On the occurrence of testate amoebae (Protozoa, Amoebozoa, Rhizopoda) in Brazilian inland waters. III. Family Difflugiidae: Genus *Difflugia*

Fábio Amodêo Lansac-Tôha*, Luiz Felipe Machado Velho, Maria Cláudia Zimmermann-Callegari, Cláudia Costa Bonecker and Erica Mayumi Takahashi

*Departamento de Biologia/Nupélia, Programa de Pós-Graduação em Ecologia de Ambientes Aquáticos Continentais, Universidade Estadual de Maringá, Av. Colombo, 5790, 87.020-900, Maringá, Paraná, Brasil. *Author for correspondence.*

ABSTRACT. Among the testate amoebae the genus *Difflugia* contains the largest number of species, comprising about three hundred named species, varieties and forms. Testate amoebae fauna, more intensively studied in recent years in Brazil, hailed from a variety of different habitats such as sediments, aquatic macrophytes and the plankton. However, these studies have been limited to few geographic regions. In this study we furnish current information on the geographic distribution and occurrence of the species of genus *Difflugia* in Brazilian inland waters. Taxonomic information is also provided. A total of 60 infra-generic taxa is listed, among which *Difflugia corona* Wallich, *D. lobostoma* Leidy, *D. oblonga* Ehrenberg, *D. urceolata* Carter and *D. acuminata* Ehrenberg are the most frequent and the most widespread in freshwater environments in Brazil.

Key words: aquatic Protozoa, testate amoebae, *Difflugia*, geographical distribution, Brazil.

RESUMO. Ocorrência de tecamebas (Protozoa, Amoebozoa, Rhizopoda) em águas continentais brasileiras. III. Família Difflugiidae. Gênero *Difflugia*. Entre as tecamebas, o gênero *Difflugia* apresenta o maior número de espécies, com aproximadamente 300 espécies, variedades e formas descritas. No Brasil, a fauna de tecamebas, proveniente de diferentes hábitats, como sedimento,macrófitas aquáticas e plânton, tem sido mais intensivamente estudada nos últimos anos. No entanto, essas pesquisas estão limitadas a poucas regiões geográficas. Neste estudo,são fornecidas informações sobre a distribuição geográfica e a ocorrência das espécies do gênero *Difflugia* no Brasil. Informações taxonômicas atualizadas são fornecidas. É apresentado um total de 60 táxons infragenéricos, dentre os quais *Difflugia corona* Wallich, *D. lobostoma* Leidy, *D. oblonga* Ehrenberg, *D. urceolata* Carter and *D. acuminata* Ehrenberg são os que apresentam maior freqüência de ocorrência e os mais amplamente distribuídos nos sistemas de água doce brasileiros.

Palavras-chave: protozoários aquáticos, tecamebas, *Difflugia*, distribuição geográfica, Brasil.

Testate amoebae fauna have been recently more intensively studied in Brazil from different habitats such as sediments (Barbosa, 1995; Hardoim, 1997; Eichler-Coelho *et al.*, 1997; Oliveira, 1999), aquatic macrophytes (Hardoim and Heckman, 1996; Torres, 1996a), sphagnum and moss (Rhoden and Pitoni, 1999) and plankton from rivers, reservoirs and lakes (Dabés, 1995; Velho *et al.*, 1996; Velho and Lansac-Tôha, 1996, Lansac-Tôha *et al.*, 1997; Velho *et al.*, 1999). However, these researches are limited to a few geographic regions. Consequently, such studies are still fledging to provide a real picture on the species richness of this group. On the other hand, a growing number of studies are including these organisms, which have contributed in an expressive manner towards the knowledge of testate amoebae in Brazilian freshwater environments.

Among the testate amoebae the genus *Difflugia* contains the largest number of species (Ogden, 1988, Ogden and Meisterfeld, 1989). The taxonomy of the species belonging to this genus has been based mainly on differences in size and shape of the agglutinated shells. These differences in shell features have resulted in about three hundred named species, varieties and forms being currently attributed to the genus (Ogden, 1983).

In previous studies we have furnished current information on the geographical distribution of Arcellidae (Lansac-Tôha *et al.*, 2000a), Centropyxidae, Plagiopyxidae and Trigonopyxidae

(Velho *et al.*, 2000), and this study is the third in a series of papers that intends to synthesize the knowledge on testate amoebae occurrence and to identify areas in which information on these organisms is lacking within Brazil. An update on the identification of *Difflugia* species in Brazil will be provided.

Material and methods

The occurrence and geographical distribution of *Difflugia* discussed in this study took into consideration only those found in scientific publications, dissertations and theses. We shall list for each species the principal, and frequently all, pertinent taxonomic references.

Results

Difflugiidae Awerintzew, 1906

***Difflugia achlora* (Pénard, 1902)**

Pénard, 1902: 283, textfigs. 7-8 (as *D. gramen* var. *achlora*); Stepánek and Jiri, 1958: 143, fig. 3 (as *D. gramen* var. *achlora*); Gauthier-Lièvre and Thomas, 1958: 259, pl. VIII, figs. i-l (as *D. gramen* var. *achlora*); Green, 1963: 505, figs. 18-19 (as *D. gramen* var. *achlora*); Dioni, 1970: 216-217, fig. 33b (as *D. gramen* var. *achlora*); Vucetich, 1972a: 276, pl. I, fig. 6; 1973: 302, pl. III, fig. 26 (as *D. gramen* var. *achlora*); Grospietsch, 1972: 16 (as *D. gramen* var. *achlora*); Ogden, 1980: 130, figs. 12-17; Ogden and Meisterfeld, 1989: 121, fig. 24.

Comments: In Brazil, this species has been found only in plankton samples from the Suia Missu river, state of Mato Grosso (Green, 1975) and from the São Francisco river basin, state of Minas Gerais (Dabés, 1995, 1999) (Figure 1).

***Difflugia acuminata* Ehrenberg, 1838**

Ehrenberg, 1838: 131, pl. IX, fig. 3; Pénard, 1902: 233, textfig. 9; De la Rua, 1912: 46, fig. 4; Franken, 1933: 193, pl. II, fig. 2; Gauthier-Lièvre and Thomas, 1958: 323, fig. 44a-c; Chardez, 1967, pl. IV, fig. 1; Laminger, 1972, fig. 12.2-g-h, Grospietsch, 1972: 14, fig. 31; Lena and Cachi, 1972, pl. I, figs. 6-8; Vucetich, 1973: 307, pl. IV, fig. 36; Boltovskoy and Lena, 1974, pl. II, figs. 7-8; Green, 1975, fig. 7; Lena and Zaidenwerg, 1975, pl. II, fig. 7; Chardez and Hellebaut, 1978, figs. 24-25; Ogden, 1979: 146, fig. 3; 1984: 243, figs. 7-8; Ogden and Hedley, 1980: 118, pl. XLVIII, figs. A-C; Lena, 1983, pl. III, fig. 5; Velho and Lansac-Tôha, 1996: 186, pl. 2, fig. 14; Hardoim, 1997: 235, fig. 79.

Comments: This species has been registered in the state of Mato Grosso in plankton samples from the Suia Missu river basin (Green, 1975) and in bottom and periphyton samples of the Pantanal de Poconé (Hardoim and Heckman, 1996; Hardoim, 1997); in the state of Goiás in plankton samples from the Corumbá river and tributaries (Lansac-Tôha *et al.*, 1999, 2000b); in the state of Minas Gerais in plankton samples from reservoirs and rivers (Rolla *et al.*, 1992; Dabés, 1995; Bonecker *et al.*, 1996; Landa, 1997; Landa and Mourgués-Schurter, 2000a and b), in the state of Sergipe in bottom samples from Piauí river (Zucon and Loyola e Silva, 1992); in the state of Rio de Janeiro in the plankton from Manguinhos and Angra dos Reis (Cunha, 1913, 1916), in the state of São Paulo in the plankton from Broa Reservoir (Neumann-Leitão *et al.*, 1990); in the state of Paraná in the plankton from artificial lakes (Nunes *et al.*, 1996) and in the states of Paraná and Mato Grosso do Sul in the plankton from the Upper Paraná river floodplain (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997; Velho *et al.*, 1999) and in the state of Rio Grande do Sul in bottom samples of coastal lagoons (Closs and Medeiros, 1965, 1967) and in periphyton samples from a small impoundment (Torres, 1996a) (Figure 1).

***Difflugia acuminata* var. *magna* Deflandre, 1926**

Deflandre, 1926: 519, fig. 4; Gauthier-Lièvre and Thomas, 1958: 324, fig. 44d; Green, 1963, fig. 27; Chardez, 1967, pl. IV, fig. 1; Vucetich, 1973: 308, pl. IV, fig. 37; Vucetich and Lopretto, 1995, fig.14; Velho and Lansac-Tôha, 1996: 186, pl. II, fig. 15.

Comments: In Brazil this taxon has been registered only in the Upper Paraná river floodplain in plankton samples, states of Paraná and Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997) (Figure 1).

***Difflugia acutissima* Deflandre, 1931**

Deflandre, 1931: 84, pl. XII, figs. 1-3; Gauthier-Lièvre and Thomas, 1958: 317, fig. 40a-d; Chardez, 1967, pl. IV, fig. 15; Dioni, 1970: 211-212, pl. III, fig. 27; Ogden and Zivkovic, 1983: 342-344, fig. 1; Todorov and Golemansky, 1998: 84 and 86.

Comments: The species has been registered only in plankton and periphyton samples from the São Francisco river basin, state of Minas Gerais (Dabés, 1995, 1999; Dabés and Velho, 2001) (Figure 1).

***Difflugia angulostoma* Gauthier-Lièvre and Thomas, 1958**

Gauthier- Lièvre and Thomas, 1958: 253-254, fig. 1; Vucetich, 1973: 303, pl. III, fig. 27.

Comments: The species has been registered only in the states of Rio Grande do Sul (Torres, 1996a)

and Minas Gerais (Dabés and Velho, 2001) in periphyton samples (Figure 1).

***Difflugia avellana* Pénard, 1890**

Pénard, 1890: 144, pl. IV, figs. 38-40; 1902: 261, textfigs. 1-4; Gauthier-Liévre and Thomas, 1958: 287-288, fig. 20a-b; Boltovskoy and Lena, 1966: 59, pl. I, figs. 8-9; Lena and Cachi, 1972, pl. I, fig. 15; Laminger, 1973, fig. 31i.

Comments: The species has been registered in plankton samples from the Tietê river basin, state of São Paulo (Prowazek, 1910), and in bottom samples from the Mirim Lagoon, state of Rio Grande do Sul (Closs and Medeiros, 1967) (Figure 1).

***Difflugia bacillifera* Pénard, 1890**

Pénard, 1890: 146, pl. IV, figs. 61-66; Franken, 1933: 195, pl. IV, fig. 5; Chardez, 1967, pl. III, fig. 30; Meisterfeld, 1979: 253-254, pl. I, fig. 7, pl. II, figs. 8-9; Ogden and Hedley, 1980: 124, pl. LI, figs. A-C; Hardoim, 1997: 237, fig. 80.

Comments: The species has been registered in the state of Mato Grosso in bottom samples from the Pantanal do Poconé (Hardoim, 1997), and in the state of Minas Gerais in plankton samples from small reservoirs (Landa and Mourgués-Schurter, 2000a) (Figure 1).

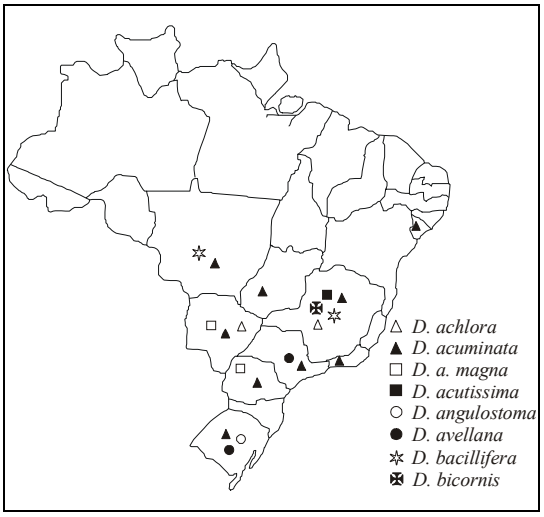

Figure 1. Geographic distribution of the *Difflugia achlora, D. acuminata, D. acuminata magna, D. acutissima, D. angulostoma, D. avellana, D. bacillifera* and *D. bicornis* in Brazilian inland waters

***Difflugia bicornis* Pénard, 1890**

Pénard, 1890: 141, pl. IV, figs. 12-14; Ogden and Zivkovic, 1983: 344, fig. 2; Ogden, 1984: 246; Dabés and Velho, 2001, fig. 4a.

Comments: The only occurrence of *D. bicornis* in Brazil has been made from the São Francisco river basin in periphyton samples, state of Minas Gerais (Dabés and Velho, 2001) (Figure 1).

***Difflugia bidens* Pénard, 1902**

Pénard, 1902: 264-265, textfigs. 1-8; Stepánek, 1967, fig. 15.4; Laminger, 1972, fig. 12.1f; Medioli and Scott, 1983: 21, pl. I, figs. 1-5; 1985: 26-27, fig. 1; Patterson *et al.*, 1985, pl. II, figs. 13-14.

Comments: *D. bidens* has been registered only in bottom samples from the Mirim Lagoon, state of Rio Grande do Sul (Closs and Medeiros, 1967), and from the Cananéia-Iguape Estuary, state of São Paulo (Eichler *et al.*, 1997) (Figure 2).

***Difflugia brevicolla* Cash and Hopkinson, 1909**

Playfair, 1917: 646, pl. XXXVI, fig. 4; Gauthier-Lièvre and Thomas, 1958: 281, fig. 15a-b; Chardez, 1967, pl. V, fig. 24; Stepánek, 1967, fig. 14.2-3; Laminger, 1972, fig. 12.1d-e; Green, 1975, fig. 8; Chardez and Hellebaut, 1978, fig. 14; Ogden, 1980, figs. 13-17; Todorov and Golemansky, 1998: 86.

Comments: The only registers of *D. brevicola* in Brazil have been made by Green (1975) in plankton samples from the Suia Missu river basin, in the state of Mato Grosso (Figure 2).

***Difflugia bryophila* (Pénard, 1902)**

Pénard, 1902: 221, textfig. 7 (as *D. pyriformis* var. *bryophila*); Gauthier- Lièvre and Thomas, 1958: 338-339, fig. 52b-c; Chardez, 1967, pl. III, fig. 16; Godeanu, 1970a, fig. 1l; Boltovskoy and Lena, 1971a, pl. I, fig. 11; 1974, pl. VI, figs. 11-13; Lena, 1983, pl. III, figs. 11-12 (as *D. pyriformis* var. *bryophila*); Ogden, 1983, fig. 1; 1984: 246, figs. 9-11.

Comments: The species has been registered only in the Mirim Lagoon in bottom samples, state of Rio Grande do Sul (Closs and Medeiros, 1967) (Figure 2).

***Difflugia capreolata* Pénard, 1902**

Pénard, 1902: 228, textfigs. 1-4; Bolli and Saunders, 1954: 48, fig. 2; Gauthier- Lièvre and Thomas, 1958: 340, fig. 53; Closs and Madeira, 1962: 9, pl. IV, figs. 3-5, pl. V, fig. 5-6; 1967, pl. I, fig. 4; Chardez, 1967, pl. III, fig. 37; Vucetich, 1970: 45, fig. 6; 1973: 310, pl. V, fig. 41; Dioni, 1970: 211, pl. II, fig. 20; Brant-Ribeiro, 1970: 15-16, pl. I, figs. 1-2; Madeira-Falcetta, 1974, pl. IV, fig. 15; Lena and Zaidenwerg, 1975, pl. III, fig. 7; Ogden and Zivkovic, 1983: 344, fig. 3; Lena, 1983, pl. III, fig. 18; Haman, 1990, pl. I, figs. 6-7; Bonetti and Eichler, 1997, pl. I, figs. 2-3; Torres, 1998: 547, fig. 5.

Comments: *D. capreolata* has been registered in Brazil in bottom samples, mainly in coastal lagoons or estuaries: state of Rio Grande do Sul (Closs and Madeira, 1962, 1967; Closs and Medeiros, 1967; Madeira-Falcetta, 1974); state of Santa Catarina (Madeira-Falcetta, 1974); state of São Paulo (Eichler-Coelho *et al.*, 1997; Bonetti and Eichler, 1997; Oliveira, 1999); state of Minas Gerais (Brant-Ribeiro, 1970); and state of Sergipe (Zucon and Loyola e Silva, 1992). The species has been also found in plankton samples in Manguinhos, state of Rio de Janeiro (Prowazek, 1910), and in periphyton samples of a reservoir, state of Rio Grande do Sul (Torres, 1996a, 1998) (Figure 2).

***Difflugia claviformis* (Pénard, 1899)**

Stepánek, 1967, fig. 8.6-8; Chardez and Hellebaut, 1978, fig. 20 (as *D. pyriformis claviformis*); Ogden, 1979: 146, fig. 4; Ogden and Hedley, 1980: 126, fig. LII, figs. A-D.

Comments: *D. claviformis* has been registered in Brazil only by Madeira-Falcetta (1974) in samples of bottom from coastal lagoons, state of Rio Grande do Sul (as *D. pyriformis* var. *claviformis*) (Figure 2).

***Difflugia corona* Wallich, 1864**

Wallich, 1864: 241, pl. XVI, figs. 19-20; Pénard, 1902: 288, textfigs. 1-2; Deflandre, 1926: 523-524, figs. 14-16; Oye, 1931: 60, fig. 5; Franken, 1933: 193, pl. IV, fig. 6; Gauthier- Lièvre and Thomas, 1958: 254-255, fig. 2a; Boltovskoy, 1956: 307, pl. I, fig.5; Closs and Madeira, 1962: 8, pl IV, figs.15-16, pl. VI, figs. 10-11; Chardez, 1967, pl. V, fig. 3; Dioni, 1967: 121; Brant-Ribeiro, 1970: 16-17, pl. I, figs. 3-5; Boltovskoy and Lena, 1971a: 446, pl. III, figs. 1-6; 1974: 22, pl. III, figs. 5-7; Grospietsch, 1972: 14, fig. 28; Vucetich, 1972a: 277-278; 1973: 301, pl. III, fig. 23; Madeira-Falcetta, 1974, pl. IV, fig 13; Lena and Zaidenwerg, 1975, pl. IV, figs. 1-2; Kudo, 1975: 450; Chardez and Hellebaut, 1978, fig. 1; Ogden and Hedley, 1980: 128, pl. LIII, figs. A-D; Ogden and Zivkovic, 1983: 346-347, fig. 4; Lena, 1983, pl. III, figs. 1-3; Medioli and Scott, 1983: 22, pl. I, fig. 6-14; 1985: 27, fig. 2; Patterson *et al.*, 1985, pl. II, figs. 1-6; Barbosa, 1995, fig. 3.5; Velho and Lansac-Tôha, 1996: 179-181, pl. I, fig. 1; Hardoim, 1997: 239, fig. 81.

Comments: *D. corona* is the species of *Difflugia* with the largest number of records in Brazil: state of Sergipe (Zucon and Loyola e Silva, 1992); state of Rio de Janeiro (Cunha, 1913); state of Minas Gerais (Brant-Ribeiro, 1970; Dabés, 1995, 1999; Bonecker *et al.*, 1996; Landa and Mourgués-Schurter, 2000b; Dabés and Velho, 2001); state of Goiás (Lansac-Tôha *et al.*, 1999, 2000); state of São Paulo (Prowazek, 1910; Oliveira *et al.*, 1992; Durigan *et al.*, 1992; Bonetti and Eichler, 1997; Eichler *et al.*, 1997); state of Mato Grosso (Green, 1975; Hardoim and Heckman, 1996; Hardoim, 1997); state of Mato Grosso do Sul (Daday, 1905; Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997; Velho *et al.*, 1999); state of Paraná (Barbosa, 1995; Nunes *et al.*, 1996; Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997; Velho *et al.*, 1999); state of Santa Catarina (Madeira-Falcetta, 1974) and state of Rio Grande do Sul (Closs and Madeira, 1962, 1967; Closs and Medeiros, 1965, 1967; Madeira-Falcetta, 1974; Torres and Jebram, 1994; Torres, 1996a) (Figure 2).

***Difflugia corona* var. *crenulata* Gauthier-Lièvre and Thomas, 1958**

Gauthier- Lièvre and Thomas, 1958: 256, fig. 2b-c; Stepánek, 1967, fig. 11.2.

Comments: This taxon has been registered only in the state of Minas Gerais in plankton samples (Dabés, 1995) (Figure 2).

***Difflugia corona* f. *tuberculata* Vucetich, 1973**

Vucetich, 1973: 302, pl. III, fig. 24; Velho and Lansac-Tôha, 1996: 181, pl. I, fig. 2.

Comments: The taxon has been registered in Brazil only in plankton samples from the upper Paraná river floodplain, states of Paraná and Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.,* 1997; Velho *et al.*, 1999) (Figure 2).

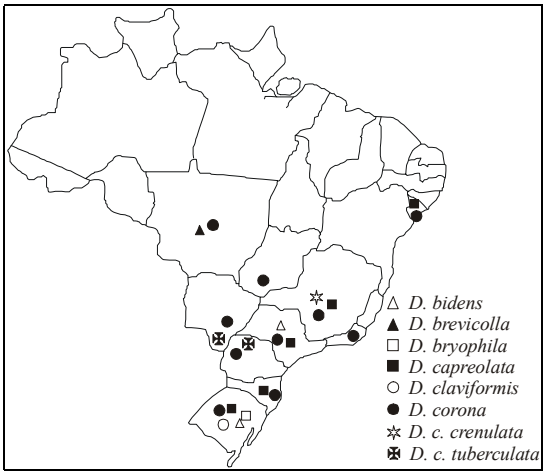

Figure 2. Geographic distribution of the *Difflugia bidens, D. brevicolla, D. bryophila, D. capreolata, D. claviformis, D. corona, D. corona crenulata* and *D. corona tuberculata* in Brazilian inland waters

***Difflugia correntina* Vucetich, 1978**
Vucetich, 1978: 87, pl. II, figs. 2-3; Vucetich and Escalante, 1986: 33-34, pl. I, figs. 1-6; Velho and Lansac-Tôha, 1996: 185, pl. II, fig. 11; Oliveira, 1999, pl. I, fig. 5.

Comments: Species has been registered in plankton from the Upper Paraná river floodplain, state of Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997) and in bottom samples from Itanhaém river basin, state of São Paulo (Oliveira, 1999) (Figure 3).

***Difflugia constricta* (Ehrenberg, 1830)**
Pénard, 1890: 148-149, pl. V, figs. 1-16; 1902: 299, textfigs. 1-2; Franken, 1933: 195, pl. IV, fig. 3; Kudo, 1975: 449, fig. 206f.

Comments: The species has been registered in Brazil only by Prowazek (1910) in plankton samples, state of São Paulo; by Wailes (1913) in samples of mosses, state of Rio de Janeiro; by Cunha (1913, 1916) in plankton samples, state of Rio de Janeiro (Figure 3).

***Difflugia curvicaulis* Pénard, 1899**
Franken, 1933: 193, pl. II, fig. 1; Gauthier-Lièvre and Thomas, 1958: 330, fig. 47a-b; Chardez, 1967, pl. IV, fig. 5; Grospietsch, 1972: 15, fig. 30; Laminger, 1972, fig. 12.2i-j; Vucetich, 1973: 308-309, pl. IV, fig. 39; Chardez and Hellebaut, 1978, fig. 31; Ogden, 1979: 146, fig. 6; Ogden and Hedley, 1980: 130, pl. LIV, figs. A-D; Velho and Lansac-Tôha, 1996: 186-187, pl. II, fig. 16.

Comments: In Brazil the species has been registered in plankton samples from Manguinhos, state of Rio de Janeiro (Cunha, 1913; 1916); in bottom samples from Patos and Mirim Lagoons (Closs and Medeiros, 1965, 1967) and aquatic macrophytes samples of a reservoir, state of Rio Grande do Sul (Torres, 1996a); in plankton samples from the Upper Paraná river floodplain, state of Paraná and Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997); in plankton samples from the Pantanal, state of Mato Grosso do Sul (Bonecker *et al.*, 1998); and in plankton samples from the Corumbá Reservoir and tributaries, state of Goiás (Lansac-Tôha *et al.*, 2000b) (Figure 3).

***Difflugia difficilis* Thomas, 1955**
Thomas, 1955: 254, pl. I., figs. 4-5; Gauthier-Lièvre and Thomas, 1958: 282-283, fig. 16 a-c; Chardez, 1967, pl. IV, fig. 22; Lena and Cachi, 1972: 380, pl. I. figs. 17-19; Lena and Zaidenwerg, 1975, pl. IV, fig. 4; Ogden and Zivkovic, 1983: 349, fig. 5; Todorov and Golemansky, 1998: 86.

Comments: The species has been registered in Brazil only in plankton samples from the Peruaçu river, state of Minas Gerais (Dabés, 1999) (Figure 3).

***Difflugia echinulata* Pénard, 1911**
Pénard, 1911: 304, pl. X, fig. 8; Gauthier-Lièvre and Thomas, 1958: 332, fig. 4a-c; Chardez, 1967, pl. IV, fig. 35; Vucetich, 1974: 34, pl. II, fig. 7; Velho and Lansac-Tôha, 1996:188, pl. III, fig. 19.

Comments: *D. echinulata* has been registered only in the state of Rio Grande do Sul in bottom samples from a coastal lagoon (Madeira-Falcetta, 1974); state of Paraná and Mato Grosso do Sul in plankton samples from the Upper Paraná river floodplain (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997); and in the state of Goiás in plankton samples from the Corumbá Reservoir and tributaries (Lansac-Tôha *et al.*, 2000b) (Figure 3).

***Difflugia elegans* Pénard, 1890**
Pénard, 1890: 140, pl. 4, figs. 4-11; 1902:236, figs. 1-13; Deflandre, 1926: 521-522, figs. 9 and 11; Franken, 1933: 194, pl. II, figs. 3-4; Gauthier-Lièvre and Thomas, 1958:333, fig. 49a-c; Schonborn, 1966, fig. 5q-v; Chardez, 1967, pl. IV, fig. 25; Grospietsch, 1972:13, fig. 38; Laminger, 1972, fig. 12.4c; Vucetich, 1973:306, pl. III, fig. 33; Boltovskoy and Lena, 1974, pl. I, fig. 4a-b; Lena and Zaidenwerg, 1975, pl. II, fig. 6; Green, 1975: 550, fig. 9: Ogden, 1979:146, fig. 5; Ogden and Hedley, 1980:132, pl. LV, figs. A-C; Ogden and Zivkovic, 1983, fig. 21; Torres and Jebram, 1994: 72, fig. 4A; Velho and Lansac-Tôha, 1996:187, pl. II, fig. 17.

Comments: Records of this species in Brazil are from plankton samples from Manguinhos, state of Rio de Janeiro (Cunha, 1913); in plankton from lakes of the Suia Missu river basin and bottom samples from the Pantanal, state of Mato Grosso (Green, 1975; Hardoim and Heckman, 1996); in plankton and periphyton from lakes of the São Francisco river basin, state of Minas Gerais (Dabés, 1995, 1999; Landa and Mourgués-Schurter, 2000b; Dabés and Velho, 2001); in plankton from Corumbá Reservoir and tributaries, state of Goiás (Lansac-Tôha *et al.*, 1999, 2000b); in bottom samples from coastal lagoons (Closs and Medeiros, 1965, 1967; Madeira-Falcetta, 1974) and in aquatic macrophytes samples from reservoirs (Torres and Jebram, 1994; Torres, 1996a); and in plankton from the Upper Paraná river floodplain, states of Paraná and Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997) (Figure 3).

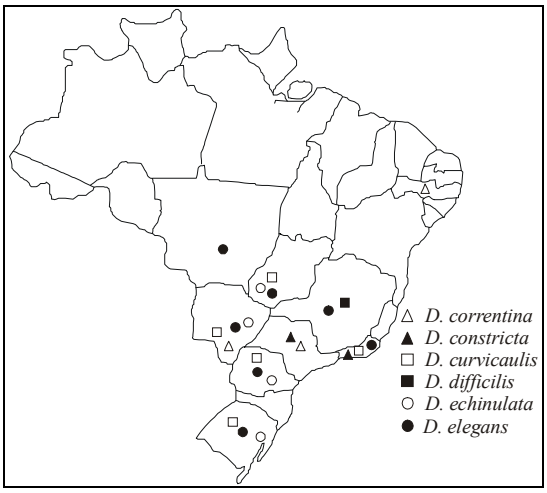

Figure 3. Geographic distribution of *Difflugia correntina, D. constricta, D. curvicaulis, D. difficilis, D. echinulata* and *D. elegans* in Brazilian inland waters

***Difflugia globularis* Wallich, 1864**
Wallich, 1864: 241, pl. XV, fig. 4h; pl. XVI, fig. 17 (as *D. proteiformes* sub esp. *globularis*); Boltovskoy, 1956: 307, fig. 8; Gauthier- Lièvre and Thomas, 1958: 308, fig. 35; Closs and Madeira, 1962: 12, pl. III, fig. 5, pl. IV, fig. 17, pl. V, fig. 9; 1967, pl. I, fig. 5; Green, 1963, fig. 21; Boltovskoy and Lena, 1966: 60, pl. I, fig. 12; 1971a, pl. I, figs. 6-7; 1974, pl. III, fig. 8; Chardez, 1967, pl. III, fig. 42; Torres, 1998: 548, fig. 6.

Comments: Registers of this species in Brazil come from the state of Rio Grande do Sul (Closs and Madeira, 1962, 1967; Closs and Medeiros, 1965, 1967; Madeira-Falcetta, 1974; Torres, 1998); state of Mato Grosso (Green, 1975); state of Minas Gerais (Dabés, 1995), and state of Goiás (Lansac-Tôha *et al.,* 2000b) (Figure 4).

***Difflugia globulosa* Dujardim, 1837**
Pénard, 1890: 142, pl. IV, figs. 20-21, 24-29; 1902: 257; Franken, 1933: 194, pl. II, fig. 10; Gauthier-Lièvre and Thomas, 1958: 310, fig. 36a*;* Boltovskoy and Lena, 1966: 60, pl. I, fig. 13; Chardez, 1967, pl. III, fig. 40; Grospietsch, 1972: 13-14; Lena and Cachi, 1972, pl. I, fig. 11; Chardez and Hellebaut, 1978, fig. 43; Meisterfeld, 1973: 86; Ogden and Hedley, 1980: 134, pl. LVI, figs. A-C; Ogden, 1988: 367-369, figs. 1-16.

Comments: Registers of this species in Brazil are from the state of Rio de Janeiro (Prowazek, 1910) and the state of Rio Grande do Sul (Closs and Medeiros, 1967; Torres, 1996a) (Figure 4).

***Difflugia globulus* (Ehrenberg, 1848)**
Franken, 1933: 194, pl. II, fig. 9; Chardez, 1967, pl. III, fig. 41; Medioli and Scott, 1983: 24-25, pl. V, figs.1-15; Patterson *et al.*, 1985, pl. I, figs. 17-18; Oliveira, 1999, pl. II, fig. 3.

Comments: Species has only been registered in the state of São Paulo in bottom samples (Oliveira, 1999) (Figure 4).

***Difflugia gramen* Pénard, 1902**
Pénard, 1902: 281, textfigs. 1-3; Playfair, 1917: 644-645, pl. XXXV, fig. 10; Franken, 1933: 194, pl. II, fig. 7a-b; Gauthier- Lièvre and Thomas, 1958: 257, pl. VIII, figs. a-e; Grospietsch, 1958: 319; 1972: 15, fig. 27; Stepánek and Jiri, 1958: 139-142, fig. 1; Green, 1963: 505; Chardez, 1967, pl. IV, fig. 40;: Vucetich, 1972a: 275, pl. I, fig. 4; 1973: 302, pl. III, fig. 25; Lena and Cachi, 1972, pl. I, figs. 39-40; Boltovskoy and Lena, 1974: 23, pl. II, figs. 9-10; Lena and Zaidenwerg, 1975, pl. II, fig. 16a-b; Chardez and Helleabut, 1978, fig. 5; Ogden, 1980: 125-126, figs. 1-6; 1983: 50; Ogden and Hedley, 1980: 136, pl. LVII, figs. A-C; Ogden and Zivkovic, 1983: 357, fig. 11; Lena, 1983, pl. III, fig. 14; Ogden and Meisterfeld, 1989: 121-122, figs. 5-6; Velho and Lansac-Tôha, 1996: 182, pl. I, fig. 6; Torres, 1998: 546-547, fig. 4.

Comments: Records of this species in Brazil are from plankton samples in the states of Rio de Janeiro (Cunha, 1913), Mato Grosso (Green, 1975), Minas Gerais (Dabés, 1995; Bonecker *et al.*, 1996, 1997), Goiás (Lansac-Tôha *et al.*, 1999, 2000b) and Paraná and Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997); and from moss samples, state of Rio de Janeiro (Wailes, 1913), and aquatic macrophytes, state of Rio Grande do Sul (Torres, 1996a, 1998) and state of Minas Gerais (Dabés and Velho, 2001) (Figure 4).

***Difflugia gramen* f. *globulosa* Stepánek and Jiri, 1958.**
Stepánek and Jiri, 1958: 142-143, fig. 2; Chardez, 1967, pl. IV, fig. 41; Dioni, 1970: 217, pl. III, fig. 33a.

Comments: The taxon has been found only in a marginal lake from São Francisco river, state of Minas Gerais, in periphyton samples (Dabés and Velho, 2001) (Figure 4).

***Difflugia hydrostatica* Zacharias, 1897**
Grospietsch, 1957, fig. 3; 1972: 16, fig. 33; Ogden and Meisterfeld, 1989: 122, figs. 10-15; Dabés and Velho, 2001, fig. 4b.

Comments: The species has been found only in periphyton samples from a marginal lake of the São Francisco river, state of Minas Gerais (Dabés and Velho, 2001) (Figure 4).

***Difflugia kempnyi* Stepánek, 1953**
Stepánek, 1953: 492, figs. 1-3; 1967, fig. 8.1; Gauthier-Lièvre and Thomas, 1958: 285-286, fig. 18; Dioni, 1970: 212-213, pl. III, fig. 30; Velho and Lansac-Tôha, 1996: 183, pl. II, fig. 9.

Comments: In Brazil this species has been registered only in the plankton from the Upper Paraná river floodplain, state of Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997) and from the Corumbá Reservoir and tributaries, state of Goiás (Lansac-Tôha *et al.*, 2000b) (Figure 4).

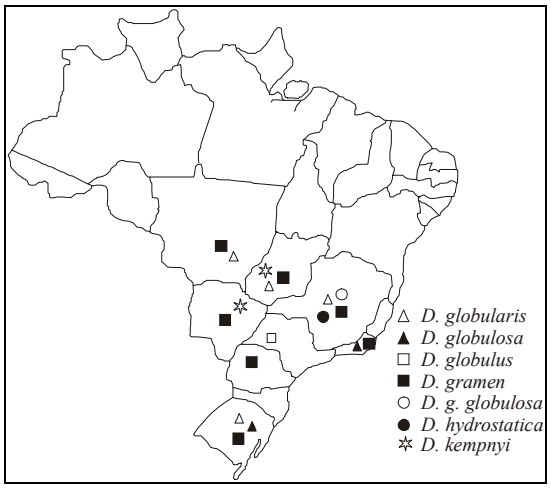

Figure 4. Geographic distribution of *Difflugia globularis, D. globulosa, D. globulus, D. gramen, D. gramen globulosa, D. hydrostatica* and *D. kempnyi* in Brazilian inland waters

***Difflugia lageniformis* (Wallich, 1864)**
Wallich, 1864: 240, pl. XV, fig. 2b (as *D. proteiformis* sub sp. *mitriformis* var. *lageniformis*); Boltovskoy, 1956: 306, fig. 3; Gauthier- Lièvre and Thomas, 1958: 304-305, fig. 32b-e (as *D. urceolata* var. *lageniformis*); Closs and Madeira, 1962: 11, pl. V, figs. 7-8; 1967, pl. I, fig. 8; Boltovskoy and Lena, 1966: 61, pl. I, fig. 3 (as *D. pyriformis lageniformis*).

Comments: Species has been registered only in bottom samples from coastal lagoons in the state of Rio Grande do Sul (Closs and Madeira, 1962, 1967; Closs and Medeiros, 1965; Madeira-Falcetta, 1974) (Figure 5).

***Difflugia lanceolata* Pénard, 1890**
Pénard, 1890: 145-146, pl. IV, figs. 59-60; Gauthier-Liévre and Thomas, 1958: 314, fig. 38a-b; Godeanu, 1970b: 295, fig. 4; Grospietsch, 1972: 16, fig. 37; Vucetich, 1973: 311, pl. V, fig. 43; Chardez and Hellebaut, 1978, figs. 16 and 34; Ogden and Hedley, 1980: 140, pl. LIX, figs. A-D; Lena, 1983, pl. III, fig. 19; Ogden, 1983: 11, fig. 6; Yeates and Foissner, 1995: 4, figs. 19-22; Hardoim, 1997: 241, fig. 82.

Comments: In Brazil the only registers of *D. lanceolata* are from the state of Mato Grosso (Green, 1975; Hardoim and Heckman, 1996; Hardoim, 1997) and the state of Goiás (Lansac-Tôha *et al.,* 1999, 2000b) (Figure 5).

***Difflugia lebes* Pénard, 1902**
Pénard, 1902: 271, textfig. 1; Deflandre, 1926: 518; Chardez, 1967, pl. V, fig. 20.

Comments: In Brazil this species has been collected only in the plankton from the Tietê river basin, state of São Paulo (Prowazek, 1910) and in the bottom from coastal lagoons, state of Rio Grande do Sul (Closs and Medeiros, 1965; Madeira-Falcetta, 1974) (Figure 5).

***Difflugia limnetica* (Levander, 1900)**
Pénard, 1902: 279, textfigs 1-8; Gauthier-Lièvre and Thomas, 1958: 261-262, fig. 5a-b; Schönborn, 1962: 21-34, figs. 1-2; Green, 1963: 506, fig. 24; Rhoden and Pitoni, 1999: 103, fig. 20.

Comments: The species has been registered in plankton samples in state of Piauí (Cunha, 1916); state of Rio de Janeiro (Cunha, 1913); state of Goiás (Lansac-Tôha *et al.*, 1999, 2000b); state of São Paulo (Neumann-Leitão *et al.*, 1990) and state of Paraná (Nunes *et al.,* 1996); and samples of *Sphagnum*, state of Rio Grande do Sul (Rhoden and Pitoni, 1999) (Figure 5).

***Difflugia lismorensis* Playfair, 1917**
Playfair, 1917: 645-646, pl. XXXVI, fig. 1; Gauthier-Lièvre and Thomas, 1958: 263-265, fig. 6 (as *D. lismorensis* var. *quinquelobata* and *D. lismorensis* var. *elongata*); Vucetich, 1970: 46, fig. 5; 1973: 303, pl. III, fig. 28; Green, 1975: 550, fig. 10; Ogden and Zivkovic, 1983: 352-353, fig. 8.

Comments: The only registers for this species in Brazil have been made in plankton samples from lakes of the Suia Missu river basin, state of Mato Grosso (Green, 1975) and from marginal lakes of the São Francisco river basin, state of Minas Gerais (Dabés, 1995) (Figure 5).

***Difflugia lithophila* Pénard, 1902**

Pénard, 1902: 274-275, textfigs. 1-5 (as *D. hydrostatica* var. *litophila*); Gauthier-Lièvre and Thomas, 1958: 286-287, fig. 19a-d; Dioni, 1970: 211, pl. IV, fig. 37; Vucetich, 1973: 311, pl.V, fig. 44; Ogden and Hedley, 1980: 142, pl. LX, figs. A-C; Velho and Lansac-Tôha, 1996: 185, pl. II, fig. 12.

Comments: In Brazil the species has been registered only in the Upper Paraná river floodplain in plankton samples, states of Paraná and Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997); in the Corumbá river and tributaries in plankton samples, state of Goiás (Lansac-Tôha *et al.*, 2000b); in a reservoir of Porto Alegre city in periphyton samples, state of Rio Grande do Sul (Torres, 1996a) and in a marginal lake from the São Francisco river in periphyton samples, state of Minas Gerais (Dabés and Velho, 2001) (Figure 5).

***Difflugia lobostoma* Leidy, 1879**

Leidy, 1879: 112, figs. 15-16; Pénard, 1902: 277, textfigs. 1 and 5; De la Rua, 1912: 46, fig. 3; Franken, 1933: 193-194, pl. III, fig. 4a-c; Gauthier-Lièvre and Thomas, 1958: 265, pl. IX, figs. A-E; Green, 1963: 506, figs. 25-26; Chardez, 1967, pl. IV, fig. 47; Closs and Madeira, 1967: 15, pl. I, fig. 6; Stepánek, 1967, fig. 20.8-10; Dioni, 1970: 213-214, pl. III, fig. 25; Grospietsch, 1972: 17, fig. 24; Vucetich, 1973: 300, pl. III, fig. 21; Kudo, 1975: 449, fig. 206e; Chardez and Hellebaut, 1978, fig. 10; Ogden, 1980: 126-130, figs. 8-11; Ogden and Meisterfeld, 1989: 123, fig. 28; Torres and Jebram, 1994: 71, figs. 4C-D; Velho and Lansac-Tôha, 1996: 181-182, pl. I, fig. 3; Hardoim, 1997: 243, fig. 83.

Comments: In Brazil *D. lobostoma* has been registered in the state of Rio Grande do Sul (Closs and Medeiros, 1965, 1967; Closs and Madeira, 1967; Madeira-Falcetta, 1974; Torres and Jebram, 1994; Torres 1996a and b); state of Santa Catarina (Madeira-Falcetta, 1974); state of Paraná (Nunes *et al.*, 1996; Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997; Velho *et al.*, 1999); state of São Paulo (Prowazek, 1910); state of Mato Grosso do Sul (Daday, 1905; Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997; Bonecker *et al.*, 1998; Velho *et al.*, 1999); state of Mato Grosso (Green, 1975; Hardoim and Heckman, 1996; Hardoim, 1997); state of Minas Gerais (Rolla *et al.*, 1992; Dabés, 1995, 1999; Bonecker *et al.*, 1996; Landa and Mourgués-Schurter, 1999, 2000a and b; Dabés and Velho, 2001); state of Goiás (Lansac-Tôha *et al.,* 1999, 2000b), and in the state of Sergipe (Zucon and Loyola e Silva, 1992) (Figure 5).

***Difflugia lobostoma* var. *multilobata* Gauthier-Lièvre and Thomas, 1958**

Gauthier- Lièvre and Thomas, 1958: 266, pl. IX, figs. D-F; Chardez, 1967, pl. IV, fig. 45; Vucetich, 1972a: 277, pl. II, fig. 3; 1973: 301, pl. III, fig. 22; Boltoviskoy and Lena, 1974, pl. VI, figs. 8-9; Chardez and Hellebaut, 1978, fig. 11; Velho and Lansac-Tôha, 1996: 182, pl. I, fig. 4

Comments: Taxon has been registered in Brazil only in plankton samples from the Upper Paraná river floodplain, states of Paraná and Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.,*1997; Velho *et al.*, 1999) (Figure 5).

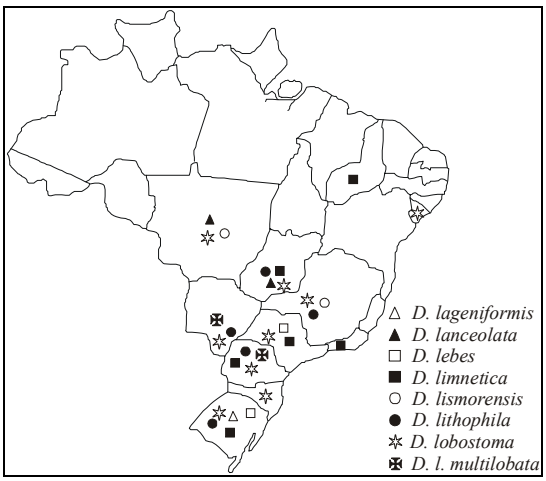

Figure 5. Geographic distribution of *Difflugia lageniformis, D. lanceolata, D. lebes, D. limnetica, D. lismorensis, D. lithophila, D. lobostoma* and *D. lobostoma multilobata* in Brazilian inland waters

***Difflugia lucida* Pénard, 1890**

Pénard, 1890: 145, pl. IV, figs. 52-58; 1903: 256; Hoogenraad and Groot, 1948, fig. 3; 1951, fig. 12; Gauthier-Lièvre and Thomas, 1958: 294-295, fig. 25a-e; Chardez, 1967, pl. V, fig. 23; Laminger, 1972, fig. 14n; Vucetich, 1972b: 126-127, figs. 2-3; Ogden, 1983: 61-63, fig. 44; Ogden and Zivkovic, 1983: 353; Lüftenegger *et al.*, 1988: 163, pl. I, fig. 6; Ogden and Meisterfeld, 1991: 259-261, figs. 2-24.

Comments: *D. lucida* has been registered by Dabés (1995) in the plankton of a marginal lake from the São Francisco river basin, state of Minas Gerais (Figure 6).

***Difflugia manicata* Pénard, 1902**

Stepánek, 1967, fig. 14-12; Ogden and Hedley, 1980: 146, pl. LXII, figs. A-C; Ogden, 1983: 16, fig. 8.

Comments: The only register of *D. manicata* in Brazil comes from aquatic macrophytes samples

from a reservoir, state of Rio Grande do Sul (Torres, 1996a) (Figure 6).

***Difflugia microclaviformis* (Kourov, 1925)**
Gauthier-Lièvre and Thomas, 1958: 347, fig. 55a-b (as *D. oblonga* var. *microclaviformis*); Chardez, 1967, pl. III, fig. 13 (as *D. oblonga* v. *microclaviformis*); Ogden, 1983: 35-38, fig. 24 (comb. nov.); Ogden and Zivkovic, 1983: 356; Dabés and Velho, 2001, fig. 4c.

Comments: The only register of this species in Brazil has been made by Dabés and Velho (2001) in periphyton samples from a marginal lake of the São Francisco river, state of Minas Gerais (Figure 6).

***Difflugia microstoma* (Thomas, 1954)**
Ogden, 1983: 53, fig. 35 (comb. nov.); Todorov and Golemansky, 1998: 87; Dabés and Velho, 2001, fig. 4c.

Comments: The species has been registered in Brazil only in periphyton samples from a marginal lake of the São Francisco river, state of Minas Gerais (Dabés and Velho, 2001) (Figure 6).

***Difflugia minuta* Rampi, 1950**
Gauthier- Lièvre and Thomas, 1958: 311-312, fig. 37a-c; Ogden, 1983: 53-55, fig. 36.

Comments: The species has been registered only in the state of Mato Grosso, in plankton samples from the Suia Missu river basin (Green, 1975) (Figure 6).

***Difflugia mitriformis* Wallich, 1864**
Wallich, 1864: 240, pl. XV, fig. 2a, p, q, pl. XVI, fig. 7 (as *D. proteiformis* subsp. *mitriformis*); Boltovskoy, 1956: 305-306, fig. 2; Closs and Madeira, 1962: 9-10, pl. IV, figs. 6-7, pl. VI, figs. 1-4; 1967, pl. I, fig. 2; Boltovskoy and Lena, 1966: 60-61, figs. 5-7; 1971b, pl. II, fig. 1; 1974, pl. I, fig. 3; Lena and Cachi, 1972, pl. I, fig. 9; Madeira-Falcetta, 1974, pl. IV, fig. 16; Torres, 1996c, fig. 8; 1998: 546, fig. 3.

Comments: Registers of this species in Brazil have been made in the state of Rio Grande do Sul (Closs and Madeira, 1962, 1967; Closs and Medeiros, 1965, 1967; Torres, 1996a and c, 1998) (Figure 6).

***Difflugia muriculata* Gauthier-Lièvre and Thomas, 1958**
Gauthier- Lièvre and Thomas, 1958: 270, fig. 8; Chardez, 1967, pl. III, fig. 24.

Comments: The only register of this species in Brazil has been made for the Upper Paraná river floodplain, states of Paraná and Mato Grosso do Sul, in plankton samples (Velho *et al.*, 1999) (Figure 6).

***Difflugia muriformis* Gauthier- Lièvre and Thomas, 1958**
Gauthier-Lièvre and Thomas, 1958: 271, pl. X, figs. a-c; Vucetich, 1973: 305, pl. IV, fig. 31; Velho and Lansac-Tôha, 1996: 183, pl. I, fig. 7.

Comments: In Brazil species has been registered in plankton samples from the state of Minas Gerais (Dabés, 1995); state of Goiás (Lansac-Tôha *et al.,* 2000b), and states of Paraná and Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997; Velho *et al.*, 1999), and periphyton samples, state of Minas Gerais (Dabés and Velho, 2001) (Figure 6).

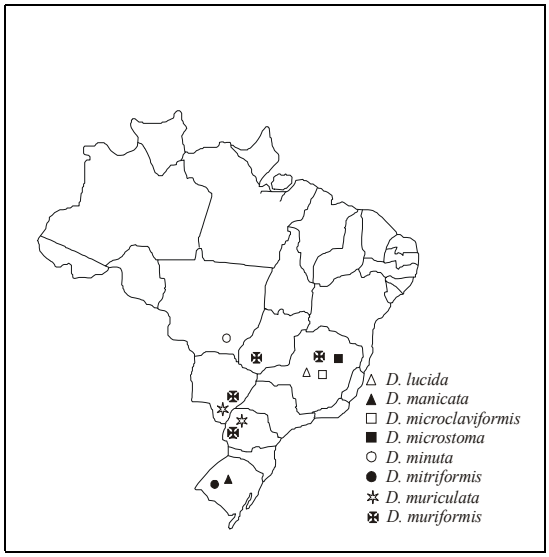

Figure 6. Geographic distribution of *Difflugia lucida, D. manicata, D. microclaviformis, D. microstoma, D. minuta, D. mitriformis, D. muriculata* and *D. muriformis* in Brazilian inland waters

***Difflugia nodosa* (Leidy, 1879)**
Pénard, 1890: 136-137, pl. III, figs. 45-46 (as *D. pyrifformis* var. *nodosa*); Gauthier-Lièvre and Thomas, 1958: 296-297, fig. 26 (as *D. oblonga* var. *nodosa*); Stepánek, 1967, fig. 16.13 (as *D. oblonga* var. *nodosa*); Chardez, 1967, pl. III, fig. 21 (as *D. oblonga* var. *nodosa*); Chardez and Hellebaut, 1978, fig. 19 (as *D. pyrifformis* var. *nodosa*); Ogden and Zivkovic, 1983: 356, fig. 10 (comb. nov.).

Comments: The species has been registered only in samples of plankton of a marginal lake from the São Francisco river basin, state of Minas Gerais (Dabés, 1995) (Figure 7).

***Difflugia oblonga* Ehrenberg, 1838**
Ehrenberg, 1838, pl. IX, fig. 3; Pénard, 1890: 136, pl. III, figs. 30-38 (as *D. pyriformis*); Oye, 1931: 57-58,

fig. 1; Boltovskoy, 1956: 303-304, fig. 1 (as *D. pyriformis*); Gauthier-Lièvre and Thomas, 1958: 343, pl. XI, figs. A-E; Closs and Madeira, 1962: 10, pl. IV, figs. 1-2, pl. VI, figs. 5-6; 1967, pl. I, fig. 1 (as *D. pyriformis*); Boltovskoy and Lena, 1966: 61, pl. I, figs. 1-2; 1971a: 133-134, pl. II, figs. 4-6; 1971b, pl. III, figs. 7-14; 1974, pl. VI, figs. 3-7 (as *D. pyriformis*); Dioni, 1967: 121; 1970: 214, pl. III, fig. 28; Chardez, 1967, pl. III, fig. 1; 1968, pl. I, fig. 1; Grospietsch, 1972: 17, fig. 32; Laminger, 1972, fig. 12.1p; Lena and Cachi, 1972: 380, pl. I, figs. 4-5(as *D. pyriformis*); Vucetich, 1973: 310, pl. V, fig. 42; Chardez and Decloitre, 1973, figs. 1-2, 5-8, 11; Madeira-Falcetta, 1974, pl. IV, fig. 12 (as *D. pyriformis*); Lena and Zaidenwerg, 1975, pl. II, fig. 9 (as *D. pyriformis*); Green, 1975: 550, figs. 14-16; Kudo, 1975: 449, fig. 206a; Chardez and Hellebaut, 1978, figs. 22, 32 and 35 as (*D. pyriformis*); Ogden and Fairman, 1979: 376, figs. 1-3; Ogden and Hedley, 1980: 148, pl. LXIII, figs. A-C; Medioli and Scott, 1983: 25-26, l. II, figs. 1-17, 24-26; 1985: 35, fig. 12; Patterson *et al*, 1985, pl. I, figs. 4-12; Haman, 1990, pl. I, figs. 18-20 (as *D. pyriformis*); Barbosa, 1995, fig. 3.9-10; Velho and Lansac-Tôha, 1996: 187-188; pl. II, fig. 18; Hardoim, 1997: 245, fig. 84; Oliveira, 1999, pl. I, fig. 1.

Comments: Some authors (Boltovskoy and Lena, 1971a and b; Chardez and Decloitre, 1973), based on the original descriptions of *D. oblonga*, Ehrenberg, 1838 and *D. pyriformis* Perty, 1849, hold that these are two species and the two are not synonymous. Differentiation of these two species is based on the surface features of the test. *D. oblonga* presents an even test, with no attached material, while *D. pyriformis* has an uneven one, with adhered material. If these are two valid species (not synonymous), a great deal of *D. oblonga* registered in Brazil, including descriptions and ilustrations, should be considered as registers of *D. pyriformis*. However, other authors (Gauthier-Lièvre and Thomas, 1958; Ogden and Hedley, 1980; Hardoim, 1997) consider these two species synonymous (*D. oblonga* should be preferred to *D. pyriformis*). These authors do not consider the test features so relevant as to differentiate these species. In this paper the criteria of the last authors are preferred.

D. oblonga has been registered in the state of Rio de Janeiro (Wailes, 1913; Cunha, 1916); state of Mato Grosso (Green, 1975; Hardoim and Heckman, 1996; Hardoim, 1997); state of Sergipe (Zucon and Loyola e Silva, 1992); state of Goiás (Lansac-Tôha *et al.*, 1999, 2000b); state of Minas Gerais (Dabés, 1995; Landa and Ferreira, 1995; Bonecker *et al.*, 1996; Landa, 1997; Landa and Mourgués-Schurter, 1999, 2000a and b); state of São Paulo (Eichler and Bonetti, 1995; Eichler-Coelho *et al.*, 1996, 1997; Oliveira, 1999); state of Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.,* 1997, Velho *et al.,* 1999); state of Paraná (Madeira-Falcetta, 1974; Barbosa, 1905; Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997); state of Santa Catarina (Madeira-Falcetta, 1974) and state of Rio Grande do Sul (Closs and Madeira, 1962, 1967; Closs and Medeiros, 1965, 1967; Madeira-Falcetta, 1974, Torres, 1996a). Some of these registers refer to *Difflugia pyriformis* (Figure 7).

***Difflugia penardi* Hopkinson, 1909**

Gauthier-Lièvre and Thomas, 1958: 313, fig. 36d; Green, 1963: 506, fig. 22; Chardez, 1967, pl. III, fig. 29; Godeanu, 1970a, fig. 1n; Chardez and Hellebaut, 1978, fig. 9; Ogden and Hedley, 1980: 152, pl. LXV, figs. A-D; Rhoden and Pitoni, 1999: 103-104, fig. 21.

Comments: The species has been registered in plankton samples from the Suia Missu river basin and bottom samples from the Cuiabá river, state of Mato Grosso (Green, 1975); and in samples of *Sphagnum*, state of Rio Grande do Sul (Rhoden and Pitoni, 1999) (Figure 7).

***Difflugia pleustonica* Dioni, 1970**

Dioni, 1970: 212, pl. IV, fig. 38a-c; Velho and Lansac-Tôha, 1996: 185, pl. II, fig. 10.

Comments: The species has been found only in plankton samples from the Upper Paraná river floodplain, states of Paraná and Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997; Velho *et al.,* 1999) (Figure 7).

***Difflugia protaeiformis* Lamark, 1816**

Medioli and Scott, 1983: 17-20, pl. I, figs. 15-20; Haman, 1990, pl. I, figs. 14-17; Haman and Kohl, 1994: 231, pl. I, figs. 9-11; Barbosa, 1995, fig. 3.6; Bonetti and Eichler, 1997, pl. I, fig. 1; Oliveira, 1999, pl. I, fig. 4.

Comments: The species has been registered only in bottom samples from estuary areas in the state of Paraná (Barbosa, 1995) and state of São Paulo (Eichler *et al.*, 1997; Bonetti and Eichler, 1997; Oliveira, 1999) (Figure 7).

***Difflugia pseudogramen* Gauthier-Lièvre and Thomas, 1960**

Gauthier-Lièvre and Thomas, 1960: 592, fig. 12d-e (as *Difflugia (Pseudocucurbidello) pseudogramem*); Stepánek, 1967, fig. 15.5; Vucetich, 1973: 313, pl. V,

fig. 49; Velho and Lansac-Tôha, 1996: 182, pl. I, fig. 5

Comments: The only registers for this species in Brazil have been made in plankton samples from the Upper Paraná river floodplain, states of Paraná and Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997) and from the Corumbá Reservoir and tributaries, state of Goiás (Lansac-Tôha *et al.*, 1999, 2000b), and in aquatic macrophytes samples from a marginal lake of the São Francisco river, state of Minas Gerais (Dabés and Velho, 2001) (Figure 7).

***Difflugia scalpellum* Pénard, 1899**

Pénard, 1902: 243-244, textfigs. 1-7; Deflandre, 1953, fig. 91a; Dioni, 1970, pl. III, fig. 24; Laminger, 1972, fig. 12.2a-b; Ogden, 1979: 148-150, figs. 13-16.

Comments: In Brazil the species has been recorded only in the Mirim Lagoon in bottom samples, state of Rio Grande do Sul (Closs and Medeiros, 1967) (Figure 7).

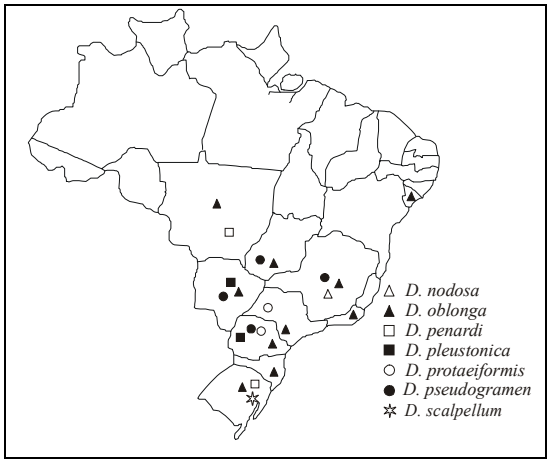

Figure 7. Geographic distribution of *Difflugia nodosa, D. oblonga, D. penardi, D. pleustonica, D. protaeiformis, D. pseudogramen* and *D. scalpellum* in Brazilian inland waters

***Difflugia schuurmani* Oye, 1931**

Oye, 1931: 61; 1932: 326-327, fig. 5; Gauthier-Lièvre and Thomas, 1958: 277, fig. 12; Laminger, 1973, fig. 31h; Ogden and Zivkovic, 1983: 357, fig. 11d-e; Ogden and Meisterfeld, 1989: 123.

Comments: The only registers of *D. schuurmani* in Brazil have been made in plankton samples from the Suia Missu river basin, state of Mato Grosso (Green, 1975), and São Francisco river basin, state of Minas Gerais (Dabés, 1995) (Figure 8).

***Difflugia smilion* Thomas, 1953**

Thomas, 1953: 132, figs. 6-13; Gauthier- Lièvre and Thomas, 1958: 320, fig. 42f; Green, 1963, fig. 30; 1975, fig. 11; Chardez, 1967, pl. IV, fig. 18; Chardez and Hellebaut, 1978, figs. 28-29; Ogden and Zivkovic, 1983: 359, fig. 12.

Comments: *D. smilion* has been registered in our country only in the Suia Missu river basin in plankton samples, state of Mato Grosso (Green, 1975) (Figure 8).

***Difflugia stellastoma* Vucetich, 1989**

Vucetich, 1989: 741-742, figs. 5-8; Velho and Lansac-Tôha, 1996: 183, pl. I, fig. 8.

Comments: In Brazil this species has been registered only in samples of plankton from the Upper Paraná river floodplain, states of Paraná and Mato Grosso do Sul (Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997; Velho *et al.*, 1999) and from the Corumbá Reservoir and tributaries (Lansac-Tôha *et al.,* 2000b) (Figure 8).

***Difflugia urceolata* Carter, 1864**

Carter, 1864: 27, pl. I, fig. 27; Franken, 1933: 193, pl. III, fig. 1; Boltovskoy, 1956: 304, pl. I, fig. 7; Gauthier-Lièvre and Thomas, 1958: 303, fig. 31; Closs and Madeira, 1962: 7-8, pl. IV, figs. 11-14, pl. V, figs. 1-4; Green, 1963, fig. 12; Chardez, 1967, pl. V, fig. 7; Dioni, 1970: 219, pl. IV, fig. 39; Boltovskoy and Lena, 1971a, pl. II, figs. 8-13; !974: 27, pl. III, figs. 12-13; Grospietsch, 1972: 19, fig. 22; Laminger, 1972, fig. 14j; Godeanu, 1972: 404, fig. 4; Lena and Cachi, 1972, pl. I, figs. 10 and 26; Vucetich, 1973: 312, pl.V, fig. 46; Madeira-Falcetta, 1974, pl. IV, fig. 14; Lena and Zaidenwerg, 1975, pl. V, figs. 1-2; Kudo, 1975: 449, fig. 206b; Ogden and Hedley, 1980: 158, pl. LXVIII, figs. A-D; Medioli and Scott, 1983: 31-32, pl. III, figs. 1-23, pl. IV, fig. 1-4; 1985: 28-29, fig. 5; Ogden, 1983: 57-59, fig. 40; Lena, 1983, pl. III, figs. 20-21; Patterson, 1985, pl. II, figs. 11-12; Haman, 1990, pl. I, figs. 24-26; Velho and Lansac-Tôha, 1996: 185-186, pl. II, fig. 13; Hardoim, 1997: 249, fig. 86; Oliveira 1999, pl. I, fig. 6.

Comments: In Brazil records of this species are from the state of Rio Grande do Sul (Closs and Madeira, 1962; Closs and Medeiros, 1965, 1967; Madeira-Falcetta, 1974; Torres, 1996a); state of Santa Catarina (Madeira-Falcetta, 1974); state of Paraná (Barbosa, 1995; Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997); state of Mato Grosso do Sul (Daday, 1905; Velho and Lansac-Tôha, 1996; Lansac-Tôha *et al.*, 1997; Bonecker *et al.*, 1998); state of Mato Grosso (Green, 1975; Hardoim and Heckman, 1996; Hardoim, 1997); state of São Paulo (Sipaúba-Tavares *et al.*, 1995; Eichler and Bonetti, 1995; Eichler-Coelho

et al., 1997; Oliveira, 1999); state of Rio de Janeiro (Prowazek, 1910; Cunha, 1913, 1916); state of Minas Gerais (Dabés, 1995); state of Goiás (Lansac-Tôha *et al.*, 2000b); and state of Sergipe (Zucon and Loyola e Silva, 1992) (Figure 8).

***Difflugia urens* Patterson, Mackinnon, Scott and Medioli, 1985**

Patterson *et al.*, 1985: 135, pl. III, figs. 5-14; Barbosa, 1995, fig. 3.7.

Comments: Species has been registered only by Barbosa (1995) in bottom samples from the Guaratuba Bay estuary, state of Paraná (Figure 8).

***Difflugia ventricosa* Deflandre, 1926**

Deflandre, 1926: 520, figs. 6-7; Gauthier-Lièvre and Thomas, 1958: 322, fig. 43; Chardez, 1967, pl. IV, fig. 7; Ogden, 1983: 41, fig. 27; Todorov and Golemansky, 1998: 87.

Comments: *D. ventricosa* has been found in Brazil only in the Pantanal do Poconé in bottom samples, state of Mato Grosso (Hardoim and Heckman, 1996) (Figure 8).

***Difflugia venusta* (Pénard, 1902)**

Pénard, 1902: 220, textfig. 5 (as *D. pyriformis* var.*venusta*); Gauthier- Lièvre and Thomas, 1958: 347, fig. 55 e-f (as *D. oblonga* var. *venusta*); Chardez, 1967, pl. III, fig. 12; Dioni, 1970: 214, pl. IV, fig. 36 (as *D. oblonga* var. *venusta*); Chardez and Hellebaut, 1978, fig. 33 (as *D. pyriformis* v*enusta*); Ogden, 1983: 41 and 45, fig. 28 (comb. nov.); Todorov and Golemansky, 1998: 87.

Comments: The only register of this taxon in Brazil has been made by Wailes (1913) in moss samples, state of Rio de Janeiro (Figure 8).

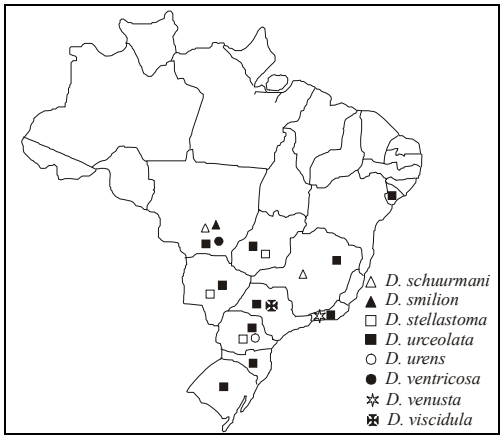

Figure 8. Geographic distribution of *Difflugia schuurmani, D. smilion, D. stellastoma, D. urceolata, D. urens, D. ventricosa, D. venusta* and *D. viscidula* in Brazilian inland waters

***Difflugia viscidula* Pénard, 1902**

Pénard, 1902: 259-260, textfigs. 1-4; Laminger, 1972, fig. 14.h; Boltovskoy and Lena, 1974, pl. II, figs. 13-15; Ogden and Hedley, 1980: 160, pl. LXIX, figs. A-D; Ogden, 1983: 24-26, fig. 17; Oliveira, 1999, pl. II, fig. 1.

Comments: *D. viscidula* has been found in bottom samples from the estuary of Itanhaém river, state of São Paulo (Oliveira, 1999) (Figure 8).

Discussion

Difflugia is the most diverse genus among testate amoebae (Ogden, 1988; Ogden and Meisterfeld, 1989). Sixty-four taxa, including species, varieties and forms of *Difflugia*, are recorded in this study.

As observed for Arcellidae (Lansac-Tôha *et al.*, 2000a), Centropyxidae, Trigonopyxidae and Plagiopyxidae (Velho *et al.*, 2000), the greater number of *Difflugia* species is recorded in plankton samples (40 taxa). Whereas *Difflugia* is more diverse in sediments than among macrophytes, the above referenced families are more specious in samples taken from plankton and vegetation. Velho *et al.* (1999) suggested that although the testate amoebae species are primarily associated with marginal vegetation and sediments, the great number of testate amoebae recorded in plankton, mainly from small, shallow lakes and running water systems, is due to the fact that these systems can act as a collector of species from a variety of habitats.

Considering the geographical distribution of *Difflugia* species in Brazil, information is avaliable for these organisms in their different habitats (sediments, plankton, aquatic vegetation). However, these studies are limited to a few regions, such as the southern and southeastern regions, while the extensive north and northeastern regions, including the Amazon, are scarcely studied. In the Amazon region there is an important study on testate amoebae in the litter of creeks (Walker, 1982). Although the author did not identify the organisms to species level, the number of morphotypes recorded (119) suggests the great species richness of this group in that region.

Recent studies on taxonomy and systematics of the genus *Difflugia* (Ogden, 1988; Ogden and Meisterfeld, 1989) affirmed that earlier studies on testate amoebae, especially on agglutinated species, were based essentially on the size, composition and architecture of the shell. The variability in these features led to a great number of specimens being described as different species. Moreover, the same studies showed that other characteristics are also very important for an accurate identification of the

species in this genus. This includes, for example, cytoplasmic features and production of idiosomes. Based on cultured organisms these characteristics were used by Ogden (1979) to transfer some agglutinated *Difflugia* to the genus *Netzelia*. Thus the development of new studies on testate amoebae, especially of the genus *Difflugia* from freshwater systems in Brazil, must take into account these aspects of the group's taxonomy and systematics.

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