1979) found 63 brackish and nearshore species in British waters.

Much more research activities are or have been undertaken in relation to fossil Foraminifera in Belgium: Tertiary foraminifers are studied at the Catholic University of Leuven (H. HOOYBERGHS, †F. DE MEUTER and former colleagues). More specifically, Oligocene forms are the subject of a Ph.D. at the Royal Belgian Institute of Natural Sciences (E. DE MAN). Cretaceous and Paleocene foraminifers are investigated by F. ROBASZYNSKI and T. MOORKENS, both retired but still doing research. L. HANCE, guest professor at the UCL, and his Ph.D. researcher F.-X. DEVUYST, study the foraminifers of the Paleozoicum, which were also the main research involvement of the late R. CONIL (UCL). Furthermore, the existence of doctoral papers on Foraminifera of P. LAGA (Pliocene), F. DE MEUTER (Miocene), J. BACCAERT (large Foraminifera), W. WILLEMS (Ypresian) and T. MOORKENS (Paleocene) was brought to our attention.

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(References and further reading on fossil Foraminifera in Belgium are not included because the current publication focuses on present-day biodiversity.)

APICOMPLEXA (SPOROZOA) - APICOMPLEXANS or NON-MOTILE PARASITIC PROTOZOANS (SPOROZOANS)

(SPORENDIERTJES - APICOMPLEXANS, APICOMPLEXÉS, SPOROZOAIRES - SPOROZOEN, SPORENTIERCHEN)



Probably the largest and best-known taxon of parasitic protozoans; unicellular organisms possessing an apical complex of microtubules; many apicomplexans are bloodstream parasites with complex life cycles, and both asexual and sexual reproduction; they infect vertebrates, causing serious illnesses (e.g. species of the genus *Plasmodium* cause malaria, others cause coccidiosis, toxoplasmosis, etc.), and invertebrates (some apicomplexans may be useful for man in controlling populations of pest insects); ca. 5,000 described species worldwide, but a multiple of this number still to be discovered.

Questionnaire on the Aggregatidae completed by Eric HOCHBERG (Santa Barbara Museum of Natural History).



Species of Aggregatidae parasitise crustaceans and cephalopods. None have been recorded in Belgian marine waters so far, but 4 to 8 species are expected based on host-parasite relationships. A list of European species can be found in HOCHBERG (1990). Taxonomic knowledge of this group is very poor and no Belgian expert could be identified.

Representative collections are managed by the Santa Barbara Museum of Natural History and the University of Vigo.

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METAZOA - METAZOANS or MULTICELLULAR ANIMALS

(VEELCELLIGE DIEREN, MEERCELLIGE DIEREN - MÉTAZOAIRES - MEHRZELLIGEN TIERE, VIELZELLIGEN TIERE)



Multicellular, heterotrophic, diploid organisms with development proceeding via a blastula; include all faunal groups from Porifera to Mammalia.

PORIFERA - SPONGES

(SPONZEN - ÉPONGES - SCHWÄMME)



Multicellular animals without tissues and organs; numerous microscopic ostia by which water enters the canal system through the body and one or a few oscula from which water exits; physiological functions by individual cells; no nervous, muscular or hormonal systems; adults sessile; larvae ciliated and free-swimming; most species are dioecious; the vast majority are marine, ca. 100 species live in fresh water; more than 7,000 living species described worldwide; a considerable number of additional species is expected.

Questionnaire completed by Philippe WILLENZ (Royal Belgian Institute of Natural Sciences).



Five freshwater and ca. 27 marine species have been recorded. Given the fact that hard substrates are crucial for the settling of sponges, the relative high number of marine species seems to contrast somewhat with the rarity of natural hard substrates. Man-made constructions are probably the major explanation for this. Furthermore, it is most unlikely that all the recorded species still occur in the Belgian marine waters. For the freshwater habitat and specifically the more diverse running waters (RASMONT 1957), Lower and Middle Belgium show the highest species richness (RICHELLE-MAURER *et al.* 1994). *Trochospongilla horrida* was first reported in Belgium in 1994 while the other freshwater species were observed much earlier.

Taxonomic knowledge of the Porifera in Belgium is moderate, and information on actual trends like spreading or regression is not available. RICHELLE-MAURER *et al.* (1994) propose the use of sponges as bio-indicators for the detection of heavy metals in the environment.

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MYXOZOA - MYXOZOANS

(MYXOZOËN - MYXOZOAIRES - MYXOZOEN)



Myxozoans have traditionally been classified within the Protozoa. Recent investigations (SMOTHERS et al. 1994) show that it is a metazoan group, possibly related to the Cnidaria (pers. comm. E. KARLSBAKK). Some experts consider the Myxozoa as a highly derived group of cnidarians.

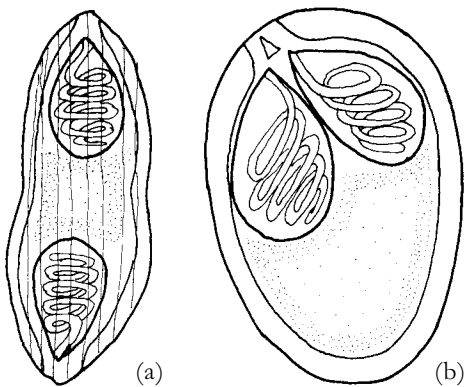
Spore producing parasites of fishes, amphibians and reptiles, and also of annelids and bryozoans; present in host species living in marine as well as in freshwater habitats; ca. 1,400 described species worldwide; a total species number between 3,000 and 5,000 is expected.

Questionnaire completed by Egil KARLSBAKK (University of Bergen) for the marine species and by Steven FEIST (Centre for Environment, Fisheries and Aquaculture Science, Weymouth) for the freshwater species.



At least 49 species could occur in Belgian marine waters following species observations in adjacent waters and host-parasite relationships. Furthermore, some 20 additional species, among others exotic myxozoans carried by introduced or vagrant fish species, are expected in our marine zone. These numbers together would result in a total of ca. 70 species of Myxozoa in Belgian marine waters. A partial list of

European marine Myxozoa can be found on the website 'European register of marine species' (ERMS). Some ten freshwater species were recorded, while not fewer than 50 additional ones are expected (SHULMAN 1966).



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Examples of Myxozoa parasitising fishes in Belgian waters: (a) *Myxidium rbodei* LÉGER, 1905 from the kidney of roach (*Rutilus rutilus*); (b) *Myxobolus cyprini* DOFLEIN, 1898 from the musculature of chub (*Leuciscus cephalus*) (drawings by M. LONGSHAW).

The highest species richness is expected in marine and running freshwater habitats. Stagnant freshwater bodies show a lower species richness. For Belgium and the neighbouring countries, it is obvious that taxonomic knowledge of this group is very poor. Moreover, no Belgian expert could be identified for this group.

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CNIDARIA - CNIDARIANS

(NETELDIEREN - CNIDAIRES - NESSELTIERE)



Metazoans with two basic body forms (polyp and medusa); ectodermal and gastrodermal epithelia, separated by mesogloea; nerve net acting as nervous system; cnidae used in predation and defence; mostly carnivorous, although, in some species, nutrition is supplemented by dissolved organic material and photosynthesising endosymbionts; phylum contains four major classes: the Anthozoa (sea anemones, corals, etc.), Hydrozoa (hydras), Cubozoa (sea wasps) and Scyphozoa (jellyfish); all species are aquatic, most are marine; size of adult individuals range from less than 1 mm to 70 m long; ca. 9,000 living species described worldwide.

Basic information on the marine species was provided by Francis KERCKHOF (Marine Ecosystem Management / RBINS). Questionnaires were completed by Bregje BEYST and Ann DEWICKE (Ghent University) for the marine species, and by Jean BOULLON (Free University of Brussels) for the brackish and freshwater species.



Some 90 marine species have been recorded (LELOUP 1952), but many listed species are probably not living in Belgian waters as they were found cast ashore or because they belong to the so-called trawler fauna brought in by fishermen from their fishery grounds. However, based on comparable data from the Netherlands (more than 130 species) and Sweden (210 species), and given the fact that the sampling methods used by Belgian scientists during their monitoring campaigns of the past decades were not specifically aimed at cnidarians, many additional species can be expected as already observed by MASSIN *et al.* (2002). Another example: recent research of specific habitats such as the Sluice dock in Ostend and the groynes on the Belgian beaches revealed the presence of the sea anemones *Haliplanella lineata* (KERCKHOF, unpublished) and *Sagartia elegans* (FAASSE & DE BLAUWE 2003).

Eight brackish and freshwater species (LELOUP 1952) have been observed, four of which belong to the genus *Hydra*. Based on species observations in similar habitats outside Belgium, at least three additional species are expected (VERVOORT 1946). Upper Belgium shows the highest species richness. The number of freshwater species is increasing because of the immigration and introduction of at least three species since 1900. For the non-marine species of this group, no scientific expert able to identify organisms to the species level could be identified. Taxonomic knowledge of this group in Belgium is very poor for the marine as well as for the brackish and freshwater habitats.

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CTENOPHORA - CTENOPHORES or COMB JELLIES

(RIBKWALLEN, KAMKWALLEN - CTÉNOPHORES, CTÉNAIRES - RIPPENQUALLEN)



Diploblastic metazoans with biradial symmetry; basic body form is ovoid, typically around 1 cm; most species are planktonic; locomotion by rows of comb plates (fused cilia); nerve net acting as nervous system; no respiratory, circulatory or excretory system; adhesive colloblasts; sexual reproduction, mostly hermaphroditic; ctenophores are all predatory, although nutrition in some species is supplemented by photosynthetic algae; all species are marine, occurring from the surface waters to at least 3,000 m; about 100 described species worldwide, but many unknown species probably exist in deep waters.

Questionnaire completed by Bregje BEYST and Ann DEWICKE (Ghent University).



At least two species are present in Belgian marine waters. *Pleurobrachia pileus*, representing the class Tentaculata, is very common along the coast. *Beroe gracilis*, up to 1982 erroneously identified (KERCKHOF 1982) as *Beroe cucumis*, belongs to the class Nuda and feeds on *P. pileus*. Recently, *Bolinopsis infundibulum* and *Beroe cucumis* have been observed along the Dutch coast (HOLSTEIJN 2002), although these species normally occur more to the north. If they continue to expand their distribution area in southern direction, they could appear in Belgian marine waters in the near future. Since fixation of ctenophores is often difficult, the identification of specimens and the set up of a representative collection is problematic.

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PLATYHELMINTHES - FLATWORMS

(PLATWORMEN - VERS PLATS - PLATTWÜRMER)



Phylum with the simplest structure of the bilaterally symmetrical and triploblastic animals; body flattened dorsoventrally; acoelomate; includes the Turbellaria, Trematoda, Monogenea and Cestoda.

TURBELLARIA - TURBELLARIANS or FREE-LIVING FLATWORMS

(TRILHAARWORMEN, VRIJLEVENDE PLATWORMEN - TURBELLARIÉS, VERS PLATS LIBRES - STRUDELWÜRMER)



Ciliated, mostly free-living flatworms; some taxa are parasitic or symbiotic; most species are predators or scavengers; hermaphrodites with complex reproduction system and internal fertilisation, some also reproduce by fission; they inhabit marine, freshwater, benthic, periphyton and moist terrestrial systems; most species are relatively small (0.5 to 5 mm); ca. 8,000 species have been described worldwide while the expected species number ranges from 15,000 to 20,000.

Data provided by Ernest SCHOCKAERT (Limburg University Centre).



The estimated number of known marine and brackish water species in Belgium is 400. Given the fact that new species, some even unknown to science, are still discovered in our coastal and marine zone, the real number of species will be higher. A partial species list is presented in SCHOCKAERT *et al.* (1989).

The freshwater fauna is almost completely unknown. At least 50 species are expected. All known Belgian turbellarian species are free-living. An example of a recent introduction is the Ponto-Caspian invader *Dendrocoelum romanodanubiale* in the Albert Canal (pers. comm. T. VERCAUTEREN).

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TREMATODA - TREMATODES or FLUKES

(ZUIGWORMEN - TRÉMATODES, VERS INTESTINAUX - SAUGWÜRMER)



Most are endoparasitic and have two to four hosts in the life cycle; usually two holdfast organs without hooks: an anterior oral sucker surrounding the mouth and a ventral sucker; adults occur in the definitive host, normally a vertebrate; most species have a molluscan intermediate host; the flukes of the subclass Aspidobothrea have a single host in the life cycle and some are ectoparasitic; 15,000 to 18,000 digenean (Trematoda s.s., excl. Monogenea) species have been recorded worldwide.

Questionnaire completed by David GIBSON (The Natural History Museum, London). Additional data from collection archives, unpublished observations and personal communications.



A preliminary list of 103 species is compiled based on the collections of the Royal Belgian Institute of Natural Sciences and the Zoological Museum of the University of Liège, on grey literature and on communications from the Prince Leopold Institute of Tropical Medicine, the Institute for Forestry and Game Management, the Ghent University, the Sea Fisheries Department, the Scientific Institute of Public Health and the Marine Ecosystem Management Department of the RBINS. No published overview of this taxon is available. The total number of trematode species in Belgium is estimated at 325, based on the fauna in the neighbouring countries and information contained in the host-parasite database managed by The Natural History Museum in London.

As it is often the case for parasitic taxa, taxonomic and faunal studies concerning the Trematoda are scarce and only some species of medical, pharmaceutical or veterinary interest are studied (e.g. *Fasciola hepatica* and *Schistosoma* spp.). Most species occur as fish parasites. Main collections in relation to the Belgian fauna are housed in the Royal Belgian Institute of Natural Sciences and the Zoological Museum of the University of Liège. Few specimens are present in the medical and veterinary departments of universities and other scientific institutes. In the Netherlands, 100 species are observed hitherto, but not less than 500 additional species are expected. In the United Kingdom, 400 trematode species have been recorded and a considerable number of additional species is expected.

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MONOGENEA - MONOGENEANS or MONOGENETIC FLUKES

(ECTOPARASITAIRE PLATWORMEN, UITWENDIGE ZUIGWORMEN - VERS MONOGÈNES - MONOGENE SAUGWÜRMER)



Monogenea are often placed in the class Trematoda. They are treated apart here to obtain a more detailed presentation. Hermaphroditic, ectoparasitic flatworms mostly found on the gills or skin, or in the nose, mouth, etc. of fish, amphibians and reptiles, some on mammals, crustaceans and cephalopods; direct life cycle: free-swimming larva attaches to a new host and grows into an adult worm; found in freshwater and marine habitats; adults most often less than 10 mm in length; adhesive structures at both ends of the worm; mouth sometimes encircled by a sucker; the posterior adhesive structure, the opisthaptor, is a complex of suckers, suckerlets, hooks, anchors, etc.; can cause serious problems for example in aquarium or hatchery; 7,000 to 8,000 described monogenean species worldwide, while a total of more than 20,000 is expected.

One of the most significant radiations of platyhelminth fish parasites is demonstrated within the monogenean 'supergenera' *Dactylogyru*s and *Gyrodactylus*. More than 400 *Gyrodactylus* species have been described at present, but the estimated species number is about 20,000 (BAKKE *et al.* 2002). Gyrodactylids display the widest host range of any monogenean family

(they are found on 19 orders of bony fishes), encompassing both highly specific and generalist species. The combination of viviparity, progenesis and protogyny is unique in the animal kingdom. Advanced progenesis allows the first-born daughter to be produced within 24 hours after her parents' birth. This may result in an explosive population growth, especially when transmission is favoured under aquacultural conditions. The population dynamics resemble those of microparasites rather than those of typical helminth macroparasites (CABLE & HARRIS 2002).

Information provided by Tine HUYSE (Catholic University of Leuven), with additional data from David GIBSON (The Natural History Museum, London).

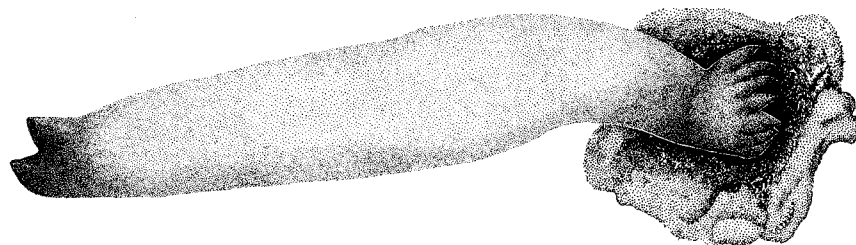


So far, 21 species have been recorded in Belgium, but the presence of 300 to 500 species of this poorly studied and species-rich taxon is expected. All species in Belgian waters occur as ectoparasites on the gills, skin and fins of marine and freshwater fish. The knowledge of this group in Belgium is poor. A representative collection does not exist although a few specimens are present in the Royal Belgian Institute of Natural Sciences and in some university collections. A larger collection is housed by the natural history museums of London and Stockholm.

The genus *Gyrodactylus* is one of the largest within the Monogenea. A first study on *Gyrodactylus* spp. parasitising marine fishes in the North Sea revealed the presence of six new species, of which two are hitherto described (GEETS *et al.* 1998, HUYSE & VOLCKAERT 2002).

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The monogenean *Gyrodactylus branchialis*. The parasitising specificity of monogeneans is illustrated by the fact that this species, for example, only occurs on the gills of the common goby (*Pomatoschistus microps*). Length: 130-150 μm (drawing by H. VAN PAESCHEN, based on photographs by T. HUYSE).

CESTODA - TAPEWORMS

(LINTWORMEN - CESTODES - BANDWÜRMER)



Adults occurring as elongated and flattened endoparasites in the intestines of vertebrates, involving at least two hosts of different species; usually one or more larval stages either in vertebrates or invertebrates; no mouth nor digestive organ present; head, with an attachment organ (scolex), followed by a series of body units (proglottids); no epidermis but covered with a thick cuticle; length ranges from less than 10 mm to more than 30 m; 5,000 species are known worldwide.

Questionnaire completed by David GIBSON (The Natural History Museum, London). Additional data from collection archives, unpublished observations and personal communications.



The number of observed species in our country is unknown, because only species with special interest to human and animal health are studied. A preliminary list of 144 species is compiled based on the collections of the Royal Belgian Institute of Natural Sciences and the Zoological Museum of the University of Liège, on grey literature and on communications from the Prince Leopold Institute of Tropical Medicine, the Institute for Forestry and Game Management, the Ghent University, the Sea Fisheries Department, the Scientific Institute of Public Health and the Marine Ecosystem Management Department of the RBINS. No published overview of this taxon is available. At least 250 tapeworm species are expected to occur in Belgium, based on figures of the host-parasite database at The Natural History Museum in London.

The expected species number of 250 is probably an underestimation since more than 500 species and subspecies are mentioned in an anonymous, dateless manuscript titled 'Cestodes belges - Catalogue alphabétique', found in the archives of the Royal Belgian Institute of Natural Sciences. This manuscript, possibly based on somewhat obsolete systematics and probably containing synonyms and doubtful observations, needs further investigation, and may not (yet) be used as a reference for the number of tapeworm species in Belgium. Main collections in relation to the Belgian fauna are housed in the Royal Belgian Institute of Natural Sciences and the Zoological Museum of the University of Liège. A few specimens are present in the medical and veterinary departments of universities and other scientific institutes. In the Netherlands, 80 species have been recorded and more than 400 additional species are expected.

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GNATHOSTOMULIDA - GNATHOSTOMULIDS or JAW WORMS

(KAAKWORMEN - GNATHOSTOMULIDES - KIEFERMÄULCHEN, KIEFERMÜNDCHEN)



Quite recently described phylum (1956); bilaterally symmetrical, unsegmented marine worms mainly occurring in interstitial habitats, on algae and plants or in the black, anaerobic layer produced by sulfur-metabolising bacteria; jaw worms are small

(less than 1 mm) and transparent; hermaphrodites; feeding on bacteria, protists and fungi; 80 species described worldwide, at least 170 additional species expected.

Questionnaires completed by Martin SØRENSEN and Reinhardt KRISTENSEN (University of Copenhagen), Wolfgang STERRER (Bermuda Natural History Museum) and Alessandra FALLENI (University of Pisa).



So far, no jaw worms have been recorded from Belgian marine waters. Not because the group is poorly represented, but because Gnathostomulida have not been investigated yet in the Belgian part of the North Sea. SØRENSEN and KRISTENSEN state that the Belgian waters contain several species and probably also some undescribed taxa because this group is only well investigated in the Western Atlantic. The expected number of gnathostomulid species in Belgian waters ranges from 9 to 22. For this group, no specialist could be identified in our country and taxonomic knowledge is obviously lacking.

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'MESOZOA - MESOZOANS'

(WEINIGCELLIGEN, MIDDENDIEREN - MÉSOZOAIRE - MITTELTIERE)



Probably have the simplest structure of any metazoan form. Until recently, the phylum Mesozoa was subdivided in two classes: Dicyemida (or Rhombozoa) and Orthonectida. New insights elevated both classes to the rank of phylum, outdating the name Mesozoa.

Common characteristics for Dicyemida and Orthonectida: minute, parasitic vermiform animals generally consisting of 20 to 30 cells; lacking circulatory, respiratory, digestive and nervous systems; asexual and sexual reproduction; size ranges from less than 1 to 7 mm.

DICYEMIDA ('RHOMBOZOA') - DICYEMIDS ('RHOMBOZOANS')

(DICYEMIDEN - DICYÉMIDES - DICYEMIDEN)



Specific characteristics: often only one axial cell (through long axis of the body), surrounded by a single, ciliated cell layer (somatoderm); axial cell(s) involved in reproduction, not in digestion; two types of larva; parasitic in the kidneys of bottom-dwelling cephalopods; more than 200 known species worldwide.

Questionnaire completed by Eric HOCHBERG (Santa Barbara Museum of Natural History).



No dicyemid species from Belgian waters have been recorded although three to more than 15 species are expected based on host-parasite associations and species lists for Europe (HOCHBERG 1990). For example, *Sepia officinalis* and *Octopus vulgaris*, only two of the common cephalopod species in Belgian marine waters, can each be parasitised by a different set of four dicyemid species. Representative collections with species occurring in Belgium are housed in the 'Muséum d'Histoire Naturelle' in Geneva (Switzerland) and the


Santa Barbara Museum of Natural History (California, USA). The status of this group is indissolubly related to the trends displayed by their hosts, i.c. cephalopods.

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ORTHONECTIDA - ORTHONECTIDS

(ORTHONECTIDEN - ORTHONECTIDES - ORTHONECTIDEN)

 Specific characteristics: free-swimming adults; sexual reproduction results in ciliated larvae entering the body of suitable hosts (Platyhelminthes, Nemertea, Annelida, Mollusca, Echinodermata and Tunicata), where they grow to form a multinucleate plasmodium of less than 1 mm; less benign than dicyemids since they may affect host reproduction; ca. 22 species described worldwide; undoubtedly, there are many undescribed species as these organisms are very small parasites and the percentage incidence in a particular host species is often very low.

Questionnaire completed by Eugene KOZLOFF (University of Washington).


 So far, no orthonectids seem to have been reported from Belgium. Based on host-parasite relationships for hosts also known from Belgian marine waters, at least six described (KOZLOFF 1992, 1993), and some undescribed species, are expected. The tidal and subtidal zones are expected to show the highest species richness. Taxonomic knowledge of this group in Belgium is totally lacking, in contrast with for example France, where it is considered to be good. No expert nor representative collection could be identified in Belgium.

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NEMERTEA - RIBBON WORMS or NEMERTEANS

(SNOERWORMEN - NÉMERTIENS, NÉMERTES - SCHNURWÜRMER)

 Bilaterally symmetrical, usually cylindrical, unsegmented worms with eversible proboscis which is sometimes used for gripping or burrowing; body length ranging from 0.5 mm to 30 m; almost all marine (some as symbionts/commensals in gill chambers of crustacean decapods or mantle cavity of molluscs), a few occur in freshwater or moist terrestrial habitats; external fertilisation, some are viviparous; mainly carnivorous; almost 1,200 species described worldwide.

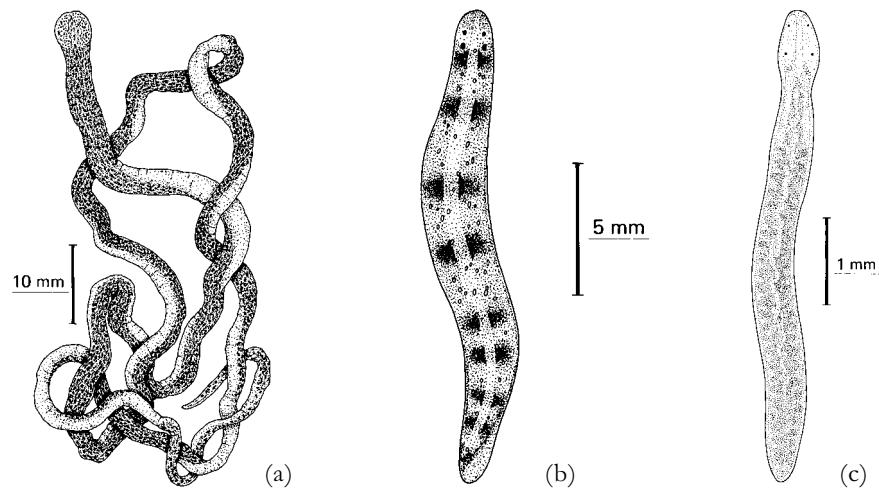
Questionnaire completed by Ray GIBSON (Liverpool John Moores University).



Ten species are reported from the Belgian marine waters (P.J. VAN BENEDEN 1861, E. VAN BENEDEN 1883). More recent observations are lacking. A new and comprehensive survey is needed and would probably double or triple the species number. The species occurring in Belgian waters can be found in the species list of the United Kingdom (GIBSON 1995). No expert able to identify organisms to the species level, neither a representative collection, could be identified in Belgium. Obviously, this group is poorly known in our country.

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Examples of ribbon worms observed in Belgian marine waters: (a) *Emplectonema neesii*, (b) *Oerstedtia dorsalis* and (c) *Tetrastemma flavidum*. The first two were recorded by P.J. VAN BENEDEN, the latter by E. VAN BENEDEN (from GIBSON 1982, courtesy of Cambridge University Press).

NEMATODA - NEMATODES


(NEMATODEN, SPOELWORMEN, RONDWORMEN - NÉMATODES - FADENWÜRMER, NEMATODEN)



Spindle or thread-like body shape, round upon cross section and with bilateral symmetry; crawling or swimming with undulating movements; post-embryonic development is characterised by four moults; nematodes show a wide range of life histories from entirely free-living to parasitic in plants and animals; as parasites, some species belong to the most serious pest organisms to mankind (e.g. causing filariasis); nematodes can be found in any habitat but depend on moisture for their locomotion and active life; most can survive periods of drought (cryptobiosis, quiescence); feeding on bacteria or algae,

omnivorous or predacious on nematodes and other small invertebrates; body length from less than 0.1 mm to 9 m; ca. 25,000 species described; the estimated total number of nematode species would be between 100,000 and 1,000,000 species.

Questionnaire completed by Wilfrida DECRAEMER (Royal Belgian Institute of Natural Sciences).

 COOMANS (1989) lists 519 free-living species. More than half of these are present in the marine environment. A species list of nematodes of the Belgian Continental Shelf recorded between 1970 and 1998 can be found in CATTRIJSSE & VINCX (2001). During the last decades, the number of species increased because of research intensification. BERT (2002), for example, next to removing 6 species from COOMANS's list because of synonymy, added 27 species of Tylenchida new for the Belgian fauna.

A considerable number of additional species is expected (total nematode fauna roughly estimated at 2,500 species in Belgium) because of some knowledge gaps in relation to freshwater habitats, moorland and deciduous forests, and based on the figures of the Netherlands (1,700 species observed, ca. 2,500 expected; both figures excluding the nematodes parasitising vertebrates). Although a lot of research was and is being done on nematodes as animal parasites, no inventory of species parasitising vertebrates seems to be available for Belgium. Five parasitic species are commonly found in harbour porpoises stranded or bycaught in Belgium (DEBACKER *et al.* 2002, JAUNIAUX *et al.* 2002).

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NEMATOMORPHA - HORSEHAIR WORMS

(PAARDENHAARWORMEN - NÉMATOMORPHES - SAITENWÜRMER)



Long and slender body, covered with a thin white, creamy yellow, brown or dark cuticle, adorned in Nectonematoidea; juveniles of the Gordioidea are endoparasitic in aquatic and terrestrial arthropods (particularly crickets, grasshoppers and beetles); juveniles of the Nectonematoidea are parasites of hermit crabs, true crabs and shrimps; adults do not feed and are free-living, mainly occurring in fresh water and damp soil (Gordioidea) or found swimming in the pelagic zone of the Atlantic, North Pacific and Indian Oceans, and in the Mediterranean Sea (Nectonematoidea); locomotion via body undulations as in nematodes; internal fertilisation; length of adults up to 1 m; 320 species of Gordioidea and four species of Nectonematoidea described; at least 70 additional species expected.

Questionnaire completed by Andreas SCHMIDT-RHAESA (University of Bielefeld).



The Belgian nematomorph fauna was only once subject to an investigation. SCHUURMANS STEKHOVEN published a list of 12 species in 1943. Since then, no studies, publications or observations seem to be available. At least five additional species are expected. A representative collection, on which SCHUURMANS STEKHOVEN based his publication, is present in the Royal Belgian Institute of Natural Sciences. Three species, *Gordius beinzei*, *G. longareolatus* and *Gordionus divergens* are, until now, only known from Belgium. Small water bodies, including temporary ones, are essential for the survival of horsehair worms (SCHMIDT-RHAESA 1997).

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ACANTHOCEPHALA - SPINY-HEADED OR THORNY-HEADED WORMS

(HAAKWORMEN, STEKELSNUITWORMEN - ACANTHOCÉPHALES - HAKENWÜRMER)



Obligate intestinal parasites of vertebrates; larval development in intermediate arthropod host; body unsegmented, laterally flattened or cylindrical, usually gently curved; no mouth nor intestine (food uptake through tegument); from less than 2 mm up to 70 cm, most species shorter than 10 mm; ca. 1,150 species described, but it is likely that the majority of spiny-headed worm species are as yet unknown to science.

Questionnaire completed by Matthew WAYLAND (The Natural History Museum, London).



At least three species, *Acanthocephalus anguillae*, *A. lucii* and *Neoechinorhynchus rutili*, have been observed (VAN DAMME 1985, SCHABUSS *et al.* 1997). Based on data from the host-parasite database of The Natural History Museum and on GOLVAN (1994), at least nine other species will certainly occur and 13 additional ones can be expected. Representatives of most of the species observed and expected in Belgium are housed in the helminth collection of The Natural History Museum in London. Since the survival of these species is entirely dependent on the survival of their intermediate and definitive hosts,

possible trends are directly linked to the status of the parasitised taxa. Aquatic habitats (both freshwater and marine) are especially important for the survival of spiny-headed worms occurring in Belgium, because the majority of them use aquatic intermediate hosts and many also have aquatic definitive hosts.

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ROTIFERA - ROTIFERS

(RADERDIERTJES - ROTIFÈRES, PORTES-ROUES - RÄDERTIERE)



Transparent organisms with anterior ciliated corona and complex masticatory apparatus; size from 50 µm to 2 mm; occur in great numbers in freshwater lakes and ponds; few brackish or marine species; some inhabit soils or bryophytes, but need a film of moisture; mainly free-living predators, using the corona for locomotion; the few sessile ones attach by foot; some species are parasites of Oligochaeta; parthenogenetic reproduction (Bdelloidea) or with alternating parthenogenetic and sexual periods (Monogononta); since rotifers can tolerate adverse environmental conditions (for example drying or freezing), they can colonise temporary pools and polar regions; ca. 1,800 valid species are recognised but many more are expected.

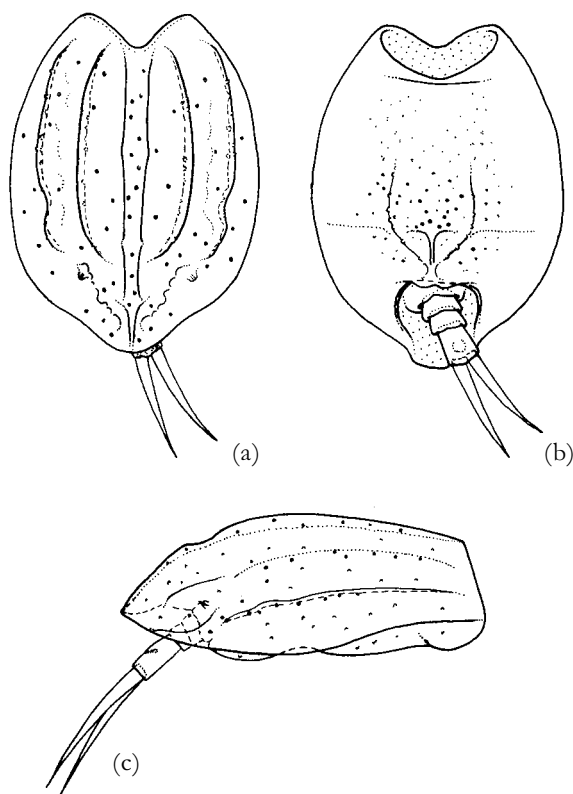
Questionnaire completed by Hendrik SEGERS (Belgian Biodiversity Platform).



Some 300 species are recorded and many hundreds are expected (1,200 species are expected in the Netherlands). Partial species lists can be found in DE RIDDER (1989, 1991). Representative collections are housed in the Royal Belgian Institute of Natural Sciences and the universities of Ghent and Antwerp. For Europe, taxonomic knowledge of Rotifera is highest in Belgium and Germany.

The number of species is rising because of increasing research. Some five species were first described from Belgium and have not (yet) been observed in other countries. Since 1990, 43 new species for the Belgian fauna have been recorded, including several species new to science. If the factor 'increasing knowledge' is not considered, the number of species is probably decreasing because of acidification and manuring. Geographically, the species diversity is highest in Lower Belgium (incl. the Kempen), followed by, in decreasing order of richness, Upper Belgium with the Hautes Fagnes, the coastal area, the Belgian Lorraine and Middle Belgium with the Sonian Forest. The lowest species richness is found in the tidal zone. Concerning the ecological richness, most Belgian species occur in stagnant fresh water, followed by the interstitial environment (in fresh water as well as in brackish and marine waters), the terrestrial habitats and finally the non-interstitial marine zone. Dune pools are an example of a habitat with a crucial importance for the survival of some particular Belgian taxa (SEGERS 1998). An example of an introduced species is *Keratella*

americana; the arrival of the non-indigenous species *Kellicottia bostoniensis* is expected. Occasional intruders during warm summers are *Brachionus variabilis* and *Keratella tropica*.



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(a) Dorsal, (b) ventral and (c) lateral view of *Lepadella deridderae*, a rotifer discovered in Belgium in 1996. The species was found in a temporary pond in an unmown, old-stabilised wet dip in the 'Westhoek' nature reserve, De Panne (from SEGERS *et al.* 1996, courtesy of the Royal Belgian Zoological Society).

SEGERS, H., DE SMET, W. & BONTE, D., 1996. Description of *Lepadella deridderae deridderae* n. sp., n. subsp. and *L. deridderae alaskae* n.sp., n.subsp. (Rotifera: Monogononta: Colurellidae). *Belgian Journal of Zoology*, 126 (2): 117-122.

CYCLIOPHORA - CYCLIOPHORANS

(LIPKLEVERS - CYCLIOPHORES - CYCLIOPHOREN)



Phylum described in 1995, showing affinities to Rotifera; commensals or symbionts found on common and Norwegian lobsters among others in the North Sea; bilaterally symmetrical body with distinct head and trunk; mouth surrounded by a circle of cilia used in feeding; both sexual and asexual reproduction; adult stage ca. 350 µm long; so far, only three species are known worldwide.

Data provided by Reinhardt KRISTENSEN (University of Copenhagen).



So far, there has been no firm record of cyclophoran species, but *Symbion pandora* is expected to be present on Norwegian lobsters in Belgian marine waters and one more, still undescribed, *Symbion* sp. could occur. Representatives of this group have been

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KINORHYNCHA - KINORHYNCHS or MUDDRAGONS

(SLURFWORMEN - KINORHYNQUES - HAKENRÜSSLER)



Small (about 1 to 5 mm long but most are shorter than 2 mm), spiny, segmented 'Pseudocoelia'; body flattened ventrally and domed dorsally; eversible head or introvert with scalids; separate sexes, presumably internal fertilisation; free-living, marine organisms in sediments from the intertidal to abyssal depths; some have been found in association with other invertebrates or aquatic plants; ca. 150 species described.

Questionnaires completed by Martin SØRENSEN and Reinhardt KRISTENSEN (University of Copenhagen), and Birger NEUHAUS (Museum of Natural History, Berlin).



The only published record of kinorhynchs from the Belgian coast can be found in GREEFF (1869) who mentions five species found in the vicinity of Ostend and Nieuwpoort (HUYS & COOMANS 1989, with species list). Because of taxonomic uncertainty and the fact that some determinations were based on immature stages, it is unclear how many valid species have been observed. Consulted experts suspect that the real number of species found by GREEFF ranges from two to four. The occurrence of 15 to 20 additional species is expected.

A collection is present at the Royal Belgian Institute of Natural Sciences. Specimens of some kinorhynch representatives observed or expected in the Belgian marine waters are housed in the collections of the Smithsonian Institution (Washington). Taxonomic knowledge of this group is totally lacking. Several species of Kinorhyncha are definitely present in Belgian waters, but a thorough investigation has never been achieved.

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PRIAPULA - PRIAPULANS

(PRIAPULIDEN - PRIAPULIENS - RÜSSELWÜRMER)



Unsegmented marine worms showing a mixture of bilateral and radial symmetry; retractile introvert (= presoma) with scalids acts as a locomotion and feeding organ; separate sexes, hermaphroditic individuals rarely occur; fertilisation internal or

external; free-living in marine littoral sediments worldwide; size ranges from 0,5 mm to 30 cm; 17 species known worldwide; the group reflects a long history: fossils similar to modern forms are common in the Cambrian Burgess Shale deposits of Canada (making them the so-called 'longest-existing living fossils' among Metazoa).

Questionnaire completed by Volker STORCH (University of Heidelberg).



So far, no records of Priapulida exist. Based on the distribution in adjacent waters, one species, *Priapulid candatus*, is almost certainly present in Belgian waters. Two other species, *Halicryptus spinulosus* and *Tubiluchus* sp. may also occur. Specimens of these species are present in the collection of the Smithsonian Institution (Washington). Undisturbed marine sediments (sand, soft bottom) are essential for the survival of priapulid species.

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GASTROTRICHA - GASTROTRICHS

(BUIKHAARWORMEN, GASTROTRICHEN - GASTROTRICHES - BAUCHHÄRLINGE)



Dorsoventrally flattened worms with two or more adhesive tubes; hermaphroditic or parthenogenetic reproduction; common in the benthic fauna of marine and freshwater habitats, living in sediments or among filaments of plants, some are planktonic; easily overlooked because average length is 0.5 mm (from 0.1 to 4 mm); locomotion by ventral cilia; ca. 450 living species described, many more to be expected.

Questionnaire completed by Philippe JOUK (Royal Zoological Society of Antwerp), with the contribution of William and Margaret HUMMON (Ohio University).



During a one-off investigation, part of a broad study of the meiofauna along the Belgian coast, 37 species were recorded (JOUK *et al.* 1992, with species list). Twenty species were observed in the eulittoral zone, 13 in the sublittoral zone and four occurred in both. Although only a few sites were investigated, the Belgian coast can be considered as one of the best known in the world for this group. For comparison, only 20 species are recorded from the coast of the Netherlands, where 150 species (in marine and freshwater systems) are expected. Taxonomic knowledge is considered to be moderate, but a Belgian expert able to identify organisms to the species level could not be found. Until now, no freshwater species are known from Belgium although ten or more are expected. In the Netherlands, seven freshwater species have been recorded so far.

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LORICIFERA - LORICIFERANS



Phylum described in 1983; bilateral, unsegmented, small (less than 400 µm) species with a body divided into a head, neck and thorax retractable into the abdomen; lorica of six cuticular plates covers abdomen; head houses an introvert with a ring of eight stylets surrounding its base, and a mouth at its apex; distributed worldwide in the marine interstitial environment; only 25 species have been described hitherto but at least 100 additional ones have been found and are waiting for description; hundreds of species are expected to be discovered in the deep sea.

Data provided by Reinhardt KRISTENSEN (University of Copenhagen).



To date, no Loricifera have been observed in the Belgian marine waters. Some six species are expected: *Nanaloricus mysticus* will almost surely be present, while *N. kbaitatus*, *Rugiloricus caroliensis* and three new species, *Nanaloricus* sp.n., *Rugiloricus* sp.n. and *Pliciloricus* sp.n. should occur. Species of the genera *Rugiloricus* and *Pliciloricus* are often observed in habitats ranging from fine sands to mud, which are sediment types common in Belgian marine waters.

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ENTOPROCTA or KAMPTOZOA - ENTOPROCTS

(KELKWORMEN - ENTOPROCTES, KAMPTOZOAIREN - KELCHWÜRMER, KAMPTOZOEN)



Small (0.5-5 mm), sessile filter-feeders, many of which are colonial; the few solitary forms are often associated with sponges, bryozoans, polychaetes and sipunculids; visceral mass housed within a cup-shaped calyx on a supporting stalk; in colonial forms, the individuals or zooids are united, generally by a stolon; ring of tentacles used in feeding; almost all species are marine, one genus in fresh water; differ from the superficially resembling Ectoprocta among others by the position of the anal opening within the ring of tentacles; ca. 150 species described but a total number of up to 300 species is expected worldwide.

Questionnaire completed by Peter EMSCHERMANN (University of Freiburg).



Some ten species have been recorded (various publications), all of them are marine, with the exception of the freshwater species *Urnatella gracilis*. Up to ten additional species are expected. Taxonomic knowledge of this group is poor and no scientist able to identify organisms to the species level was found. Representative collections, holding the majority of the Entoprocta species observed and expected in Belgium, are housed in The Natural History Museum in London and the Zoological Museum in Copenhagen.

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ARACHNIDA - ARACHNIDS

(SPINACHTIGEN - ARACHNIDES - SPINNENTIERE)



Large and very diverse group of arthropods with body consisting of two parts: cephalothorax and abdomen; cephalothorax (fusion of head and thorax) bears six pairs of appendages: one pair of chelicerae, one pair of pedipalps and four pairs of legs; respiration via tracheae or book lungs, cutaneous in many small forms; includes the orders Amblypigi, Palpigradi, Ricinulei, Scorpiones, Solifugae, Uropygi, Araneae, Pseudoscorpiones, Opiliones and Acari, only the last four being indigenous in Belgium (several findings of introduced scorpions are recorded, LONEUX 2002).

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ARANEAE - SPIDERS

(SPINNEN - ARAIGNÉES - (WEB)SPINNEN, ARANEEN)



Major and worldwide distributed group of carnivorous and almost exclusively terrestrial arthropods with size ranging from 0.37 mm to over 110 mm; show great diversity of form and habitat; broad prosoma carrying cheliceral fangs with poison glands, used to paralyse prey; most species with eight eyes; prosoma attached to opisthosoma by a narrow pedicel; opisthosoma contains book lungs and/or tracheae, silk-producing glands and spinnerets; nearly 3,500 genera encompassing almost 40,000 described species.

Questionnaire completed by Léon BAERT (Royal Belgian Institute of Natural Sciences).



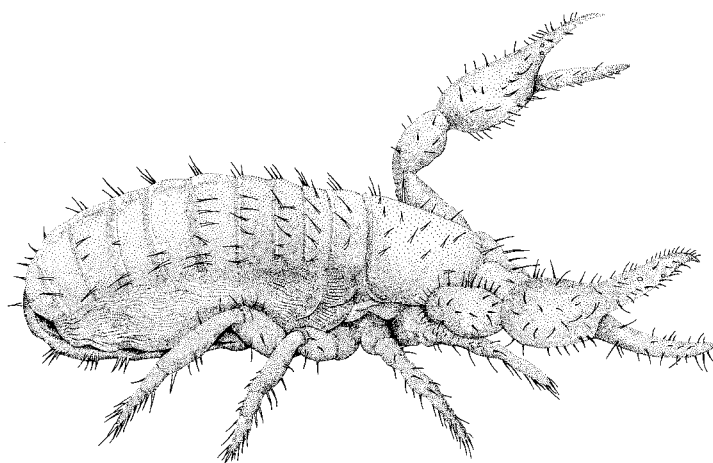
So far, 679 species of spiders have been recorded (BOSMANS & VANUYTVEN 2001, KEKENBOSCH *et al.* 1977, MAELFAIT *et al.* 1998, all three with species list), 254 of which belong to the family Linyphiidae (sheet-web weavers). Taxonomic knowledge of this group in Belgium is very good and a representative collection is housed in the Royal Belgian Institute of Natural Sciences. Since 1955, the species number has increased with 270 species (= 30%) thanks to the intensification of sampling and inventories. The region with the highest number of species is the Lorraine, followed by Upper Belgium, Lower Belgium, the coastal zone and the Hautes Fagnes.

Destruction and desiccation of habitats are the most important threats for spider species in Belgium. At present, only about half of the species recorded in Belgium is safe or at low risk. In Flanders, spider biodiversity is most heavily threatened in oligotrophic grasslands, deciduous forests, heathland and various wetland habitats. These are the habitat types prior

attention should be directed to by nature conservation policy makers (MAELFAIT *et al.* 1998). Four species of the family Pholcidae have been recorded as alien species, two of which (*Holocnemus pluchei* and *Crossopriza lyoni*) established viable populations in the proximity of the port of Antwerp (VAN KEER & VAN KEER 2001).

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8

In 1995, the pseudoscorpion *Microbisium brevifemuratum* (ELLINGSEN, 1903) was found for the first time in Belgium (nature reserve 'De Liereman', Province of Antwerp). The species lives in wet, acid biotopes with *Sphagnum* and occurs in North and Central Europe. Length: ca. 2 mm (drawing by H. VAN PAESSCHEN, based on photographs by H. HENDERICKX).

PSEUDOSCORPIONES - FALSE SCORPIONS or PSEUDOSCORPIONS

(PSEUDOSCHORPIOENEN, BASTAARDSCHORPIOENEN - PSEUDOSCORPIONS, FAUX-SCORPIONS - PSEUDOSKORPIONE, AFTERSKORPIONE)



Small (1 to 5 mm long) arachnids with greatly enlarged and chelate pedipalps giving them a superficial appearance of a true scorpion deprived of the post-abdomen and sting; occurring in leaf litter and under bark on all continents, predated on other small animals; some 434 genera encompassing over 3,000 described species worldwide, but far more species are expected.

Questionnaire completed by Hans HENDERICKX (independent researcher, Mol).



Twenty-two species are listed in HENDERICKX (1999). Two additional species for Belgium have been discovered since then: *Chernes habni* (HENDERICKX & VETS 1999) and *Neobisium sylvaticum* (HENDERICKX, in press). Up to 5 additional species are

expected, based on the observed fauna in neighbouring countries. Taxonomic knowledge of this group in Belgium is considered to be moderate. The joint collection of HENDERICKX and VETS forms a representative collection of species occurring in Belgium. Some pseudoscorpions occur as symbionts: *Lasiochernes pilosus* with the mole (*Talpa europaea*) and *Cbernes vicinus* with the ant *Lasius fuliginosus*. Bird nests in hollow trees, dead and overmature trees in ancient woodland and *Sphagnum* moors are essential habitats for the Belgian pseudoscorpion fauna.

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OPILIONES - HARVESTMEN or OPILIONIDS

(HOOIWAGENS - FAUCHEURS - WEBERKNECHTE)



Arachnids characterised by long legs with multi-jointed, flexible tarsi, making them agile climbers and fast runners; compared to the Araneae, prosoma and opisthosoma are broadly joined; bulbous body shape; prosomal carapace protrudes as a tubercle, with one eye on each side; living in tropical to temperate areas worldwide, in vegetation, leaf litter and caves; body size ranges between 5 and 10 mm; feeding on small prey; ca. 650 genera and 2,400 species described worldwide; a total of 3,500 to 5,000 species is expected.

Questionnaire completed by Luc VANHERCKE (independent expert, Ghent).



Twenty-six species have been recorded, 19 of which belong to the family Phalangiidae (daddy long-leg spiders). At least four additional species are expected. A species list, together with other data on the Belgian opilionid fauna, is available on <http://www.elve.net/opilio>. This group is considered to be taxonomically well known in Belgium. A representative collection is housed in the Royal Belgian Institute of Natural Sciences. Regarding the habitats, caves and trees were not or poorly studied until now and future campaigns should have special attention for them.

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ACARI - MITES and TICKS

(MIJTEN en TEKEN - ACARIENS - MILBEN, ACARIDEN)



Diverse assemblage of small arachnids characterised by the mouth region consisting of cheliceral and pedipalpal segments, movable and terminal (gnathosoma), and by having lost external signs of segmentation with few exceptions; mites are usually less than 1 mm long, while ticks are generally much larger; all ticks are parasitic throughout their life cycle, feeding on the blood of reptiles, birds or mammals; like ticks, many mites parasitise terrestrial vertebrates, but they also parasitise invertebrates, while some prey on invertebrates or feed on plants, mushrooms, bacteria, algae or decomposing organic matter; ca. 30,000 species are described worldwide, while a total of 500,000 species is expected.

Questionnaire completed by Georges WAUTHY, with the contribution of Alexander FAIN (both Royal Belgian Institute of Natural Sciences). Additional information from Philippe LEBRUN (Catholic University of Louvain).



Some 970 species have been observed: 175 parasitic species subdivided in 75 species, of which 15 ticks (FAIN 1990), parasitising vertebrates, and 100 species parasitising invertebrates (COOREMAN 1963, FAIN *et al.* 1995); ca. 550 species living in the soil (ANDRÉ *et al.* 2002, LEBRUN *et al.* 1989, WAUTHY 1994); ca. 120 species occurring on trees and rocks (ANDRÉ 1986); ca. 30 cavernicolous species (pers. comm. X. DUCARME); 34 species occurring in houses (pers. comm. D. GRIDELET-DE SAINT-GEORGES); ca. 50 species living in food and agricultural products (pers. comm. D. GRIDELET-DE SAINT-GEORGES) and ca. 15 aquatic species (DEWEZ & WAUTHY 1981). Up to 250 additional species, ca. 100 parasitic ones, 100 occurring in soils and 50 living in food and agricultural products, are expected.

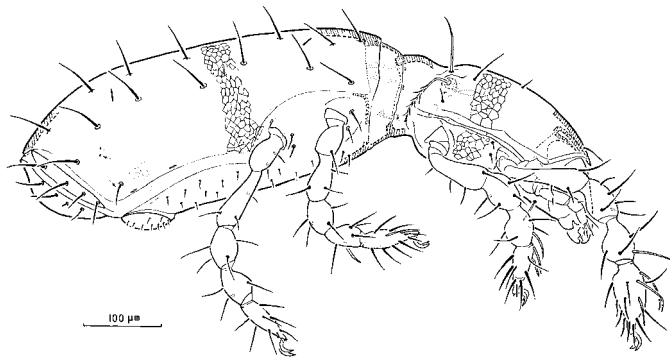
Taxonomic knowledge of this group in Belgium is considered to be moderate to good but information on trends is not available. Major collections are present in the Royal Belgian Institute of Natural Sciences. The FAIN collection, among others including a representative tick collection for the Belgian fauna, focuses mainly on parasitic species and contains ca. 3,000 holotypes and paratypes. Free-living species are mainly kept in the COOREMAN and LIONS collections, among others containing around 20 holotypes. Other smaller collections exist and contain altogether some ten holotypes.

Geographically, the highest species diversity is found in Upper Belgium (with the Hautes Fagnes) followed by, in decreasing order of species richness, the Lorraine region, Middle Belgium (with the Sonian Forest), Lower Belgium and finally the coastal, tidal and marine zones (LEBRUN *et al.* 1989). More than half of the recorded species is present as free-living organisms in terrestrial habitats. Other species occur as parasites of vertebrates, as commensals of birds or are present in the aquatic environment. Up to 150 different species and 100,000 individuals can be found on 1 m² of soil organic layer in deciduous forests (LEBRUN 1971).

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9

Adult female of *Eulobmannia ribagai* BERLESE, 1910. This is an example of a hypogeic oribatid mite occurring in Belgium and featuring a remarkable articular zone between the anterior and posterior parts of the body. This articulation enhances the agility of the species to move through slits and pores. Surface reticulation shown at two places (from LEBRUN & WAUTHY 1981).

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PYCNOGONIDA - SEA SPIDERS

(ZEESPINNEN - PYCNOGONIDÉS - ASSELSPINNEN, SEESPINNEN)



As their names Pycnogonida or Pantopoda suggest, legs are their dominant feature: most of the species have four pairs of long legs, though some have five or six pairs; the males of some species have an extra pair of legs to collect and brood the eggs; most pycnogonids are small, only a few mm, while some species are much larger and gigantism occur; common in all oceans, especially cold ones; ca. 1,000 described species worldwide; feeding on the soft parts of sponges, hydroids, soft corals, anemones, ectoprocts and clams.

Questionnaire completed by Ann DEWICKE and Bregje BEYST (Ghent University).



Fourteen species have been recorded. GILTAY (1928) suggested 12 species for Belgium, based on the pycnogonid specimens present in the collection of the Royal Belgian Institute of Natural Sciences. Since then, new field information on the species in Belgian waters was lacking, and only the presence of *Pycnogonum littorale* was noted in some publications. Since 1993, intensive sampling has been performed by researchers from

the Ghent University. As a result, ten of the 12 species suggested by GILTAY were found again and two new species for the Belgian fauna were discovered. Despite this, taxonomic knowledge of this group in Belgium is poor. Representative collections are present at the Ghent University and the Royal Belgian Institute of Natural Sciences.

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HEXAPODA - HEXAPODS

(ZESPOTIGEN - HEXAPODES - SECHSFÜßER)



Arthropods with body consisting of three parts: head (six segments), thorax (three segments) and abdomen (max. 12 segments); head usually with eyes, antennae, mandibula and maxillae; thorax with three pairs of legs; subdivided in Apterygota (wingless forms, Ametabola: have no metamorphosis) and Pterygota or Insecta (winged forms, Eumetabola: with metamorphosis).

APTERYGOTA - PRIMITIVE WINGLESS HEXAPODS or APTERYGOTES

(ONGEVLEUGELDE ZESPOTIGEN, OERINSECTEN - APTERYGOTES - URINSEKTEN, FLÜGELLOSE SECHSFÜßER)



Wingless hexapods without metamorphosis (Ametabola); include the Protura, Diplura, Collembola and Thysanura.

PROTURA - PROTURANS

(PROTUREN - PROTURES, PROTOURES - BEINTASTLER, PROTUREN)

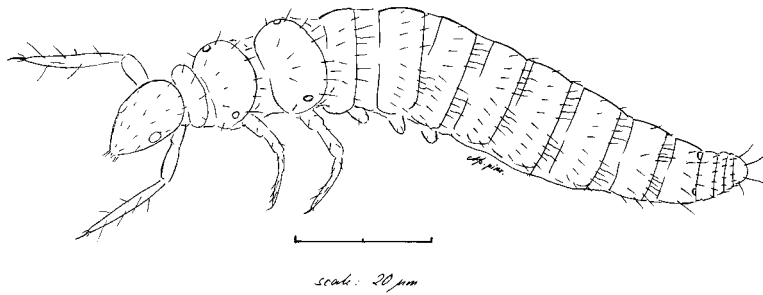


Small (0.5 to 2.5 mm long), entognathous hexapods which inhabit soil and leaf litter in all parts of the world, preferring moist organic soils; not discovered until 1907; no eyes, no or very reduced antennae, no cerci, three pairs of thoracic limbs and limb-like abdominal appendages; more than 660 species described worldwide, but this would only be about 10% of the total number of Protura species.

Questionnaire completed by Andrzej SZEPTYCKI (Institute of Systematics and Evolution of Animals, Poland).



Five species have been recorded (LERUTH 1939, with species list) while 40 to 50 species are expected based on observations in neighbouring countries, mainly the Grand Duchy of Luxembourg, where 32 species were recorded and some more are expected (SZEPTYCKI *et al.* 2002). Other features observed in adjacent areas are the co-existing of up to eight different species within 1 dm³ of soil and the occurrence of 5,000 to 140,000 individuals of the same species on a surface of 1 m². Taxonomic knowledge of this terrestrial group is very poor and no Belgian expert, nor a representative collection, could be identified. A thorough investigation of soil habitats, with exception of extremely wet as well as intensely cultivated soils, is needed for a better knowledge of this group in Belgium.



10

Eosentomon sp. collected in the Grand Duchy of Luxembourg. A recent study of the Protura fauna of this neighbouring country revealed among others five new *Eosentomon* spp. (drawing by A. SZEPTYCKI).

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DIPLURA - DIPLURANS

(TWEESTAARTEN - DIPOLOURES - DOPPELSCHWÄNZE, DIPLUREN)



Small to medium sized, mostly white, entognathous hexapods inhabiting soil and leaf litter and occurring all over the world; no eyes; possessing many segmented antennae, an abdomen with styles and exsertile vesicles, and variably formed, paired cerci; ca. 800 species known worldwide.

Questionnaire completed by Bruno CONDÉ (University Henri Poincaré, Nancy).



Two or three species have been observed (LERUTH 1939, CONDÉ 1956) while a number of seven to ten species is expected, mainly based on observations in France where taxonomic knowledge of this group is good. For Belgium and other neighbouring countries, this knowledge is very poor and no Belgian expert, nor a representative collection, could be identified. A thorough and sustained investigation of caves and soils is needed.

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COLLEMBOLA - SPRINGTAILS or COLLEMBOLANS


(SPRINGSTAARTEN - COLLEMOLES - SPRINGSCHWÄNZE)

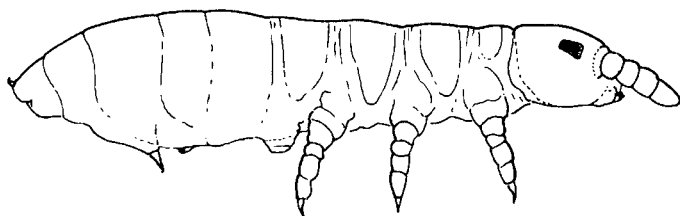


Small to minute entognathous hexapods common in leaf litter and other humid microclimates; occurring all over the world, even in the deserts of Australia and on Antarctica (able to survive temperatures below -60°C); eyes occur as simple ocelli or are absent; possessing a ventral tube enabling the absorption of moisture and a furca which is a forked, springing organ; springtails have been around for at least 400 million years; most species feed on fungi, bacteria, algae or various plant material, some are carnivorous on

nematodes or other collembolans; more than 6,000 species described worldwide, and some experts estimate a real species number of 50,000.

Questionnaire completed by Wim JACOBS, Frans JANSSENS (both RUCA, University of Antwerp) and Luc DE BRUYN (Institute of Nature Conservation).

 So far, 130 species have been observed (<http://wcc.ruca.ua.ac.be/Evolutionary-Biology/coll>, with partial species list). Some 120 additional species are expected mainly relying on the Collembola fauna observed in the Netherlands. Taxonomic knowledge of this group in Belgium is moderate and a representative collection is housed in the University of Antwerp (RUCA), while another collection is managed by the Royal Entomological Society of Antwerp. Caves are identified as crucial habitats for the survival of various populations and species of Collembola in Belgium.



11

The xerophyl springtail *Xenylla maritima* (TULLBERG, 1869) was observed for the first time in Belgium in 2002. It shows a marked preference for dunes, and occurs also on tree trunks or in the litter of coniferous trees. Length: 1.4 mm (from FJELLBERG 1998, published by Brill, Leiden).


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THYSANURA - SILVERFISH and FIREBRATS

(ZILVERVISJES - THYSANOURES - BORSTENSCHWÄNZE)

 Hexapods with ectognathous mouth parts and reduced compound eyes; antennae consisting of 30 or more segments; the abdomen ends in three caudal filaments: two cerci and a telson; occur in leaf litter or under bark or stones, mostly feeding on plant and fungal material; some species are found in houses; ca. 250 species worldwide.

Questionnaire completed by Koen LOCK (Ghent University). Additional information from Frans JANSSENS (RUCA, University of Antwerp) and Peter DE BATIST (Royal Entomological Society of Antwerp).

 Five species, of which two cavernicolous (TERCAFS 1960), are listed in LOCK (2001) and RAPPÉ (1989). *Lepisma saccharina* was introduced before 1900. One or two additional species are expected based on their occurrence in neighbouring countries. Taxonomic knowledge of this group in Belgium is moderate and one expert was identified. A representative collection is housed in the Royal Belgian Institute of Natural Sciences. The highest diversity is found in the Belgian Lorraine, followed by Upper Belgium, the Hautes Fagnes and Middle Belgium, while the western part of the country shows a lower diversity.

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INSECTA (PTERYGOTA) - INSECTS (PTERYGOTES)

(INSECTEN - INSECTES - INSEKTEN)



Hexapods usually having two pairs of wings, one on the second and one on the third thoracic segment; subdivided in Exopterygota (Hemimetabola) and Endopterygota (Holometabola); in the Exopterygota, the wings develop outside the body and there is an incomplete metamorphosis without a pupal stage; in the Endopterygota, the wings develop inside the body and the metamorphosis to adult form is elaborate, involving a pupal stage; with around one million described species, and a multiple of this number still to be discovered, insects are by far the most species-rich, and evolutionary the most successful, faunal group on earth.

EPHEMEROPTERA - MAYFLIES

(EENDAGSVLIEGEN, HAFTEN - ÉPHÉMÉROPTÈRES, ÉPHÉMÈRES - EINTAGSFLIEGEN, HAFTEN)



Common exopterygotes found in almost all freshwater habitats, as well as in some brackish ones; aquatic larval stage; most subadult and adult mayflies have two pairs of wings, the second pair being considerably smaller than the first one; wings can not be folded; only insect order having a subimago (last non-adult life stage) with wings; possessing two long cerci and usually a long median caudal filament at the end of the abdomen; in many species, adults live only for one or two days, while in others the adult life span may be as short as two hours or as long as 14 days; mayflies date from the Carboniferous and Permian times and are the oldest of the extant winged insects; ca. 2,100 described species worldwide.

Questionnaire completed by Hendrik GYSELS (Ghent University).



In STROOT & MOL (1989), 65 species are listed. This high number is possibly a slight overestimation of the real species number because of uncertainties of nomenclature and systematics. Based on the Ephemeroptera fauna observed in the Netherlands (MOL 1985a, 1985b), some species not mentioned in STROOT & MOL (1989) are expected. Taxonomic knowledge of this group in Belgium is moderate and a representative collection is managed by the Royal Belgian Institute of Natural Sciences. Another collection of importance is housed in the Zoological Laboratory of the University of Utrecht. Because of habitat destruction, drying out of the land, acidification, manuring and pollution, at least ten species are expected to disappear from Belgium in the next decades if present trends are maintained. The highest species richness is found in Upper Belgium, followed by the Belgian Lorraine, the Hautes Fagnes, and Lower and Middle Belgium. Oxygen-rich,

unpolluted freshwater habitats are of paramount importance for the survival of most Ephemeroptera species.

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ODONATA - DRAGONFLIES and DAMSELFLIES

(LIBELLEN en WATERJUFFERS - LIBELLULES - LIBELLEN)



Relatively large exopterygotes with transparent, many-veined wings, massive compound eyes and biting mouth parts; wings can not be folded; highest diversity in tropical and subtropical regions; aquatic larval stage; adults and larvae are aggressive carnivores preying mostly on other insects; very ancient order of insects: fossil record dates back to more than 300 million years; fossil record shows that Odonata or their relatives are the largest flying insects; one species, *Meganeura monyi*, had a wingspan up to 75 cm; ca. 5,300 species described worldwide, while a real species number of 10,000 is expected.

Questionnaires completed by Geert DE KNIJF (Institute of Nature Conservation), Henri DUMONT (Ghent University) and Philippe GOFFART (Catholic University of Louvain).



So far, 69 species have been observed (MICHIELS *et al.* 1986, DE KNIJF & ANSELIN 1996, <http://www.gomphus.be>) and one additional species is expected (BOS & WASSCHER 1997). With 20 to 30 Belgian Odonata experts and more than 250 collaborators, the taxonomy and distribution of this group in Belgium are very well known. A representative collection is housed in the Royal Belgian Institute of Natural Sciences. Smaller collections can be found at the Centre de Recherche de la Nature, des Forêts et du Bois (Gembloux) and in most universities. The highest diversity is found in the north-eastern part of Belgium, followed by the Belgian Lorraine (DE KNIJF & ANSELIN 2001, DE KNIJF *et al.* 2002). The number of species remains approximately the same, but the number of populations is decreasing for some species and increasing for others.

Most important threats for the Belgian Odonata fauna are the destruction of habitats, water pollution, acidification and manuring. If present trends are maintained, one or two species could disappear from Belgium in the next decade, and two additional ones during the following ten years. A red list for Flanders (DE KNIJF & ANSELIN 1996) indicates the disappearance of seven species. The red list status and other useful data of Odonata species occurring in the Walloon

Region can be consulted at <http://mrw.wallonie.be/cgi/dgrne/sibw/sibw.esp.list2.pl?VAR=Libellules>.

Up to 48 different species can be found within one UTM area of 5 km by 5 km (DE KNIJF *et al.* 2002). Crucial habitats for the conservation of Odonata species are, in decreasing order of importance: (1) mesotrophic and natural eutrophic ponds, peat bogs and marshes, (2) oligotrophic peat moors and fens, and (3) oxygen-rich running waters (DE KNIJF & ANSELIN 1996). Some Mediterranean species are observed on a more or less frequent basis, but none of these are considered as established alien species (yet).

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PLECOPTERA - STONEFLIES

(STEENVLIEGEN - PLÉCOPTÈRES - STEINFLIEGEN)



Ancient order (known since the Permian) of small to medium-sized exopterygotes with weak (biting) mouth parts and generally two long, threadlike cerci; aquatic larvae mostly living in cooler waters, used as indicators of water quality because of their sensitivity to pollution; many species with restricted distribution; adults have large foldable wings or reduced wings; ca. 2,000 described species worldwide.

Questionnaire completed by Thierry VERCAUTEREN (Provincial Institute for Hygiene, Antwerp).



Following AUBERT (1956, 1957, both with species list), 48 species (of which 16 belong to the Nemouridae) have been observed frequently or sporadically. Some ten additional species are to be found (AUBERT 1956). This group is considered to be

taxonomically well known in Belgium, but a recent synoptical publication for Belgium and adjacent areas is not available. Consequently, identifications are often based on incomplete and somewhat older keys. Furthermore, although stoneflies (mainly the larvae) are regularly collected in the frame of water quality assessment, identifications at the species level are rarely performed (not needed for biotic index) or are seldom published if achieved. A collection is housed in the Royal Belgian Institute of Natural Sciences. Factors endangering stonefly populations are pollution, habitat destruction, acidification and eutrophication. The highest Plecoptera diversity is found in Upper Belgium, followed by Middle Belgium (with the Sonian Forest) and the Hautes Fagnes, the Belgian Lorraine, and Lower Belgium with the Kempen (AUBERT 1956).

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BLATTODEA - COCKROACHES

(KAKKERLAKKEN - BLATTES, CAFARDS - SCHABEN(ARTIGE), KAKERLAKEN)



Dorsoventrally flattened, omnivorous exopterygotes with somewhat hardened forewings and expansive hindwings; wings often reduced or absent; eggs are deposited or carried in ootheca; most cockroaches have a tropical habitat; many Blattodea are forest floor species though some are cave dwellers, semi-aquatic, burrowing, wood boring or even housing in the nests of social insects; some cosmopolitan pest species are associated with human habitations; present for at least 250 million years and it is thought that in the late Carboniferous, cockroaches, in terms of numbers of individuals, outnumbered all other flying insects; ca. 3,500 species worldwide, of which less than 1% have a pest status.

Questionnaire completed by Hendrik DEVRIESE (scientific associate, Royal Belgian Institute of Natural Sciences).



Based on DEVRIESE (1991) and KRUSEMAN (1979), both with species list, four indigenous species have been recorded. No additional ones are expected. Furthermore, four introduced species established viable populations in homes and warehouses. This terrestrial group is taxonomically well known in Belgium and representative collections are housed in the Royal Belgian Institute of Natural Sciences and the Gembloux Agricultural University. The increasing number of introduced individuals is due to the intensification of trade and transport. The highest diversity is found in Middle Belgium with the Sonian Forest, followed by Upper and Lower Belgium (with the Kempen) and the Belgian Lorraine. The coastal area and Hautes Fagnes show a lower diversity (DEVRIESE 1991, GOETGHEBUER 1953).

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MANTODEA - MANTIDS

(BIDSPRINKHANEN - MANTES - FANGSCHRECKEN)



Raptorially predatory, mostly medium-sized exopterygotes with very mobile head and large compound eyes; occurring throughout the tropics and in many sunny temperate zones; eggs are deposited in large, foamy ootheca; all species are carnivorous and prey on insects and spiders; powerful forelegs and jaws to catch and eat their prey; in some species, the female eat the male during copulation; about 2,000 described species worldwide.

Information provided by Hendrik DEVRIESE (scientific associate, Royal Belgian Institute of Natural Sciences), Jean-Yves BAUGNÉE (Observatory of Fauna, Flora and Habitats) and Jean-Paul JACOB (Centre de Recherche de la Nature, des Forêts et du Bois, Gembloux).



One species, *Mantis religiosa*, is known from the southernmost part of the Province of Luxembourg [mainly Torgny (Rouvroy) - natural reserve 'Raymond Mayné', and surrounding area]. The most recent published observation seems to go back to 1968 (PARENT 1976). The species is protected in the Walloon Region (AERW of 9 July 1987) and is listed in annex IIb (species placed under strict protection) of the Walloon Decree of 6 December 2001 in relation to the conservation of Natura 2000 sites as well as the faunal and floral wildlife. The present status of *M. religiosa* in Belgium is uncertain.

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ORTHOPTERA - GRASSHOPPERS, LOCUSTS and CRICKETS

(SPRINKHANEN en KREKELS, RECHTVLEUGELIGEN - CRIQUETS, SAUTERELLES et GRILLONS ou ORTHOPTÈRES - HEUSCHRECKEN)



Relatively large, mostly plant-feeding exopterygotes with hardened forewings, hind legs usually modified as jumping legs and powerful biting mouth parts; males can produce sounds via forewings or through interaction of forewings and hind legs; wings are sometimes reduced; some species are parthenogenetic; ca. 20,000 species known worldwide, many more to be discovered.

Questionnaire completed by Hendrik DEVRIESE (scientific associate, Royal Belgian Institute of Natural Sciences).



So far, 51 species have been registered in Belgium: 18 Tettigonioidea, 5 Grylloidea, 5 Tetrigoidea and 23 Acridoidea (DECLLEER *et al.* 2000, with species enumeration and preliminary red list). Five species have not been observed anymore since 1960. Some five additional species are expected (KLEUKERS *et al.* 1997). This group is taxonomically well known in Belgium and there are a lot of experts able to identify specimens to the species level. A representative collection can be found in the Royal Belgian Institute of Natural Sciences. Another collection is housed in the Gembloux Agricultural University. The highest species diversity is found in Upper Belgium (excl. the Hautes Fagnes), followed by, in decreasing order of diversity, the Belgian Lorraine, Lower Belgium with the Kempen, Middle Belgium with the Sonian Forest, the coastal area and the Hautes Fagnes (DECLLEER *et al.* 2000). If present tendencies persist, three to five species of Orthoptera will disappear from Belgium because of habitat destruction, drying out of the land, acidification and manuring (DECLLEER *et al.* 2000).

Important habitats for the preservation of Orthoptera species are dry and wet grasslands, dunes, rocks and peat areas (KLEUKERS *et al.* 1997, MARSHALL & HAES 1988, INGRISCH & KÖHLER 1998). On a population level, up to 15 species per ha and more than 40 individuals per m² can be found (INGRISCH & KÖHLER 1998). Taking 1900 as reference, five species have been introduced: *Acheta domesticus* (house cricket, introduced more than two centuries ago), *Tachycines asynamorus* (greenhouse camel-cricket), *Meconema meridionale* (southern oak bush-cricket, imported specimens are able to establish viable populations in urban environments), *Anacridium aegyptium* (Egyptian grasshopper) and *Gryllomorpha dalmatina*.

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DERMAPTERA - EARWIGS

(OORWORMEN - PERCE-OREILLES, DERMAPTÈRES - OHRWÜRMER)



Oblong exopterygotes with biting and chewing mouth parts as well as shortened and hardened forewings; hindwings semicircular, often reduced; abdomen carries cerci as terminal forceps, used among others in self defence and capturing of prey; females exhibit maternal care in relation to eggs and early instar nymphs; earwigs are omnivorous, feeding on dead plant material and dead or slow invertebrates; very few species are commensals or ectoparasites of mammals; ca. 1,900 described species worldwide.

Questionnaire completed by Hendrik DEVRIESE (scientific associate, Royal Belgian Institute of Natural Sciences).



Four species have been observed (DE SELYS-LONGCHAMPS 1888, with species list). One additional species is expected (ALBOUY & CAUSSANEL 1990). This group is taxonomically well known although a synoptical overview of recent observations does not exist. A representative collection is housed in the Royal Belgian Institute of Natural Sciences. Upper (excl. the Hautes Fagnes) and Middle Belgium show the highest diversity, followed by Lower Belgium, the Hautes Fagnes, the Belgian Lorraine and the coastal area (DE SELYS-LONGCHAMPS 1888).

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PSOCOPTERA - BOOK- and BARKLICE or PSOCIDS

(HOURLUIZEN, STOFUIZEN, BOEKLUIZEN - PSOCOPTÈRES, PSOQUES - STAUBLÄUSE, RINDENLÄUSE)



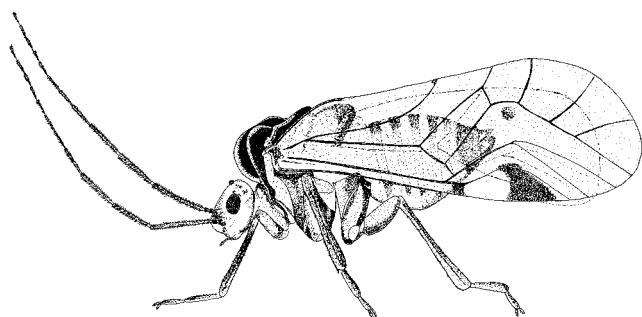
Small (0.5 to 5 mm) exopterygotes with asymmetrical, biting mouth parts; some possess delicate membranous wings, others are wingless; some species live in man-made constructions and can be pests of stored products like books, museum specimens, etc., though the majority live on trees; fossil record goes back to the Permian; 3,000 (most sources) to 4,000 described species worldwide.

Questionnaire completed by Nico SCHNEIDER (scientific associate, Luxembourg National Museum of Natural History).



Seventy-three species have been observed (LIENHARD 1998, with species list). Some nine additional species are expected based on LIENHARD (1998) and the presence of some of these species in the Grand Duchy of Luxembourg. Although this group is taxonomically well known in Belgium, no expert able to identify organisms to the species

level was found in our country. A major collection is present at the Royal Belgian Institute of Natural Sciences. Another collection is housed in the Gembloux Agricultural University. Because of increased fieldwork, the species number augmented significantly from 40 species in 1926 (BALL), over 63 in 1979 (SCHNEIDER) to reach the actual number of 73. If the factor 'increase of the faunal knowledge' is not considered, the species number stays about the same. Although data concerning the geographical species richness are not available,



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Amphigerontia contaminata (STEPHENS, 1836), a hygrophilous psocid occurring abundantly on the bark of deciduous trees and conifers. Length: 3-4 mm (drawing by N. SCHNEIDER).

Upper and Middle Belgium are expected to show the highest Psocoptera diversity. At least three species have been introduced since 1900: *Psoquilla marginepunctata*, *Dorypteryx domestica* and *D. longipennis*.

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ANOPLURA - SUCKING LICE

(ZUIGENDE LUIZEN - ANOPLURES, POUX VRAIS ou SUCEURS - ECHTE LÄUSE, SÄUGENDE LÄUSE)



Dorsoventrally flattened, ectoparasitic exopterygotes sucking blood of mammals and possessing short stout legs ending in a single large curved claw; wingless; generally blind although some possess photosensitive areas; sucking lice are extremely host specific with a particular lice species being found on only one host species; lifespan and development time are related to temperature and humidity; ca. 400 species described worldwide.

Questionnaire completed by Roland LIBOIS (University of Liège).



Fifteen species have been observed in Belgium (COOREMAN 1952, VAN DEN BROEK 1977), while about 13 more are expected based on the Anoplura fauna in neighbouring countries and the presence of their host species in Belgium. Taxonomic knowledge of this group in Belgium is poor. A collection is housed in the Royal Belgian Institute of Natural Sciences. At the population level, one or two Anoplura species and more than 100 specimens can occur per host individual.

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'MALLOPHAGA - CHEWING or BITING LICE'

(BIJTENDE LUIZEN - MALLOPHAGES, POUX BROYEURS - LÄUSLINGE, BEISSLÄUSE)



The term 'Mallophaga' is considered to have no taxonomic value, but is still used for descriptive purposes when referring collectively to the *Amblycera*, *Ischnocera* and *Rhyncophthirina*. Dorsoventrally flattened, wingless ectoparasites of mainly birds and some mammal species; biting mouth parts; reduced or no eyes; most species feed on fragments of hair and feathers, some on blood; some species have a symbiotic relationship with bacteria; highly host specific; 4,300 species and subspecies described worldwide.

Information provided by Ronald HELLENTAL (University of Notre Dame, Indiana), Roger PRICE (University of Minnesota) and Ricardo PALMA (Museum of New Zealand). Additional collection information.



Based on the 'Mallophaga' collection assembled by J. COOREMAN and integrated in the entomological collection of the Royal Belgian Institute of Natural Sciences, a preliminary list with 124 species was compiled for Belgium. Via host-parasite associations using the Belgian list of mammal and bird species, it was found that not less than 873 species and 23 subspecies of chewing lice could occur in Belgium. A document containing the list of expected chewing lice species in Belgium (associated with their host species) is available at the CBD-National Focal Point, RBINS. Although this high number is maybe an over-estimation of the real number, because of the used deduction method and in comparison with the 425 'Mallophaga' species in the United Kingdom (SIMS *et al.* 1988), it illustrates the diversity of this very poorly known faunal group. Chewing lice are expected to parasitise about 26% of the mammal species and 74% of the bird species in our country.

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HETEROPTERA - TRUE BUGS

(WANTSSEN - HÉTÉROPTÈRES, PUNAISES - WANZEN)



Often flattened exopterygotes with elongated, piercing-sucking mouth parts; at rest, wings lie flat over the abdomen; forewing often subdivided into thickened, coriaceous basal and membranous distal region; true bugs are adapted to a broad range of habitats and include terrestrial, freshwater and marine groups; feeding on plant or animal material; some species are blood sucking disease vectors; ca. 62,000 species described worldwide.

Questionnaire completed by Michel DETHIER (Gembloux Agricultural University). Additional information provided by Jean-Yves BAUGNÉE (Observatory of the Fauna, Flora and Habitats).



To date, 620 species are known from Belgium (BAUGNÉE *et al.*, in prep.) and some 30 additional ones are expected. Since BOSMANS & MERCKEN (1989), the species number has increased by 97 species. Heteroptera are relatively well known in Belgium but a complete cartography is only developed for the aquatic species. This led to the first red list ever on invertebrates in Flanders (BOSMANS 1994, with additions on cd-rom, see BONTE *et al.* 2001). Five to ten Belgian experts are able to identify specimens to the species level. Representative collections for the Belgian fauna are housed in the Royal Belgian Institute of Natural Sciences and the Gembloux Agricultural University. Other (smaller) collections have been developed by experts or within universities.

The terrestrial environment shows the highest species richness, followed by stagnant and running freshwater habitats. Most important threats for the true bugs are the destruction and fragmentation of habitats and the drying out of the land. The highest species richness is found in the Belgian Lorraine, the Fagne-Famenne Calestienne, the Meuse valley and the

Kempen. Habitats with an essential importance for the preservation of Heteroptera species are dry grasslands, mowed fields, wet pastures with pools, fallow lands, dunes, heathlands, etc.

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AUCHENORRHYNCHA - HOPPERS and CICADAS

(CICADEN - AUCHÉNORRHYNQUES, CIGALES - ZIKADEN)



Exopterygotes with elongated, piercing-sucking mouth parts and often entirely hardened forewings; at rest, wings are held over the body like a tent; most species possess capacity to jump; larvae sometimes occur in a foamy substance or in the soil; feeding on plant material; ca. 35,000 species described worldwide but a real species number of 100,000 is expected (some authors even mention 1,000,000).

Questionnaires completed by Jean-Yves BAUGNÉE (Observatory of the Fauna, Flora and Habitats) and Jan VAN STALLE (scientific associate, Royal Belgian Institute of Natural Sciences).



At present, 393 species are known in Belgium, while the occurrence of 15 other species is considered to be doubtful (VAN STALLE 1989; BAUGNÉE, in prep.). This species number means an increase of more than 150 species in comparison with the species

total published in 1951 (SYNAVE 1951a, 1951b). Based on BAUGNÉE (in prep.) and the checklists of adjacent areas, 30 to 60 additional species are expected. A better knowledge of this group in Belgium is needed and could be achieved through additional fieldwork and revisions of the existing collections at the Royal Belgian Institute of Natural Sciences and the Gembloux Agricultural University.

Most Auchenorrhyncha species in Belgium are terrestrial. Others occur in freshwater or marine habitats or as symbionts, parasites or commensals. The highest species richness is found in the Belgian Lorraine, followed by the rest of the territory, including the coastal zone. Only the tidal area clearly shows a lower diversity. Calcareous grasslands, heaths, dunes, marshes and broad-leaved forests are some of the essential habitats for the conservation of hoppers and cicadas in Belgium.

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PSYLLOIDEA - JUMPING PLANT LICE or PSYLLIDS

(BLADVLOOIEIEN - PSYLLES, FAUX PUCERONS - BLATTFLÖHE)



Small plant-feeding Sternorrhyncha with specially developed legs for jumping; exopterygotes; although adults have two pairs of wings with reduced venation, they are weak flyers; adults and nymphs feed by sucking sap of plants, thereby often injecting toxic saliva causing plant galling, malformations or necroses; some species transmit plant diseases; more than 2,000 species described worldwide.

Questionnaires completed by Jean-Yves BAUGNÉE (Observatory of the Fauna, Flora and Habitats), Ian HODKINSON (Liverpool John Moores University) and Pavel LAUTERER (Moravian Museum, Brno).



About 64 species have been recorded for Belgium (BAUGNÉE *et al.* 2002, with species list). Some 15 additional species are expected. This group is poorly known in Belgium. Next to the checklist of BAUGNÉE *et al.* (2002), the most recent catalogues are

those of LETHIERRY (1892) and LAMEERE (1900), with respectively 20 and 18 species enumerated. New explorations in all parts of the country are needed to obtain a more complete picture of the distribution and actual frequency of the species. Collections are present in the Royal Belgian Institute of Natural Sciences and the Agricultural Research Centre of Gembloux.

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ALEYRODIDEA - WHITEFLIES

(WITTE VLIEGEN - MOUCHES BLANCHES, ALEURODES DES SERRES - MOTTENLÄUSE, WEISSE FLIEGEN)



Minute (2 to 3 mm), moth-like Sternorrhyncha feeding on plant material; exopterygotes; body and wings covered with white substance; hindwings nearly as large as forewings; except for the first stage, larvae possess neither legs nor antennae, and live attached to the food plant; about 1,200 species worldwide.

Information provided by Jon MARTIN (The Natural History Museum, London).



Following MARTIN *et al.* (2000), the whitefly fauna of Europe and the Mediterranean Basin comprises 56 species. Seven of them have been observed in Belgium (mostly old observations) or are occurring throughout Europe and at least six other species are expected in Belgium. Knowledge of this group in Belgium is clearly very poor and field surveys are needed to remedy. Neither a Belgian specialist of whiteflies, nor a representative collection, could be identified.

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ADELGIDAE and PHYLLOXERIDAE - OVIPAROUS APHIDS or CONIFER APHIDS and PHYLLOXERA

(SPARRENGALLUIZEN en DWERGLUIZEN - PUCERONS ADELGINES, PUCERONS DES ÉCORCES et PHYLLOXÈRES - TANNENGALLÄUSE und ZWERGLÄUSE)



'*Adelgoidea*' is often used to refer collectively to these two families. Often classified within the Aphidoidea among others because of the similar morphology; exopterygotes feeding on woody plants; serious grape pests; ca. 150 species estimated worldwide.

Questionnaire completed by Andrea BINAZZI (Experimental Institute for Agricultural Zoology, Firenze) with the contribution of Georges REMAUDIÈRE (Muséum National d'Histoire Naturelle, Paris).



Four species have been registered (NEF 1984). Based on their presence in neighbouring countries (and the presence of their host plants in Belgium), nine other species occur almost certainly in Belgium, which brings the total up to 13 species. In addition to these, nine other species could occur based on the presence of introduced host conifers (such as *Pinus strobus*, *Picea orientalis*, etc.). This group is poorly known in Belgium. Reference collections are housed in The Natural History Museum in London and in the Experimental Institute for Agricultural Zoology in Firenze.

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APHIDOIDEA - PLANT LICE or APHIDS

(BLADLUIZEN - PUCERONS, APHIDES - BLATTLÄUSE)

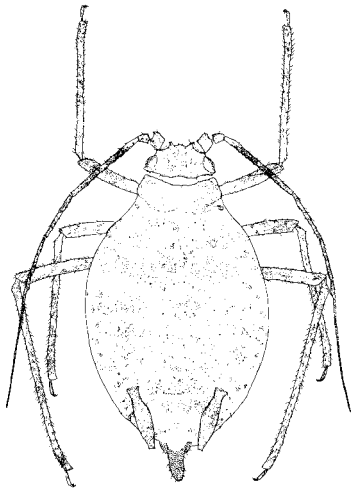


Small (1-5 mm), soft-bodied Sternorrhyncha occurring predominantly in the northern temperate regions of the world; exopterygotes often found feeding together in large clusters on their host plants; complex life cycle including both parthenogenetic and sexual reproduction as well as the production of eggs or living young depending upon the cycle; adults include winged and wingless forms; possessing two prominent structures on the abdomen called cornicles or siphunculi that excrete warning pheromones; most produce saccharine anal secretions (honeydew); ca. 4,700 species worldwide, of which ca. 250 are serious pests.

Questionnaire completed by Juan Manuel NIETO NAFRÍA, Nicolás PÉREZ HIDALGO (both University of León) and Guy LATTEUR (Agricultural Research Centre).



So far, 371 Aphididae species have been recorded in Belgium (NIETO NAFRÍA *et al.* 1999). Since 1996, the species number has augmented with as much as 125 species (34.5%). Roughly estimated, a total species number of around 500 is expected for Belgium, based on the plant lice faunas of other European countries (NIETO NAFRÍA & MIER DURANTE 1999, PATTI & BARBAGALLO 1998). This group is taxonomically relatively well known in Belgium. Information on trends is not available. Representative collections are present at the Agricultural Research Centre and the University of León. Some 16 species are considered to have been introduced; they mainly occur in greenhouses.



13

Wingless viviparous female of *Hyperomyzus (Hyperomyzella) rhinanthi* (SCHOUTEDEN, 1903). The aphid shows host alternation between *Ribes rubrum* and *Rhinanthus* spp. and is widespread in Europe. Length: 2.6 mm (drawing by Nicolás PÉREZ HIDALGO).

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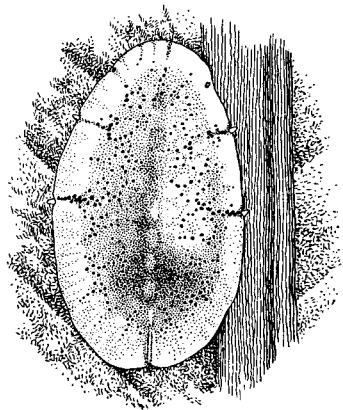
COCCOIDEA - SCALE INSECTS and MEALYBUGS

(SCHILDLUIZEN - COCHENILLES - SCHILDLÄUSE)




Sternorrhyncha with modified body shape adapted to their plant-sucking way of life; exopterygotes; adult females are wingless, bag-like and possess reduced or no legs; males usually have two pairs of wings and possess a distinct head, thorax and abdomen; first instars are mobile and contribute largely to the dispersal of the population; other immature instars generally sessile; some scale insects are serious plant pests, others are beneficial (a.o. through the production of wax; some are used for controlling noxious weeds); probably more than 7,600 species world-wide.

Questionnaire completed by Maurice JANSEN (Plant Protection Service, Wageningen).



14

Coccus hesperidum is a common scale insect in southern Europe that cannot survive in the wild at our latitude. In Belgium, it often occurs in greenhouses and houses. This polyphagous species can among others be found on agave, oleander, apple and citrus. Adult length: 1.5-4 mm; width: 1-2.5 mm (from BORCHSENIUS 1957).

 So far, 27 species have been recorded: 19 in the wild and 8 in greenhouses (KOSZTARAB & KOZAR 1988 combined with non-published data of the Netherlands Plant Protection Service). Based on figures and tendencies observed in the Netherlands, the United Kingdom and Central Europe, a total species number of 100 to 125 is expected in the field complemented by ca. 50 species in greenhouses. The knowledge of this group in Belgium is poor. No expert could be identified in Belgium. Species number increases because of plant trade and the introduction of plants by individuals after a holiday abroad. On the other hand, some five species will probably disappear from Belgium in the following decades owing to the drying out of marshes and related habitats, and/or a shift of their distribution area. The Hautes Fagnes and the coastal zones show the highest species richness while the rest of Belgium shows a somewhat lower diversity.

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THYSANOPTERA - THRIPS

(TRIPSEN - THRIPS, THYSANOPTÈRES - FRANSENFLÜGLER, THRIPISE)

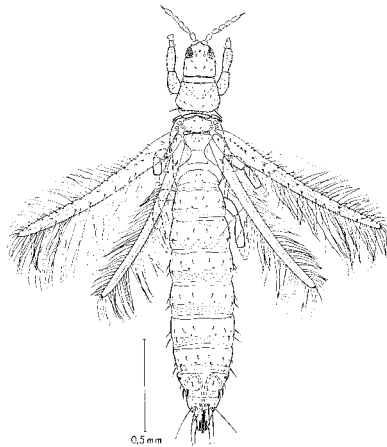


Small (0.5-1.5 mm), flattened exopterygotes; wings, if present, are very narrow, with a fringe of long hairs; some are predaceous, but many feed by sucking plant juice and are agricultural pests; oldest fossil thrips seem to date back to the Permian; ca. 5,000 species described worldwide.

Information provided by Richard ZUR STRASSEN (University of Frankfurt) and Bert VIERBERGEN (Plant Protection Service, Wageningen).



Less than 20 species, almost half of which have been introduced, are known from Belgium. It seems that only some species with a (possible) pest status in greenhouses have been observed. Among others based on the number of species in the Netherlands (148), UK (180), Germany (225), France (250) and Denmark (103), B. VIERBERGEN estimates the number of Thysanoptera species in Belgium to be at least 110. Knowledge of this group in Belgium is very poor. No Belgian expert could be identified. The most complete collection at the European level is housed in the Senckenberg Institute in Frankfurt am Main. Another collection is kept by The Natural History Museum in London. For the thrips possibly occurring in Belgium, the collection of the Plant Protection Service in Wageningen can be consulted.



15

Limothrips cerealium HALIDAY, 1836 is one of the many expected but not yet observed thrips in Belgium. Its presence in the Netherlands, France, Germany and the United Kingdom was ascertained a long time ago (from ZUR STRASSEN 1972).

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NEUROPTERA (PLANIPENNIA) - LACEWINGS, ANT LIONS

(NETVLEUGELIGEN - NÉVROPTÈRES - ECHTE NETZFLÜGLER, NEUROPTEREN)



Endopterygotes with two pairs of large, highly veined, subequal wings; eggs often deposited on stalks; larvae possess sucking jaws and are predating on ants, aphids, mites or freshwater sponges; almost 5,000 described species worldwide.



See below under Raphidioptera.

MEGALOPTERA - ALDER FLIES, DOBSON FLIES, FISH FLIES

(ELZENVLIEGEN - MÉGALOPTÈRES - GROSSFLÜGLER, SCHLAMMFLIEGEN)



Minute to very large, primitive endopterygotes with aquatic larvae predating on insects, annelids, crustaceans and molluscs; large membranous wings (up to 16 cm wing span); adults are fluid feeders, some eat soft-bodied prey; formerly classified within the Neuroptera; ca. 300 extant species worldwide.



See below under Raphidioptera.

RAPHIDIOPTERA - SNAKE FLIES

(KAMEELHALSVLIEGEN - RAPHIDIOPTÈRES, MOUCHES SERPENTS - KAMELHALSFLIEGEN)



Endopterygotes with an elongated pronotum giving a snake-like appearance; terrestrial, predaceous larvae mostly feeding on aphids; females possess an elongated ovipositor; elongated, highly veined wings; formerly classified within the Neuroptera; ca. 150 described species worldwide.

Questionnaires on Neuroptera, Megaloptera and Raphidioptera were completed by Colin PLANT (consultant entomologist, United Kingdom).



Neuroptera, Megaloptera and Raphidioptera are discussed together.

So far, 37 Neuroptera, two Megaloptera and four Raphidioptera species have been recorded in Belgium. Based on the available European data, at least five additional species of Neuroptera are expected. Knowledge of these groups is very poor: Belgium is perhaps the poorest recorded country in western Europe for these taxa. No Belgian expert has been identified. These groups are mainly terrestrial, although the larvae of some species occur in fresh water. The larvae of three species live in close relation with freshwater sponges. Arboreal habitats are essential for the preservation of the species.

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MECOPTERA - SCORPION FLIES

(SCHORPIOENVLIEGEN - MÉCOPTÈRES - SCHNABELFLIEGEN, SKORPIONSFLIEGEN)



Small to medium, fragile endopterygotes with the head drawn out as a downward pointing rostrum; in some species, the last segment of the males is modified into pincers and held upright, giving them a scorpion-like appearance; chewing mouth parts; two pairs of similar narrow wings carried horizontally when at rest; larvae aquatic or terrestrial; among the oldest of the holometabolous insects (fossil record goes back to the lower Permian); ca. 550 described species worldwide.

Questionnaire completed by Robert GÜSTEN (Nature History Museum Mainz). Additional information from Victor NAVEAU (Royal Entomological Society of Antwerp) and Wolfgang DOROW (Senckenberg Research Institute).



Seven or eight species are known from Belgium (DE SELYS-LONGCHAMPS 1888, BERLAND 1962). It is still unclear whether *Panorpa communis* and *P. vulgaris* are distinct species. *Bittacus italicus* and *B. hageni*, mainly Mediterranean species, have been very rarely recorded in Belgium and the few observations of *B. hageni* may in fact pertain to *B. italicus*. No additional species are expected. One or two species are threatened in Belgium. Especially humid riverine forests are essential for the preservation of scorpion flies (HOFFMANN 1966).

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SIPHONAPTERA - FLEAS

(VLOOIEN - PUCES - FLÖHE)



Minute to small, laterally compressed, wingless endopterygotes often with legs modified for jumping; sucking-piercing mouth parts; legless larvae scavenge in nest material of host; transmitter of several important diseases, e.g. bubonic plague and typhus fever; ectoparasites on mammals and birds; ca. 2,400 species worldwide.

Questionnaire completed by Roland LIBOIS (University of Liège).



So far, 43 species have been observed (COOREMAN 1950, non-published list by LIBOIS). Based on SMIT (1967) and BEAUCOURNU & LAUNAY (1990), eight additional species could occur in Belgium. Species of this group are relatively well known except for their chorology. A representative collection is housed in the Royal Belgian Institute of Natural Sciences. Another collection is managed by the University of Liège. Since 1950, the species number has increased by six. As parasites of micro-mammalia (rodents and insectivores), the trends shown by the Siphonaptera are similar to those of their host species. For instance, *Rhinolophopsylla unipectinata* could disappear from Belgium during the following decades because of the regression of *Rhinolophus* species. For the same reason, Chiroptera nurseries and underground cavities are essential for the survival of some Siphonaptera species in Belgium.

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COLEOPTERA - BEETLES

(KEVERS - COLÉOPTÈRES - KÄFER)



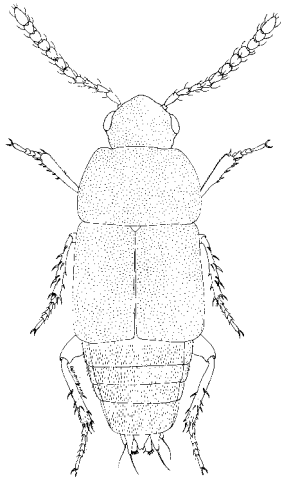
Endopterygotes with hardened forewings (elytra) and membranous hindwings, often reduced or absent; biting mouth parts; complete metamorphosis; successful in almost all terrestrial and freshwater ecosystems; most lifestyles present (herbivores, predators, detritivores, parasites); some are important biological control agents, others are serious agricultural pests; largest and most diverse order with 166 families and ca. 370,000 described species worldwide; a multiple of this number still has to be discovered.

Information provided by diverse experts in relation to specific families (see table 1) was compiled and completed by literature data and with the help of Didier DRUGMAND (Royal Belgian Institute of Natural Sciences).



Approximately 4,500 species (a very rough estimate) have been recorded in Belgium. Between 100 and 500 additional species are expected based on the numbers in neighbouring countries (ca. 4,200 species recorded in the Netherlands and ca. 300 additional species expected). A general overview of this group is not available, although initiatives in this context were launched several times. Experts with a synoptical knowledge of the Belgian Coleoptera could not be identified.

The species-richest families are: Staphylinidae (1030), Curculionidae (estimated between 500 and 700), Carabidae including Cicindelidae (402), Chrysomelidae (334), Dytiscidae (117 observed, ten additional ones expected), Scarabaeoidea (superfamily: 123), Cerambycidae (122), Elateridae (94), Scolytidae (76), Coccinellidae (61) and Pselaphidae (52).



16

Tachinus flavolimbatus, a new staphylinid for the Belgian fauna. The first Belgian observation was made in 2002 in the Ruhrbush forest reserve (Butgenbach, Province of Liège). It is the most northeastern record of this Mediterranean species. Length: 2-3 mm (drawing by M. LECLERCQ).

Smaller families are the Anobiidae (43), Tenebrionidae (35), Buprestidae (30), Haliplidae (19), Ptinidae (16), Bruchidae (15), Gyrinidae (9), Lucanidae (5), Trogidae (4). The Urodontidae, Bostrichidae, Lycidae and Lampyridae each have three species in Belgium. Biphyllidae, Lymexylidae and Noteridae are limited to two Belgian species each. The Hygrobiidae, Platypodidae, Homalidae, Drilidae, Microsporidae and Phloiophilidae are each represented by one species in Belgium. No species number could be found for several families. An example of a recent observation of an aquatic beetle new to the Belgian fauna is *Oulimnius rivularis*, observed in Edegem (Province of Antwerp) in 2001 (pers. comm. T. VERCAUTEREN). Another example is *Tachinus flavolimbatus* (figure 16).

Data gathered via the questionnaire show a clear and alarming regression in native species numbers and population numbers and sizes for almost all families (see table 1 for more detailed information on the threats, important habitats for conservation, etc.). Many species have been introduced over the past few hundreds of years. Perhaps the most recent example is *Harmonia axyridis* (Coccinellidae), introduced as control agent of aphids and originating from Asia. The most important Belgian Coleoptera collection is housed in the Royal Belgian Institute of Natural Sciences. Smaller collections can be found in the Zoological Museum of the University of Liège, the Free University of

Brussels, the Ghent University, the Gembloux Agricultural University and the 'Cercle des Entomologistes Liégeois'. There are also several well-established private collections.

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Table 1. Evaluation of some coleopteran families in Belgium. Information from Jean-Yves BAUGNÉE (OFFH), Étienne BRANQUART (CRNFB), Roger CAMMAERTS (ULB), Georges COULON (RBINS), Raphaël DE COCK (UIA), Konjev DESENDER (RBINS), Claude DOPAGNE (Bolland), Didier DRUGMAND (RBINS), Guy HAGHEBAERT (RBINS), Geoffrey MIESSEN (Malmédy), Peter VERDYCK (RBINS), Veerle VERSTEERT (RBINS) and the Coccinula working group. [^(c): for some families, one or more vernacular names could not be found; n.m.: not mentioned]

Family ^(c)	Observed species	Additional expected species	Taxonomic knowledge	Main collection(s)	Trend	Threatened number	Threats	Geographical species richness	Important habitats for conservation
Anobiidae (furniture or death-watch beetles - kloplekvers - vrillettes - Nagekäfer)	43	0	moderate	RBINS	status quo	n.m.	n.m.	Lower Belgium > Middle Belgium > Upper Belgium	presence of dead wood
Bostrichidae (bostrichids - schorskevers - bostrichidés - Holzbohrkäfer)	3	0	good	RBINS	status quo	n.m.	n.m.	Lower Belgium > Upper Belgium > Middle Belgium	n.m.
Carabidae, incl. Cicindelidae (ground and tiger beetles - loopkevers en zandloopkevers - coléoptères carabiques - Laufkäfer)	402	0	good	RBINS	negative	50% vulnerable or threatened	habitat destruction and fragmentation, acidification, manuring, pollution	highest in Belgian Lorraine and coastal area	dune habitats, old forests, heaths, peat areas, river banks, salt marshes
Cerambycidae (longhorn or longicorn beetles - boktorren - longicornes, cerambycidés - Bockkäfer)	122	unknown	moderate to good	RBINS	unknown	unknown	removing of dead wood, forest clearance	Upper Belgium > Middle Belgium (Flanders poorly investigated)	(old) forests with dead wood
Chrysomelidae (chrysomelid or leaf beetles - bladkevers of bladhaantjes - chrysomèles - Blatterkäfer)	334	10-25	moderate to good	RBINS	unknown	unknown	unknown	Middle Belgium > Lower Belgium > Belgian Lorraine	areas with high plant diversity

Family (*)	Observed species	Additional expected species	Taxonomic knowledge	Main collection(s)	Trend	Threatened number	Threats	Geographical species richness	Important habitats for conservation
Coccinellidae (lady or ladybird beetles - lieveheersbeestjes - coccinellidés, coccinelles - Marienkäfer)	61	2	good for typical ladybird beetles, bad to moderate for other subfamilies	RBINS, FUSAGx	status quo	≥ 6 spp. threatened	habitat destruction, drying out of the land, alien species	highest in Kempen, Belgian Lorraine, Hautes Fagnes, Fagne-Famenne and some areas in Middle Belgium	dry and wet heathland, moors, marshes, fens, mixed forests, parks
Dytiscidae (predaceous water or diving beetles - waterroofkevers - dytiques - Schwimmkäfer)	117	10	moderate	RBINS	negative	12 spp. not found since 1950, 5 spp. threatened, 22 spp. vulnerable	habitat destruction, pollution, drying out of the land, acidification and manuring	Middle Belgium > Lower Belgium > coastal zone and Hautes Fagnes > Upper Belgium > Belgian Lorraine	small water bodies, pools, ditches
Elatерidae (click beetles - kniptorren - taupins, elateridés - Schnellkäfer)	94 known, 81 found at present	0	good	RBINS, FUSAGx, ULg, private collections	negative	mainly xylophagous spp. are threatened (near disappearance in Belgium), others more abundant (e.g. pest spp.)	habitat destruction, isolation of woodland, dead wood removal	Upper Belgium and Belgian Lorraine > Middle Belgium > Lower Belgium	dead wood, old forests, hollow trees
Lampyridae (glow-worms, fireflies - glimwormen, vuurvliegen - verluisants, lucioles - Glimwürmchen)	3	1	good	RBINS, RMCA	status quo	population number and size decrease	habitat destruction, drying out of the land, pollution, pesticides	Middle Belgium > Upper Belgium > Lower Belgium > Belgian Lorraine > tidal area > Hautes Fagnes	forests, sunken roads, areas with less light pollution
Lymexylidae (lymexyloids - (scheeps)werfkevers - lymexylonidés - Werftkäfer)	2	0	good	RBINS, FUSAGx	status quo	n.m.	n.m.	Middle Belgium > Belgian Lorraine > Upper Belgium	forests with dead wood

Family (°)	Observed species	Additional expected species	Taxonomic knowledge	Main collection(s)	Trend	Threatened number	Threats	Geographical species richness	Important habitats for conservation
Pselaphidae (short-winged mold beetles - dwergkevers - pselaphides - Palpenkäfer)	52	10-13	good	RBINS, private collections	status quo	under investigation	habitat destruction, drying out of the land	Upper Belgium > Middle Belgium > Belgian Lorraine	dry calcareous grasslands, old deciduous forests, wet areas incl. salt marshes, river banks, karst areas
Ptinidae (prinids - diefkevers - ptinidés - Diebskäfer)	16	± 5	good	RBINS, FES, private collections	status quo	n.m.	n.m.	Belgian Lorraine > Upper Belgium > Middle Belgium	n.m.
Scarabaeoidea (superfamily) (lamellicorn or coprophagous beetles - bladsprietigen - scaraboides - Blatthornkäfer)	123	10	good	RBINS, private collections	negative	26 spp. disappeared since 1950, 40 spp. threatened	pollution, alteration of agro-pastoral methods, veterinary antibiotics	Middle Belgium > Lower Belgium > Belgian Lorraine	sandy and coastal biotopes, slopes not accessible with machinery
Scolytidae (bark beetles - schorskevers - scolytes - Borkenkäfer)	76	20	good	RBINS, FUSAGx	unknown	unknown	removal of dead wood	Middle Belgium > Upper Belgium > Belgian Lorraine	forested areas, presence of dead or dying wood
Staphylinidae (rove beetles - kortschildkevers - staphylins - Kurzflügler)	1030	50	good	RBINS, MNHN, NHM, Humbold Univ. Berlin	negative	under investigation	habitat destruction, pollution, drying out of the land	Brabantine district > Mosan district > Flanders district > Kempen and Ardenne district > maritime and Lorraine district	dry calcareous grasslands, peat soils, deciduous forest, wet areas

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STREPSIPTERA - TWISTED-WING INSECTS, STYLOPIDS or STREPSIPTERANS

(WAAIERVLEUGELIGEN - STREPSIPTÈRES - FÄCHERFLÜGLER)



Small endopterygotes with strong sexual dimorphism; females without wings, eyes and antennae; free-living males with enlarged hindwings and reduced forewings (halteres); females parasitising bees, wasps and other insects; ca. 560 species worldwide.

Questionnaire completed by Guy HAGHEBAERT (scientific associate, Royal Belgian Institute of Natural Sciences).



Five species have been recorded (HAGHEBAERT 1993, with species list). Some five additional species could be expected (KINZELBACH 1969). The knowledge of this group in Belgium is poor and information on trends is not available. A collection is present in the Royal Belgian Institute of Natural Sciences. Most species are found in the coastal area (above the high-water mark), followed by, in decreasing order of richness, Upper Belgium and Middle Belgium with the Sonian Forest (PASTEELS 1949, HAGHEBAERT 1993). Stylopids occur as terrestrial free-living organisms or as parasites of Hymenoptera and Homoptera. Consequently, appropriate habitats for these two insect groups are also very important for the survival of Strepsiptera.

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DIPTERA - TRUE FLIES or FLIES and MOSQUITOES

(TWEEVLEUGELIGEN, VLIEGEN en MUGGEN - DIPTÈRES, MOUCHES et MOUSTIQUES - ZWEIFLÜGLER, FLIEGEN und MÜCKEN)



Endopterygotes with well-developed forewings and hindwings reduced to club-shaped halteres (organs of balance); compound eyes large; piercing, sucking or sponging mouth parts; legless larvae; some are vectors of diseases for livestock and humans; diverse order with many different ecological roles in larval as well as adult stage; gues-timates range from 120,000 to more than 150,000 described species worldwide; a multiple of these numbers to be discovered.

Questionnaire completed by Patrick GROOTAERT (Royal Belgian Institute of Natural Sciences).

 In GROOTAERT *et al.* (1991), 4,474 species are listed. Mainly thanks to a better faunal knowledge, but also because of the appearance of Mediterranean species, the species number is increasing. Based on the Diptera fauna of the United Kingdom, around 2,200 additional species are expected (CHANDLER 1998). This group is moderately known in Belgium; a representative collection is housed in the Royal Belgian Institute of Natural Sciences. Next to the terrestrial environment, containing by far the highest number of Diptera species in Belgium, an important part of the true flies fauna is related to stagnant and running freshwater habitats. Furthermore, some species occur as parasites or commensals (GROOTAERT *et al.* 1991). Fragmentation and habitat destruction are identified as the biggest threats for this group. The highest species richness is found in Upper Belgium (excl. the Hautes Fagnes). A somewhat lower diversity is found in the Belgian Lorraine, the Hautes Fagnes and Middle Belgium. In Lower Belgium, the species richness is further decreasing towards the proximity of the North Sea (GROOTAERT *et al.* 1991).

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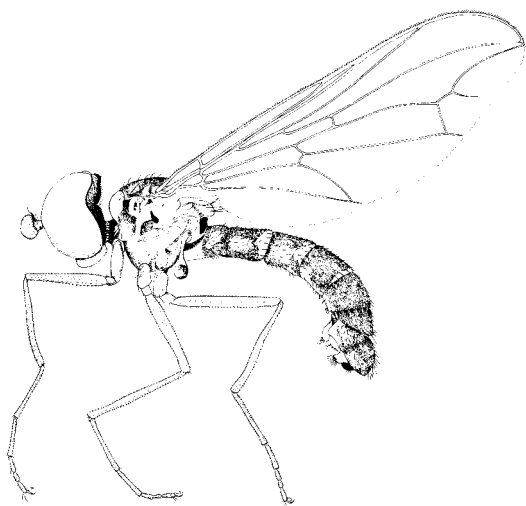
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Nephrocerus lapponicus, one of the three species of this Pipunculidae genus occurring in Belgium. Body length: 7.3-7.8 mm; wing length: 7.0-8.6 mm (from GROOTAERT & DE MEYER 1986).

Table 2. Evaluation of some dipteran families in Belgium. Information from Luc DE BRUYN (IN), Marc DE MEYER (RMCA), Kris DECLER (IN), Boudewijn GODDEERIS (RBINS), Patrick GROOTAERT (RBINS), Marcel LIECLERCQ (Beyne-Heusy), Jacques PETIT (Bassenge), Jan SCHEERS (RUCA), Guy TOMASOVIC (FUSAGx). See GROOTAERT *et al.* (1991) for more information on these and other dipteran families. [⁽¹⁾: for some families, one or more vernacular names could not be found; ⁽²⁾: cause animal and human myiasis; ⁽³⁾: used as biological control agents of Trematoda infesting humans and animals; n.m.: not mentioned]

Family ⁽¹⁾	Observed species	Additional expected species	Taxonomic knowledge	Main collection(s)	Trend	Threatened number	Threats	Geographical species richness	Important habitats for conservation
Agromyzidae (leafminer flies - mineervliegen - mouches mineuses - Minierfliegen)	173	300-500	insufficient	private collection	unknown	unknown	unknown	unknown	unknown
Asilidae (robber flies - roofvliegen - asilides - Raubfliegen)	50	n.m.	moderate	RBINS, FUSAGx	negative	19 spp. threatened	habitat destruction	Upper Belgium > Belgian Lorraine > Middle Belgium > Hautes Fagnes > Lower Belgium > coastal zone	sandy or open mesobrometum environments, old forests and edges
Bibionidae (St Mark's, march or fever flies - maartse of zwarte vliegen - bibionidés, mouches de St Marc - Märzfliegen, Haarmücken)	18	1	moderate	RBINS, FUSAGx	negative	3 spp. disappeared, 8 spp. threatened	habitat destruction, acidification, manuring, pollution	Middle Belgium and Belgian Lorraine > Upper Belgium > Lower Belgium > Hautes Fagnes	grasslands and open spaces in the forest environment
Chironomidae (midges - dansmuggen, vedermuggen - chironomides - Zuckmücken)	352	150	moderate	RBINS	negative	unknown	water pollution, habitat destruction	unknown	freshwater and semi-aquatic habitats
Chloropidae (grass or frit flies - halmvliegen - mouches des chaumes - Halmfliegen, Gelbkopffliegen)	113	> 10	moderate	RBINS	positive due to knowledge increase	n.m.	n.m.	± equal richness throughout the country, coastal zone with lower richness	habitats with Poaceae, Cyperaceae, Juncaceae and/or Juncaginaceae

Family ⁽¹⁾	Observed species	Additional expected species	Taxonomic knowledge	Main collection(s)	Trend	Threatened number	Threats	Geographical species richness	Important habitats for conservation
Conopidae (thick-headed flies - blaaskopvliegen - conopides - Blaskopvliegen)	34	4	moderate	RBINS	unknown	unknown	unknown	Upper Belgium, Belgian Lorraine and Montagne Saint-Pierre > Hautes Fagnes, Lower and Middle Belgium > coastal zone	xerothermic grasslands, fallow land, <i>Calluna</i> heathland
Empididae (dance flies - dansvliegen - empidides - Tanzvliegen)	175	10	moderate to good	RBINS, FUSAGx, ULg	status quo	9 spp. threatened	fragmentation	Middle and Upper Belgium and Belgian Lorraine > Hautes Fagnes > Lower Belgium and coastal zone	<i>spp. show high habitat- specificity and are good indicators for site quality assessment</i>
Gasterophilidae ⁽¹⁾ (horse bot flies - maagvliegen - gastrophiles - Magenvliegen, Magendasseln)	3	3	good	private collection, FUSAGx	negative	unknown	prophylactic measures of breeders and veterinary services	highest in Upper Belgium, Hautes Fagnes, mammal breeding zones and forests	n.m.
Hippoboscidae (louse flies - luisvliegen - hippoboscides - Lausvliegen)	10	'some'	moderate	RBINS NHM	following trends of mammals and birds (Hippoboscidae are obligate ectoparasites of these groups)	unknown	hunting, poaching, pollution	n.m.	n.m.
Hybotidae (dance flies - dansvliegen - hybotides - Tanzvliegen)	165	10	moderate to good	RBINS, FUSAGx, ULg	status quo	10 spp. threatened	fragmentation	Middle and Upper Belgium and Belgian Lorraine > Hautes Fagnes > coastal zone and Lower Belgium	<i>spp. show high habitat- specificity and are good indicators for site quality assessment</i>
Hypodermatidae ⁽¹⁾ (warble flies - hypodermes, mouches du varon - Hautdasseln)	3	0	good	private collection, FUSAGx	negative	unknown	prophylactic measures of breeders and veterinary services	highest in Upper Belgium, Hautes Fagnes, mammal breeding zones and forests	n.m.

Family ⁽¹⁾	Observed species	Additional expected species	Taxonomic knowledge	Main collection(s)	Trend	Threatened number	Threats	Geographical species richness	Important habitats for conservation
Oestridae ⁽¹⁾ (bot flies - horzels - oestres - Dasselvliegen)	4	0	good	private collection, FUSAGx	negative	unknown	prophylactic measures of breeders and veterinary services	highest in Upper Belgium, Hautes Fagnes, mammal breeding zones and forests	n.m.
Pipunculidae (big-headed flies - grootoogvliegen, oogkopvliegen - pipunculides - Augenfliegen)	79	10-15	good	RBINS	unknown	unknown	unknown	Middle Belgium > Upper Belgium > Lower Belgium > Hautes Fagnes > Belgian Lorraine > coastal zone	calcareous grasslands, boreomontane habitats
Sciomyzidae ⁽²⁾ (snail-killing or marsh flies - slakkendodende vliegen - sciomyzides, mouches malacophages - Schneckenfliegen, Hornfliegen)	66	n.m.	good but probably incomplete	RBINS FUSAGx, private collection	unknown	unknown	habitat destruction, drying, pollution	considerable richness throughout Belgium with exception of Hautes Fagnes and coastal zone	marshy aquatic environments
Syrphidae (hover flies - zweervliegen - syrphides - Schwebfliegen)	322	5	moderate to good	RBINS ULg	negative	> 50 spp. threatened	habitat destruction, lack of adequate habitat management	highest richness in Upper Belgium	old woodlands, wetlands, wet heathlands, semi-natural grasslands and dunes
Tabanidae (horse and deer flies - dazen - taons, tabanides - Bremsen)	39	1-2	good	private collection, FUSAGx	status quo	unknown	habitat destruction, drying out of the land, pollution	highest in Lower Belgium, Hautes Fagnes and Lorraine	marshes and lakes
Tephritidae (fruit flies - boorvliegen - téphritides, mouches des fruits - Fruchtfiegen, Bohrfiegen)	67	n.m.	moderate	FUSAGx, private collection	unknown	unknown	pesticides and insecticides, habitat destruction, acidification and manuring	considerable richness throughout Belgium with exception of Hautes Fagnes and coastal zone (larvae parasitises phanerogams)	habitats with wild or cultivated flora

TRICHOPTERA - CADDISFLIES

(KOKERJUFFERS, SCHIETMOTTEN - TRICHOPTÈRES - KÖCHERFLIEGEN)



Small to medium, brownish or grayish, moth-like endopterygotes; two pairs of membranous wings with silky hairs; larvae aquatic, most species building specific cases, nets or tubes; primarily important as fish food; often used as biological indicators for water quality assessment; about 7,000 described species worldwide.

Questionnaires completed by Thierry VERCAUTEREN (Provincial Institute for Hygiene, Antwerp) and Alain DOHET (Public Research Centre Gabriel Lippmann, Luxembourg).



Mainly based on research activities of Philippe STROOT, 202 species are registered (STROOT 1984-1987, STROOT & NEVEN 1989, some with species list). Some 20 to 25 additional species could be found (STROOT 1987, 1989). Except for the larval stages of some subgroups, the caddisflies are well known in Belgium. A representative collection is managed by the Royal Belgian Institute of Natural Sciences. Another, somewhat smaller, collection is housed in the Zoological Institute of the University of Liège. Thanks to the intensification of research activities, the species number has increased with 36 species since 1950. The highest species richness is found in Upper Belgium (including the Hautes Fagnes, containing some species not occurring elsewhere in Belgium), followed by, in decreasing order of diversity, Middle Belgium, Lower Belgium and the Belgian Lorraine (STROOT 1987). Nineteen species are clearly in regression (STROOT & DEPIEREUX 1989) because of habitat destruction, pollution, desiccation, clearing of river banks, acidification and eutrophication. The potamic environment, river sources, old river branches, temporal water bodies, marshes, peat bogs and floodable areas are some of the habitats identified as very important for the conservation and survival of many caddisfly species in Belgium.

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LEPIDOPTERA - BUTTERFLIES and MOTHS

(VLINDERS en MOTTEN - PAPILLONS et PHALÈNES - SCHMETTERLINGE)



Very small to largest (by wing span) endopterygotes with two pairs of membranous wings, covered with overlapping colourful (as is the rest of the body) scales; compound eyes well developed; mouth parts of most species modified in a long, coiled proboscis for sucking; larvae (caterpillars) with chewing mouth parts; generally phytophagous, sometimes significant crop pests; a few feed on clothes or stored food products; one of the largest insect orders with ca. 127 families and 165,000 known species worldwide; the real total of extant species is expected to be much higher.

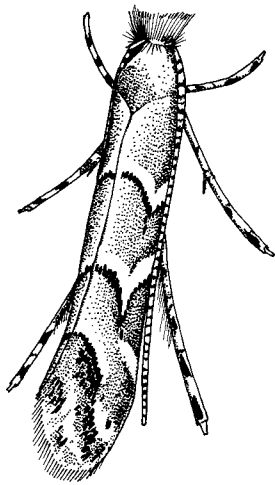
Questionnaires completed by Willy DE PRINS (scientific associate, Royal Museum of Central-Africa) for the Lepidoptera and by Dirk MAES (Institute of Nature Conservation) in collaboration with Hans VAN DYCK (University of Antwerp) and Philippe GOFFART (Catholic University of Louvain) for the Rhopalocera.



In DE PRINS (1998), 2,405 species, belonging to 71 families, are listed. Since then, 18 new species have been found (various articles in 'Phegea'). At least 100 additional species are expected based on KUCHLEIN (1993). The group is taxonomically well known in Belgium and a considerable number of experts able to identify Lepidoptera (especially the Rhopalocera) to the species level are studying and monitoring these species. A representative collection is housed in the Royal Belgian Institute of Natural Sciences. Another collection is developed by the Flemish Entomological Society and housed in the University of Antwerp (RUCA). In average, two or three new species for the Belgian fauna are discovered each year. Unfortunately, if present trends continue, some ten Lepidoptera species are expected to disappear from Belgium each year because of habitat destruction, drying out of the land, acidification, manuring and pollution.

The highest species richness is found in zones with calcareous habitats, followed by, in decreasing order of diversity, the Belgian Lorraine, Middle Belgium with the Sonian Forest, Upper Belgium, Lower Belgium with the Kempen, the Hautes Fagnes and the coastal and tidal area. Dry calcareous slopes, peat moors and fen meadows (= wet, nutrient-poor grasslands) were identified as important habitats for the conservation of specific or scarce populations. Since 1900, some 20 species were introduced and mainly observed in the proximity of railway stations or the harbour of Antwerp.

Regarding the Rhopalocera, 111 species have been recorded and no additional species are expected. This group is very well known and monitored in Belgium; collections are housed in the Gembloux Agricultural University, the Royal Belgian Institute of Natural Sciences, the Royal Zoological Society of Antwerp and the Ghent University. Since 1980, 16 species (14%) have disappeared in Belgium (VAN SWAAY *et al.* 1997a). Red lists for the Flemish (http://www.instat.be/content/page.asp?pid=FAU_VL_Rode_Lijst) and the Walloon Region (http://mrw.wallonie.be/dgrne/sibw/especes/ecologie/papillons/ISB_SURWAL/liste_rouge.htm) are available. The highest diversity is found in the Belgian Lorraine, followed by the Viroin valley and Upper Belgium with the Hautes Fagnes (GOFFART *et al.* 1992). Important habitats for butterflies are wet and dry poor grasslands, peat areas, calcareous grasslands, marshes and wet heathlands (MAES & VAN DYCK 1999, GOFFART



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Cameraria obridella DESCHKA & DIMIC, 1986, in resting position. Although the first observation in Belgium of this leafmining species, originating from Central Europe, was made only recently in Tervuren (1999), the species has already spread over the whole Belgian territory. Wing span: 6-8 mm (drawing by W. DE PRINS).

et al. 1992). About 20 rhopaloceran species are legally protected, some only in Flanders or in Wallonia, others in both regions.

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HYMENOPTERA - BEES, ANTS, WASPS and SAWFLIES

(VLIESVLEUGELIGEN - HYMÉNOPTÈRES - HAUTFLÜGLER, HYMENOPTEREN)



Minute to large endopterygotes with highly variable mouth parts; two pairs of membranous wings coupled by hamuli, some species wingless; larvae usually legless with distinct head or caterpillar-like; females with ovipositor modified for inserting eggs into tissue or transformed into a stinger; important pollinators and biological control agents, few pest or nuisance species; based on the complexity and diversity of their biology, Hymenoptera are often considered to be the most advanced insect group; 198,000 described species worldwide, while a multiple of this number still has to be discovered.

Questionnaire completed by Alain PAULY (Gembloux Agricultural University) and Jean-Luc BOEVÉ (Royal Belgian Institute of Natural Sciences).



Probably the most species-rich animal group in Belgium. The total number of species is estimated at least at 7,200 based on the following recorded numbers and guesstimates for the different subgroups: Symphyta 462 (recorded number, see MAGIS 1994); Aculeata 837 (recorded number, see PAULY 1999); Ichneumonoidea ± 3,300; Cynipoidea ± 190; Proctotrupoidea ± 343; Platygastroidea ± 252; Ceraphronoidea ± 87; Chalcidoidea ± 1,800; Mymarommatoidea 1. Of the estimated number of species, only less than half have been recorded or identified in collections.

Table 3. Evaluation of some hymenopteran families in Belgium. Information from Yvan BARBIER (UMH), Johan BILLEN (KUL), Wouter DEKONINCK (RBINS), Jean LECLERCO (Jupille), Sébastien PATINY (FUSAGx), Pierre RASMONT (UMH), Camille THIRION (Flemalle), Raymond WAHIS (Chaudfontaine). [°]: for some families, one or more vernacular names could not be found; n.m.: not mentioned]

Family (°)	Observed species	Expected additional species	Taxonomic knowledge	Main collection(s)	Trend	Threatened number	Threats	Geographical species richness	Important habitats for conservation
Andrenidae (andrenid bees - andrenides - Sandbienen)	84	20	moderate	Oberöster-reiches Landes Museum Linz, FUSAGx, Naturalis, NHM	negative	n.m.	modification of agricultural practices	higher in Lorraine, Hautes Fagnes, Middle and Upper Belgium	parcels with high floral diversity
Apoidea (superfamily) (bees - bijen - abeilles - Bienen)	376	0	good	FUSAGx, UMH, RBINS	status quo	some species in expansion, others in regression	n.m.	high throughout country, lower richness in Hautes Fagnes and coastal zone	n.m.
Chrysididae (gold wasps - goudwespen - chrysidés - Goldwespen)	49	0	good	FUSAGx, RBINS, private collection	negative	9 spp. disappeared since 1950, 5-10 spp. threatened	habitat destruction	highest in Lower and Middle Belgium and on Montagne St-Pierre	heathlands, old hedges, forest edges, ecologically managed diverse gardens
Eumenidae (eumenid wasps - euménides - solitären Faltenwespen)	41	0	good	FUSAGx, RBINS	status quo	n.m.	n.m.	highest in Belgian Lorraine and Lower and Middle Belgium	sandy or calcareous open landscapes, old hedges, forest edges
Formicidae (ants - mieren - fourmis - Ameisen)	75	5	good	RBINS, Natuurhistorisch Museum Maastricht	negative	15 spp.	habitat destruction, pollution	Lower Belgium > Hautes Fagnes > Ardenne > Middle Belgium	sandy areas, heathlands, calcareous soils, forests

Family (C)	Observed species	Expected additional species	Taxonomic knowledge	Main collection(s)	Trend	Threatened number	Threats	Geographical species richness	Important habitats for conservation
Ichneumonidae (ichneumon wasps, ichneumonids - sluipwespen - ichneumonides - Schlupfwespen)	300	500-1500	insufficient to moderate	RBINS, FUSAGx	status quo	± 20 spp.	disappearing Lepidoptera (host-specific relation)	throughout country, even in urban areas	mixed forests, fallow land, gardens, natural (river) banks, slopes, heathland
Pompilidae (spider wasps - spinnendoders - pompiles - Wegwespen)	70	0	good	FUSAGx, RBINS, private collection	positive (new spp. found)	n.m.	n.m.	Calestienne > Belgian Lorraine and Upper Belgium > Kempen and Middle Belgium > coastal zone	fallow land, reed-beds besides lakes, xerothermic calcareous grasslands
Sphecidae (sphecid wasps - graafwespen - sphécides - Grabwespen)	170	0	good	FUSAGx, RBINS	status quo	n.m.	n.m.	high throughout country, lower richness in Hautes Fagnes and coastal zone	sandy or calcareous open areas, old hedges, forest edges, ecologically managed diverse gardens
Vespidae (wasps - wespen - guépes - Wespen)	15	0	good	FUSAGx, RBINS	positive (2 new spp. since 1995: due to temp. rise?)	n.m.	n.m.	highest in Belgian Lorraine and Middle and Upper Belgium	some taxa related to thermophilous biotopes, most have no strict preference

In neighbouring countries, the Hymenoptera fauna is estimated as follows: ca. 7,500 species in the Netherlands, more than 8,000 in France and around 7,000 in the United Kingdom. In Germany, 8,896 species have been recorded hitherto (DATHE *et al.* 2001).

This group is moderately known in Belgium. Nowadays, some 15 Belgian hymenopterologists are contributing to this knowledge. In general, the highest species diversity is found in the Belgian Lorraine, followed by, in decreasing order of richness, Lower Belgium with the Kempen, Middle Belgium with the Sonian Forest and finally Upper Belgium. For some groups (Symphyta, Formicidae) however, Upper Belgium shows the highest richness. The Aculeata show the highest richness on Cretaceous grounds of the Montagne Saint-Pierre and the lower valley of the Geer.

Collections are present in the Royal Belgian Institute of Natural Sciences and the Gembloux Agricultural University. If current trends continue, 25 to 50% (depending on the group) of the species are or could become extinct, threatened, etc. (RASMONT *et al.* 1993). Sand quarries, coastal dunes, heather moors, calcareous grasslands and forest edges are some of the habitats identified as crucial for the Aculeata (DAY 1991). For other subgroups, important habitats for conservation are the wet environments (Symphyta, Chalcidoidea) and forests (Ichneumonoidea, Chalcidoidea, Proctotrupeoidea).

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MYRIAPODA - MYRIAPODS

(MYRIAPODEN - MYRIAPODES - MYRIAPODEN)



Terrestrial arthropods with elongated body and variable number of somites; mostly living in moist environments; fossil record goes back to the Cambrian; include Chilopoda, Symphyla, Diplopoda and Pauropoda.