discovery, one by Wight, whose specimens are at CAL and K; the second by Fischer in PCH and the third by an unknown collector in MH. Among these, only Fischer mentioned the place of collection. On the evidence of a recent monographic study of the South Indian *Impatiens*[5], this species is strictly endemic to Tamil Nadu region and there are no reports of its collection since 1917. But interestingly, few studies[8–11] have reported the distribution of *I. concinna* in Idukki and northern Kerala regions. A detailed herbarium survey of K, CAL, MH, CALI, TBGT, KFRI, FRC and RHT revealed that there is no specimen of this species deposited in any of these herbaria from Kerala. On perusal of the data and information collected through personal communication with some of the authors of the previous reports, it is confirmed that the report of this species from Kerala is based on misidentified specimens.

I. concinna naturally grows in grasslands at an altitude of 1600 (Atumalai) to 2000 m (Palamala hills) in the Western Ghats and was considered as 'Possibly Extinct'[2]. Based on the present collection, perusal of the literature and herbarium specimens, the threat status of this species is updated as 'Critically Endangered' (CR B1ab (i, ii, iv) and 2ab (i, ii, iv)) using IUCN Red List Categories and Criteria[12]. The area of occupancy is estimated to be less than 1 sq. km and the known populations contain a maximum of 100 plants. The flowering and fruiting are observed during September–November.

Specimen collected: India. Kerala, Palakkad, Dhoni hills, Palamala, 10°54′.37.7″N, 076°37′.41.4″E ± 1900 m altitude 28 September 2013, K. M. Prabhukumar 103034 (CALI); K. M. Prabhukumar 7468 & 7592 (CMPR). Fischer sin. num. (PCH); exsiccatum s.n., 21 October 1929, 7481 (MH).

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Snowflake coral, *Carijoa riisei* from Grand Island, Goa: a case of invasion of an alien species or re-establishment of a native species?

Invasion is an ecological phenomenon of introduction of organisms to areas outside their native ranges. It concerns all aspects relating to their transport, establishment and spread in a new region[1]. An invasive species causes imbalance to the ecosystem by monopolizing food and spatial resources and consequently disrupting the native community[2]. Biological invasion is presently one of the major sources of stress to the coral reef habitats, which harbour 25% of total marine biodiversity and contribute to 10% of total fishery production[3,4]. In India, the coral reefs are located in the Gulf of Kachchh, Gulf of Mannar, Andaman & Nicobar Islands, Lakshadweep and some minor reefs are identified at Malavan (Maharashtra) and Grande Island (Goa).

A survey was conducted in the coral reefs of Grande Island, Goa, India (73°46′46.605″E, 15°21′0.636″N) in November 2014, during which the occurrence of *Carijoa riisei* (Duchassaing and Michelotti 1860) was observed from the site with colonies attached over a shipwreck (130 × 30 m) at a depth of 10–12 m (Figure 1 *a*). Several colonies, white and beige in colour, were observed with branches 8–10 cm long and 3.5 mm wide (Figure 1 *b*). Percentage cover of the species was calculated using a 1 × 1 m quadrat following English *et al.*[5].

The species was identified based on its characteristic features, viz. presence of eight tentacles in each polyp and each axial polyp having several lateral polyps (Figure 1 *c*), following Dhivya *et al.*[6]. The other coral species observed in the reef during the survey included *Turbinaria mescenterina*, *Favites* sp., *Favites abdita* and *Dendrophyllia* sp. The

calculated percentage cover showed an average of 55 ($n = 5$) of live *C. riisei* in the affected region. The present study could not make an assessment of the impact of *C. riisei* on the coral reefs of Grande Island as there is no prior report on the status of reefs from this region.

C. riisei, commonly called 'snowflake coral' or 'branched pipe coral' is considered an alien species of soft coral known to inhabit both reefs as well as introduced artificial surfaces (metal, concrete, plastic, rope) which are not exposed to direct sunlight[6,7]. It is designated as a highly potential invasive species as it outcompetes other organisms and spreads over the entire space, under favourable conditions[6–10]. Earlier reports elucidate the destructive impact of *C. riisei* on coral reefs, especially by overgrowing on black corals and other soft corals[7–10]. Once established over the coral, it spreads through vegetative propagation and smothers the host[9]. The invasive potential of *C. riisei* is attributed to its feeding behaviour (filter feeders), fast growth rate through linear branching (1 cm/week) and early sexual maturation (maturity is achieved when the branch length is 2.5 cm)[7].

C. riisei is known to be native to the tropical Western Atlantic and Caribbean, from Florida to Brazil and the first report of its invasion was from Hawaii in 1972 (ref. 11). Later various reports suggested the spreading of the species in different parts of the world, including India[4,6,7,12,13]. The first report of its occurrence in India was from the Gulf of Mannar[12], followed by reports from Andaman & Nicobar Islands[4,6] and the Gulf of Kachchh[13] (Figure 2). The present report of mature colonies (with branch length more than 2.5 cm) of *C. riisei* in Goa waters explains the extensive spread of the species in major as well as minor reefs of the country. Apart from India, the species was also reported from Columbia, Chuuk, Palau, Philippines, Indonesia, Australia and Thailand[7,12,13]. Recently, a mitochondrial (mtDNA) and nuclear (nDNA) sequence study revealed that the Hawaiian population, which was the first report of invasion by the species, is derived from Indo-Pacific rather than Caribbean–Atlantic[14].

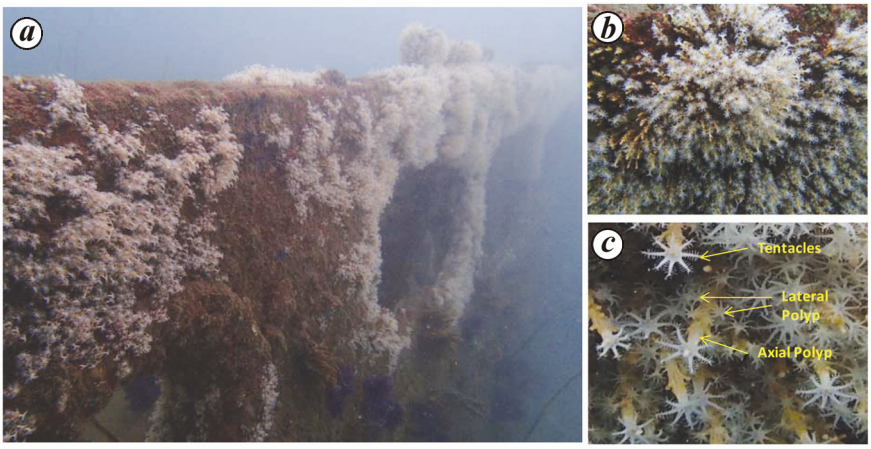

Figure 1. ***a***, Growth of *Carijoa riisei* on a shipwreck; ***b***, *C. riisei* colony; ***c***, Polyp structure of the coral.

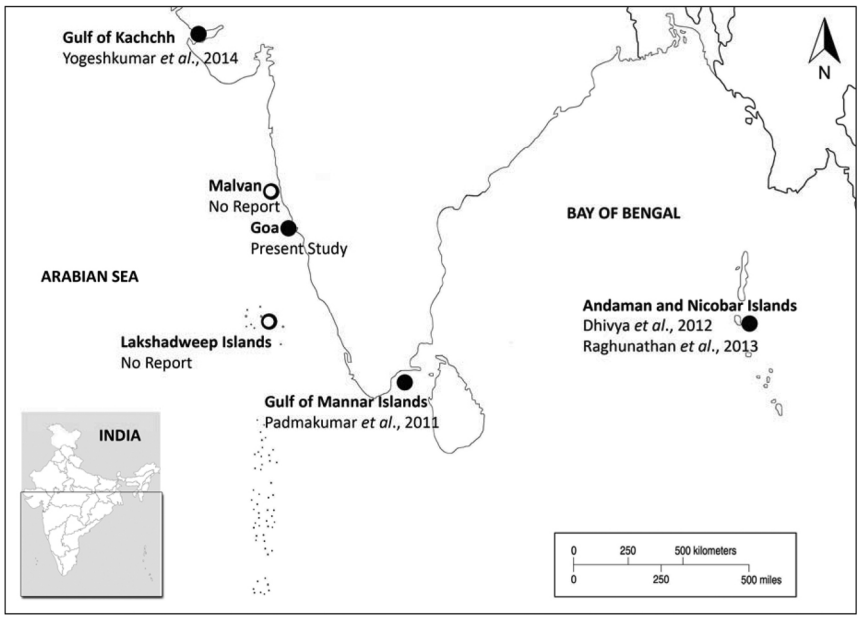

Figure 2. Distributional records of *C. riisei* in India.

The study concluded that the evolutionary origin of the genus is in the Indo-Pacific and hence the population which was earlier considered as invasive to Pacific is in fact a native species. This enhances the geographical distributional range of the species, thus rendering the assumption of *C. riisei* to be an 'alien species' after the report from Hawaii in 1972, as unsustainable. The occurrence of *C. riisei* in Goa during the present study could possibly be attributed to rapid spread of an invasive alien organism, or re-establishment of a native species to India or a new locational record for *C. riisei,* probably with pan-India distribution.

The Global Invasive Species Database[15], managed by the Invasive Species Specialists Group of the IUCN Species Survival Commission has recognized 25 marine invasive species from India, comprising 11 alien, 8 native and 6 species with unspecified biostatus. The red seaweed, *Kappaphycus alvarezii,* reported to have affected the coral reefs in Gulf of Mannar[15–17] is listed as invasive alien species in the database. Significantly, the database does not recognize *C. riisei* as an invasive species in India.

Biological invasion is characterized by the appearance of a state of dominance of a species and the rapidity of change observed[18]. A typical case of biological invasion would show evidence for the introduction of an alien species, its survival in a new environment, establishment and proliferation, and consequent

out-spacing of the native species[19]. The entire process depends on various environmental factors, including the favourable condition of the alien species to proliferate, which vary with different geographical locations. In Hawaii, *C. riisei* has been reported[8–10] to dominate the black coral (*Antipathes* sp. and *Myriopathes* sp.) community at a depth of 70 m. In Columbia, it was reported to outcompete other soft coral species[7], indicating the invasive potential of *C. riisei*.

The distribution of *C. riisei* has been reported in India only in recent years, and the studies do not establish its state of dominance, out-spacing any native species or rapidity of change or its impact on the reef ecosystem. Padmakumar *et al.*[12] reported that 2.16% of the reef area of Poovarasanpatti Island in the Gulf of Mannar is covered by *C. riisei*. The study reports the occurrence of the species in Grande Island as a new locational record and could not assess the impact on the reef due to lack of baseline data on the reef health.

It is desirable to undertake coordinated and concerted research to monitor the reef health in all sites where the occurrence of *C. riisei* has been reported, in order to conserve the fragile reef ecosystem of the country, already challenged with large-scale climatological and environmental changes. Though the present study does not contest the invasive potential of *C. riisei*, as reported from various parts of the world, it calls for a systematic genetic profiling of the said species in order to scientifically prove its evolutionary origin and nativity, so as to put to rest the claims on biological invasion of Indian reefs by this 'alien coral species'.

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Intrusion of coral-killing sponge (*Terpios hoshinota*) on the reef of Palk Bay

Coral disease, epizootics, bleaching and bioinvasions are threatening the persistence of coral reefs world over, including India[1-4]. Now sponge overgrowth on corals has also been included in the list of serious threats at various geographical locations[5]. The first encrusting cyanobacteria sponge *Terpios hoshinota* outbreak was reported from Guam[6], which is expanding its range and causing mortality ranging from 30% to 80% in coral reefs of various geographical locations. Recently invaded reefs include the Great Barrier Reef (Australia), some reefs in Philippines, America, Taiwan, Japan and Maldives[7–11]. As a result, *T. hoshinota* is now well recognized as a potential threat to the survival of corals and other associated organisms, consequently creating serious concerns about its unchecked geographical expansion.

In August 2014, assessment was carried out in Palk Bay (09°20′052″N, 79°17.468″E) up to a maximum depth of 5 m and at an average depth of 3 m between. After *T. hoshinota* growth was noticed, five sites were randomly selected to quantify sponge overgrowth signs in coral colonies. Five 20×4 m line