A key to the identification of agglutinant and monothalamous foraminifera from Brazilian mangroves

Décio Semensatto

1 Universidade Federal de São Paulo (Unifesp), Laboratory of Integrated Sciences (LabInSciences), Departamento de Ciências Ambientais (Unidade José de Filippi - Rua Prof. Artur Riedel, n° 275 - Jd. Eldorado - 09972-270 - Diadema - SP - Brazil)

*Corresponding author: decio.semensatto@unifesp.br

Descriptors: Foraminifera, Systematics, Mangrove, Identification key.

ABSTRACT
Identification keys are essential tools to guarantee higher precision during the taxonomic work. However, such keys are rare for foraminifera and often encompass a restrict group of species from a given geographic region. Thus, the taxonomic identification process usually occurs by visual comparison and by verifying the description of morphological attributes, which requires the previous knowledge of the species before identification. The use of an identification key seeks to help in this crucial step and contribute to the best taxonomic precision, which errors may propagate in the subsequent analyses that are supported by estimations on species richness and abundances. Moreover, it constitutes an extra tool to assist in the training of new researchers. This paper brings an identification key for agglutinant and monothalamous foraminifera from Brazilian mangroves, considering 50 genera and 91 species.

INTRODUCTION
Accurate taxonomic identification is a crucial step in research involving community ecology. Taxonomic errors can propagate along a chain of analysis, when ecological indices, transfer functions and statistical calculations differentiate taxonomic groups, and even over time if a particular work becomes a reference for other researchers to identify species (Wu, 1982; Bortolus, 2008; Payne et al., 2011; Vink et al., 2012). Such consequences can lead to inaccurate or erroneous interpretations of recent and past environmental scenarios and may lead to improper decisions about environmental management when they are based on indicators such as species richness, abundance and diversity. In the case of using indexes such as Shannon (H'), both underestimation and overestimation of rare species significantly impact the value of diversity, as this index applies the logarithm on relative abundance and thus reduces the algebraic difference between dominant species and rare species (Magurran and McGill, 2011).

The use of recent foraminifera as bioindicators has been proposed for several purposes (Scott et al., 2001; Yanko et al., 2003; Murray, 2006; Alve et al., 2009; Sabean et al., 2009; Frontalini et al., 2009; Bouchet et al., 2012; Alve et al., 2019). Although some species are recognized relatively easily, there are cases where only the detailed analysis of morphological attributes will ensure correct identification. Recently, the development of environmental DNA (eDNA) detection tools has pointed to new challenges in the field of taxonomy for foraminiferal species identification and estimating diversity (Pawlowski et al., 2014, 2016;...
Siemensma et al., 2017). However, in most cases, the identification of foraminifera species is based on the visual comparison between the test and images published in the literature, in addition to the observation of specific morphological characteristics described in detail in some classical references. However, these references do not provide species identification keys, and consulting their content usually requires pre-identification of the test in question.

Identification keys are handy tools in training researchers for taxonomy as well as for harmonizing species identification/taxonomic levels. Although certain areas of knowledge widely use these tools, such as Botany, there are few keys available about foraminifera (e.g., Todd and Low, 1981; Clark and Patterson, 1993; Revets, 2005). In this perspective, the present work proposes a key for the identification of Brazilian mangrove agglutinant and monothalamous foraminifera, aiming to contribute to the harmonization between research groups and results in the identification of species, as well as assisting in the training of new researchers.

**MATERIAL AND METHODS**

The construction of the identification key started from the creation of a database of occurrence of agglutinant and monothalamous foraminifera species from Brazilian mangroves. Therefore, it includes only articles published in national and international scientific journals, raised from searches in the main platforms of scientific publication available in Periódicos Capes (www.periodicos.capes.gov.br), totaling 19 productions (17 articles, one book chapter and one seminar paper in conference proceedings). The species list reported only for samples collected at mangroves in these papers was compiled, and then the key was constructed to the genus level. For each genus it is also listed the species respectively found in Brazilian mangroves. The construction of the key up to the genus aimed to make it less complex, and the identification of the species should be accompanied by consulting the literature where there are descriptions and images, in addition to the fact that some genera are represented by only one species.

Given that the purpose of this key is to help the researcher correctly identify a species based on the visualization of the test, the key refers to only the morphological attributes that are visible and distinguishable under the stereomicroscope. The organization of the morphological attributes of the species is based on compilation and systematic work of foraminifera that serve as reference for several works (e.g. Ellis and Messina, 1940 et seq.; Closs, 1962; Boltovskoy et al., 1980; Loeblich and Tappan, 1988; Brönnimann et al., 1992; Hayward and Hollis, 1994; Hayward et al., 1999; Scott et al., 2001; Sen Gupta, 2003; Debenay, 2013). In addition to the identification key, species systematics was also organized with hierarchical levels harmonized with the World Foraminifera Database platform (Hayward et al., 2019).

**THE IDENTIFICATION KEY**

The key includes 50 genera, which in turn covers 91 species. The key is binary-type, i.e., only two answers are possible and are mutually exclusive. The identification pathways follow steps referenced with numbers. Each step can result in the identification of a genus (so, the identification pathway finishes) or in the indication of the next step to be consulted. In the case of the announced feature coincides with that observed by the researcher, the pathway indicate: “go to ‘number’”. The entry number in the step is followed by another in parentheses, which indicates which is the previous step to reach that point of the pathway (e.g., ‘36 (32)’ indicates that the researcher has reached step #36 from step #32). Thus, if the identification finishes and does not match the test under observation, it is possible to return to the previous steps and look for alternatives. The images of most of species can be found in plates II, III and III (see Systematics section).

1. Uncoiled test (uniserial, biserial or triserial arrangement) – go to 2.

Coiled test (trochospiral, planispiral or streptospiral. The coiled portion can be followed by a uniserial, biserial or triserial portion) – go to 26.

2 (1). Unilocular test – go to 3.

Multilocular test – go to 14.

3 (2). Test without wall projections – go to 4.

Test with wall projections – go to 9.

4 (3). Test rectilinear tubular – genus *Bahianotubus*.

Test with another shape – go to 5.

5 (4). Test fusiform – genus *Bahianofusus*.

Test with another shape – go to 6.

6 (5). Globular test – genus *Blysmasphaera*.

Test with another shape – go to 7.
Plate I. 1. *Acostata mariae*. Image adapted from Laut et al. (2017), Pl. I, Figure 1. 2a. *Acupeina tripertorata*. Image adapted from Laut et al. (2012), Figure 17, II. 20. 2b. *Acupeina tripertorata*. Aperture view. Image adapted from Santa-Cruz (2004), Pl. VI, Figure 2. 3a,b. *Ammoastuta inepta*. Test collected at the intertidal zone from the São Francisco River delta, Brazil, Recent. Image from the author’s collection.

4. *Ammoastuta salsa*. Image adapted from Santa-Cruz (2004), Pl. VI, Figure 5. 5. *Ammobaculites exiguae*. Image adapted from Semensatto Jr. & Dias-Brito (2004), Figure 4, II. 6. *Ammobaculoides* sp. (species illustrated: *Ammobaculoides troelseni*) Image adapted from Brönnimann and Dias-Brito (1982), Pl. I, Figure 5. 7. *Ammodiscoides turbinatus*. Image adapted from Laut et al. (2012), Figure 17, Il. 2. 8. *Ammodiscus* sp. Image adapted from Santa-Cruz (2004), Pl. VI, Figure 5. 9. *Amnopemphix* sp. (species illustrated: *Amnopemphix*?). Image adapted from Barbosa et al. (2005), Pl. 3, Figure 6. 10. *Ammococcalaria* sp. Image adapted from Disaró (2006), Pl. 1, Figure 10. 11. *Ammotium cassis*. Test collected at the intertidal zone from the São Francisco River delta, Brazil, Recent. Image from the author’s collection.

12. *Ammotium directum*. Image adapted from Disaró (2006), Pl. I, Figure 12. 13. *Ammotium morenoi*. Test collected at the intertidal zone from the São Francisco River delta, Brazil, Recent. Image from the author’s collection.

14. *Ammotium pseudocassis*. Image adapted from Semensatto Jr. & Dias-Brito (2004), Figure 4, II. 11. 15. *Ammotium saburni*. Test collected at the intertidal zone from the São Francisco River delta, Brazil, Recent. Image from the author’s collection. 16a,b. *Arenoparrella mexicana*. Test collected at the intertidal zone from the São Francisco River delta, Brazil, Recent. 17. *Asterotrochammina* sp. (species illustrated: *Asterotrochammina camposi*). Image adapted from Rudorff (2008), Pl. II, Figure 25. 18. *Astrammina rara*. Test collected at the mangrove from Ilha do Cardoso, Brazil, Recent. Image from the author’s collection. 19. *Bahianofusus pontoni*. Image adapted from Disaró (2006), Pl. 1, Figure 20. 20. *Bahianotubus salvadorensis*. Image adapted from Laut et al. (2012), Figure 17, Il. 2. 21. *Blysmasphaera broennimanni*. Image adapted from Semensatto et al. (2008), Pl. I, Figure C. 22. *Blysmasphaera bronnimannii*. Image adapted from Semensatto et al. (2008), Pl. I, Figure B. 23. *Blysmasphaera bronnimanni*. Image adapted from Schmiedl et al. (2002), Pl. I, Figure E. 24. *Coronella exilis*. Test collected at the mangrove from Bertioga Channel, Brazil, Recent. Image from the author’s collection. 25. *Chitinosaccus guaratibaensis*. Image adapted from Laut et al. (2012), Figure 17, II. 1. 26. *Chitinosaccus zuluensis*. Image adapted from Smitt (1956), Figure 1, Il. D.
Plate II. 1a,b. *Deuterammina* sp. Test collected at tidal marshes, Portugal, Recent. Image courtesy of Prof. Dr. Francisco Fatela and Dr. João Moreno. 2. *Discammina* sp. Image adapted from Panchang & Nigan (2014), Pl.1, Figure 18. 3a,b. *Discorinopsis aguayoi*. Image adapted from Camacho et al. (2015), Figure 3, IIs. 26, 27. 4a,b. *Entzia macrescens*. Test collected at tidal marshes, Portugal, Recent. Image courtesy of Prof. Dr. Francisco Fatela and Dr. João Moreno (*Judammina macrescens*). 5. “*Glomospira*” *glomerata*. Image adapted from Galeotti et al. (2004), Pl. 2, II. 7. 6. *Glomospira gordialis*. Test collected at the intertidal zone from Curimataú River, Brazil, Recent. Image from the author’s collection. 7. *Haplophragmoides manilaeensis*. Test collected at the intertidal zone from the São Francisco River delta, Brazil, Recent. Image from the author’s collection. 8. *Haplophragmoides wilberti*. Test collected at the intertidal zone from the São Francisco River delta, Brazil, Recent. Image from the author’s collection. 9. *Hemisphaerammina bradyi*. Image adapted from Waskowska and Kamiński (2019), Figure 4, II. G. 10-12. *Iridia diaphana*. Image adapted from Kamiński et al. (2008), Pl. 7, Figures 7, 9, 10. 13a,b. *Lepidodeuterammina ochracea*. Image adapted from Camacho et al. (2015), Figure 3, IIs. 5, 6. 14. *Lituola* sp. Image adapted from Barbosa et al. (2005), Pl. 1, Figure 23. 15. *Lituotuba* sp. (species illustrated: *Lituotuba lituiformis*). Image adapted from Laut et al., (2014), Figure 9, FB1, II. D. 16. *Miliammina earlandi*. Image adapted from Disaró (2006), Pl. 2, Figure 16. 17a,b. *Miliammina fusca*. Test collected at the intertidal zone from the São Francisco River delta, Brazil, Recent. Image from the author’s collection. 18. *Monotalea salsa*. Image adapted from Semensatto-Jr. & Dias-Brito (2004), Figure 4, II. 8. 19a,b. *Paratrochammina clossi*. Image adapted from Laut et al. (2017), Pl. V, Figure B, and Disaró (2006), Pl. II, Figure p. 20. *Polysaccammina hyperhalina*. Image adapted from Semensatto-Jr. & Dias-Brito (2004), Figure 4, II. 13.
Plate III. 1. Polysaccammina ipohalina. Image adapted from Santa-Cruz (2004), Pl. I, Figure 2. 2a,b. Portatrochammina sp. Image adapted from Camacho et al. (2015), Figure 3. 3a,b. Protoschista findens. Image adapted from Jones (1994), Pl. 32, Figures 10A and B. 4a-c. Psammosphaera frankel. Image adapted from Rhumbler (1935), Pl. 5, Figures 4A, B and C. 5a,b. Psammosphaera fusca f. adhaerens. Image adapted from Rhumbler (1935), Pl. 9, Figures 5A and B. 6. Pseudoclavulina curta. Image adapted from Disaró (2006), Pl. II, Figure 6. 7a,b. Pseudoclavulina gracilis. Image adapted from Cushman & Todd (1948), Pl. 7, Figures 17A and B. 8. Pseudothurammina limnetis. Image adapted from Santa-Cruz (2004), Pl. VIII, Figure 1, Pl. VII, Figure 6. 9a,b. Remaneica sp. (species illustrated: Remaneica helgolandica). Image adapted from Encarnação (2012), Figures 9A and B, Ils. 2, 3. 10. Reophax nana. Image adapted from Rudorff (2008), Pl. 1, Figure 8. 11a-c. Rotaliammina sp. (species illustrated: Rotaliammina squamiformis). Adapted from Loeblich & Tappan (1994), Pl. 24, Figures 11A, B and C. 12a,b. Siphotrochammina lobata. Image adapted from Santa-Cruz (2004), Pl. VIII, Figure 1, Pl. VII, Figure 6. 13. Spiroplectammina biformis. Image adapted from Nathan et al. (2014), Figure 23, Il. 7. 14. Textularia earlandi. Test collected at the intertidal zone from Curimataú River, Brazil, Recent. Image from the author’s collection. 15. Textularia gramin. Image adapted from Zerfass et al. (2006), Figure 6, Il. 5. 16a,b. Tholosina centroforata. Image adapted from Rhumbler (1935), Pl. 4, Figures 16A and B. 17a,b. Thiphotrocha comprimata. Image adapted from Santa-Cruz (2004), Pl. VIII, Figures 17A and B. 18. Trilocularena patensis. Test collected at the intertidal zone from the São Francisco River delta, Brazil, Recent. Image from the author’s collection. 19a. Trochammina inflata. Test collected at the intertidal zone from the São Francisco River delta, Brazil, Recent. Image from the author’s collection. 19b. Trochammina inflata. Test collected at tidal marshes, Portugal, Recent. Image courtesy of Prof. Dr. Francisco Fatela and Dr. João Moreno. 20. Trochammina squamata. Image adapted from Laut et al. (2007), Pl. I, Figure 14. 21. Trochamminita irregularis. Image adapted from Encarnação (2012), Figure 9.6. 22. Trochamminita salsa. Test collected at tidal marshes, Portugal, Recent. Image courtesy of Prof. Dr. Francisco Fatela and Dr. João Moreno. 23. Warrenita palustris. Test collected at the intertidal zone from the São Francisco River delta, Brazil, Recent. Image from the author’s collection.
7 (6). Test a saclike chamber with a rounded terminal aperture – genus *Chitinosaccus*.
   Test hemispherical, with or without apparent aperture – go to 8.

8 (7). No apparent aperture – genus *Hemisphaerammina*.
   Two or more apertures just above the base of the test – genus *Tholosina*.

9 (3). Test free – go to 10.
   Test attached – go to 12.

10 (9). Test without projections, large (up to 6mm), consisting of one to several loosely joined spherical chambers – genus *Psammosphaera*.
   Test with projections – go to 11.

11 (10). Smooth and homogeneous wall with numerous tubular extensions and with sand grains larger than the thickness of the wall – genus *Astrammina*.
   Wall finely agglutinated with silt grains and with up to five mammillae irregular projections – genus *Pseudothurammina*.

12 (9). Wall proteinaceous – genus *Iridia*.
   Wall agglutinated – go to 13.

13 (12). Wall thick, of agglutinated fine sand, sponge spicules, and other foraminiferal tests – genus *Crithionina*.
   Wall thin, flexible – genus *Pseudothurammina*.

14 (2). Elongate chambers and cribrate aperture – genus *Ammoastuta*.
   Chambers with other forms – go to 15.

15 (14). Biserial portion at least in one stage – go to 16.
   Test without biserial portion – go to 19.

16 (15). Test with initial biserial portion followed by a uniserial portion – go to 17.
   Test with other features – go to 18.

17 (16). Initial portion acute, aperture evaginated – genus *Bigenerina*.
   Initial portion rounded, aperture terminal rounded – genus *Monotalea*.

18 (16). Test with a tiny initial triserial portion followed by a biserial portion – genus *Textularia*.
   Test only biserial – genus *Caronia*.

19 (15). Test arched with aperture an elongate slit at the terminal end of the test – genus *Warrenita*.
   Test not arched – go to 20.

20 (19). Chambers with irregular shape – genus *Polysaccammina*.
   Chambers with regular shape – go to 21.

21 (20). Loosely joined spherical chambers – genus *Psammosphaera*.
   Chambers with another shape – go to 22.

22 (21). Test with two or more branching uniserial stages – genus *Protoschista*.
   Test without branching series – go to 23.

23 (22). Hemispherical chambers – genus *Ammopemphix*.
   Chambers with another format – go to 24.

24 (23). Early-stage triserial and triangular, then uniserial with cylindrical chambers – genus *Pseudoclavulina*.
   Test only uniserial – go to 25.

25 (24). Aperture rounded – genus *Reophax*.
   Aperture lenticular – genus *Acostata*.

26 (1). Test planispiral (can be initially streptospiral or followed by a uniserial or biserial portion) – go to 27.
   Another coil – go to 39.

27 (26). Test discoid – go to 28.
   Test not discoid – go to 30.

28 (27). Initial portion streptospiral – genus *Glomospira*.
   Initial portion no-streptospiral – go to 29.

29 (28). Test with a “w” outline in the lateral section – genus *Ammodiscoides*.
   Test without “w” outline – genus *Ammodiscus*.

30 (27). Test with a uniserial or biserial portion – go to 31.
Test without a uniserial or biserial portion – go to 36.

31 (30). Initial planispiral with biserial followed by uniserial portion – genus Ammobaculoides. Another arrangement – go to 32

32 (31). Only biserial portion – genus Spiroplectammina. Only uniserial portion – go to 33.

33 (32). Sutures rather indistinct – go to 34. Sutures distinct – go to 35.

34 (33). Later part with tubular chambers – genus Lituotuba. Later part with short and broad chambers – genus Ammoscalararia.

35 (33). Sutures oblique in the uniserial portion – genus Ammotium. Sutures not oblique in the uniserial portion – go to 36.

36 (35). Single aperture – genus Ammobaculites. Aperture with several pores – genus Lituola.

37 (30). Aperture an interiomarginal arch evaginated at the base of the final chamber – genus Haplophragmoides. Other aperture – go to 38.

38 (37). Chambers and sutures not distinct – genus Discammina. Globular chambers distinct, irregularly arranged, depressed sutures – genus Trochamminita.

39 (26). Trochospiral test – go to 40. Another coil – go to 52.

40 (39). Test plan-convex or concave-convex – go to 41. Test not plan-convex nor concave-convex – go to 45.

41 (40). Chambers with large pores in the center and edges – genus Discorinopsis. Chambers without pores – go to 42.

42 (41). Chambers extending back at the periphery – genus Lepidodeuterammina. Chambers not extending back at the periphery – go to 43.

43 (42). Aperture interiomarginal and extraulimbical with secondary openings – genus Asterotrochammina. Other aperture – go to 44.

44 (43). Aperture a low interiomarginal arch in the final septal face – genus Portatrochammina. Aperture a small rounded interiomarginal extrumbilical opening – genus Remaneica.

45 (40). Slit-like aperture areal to interiomarginal– genus Arenoparrella. Aperture with another shape – go to 46.

46 (45). Supplementary areal apertures – genus Entzia. Without supplementary apertures – go to 47.

47 (46). Siphon-like aperture, chambers rounded – genus Siphotrochammina. Aperture with another shape – go to 48.

48 (47). Aperture umbilical – genus Rotaliaammina. Aperture umbilical-extraulimbical – go to 49.

49 (48). Chambers distinctly “T”-shaped in the umbilical side – genus Tiphotrocha. Chamber with other features – go to 50.

50 (49). Secondary aperture at the umbilical tip – genus Deuterammina. Without secondary aperture – go to 51.

51 (50). Aperture with a lip – genus Trochammina. Aperture without a lip – genus Paratrochammina.

52 (39). Milioline coil – go to 53. Another coil – go to 54.

53 (52). Triloculine test – genus Trilocularena. Quinqueloculine test – genus Milliammina.

54 (52). Initial portion streptospiral followed by a uniserial portion – genus Acupeina. Initial portion streptospiral followed by a planispiral portion – genus Glomospira.
SYSTEMATICS

Phylum FORAMINIFERA

Class MONOTHALAMEA Haeckel, 1862 (Pawlowski, Holzmann and Tyska, 2013).
Order ASTRORHIZIDA Lankester, 1885.
Suborder ASTRORHIZINA Lankester, 1885.
Superfamily ASTRORHIZOIDEA Brady, 1881.
Family RHABDAMMINIDAE Brady, 1884.
Subfamily BATHYSIPHONINAE Avnimelech, 1952.
Genus Bahianotubus Brönnimann, Zaninetti and Moura, 1979.
Bahianotubus salvadorensis Brönnimann, Zaninetti and Moura, 1979, Pl. I, Figure 20.

Suborder SACCAMMININA Lankester, 1885.
Superfamily PSAMMOSPHAEROIDEA Haeckel, 1894.
Family LACUSTRINELLIDAE Mikhelevic, 1995.
Genus Ammopemphix Loeblich, 1952.
1931 Urnula Wiesner.
1952 Ammopemphix Loeblich.
Ammopemphix sp., Pl. I, Figure 9.

Family PSAMMOSPHAERIDAE Haeckel, 1894.
Subfamily PSAMMOSPHAERINAE Haeckel, 1894.
Genus Psammosphaera Schulze, 1875.
1875 Psammosphaera Schulze.
1913 Arphammosphaera Rhumbler.
1935 Psammella Rhumbler.
1939 Arenosphaera Shchendrina.
Psammosphaera frankei (Rhumbler, 1935), Pl. III, Figures 4A, B and C.
1935 Psammella Frankei Rhumbler.
2018 Psammosphaera frankei Hayward, Le Coze and Gross.
Psammosphaera fusca f. adhaerens Rhumbler, 1935, Pl. III, Figures 5A and B.
1935 Psammosphaera fusca f. adhaerens Rhumbler.
1977 Psammosphaera adherens (Rhumbler) Zaninetti, Brönnimann, Beurlen and Moura.
Superfamily SACCAMMINOIDEA Brady, 1884.
Family CRITHIONINIDAE Hofker, 1972.
Subfamily CRITHIONININAE Hofker, 1972.
Genus Crithionina Goës, 1894.
1894 Crithionina Goës.
1913 Arcrithionum Rhumbler.
Crithionina mamila Goës, 1894.
Crithionina sp.
Family SACCAMMINIDAE Brady, 1884.
Subfamily THOLOSININAE.
Genus Iridia Heron-Allen and Earland, 1914.
**Iridia diaphana** Heron-Allen and Earland, 1914, Pl. II, Figures 10-12.
1914 *Iridia diaphana* Heron-Allen and Earland.
1921 *Iridia diaphana* (Heron-Allen and Earland) Cushman.
1935 *Iridia diaphana* (Heron-Allen and Earland) Doyle.

**Iridia sp.**
Genus *Tholosina* Rhumbler, 1935.

**Tholosina centroforata** Rhumbler, 1935, Pl. III, Figures 16A and B.

Subfamily THURAMMININAE Miklukho-Maklay, 1963.
Genus *Astrammina* Rhumbler, 1931.
1931 *Astrammina* Rhumbler.
1932 *Armorella* Heron-Allen and Earland.

**Astrammina rara** Rhumbler, 1931, Pl. I, Figure 18.
1871 *Astrammina rara* Rhumbler, 1931.
1932 *Armorella sphaerica* Heron-Allen and Earland.
1977 *Astrammina sphaerica* (Heron-Allen and Earland) Zaninetti, Brönnimann, Beurlen and Moura.
1980 *Astrammina sphaerica* (Heron-Allen and Earland) Lena.
1986 *Astrammina sphaerica* (Heron-Allen and Earland) Schröder.
2013 *Armorella sphaerica* (Heron-Allen and Earland) Debenay.

Genus *Bahianofusus* Brönnimann, Zaninetti and Moura, 1979.

**Bahianofusus pontei** Brönnimann, Zaninetti and Moura, 1979, Pl. I, Figure 19.

Genus *Pseudothurammina* (Scott, Medioli and Williamson, 1981).

**Pseudothurammina limnetis** (Scott and Medioli, 1980), Pl. III, Figure 8.
1980 *Thurammina limnetis* Scott and Medioli.
1981 *Pseudothurammina limnetis* (Scott and Medioli) Scott, Medioli and Williamson.
1994 *Pseudothurammina limnetis* (Scott and Medioli) Hayward and Hollis.
1999 *Pseudothurammina limnetis* (Scott and Medioli) Hayward, Grenfell, Reid and Hayward.
2013 *Pseudothurammina limnetis* (Scott and Medioli) Debenay.

Family STEGNAMMINIDAE Moreman, 1930.
Subfamily HEMISPHAERAMMININAE Loeblich and Tappan, 1961.
Genus *Hemisphaerammina* Loeblich and Tappan, 1957.

**Hemisphaerammina bradyi** Loeblich and Tappan, 1957, Pl. II, Figure 9.

Order ALLOGROMIIDA Loeblich and Tappan, 1961.
Family ALLOGROMIIDAE Rhumbler, 1904.
Genus *Blysmasphaera* Brönnimann, 1988.

**Blysmasphaera brasiliensis** Brönnimann, 1988, Pl. I, Figure 22.

**Blysmasphaera broennimanni** Semensatto, Oliveira and Dias-Brito, 2008, Pl. I, Figure 23.

Subfamily ALLOGROMIIINAE Rhumbler, 1904.
Genus *Chitinosaccus* Smitter, 1956.

**Chitinosaccus guaratibaensis** Brönnimann, Zaninetti and Moura,
1979, Pl. I, Figure 25.

**Chitinosaccus zuluensis** Smitter, 1956, Pl. I, Figure 26.

**Chitinosaccus sp.**

Class GLOBOTHALAMEA Pawlowski, Holzmann and Tyszka, 2013.
Subclass TEXTULARIANA Mikhalevich, 1980.
Order LITUOLIDA.

Suborder LITUOLINA Lankester, 1885.
Superfamily LITUOLOIDEA.

Family DISCAMMINIDAE Mikhalevich, 1980.
Genus *Ammoscalaria* Höglund, 1947.

**Ammoscalaria sp.**, Pl. I, Figure 10.

Genus *Discammina* Lacroix, 1932.

**Discammina sp.**, Pl. II, Figure 2.

Family HAPLOPHRAGMOIDIDAE Maync, 1952.
Genus *Haplophragmoides* Cushman, 1910.

1910 *Haplophragmoides* Cushman.
1960 *Recurvoidella* Uchio.
1973 *Linguaferrina* Alekseychik-Mitskevich.
1973 *Pauciloculina* Alekseychik-Mitskevich.
1973 *Subtilina* Alekseychik-Mitskevich.
1981 *Pseudohaplophragmoides* Saidova.
1988 *Haplophragmoides* Loeblich and Tappan.

**Haplophragmoides manilaensis** Andersen, 1952, Pl. II, Figure 7.

**Haplophragmoides wilberti** Andersen, 1953, Pl. II, Figure 8.

1953 *Haplophragmoides wilberti* Andersen.
1994 *Haplophragmoides wilberti* (Andersen) Hayward and Hollis.
1999 *Haplophragmoides wilberti* (Andersen) Hayward, Grenfell, Reid and Hayward.

2013 *Haplophragmoides wilberti* (Andersen) Debenay.

**Haplophragmoides sp.**

Genus *Trochamminita* Cushman and Brönnimann, 1948.

**Trochamminita irregularis** Cushman and Brönnimann, 1948, Pl. III, Figure 21.

1948 *Trochamminita salsa* Cushman and Brönnimann.
1957 *Trochamminita salsa* (Cushman and Brönnimann) Saunders.

**Trochamminita salsa** (Cushman and Brönnimann, 1948), Pl. III, Figure 22.

1948 *Labrospira salsa* Cushman and Brönnimann.
1948 *Trochamminita irregularis* Cushman and Brönnimann.
1957 *Trochamminita salsa* (Cushman and Brönnimann) Saunders.
1994 *Trochamminita salsa* (Cushman and Brönnimann) Hayward and Hollis.

1999 *Trochamminita salsa* (Cushman and Brönnimann) Hayward, Grenfell, Reid and Hayward.
Family LITUOLIDAE Blainville, 1827.

Subfamily AMMOASTUTINAE Loeblich and Tappan, 1984.
Genus *Ammoastuta* Cushman and Brönnimann, 1948.

*Ammoastuta inepta* (Cushman and McCulloch, 1939), Pl. I, Figures 3A and B.
1939 *Ammobraculites ineptus* Cushman and McCulloch.
1948 *Ammoastuta inepta* (Cushman and McCulloch) Cushman and Brönnimann.
1962 *Ammoastuta inepta* (Cushman and McCulloch) Closs.

*Ammoastuta salsa* Cushman and Brönnimann, 1948, Pl. I, Figure 4.
1948 *Ammoastuta salsa* Cushman and Brönnimann.
1952 *Ammoastuta salsa* (Cushman and Brönnimann) Bursch.
1986 *Ammoastuta salsa* (Cushman and Brönnimann) Brönnimann.

Subfamily AMMOMARGINULININAE Podobina, 1978.
Genus *Ammobaculites* Cushman, 1910.

*Ammobaculites dilatatus* Cushman and Brönnimann, 1948.
1948 *Ammobaculites dilatatus* Cushman and Brönnimann.
2002 *Ammotium dilatatus* (Cushman and Brönnimann) Debenay, Guiral and Parra.

*Ammobaculites exiguus* Cushman and Brönnimann, 1948, Pl. I, Figure 5.
1948 *Ammobaculites exiguus* Cushman and Brönnimann.
1992 *Ammobaculites exiguus* (Cushman and Brönnimann) Brönnimann, Whittaker and Zaninetti.
1994 *Ammobaculites exiguus* (Cushman and Brönnimann) Hayward and Hollis.
1999 *Ammobaculites exiguus* (Cushman and Brönnimann) Hayward, Grenfell, Reid and Hayward.
2013 *Ammobaculites exiguus* (Cushman and Brönnimann) Debenay.

Genus *Ammotium* Loeblich and Tappan, 1953.
1953 *Ammotium* Loeblich and Tappan.
1960 *Ammovaginulina* Nakkady and Eissa.
1988 *Ammotium* Loeblich and Tappan.

*Ammotium angulatum* Brönnimann, Whittaker and Zaninetti, 1992.

*Ammotium cassis* (Parker, 1870), Pl. I, Figure 11.
1870 *Lituola cassis* Parker.
1870 *Ammobaculites cassis* (Parker) Parker.
1870 *Haplophragmium cassis* (Parker) Parker.
1953 *Ammotium cassis* (Parker) Loeblich and Tappan.
1980 *Ammotium cassis* (Parker) Boltovskoy, Giussani, Watanabe and Wright.

*Ammotium directum* (Cushman and Brönniman, 1948), Pl. I, Figure 12.
1948 *Ammobaculites directus* Cushman and Brönnimann.
1948 *Ammobaculites diversus* Cushman and Brönnimann.
1953 *Ammotium directum* Loeblich and Tappan.

*Ammotium morenoi* (Acosta, 1940), Pl. I, Figure 13.
1940 *Ammobaculites morenoi* Acosta.
1948 *Ammobaculites salsus* Cushman and Brönniman.
1948 *Ammobaculites salsus var. distinctus* Cushman and Brönniman.
1952 *Ammoscalaria fluvialis* Parker.
1957 *Ammotium palustre* Warren.
1992 *Ammotium morenoi* Brönnimann, Whittaker and Zaninetti.

**Ammotium planissimum** (Cushman, 1927).
1927 *Haplophragmoides planissima* Cushman.
1973 *Ammotium planissimum* Lankford and Phleger.

**Ammotium pseudocassis** (Cushman and Brönnimann, 1948), Pl. I, Figure 14.
1948 *Ammobaculites pseudocassis* Cushman and Brönniman.
1953 *Ammotium pseudocassis* (Cushman and Brönniman) Loeblich and Tappan.
1992 *Ammotium pseudocassis* (Cushman and Brönniman) Brönnimann, Whittaker and Zaninetti.

**Ammotium salsum** (Cushman and Brönnimann, 1948) Pl. I, Figure 15.
1948 *Ammobaculites salsus* Cushman and Brönniman.
1953 *Ammotium salsum* (Cushman and Brönnimann) Loeblich and Tappan.
1967 *Ammotium palustre* Warren.
2013 *Ammotium salsum* (Cushman and Brönnimann) Boltovskoy, Giussani, Watanabe and Wright.
2013 *Ammotium salsum* (Cushman and Brönnimann) Debenay.

Subfamily LITUOLINAE Blainville, 1827.
Genus *Lituola* Lamarck, 1804.
1804 *Lituola* Lamarck.
1862 *Lituola* Reuss.
1918 *Lituola* (Lamarck) Cushman.

**Lituola sp.**, Pl. II, Figure 14.

Superfamily LITUOTUBOIDEA.
Family LITUOTUBIDAE Loeblich and Tapan, 1984.
Genus *Lituotuba* Rhumbler, 1895.
1895 *Lituotuba* Rhumbler.
1913 *Arliturutubum* Rhumbler.
1981 *Lituiforminoides* Saidova.
1988 *Lituotuba* (Rhumbler) Loeblich and Tappan.

**Lituotuba sp.**, Pl. II, Figure 15.

Superfamily RECURVOIDOIDEA Alekseychik-Mitskevich, 1973.
Family ACUPEINIDAE Brönnimann and Zaninetti, 1984.
Genus *Acupeina* Brönnimann and Zaninetti, 1984.

**Acupeina triperforata** (Millett, 1899), Pl. I, Figures 2A and B.
1899 *Haplophragmium agglutinans var. triperforata* Millett.
1948 *Haplophragmium salsum* (Millett) Cushman and Bronnimann.
1984 *Acupeina triperforata* (Millett) Brönnimann and Zaninetti.
2002 *Acupeina triperforata* (Millett) Debenay, Guiral and Parra.
2013 *Acupeina triperforata* (Millett) Debenay.
Suborder RZEHAKININA Saidova, 1981.
Superfamily RZEHAKINOIDEA Cushman, 1933.
Family TRILOCULARENIDAE Mikhailovich and Kaminski, 2008.
Genus Trilocularena Loeblich and Tappan, 1955.

*Trilocularena patensis* Closs, 1963, Pl. III, Figure 18.
1963 *Trilocularena patensis* Closs.
2013 *Trilocularena patensis* (Closs) Debenay.

Suborder SPIROPLECTAMMININA Mikhailovich, 1992.
Superfamily SPIROPLECTAMMINOIDEA Cushman, 1927.
Family SPIROPLECTAMMINIDAE Cushman, 1927.
Subfamily SPIROPLECTAMMININAE Cushman, 1927.
Genus Ammobaculoides Plummer, 1932.

*Ammobaculoides* sp., Pl. I, Figure 6.
Genus *Spiroplectammina* Cushman, 1927.

*Spiroplectammina biformis* (Parker and Jones, 1865), Pl. III, Figure 13.
1835 *Textularia aglutinans* var. *biformis* Parker and Jones.
1884 *Spiroplecta biformis* (Parker and Jones) Brady.
1932 *Spiroplectammina biformis* (Parker and Jones) Heron-Allen and Earland.
1962 *Spiroplectammina biformis* (Parker and Jones) Closs.
2013 *Spiroplectammina biformis* (Parker and Jones) Debenay.

Family TEXTULARIOPSIDAE Loeblich and Tappan, 1982.
Genus Monotalea Brönnimann, Whittaker and Zaninetti, 1992.

*Monotalea salsa* Brönnimann, Whittaker and Zaninetti, 1992, Pl. II, Figure 18.
1992 *Monotalea salsa* Brönnimann, Whittaker and Zaninetti.
2013 *Monotalea salsa* (Brönnimann, Whittaker and Zaninetti) Debenay.

Suborder TROCHAMMININA Saidova, 1981.
Superfamily TROCHAMMINOIDEA Schwager, 1877.
Family REMANEICIDAE Loeblich and Tappan, 1964.
Subfamily ASTEROTROCHAMMININAE Brönnimann, Zaninetti and Whittaker, 1983.
Genus Asterotrochammina Bermúdez and Seiglie, 1963.

*Asterotrochammina* sp., Pl. I, Figure 17.
Subfamily REMANEICINAE Loeblich and Tappan, 1964.
Genus *Remaneica* Rhumbler, 1938.

*Remaneica* sp., Pl. III, Figures 9A and B.
Family TROCHAMMINIDAE Schwager, 1877.
Subfamily ARENOPARELLINAE Saidova, 1981.
Genus Arenoparrella Andersen, 1951.

*Arenoparrella mexicana* (Kornfeld, 1931), Pl. I, Figures 16A and B.
1931 *Trochammina inflata* var. *mexicana* Kornfeld.
1951 *Arenoparrella mexicana* (Kornfeld) Andersen.
1992 *Arenoparrella mexicana* (Kornfeld) Brönnimann, Whittaker and Zaninetti.
2007 *Arenoparrella mexicana* (Kornfeld) Berkeley, Perry, Smithers, Horton and Taylor.
2013 *Arenoparrella mexicana* (Kornfeld) Debenay.
Subfamily JADAMMININAE Saidova, 1981.

Genus *Entzia* Daday, 1883.

1883 *Entzia* Daday.
1938 *Jadammina* Bartenstein and Brand.
2018 *Entzia* Hayward, Le Coze and Gross.

*Entzia macrescens* (Brady, 1870), Pl. II, Figures 4A and B.
1870 *Trochammina inflata* var. *macrescens* Brady.
1938 *Jadammina macrescens* (Brady) Bartenstein and Brand.
1980 *Trochammina macrescens* (Brady) Scott and Medioli.
1994 *Jadammina macrescens* (Brady) Hayward and Hollis.
1999 *Jadammina macrescens* (Brady) Hayward, Grenfell, Reid and Hayward.
2005 *Trochammina macrescens* (Brady) Barbosa, Scott, Seoane and Turcq.
2013 *Jadammina macrescens* (Brady) Debenay.
2018 *Entzia macrescens* (Brady) Hayward, Le Coze and Gross.

*Entzia polystoma* (Bartenstein and Brand, 1938).
1938 *Jadammina polystoma* Bartenstein and Brand.
2018 *Entzia polystoma* Hayward, Le Coze and Gross.

*Entzia* sp.

Subfamily POLYSTOMAMMININAE Brönnimann and Beurlen, 1977.

Genus *Deuterammina* Brönnimann, 1976.

1976 *Deuterammina* Brönnimann.
1983 *Deuterammina (Centrodeuterammina)* (Brönnimann) Brönnimann and Whittaker.
1988 *Deuterammina* (Brönnimann) Loeblich and Tappan.

*Deuterammina* sp., Pl. II, Figures 1A and B.

Genus *Lepidodeuterammina* Brönnimann and Whittaker, 1983.

1983 *Deuterammina (Ledpdodeuterammina)* Brönnimann and Whittaker.
1988 *Lepidodeuterammina* (Brönnimann and Whittaker) Loeblich and Tappan.

*Lepidodeuterammina ochracea* (Williamson, 1858), Pl. II, Figures 13A and B.
1858 *Rotalina ochracea* Williamson.
1983 *Deuterammina (Lepideuterammina) ochracea* Brönnimann and Whittaker.
1980 *Trochammina ochracea* (Williamson) Boltovskoy, Giussani, Watanabe and Wright.
2018 *Lepideuterammina ochracea* Hayward, Le Coze and Gross.

Subfamily ROTALIAMMININAE Saidova, 1981.

Genus *Rotaliammina* Cushman, 1924.

1924 *Rotaliammina* Cushman.
1964 *Polysiphotrocha* Seiglie.
1988 *Rotaliammina* (Cushman) Loeblich and Tappan.

*Rotaliammina* sp., Pl. III, Figures 11A, B and C.

Genus *Siphotrochammina* Saunders, 1957.

*Siphotrochammina lobata* Saunders, 1957, Pl. III, Figures 12A and B.
1957 *Siphotrochammina lobata* Saunders.
1977 *Siphotrochammina elegans* Zaninetti, Brönnimann, Beurlen and Moura.
2013 *Siphotrochammina lobata* (Saunders) Debenay.

*Siphotrochammina* sp.
Genus *Tiphrotrocha* Saunders, 1957.

*Tiphrotrocha comprimata* (Cushman and Brönnimann, 1948), Pl. III, Figures 17A and B.

1948 *Trochammina comprimata* Cushman and Brönnimann.

1957 *Tiphrotrocha comprimata* (Cushman and Brönnimann) Saunders.

1980 *Tiphrotrocha comprimata* (Cushman and Brönnimann) Scott and Medioli.

1992 *Tiphrotrocha comprimata* (Cushman and Brönnimann) Brönnimann, Whittaker and Zaninetti.

2006 *Tiphrotrocha comprimata* (Cushman and Brönnimann) Horton and Edwards.

Subfamily TROCHAMMININAE Schwager, 1877.

Genus *Paratrochammina* Brönnimann, 1979.

*Paratrochammina classi* Brönnimann, 1979, Pl. II, Figures 19A and B.

*Paratrochammina sp.*

Genus *Portatrochammina* Echols, 1971.

1971 *Portatrochammina* Echols.

1983 *Portatrochammina* (*Paratrochammina*) (Echols) Brönnimann, Zaninetti and Whitakker.

1971 *Portatrochammina* (Echols) Loeblich and Tappan.

*Portatrochammina sp.*, Pl. III, Figures 2A and B.

Genus *Trochammina* (Parker and Jones, 1859).

1859 *Rotalia* (*Trochammina*) Parker and Jones.

1860 *Trochammina* (Parker and Jones) Jones and Parker.

1988 *Trochammina* (Parker and Jones) Loeblich and Tappan.

*Trochammina inflata* (Montagu, 1808), Pl. III, Figures 19A and B.

1808 *Nautilus inflatus* Montagu.

1859 *Trochammina inflata* (Montagu) Parker and Jones.

1994 *Trochammina inflata* (Montagu) Hayward and Hollis.

1999 *Trochammina inflata* (Montagu) Hayward, Grenfell, Reid and Hayward.

2006 *Trochammina inflata* (Montagu) Horton and Edwards.

2013 *Trochammina inflata* (Montagu) Debenay.

*Trochammina squamata* Jones and Parker, 1860, Pl. III, Figure 20.

1860 *Trochammina squamata* Jones and Parker.

1964 *Trochammina squamata* (Jones and Parker) Hedley, Hurdle and Burdett.

1980 *Trochammina squamata* (Jones and Parker) Boltovskoy, Giussani, Watanabe and Wright.

*Trochammina sp.*

Suborder VERNEUILININA Mikhalevich and Kaminski, 2000.

Superfamily VERNEUILINOIDEA Cushman, 1911.

Family REOPHACELLIDAE Mikhalevich and Kaminski, 2000.

Subfamily CARONIINAE Brönnimann, Whittaker and Zaninetti, 1992.

Genus *Caronia* Brönnimann, Whittaker and Zaninetti, 1992.

*Caronia exilis* (Brönnimann and Cushman, 1948), Pl. I, Figure 24.

1948 *Gaudryina exilis* Brönnimann and Cushman.
1992 Caronia exilis (Brönnimann and Cushman) Brönnimann, Whittaker and Zaninetti.
2002 Caronia exilis (Brönnimann and Cushman) Debenay, Guiral and Parra.
2013 Caronia exilis (Brönnimann and Cushman) Debenay.

Order TEXTULARIIDIA.
Suborder TEXTULARINA Delage and Hérouard, 1896.
Superfamily EGERELLOIDEA Cushman, 1937.
Family PSEUDOGAUDRYINIDAE Loeblich and Tappan, 1985.
Subfamily PSEUDOGAUDRYININAE Loeblich and Tappan, 1985.
Genus Pseudoclavulina Cushman, 1936.
Pseudoclavulina curta Cushman and Brönnimann, 1948, Pl. III, Figure 6.
Pseudoclavulina gracilis Zheng, 1988, Pl. III, Figures 7A and B.
Pseudoclavulina sp.

Family VALVULAMMINIDAE Loeblich and Tappan, 1986.
Genus Discorinopsis Cole, 1941.
Discorinospsis aguayoi (Bermúdez, 1935), Pl. II, Figures 3A and B.
1935 Discorbis aguayoi Bermúdez.
1941 Discorinopsis aguayoi Cole.

Superfamily TEXTULARIOIDEA Ehrenberg, 1838.
Family TEXTULARIIDAE Ehrenberg, 1838.
Subfamily TEXTULARIINAE Ehrenberg, 1838.
Genus Bigenerina d’Ornigny, 1826.
Bigenerina sp., Pl. I, Figure 21.
Genus Textularia Defrance, 1824.
Textularia earlandi Parker, 1952, Pl. III, Figure 14.
1952 Textularia earlandi Parker.
1994 Textularia earlandi (Parker) Hayward and Hollis.
1999 Textularia earlandi (Parker) Hayward, Grenfell, Reid and Hayward.
2010 Textularia earlandi (Parker) Alve and Goldstein.

Textularia gramen d’Orbigny 1846, Pl. III, Figure 15.

Class MONOTHALAMEA.
Order ASTORHIZIDA.
Suborder SACCAMMININA.
Superfamily PSAMMOSPHAEROIDEA.
Family POLYSACCAMMINIDAE.
Subfamily POLYSACCAMININAE.
Genus Polysaccammina Scott, 1976.
Polysaccammina hyperhalina Medioli, Scott and Petrucci, 1983, Pl. II, Figure 20.
Polysaccammina ipohalina Scott, 1976, Pl. III, Figure 1.
1976 Polysaccammina ipohalina Scott.
1980 Polysaccammina ipohalina (Scott) Scott and Medioli.

Class NODOSARIATA Mikhalevich, 1992 emend. Rigaud, Vachard, Schlagintweit, Martini and 2015.
Subclass HORMOSINANA Mikhalevich, 1992.
Superfamily CRIBRATINOIDEA Loeblich and Tappan, 1984.
Family THOMASINELLIDAE Loeblich and Tappan, 1984 †.
Genus Protoschista Eimer and Fickert, 1899.
**Protoschista findens** (Parker, 1870), Pl. III, Figures 3A and B.
1870 *Lituola findens* Parker.
1953 *Protoschista findens* (Parker) Loeblich and Tappan.

Suborder HORMOSINININA.
Superfamily HORMOSINOIDEA.
Family HORMOSINIDAE.
Subfamily CUNEATINAE.
Genus *Acostata* (Acosta, 1940).
1940 *Reophax* Acosta.
1992 *Acostata* Brönnimann, Whitaker and Valleri, 1992.

**Acostata mariae** (Acosta, 1940), Pl. I, Figure 1.
1940 *Reophax mariae* Acosta.
1980 "Hormosina" mariae (Acosta) Brönnimann.
1992 *Acostata mariae* (Acosta) Brönnimann, Whitaker and Valleri.

Genus *Warrenita* Loeblich and Tappan, 1984.
**Warrenita palustris** (Warren, 1957), Pl. III, Figure 23.
1957 *Sulcophax palustris* Warren.
1984 *Warrenita palustris* Loeblich and Tappan.

Family REOPHACIDAE Cushman, 1927.
Genus *Reophax* Monfort, 1808.

**Reophax nana** Rhumbler, 1913, Pl. III, Figure 10.
1913 *Reophax nana* Rhumbler.
2005 *Reophax nana* (Rhumbler) Barbosa, Scott, Seoane and Turcq.
2013 *Reophax nana* (Rhumbler) Debenay.

**Reophax sp.**
Class TUBOTHALAMEA Pawlowski, Holzman and Tyszka, 2013.
Order MILIOLIDA Delage and Hérouard, 1896.
Family MILIAMMINIDAE Saidova, 1981.
Genus *Miliammina* Heron-Allen and Earland, 1930.

**Miliammina earlandi** Loeblich and Tappan, 1955, Pl. II, Figure 16.

**Miliammina fusca** (Brady, 1870), Pl. II, Figures 17A and B.
1870 *Quinqueloculina fusca* Brady.
1930 *Miliammina fusca* (Brady) Heron-Allen and Earland.
1936 *Miliammina fusca* (Brady) Rhumbler.
1953 *Miliammina fusca* (Brady) Miller.
1992 *Miliammina fusca* (Brady) Brönnimann, Whittaker and Zaninetti.
1994 *Miliammina fusca* (Brady) Hayward and Hollis.
1999 *Miliammina fusca* (Brady) Debenay, Grenfell, Reid and Hayward.
2013 *Miliammina fusca* (Brady) Debenay.

**Miliammina sp.**
Order SPIRILLINIDA Hohenegger and Pillar, 1975.
Suborder AMMODISCINA Mikhailovich, 1980.
Superfamily AMMODISCOIDEA Reuss, 1862.
Family AMMODISCIDAE Reuss, 1862.
Subfamily AMMODISCINAE Reuss, 1862.
Genus *Ammodiscus* Reuss, 1862.
**Ammodiscus sp.**, Pl. I, Figure 8.
Genus *Ammodiscoides* Cushman, 1909.
**Ammodiscoides turbinatus** Cushman, 1909, Pl. I, Figure 7.
Subfamily USBEKISTANINAE Vyalov, 1968.
Genus *Glomospira* Rzehak, 1885.

*“Glomospira” glomerata* (Grzybowsky, 1898), Pl. II, Figure 5.
1898 *Ammodiscus glomeratus* Grzybowsky.
2005 “*Glomospira* glomerata” Kaminski and Gradstein.

*Glomospira gordialis* (Jones and Parker, 1860), Pl. II, Figure 6.
1860 *Trochammina squamata* var. *gordialis* Jones and Parker.
1885 *Glomospira gordialis* (Jones and Parker) Rzehak.
1994 “*Glomospira gordialis*” (Jones and Parker) Hayward and Hollis.
2013 *Glomospira gordialis* (Jones and Parker) Debenay.

**Glomospira sp.**

**CONCLUSION**

Considering the territorial dimensions of the Brazilian mangroves, the high concentration of results in the states of Sao Paulo and Rio de Janeiro (Table 1), the very limited number of mangroves analyzed on the Northeastern and Northern Brazilian coast, as well as the results from several works that have never been published, the number of species is potentially higher than now recorded. Moreover, new tools for environmental genetic analysis have contributed to revealing a significant abundance of cryptic species present in the environment, which may be taken into account.

In this case, monothalamous species are a particular group rarely reported in the literature. Although in estuarine environments such species are indeed rare in abundance, their occurrence may be underestimated because not all researchers recognize the tests of these species as foraminifera. It can be inferred from the fact that certain species are reported only by a researcher or research group who, having found them at some time, tends to report them again in other works. Besides, it should be considered that some sample preparation procedures potentially eliminate species that attach to substrates, such as sieving (excluding large fragments or particles where individuals may be attached) and flotation (decantation of denser particles with attached tests).

In addition to these factors, 28 genera were reported at some point without species identification (Table 1): *Ammobaculites* sp., *Ammobaculoides* sp., *Ammodiscus* sp., *Ammopemphix* sp., *Ammoscalaria* sp., *Ammotium* sp., *Asterotrochammina* sp., *Bigenerina* sp., *Chitinosaccus* sp., *Crichtonia* sp., *Deuterammina* sp., *Discammina* sp., *Entzia* sp., *Glomospira* sp., *Haplophragmoides* sp., *Irilia* sp., *Lituola* sp., *Lituotuba* sp., *Miliammina* sp., *Paratrochammina* sp., *Portatrochammina* sp., *Pseudoclavulina* sp., *Remaneica* sp., *Reophax* sp., *Rotaliammina* sp., *Siphotrochammina* sp., *Textularia* sp. and *Trochammina* sp. In some cases, the conditions of the tests probably have not facilitated species identification, although it was possible to recognize the genus. However, in the cases of the genera *Ammobaculoides, Ammodiscus, Amnopemphix, Ammoscalaria, Asterotrochammina, Bigenerina, Deuterammina, Discammina, Lituotuba, Portatrochammina, Remaneica* and *Rotaliammina*, no species have ever been identified in the Brazilian mangroves.

In addition to the possibility that these genera include species not yet described in the literature, it may emphasize the potential impact that species omission can have on ecological indices (e.g., diversity and evenness), as well as for comparison between assemblages (similarity indices), which are strongly influenced by taxonomic accuracy. Additionally, the synonyms may draw attention, since some same genera and species are reported differently in the literature. It is the case, for example, of the genus *Entzia*, the accepted synonym for the genus *Jadammina*, which in its turn has moved to the status of “not accepted” on the platform maintained by Hayward et al. (2019).

Among the 91 species reported in Brazil, 56 of them were illustrated by SEM images (Table 1). The absence of several species is because they are
**Table 1.** List of agglutinant and monothalamous foraminifera species reported from Brazilian mangroves with the geographical regions and references, respectively. Symbol “X” indicates the presence of the species.

| Species                          | Sai Guçu River (PR) | Guaratuba Bay (PR) | Cananeia and Cardoso Island (SP) | Juréia Itatins (SP) | Santos Estuary (SP) | Bertioga Channel/Tapajá River (SP) | Guaraíba/Sepevetba (RJ) | Saquarema Lagoon (RJ) | Jacareí Lake (RJ) | Acupe (BA) | Itaparica Island (BA) | São Francisco River Delta (SE) | Anguari Estuary (AP) | References with images |
|---------------------------------|---------------------|---------------------|----------------------------------|--------------------|---------------------|-------------------------------------|--------------------------|-----------------------|---------------------|-------------|-------------------------|-----------------------------|-----------------------------|------------------------|
| Acostata mariae                 |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             |                        |
| Acupeina triperforata           | X                   |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             | a, q, n                 |
| Ammoastuta inea                 |                     | X                   |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             | a, c, q, n               |
| Ammoastuta salsa                |                     | X                   | X                                | X                  |                     |                                     |                          |                       |                     |             |                         |                             |                             | c, i, k, n               |
| Ammobaculites exigus            | X                   | X                   |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             | a, c, q, n               |
| Ammobaculites sp.               |                     | X                   | X                                | X                  |                     |                                     |                          |                       |                     |             |                         |                             |                             | c                        |
| Ammobaculoides sp.              |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             |                         |
| Ammodiscoides turbinitus        |                     | X                   |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             |                         |
| Ammodiscus sp.                  |                     |                     | X                                | X                  |                     |                                     |                          |                       |                     |             |                         |                             |                             | a, q, n                 |
| Ammopemphix sp.                 |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             | a, n                    |
| Ammoscalaria sp.                |                     | X                   |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             |                         |
| Ammotium angulatum              |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             |                         |
| Ammotium cassis                 |                     | X                   | X                                | X                  |                     |                                     |                          |                       |                     |             |                         |                             |                             | c, q, n                 |
| Ammotium directum               | X                   | X                   |                                  | X                  |                     |                                     |                          |                       |                     |             |                         |                             |                             | a, d, n, p               |
| Ammotium morenoi                |                     | X                   |                                  | X                  |                     |                                     |                          |                       |                     |             |                         |                             |                             |                         |
| Ammotium pseudocassis           |                     | X                   | X                                | X                  |                     |                                     |                          |                       |                     |             |                         |                             |                             | q                        |
| Ammotium salsum                 | X                   | X                   | X                                | X                  |                     |                                     |                          |                       |                     |             |                         |                             |                             | a, c, e, i, k, n, p, q   |
| Ammotium sp.                    |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             |                         |
| Arenoparrella mexicana          | X                   | X                   | X                                | X                  |                     |                                     |                          |                       |                     |             |                         |                             |                             | a, c, d, e, i, k, n, q   |
| Asterotrochammina sp.           |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             |                         |
| Astrammina rara                 |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             | k, n                    |
| Bahianofusus pontei             |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             | l, n                    |
| Bahianotubus salvadorensis      |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             | l, n                    |
| Bigenerina sp.                  | X                   | X                   |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             | a, c                    |
| Blysmasphaera brasiliensis      |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             | q, n, r                  |
| Blysmasphaera broennimannii     |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             | r                        |
| Caronia exilis                  | X                   | X                   | X                                | X                  |                     |                                     |                          |                       |                     |             |                         |                             |                             | a, c, e, n, k             |
| Chitinosaccus guaratibaensis    |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             | l, n                    |
| Chitinosaccus sp.               | X                   | X                   |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             | c                        |
| Chitinosaccus zuluensis         |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             | k                        |
| Crithionina mamilla             |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             |                         |
| Crithionina sp.                 |                     |                     |                                  |                    |                     |                                     |                          |                       |                     |             |                         |                             |                             |                         |
**CONTINUED TABLE 1.**

| Species                  | Colonies | X | X | X | X | X | X | X | X | X | X | a, n |
|--------------------------|----------|---|---|---|---|---|---|---|---|---|---|-----|
| Deuterammina sp.         | .         | X | . | . | . | . | . | . | . | . | . | c   |
| Discammina sp.           | .         | . | . | . | . | . | . | . | . | . | X | .   |
| Discorinopsis aguayoi    | .         | . | . | . | . | . | X | . | . | . | . | .   |
| Entzia macrescens        | X         | X | X | X | X | X | X | . | . | . | . | a, n |
| Entzia polystoma         | .         | X | X | . | . | . | . | . | . | . | X | c   |
| Entzia sp.               | .         | . | . | . | X | . | . | . | . | . | . | .   |
| “Glomospira” glomerata   | .         | . | . | . | . | . | X | . | . | . | . | .   |
| Glomospira gordialis     | .         | X | X | . | X | X | . | . | . | . | . | c   |
| Glomospira sp.           | .         | . | X | . | . | . | . | . | . | . | . | .   |
| Haplophragmoides manilaensis |          | X | X | X | . | X | X | . | . | . | X | a, q, n |
| Haplophragmoides sp.     | .         | . | . | X | . | . | . | . | . | X | . | p   |
| Haplophragmoides wilberti |          | X | X | X | . | X | X | X | X | X | . | a, c, e, i, k, q, n |
| Hemisphaerammina bradyi  | .         | X | . | . | . | . | . | . | . | . | . | .   |
| Iridia diaphana          | .         | . | . | . | . | . | X | . | . | . | . | .   |
| Iridia sp.               | .         | . | . | . | X | . | . | . | . | . | . | .   |
| Lepidodeuterammina ochracea |         | X | X | . | . | X | . | . | . | . | . | a, n |
| Lituola sp.              | .         | . | . | . | . | X | . | . | . | . | . | .   |
| Lituotuba sp.            | .         | . | . | . | . | . | X | . | . | . | . | .   |
| Miliammina earlandi      | .         | X | . | . | . | X | . | . | . | . | . | c   |
| Miliammina fusca         | X         | X | X | . | . | X | X | . | X | . | . | a, c, e, n, q |
| Miliammina pariaensis    | .         | . | . | . | X | . | . | . | . | . | . | .   |
| Miliammina sp.           | .         | . | X | X | . | . | X | . | . | . | . | .   |
| Monotalea salsa          | .         | . | . | . | X | . | . | . | . | . | X | q   |
| Pararotalia cananeiaensis |        | . | . | . | X | . | . | . | . | . | . | .   |
| Paratrochammina clossi   | .         | X | X | X | X | X | X | . | . | . | . | n   |
| Paratrochammina sp.      | .         | X | X | . | X | . | . | . | . | . | . | c   |
| Polysaccammina hyperhalina |      | X | X | . | . | . | X | . | . | . | X | a, q |
| Polysaccammina ipohalina | X         | X | X | . | . | X | X | . | X | . | . | a, c, k |
| Portatrochammina sp.     | .         | . | . | . | . | . | X | . | . | . | . | a   |
| Protoschista findes      | .         | . | . | . | . | X | . | . | . | . | . | .   |
| Psammosphera frankei     | .         | . | . | . | . | X | . | . | . | . | . | k   |
| Psammosphera fusca f. adhaeren |      | . | . | . | . | . | X | . | . | . | . | .   |
| Pseudoclavulina curta    | .         | . | . | . | X | . | . | X | . | . | . | .   |
| Pseudoclavulina gracilis | .         | . | . | . | . | . | X | . | . | . | . | .   |
| Pseudoclavulina sp.      | .         | X | . | . | . | . | . | . | . | . | . | .   |
| Pseudothurammina limnetis |          | X | X | X | . | . | . | . | . | . | . | a, c |
| Remaneica sp.            | .         | X | . | . | . | . | . | . | . | . | . | a   |
| Reophax nana             | .         | X | X | . | . | X | . | . | . | . | . | a, c |
| Reophax palustris        | .         | . | . | . | . | . | X | . | . | . | . | .   |
| Reophax sp.              | X         | . | . | . | X | X | . | X | . | . | . | .   |
| Rotaliammina sp.         | .         | . | . | . | X | . | . | . | . | . | . | .   |
| Siphotrochammina elegans | .         | . | . | . | . | X | . | X | . | . | . | k   |

*Note: X represents the presence of a particular feature or characteristic.*
### CONTINUED TABLE 1.

| Species                        | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p |
|--------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Siphotrochammina lobata        | X | X | X | X | . | . | X | . | X | c, i, n |
| Siphotrochammina sp.           | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Spiroplectammina biformis      | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Textularia earlandi            | X | X | X | . | X | X | . | . | X | d, n, q |
| Textularia gramen              | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Textularia paranaguensis       | . | . | . | . | X | . | . | . | . | . | . | n | . | . | . | . |
| Textularia sp.                 | . | . | X | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Tholosina centroforata         | . | . | . | . | . | X | . | . | . | . | . | . | . | . | . | . |
| Tiphotrecha comprimata         | X | X | X | . | X | X | . | X | . | a, c, n, k |
| Trilocularena patensis         | X | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Trochammina inflata            | X | X | X | . | X | X | . | X | . | a, c, d, i, k, n, p |
| Trochammina sp.                | . | X | X | . | . | . | . | . | . | . | . | . | . | . | . | . |
| Trochammina squamata           | X | X | X | . | X | X | . | X | . | a, n |
| Trochaminina irregularis       | . | . | X | . | X | . | X | . | X | c, k, q, n |
| Trochaminina salsa             | . | . | . | . | X | X | . | . | X | . | . | . | . | . | . | . |
| Warrenita palustris            | . | . | X | . | . | . | . | . | X | . | . | . | . | . | . | c, i, n |

*Barbosa et al. (2005); *Eichler & Bonetti (1995); *Bonetti & Eichler (1997); *Semensatto-Jr. et al. (2009); *Duleba & Debenay (2003); *Bonetti et al. (2002); *Eichler et al. (2007); *Passos et al. (2017); *Eichler (2019); *Kukimodo & Semensatto (2019); *Zaninetti et al. (1977); *Brönnimann et al. (1979); *Laut & Rodrigues (2011); *Zaninetti et al. (1979); *Zerfass et al. (2006); *Semensatto Jr. & Dias-Brito (2004); *Semensatto et al. (2008); *Laut et al. (2010).

Generally rare, and their tests may not have adequate conditions for image capture, and in the publications, it is preferred to illustrate the main species found. Thus, it is suggested to publish images of species not yet illustrated in Brazil, in order to constitute visual references and contribute to their identification.

### ACKNOWLEDGEMENTS

The author is grateful to Prof. Dr. Francisco Fatela and Dr. João Moreno (Universidade de Lisboa, Portugal), Prof. Dr. Lázaro Laut (Universidade Federal do Estado do Rio de Janeiro), Prof. Dr. Sibelle Trevisan Disaró (Universidade Federal do Paraná), Dr. Natália Rudorff (Instituto Nacional de Pesquisas Espaciais), MSc. Joana Santa-Cruz (Fundação de Amparo à Pesquisa do Estado de São Paulo), Dr. Sarita Camacho (Universidade do Algarve) and editors of journals that authorized reuse of images of foraminifera, and to Prof. Dr. Dimas Dias-Brito (Universidade Estadual Paulista, Brazil) for advising and supporting the acquiring of some foraminifera images (SEM) that form part of the author’s collection here illustrated. Part of foraminifera images acquired (SEM) was supported by scholarships granted from Fundação de Amparo à Pesquisa do Estado de São Paulo/FAPESP (Processes 01/11786-8 and 11/1687-4), Agência Nacional do Petróleo, Gás e Biocombustíveis (ANP/PRH-05), and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior/CAPES.

### REFERENCES

ALVE, E., HESS, S., BOUCHET, V. M. P., DOLVEN, J. K. & RYGG, B. 2019. Intercalibration of benthic foraminiferal and macrofaunal biotic indices: an example from the Norwegian Skagerrak coast (NE North Sea). *Ecological Indicators*, 96, 107-115.

ALVE, E., LEPLAND, A., MAGNUSSON, J. & BACKER-OWE, K. 2009. Monitoring strategies for re-establishment of ecological reference conditions: possibilities and limitations. *Marine Pollution Bulletin*, 59, 8-12, 297-310.

BARBOSA, C. F., SCOTT, D. B., SEOANE, J. C. S. & TURCQ, B. J. 2005. Foraminiferal zonations as base lines for quaternary sea-level fluctuations in south-southeast Brazilian mangroves and marshes. *Journal of Foraminiferal Research*, 35, 1, 22-43.

BOLTOVSKOY, E., GIUSSANI, G., WATANABE, S. & WRIGHT, R. C. 1980. *Atlas of benthic shelf foraminifera of the Southwest Atlantic*, Hague Publishers, Boston, MA.

BONETTI, C. & EICHLER, B. B. 1997. Benthic foraminifera and thec- amoebians as indicators of river/sea gradients in the estuarine zone of Itapitanguí River – Cananéia/SP, Brazil. *Anais da Academia Brasileira de Ciências*, 69, 4, 545-563.

BONETTI, C. H. C., EICHLER, B. B. & DEBENAY, J. P. 2002. Evolução temporal da impactação do Sistema Estuarino de Santos - São Vicente (SP, Brasil) analisada através das populações de foraminíferos sub- recentes. *Pesquisas em Geociências*, 28, 2, 273-283.
BORTOLUS, A. 2008. Error cascades in the biological sciences: the unwanted consequences of using bad taxonomy in ecology. Ambio, 37, 2, 114-118.

BOUCHET, V. M. P., ALVE, E., RYGG, B. & TELFORD, R. J. 2012. Benthic foraminifera provide a promising tool for ecological quality assessment of marine waters. Ecological Indicators, 23, 66-75.

BRÖNNIMANN, P. 1979. Recent benthonic foraminifera from Brazil. Morphology and ecology. Part IV: Trochamminids from the Campos Shelf with description of Paratrochammina n. gen. Palaontologische Zeitschrift, 53, 1-2, 5-25.

BRÖNNIMANN, P., DIAS-BRITO D. & MOURA J.A. 1981. Foraminíferos da Fácies Mangue da planicie de maré de Guaratiba, Rio de Janeiro, Brasil. Anais do II Congresso Latino-Americano de Paleontologia, 2, 877-891.

BRÖNNIMANN, P. & DIAS-BRITO, D. 1982. New Litoulacea (Proctostraca, Foraminiferida) from shallow waters of the Brazilian shelf. Journal of Foraminiferal Research, 12, 1, 13-23.

BRÖNNIMANN, P., WHITTAKER, J. E. & ZANNINETTI, L. 1992. Brackish water foraminifera from mangrove sediments of southwestern Viti Levu, Fiji Islands, Southwest Pacific. Revue de Paleobiologie, 11, 2, 13-65.

CAMACHO, S. G., MOURA, D. J. M., CONNOR, S., SCOTT, D. B. & BOSKI, T. 2015. Taxonomy, ecology and biogeographical trends of dominant benthic foraminifera species from an Atlantic-Mediterranean estuary (the Guadiana, southeast Portugal). Palaeoentologia Electronica, 18, 1-37.

CLARK, F. E. & PATTERSON, T. 1993. An illustrated key to the identification of unilocular genera of calcareous foraminifera. Journal of Paleontology, 67, 1, 20-28.

CLOSS, D. 1962. Foraminíferos e tecamebas da Lagoa dos Patos (RS). Boletim da Escola de Geologia de Porto Alegre, 11, 1-130.

CUSHMAN, J. A. & TODD, R. 1948. A foraminiferal fauna from the Cook Mountain Formation of Mississippi. Contributions from the Cushman Laboratory for Foraminiferal Research, 24, 2, 27-48.

DEBENAY, J. P. 2013. A guide to 1,000 foraminifera from southwestern Pacific New Caledonia, Muséum National d’Histoire Naturelle, Paris, France.

DISARÓ, S. T. 2006. Foraminíferos em ecossistemas de manguezal e marismas salgadas. In: MONTEIRO-FILHO, E. L. A. & ARANHA, J. M. R. (ed.), Revisões em Zoologia - I: Volume co-memorativo dos 30 anos do Curso de Pós-Graduação em Zoologia da Universidade Federal do Paraná, Secretaria do Meio Ambiente do Estado do Paraná, Curitiba, PR, pp. 67-85.

DULEBA, W. & DEBENAY, J. P. 2003. Hydrodynamic circulation in the estuaries of Estação Ecológica Juréia-Itatins, Brazil, inferred from foraminifera and thecamoebian assemblages. Journal of Foraminiferal Research, 33, 1, 62-93.

EICHLER, B. B. & BONETTI, C. 1995. Distribuição dos foraminíferos e tecamebas ocorrentes no manguezal do Rio Baguça, Cananéia, São Paulo - relações com parâmetros ambientais. Pesquisas em Geociências, 22, 1-2, 32-37.

EICHLER, P. B. 2019. Foraminiferal zonation from a subtropical mangrove in Bertioga Channel (São Paulo, SP, Brazil). Regional Studies in Marine Science, 25, 100460.

EICHLER, P. B., EICHLER, B. B., MIRANDA, L. B. & RODRIGUES, A. R. 2007. Modern foraminiferal facies in a subtropical estuarine channel, Bertioga, São Paulo, Brazil. Journal of Foraminiferal Research, 37, 3, 234-247.

ELLIS, B. F. & MESSINA, A. R. 1940. et seq. Catalogue of foraminifera, Micropaleontology Press, New York, NY.

ENCARNAÇÃO, D. S. G. C. 2012. Ecologic zonation model of the benthic foraminifera and thecamoebians of Guadiana River estuary and application in paleoenvironmental reconstruction, PhD thesis, Algarve University, Faro, Portugal, viewed 20 March 2020, <http://hdl.handle.net/10400.1/7738>.

FRONTALINI, F., BUOSI, C., DA PELO, S., COCCIONI, R., CHERCHI, A. & BUCCI, C. 2009. Benthic foraminifera as bio-indicators of trace element pollution in the heavily contaminated Santa Gilla lagoon (Cagliari, Italy). Marine Pollution Bulletin, 58, 858-877.

GALEOTTI, S., KAMINSKI, M. A., COCCIONI, R. & SPEIJER, R. P. 2004. High resolution deep-water agglutinated foraminiferal record across the Paleocene/Eocene transition in the Contessa Road Section (central Italy). Grzybowski Foundation Special Publication, 8, 83-103.

HAYWARD, B. W. & HOLLIS, C. J. 1994. Brackish foraminifera in New Zealand: a taxonomic and ecological review. Micropaleontology, 40, 3, 185-222.

HAYWARD, B. W., GRENFELL, H. R., REID, C. M. & HAYWARD, K. A. 1999. Recent New Zealand shallow-water benthic foraminifera: taxonomy, ecological distribution, biogeography, and use in paleoenvironmental assessments, Institute of Geological & Nuclear Sciences, Lower Hutt, New Zealand.

HAYWARD, B.W., LE COZE, F., VACHARD, D. & GROSS, G. 2019. The World Foraminifera Database, Flanders Marine Institute, Ostend, Belgium, viewed 04 October 2019, <http://www.marinespecies.org/foraminifera>.

JONES, R. W. 1994. The challenger foraminifera. Oxford University Press, Oxford.

KAMINSKI, M. A., CETEAN, C. G. & HENDERSON, A. S. 2008. Lectotypes of type species of Agglutinated Foraminiferal Genera in the Collections of the Natural History Museum, London. Part 1. Asthorhizina and Saccamminina. Grzybowski Foundation Special Publication, 13, 63-77.

KUKIMODO, I. & SEMENSATTO, D. 2019. Sampling strategy always matters: methodological issues on collecting samples in tropical transitional environments for ecological analysis based on recent foraminifera. Marine Micropaleontology, 148, 46-57.

LAUT, L., CLEMENTE, I., MARTINS, M. V. A., FRONTALINI, F., RAPOSO, D., BELART, P., HABIB, R., FORTES, R. & LORINI, M. L. 2017. Benthic Foraminifera and Thecamoebians of Godineau River Estuary, Gulf of Paria, Trinidad Island. Anuário do Instituto de Geociências – Universidade Federal do Rio de Janeiro, 40, 2, 118-143.

LAUT, L. L. M., SILVA, F. S., BONETTI, C., FIGUEIREDO, A. G. JR. & CRAPEZ, M. A. C. 2007. Foraminiferos and atividade bacteriana aplicados no diagnóstico ambiental do rio Itacorubi, Florianópolis, SC, Revista Brasileira de Geociências, 37, 3, 565-578.

LAUT, L. L. M., FERREIRA, D. E. S., SANTOS, V. F., FIGUEIREDO, A. G. JR., CARVALHO, M. A. & MACHADO, O. F. 2010. Foraminifera, thecamoebians and palynomorphs as hydrodynamic indicators in Araguari Estuary, Amazonian Coast, Ampá State – Brazil. Anuário do Instituto de Geociências – Universidade Federal do Rio de Janeiro, 33, 2, 52-65.

LAUT, L. L. M. & RODRIGUES, M. A. C. 2011. Foraminiferos do manguezal de Guaratuba, Rio de Janeiro: revisão taxonômica e aplicação de análises multivariadas. In: CARVALHO, I., CARVALHO, M. A. & MACHADO, O. F., 2010. Foraminifera, thecamoebians and palynomorphs as hydrodynamic indicators in Araguari Estuary, Amazonian Coast, Ampá State – Brazil. Anuário do Instituto de Geociências – Universidade Federal do Rio de Janeiro, 33, 2, 52-65.
ZANINETTI, L., BRÖNNIMAN, P., DIAS-BRITO, D., ARAI, M., CASALETTI, P., KOUTSOUKOS, E. & SILVEIRA, S. 1979. Distribution écologique des Foraminifères dans la Mangrove d’Acupe, Etat de Bahia, Brésil. Notes du Laboratoire de Paleontologie de L’Université de Genève, 4, 1, 1-17.

ZERFASS, G. S. A., ANDRADE, E. J., LESSA, G. C. & MACHADO, A. J. 2006. Foraminíferos bentônicos do estuário de Cacha-Prego Ilha de Itaparica, Bahia, Brasil. Pesquisas em Geociências, 33, 2, 43-54.