



***Neoichnology of sandy beaches on the northern coast of
Florianópolis, Santa Catarina State, S Brazil***

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INTRA-CONGRESS FIELD TRIP GUIDE

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**ICHNIA 2024 – The 5th International Congress on Ichnology
Celebrating One Ichnology!**

FIELD TRIP GENERAL INSTRUCTIONS

Welcome to the ICHNIA 2024 Intra-Congress Field Trip! Below are tips and relevant information about the excursion.

- Brazilian laws do not permit removal of animal and plants from the country, and collections need to be reported in advance to the National Biodiversity Agency. Our goal is to observe biogenic structures and **we only have permission to take photos**. Airport inspections are strict.
- The use of sunscreen, bug repellent, and a hat are highly recommended for this field trip. Brazil is experiencing a dengue outbreak, thus insect repellent should be used especially in the early morning (up to 10 a.m.) and late afternoon (beginning at 4 p.m.), when *Aedes aegyptii* females are most active.
- We will walk on the beach, so you can wear short pants and sandals if you wish. Flip-flops are not recommended on the trail at stop 3.
- Brazilians do not strip naked on the beach, either to change clothing or dive. It is only permitted at nude beaches. As a result, we recommend that you wear your swimsuit because there will be no accessible facilities to change clothing.
- We will have time for lunch at Daniela Beach, but feel free to eat whenever you want.
- Bring water with you on beach walks.

INTRODUCTION

Florianópolis is the capital of the State of Santa Catarina (SC), one of the three states that make up the southern of Brazil. Most of the city occupies the island of Santa Catarina which has an area of 400 km² and is situated parallel to the mainland, separated by a narrow channel. The oldest rocks date from the Upper Proterozoic and are characterized by the Paulo Lopes Granitoid. Most of the island is formed by Upper Proterozoic–Lower Paleozoic igneous rocks (Fig. 1). Quaternary deposits occur in the lowlands and the coastal plain and were deposited in the last 2 ka (Fig. 2) [1].

The island of Santa Catarina has an elongated and narrow shape and a jagged coastline, with several inlets, bays, and lagoons. Extensive dune fields develop on the eastern coast driven by NE winds all year, and S winds during winter. The climate is subtropical humid, and the annual average temperature is 21°C. The beaches are composed mainly of fine-grained, quartzous sand, and some mud can accumulate close to mangrove areas, driven by river discharges. The island has a microtidal regime, with a maximum amplitude of 1.2 m in conditions of sizigy and semidiurnal regime [2].

Two types of vegetation occur on the island: the Mata Atlântica Rainforest and the coastal vegetation, characterized by restinga and mangrove systems. Mangroves occur on the western coast and are low diverse, composed of only three species of trees: *Avicennia schaueriana* Stapf and Leechmann ex Moldenke, *Rhizophora mangle* (L.), and *Laguncularia racemolla* (L.) Gaertner f. [3,4]. They are more abundant on the seaward side of the bays and prefer low-energy, low-erosional inlet coasts, retaining mud deposits in these zones. *L. racemolla* is the dominant species in the island while *A. schaueriana* characterizes the tallest trees [4]. The restinga vegetation occurs on backshore and back barrier settings of sandy beaches and is chiefly composed of halophytic grasses (e.g., *Spartina montevidensis* Arech.) and shrubs.

The island beaches possess a great diversity of invertebrate and vertebrate fauna that commonly inhabit the tropical and subtropical Atlantic coast. Among the most celebrated bioturbators and bioeroders, cerianthids (e.g., *Ceriantheomorpha brasiliensis*), corals, bryozoans, polychaetes (e.g., Nereididae, *Diopatra* sp., *Thoracophelia furcifera*), mollusks (eg., *Donax hanleyanus*, *Tagelus plebeius*, *Perna perna*, *Crassostrea* spp., *Colisella subrugosa*, *Littorina* spp., *Octopus vulgaris*), crustaceans (e.g., *Ocypode quadrata*, *Emerita brasiliensis*, *Uca* sp., *Callichirus* cf. *major*, *Megabalanus* sp., *Lepas anatifera*, *Pagurus provenzanoi*), echinoderms (e.g., *Astropecten* sp., *Echinaster (Othilia) brasiliensis*, *Echinometra lucunter*), tunicates, rays, and fishes are commonly found in the shallow marine and coastal settings. Birds, reptiles, and mammals can also be observed, particularly turtles, small lizards, and rodents, besides domestic animals and humans. Tracks and trackways are the main biogenic structures left by vertebrates. A photo book about sea-life biodiversity in Santa Catarina coast can be downloaded from https://biodiversidade.ufsc.br/ebook/Livro_Web.pdf.

MAPA GEOEVOLUTIVO DA PLANÍCIE COSTEIRA DA ILHA DE SANTA CATARINA, SC, BRASIL



2013
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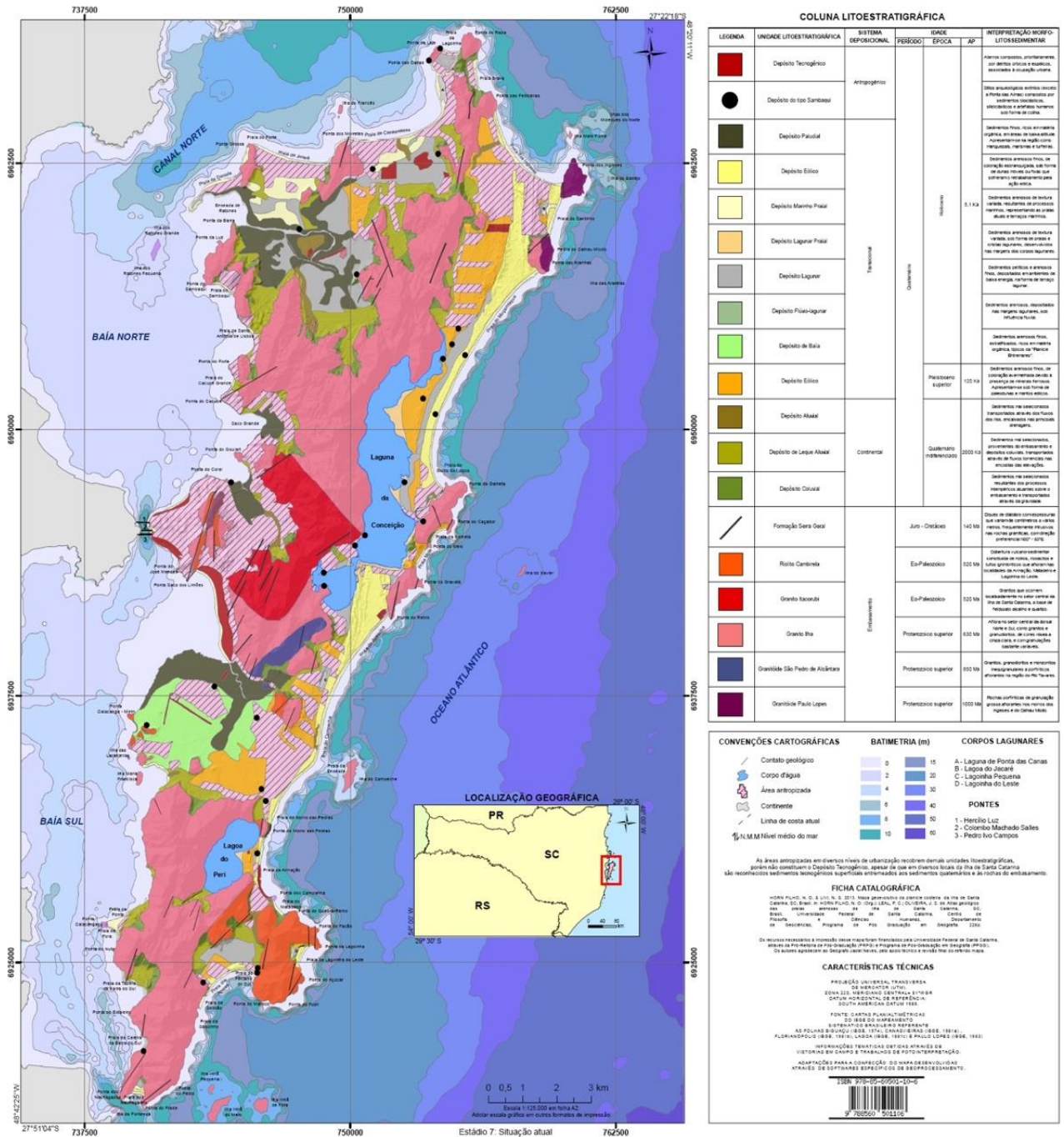


Fig. 1. Geological map of the island of Santa Catarina [modified from 1].

Netto, R.G. 2024. *Neoichnology of sandy beaches on the northern coast of Florianópolis, Santa Catarina State, S Brazil*. ICHNIA 2024 Intra-Congress Field Trip Guide, 12 pp.

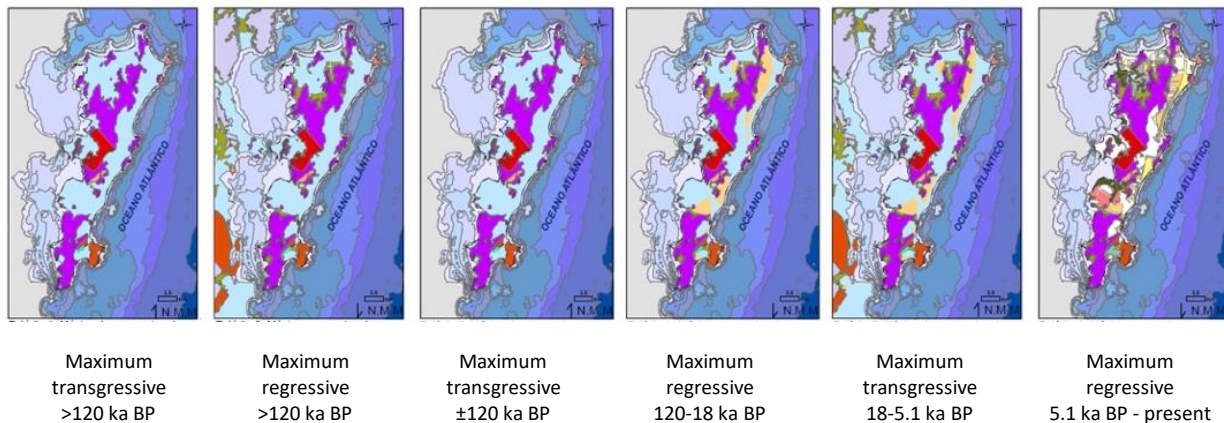


Fig. 2. Evolution of the coastal plain of the island of Santa Catarina in the Quaternary [modified from ¹].

The north of the island encompasses a variety of beaches of low to moderate energy that allow the observation of distinct forms of organism-substrate interactions. On this field trip, we will have the opportunity to observe structures being produced in real-time in coastal dunes, ocean, and inlet beaches, as well as man-made structures in rocks (engraved rock). *Please don't collect specimens or samples; this isn't allowed by Brazilian environmental and heritage laws.* Only photos are permitted.

Visiting Points

Stop 1 – Natural Park Lagoa do Jacaré das Dunas do Santinho

On this stop, we will visit the coastal dunes located north of Santinho Beach (Fig. 3), in a natural park that preserves the ecosystem of coastal dunes that stretched throughout the beach before urban growth. We will spend **30 minutes** here to observe mostly insects, lizards, birds, small mammals, and eventually crab burrows, tracks, and trackways. Interactions of arthropods with the restinga vegetation may also be observed.



Fig. 3. General view from the dune fields at the north of Santinho Beach. Left image from <https://observa.ufsc.br/2018/11/23/parque-natural-municipal-lagoa-do-jacare-das-dunas-do-santinho/>.

Stop 2 – Santinho Beach

After the dunes, we'll walk along Santinho's Beach looking for structures formed by organisms interacting with sediment. Our estimated time is **50 minutes**, and we will take a slow walk so you can fully observe the structures created in the foreshore and backshore (Figs. 4,5).



Fig. 4. General view of the Santinho Beach backshore and foreshore zones.



Fig. 5. Mollusk trails are the most common biogenic structures observed on the foreshore and ghost crab burrows on the backshore at Santinho Beach.

Stop 3 – Petroglyphs on the Santinho Beach

The southern end of Santinho Beach is demarcated by Morro das Aranhas, an outcrop of Precambrian rocks covered by restinga vegetation in the lower areas, and the Mata Atlântica Rainforest in the higher ones. Rock engravings made by the Sambaqui People around 4.8 ka can be observed throughout the hill, as well as in many other regions of the island. A trail connecting Santinho Beach to Mozambique Beach, at the other end of Morro das Aranhas, preserves some of these petroglyphs (Fig. 6). As the trail is narrow, we will do it in groups of up to 20 people, to ensure everyone can see and photograph. The complete route, round trip, takes about **20 minutes**. Those who are not visiting the trail can enjoy the beach at that time.



Fig. 6. Petroglyphs at the Morro das Aranhas trail.

The trail has explanatory totems in Portuguese. The most important information they transmit is summarized below:

“This area was prepared for your visit. In addition to the magnificent landscape, two archaeological sites are preserved: lithic workshops and rock engravings. Along the way, totems are distributed with information about local archaeology and history. It is the only museum of its kind in Brazil. Petroglyphs are archaeological sites characterized by figures or geometric shapes engraved or painted on the rocks. On the coast of Santa Catarina, they are always engraved, forming grooves that mark the drawings. Usually, they are today in places of difficult access, almost always in remarkable geographical points, as in the coast to the sea, in promontories, tips and islands, always associated with other types of archaeological sites.

The Sambaqui People, the indigenous people who settled on the coast of Santa Catarina around 7 ka were responsible for the production of a vast lithic material culture, in which axes, pylons, arrowheads, and zooliths (stone animals), besides the petroglyphs. Archaeological discoveries made in these sites show some of the feelings that drove the Sambaqui Man. Necklaces and bracelets of shells and stone lip adornments prove that the taste for beauty already impressed these ancient human beings. There are no known reasons why the Sambaqui Man produced these petroglyphs. Are they related to forms of worship, relationships with nature, or events relevant to the people that create them? What feelings drove these men to leave inscriptions in the landscapes where they lived? What emotions did they experience when they observed that they could leave marks that time did not erase?”

Stop 4 – The Daniela Beach

On this stop, we will visit the sandy spit of Daniela Beach, located in the extreme north of the island. The spit is composed of composed of fine, well-sorted sands, and extends for 3 km, has an average width of 435 m and an altitude of 2.5 m. Tidal and longitudinal currents are the main responsible for the sediment transport along the coastline, with preferential NE-SW direction [5]. The spit also delimitates the Ratones Cove and the mouth of North Bay.

Like in Santinho Beach, we'll walk along the Daniela spit (Fig. 7A) looking for biogenic structures in the sedimentary substrate, with a stop to see fragments of mangrove trees in situ on the foreshore being bioeroded by marine organisms (Fig. 7B-C). We estimate a **60 minutes** of a slow walk until the next stop, at Ratones Cove.



Fig. 7. A. The sandy spit at Daniela Beach (image from <https://www.pousadabellearti.com.br/praiada-daniela>). B-C. Fragments of an ancient mangrove with marine bioeroders. D. Ghost crab (*Ocypode quadrata*) burrow. E. The sand spit at Ratoes Cove. F-G. *Callichirus* cf. *major* burrow openings with fecal pellets. Note the substrate biostabilization in G. H. Bird tracks in a stiff substrate. G. Fish poop.

Stop 5 – The Ratoles Cove

At the end of the Daniela spit there is a beach that characterizes the seaward side of Ratoles Cove (Fig. 7E). There we can observe distinct structures produced by invertebrates and vertebrates, on the beach (Fig. 7D, H) and on intertidal substrates exposed at low tide (Fig. 7F-G, I). The lowest tide will be at 6:45 p.m. on April 17, 2024, but it is expected to be already falling at 2 p.m.



Fig. 8. A-B. The restinga/mangrove system at Ponta das Canas Beach. C-E. Crab burrows on the mangrove substrates. F-G. Biostabilized lagoon margins preserving bird tracks and invertebrate burrows.

Stop 6 – The Cachoeira do Bom Jesus/Ponta das Canas Beach

Our last stop is just in front of our hotel! We will visit the mangrove/restinga system at Ponta das Canas Beach (Fig. 8A-B). You can explore thin microbial mats and biogenic structures produced on the margins of a shallow lagoon, as well as how substrate biostabilization by biofilms acts in trace and body preservation (Fig. 8C-G).. Arthropod-plant interactions in the surrounding vegetation can also be observed. While walking in the mangrove zone, watch your steps! The mangrove is the natural habitat of *Caiman latirostris*, the most common Brazilian caiman. Even though they're not common in Ponta das Canas Beach, you should be careful.

Final Remarks

We hope you enjoyed our trip! Share your best photos with us, especially those with colleagues, through ichnia2024@gmail.com.

Our field trip ends with the ICHNIA 2024 Soccer Game. The game is scheduled for 5 p.m., and this year it will be in very Brazilian style – on the beach! Those who don't play are invited to cheer!

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