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Invasive corals trigger seascape changes in the southwestern Atlantic

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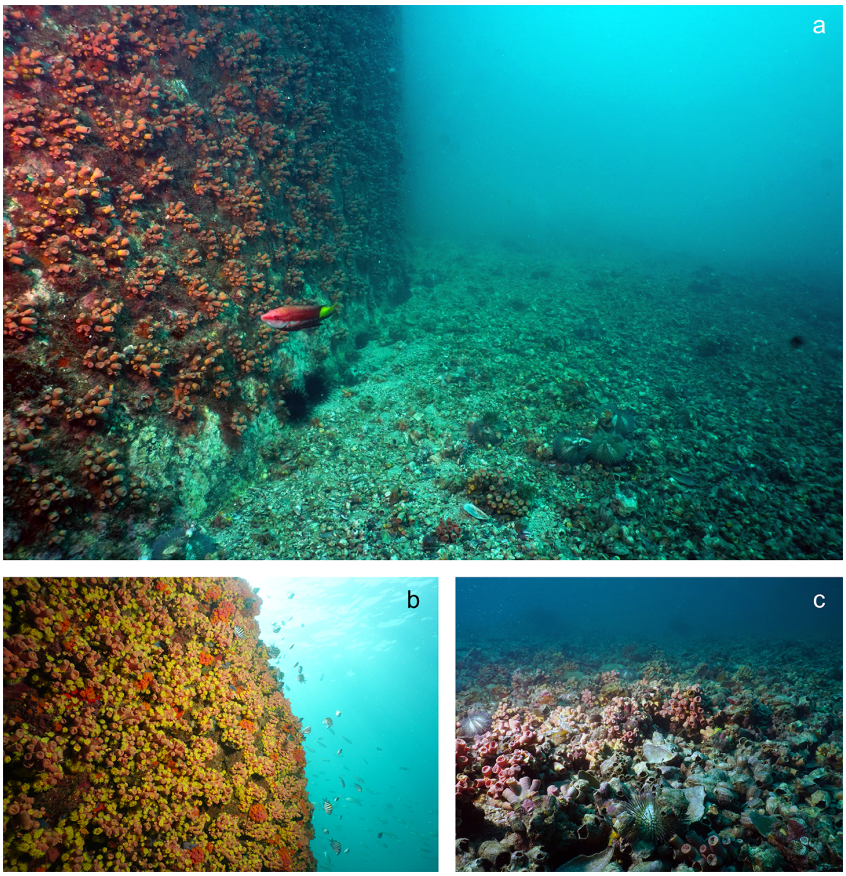

Invasive sun-corals (*Tubastraea tagusensis* and *Tubastraea coccinea*) are triggering a significant seascape change on both hard and soft bottoms on the Brazilian southeastern coast. Biological invasions are today amongst the main threats to ecosystem function and considered the second main cause of biodiversity loss (Molnar et al. 2008). That being so, each novel invasion brings unpredictable threats and changes to the invaded environment that need to be understood and addressed.

Sun-corals were first reported in the southwestern Atlantic on oil platforms in the late 1980s (Castro and Pires 2001). Since then, they have established themselves as fierce competitors on rocky shores along 3500 km of coastline, from Ceará to Santa Catarina states (Creed et al. 2017). In some regions the invasion is of an unprecedented magnitude, with sun-corals occupying nearly 100% of the hard substrate (Mantelatto et al. 2011), causing higher order impacts such as benthonic (Silva et al. 2019) and nektonic community structural and functional changes (Miranda et al. 2018). Currently, these invaders are changing the soft-bottom seascape as well, in a most surprising and previously unreported way. A positive feedback known as invasion meltdown, where invasive species facilitate other invasives to increase community change

(Simberloff and Von Holle 1999), has been established between sun-corals and the invasive scissor date mussels *Leiosolenus aristatus.* The latter bore into the coral skeleton and cohabit with the top-heavy corals, facilitating their dislodgment and toppling. The colonies settle and accumulate on soft sediments beneath. In several localities on Búzios Island, northern São Paulo State, at least two corallith layers are observed, consisting of living colonies over dead sun-coral skeletons, totaling around 20–30 cm in thickness and extending more than 20 m from the rocky shore. These layers are composed of over 50% *Tubastraea* spp., together with dead barnacles and shellfish that were incrusted and probably dislodged by the invasive corals. This high cover of *Tubastraea* spp. over soft sediment suggests that this phenomenon has been occurring for years-to-decade.

Apparently, as an outcome of wave action, the first deposited layer of sun-corals suffocated as a consequence of rolling over the sediment. However, the second layer has several thriving *Tubastraea* colonies that accommodated on the skeleton layer below them preventing direct contact to the sediment. Unattached colonies, or coralliths, have been previously reported for several scleractinian corals (Glynn 1974; Capel et al. 2012, Hoeksema et al. 2018), and usually result from colony fragmentation. In a process analogous to reef construction, and as previously reported for corallith beds, *Tubastraea* spp. skeletons are colonized by invertebrates and algae, transforming previously soft bottoms into consolidated substrate that ultimately changes ecosystem function. As the abundance of sun-corals continues to increase, these corallith beds and/or embryonic reefs, dominated by the invasive species, are expected to increase in frequency and size. The same process has been reported by divers at other sites invaded by the sun corals at Ilha Grande, Rio de Janeiro State.

Although the increment of consolidated substrate may be viewed as a positive outcome in terms of providing new surface for settlement (Sheppard 1981), at Búzios Island such changes mirror those impacts observed in some of the worst invasive autogenic ecosystem engineers known at present (Guy-Haim et al. 2018), such as the Australian tubeworm *Ficopomatus enigmaticus* (Bruschetti et al. 2011) and the Asian date mussel *Arcuatula senhousia* (Crooks 1998). Although systematic research on biodiversity changes is underway, fishes and invertebrates that inhabit soft bottoms are being displaced and might decrease locally. In terms of biodiversity and ecosystem function loss, the habitat engineer capacity of the sun-corals coupled with their longevity might prove to make them the most pervasive marine invasive species yet found in the southwestern Atlantic.

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