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A review of the phyllopods (Crustacea : Anostraca, Notostraca, Conchostraca) of the Belgian fauna

by Luc BRENDONCK

Abstract

A restricted number of phyllopods have been found (although rarely) in ephemeral habitats in the central, the eastern, and the north-eastern parts of Belgium. Except for a recent record of a conchostracan species (*Leptestheria dahalacensis*), however, no more representatives were collected since 1959. Also, in the whole of Europe, the number of phyllopod localities is constantly decreasing by the destructive antropogenic influence on the biosphere. A brief account is presented of the systematics, the morphology, and the distribution of former and recent Belgian phyllopods, together with a key for these species.
Key-words : phyllopods, review, systematics, morphology, ecology, identification, distribution.

Résumé

Un nombre limité des espèces phyllopodes étaient trouvés dans des biotopes temporaires dans la partie centrale, et nord-est de la Belgique. A l'exeption d'un habitat récent d'un phyllopode conchostracé (*Leptestheria dahalacensis*), plus des représentants étaient trouvés depuis 1959. Dans toute l'Europe, le nombre des localités des phyllopodes diminue constamment à cause de l'influence destructeur de l'homme sur le biosphère. Un rappel succint est présenté de la systématique, de la morphologie, de l'écologie et de la distribution des phyllopodes belges disparus et récents, avec un clé de détermination pour ces espèces.
Mots-clefs : phyllopodes, review, systématique, morphologie, écologie, détermination, distribution.

Introduction

Phyllopods are cosmopolitan, relative primitive crustaceans, characterised by a slight differentiation of the thoracal appendages, which are flattened and leaf-like. Beside their respiratory function, the appendages also serve for locomotion and feeding.
Relying on museum collections, the papers by MAITLAND (1897) and LAMEERE (1895), and some personal communications, we could conclude that a restricted number of phyllopods were once present (although rare) in ditches, ponds, cart traces and clay (or loam) pits in the central, the eastern, and the north-eastern parts of Belgium. However, since 1959, no more phyllopods were found, this in contrast with for example France (NOURISSON and THIERY, 1988 ; THIERY and PONT, 1988 ; THIERY and CHAMPEAU, 1988) and the Netherlands (LEENTVAAR, 1978 ; HIGHLER and REPKO, 1982 ; VISSER and MOLLER PILLOT, 1986). Recently, however, a new Belgian conchostracan species was collected from an artificially temporary fishpond (BRENDONCK et al. 1989).
The present report will present a brief diagnosis of systematical, ecological, and morphological aspects of the phyllopods in general and of the older and recent Belgian representatives, together with a key for these species and an account of their distribution.

Classification

The term 'phyllopod' is considered to have no taxonomical value, but is still used for descriptive purposes when referring collectively to the anostracan, notostracan, and conchostracan orders within the class of the Branchiopoda which also includes the polyphyletic group of the Cladocera (FRYER, 1987). The classification of the branchiopods as such is difficult because of the heterogeneous nature of the organisms involved. The differences between the subgroups are more evident than their similarities, which is a reflection of the ancient nature of these taxa. Branchiopods have existed at least since the Devonian and are certainly among the most primitive of extant crustaceans (FRYER, 1987). It is not surprising that, although some examples of evolutionary conservatism are exhibited in the Branchiopoda, there should have been considerable adaptive radiation which has not been adequately reflected in many former classifications. The classification of FRYER (1987) stresses the heterogenity between the several branchiopod taxa.
Since the earlier works of DADAY (1910-1927), LINDER (1941, 1952), and LONGHURST (1955), the taxonomy of phyllopods has been modified several times ; many species and genera became synonyms, and new species, genera, and even families were added.

Ecology, distribution and morphology

Freshwater phyllopods are typical inhabitants of temporary, predator-poor aquatic environments which dry out periodically or show striking changes in the water

FIG. 1

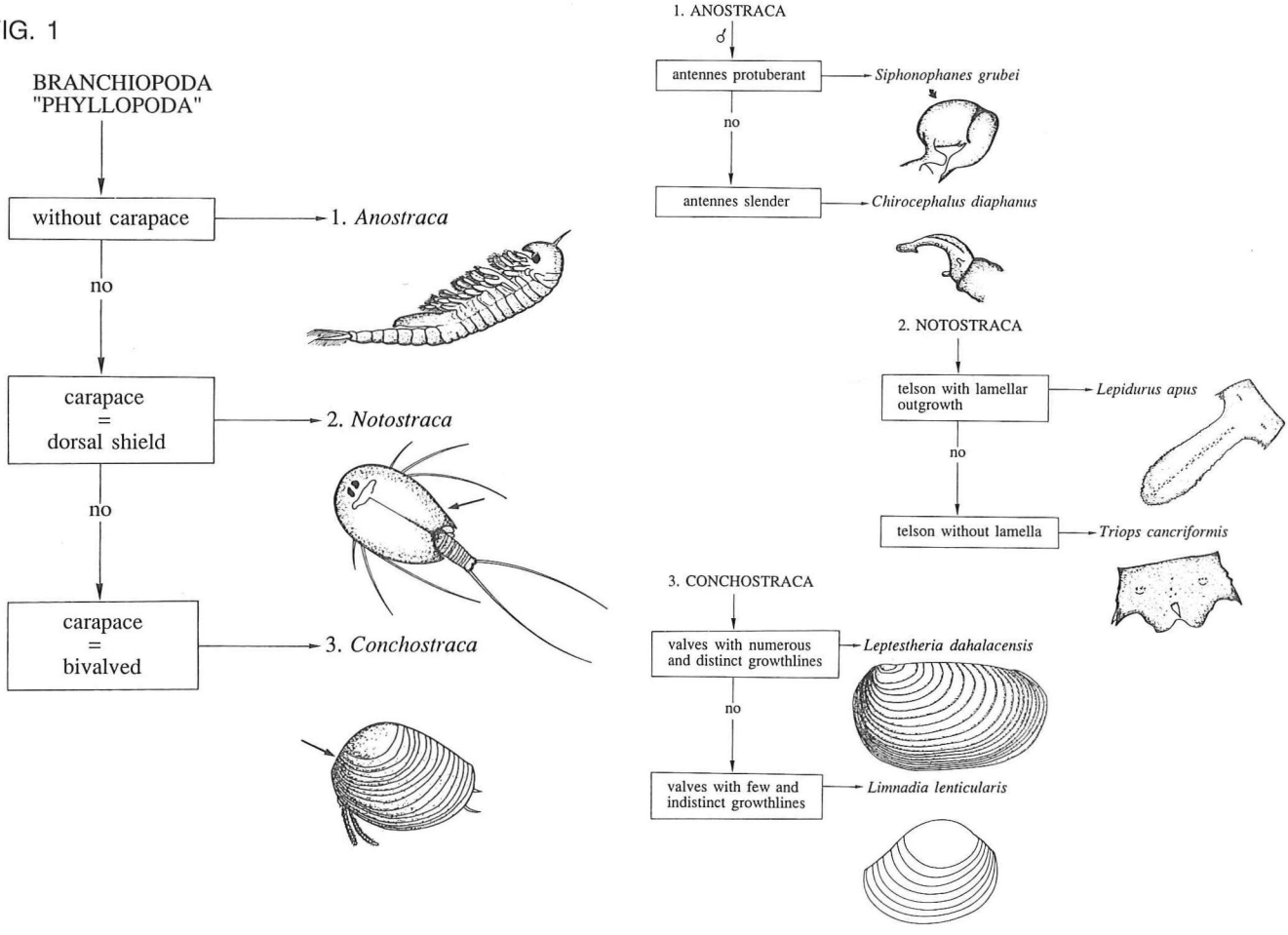

Fig. 1 : Identification key to the different phyllopod taxa and their Belgian representatives.

level. Such habitats occur in both desert regions and in climates where the mean annual precipitation exceeds the yearly evaporation rate (BELK and COLE, 1975). One type of ephemeral waters are vernal pools in arctic or high-altitude regions where melting snow is a regular event or where ponds are frozen during winter months, producing a physiologic dry phase. A regular periodicity may also exist for transitory waters in warm, humid regions where flooding depends on predictable annual patterns of precipitation (BELK and COLE, 1975 ; MOORE, 1970). Phyllopods are however most common in desert rainwater pools which may fill for a few weeks only (RZOSKA, 1961).

Anostracans, notostracans and conchostracans ensure their survival during adverse periods by the production of shelled, dormant embryos. These so-called drought-resistant cysts can survive extremely unfavorable circumstances and will yield the next generation when the (a)-biotic environment returns favorable (BELK and COLE, 1975 ; LAVENS and SORGELOOS, 1987). The production of dormant cysts synchronises life-cycles to the variations that occur in the habitat and provides indirect ways for dispersal such as passive transportation by wind, by waterfowl, and by men (HORNE, 1966 ; MAC DONALD, 1980 ; PERSOONE and SORGELOOS, 1980).

Within the temporary freshwater biotopes, some environmental factors have determining influence on the species combinations which can be found ; eventual periodic currents, the stability of the hydrologic situation, the type of substrate, the trofic level of the water, and the presence or absence of vegetation (CUPPEN and VISSER, 1983). Temperature also has an important influence on the occurence of phyllopods. Populations sometimes disappear for a number of years but can suddenly be reestablished after a cold winter or during a hot, humid summer.

Phyllopods have a wide geographical distribution, occurring from the circumpolar areas up to the subtropical deserts. Some species were also collected from altitudes above 2000 m. They are however most abundant in subtropical regions.

In fig. 1, a key is presented to the different phyllopod taxa and their Belgian representatives.

1. Anostraca.

INTRODUCTION

The body is metameric and elongate withouth carapace and ending posteriorly in a caudal furca. Adults generally measure between 1 and 4 cm. The paired compound eyes are pedunculate and a small naupliar eye is situated anteromedially. The first antennae are short, uniramous and unsegmented. The second antennae of the females are uniramous and unsegmented, while those of the males are large, uniramous, two-jointed prehensile structures used to clasp females during mating. The thorax usually consists of 11 leg-bearing segments. The legs are biramous, foliaceous, lobed, setose and are ventrally directed. They show a high degree of serial homology and each limb bears a respiratory epipodite. The abdomen is composed of eight segments and a telson, bearing a pair of cercopods (furca). The genital region is formed by partial fusion of the two anterior abdominal segments and their ventral surface bears paired, retractile penes in the males, or a single, median brood-pouch in the females.
With the exception of some parthenogenetic *Artemia* species, nearly all anostracans are bisexual.
Anostracans swim with their ventral side up by using their thoracal appendages. During swimming, bacteria, algae, and particulate matter are filtered from the surrounding medium. Some species can scrape food items from surfaces, while *Branchinecta gigas* preys on other anostracans.

BELGIAN SPECIES

1. *Chirocephalus diaphanus* PREVOST, 1803. (see Fig. 2A)
This is a circummediterranean species with a north-western extension and it is scattered over the whole of Europe. It is the most frequently found anostracan in France, Spain, and Italy. This species has also been recorded from the Netherlands, England, Switzerland and W-Germany (FLOBNER, 1972). It frequently occurs together with other anostracan species (ALONSO, 1985). The species is found in waters rich in organic material, inundated ditches and fallow-fields, and has also been recorded in flooded depressions in the peat-meadows of the Pyrenees, more than 2000 m above sea level. *C. diaphanus* appears to be indifferent to the turbidity caused by inorganic particles in suspension and prefers little mineralised waters (ALONSO, 1985).
In Belgium it was only found in Halen (08.1903). No further specifications are given concerning the type of locality (material originating from the K.B.I.N., IG 9302).

2. *Siphonophanes grubei* DYBOWSKI, 1860.
A west-palearctic species, occurring from Eastern-France over Denmark, Northern-Germany, the Polish plain, Czechoslovakia, Hungary, and Roumania to the western region of the U.S.S.R. It is the most abundant anostracan in Germany (FLOBNER, 1972). In the Netherlands it is known from North-Brabant and Gelderland with some recent records in the environment of 's Hertogenbosch and the eastern border of the Veluwe (STERK, 1949 ; VISSER and MOLLER PILLOT, 1986).
S. grubei is a typical spring species, occurring soon after the snow melts. This species has been recorded during winter in ice-covered water. It is a typical inhabitant of pools in or at the fringe of woods and has regularly been recorded together with *Lepidurus apus* (Notostraca) (FLOBNER, 1972).
This species has not yet been collected in Belgium, though has probably been observed in 1970 in a ditch in the environment of Geel (WOUTERS pers. comm.).

2. Notostraca (tadpole shrimps).

INTRODUCTION

Species in this group have an elongate body and can measure up to 10 cm. They are distinguishable from other branchiopods by their broad shield like carapace covering the head, thorax, and a variable portion of the abdomen. Two sessile compound eyes are situated close together on the anterior part of the carapace, with a minute ocellus in front and a dorsal organ behind them. The antennules are uniramous and the antennae are either greatly reduced or absent in the adults. The thorax usually consists of 11 segments, each bearing a pair of ventral appendages. The abdominal body rings (up to 31) vary in number, even within one species. The anterior rings have several pairs of legs per ring, while the posterior rings lack appendages. The rami of the caudal furca (cerci) are long and multiarticulate.
Notostracans usually live near the bottom and use their thoracal appendages to crawl or swim. They are detritus feeders and predators.
Reproduction is bisexual in some species. In other species, the reproductive mode varies on geographical basis, with northern populations being hermaphroditic and southern populations being bisexual. Cysts are carried for a short time in a pair of capsular ovisacs on the appendages of the 11th segment, before they are deposited.

BELGIAN SPECIES

3. *Lepidurus apus* LINNAEUS, 1758. (see Fig. 2C)
This species is known from the whole of Europe (FLOBNER, 1972). From the Netherlands, *L. apus* has been recorded from Gelderland and North-Brabant, with some recent records from Eefde (HIGHLER and REPKO, 1982). In France, it has been found in the

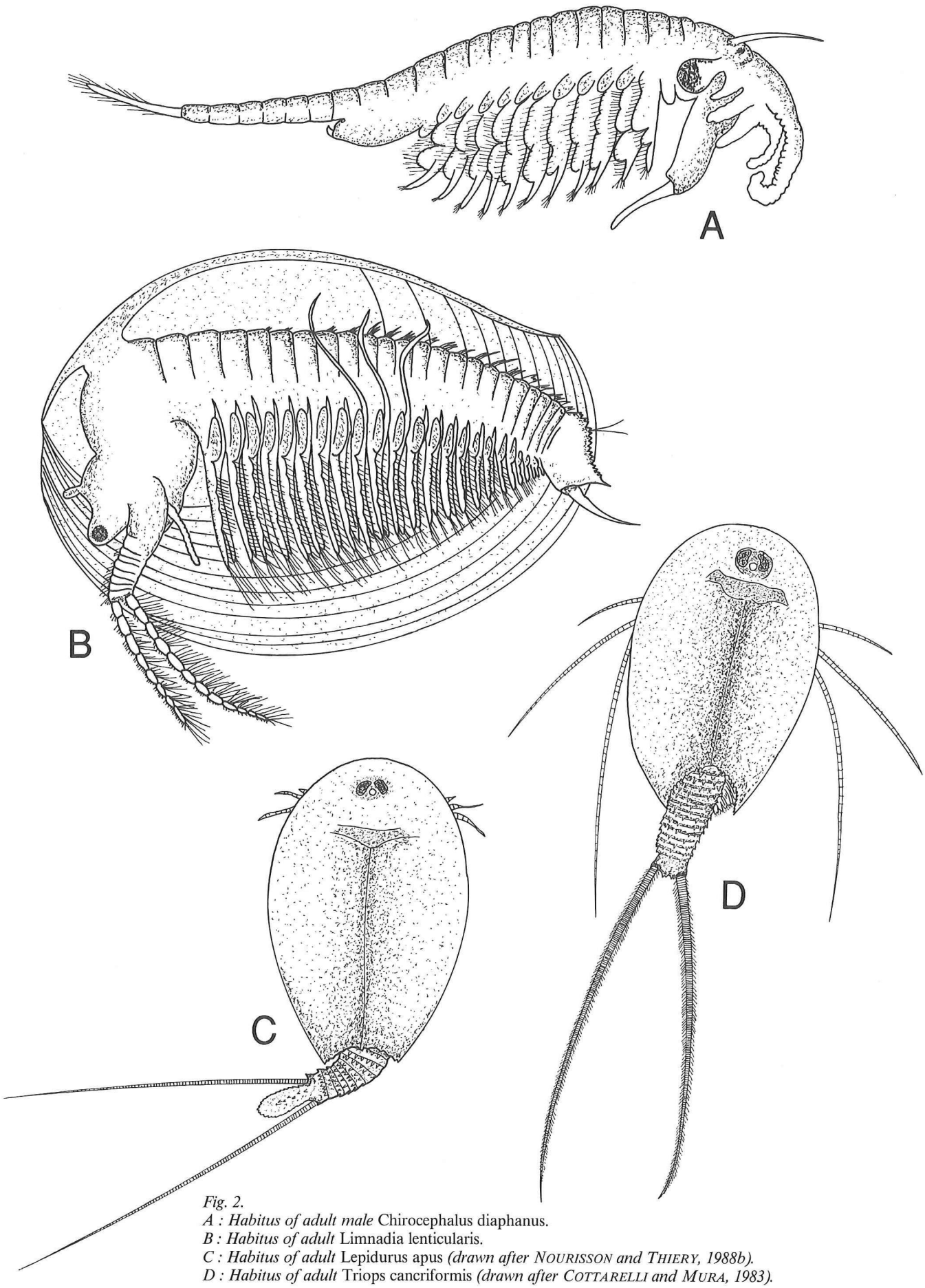

Fig. 2.
A : Habitus of adult male Chirocephalus diaphanus.
B : Habitus of adult Limnadia lenticularis.
C : Habitus of adult Lepidurus apus *(drawn after* NOURISSON *and* THIERY, *1988b).*
D : Habitus of adult Triops cancriformis *(drawn after* COTTARELLI *and* MURA, *1983).*

environments of Paris, the South-West, and the Provence (NOURISSON and THIERY, 1988 a, b).
Like *Siphonophanes grubei, L. apus* occurs early in the year. It prefers pools with clear, little mineralised and distrophic waters characterised by abundant aquatic vegetation (mosses, Ranunculaceae, Characeae) (ALONSO, 1985) but also occurs in flooded ditches and pools in woods, regularly together with *S. grubei.* When the pools remain filled for a long time, more than one generation can occur during the year (FLOBNER, 1972). Most authors consider this a typical spring-species, although its appearance in fall has also been recorded (STELLA and MARGARITORA, 1968).
L. apus has been found in Belgium in Balen or Halen. No further details are known abouth the date of collection nor the type of locality. (Material originating from the K.B.I.N.).

4. *Triops cancriformis* BOSC, 1801. (see Fig. 2D)
This species is known from the whole of Europe (FLOBNER, 1972). It is relatively abundant in France especially from the coastal zone, the South, and the environment of Paris (NOURISSON and THIERY, 1988 a, b). Around 1920 it has been recorded from the Netherlands in the surroundings of Drenthe (BEYERINCK 1923, 1924).
T. cancriformis has a preference for shallow open pastures, and pools and ditches with a loamy substrate, rich in vegetation and remains of organic material, with little mineralised water (ALONSO, 1985). Unlike *L. apus* and *S. grubei, T. cancriformis* is a typical fall-species, occurring during summer and autumn (FLOBNER, 1972).
When pools last for a long time, more than one generation can occur, often in very high densities.
T. cancriformis has been collected in Belgium in Halen (08.1892 and 08.1903, without further indications), Limburg (23.10.1893, without any details), Brabant (no date, no locality), and in Céroux-Mousty (no date, no indications). (Material originating from the K.B.I.N., IG 9302).

3. Conchostraca (clam shrimps).

INTRODUCTION

FRYER (1987) abandoned the name Conchostraca as a taxonomic unit, although it is still useful for descriptive purposes. Two former conchostracan taxa (Spinicaudata and Laevicaudata) are now given ordinal status. For this work only the Spinicaudata are of importance. The body is short, completely enveloped in a bivalved carapace, measuring between 3 and 15 mm in length. The valves are generally marked by concentric lines of growth. The head is subtriangular in shape and bears the compound eyes. Posterior to the eyes, on the dorsal surface, a clublike stalked organ (frontal organ) is present in the family of the Limnadiidae. The front of the head is produced downwards, forming a frontal process or rostrum. The antennules are small and unsegmented or multisegmental. The large antennes are biramous and are used for swimming, burrowing, adhering to surfaces and they aid males in clasping females. The trunk is generally composed of 10 to 32 segments, each bearing a pair of phyllopodous limbs (decreasing in size towards the posterior), used for locomotion and feeding. In males, the first one or two trunk limbs lose their phyllopodous lobes and bear hook-like endites (claspers). These are used for holding the ventral edge of the female carapace during mating. The telson is large and directed ventrally. Terminally, a pair of blade-like anal spines and a pair of serrate and spinose caudal rami (furca) flank the anus.
Conchostracans are non-selective algal and detrital filter feeders. Some species burrow in the substrate-surface and lie filtering with their ventral surface pointed upwards.
Reproduction is bisexual, hermaphroditic, or parthenogenetic. Fertilised eggs are brooded inside the carapace for a short period and are shed when the female moults.

BELGIAN SPECIES

5. *Limnadia lenticularis* LINNAEUS, 1761. (see Fig. 2B)
A Holarctic species, being most abundant in northern temperate climates (FLOBNER, 1972). In France, the species has been found in the environment of Paris and in the Alsace (NOURISSON and THIERY, 1988 a, b). In the Netherlands, the species has been collected in 1960 from an artificially temporary fishpond in Valkenswaard (LEENTVAAR, 1960, 1961).
L. lenticularis inhabits a variety of ephemeral waters, like flooded meadow-lands, ditches, and pools in the open field, mostly with a bottom covered with a thick layer of vegetation. It has rarely been found in organically polluted waters nor in cold wood pools with scarce vegetation. *L. lenticularis* is a weak thermophylic late-species, which occurs in Middle Europe from June till October (FLOBNER, 1972).
In Belgium it has been found from a marsh in Genk (4.07.1946) and from Zolder-Zonhoven (1959, without further specifications). (Material originating from the K.B.I.N., IG 26062 and 14901).

6. *Leptestheria dahalacensis* RUPPEL, 1837.
(see BRENDONCK et al., 1989).

Discussion

In comparison with the adjacing countries, few phyllopod representatives have as yet been found in Belgium.

Also, the number of localities where the stenoecious phyllopods are found in Europe diminishes every year; Many pools and ditches where phyllopods were found are destroyed, mainly in the surroundings of big cities by the expansion of the road-system, by the lowering of the ground water table, by draining the flooded weadow planes, the metalling of wood paths and not at least by the destructive influence of pesticides and the eutrofication of many inland waters.

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