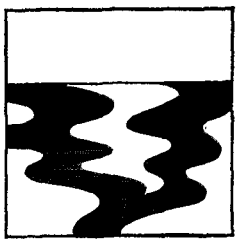

# *The Cladoceran fauna of Nigeria : A checklist, review of literature and distribution* (1)

Cecilia Y. Jeje (2)

Abstract

*A study based on 623 samples collected from 145 locations between 1971 and 1981 from a variety of Nigerian freshwater habitats in Nigeria yielded 61 species and 1 subspecies of Cladocera from 31 genera. This represents the largest numbers and taxa of the group identified to date from Nigerian freshwater systems; 32 are new records for Nigeria and 4 new records for Africa. These are* Ilyocryptus verrucosus, Chydorus reticulatus, Camptocercus lilljeborgi dadayi *&* Leydigia leydigi. *The occurence of species in various habitat types is discussed. The study also indicates close faunal links between Africa and South America.*

Key words : Zooplankton — Cladocera — West Africa — Nigeria.

Résumé

Les Cladocères du Nigeria : mise à jour de l'inventaire et éléments de répartition

*L'étude a porté sur 623 échantillons collectés entre 1971 et 1981 dans 145 stations en eau douce au Nigeria. On a dénombré 61 espèces et une sous-espèce pour 31 genres de Cladocères. Trente deux espèces sont nouvelles pour le Nigeria et 4 pour l'Afrique. Ce sont* Ilyocryptus verrucosus, Chydorus reticulatus, Camptocercus lilljeborgi dadayi *et* Leydigia leydigi. *La présence des espèces dans les divers habitats est discutée. Il apparaît par ailleurs des liens faunistiques étroits entre l'Afrique et l'Amérique du Sud.*

Mots-clés : Zooplancton — Cladocères — Afrique de l'Ouest — Nigeria.

## INTRODUCTION AND REVIEW OF NIGERIAN LITERATURE

Information on the systematics and distribution of different species of Nigerian Cladocera is limited, even though they play an important role (together with other zooplankters) in channeling primary production into fish production. Assessing the nutrional value of individual species of Cladocera as food for fish can only be done when species are correctly identified. Cladocera may also serve as indicators of water quality (Gannon & Stemberger,

(1) *Research work was carried out in the laboratory of Professor C. H. Fernando, Department of Biology, University of Waterloo, Ontario, Canada.*

(2) *Dept. of Zoology, University of Ibadan, Ibadan, Nigeria.*

1978) and are useful in paleolimnological studies (FREY, 1959; GOULDEN, 1968). Although their relative importance in the zooplankton may not be as high as in temperate regions (BURGIS *et al.*, 1970, BURGIS, 1973; LEWIS, 1979) they are nevertheless of importance in production.

The first African records of Cladocera (and Copepoda) were by BLANCHARD & RICHARD (1890) from lakes in Algeria. The earliest known record of systematic work on Nigerian freshwater material was by BRADY (1910) on some species of *Cyclops* (Copepoda) and other Entomostraca collected from northern Nigeria. GREEN (1962) in his work on the River Sokoto lists the largest checklist of Cladocera from Nigeria prior to this study. He identified 29 species with one new species, *Alona holdeni*. This species has been since recorded by EGBORGE (1981) from Lake Asejire.

Other contributions include IMEVBORE (1965) in a checklist of the Crustacea and Rotifera in the Eleiyele reservoir identifying 8 species of Cladocera also recorded in this study. EGBORGE (1972) gives a checklist of zooplankton of the River Oshun in which he identified 5 species, all previously recorded by GREEN (1962). EGBORGE (1974) investigated the fortnightly variations in the population density of the Crustacea, Rotifera, Insecta (larvae) and the Foraminifera over a fourteen month period but lays no emphasis on the systematics of various groups. CLARKE (1978) compares the zooplankton of Lake Kainji and the Rivers Niger and Swashi and identifies 4 species of Cladocera also previously identified by GREEN (1962). He observed that Lake Kainji showed much greater diversity of zooplankton than the relatively unstable riverine habitats. ADENIJI (1979) investigates the circadial vertical migration of zooplankton during homothermy and its significance to fish distribution and abundance, while EGBORGE (1979) reports observations on the vertical distribution of the zooplankton in Lake Asejire. EGBORGE & SAGAY (1979) examine the distribution of phytoplankton and zooplankton in some Ibadan freshwater ecosystems without identifying the Cladocera. EGBORGE (1981) discusses the composition, seasonal variation and distribution of zooplankton in Lake Asejire and gives 3 new records of Cladocera for Nigeria — *Daphnia hyalina lacustris, Alona karua and Macrothrix laticornis.*

The work of DUMONT & VAN DE VELDE (1977) on Cladocera and Conchostraca collected by Professor T. MONOD in the valley of the River Niger during December 1972 to January 1973, in Mali, is of great importance to the knowledge of systematics of the Cladocera in Nigeria as a large proportion of the River Niger and a major tributary, River Benue, traverse Nigeria. They identified 35 species of Cladocera of which 26 species wera also seen in this study.

Extensive work on the Cladocera has been done on Lake Chad on the northeastern border of Nigeria, the importance of which cannot be overemphasized. These include the works of GAUTHIER (1939), REY & ST-JEAN (1968), ROBINSON & ROBINSON (1971) and LÉVÈQUE (1979).

From this review of literature, it is noted that very few Nigerian workers give information on the systematics of the Cladocera. This study therefore represents a checklist of Nigerian Cladocera obtained after a systematic study was carried out on the samples used. Illustrations of whole specimens of all the species identified are not given in this paper as definitive identification of some Cladocera can only be made up to genus level with such illustrations. Thereafter, detailed analysis of the valve surface and its posteroventral corner, antennules, antenna, labral plate, first leg and postabdomen must be made for specific and or subspecific identifications.

The 61 species of Cladocera identified from Nigerian zooplankton in this study belong to the families Sididae, Bosminidae, Daphniidae, Moinidae, Macrothricidae and Chydoridae, The families Polyphemidae and Leptodoridae are not represented in tropical freshwater zooplankton, and were not found in this study either.

## MATERIALS AND METHODS

From March 1971 to March 1981, 623 samples were collected from 145 localities in Nigeria from a variety of freshwater habitats and coded as: (a) Lakes; (b) Rivers, streams, deltas, irrigation canals; (c) Ponds; (d) Fish ponds; (e) Pools, ditches temporary habitats, marshes; (c) Dam sites, reservoirs; (g) Habitat type unknown. Sampling localities are shown in Figure 1.

Samples were collected with plankton nets of mesh sizes 10 (157 μ) and 25 (64 μ) and were immediately fixed and preserved in 5% formalin. Sorting and identification of specimens were done with a Wild-Leitz stereo-zoom dissecting microscope. External morphology of Cladocera was examined by placing a specimen on a slide without a cover slip in a drop of glycerine, the viscosity of which made it easier to clean off debris as well as to turn the specimen around without damage. Glycerine also prevented the specimen from drying out. For detailed study of taxonomically important parts of the Cladocera (e.g. antennules, labral plate, antennas, valve reticulation and postabdomen), specimens were dissected with fine tungsten dissecting needles. They were then

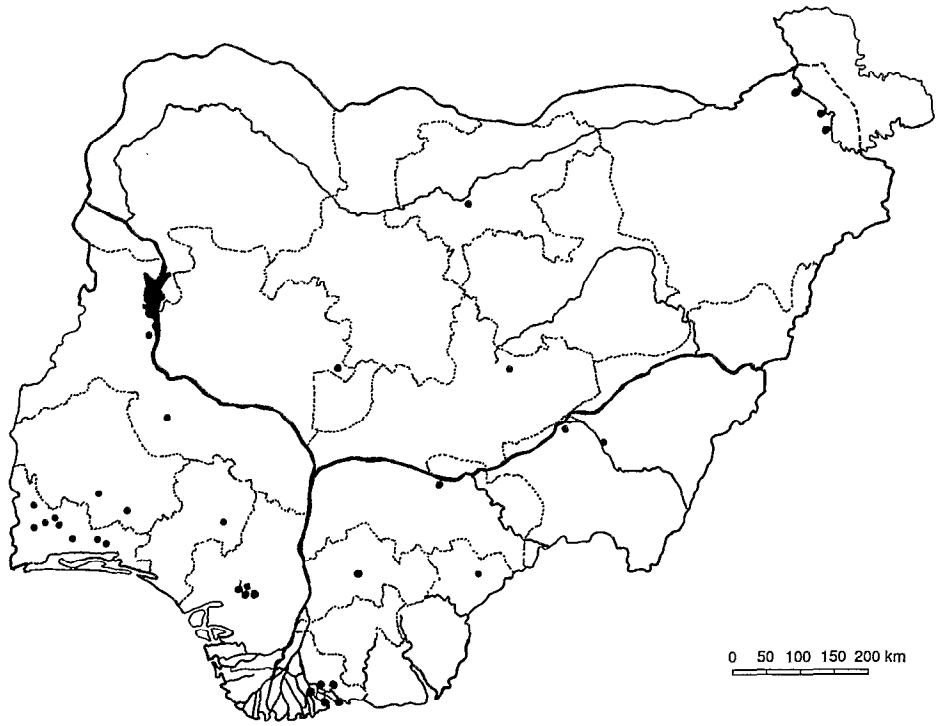


FIG. 1. — Map of Nigeria showing sampling localities. Points may represent more than one locality which are closely situated to each other

*Carte du Nigeria montrant les localités échantillonnées. Les points peuvent représenter plus d'une localité, dans le cas où les localités sont proches l'une de l'autre*

stained with polyvinyl-lactophenol tinted with lignin pink (GRAY & WESS, 1950). Observation of the head shield of the chydorids was often required for species identification and the technique employed was that of MEGARD (1965). The specimen was placed on a depression slide and 2-3 drops of concentrated HCl was added before heating for 3-5 minutes, by which time hydrolysis was complete leaving only the intact exoskeleton. This was then transferred from the acid to water and finally to a small drop of polyvinyl-lactophenol on a glass slide for separation of the head shield using fine tungsten needles.

Illustrations were made with a Leitz camera-lucida system at appropriate magnification. The identifications and description of Cladocera were based on the general works of FRYER (1957), EDMONDSON (1959), FREY (1959, 1980), MANUJLOVA (1964) and FLÖSSNER (1972). GOULDEN (1968) and SMIRNOV (1971) were used for detailed taxonomic work on the families Moinidae and Chydoridae respectively. SMIRNOV (1976) was used for study of the Marothricidae. Papers dealing with African species include RICHARD (1892), HARDING (1957), REY & ST-JEAN (1968, 1969), PROSZYNSKA (1967), LAMOOT (1974), DUMONT & VAN DE VELDE (1977), DUMONT *et al.* (1981) and KOŘINEK (1984).

Comparative material was available in the extensive tropical zooplankton collection of Prof. C. H. FERNANDO of the Department of Biology, University of Waterloo, Canada.

## RESULTS

All the information available to date on the Cladocera of Nigerian freshwaters is summarized in Table I. This includes former descriptions or identifications, habitat types when available from this study, and the sources of the descriptions.

## DISCUSSION

The Cladoceran fauna recorded from Nigeria appears to contain typical tropical as well as

TABLE I

Habitat type : a = lakes ; b = rivers, streams, deltas, irrigation canals ; c = ponds ; d = fishponds ; e = pools, ditches, temporary habitats, marshes ; f = dam sites and reservoirs : g = habitat inconnu

Species list of Nigerian Cladocera

*Type d'habitat : a = lacs ; b = fleuves, deltas, canaux d'irrigation ; c = étangs ; d = viviers ; e = trous d'eau, fossés, habitats temporaires, marais ; f = barrages et réservoirs ; g = habitat inconnu*

*Liste des Cladocères du Nigeria*

| | | |
|---|---|---|
| Family : SIDIDAE Sars, 1865 | | |
| Diaphanosoma excisum Sars, 1885 - | a, b, c, d, e, f, g ; | 1, 2, 3, 4, 5, 6, 7 |
| Diaphanosoma sarsi Richard, 1895* - | a, f, g ; | 7 |
| Pseudosida bidentata Herrick, 1884* - | b, f ; | 7 |
| Pseudosida szalayi Daday, 1898 - | g ; | 2 |
| Family : DAPHNIIDAE Straus, 1820 | | |
| Ceriodaphnia cornuta Sars, 1888 - | a, b, c, d, e, f, g ; | 2, 3, 4, 5, 6, 7 |
| Ceriodaphnia dubia Richard, 1894 - | g ; | 2 |
| Daphnia longispina Müller, 1785 - | e ; | 5, 7 |
| Daphnia hyalina lacustris Sars, 1862 - | g ; | 5 |
| Scapholeberis kingi Sars, 1903* - | a ; | 2, 7 |
| Simocephalus serrulatus Koch, 1841 - | a ; | 2, 7 |
| Simocephalus vetulus Müller, 1776 - | c ; | 1, 3, 7 |
| Family : BOSMINIDAE Sars, 1865 | | |
| Bosmina longirostris Müller, 1785 - | a, b ; | 7 |
| Bosminopsis deitersi Richard, 1895 - | a ; | 2, 4, 5, 6, 7 |
| Family : MOINIDAE Goulden, 1967 | | |
| Moina micrura Kurz, 1874 - | a, b, c, d, e, f, g ; | 4, 5, 6, 7 |
| Moina reticulata Daday, 1905* - | f ; | 7 |
| Moina dubia Richard, 1874 - | g ; | 2, 3 |
| Moinodaphnia macleayi (King, 1853)* - | a, b, c, d, e, f, g ; | 7 |
| Family : MACROTHRICIDAE Baird, 1843 | | |
| Echinisca capensis capensis Sars, 1916* - | a, b ; | 7 |
| Echinisca rosea Liévin, 1848* - | a, f ; | 7 |
| Echinisca triserialis Brady, 1886 - | a, b, f ; | 2, 7 |
| Grimaldina brazzai Richard, 1892 - | f ; | 2, 7 |
| Guernella raphaelis Richard, 1892* - | b, f ; | 7 |
| Ilyocryptus spinifer Herrick, 1882 - | a, f ; | 2, 3, 7 |
| Ilyocryptus verrucosus Daday, 1905** - | a, b ; | 7 |
| Macrothris goeldi Richard, 1897 - | b ; | 2, 5, 7 |
| Macrothrix laticornis (Jurine, 1820) - | g ; | 5 |
| Macrothrix spinosa King, 1853 - | a, b, f, g ; | 7 |
| Family : CHYDORIDAE Stebbing, 1902 | | |
| Sub family : CHYDORINAE Stebbing, 1902 | | |
| Alonella excisa Fischer, 1854 - | a, b, f ; | 2, 7 |
| Chydorus eurynotus Sars, 1901 - | a, f ; | 2, 3, 7 |
| Chydorus parvus Daday, 1898* - | a, b, g ; | 7 |
| Chydorus pubescens Sars, 1901* - | b, f ; | 7 |
| Chydorus reticulatus Daday, 1898** - | b ; | 7 |
| Chydorus sphaericus sphaericus O.F. Müller, 1785* - | a, b, c, e, f ; | 7 |
| Chydorus sp. (formerly venticosus) Daday, 1898 - | b, f ; | 7 |
| Dadaya macrops Daday, 1898* - | a, b, f ; | 7 |
| Disparalona rostrata Koch, 1841* - | a ; | 7 |
| Dunhevedia crassa King, 1853* - | b ; | 7 |
| Dunhevedia serrata Daday, 1898 - | b ; | 3, 7 |
| Ephemeroporus barroisi Richard, 1894 - | a, b, f ; | 2, 7 |
| Pleuroxus aduncus (Jurine, 1820) - | g ; | 2 |
| Pleuroxus hamatus Birge, 1879* - | a, f ; | 7 |
| Pleuroxus laevis Sars, 1862 - | a, f ; | 2, 7 |
| Pleuroxus similis Vavra, 1900* - | b, g ; | 7 |
| Pseudochydorus globosus Baird, 1893 - | a ; | 2, 7 |
| Sub family : ALONINAE Frey, 1967 | | |
| Acroperus harpae (Baird, 1835) - | g ; | 2 |
| Alona affinis Leydig, 1860 - | a ; | 2, 7 |
| Alona cambouei Guerne and Richard, 1893* - | a ; | |
| Alona costata Sars, 1862 - | a, b ; | 7 |
| Alona davidi Richard, 1895 - | b ; | 2, 5, 7 |
| Alona eximia Kiser, 1948 - | b ; | 2, 7 |
| Alona guttata Sars, 1862* - | a, f ; | 7 |
| Alona holdeni Green, 1962 - | g ; | 2, 5 |
| Alona harua King, 1853 - | f ; | 5, 7 |
| Alona monacantha Sars, 1901* - | a, b, f ; | 7 |
| Alona quadrangularis O.F. Müller, 1785* - | a ; | 7 |
| Alona rectangula rectangula Sars, 1862* - | a, b ; | 7 |
| Alona rectangula serrata Daday, 1908* - | b, c ; | 7 |
| Alona verrucosa Sars, 1901 - | f ; | 2, 5, 7 |
| Camptocercus lilljeborgi dadayi Schoedler, 1862** - | a ; | 7 |
| Camptocercus rectirostris Schoedler, 1862 - | g ; | 2, 7 |
| Euryalona orientalis Daday, 1898 - | a, f ; | 2, 7 |
| Graptoleberis testudinaria Fischer, 1851 - | a ; | 2, 7 |
| Indialona globulosa insulcata Daday, 1898 - | a ; | 2, 5, 7 |
| Kurzia longirostris Daday, 1898 - | a, b, f ; | 2, 4, 5, 7 |
| Leydigia acanthocercoides Fischer, 1854* - | a, b ; | 7 |
| Leydigia australis Sars, 1885* - | a ; | 7 |
| Leydigia ciliata Gauthier, 1939 - | a ; | 2, 7 |
| Leydigia leydigi Schoedler, 1863** - | a ; | 7 |
| Leydigia macrodonta macrodonta Sars, 1916* - | a ; | 7 |
| Oxyurella singalensis Daday, 1898 - | a ; | 7 |
| Oxyurella ciliata Bergamin, 1939* - | a ; | 7 |

Reference : 1 = Brady (1910) ; 2 = Green (1962) ; 3 = Imevbore (1965) ; 4 = Egborge (1972) ; 5 = Egborge (1981) ; 6 = Clarke (1978) ; 7 = this study. * = new records for Nigeria ; ** = new records for Africa.

*Références : de 1 à 6, voir ci-dessus. 7 : présente étude. * = espèce nouvelle pour le Nigeria ; ** = espèce nouvelle pour l'Afrique.*

cosmopolitan species. It is marked by the total absence of the families Polyphemidae, Leptodoriade and Holopedidae. A total of 61 cladoceran species, of which 32 are new records for Nigeria and 4 new records for Africa, were identified in this study. This is compared with records of previous Nigerian workers in Table I and represents the largest number of taxa recorded from Nigeria. The total number recorded falls within the expected range of 40-75 species in the tropics contrasting with the range of 90-100 species in a temperate area (FERNANDO, 1980a).

The three commonest limnetic cladocera of Nigeria are *Diaphanosoma excisum, Ceriodaphnia cornuta*, and *Moina micrura*, all of which are eurytopic species and occur in all 7 habitat types (Table I). The occurrence of these species along with *Grimaldina brazzai, Ephemeroporus barroisi, Chydorus eurynotus, Dadaya macrops, Indialona globulosa* and *Euryalona orientalis* are indicative of a typical tropical species assemblage (FERNANDO, 1980a, b). These species are also characteristic of the South East Asian faunal composition. The record of *Ceriodaphnia rigaudi* by EGBORGE (1981) is actually that of the seasonal cyclomorph of *Ceriodaphnia cornuta* brought about by predation pressure (ZARET, 1972).

Lakes were the most extensively sampled habitat and had the most diverse fauna, with a total of 44 species, probably because of their stability in addition to extensive sampling. Rivers and streams yielded 31 species although extensively sampled. This relatively high number could result from the slower moving regions of such rivers and streams, or from the interconnection of lakes and ponds with such water courses. This is evidenced by the occurrence of 28 species of Cladocera (GREEN, 1962) in the River Sokoto where samples were taken from the main channel of the river and a pool which became isolated from the river during the dry season.

Ponds were not well represented and hence their low species diversity is to be expected. Temporary habitats contained 28 species, probably developed from dried resistant eggs (ephippia). It is interesting that males of *Ilyocryptus spinifer* were recorded from a temporary pool at Eku-kokori (JEJE, *in prep.*). Temporary pools may undergo rapid and wide temperature fluctuations which may trigger this development of males.

This study reveals close faunal links between Africa and South America, in addition to tropical Asia, and includes a few records for Africa of species hitherto known only from South America. Prior to this study, *Ilyocryptus verrucosus* had been reported only from Paraguay (DADAY, 1905; VILLAGRA DE GAMUNDI, 1984; JEJE, *in prep.*). This species is characterized by the 2-segmented antennules with three groups of setae along the anterior margin, 4-6 long lateral denticles on the postabdomen and 24-26 short anal teeth. The ventral margin is not broadly rounded, with a series of sparsely feathered setae, decreasing in size in the dorsal direction, each, beginning from mid-ventral region with single, thick basal spine (fig. 2-7). Similarly, *Moina reticulata* also originally reported from Paraguay (DADAY, 1905) and recorded from the Ivory Coast, West Africa (LAMOOT, 1974) and from India (FERNANDO & KANDURU, 1984), was identified in this study. It is characterised by the rounded body, distinctly reticulated carapace; slight supraocular depression on head; small ocellus, and postabdomen with triangular, backwardly projecting fleshy fold behind the two feathered, natatorial setae. Another species, *Camptocerous lilljeborgi dadayi* Stingelin (1913) had prior to this study been recorded only once from Corrientes (Argentina) (SMIRNOV, 1971). The posterior ventral corner of the valve is rounded with a row of minute denticles; postabdomen very long, 0,85 times as long as body, narrow, tapering distally; claw with 3 spines on the concave margin, (fig. 22-25).

In addition, *Chydorus reticulatus* (fig. 8-14) is reported from Africa for the first time. It is identified by the strongly reticulated valves with hexagonal markings; distinct posteriordorsal valve corner; rounded ventral margin without denticles and rounded labral plate. The head shield is strongly reticulated while the postabdomen possesses an indistinct post-anal corner with 7-10 anal denticles on the dorsal margin, which are continuous to the preanal corner with a series of spinules. Similarly, *Leydigia leydigi* (fig. 15-21) previously recorded from the Holoarctic and neotropical regions, Sumatra, Australia and Europe USSR (SMIRNOV, 1971) is also recorded from Africa for the first time. Its characteristic features include the absence of reticulation or lines on valve surface; posterior ventral valve margin rounded without denticles; labral plate with undulating surface with setae of varying form; postabdominal claw with a small spine and lateral seta in groups of 10-12, well developed, with distal seta largest in each group.

The record of *Leydigia macrodonta macrodonta* represents its second record from Africa since SARS (1916) (JEJE, *in prep.*). Its subspecies *Leydigia macrodonta louisi* has been reported from Kenya (JENKIN, 1934). Cladoceran subspecies are distinguished inter alia by differences in the form and armature of the postabdomen, the length of the antennules in relation to the apex of the rostrum.

*Daphnia* species are fewer (rare) in the tropics (FERNANDO, 1980a, b). Only *Daphnia longispina* was

PLATE 1

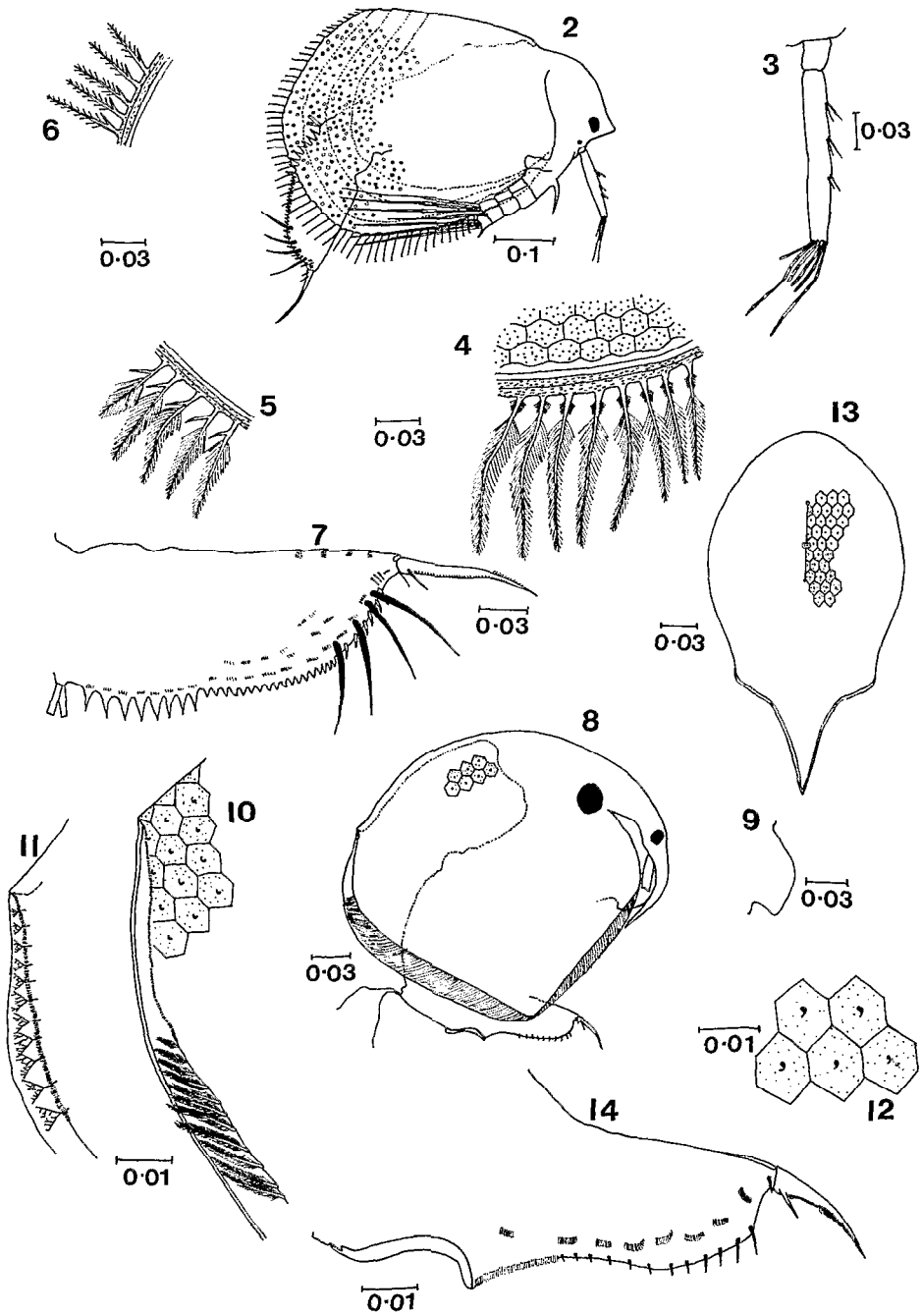


FIG. 2-7. — *Ilyocryptus verrucosus*, female : 2 = parthenogenetic female; 3 = antennule; 4 = Setae along the ventral valve margin; 5 = setae along the posterior ventral valve margin; 6 = setae along the posterior corner of the valve margin; 7 = postabdomen

Ilyocryptus verrucosus, *femelle : 2 = femelle parthénogénétique; 3 = Antennule; 4 = soies le long de la marge de la valve ventrale; 5 = soies le long de la marge de la valve ventrale postérieure; 6 = soies le long de l'angle postérieur de la marge de la valve; 7 = Postabdomen*

FIG. 8-14. — *Chydorus reticulatus*, female : 8 = parthenogenetic female; 9 = labral plate; 10 = posterior ventral margin of the valve; 11 = upper posterior dorsal margin of the valve; 12 = valve reticulation; 13 = head shield; 14 = postabdomen

Chydorus reticulatus, *femelle : 8 = femelle parthénogénétique; 9 = lèvre supérieure; 10 = marge ventrale postérieure de la valve; 11 = marge dorsale postéro-supérieure de la valve; 12 = réticulation de la valve; 13 = casque; 14 = postabdomen*

PLATE 2

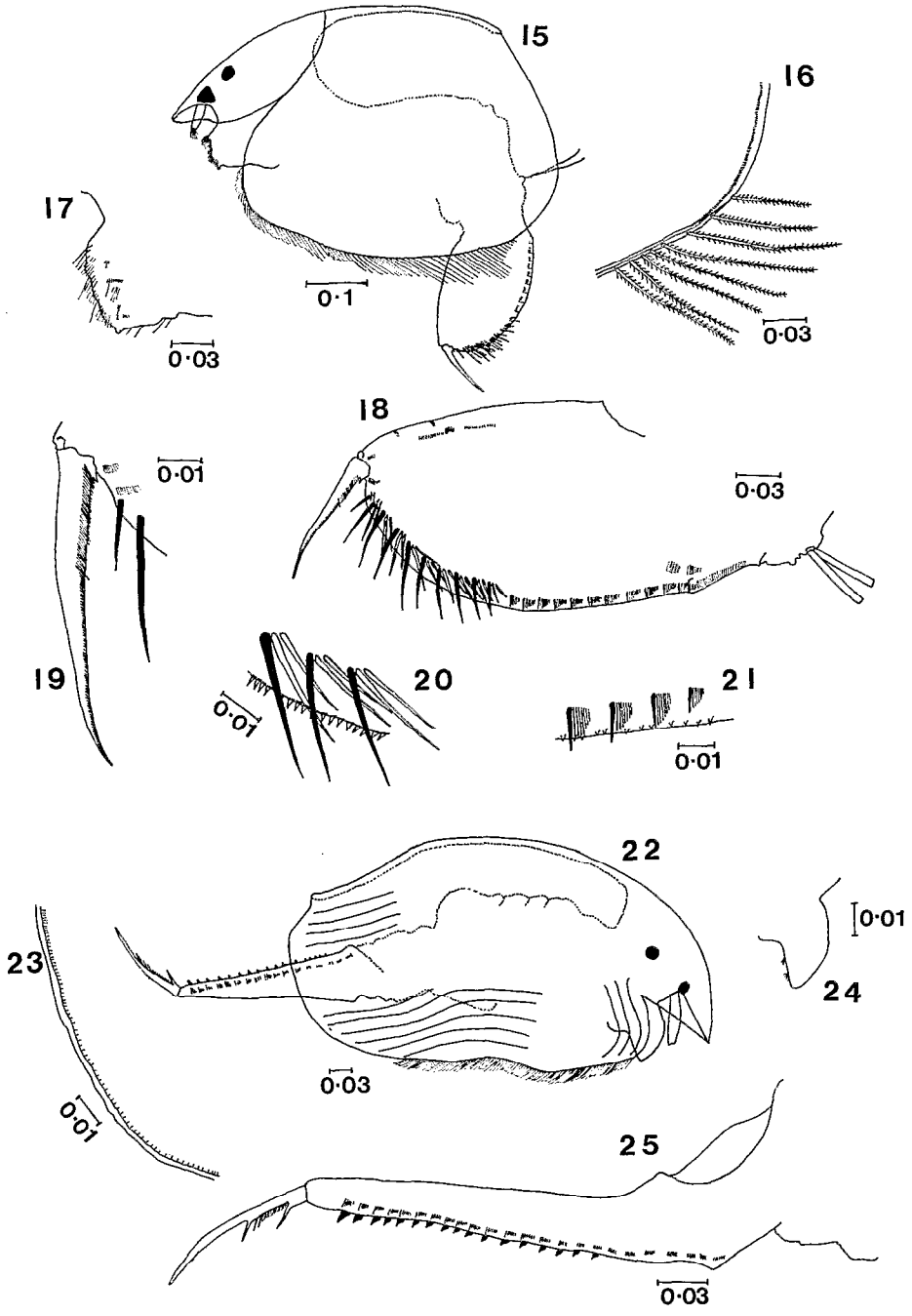


FIG. 15-21. — *Leydigia leydigi*, female : 15 = parthenogenetic female; 16 = posterior ventral margin of the valve; 17 = labral plate; 18-21 = postabdomen

Leydigia leydigi, *femelle : 15 = femelle parthénogénélique; 16 = marge ventrale postérieure de la valve; 17 = lèvre supérieure; 18-21 = postabdomen*

FIG. 22-25. — *Camptocercus lilljeborgi dadayi*, female : 22 = parthenogenetic female; 23 = posterior ventral margin of the valve; 24 = labral plate; 25 = postabdomen

Camptocercus lilljéborgi dadayi, *femelle : 22 = femelle parthénogénélique; 23 = marge ventrale postérieure de la valve; 24 = la lèvre supérieure; 25 = postabdomen*

identified in this study. 25 species are considered as being rare (limited to one or two habitat types; Table I). This rarity may be due in some casesto lack of intensive or inefficient sampling techniques. However, some species are extremely short-lived and with high tropical temperatures are unlikely to be collected unless intensive sampling occurs throughout the year.

Little is also known about the competitive interactions among species that allow coexistence in one water body and exclusion in another. As knowledge on the physiology and ecology of individual species is acquired, these interactions will be better understood and will give a more valuable insight into the composition and distribution of Nigerian zooplankton.

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