Check List the journal of biodiversity data

NOTES ON GEOGRAPHIC DISTRIBUTION

Check List 15 (6): 965–971
https://doi.org/10.15560/15.6.965

PENSOFT

Deep-sea oceanic basslets (Perciformes, Howellidae) from Brazil: new records and range extensions

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Abstract
This study reports the occurrence of the oceanic basslet (Howellidae) in Brazilian waters. *Bathysphyraenops simplex* Parr, 1933, a rare species with a worldwide distribution, is recorded for the first time in Brazilian waters, based on three specimens collected off Rocas Atoll and Rio Grande do Norte. *Howella atlantica* Post & Quéro, 1991, known from the western and eastern Atlantic Ocean (64°N to 21°S), including waters around the Trindade Island, is reported off Rio Grande do Norte, Pernambuco, Rocas Atoll, and the Fernando de Noronha Archipelago. In addition, specimens previously reported in the literature as *Howella brodie* Ogilby, 1899 are reidentified as *H. atlantica*, extending the known distribution of this species to northeastern and southeastern Brazil. Measurements and counts for all specimens examined are provided.

Keywords
Mesopelagic fishes, tropical islands, western South Atlantic.

Academic editor: Zeehan Jaafar | Received 20 August 2019 | Accepted 14 October 2019 | Published 1 November 2019

Citation: Eduardo LN, Villarins BT, Martins JR, Lucena-Frédou F, Frédou T, Lira AS, Travassos PE, Bertrand A, Mincarone MM (2019) Deep-sea oceanic basslets (Perciformes, Howellidae) from Brazil: new records and range extensions. Check List 15 (6): 965–971. https://doi.org/10.15560/15.6.965

Introduction

The representatives of the family Howellidae Ogilby, 1899, commonly known as oceanic basslets or alternatively as pricklefishes (Heemstra 2016), are poorly known mesopelagic to bathypelagic fishes inhabiting the tropical and temperate waters of all oceans (Fedoryako 1976; Post and Quéro 1991; Heemstra 2016). Reaching 120 mm in standard length (SL), these fishes occur in loose aggregations, present internal ventral luminescence, and usually exhibit diel vertical migrations (Post and Quéro 1991; Herring 1992).

Species currently classified as belonging to the Howellidae have been historically placed in other families, including Serranidae (Norman 1966), Cheilodipteridae (= Apogonidae) (Schultz 1940; Mead and De Falla 1965; Fedoryako 1976), and Percichthyidae (Fraser 1972; Post and Quéro 1991). However, Prokofiev (2007a, 2007b)

demonstrated that howellids differ significantly from all other percoid groups and, as first described by Ogilby (1899), placed these species in a separate family. Prokofiev (2007b) provided a revised diagnosis of the Howellidae. Currently, the family comprises nine species in three genera: *Howella* Ogilby, 1899, *Bathysphyraenops* Parr, 1933, and *Pseudohowella* Fedoryako, 1976 (Prokofiev 2007a, 2007b; Fricke et al. 2019).

Although considered common in some locations, the diversity and distribution of howellids have been insufficiently studied, and only a few specimens have been recorded in the western South Atlantic. This study reports the occurrence of two poorly known species of Howellidae in Brazilian waters: *Bathysphyraenops simplex* Parr, 1933 and *Howella atlantica* Post & Quéro, 1991. The identity of howellids previously reported in Brazilian waters is further discussed.

Methods

The material examined was collected during the ABRACOS expeditions (Acoustics along the BRAzilian COaSt), carried out in October 2015 (Bertrand 2015) and April 2017 (Bertrand 2017) and conducted by the French RV *Antea* off northeastern Brazil, including Rocas Atoll, the Fernando de Noronha Archipelago, and the seamounts off Rio Grande do Norte. The extensive survey in 80 fishing stations from 0 to 1113 m depth resulted in the collection of about 9,000 specimens of meso- and bathypelagic fishes. Sampling was conducted using midwater (body mesh: 40 mm, cod-end mesh: 10 mm) and mesopelagic (body mesh: 30 mm, cod-end mesh: 4 mm) trawl nets. Trawl depth was continuously recorded using a Scanmar sensor fitted on the upper part of the trawl net. All specimens taken in ABRACOS expeditions are deposited in the Fish Collection of the Instituto de Biodiversidade e Sustentabilidade, Universidade Federal do Rio de Janeiro (NPM; Macaé, Brazil). Additional specimens examined from the eastern Brazilian coast are deposited in the Museu Nacional (MNRJ; Rio de Janeiro, Brazil). Morphometric and meristic data were taken according to Post and Quéro (1991) and compared with those previously reported in the literature (Table 1). Measurements were taken with calipers to the nearest 0.1 mm. Counts of vertebrae and unpaired fin elements were obtained through a Faxitron LX 60 Cabinet X-ray System. Identification followed Post and Quéro (1991) and Prokofiev (2007b).

Results

***Bathysphyraenops simplex* Parr, 1933**
Figure 1a, Table 1

New records (northeastern Brazil). 3 specimens • NPM 3266, 1 spec. (36 mm SL), RV *Antea*, ABRACOS1, sta. 22, off Rocas Atoll, 04°07′43″S, 033°47′28″W to 04°07′00″S, 033°48′59″W, 0–525 m depth, mesopelagic trawl, 8 October 2015, 21:32–22:12h • NPM 4477, 1 spec. (77 mm SL), RV *Antea*, ABRACOS2, sta. 39, off Rio Grande do Norte, 04°52′27″S, 034°35′23″W to 04°50′53″S, 034°51′05″W, 0–800 m depth, midwater trawl, 24 April 2017, 21:49–22:37h • NPM 5052, 1 spec. (75 mm SL), RV *Antea*, ABRACOS2, sta. 54B, off Rio Grande do Norte, 03°45′17″S, 034°41′04″W to 03°44′39″S, 034°40′05″W, 0–1030 m depth, midwater trawl, 3 May 2017, 13:11–13:47h.

Identification. *Bathysphyraenops* can be distinguished from other howellid genera by the following combination of characters: upper angle of opercle with two simple spines (two simple or a cluster of spines in *Howella*), two well-separated spines of equal sizes on the subopercle (one long spine with 1–3 much shorter spines join downwards and upwards in *Howella*), and preopercle with spines along its lower margin (without spines in *Pseudohowella*). In addition, *Bathysphyraenops simplex* can be distinguished from its single congener, *B. declivifrons*, by having a compressed snout (vs rounded snout), and 15 or 16 pseudobranchs (vs 20 or 21) (Fedoryako 1976).

Distribution. *Bathysphyraenops simplex* has a worldwide distribution in tropical and subtropical seas (Fedoryako 1976; Carpenter 1999; Heemstra and Yamanoue 2003; Heemstra 2016). It was originally described from the Bahamas (Parr 1933; Moore and Boardman 1991) and subsequently reported in other localities of the Atlantic Ocean, including off western Africa, Cape Verde Islands (Backus et al. 1965), Puerto Rico, Ascencion Island (Fedoryako 1976), Cuba (Heemstra and Yamanoue 2003), off New England (Moore et al. 2003), southern Gulf of Mexico (McEachran and Fechhelm 2005), and Portugal (Carneiro et al. 2014). In the Pacific Ocean, the species was reported off eastern Philippines, Kiribati (Fedoryako 1976), South China Sea (Randall and Lim 2000), off Japan, Okinotorishima Islands (Uyeno and Kubota 1970; Masuda et al. 1984; Hatooka 2002), Hawaiian Islands (Mundy 2005), Ryukyu Islands (Shinohara et al. 2005), southern Taiwan (Shao et al. 2008), New Caledonia (Fricke et al. 2011), Ogasawara Islands (Tatsuta et al. 2014), and off southern California (Davison et al. 2015). In the Indian Ocean, it is known off the northeastern Seychelles (Mead and De Falla 1965). The species is reported here for the first time in Brazilian waters, based on three specimens collected around Rocas Atoll and off Rio Grande do Norte (Fig. 2).

***Howella atlantica* Post & Quéro, 1991**
Figure 1b, Table 1

New records (northeastern Brazil). 25 specimens • NPM 4478, 10 spec. (52–67 mm SL), RV *Antea*, ABRACOS2, sta. 54B, off Rio Grande do Norte, 03°45′17″S, 034°41′04″W to 03°44′39″S, 034°40′05″W, 0–1030 m depth, midwater trawl, 3 May 2017, 13:11–13:47h • NPM 4479, 1 spec. (57 mm SL), RV *Antea*, ABRACOS2, sta. 39, off Rio Grande do Norte, 04°52′27″S, 034°35′23″W

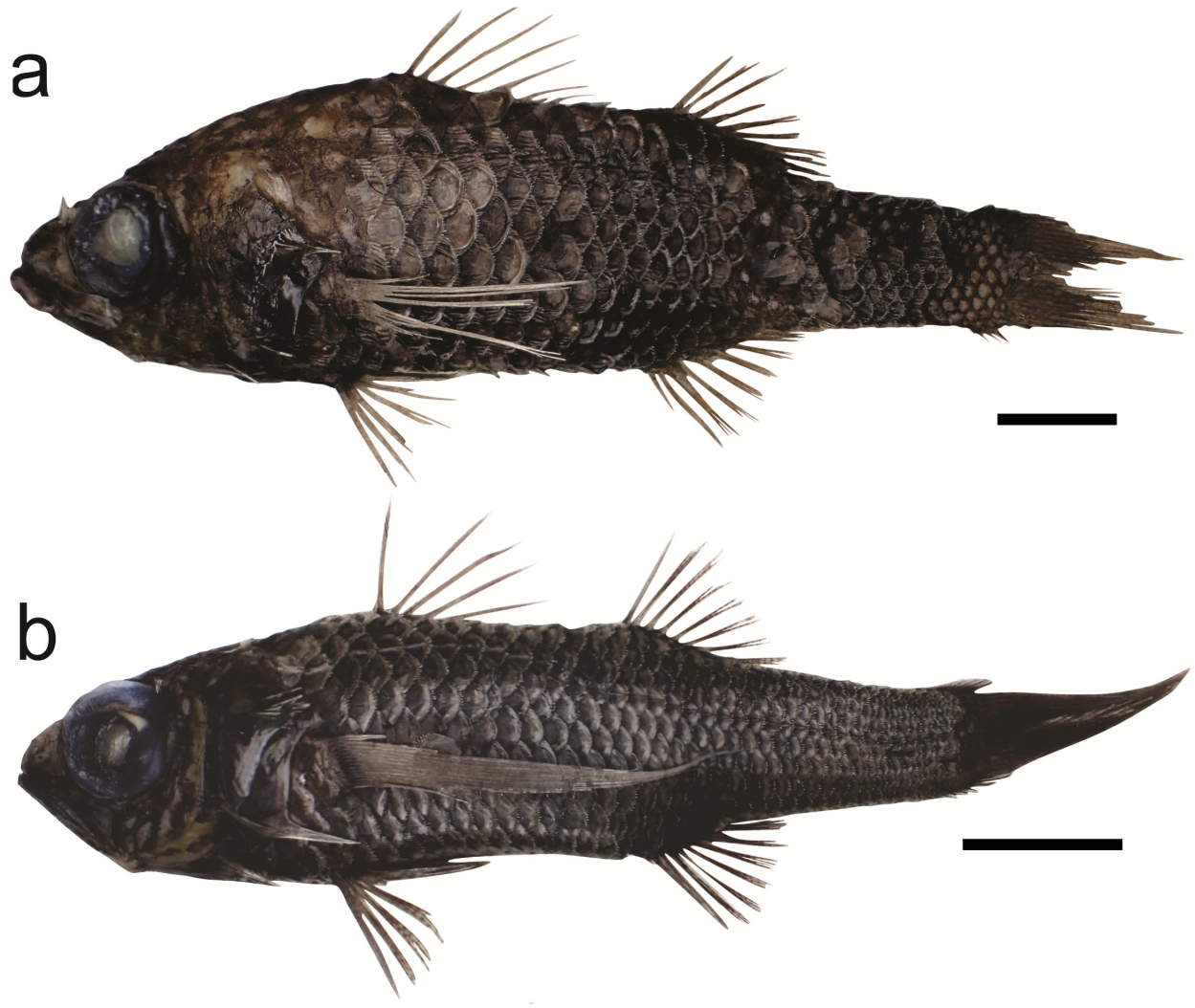

Figure 1. a. *Bathysphyraenops simplex* (NPM 4477, 77 mm SL). **b.** *Howella atlantica* (NPM 4483, 59 mm SL). Scale bars = 10 mm.

to 04°50′53″S, 034°51′05″W, 0–800 m depth, midwater trawl, 24 April 2017, 21:49–22:37h • NPM 4480, 1 spec. (60 mm SL), RV *Antea*, ABRACOS2, sta. 16, off Pernambuco, 07°36′15″S, 033°59′30″W to 07°36′49″S, 033°57′19″W, 0–680 m depth, midwater trawl, 14 April 2017, 21:53h • NPM 4481, 2 spec. (54–60 mm SL), RV *Antea*, ABRACOS2, sta. 42A, off Fernando de Noronha Archipelago, 03°15′28″S, 031°48′29″W, 03°15′28″S, 031°50′41″W, 0–780 m depth, midwater trawl, 27 April 2017, 12:23–12:26h • NPM 4482, 7 spec. (51–64 mm SL), RV *Antea*, ABRACOS2, sta. 44A, off Fernando de Noronha Archipelago, 03°52′53″S, 032°17′33″W to 03°52′13″S, 032°16′28″W, 0–850 m depth, midwater trawl, 28 April 2017, 12:44–13:17h • NPM 4483, 1 spec. (59 mm SL), RV *Antea*, ABRACOS2, sta. 52A, off Rocas Atoll, 03°43′16″S, 033°25′10″W to 03°42′14″S, 033°24′36″W, 0–984 m depth, midwater trawl, 2 May 2017, 11:47–12:18h • NPM 4484, 3 spec. (52–59 mm SL), RV *Antea*, ABRACOS2, sta. 49A, off Rocas Atoll, 04°10′38″S, 033°16′07″W to 04°10′58″S, 033°15′04″W, 0–1020 m depth, midwater trawl, 27 April, 21:17–21:52h.

Additional materials examined (eastern Brazil). 11 specimens • MNRJ 45291, 8 spec. (58–62 mm SL), RV *Thalassa*, sta. D-471, off Rio de Janeiro, 21°31′27.4″S, 039°47′30.8″W, 117.5 m depth, mid-water trawl, 23 June 1999, 19:56h • MNRJ 45457, 1 spec. (68 mm SL), RV *Thalassa*, sta. E-496, off Bahia, 13°17′34.8″S, 038°17′35.9″W to 13°12′01.8″S, 038°14′52.4″W, 1635.0–1863.6 m depth, bottom trawl, 7 June 2000, 9:27h • MNRJ 45458, 1 spec. (65 mm SL), RV *Thalassa*, sta. E-507, off Bahia, 15°08′35.7″S, 038°40′38.3″W to 15°07′09.5″S, 038°40′32.5″W, 1012.4–1049.0 m depth, bottom trawl, 11 June 2000, 10:28h • MNRJ 45478, 1 spec. (64 mm SL), RV *Thalassa*, sta. E-512, off Bahia, 15°50′31.9″S, 038°02′16.4″W to 15°50′35.9″S, 038°02′30.4″W, 1036.0–1050.8 m depth, bottom trawl, 13 June 2000, 12:06h.

Identification. *Howella* can be distinguished from other howellid genera by the following combination of characters: preopercle with spines along its lower margin (without spines in *Pseudohowella*), one long spine with 1–3 much shorter spines join downwards and upwards on the subopercle (two well-separated spines of equal sizes in *Bathysphyraenops*), and upper angle of opercle with two simple or a cluster of spines (two simple spines in *Bathysphyraenops*) (Fedoryako 1976). In addition, *H. atlantica* can be distinguished from its congeners

Table 1. Measurements and counts for specimens of *Bathysphyraenops simplex* (*n* = 3) and *Howella atlantica* (*n* = 36) from Brazil.

	Bathysphyraenops simplex			*Howella atlantica*		
	NPM 3266	**NPM 4477**	**NPM 5052**	**Range**	**Mean**	**SD**
Standard length (SL, mm)	36.0	77.0	74.6	51–68		
Measurements in % SL						
Head length	37.2	32.2	34.9	32.9–38.3	36.2	1.1
Body depth	23.3	29.2	29.0	24.1–29.7	27.7	1.2
Body width	9.7	15.6	12.1	12.5–17.6	15.2	1.2
First predorsal length	41.1	40.3	41.8	34.6–41.9	39.8	1.4
Second predorsal length	63.9	63.2	65.8	61.4–68.5	64.6	1.6
Preanal length	61.1	61.6	61.7	63.5–68.5	66.1	1.4
Prepelvic length	34.7	33.4	33.0	34.2–38.8	36.0	1.1
Prepectoral length	34.4	31.7	34.0	31.3–37.2	34.7	1.2
Pectoral fin length	19.4	28.6	24.1	31.9–48.9	42.1	3.5
Pelvic fin length	18.3	13.0	13.1	14.9–21.0	17.1	1.7
Caudal peduncle length	30.6	25.2	25.6	22.8–30.0	27.1	1.8
Caudal peduncle depth	10.0	12.5	11.8	9.1–13.4	11.9	0.9
First dorsal fin base	15.0	16.9	14.7	11.5–18.5	14.9	1.8
Second dorsal fin base	17.2	14.3	12.3	9.7–15.6	12.7	1.2
Anal fin base	12.8	13.0	10.6	9.3–15.2	11.5	1.4
Length between dorsal fins	9.4	12.1	11.5	9.6–16.3	12.2	1.7
Pelvic origin to anus	22.2	29.1	23.5	25.6–32.5	29.2	1.9
Maxilla length	12.2	13.5	13.1	13.4–16.5	14.9	0.6
Mandible length	9.7	11.2	9.4	10.4–14.1	12.1	0.9
Snout length	11.1	7.1	6.8	6.9–10.3	8.2	0.7
Eye diameter	11.7	10.9	11.1	11.2–16.0	12.8	1.1
Interorbital width	7.2	7.8	8.0	8.6–11.2	9.5	0.6
Counts						
First dorsal fin spines	8	8	8	8–8	8.0	0.0
Second dorsal fin spine	1	1	1	1–1	1.0	0.0
Second dorsal fin rays	9	9	9	8–9	8.9	0.2
Anal fin spines	3	3	3	3–3	3.0	0.0
Anal fin rays	7	7	7	6–8	7.0	0.3
Pectoral fin rays	14	14	14	14–14	14.1	0.4
Pelvic fin spine	1	1	1	1–1	1.0	0.0
Pelvic fin rays	5	5	5	5–5	5.0	0.0
Caudal fin procurrents (upper)	—	10	8	7–9	8.7	0.5
Caudal fin rays (upper)	10	9	10	9–10	9.2	0.4
Caudal fin rays (lower)	9	8	10	8–10	8.7	0.5
Caudal fin procurrents (lower)	—	10	7	6–9	7.9	0.7
Scales on lateral line (anterior)	—	—	—	2–3	2.1	0.3
Scales on lateral line (central)	—	—	—	6–9	7.8	0.6
Scales on lateral line (posterior)	—	—	—	19–27	23.7	1.9
Scales on transverse row	11	11	11	10–12	11.2	0.5
Scales on longitudinal row	34	34	—	30–37	34.7	1.7
Upper gill rakers (rudimentary)	3	3	4	3–5	3.6	0.6
Upper gill rakers	3	3	3	3–6	3.8	0.8
Upper gill rakers (total)	6	6	7	6–9	7.3	0.8
Lower gill rakers	13	13	13	11–18	13.9	1.7
Lower gill rakers (rudimentary)	6	5	5	4–8	6.0	1.1
Lower gill rakers (total)	19	18	18	18–22	19.5	1.1
Total gill rakers	25	24	25	24–30	27.1	1.5
Pseudobranchs	—	—	15	18–23	19.6	1.4
Precaudal vertebrae	10	10	10	10–10	10.0	0.0
Caudal vertebrae	16	16	16	16–17	16.1	0.3
Total vertebrae	26	26	26	26–27	26.1	0.3

by the following combination of characters: a cluster of 3–6 spines at rear end of opercle, lateral line interrupted below gap between dorsal fins, three rows of scales from lateral line to second dorsal-fin origin, and pectoral-fin rays 14–16 (Post and Quéro 1991).

Distribution. This species has been previously reported from the western and eastern Atlantic Ocean, from 64°N to 21°S (Post and Quéro 1991; Heemstra 2016). In the Brazilian EEZ, it has only been recorded around Trindade Island (Post and Quéro 1991). The current study

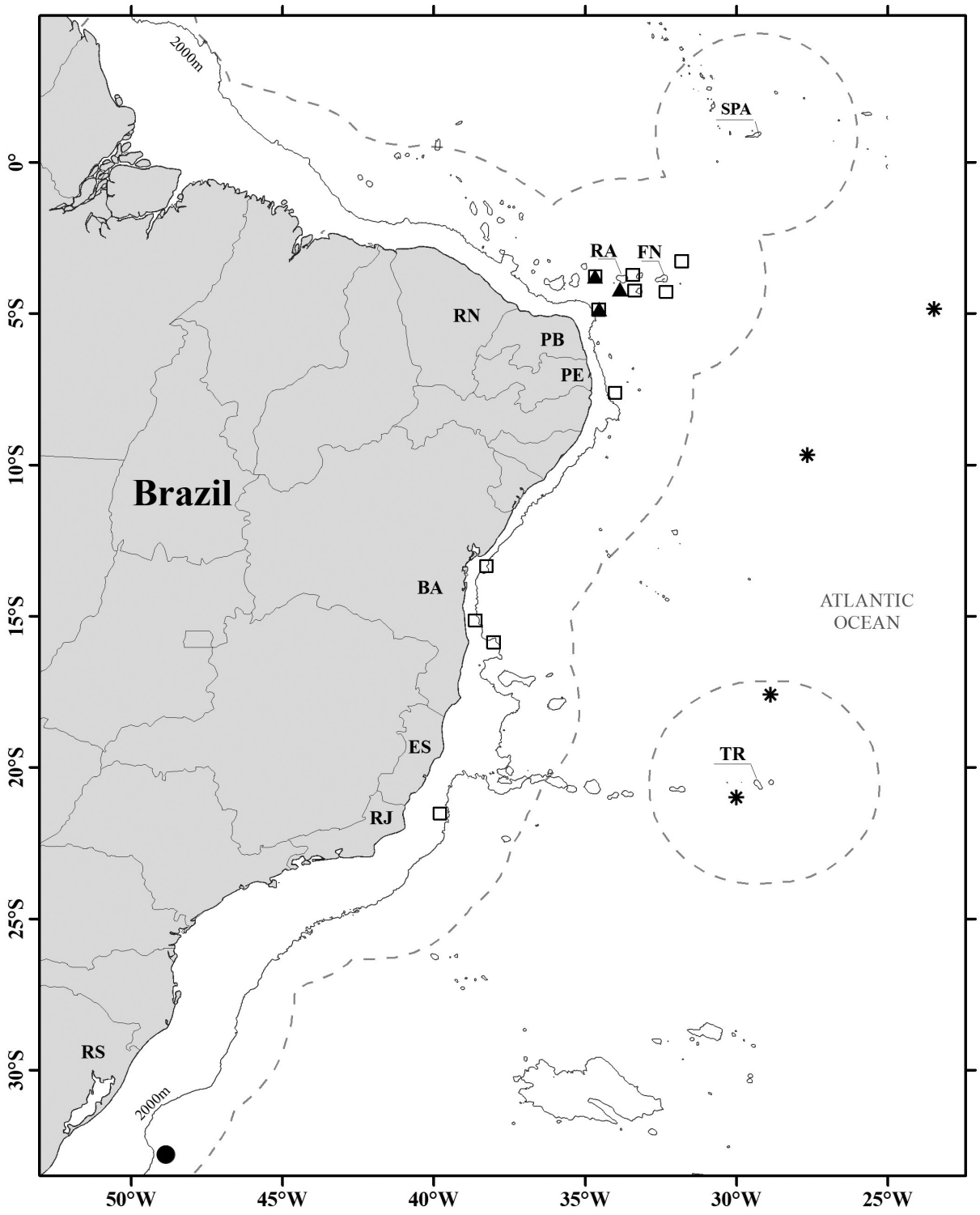

Figure 2. Distribution of *Bathysphyraenops simplex* (full triangle) and *Howella atlantica* (open square) examined in the present study. Previous records of *Howella atlantica* (asterisk) and *Howella sherborni* (full circle) along Brazilian waters (from Post and Quéro 1991). Limits of the Brazilian Exclusive Economic Zone in dash line. Oceanic islands: **SPA** – São Pedro e São Paulo Archipelago; **RA** – Rocas Atoll; **FN** – Fernando de Noronha Archipelago; **TR** – Trindade Island. Selected Brazilian states: **RN** – Rio Grande do Norte; **PB** – Paraíba; **PE** – Pernambuco; **BA** – Bahia; **ES** – Espírito Santo; **RJ** – Rio de Janeiro, **RS** – Rio Grande do Sul.

extends the known distribution of *H. atlantica* to other areas of Brazilian waters; 24 specimens were collected off Rio Grande do Norte, Pernambuco, Rocas Atoll, and the Fernando de Noronha Archipelago. Eleven specimens, previously identified as *Howella brodie* by Costa et al. (2007), were trawled off Bahia and Rio de Janeiro (Fig. 2).

Discussion

Among more than 9000 specimens of mesopelagic fishes caught during the two ABRACOS expeditions (October 2015 and April 2017), three specimens of *B. simplex* and 25 of *H. atlantica* were collected. Eleven specimens of *H. brodiei* Ogilby, 1899 reported off Bahia and Rio de

Janeiro by Costa et al. (2007) were here reidentified as *H. atlantica*. These re-identifications extend the known distribution of *H. atlantica* to northeastern and southeastern Brazil. Other howellids previously reported in Brazilian waters include: two specimens of *Howella sherborni* (Norman, 1930) (ISH 931/66: 80.7–87.8 mm SL) reported off Rio Grande do Sul (Post and Quéro 1991), and 18 specimens of *H. atlantica* (ISH 742/66 [3]: 59.1–62.7 mm SL and ISH 777/66 [15]: 61.1–71.2 mm SL) collected around Trindade Island (Post and Quéro 1991) (Fig. 2).

Knowledge regarding the diversity of deep-water fishes off Brazil is based on a few scientific expeditions and a scarcity of specimens deposited in zoological collections. Howellid species may thus be more frequent in Brazilian waters than currently thought. In addition, due to the lack of data on this group, important ecological information such as habitats niche, vertical migration, growth pattern, reproduction, and feeding behavior remain understudied. Additional studies focused on the diversity, distribution, and ecology of howellid species, as well as other poorly known deep-sea fishes in Brazilian waters are recommended.

Acknowledgements

We thank the French oceanographic fleet for funding the ABRACOS at-sea survey and the officers and crew of the RV *Antea* for their contribution to the success of the operations. Our study could not have been done without the work of all team members of BIOIMPACT (UFRPE) and LIZ (NUPEM/UFRJ) labs. We also thank Dr Cristiano R. Moreira (Museu Nacional/UFRJ) for loan of specimens, and the CNPq (Brazilian National Council for Scientific and Technological Development) for providing student scholarship to LNE and ASL, and research grant for TF and FLF. LNE is also supported by FUNBIO and HUMANIZE under the grant "Bolsas Funbio - Conservando o Futuro (011/2019)". This work is a contribution to the LMI TAPIOCA, CAPES/COFECUB program (88881.142689/2017-01), and PADDLE project (funding by the European Union's Horizon 2020 research and innovation programme, grant agreement 73427). The NPM Fish Collection has been supported by the project MULTIPESCA (FUNBIO) under the grant 'Pesquisa Marinha e Pesqueira', contract 104/2016.

Authors' Contributions

LNE, BTV, JRM, and MMM identified specimens, made measurements, and wrote the manuscript with contributions of AB, ASL, FLF, PET, and TF. AB and FLF conceived and coordinated the research project. All authors participated of the at-sea surveys and/or contributed substantially to the biological analyses.

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