ZOOLOGISCHE VERHANDELINGEN

UITGEGEVEN DOOR HET RIJKSMUSEUM VAN NATUURLIJKE HISTORIE TE LEIDEN

(MINISTERIE VAN WELZIJN, VOLKSGEZONDHEID EN CULTUUR)

No. 238

A TAXONOMIC REVISION OF THE EUROPEAN, MEDITERRANEAN AND NW. AFRICAN SPECIES GENERALLY PLACED IN *SPHAEROMA* BOSC, 1802 (ISOPODA: FLABELLIFERA: SPHAEROMATIDAE)

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LEIDEN
12 juni 1987
ISSN 0024-1652

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Jacobs, B.J.M.: A taxonomic revision of the European, Mediterranean and NW. African species generally placed in *Sphaeroma* Bosc, 1802 (Isopoda: Flabellifera: Sphaeromatidae).
Zool. Verh. Leiden 238, 12-vi-1987: 1-71, figs. 1-21, tab. 1. — ISSN 0024-1652.
Key words: Isopoda; Flabellifera; Sphaeromatidae; *Sphaeroma*; *Lekanesphaera*; *Exosphaeroma*; Verhoeff; keys; species; new species.

The European, Mediterranean and NW. African species usually assigned to the genus *Sphaeroma* are revised. The genus *Sphaeroma* as understood so far has been divided into two genera: *Sphaeroma* s.s. and *Lekanesphaera* Verhoeff, 1943. Keys to the three species of *Sphaeroma* and the thirteen species of *Lekanesphaera* are given. Two new species are described viz., *L. glabella* (from Madeira) and *L. terceirae* (from Terceira, Azores) and the synonymy of known species is provided.

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INTRODUCTION

The sphaeromatid isopod fauna of Europe, the Mediterranean and the NW. coast of Africa has been studied intensively by zoologists. These isopods, commonly found as an integral part of the littoral zone, are suitable for a great variety of studies, e.g. in the fields of ecology and biochemistry. Their rich polymorphism especially has recently been given much attention, mainly by French and Italian zoologists.

The French school of Bocquet et al., during studies of the polychromatism of *Sphaeroma serratum* (Fabr., 1787), came across several undescribed species. Since 1960 no less than six new species have been described by them from the Eastern Atlantic and the Mediterranean.

In several other instances the status of previously established Sphaeromatidae was reviewed, especially by the Italian school, who, e.g., identified most of the Mediterranean species. Verhoeff's rather radical revision with descriptions of many new species has, peculiarly, been ignored by most later workers in the field. Only Argano did some study on one of Verhoeff's new species, while Forsman (1952) synonymized *Europosphaera* with *Sphaeroma*.

The present paper is an attempt to review the systematic status of the species that have so far been assigned to the genus *Sphaeroma* and to decide their status, both taxonomically and nomenclaturally. An effort has been made to take all previous systematic studies into account, also those, like Verhoeff's papers, that have usually been ignored by modern zoologists.

It proved necessary in this study to reinstate the genus *Lekanesphaera* Verhoeff, 1943 and to describe two new species.

To clarify the position of the genus *Lekanesphaera* Verhoeff, 1943 a detailed discussion of the genera *Sphaeroma* Bosc, 1802 and *Exosphaeroma* Stebbing, 1900 will be given, while all the species of *Sphaeroma* and *Lekanesphaera* from the area studied (which until now have been considered *Sphaeroma*) will be described according to their most characteristic differences.

The specimens studied come from a number of sources. Most form part of

the collection of the Rijksmuseum van Natuurlijke Historie, Leiden, the Netherlands. Dr. M. Băceşcu, Muzeul de Historie Naturale, Bucarest, Rumania, donated Black Sea Material and Dr. R. Argano, provided me with specimens from Italy. Dr. L. Tiefenbacher, Zoologische Sammlung des Bayerische Staates, Munich, kindly lent the sphaeromatid type material of the K.W. Verhoeff collection. Important material discussed by Monod (1931) was received on loan from the Muséum National d'Histoire Naturelle, Paris through the kind offices of Prof. J. Forest. I was permitted to study the collection of the British Museum (Natural History), London, for which I want to thank Dr. R.J. Lincoln. Dr. D.M. Holdich (University of Nottingham, England) was kind enough to show me his material, which was a great help to me.

All the material studied that was not borrowed from other institutions now forms part of the collection of the Leiden Museum. Part of the specimens collected by myself are in my private collection.

I am most grateful to Drs. R. Argano, M. Băceşcu, J. Forest, D.M. Holdich, R.J. Lincoln and L. Tiefenbacher for the essential help they gave me, by entrusting me with the study of important material. Most of all I want to thank Prof. L.B. Holthuis for his continuous support and interest, and Dr. K. Harrison who read my manuscript very thoroughly and gave me many recommendations.

Alphabetical list of the depositories of the material

BMNH	British Museum (Natural History), London, U.K.
MNP	Muséum National d'Histoire Naturelle, Paris, France
PCJ	Private Collection Jacobs
RMNH	Rijksmuseum van Natuurlijke Historie, Leiden, the Netherlands
UN	University of Nottingham, U.K.
ZSBS	Zoologische Sammlung des Bayerischen Staates, Munich, W. Germany

SYSTEMATICS

Subfamily Sphaeromatinae Latreille, 1825

The three genera treated in the present paper, *Sphaeroma, Lekanesphaera* and *Exosphaeroma,* all belong to the subfamily Sphaeromatinae Latreille,

1825, one of the five subfamilies of the family Sphaeromatidae (Nom. Correct. Dahl, 1916). This subfamily was previously called Hemibranchiatae (Hansen, 1905) but as pointed out by Iverson (1982) this name is unavailable as it is not based on a genus (no genus *Hemibranchiatus, -a, -um* exists). As it contains the genus *Sphaeroma,* this is the nominotypical subfamily and it must bear the name Sphaeromatinae. Iverson was mistaken however in citing Milne Edwards (1840) as the author of the family (and subfamily) name. The first use of the family name Sphaeromatidae that I can find, albeit in the form Sphaeromides, is by Latreille (1825: 294), who used both the vernacular and scientific name: "Troisième famille Sphéromides, Sphaeromides." This antedates Milne Edwards' use by 15 years.

The history of the three genera treated in this paper is rather confused. Until 1900 all the species were placed in the genus *Sphaeroma.* In 1900 Stebbing split off the genus *Exosphaeroma* (with *Sphaeroma gigas* Leach, 1818 as the type). Ever since there has been a discussion as to the extent of the two genera and as to their differences. The only character that Stebbing (1900: 553) used to characterize *Exosphaeroma* was "having the penultimate and the two preceding joints of the maxillipeds lobed on the inner side . . .". However, intermediate forms between the typical *Exosphaeroma* and the typical *Sphaeroma* were found in Europe. Monod (1931b) gave an excellent account of the situation and divided the *Sphaeroma*-group into four sections considering the lobes of the palp segments: Section I is the typical *Sphaeroma* and contains *S. serratum.* Section IV is the typical *Exosphaeroma* with *E. gigas.* Sections II and III are more or less intermediate, but were assigned by Monod to *Sphaeroma* because of some other distinct characters. This was necessary, because some authors, like Giltay (1927) had already considered the species of group III (containing *S. hookeri* and *S. rugicauda*) to belong to *Exosphaeroma,* since the maxillipeds showed some similarity to those of *Exosphaeroma.*

Monod's redefinition of *Exosphaeroma,* however, was only accepted by a few authors, among them Hurley & Jansen (1977), but, especially in older literature dealing with non-European species, there was still confusion. The redefinition of *Exosphaeroma* did not help to clarify the situation for the European species as all of these (Monod's sections I, II and III) remained in *Sphaeroma,* which even after Monod's treatment was still a rather heterogeneous group.

Verhoeff, who had made a great name as a specialist in Oniscidea (and Myriapoda), quite late in his career started to work in the field of sphaeromatid systematics. He (Verhoeff, 1943a, 1943b, 1944a, 1944b, 1949) created numerous genera and species. His sphaeromatid papers, most of

which were published during World War II, did not get much notice and were generally overlooked by later sphaeromatid workers, whether by ignorance or intentionally is difficult to make out. Anyhow, the critical evaluation that they deserved has so far not been given to them, and I have tried here to ascertain the status of the species and genera of Sphaeromatinae that Verhoeff described, and the nomenclatural implications thereof.

On the generic level I fully agree with Monod's treatment and definition of *Exosphaeroma*. In my opinion, however, his sections I, II, III belong to two genera. Section I, as Monod also pointed out, is the true *Sphaeroma*. The species of section II and III are assigned by me to a separate genus for which the name *Lekanesphaera* Verhoeff, 1943 is available. This new genus is more or less intermediate between *Exosphaeroma* and *Sphaeroma* in the character of the lobes on the maxilliped used by previous authors, but other differences make the distinction between the three genera clearer. The generic status of all examined species could be ascertained, but several species from outside the NE. Atlantic region, which are referred to *Sphaeroma* or *Exosphaeroma*, should be examined to ensure to which genus they do belong. *Sphaeroma intermedium* (Baker, 1926) from Australia, almost certainly belongs to *Lekanesphaera*. It is possible also that other species of *Sphaeroma* from outside the area considered in this paper belong to *Lekanesphaera*. This however can only be ascertained by a direct examination. Species studied belonging to *Sphaeroma* are: *S. annandalei* Stebbing, *S. quadridentatum* Say, *S. quoyanum* Milne Edwards, *S. terebrans* Bate.

Although *Exosphaeroma* does not occur in the area under consideration (it is found in most parts of the world) its status is so closely interwoven with that of the other two genera that all three have to be considered here.

METHODS AND TERMINOLOGY

I have tried to straighten out the status and nomenclature of the various species, if possible by examination of type material. Of some species no material was available, although repeated efforts have been made to obtain this. In such cases I had to rely solely on the literature. Of most species it has been tried to provide a complete list of references, of the most common species (like *Lekanesphaera hookeri* and *L. rugicauda*) only a restricted list is given, omitting most purely local records.

In the list of examined material the following abbreviations are used: Leg. (Legit) — collected by; Coll. — collection; Exc. — excursion.

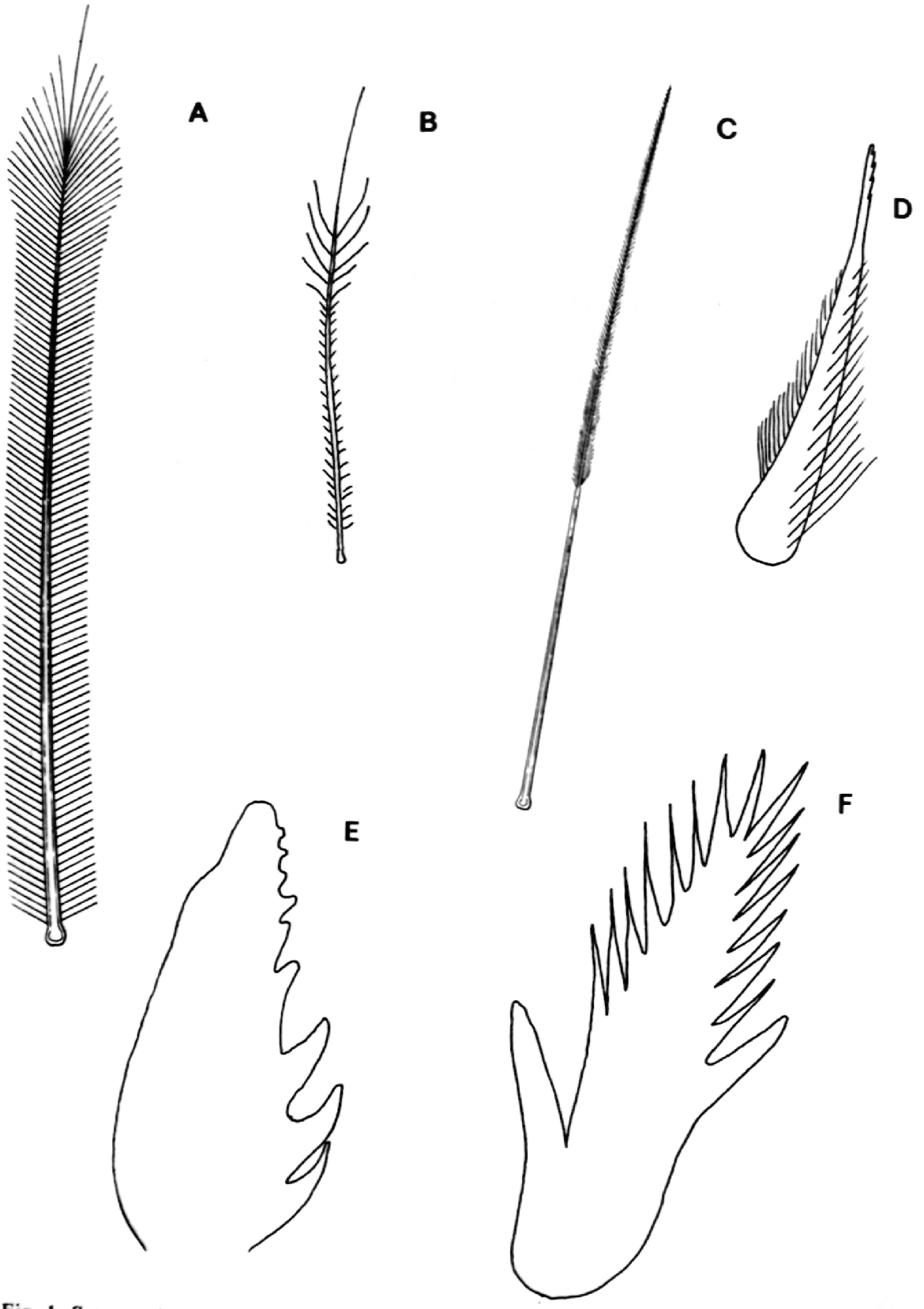

Fig. 1. Setae and spines. a, plumose seta in *S. serratum* (F.) (Pl) after Lejuez (1966); b, semi-plumose seta in *L. monodi* (Arcangeli) (Pl); c, smooth seta in *L. levii* (Argano & Ponticelli) (Pl) after Lejuez (1966); d, robust, plumose seta with swollen base in *S. serratum* (F.) (endite of Mxp); e, comb-shaped spine in *L. hookeri* (Leach) (Pl); f, serrated spine in *L. hookeri* (Leach) (Pl).

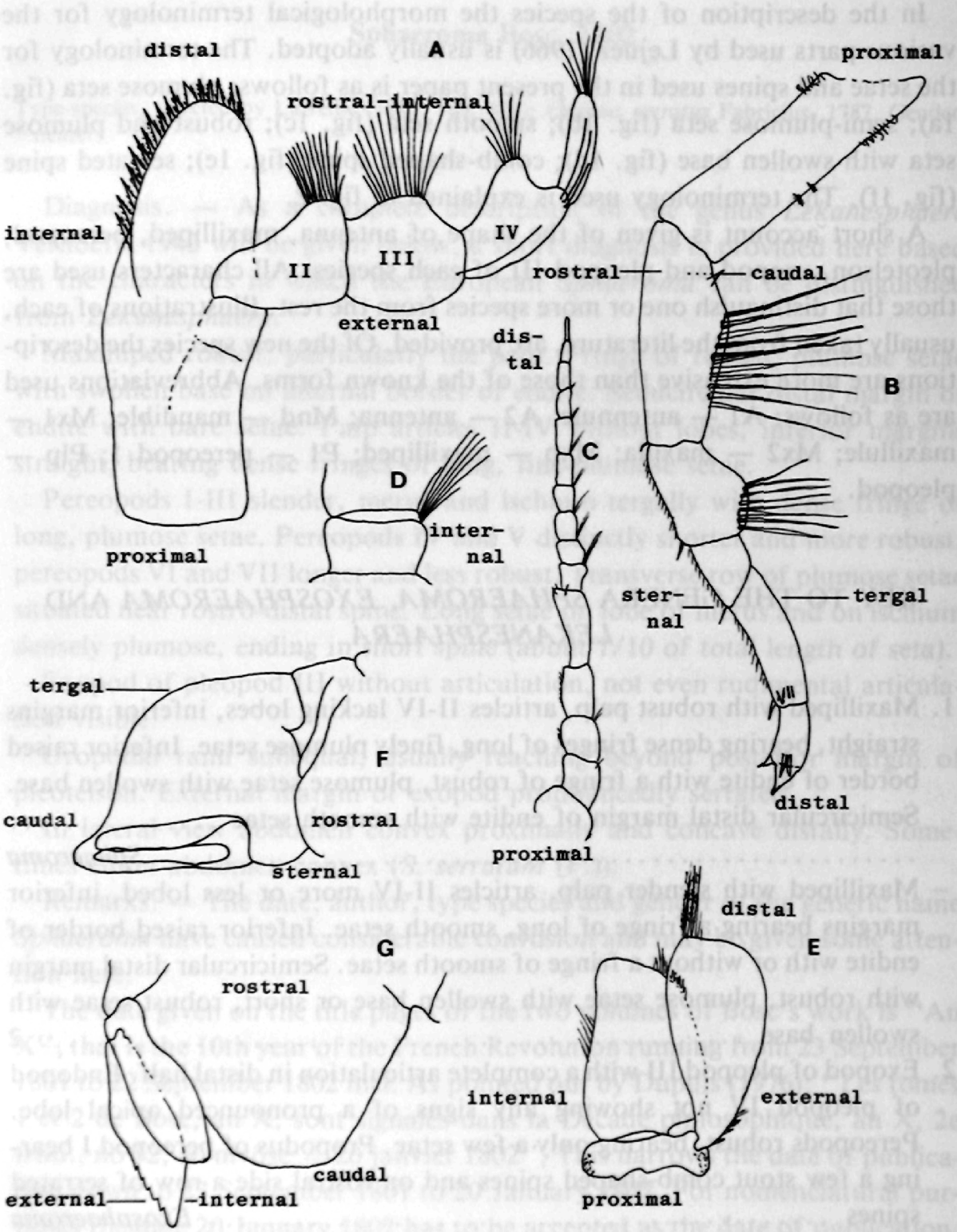

Fig. 2. Terminology. a, Mxp; b, Pl; c, A2; d, detail A2, e, Plp III; f, pleotelson in lateral view; g, pleotelson in tergal view.

In the description of the species the morphological terminology for the various parts used by Lejuez (1966) is usually adopted. The terminology for the setae and spines used in the present paper is as follows: plumose seta (fig. 1a); semi-plumose seta (fig. 1b); smooth seta (fig. 1c); robust and plumose seta with swollen base (fig. 1d); comb-shaped spine (fig. 1e); serrated spine (fig. 1f). The terminology used is explained in fig. 2.

A short account is given of the shape of antenna, maxilliped, pereopod, pleotelson, uropod and pleopod III of each species. All characters used are those that distinguish one or more species from the rest. Illustrations of each, usually taken from the literature, are provided. Of the new species the descriptions are more extensive than those of the known forms. Abbreviations used are as follows: A1 — antennule; A2 — antenna; Mnd — mandible; Mx1 — maxillule; Mx2 — maxilla; Mxp — maxilliped; P1 — pereopod 1; Plp — pleopod.

KEY TO THE GENERA *SPHAEROMA, EXOSPHAEROMA* AND *LEKANESPHAERA*

1. Maxilliped with robust palp, articles II-IV lacking lobes, inferior margins straight, bearing dense fringes of long, finely plumose setae. Inferior raised border of endite with a fringe of robust, plumose setae with swollen base. Semicircular distal margin of endite with smooth setae ..... *Sphaeroma*
– Maxilliped with slender palp, articles II-IV more or less lobed, inferior margins bearing a fringe of long, smooth setae. Inferior raised border of endite with or without a fringe of smooth setae. Semicircular distal margin with robust, plumose setae with swollen base or short, robust setae with swollen base 2
2. Exopod of pleopod III with a complete articulation in distal half. Endopod of pleopod IV not showing any signs of a pronounced apical lobe. Pereopods robust, bearing only a few setae. Propodus of pereopod I bearing a few stout comb-shaped spines and on rostral side a row of serrated spines ..... *Exosphaeroma*
– Exopod of pleopod III not articulated or sometimes with a rudimentary articulation in distal half. Endopod of pleopod IV showing a pronounced apical lobe. Pereopods slender, bearing tergally a more or less distinct fringe of smooth or semi-plumose setae, especially on merus and ischium. Propodus of pereopod I bearing one comb-shaped infero-distal spine and one serrated spine on rostrodistal region. Sometimes a transverse row of smooth setae being inserted next to serrated spine ..... *Lekanesphaera*

Sphaeroma Bosc, 1802

Type-species, selected by Latreille (1810: 109, 423): *Oniscus serratus* Fabricius, 1787. Gender: neuter.

Diagnosis. — As a complete description of the genus *Lekanesphaera* Verhoeff, 1943 will be given below, a short diagnosis is provided here based on the characters in which the European *Sphaeroma* can be distinguished from *Lekanesphaera*.

Maxilliped robust, particularly the palp. Fringe of robust, plumose setae with swollen base on internal border of endite. Semicircular distal margin of endite with bare setae. Palp articles II-IV without lobes, inferior margins straight, bearing dense fringes of long, fine-plumose setae.

Pereopods I-III slender, merus and ischium tergally with dense fringe of long, plumose setae. Pereopods IV and V distinctly shorter and more robust, pereopods VI and VII longer and less robust. Transverse row of plumose setae situated near rostro-distal spine. Long setae on lobe of merus and on ischium densely plumose, ending in short spine (about 1/10 of total length of seta).

Exopod of pleopod III without articulation, not even rudimental articulation visible.

Uropodal rami subequal, usually reaching beyond posterior margin of pleotelson. External margin of exopod pronouncedly serrated.

In lateral view abdomen convex proximally and concave distally. Sometimes entire abdomen convex (*S. serratum* (F.)).

Remarks. — The date, author, type species and gender of the generic name *Sphaeroma* have caused considerable confusion and may be given some attention here.

The date given on the title pages of the two volumes of Bosc's work is "An X", that is the 10th year of the French Revolution running from 23 September 1801 to 22 September 1802 incl. As pointed out by Dupuis (1976): "Les tomes 1 et 2 de Bosc, an X, sont signalés dans la Décade philosophique, an X, 2e trim., no 12, 30 nivôse = 20 janvier 1802". This narrows the date of publication down to 23 September 1801 to 20 January 1802. For nomenclatural purposes the date 20 January 1802 has to be accepted as the date of publication, until it can be further narrowed down.

The author of the genus *Sphaeroma* is often cited as Latreille (even by Bosc (1802) himself). Bosc (1802: 48) makes clear that he has seen the manuscript of Latreille for his "Histoire Naturelle générale et particulière des Crustacés et des Insectes" and that he was permitted by Latreille to use it. In both vol. 1, p. 82 and vol. 2, p. 182 Bosc dealt with *Sphaeroma*. He gave an account of it in his own words and added observations made by himself. It is clear that

Bosc did not just merely quote a text by Latreille, and that there is no reason to cite the author of *Sphaeroma* as "Latreille in Bosc" as in this case Latreille is not "alone responsible both for the name and the conditions that make it available" (Int. Code Zool. Nomencl., Art. 50). In contrast to the belief of Harrison and Holdich (1984), vol. 3 of Latreille's work (containing his first mention of *Sphaeroma* on p. 41) was published later than Bosc's work. Dupuis (1976: 4) showed that vol. 3 of Latreille's book was published after April 1802, as that date is mentioned on p. 369 of the text, and before 6 November 1802 as it was "signalé dès les numéro du 15 brumaire an XI = 6 novembre 1802 du Journ. typogr. et bibliogr.". All this shows that the author of *Sphaeroma* has to be cited as Bosc, 1802.

The type species was also the subject of some recent discussion. In the original description of *Sphaeroma*, Bosc (1802) mentioned the following species: in vol. 1, p. 82 *Oniscus globator* Pallas, 1772; in vol. 2, p. 186 *Oniscus assimilis* Linnaeus, 1767; *Oniscus serratus* Fabricius, 1787; *Sphaeroma cinerea* Bosc, 1802 and *Oniscus conglobator* Pallas, 1766. *Oniscus assimilis* L. 1767, was based on specimens of *Ligia oceanica* (L., 1758) which had lost the uropods. *Oniscus conglobator* Pallas, 1766 (for which *Oniscus globator* Pallas, 1772 is a later name) is a species dubia, probably *Lekanesphaera hookeri* (Leach, 1814) or *L. rugicauda* (Leach, 1814). *Sphaeroma cinerea* Bosc, 1802 is a new name for *Oniscus assimilis, Oniscus serratus* and *Oniscus conglobator* and thus a junior synonym of one of these. As the lectotype of *Sphaeroma cinerea* I now select the holotype of *Oniscus serratus* Fabricius, 1787. The two names thereby definitely become objective synonyms. The first type selection for the genus *Sphaeroma* is by Latreille (1810) where the genus *Sphaeroma* is mentioned on pp. 109 and 423: *Cymothoa serrata* (Fabr.) (= *Oniscus serratus* Fabr., 1787) is indicated on p. 423 as the type species of *Sphaeroma*. This type selection is entirely valid.

The gender of *Sphaeroma* has variously been treated as neuter and feminine. The derivation of the name *Sphaeroma* is not provided by Bosc or Latreille. Dr. C.W. Wright, Classical Adviser to the International Commission on Zoological Nomenclature, in an answer to a request for information on this point made by Dr. L.B. Holthuis pointed out that "*Sphaeroma* is a greek word, third declension, neuter". According to him it appears in Liddell & Scott's Lexicon. He also stated that "Even if it were not known as a greek word, *Sphaeroma* would not be treated as an arbitrary combination of letters. The ending -oma is a standard greek suffix producing a substantive meaning "anything made so-and-so; thus *Sphaeroma* = 'anything made spherical or globular.' "

In relation to the family name Dr. Wright noticed: "the formation of the

family name from *Sphaeroma* would in any case by governed by Article 29(a); the greek suffix -oma follows the example of -soma, and the family name must be Sphaeromatidae." Dahl (1916: 28) as well as Hurley & Jansen (1977: 6) had already pointed out that Sphaeromatidae is the correct spelling for the family name.

Key to the European, Mediterranean and NW. African species of *Sphaeroma* Bosc, 1802

1. Pleon dorsally smooth. Pleotelson of both male and female regularly convex in lateral view; margin of apex straight and smooth ..... *serratum*
– Dorsal surface of pleotelson granulose, with longitudinal rows of prominent tubercles at either side of the midline. In lateral view pleotelson subapically concave; margin of apex more or less straight, slightly to prominently crenated 2
2. Dorsal surface of pleotelson with four longitudinal rows of prominent tubercles, two on either side of midline caudally converging. Margin apex of telson slightly crenated in older specimens (practically smooth in younger ones). Uropods without tergal tubercles, exopod with four or five large, triangular, external teeth ..... *venustissimum*
– Dorsal surface of pleotelson with four long, parallel and longitudinal rows of prominent tubercles, two on either side of midline. Margin of apex of telson distinctly crenated. Endopod of uropod dorsally with prominent, median tubercles. Exopod with five to seven large, triangular, external teeth ..... *walkeri*

Sphaeroma serratum (Fabricius, 1787)
(fig. 3)

Oniscus serratus Fabr., 1787: 242.
Cymothoa serrata- Fabr., 1793: 510; Leach, 1814: 405; Leach, 1815: 368.
Sphaeroma cinerea Bosc, 1802: 186; Latreille, 1802: 16; Latreille, 1806: 65; Risso, 1816: 146; Audouin, 1826: 95; Bosc (éd. Desmarest), 1830: 151.
Sphaeroma siciliense White, 1847: 102; Hansen, 1905: 116.
Sphaeroma conglobator Pallas, 1766; Stebbing, 1910: 219-220.
Sphaeroma podicipites (part.) Monod, 1913b: 26, fig. 45 G, H (only specimen from Iles Chausey).
Sphaeroma adriaticum Verhoeff, 1943a: 171; Verhoeff, 1949: 406 – 407, 409.
Sphaeroma ischianum Verhoeff, 1943a: 173 – 174; Verhoeff, 1943b: 279-280; Verhoeff, 1944a: 111; Verhoeff, 1944b: 156; Verhoeff, 1949: 406-407, 409.
Sphaeroma aenariense Verhoeff, 1943a: 173 – 174.

Sphaeroma capreae Verhoeff, 1943b: 277-279; Verhoeff, 1944a: 111; Verhoeff, 1944b: 156; Verhoeff, 1949: 406, 410-413.
Sphaeroma foveolatum Verhoeff, 1943b: 280.
Sphaeroma aegaeum Verhoeff, 1949: 405, 407-408.
Sphaeroma dalmaticum Verhoeff, 1949: 406, 408-409.
Sphaeroma illyricum Verhoeff, 1949: 406, 408, 410.

Material examined. — RMNH: Israel: Habonim shore (littoral, leg. H. Fishelson, June 1982, many specimens). Romania: Constantza (littoral, leg. T. Negoescu, July 1980, many specimens). Greece: Paranisla, Gulf of Arta (coast, leg. W.J. Wolff & M. Loosjes, June 1964, 10 specimens); Salaora, Gulf of Arta (rocky shore, sea-weed, depth 0-1,5 m., leg W.J. Wolff & M. Loosjes, June 1964, 12 specimens): Athens, Gulf of Sardonia (rocky shore, leg. W.J. Wolff & M. Loosjes, June 1964, 1 ♂). Yugoslavia: Rovinj, Adriatic Sea (sea-weed, Exc. Leidse Biologen, August 1960, 1 juv.); Split and surroundings (beach, Exc. Leidse Biologen, May 1956, August 1960, June 1962, many specimens). Italy: Rapallo, prov. Genova (leg. J. Taapken, February 1950, 1 ♂, 4 ♀). Tunisia: Djerba, Gulf of Bou Grara (SE. coast, April 1961, many specimens). Spain: Cadaqués, prov. Gerona (bay, depth 0-4 m., leg. L.B. Holthuis, August 1949, 1950, 1954, many specimens); Rosas, prov. Gerona (beach, leg. L.B. Holthuis, August 1949, 2 ♂, 1 ♀ 1 juv.); Barcelona, prov. Barcelona (harbour, depth 0-5 m., leg. L.B. Holthuis, July 1957, 17 specimens); Denià, prov. Alicante (leg. M. Boeseman, October 1958, 3 ♂, 4 ♀, 2 juvs.); Mar Menor, prov. Murcia (stones, dead sea-weed, Exc. RMNH, May 1971, 3 ♂, 3 ♀); Fuengirola-Torreblasco, prov. Malaga (leg. M. Boeseman, October 1958, many specimens); Puerto de Santa Maria, Gulf of Cadiz, prov. Cadiz (beach, Exc. RMNH, October 1974, many specimens); Chipiona, prov. Cadiz (beach near harbour, under stones, exc. RMNH, May 1971, 1 ♀); Rio Jara, prov. Cadiz (rocky beach, algae, Exc. RMNH, October 1974, many specimens); Jidoiro Pedregoso, W. of Isla de Arosa, Ria de Arosa, prov. Pontevedra (Exc. Leidse Biologen, July 1963, 10 specimens); Isla Salvora, Ria de Arosa, prov. Pontevedra (Exc. RMNH, July 1963, many specimens). Morocco: Oued Iquem, 22 km. S. of Rabat (rocky shore, Exc. RMNH, October 1974, 10 specimens). Madeira: south coast (pebble beach, Tydeman Madeira-Mauritania Exp., October 1978, 1 ♀). Azores, Pico, south coast, Lages (harbour, rocky shore, leg. J.C. den Hartog & M.S.S. Lavaleye, October 1979, 2 ♂, 1 ♀ 1 juv.); S. Jorge, Faja de Caldeira (cobble beach and lagoon, leg. Tydeman Azores Exp., June 1981, 2 ♂). France: Cap Griz Nez, dépt. Pas de Calais (Exc. Leidse Biologen, August 1957, 2 ♂, 1 ♀); Concarneau, south coast of Pointe Cabellou, dépt. Finistère (Exc. RMNH, September 1958, many specimens). MNP: France: Iles Chausey (Sphérome trigone Risso, 1 ♂, 4 ♀).

Diagnosis of adult male. — Antenna with five-segmented peduncle and flagellum of 13 to 18 articles. Each article of flagellum with fringe of smooth setae at distal interior angle. Adult males with setae more abundant, up to three times length of article in question. In females these setae reach only to end of next segment.

Endite of maxilliped with fringe of robust, plumose setae with swollen base on internal border. Semicircular distal margin of endite with bare setae. Robust palp segments II-IV lacking lobes, interior margins straight, bearing dense fringes of long fine-plumose setae. Ratio of width of third segment to that of protruding internal margin 6 : 1. In external distal corner, third and fourth segments bearing 3-5 and 5-10 long, bare setae, respectively.

Propodus of pereopod I has one stout comb-like infero-distal spine and one serrated rostro-distal spine. Near rostro-distal spine transverse row of 6-20