

Bryological Studies on Trindade Isl

Paulo Câmara & Micheline Carvalho Silva report on their bryological explorations of this little-known island in the South Atlantic Ocean.

The Island

Trinidade is an oceanic island located in the South Atlantic, between 20° 31' 30" S and 29° 19' 30" W, and lies about 1,200 Km east off the coast of Brazil (Fig.1). It is the most remote piece of Brazilian territory and its very existence had remained largely ignored by most scientists, as well as by the public in general for many years.

Trindade arose from the sea floor as a result of volcanic activity about 3 million years ago and according to Serafini *et al.* (2010) and Silva & Alves (2011), its last volcanic activity happened ca. 50,000 years ago. It has an area of 9.8 Km², with the highest point ("Pico do Desejado") at 620m a.s.l. The oceanic depths around the island are estimated to be about 6,000 m. Of all the Brazilian oceanic islands, Trindade is the only one to have running freshwater, due to the existence of small creeks. According to Alves (1998), the climate is tropical oceanic and semi-arid with an average annual precipitation of 923 mm and annual mean temperature of 25.2 °C. It is also the biggest South Atlantic reproduction site for the green turtle (*Chelonyx mydas*) (Fig. 2).

A bit of history

Trindade was first sighted in 1502 by the Portuguese sailor João da Nova (1460-1509), but it remained largely ignored and uninhabited until 1730 when Azorean families colonized the island. This proved largely unsuccessful and they abandoned Trindade in 1795 leaving behind goats, pigs and other domestic animals, which, over the years, destroyed most of the island's original vegetation.

The first record of a person landing on Trindade is of Edmund Halley (1656-1742) who visited the island in 1700 and collected "natural history material", unfortunately it seems that this material did not survive to the present day. He is also considered to have been the first to introduce exotic animals on the island, releasing goats, hogs and hens from St Helena. Another botanically important expedition that later reached the island was that of Joseph Dalton Hooker (1817-1911) who visited Trindade in 1839 during his famous trip to Antarctica on board the ships Erebus and Terror (1839-1843). He also collected botanical specimens there, but again, nothing seems to have survived to today



and, South Atlantic

△Fig. 1. Trindade Island P. Câmara & M. Carvalho Silva

(apparently Hooker's Trindade specimens were lost after a boat capsized).

After the Azoreans left Trindade in 1795, the island was only sporadically occupied; mostly by pirates, adventurers and also garrisoned during the WWI and WWII. It also served as a prison for a brief period. Only in 1957 was the island permanently occupied, and has been so ever since.

For more on the history of the island and its vegetation we suggest Alves (1998) (in

Portuguese), Alves & Silva (2016) and Faria *et al.* (2012).

Nowadays

Nowadays there are no cities, roads or urbanization on Trindade, but only a small garrison of 32 navy personnel that runs an oceanographic outpost (Fig. 3), named POIT (Posto Oceanográfico da Ilha da Trindade). According to the Brazilian constitution (Brasil 1988), the island's administration is under the

▽Fig. 2. Trindade is the biggest South Atlantic reproduction site for the green turtle *Chelonia mydas*. P. Câmara & M. Carvalho Silva





△Fig. 3. The oceanographic outpost, POIT on Trindade. P. Câmara & M. Carvalho Silva

responsibility of the Brazilian Navy, who sends vessels there (Fig. 4) every other month to change the island's crew and to bring supplies. There is also an equipped scientific station, named ECIT (Estação Científica da Ilha da Trindade), that can house about 10 scientists.

Vegetation

Not much is known of Trindade's original vegetation as it was almost completely destroyed after years of grazing, as the introduced animals thrived over the centuries. It seems that by 1881, most of its original vegetation was already destroyed, as the explorer and writer E. Knight (1852-1925), who visited Trindade in 1881 and 1889, reported an already much degraded vegetation (Knight 1892), although

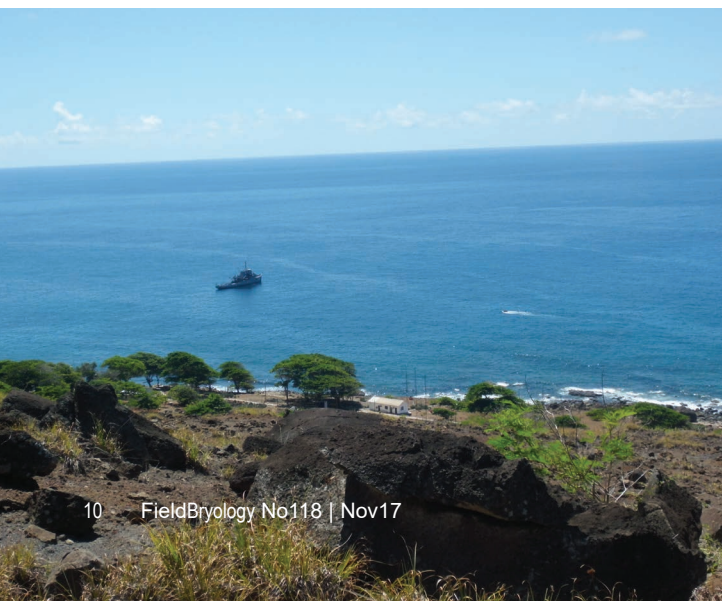
he mentioned the presence of a long-gone big waterfall on the west coast.

In order to help with the restoration of Trindade's vegetation, in the 1990s the Navy started a successful programme to eliminate the goats; consequently these have been considered completely eradicated from 1998. Since then, the vegetation has slowly recovered and the creeks have more running water, resulting in a definitely much greener island (Fig. 7).

Bryophytes

The first bryological record from Trindade is from Alves (1998) who reported eight species, six mosses and two liverworts: *Marchesinia brachiata* (Sw.) Schiffn., *Sematophyllum subsimplex* (Hedw.) Mitt., *Hyophila involuta*

▽Fig. 4, left. Brazilian Navy vessel anchored in the waters of Trindade. ▽Figs. 5&6, right. Reaching the island from the Navy vessels by helicopter (top) and by boat (bottom). P. Câmara & M. Carvalho Silva





△Fig. 7, left. A vegetated creek; a promising sign that the island vegetation is slowly recovering. P. Câmara & M. Carvalho Silva △Fig. 7, right. Paulo searching for bryophytes in the grass-dominated lowlands, up to 400m a.s.l. P. Câmara & M. Carvalho Silva

(Hook.) Jaeg., *Bryum argenteum* Hedw., *Fissidens elegans* Brid., *Philonotis uncinata* (Schwaegr.) Brid.), *Cheilolejeunea trifaria* (Nees) Mizut. and *Frullania beyrichiana*. (Lehm. & Lindenb.) Lehm. & Lindenb. The material was later identified by Dra. Olga Yano from Instituto de Botânica de São Paulo. These specimens are now housed at herbaria R and SP. We had the chance to investigate these collections and to correct some misidentifications (see below for an updated checklist).

From a bryological perspective, nowadays the island can be divided into three different kinds of vegetation: 1) From sea level up to about 100-150 m, dominated by *Ipomoea pes-caprae*

(see Fig. 3) and introduced exotic trees and fructiferous plants (e.g *Citrus tangerina* L., *Musa paradisiaca* L., *Anacardium occidentale* L.); there are no bryophytes in this region. 2) The lowlands (Fig. 7), up to ca. 400m a.s.l. dominated by grass fields (mostly Poaceae and Cyperaceae); acrocarpous mosses and hornworts are present here; and 3) the highlands, above 400m a.s.l. (Figs. 8, 9) and covered by a very interesting kind of vegetation, the so-called “Giant Fern Forest” or “Giant Ferns Nebular Forest” (Aves 1998), dominated by a single species of *Cyathea* (the identity of the species is subject to debate and is currently being investigated; it is probably *Cyathea delgadii* Sternb.), are the most

▽Fig. 8. Highlands covered by the ‘Giant Fern Forest’, dominated by a single species of *Cyathea*. P. Câmara & M. Carvalho Silva





△Fig. 9. Reaching the Giant Ferns Forest was difficult for goats as it is for bryologists (◁Fig. 10) today. P. Câmara & M. Carvalho Silva



collection of hundreds of specimens, currently deposited at herbaria UB and RB. Here we present an updated list of all bryophyte species present on the island.

Results

During our surveys, 431 specimens were collected, from those we recognized 33 species, including 20 liverworts, 12 mosses and one hornwort. The Lejeuneaceae is the most diverse family with 11 species.

Hornwort

Anthocerotaceae

Anthoceros punctatus L., Sp. Pl. 1139. 1753.

Mosses

Bartramiaceae

Philonotis uncinata (Schwägr.) Brid., Bryol. Univ. 2: 221. 1827.

Bryaceae

Bryum argenteum Hedw., Sp. Musc. 181. 1801.

Calymperaceae

Calymperes tenerum Müll. Hal., Linnaea 37: 174. 1872.

Octoblepharum albidum Hedw., Sp. Musc. Frond. 50. 1801.

Dicranaceae

Leptotrichella lindigiana (Hampe) Ochryra, Fragm. Flor.Geobot. 42:563.1997.

diverse region with acrocarps, pleurocarps and liverworts. It is thought that these highlands are more pristine as it was rather difficult for goats to reach them (Figs. 9 and 10). Alternatively, it has been suggested that the predominance of ferns is due to selective goat grazing, as goats supposedly did not appreciate the fern's taste.

In the year 2007, Brazilian authorities and funding agencies with the support of the Brazilian Navy created the PROTRINDADE, a special programme to fund scientific research in Trindade. As a consequence and starting in 2010 we were able to visit the island and start collecting mosses more diligently. This has resulted in a



△Fig. 11. Epiphytes on a rotting log in the 'Giant Fern Forest'. ▷Fig. 12. Bryophytes of Trindade, from top to bottom: *Fissidens zollingeri*, *Hyophiladelphus agrarius*. P. Câmara & M. Carvalho Silva

Fissidentaceae

Fissidens hornschuchii Mont., Ann. Sci. Nat., Bot., sér. 2, 14: 342. 1840.

Fissidens zollingeri Mont., Ann. Sci. Nat. Bot. 3, 4: 114. 1845.

Leucobryaceae

Campylopus introflexus (Hedw.) Brid. Mus. Recent. Suppl. 4: 72. 1819[1818].

Campylopus occultus Mitt., J. Linn. Soc. Bot. 12: 86. 1869.

Pottiaceae

Barbula indica (Hook.) Spreng., Nomencl. Bot. 2: 72. 1824.

Hyophiladelphus agrarius (Hedw.) R.H. Zander., Bryologist 98: 372. 1995.

Pylaisiadelphaceae

Isopterygium tenerifolium Mitt., J. Linn. Soc., Bot. 12: 499. 1869.

Liverworts

Frullaniaceae

Frullania beyrichiana (Lehm. & Lindenb.) Lehm. & Lindenb., Syn. Hepat. 460. 1845.

Frullania gibbosa Nees, Ann. Sci. Nat. Bot., sér. 2, 14: 333. 1840.

Frullania kunzei Lehm. & Lindenb., Syn. Hepat. 449. 1845.

Geocalycaceae

Chiloscyphus martianus (Nees) J.J. Engel &



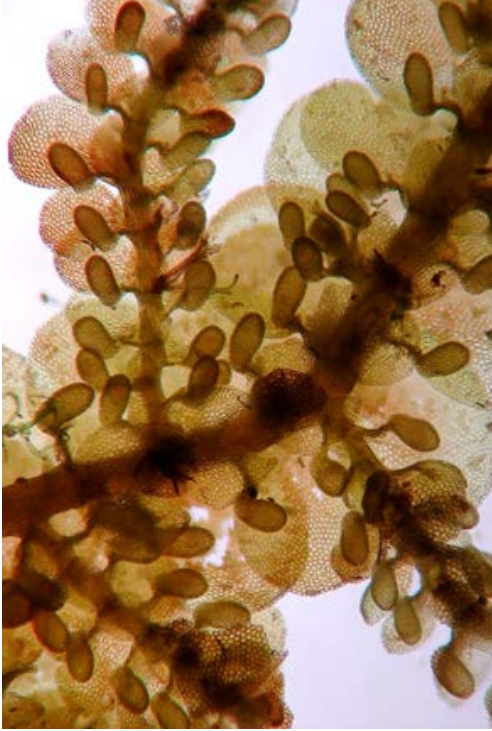
R.M. Schust., Nova Hedwigia 39: 419. 1984. [1985].

Jungermanniaceae

Jungermannia amoena Lindenb. & Göttsche, Syn. Hepat. 674. 1847.

Lejeuneaceae

Acanthocoleus aberrans (Lindenb. & Göttsche) Kruijt, Bryophyt. Biblioth. 36: 62. 1988.



<Fig. 13. Bryophytes of Trindade *Frullania caulisequa*.

△Fig. 14. *Riccia membranacea*. P. Câmara & M. Carvalho Silva

Cheilolejeunea rigidula (Mont.) R.M. Schust.,
Castanea 36: 102. 1971.

Cheilolejeunea trifaria (Reinw. Blume & Nees.)
Mizut., J. Hattori Bot. Lab. 27: 132 1964.

Frullanoides corticalis (Lehm. & Lindenb.)
Slageren, Meded. Bot. Mus. Herb. Rijks Univ.
Utrecht 544: 84. 1985.

Lejeunea caespitosa Lindenb., Syn. Hepat. 382.
1845.

Lejeunea flava (Sw.) Ness, Naturgesch. Eur.
Leberm. 3: 277. 1838.

Leuclejeunea uncioloba (Lindenb.) A. Evans,
Torreya 7: 228. 1907.

Marchesinia brachiata (Sw.) Schiffner, in Engler
& Prantl, Nat. Pflanzenfam. 1, 3: 128. 1893.

Microlejeunea bullata (Taylor) Steph., Sp. Hepat.
5: 824. 1915.

Schiffneriolejeunea polycarpa (Nees) Gradst., J.
Hattori Bot. Lab. 38: 335. 1974.

Symbiezidium barbiflorum (Lindenb. &
Göttsche) A. Evans, Bull. Torrey Bot. Club
34: 540. 1908.

Plagiochilaceae

Plagiochila corrugata (Nees) Nees & Mont., Ann.
Sci. Nat., Bot., sér. 2, 5: 52. 1836.

Ricciaceae

Riccia membranacea Göttsche, Lindenb. & ees.,
Syn. Hepat.: 608. 1846.

There are no endemics or threatened species on Trindade and its bryoflora holds great similarity with the Brazilian coast, especially the regions with Atlantic Rainforest, ca. 52% are of neotropical distribution, 21% are neotropical and African, 15% pantropical and the remaining species are cosmopolitan.

We can see a clear division of species that occur only on the highlands, including the only pleurocarp (*Isopterygium*), from those on the lowlands where the acrocarps predominate.

Our data show that Trindade is the most diverse among the Brazilian oceanic islands, followed by Fernando de Noronha, with 22 species so far. It must be noted that Noronha is much closer to the mainland (ca. 500 Km) and also much bigger in size (ca 17 Km²).

Notes on the island of Martim Vaz

With an area of about 0.3 Km² and at about 40Km away from Trindade is the island of Martim Vaz. It is extremely steep and difficult to reach, so can only be accessed by helicopter. There were no reports of bryophytes from there, and our expeditions had the chance to search specifically for mosses there, confirming their total absence today.



△Fig. 15. Some of the team enjoying a well-deserved rest and magnificent views on ‘top of the world’ P. Câmara & M. Carvalho Silva

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▽Fig. 16. Back to civilisation, leaving the island after a very rewarding expedition. P. Câmara & M. Carvalho Silva

