

Non-Indigenous Ascidians of Andaman and Nicobar Islands, India

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Abstract: Non-indigenous species are spreading world-wide knowingly or unknowingly by natural and anthropogenic means. Now-a-days non-indigenous species are in great concern as it makes native species vulnerable due to the niche shift. As ascidians are bio-fouling in nature they are easily carried by ship hulls and other floating objects from its native place to other place of world's ocean as non-indigenous one. Most of the non-indigenous species are found on the polluted jetty areas and on artificial submerged or floating objects beside the reef environment. Present paper reports eight non-indigenous ascidians from Andaman and Nicobar Islands.

Key words: Ascidiens • Non-Indigenous • Andaman and Nicobar Islands

INTRODUCTION

The concept of native species denotes that the species found in the area where it evolves to its present. The species found beyond its historic native range known as non-indigenous/ non-native/exotic/alien species, as per the definition of non-native species coined by the Executive Order- 13112 of February 3, 1999 of NOAA [1]. However, non-indigenous species becomes invasive species when it "threatens the diversity or abundance of native species or the ecological stability of infested waters or commercial, agricultural, aquacultural, or recreational activities dependent on such waters" [1]. Until it becomes invasive species, the non-indigenous species are not harmful as coho, Chinook and pink salmon are non-indigenous species to Great Lakes but not considered as invasive species as they are not harmful to the other native species and the other natural activities of that surroundings [1]. Scientists have evidence that the invasive species shift their niche from realized niche to the fundamental niche [2] and the native species residing in that niche may be excluded due to the resource partitioning according to the *Gause's Principle*. Now-a-days non-indigenous species is very common worldwide due to the global shipping movements [3-5]. The occurrence of non-indigenous species in any area is the result of bio-invasion, found almost every part of world

and are becoming the risk factor for the endemic fauna [6]. Bio-invasion is a growing environmental issue and represents a serious threat to marine as well as terrestrial biodiversity, existence of native species and economy [7]. Wide spread distributional pattern of non-indigenous species are noticeable in world's ocean among mostly algae, octocorals, bryozoans, annelids, barnacles, shrimps, molluscs, sea urchins, sea stars, ascidians, fishes etc. Ascidians are exclusively marine creatures found world-wide from intertidal zone to deep sea. These animals are commonly known as bio-fouler found on man-made structures and easily settled on the ship hulls. The present paper demonstrates the record of eight non-indigenous ascidians from different regions of Andaman and Nicobar Islands.

MATERIALS AND METHODS

Surveys were carried out to study the ascidians in Andaman and Nicobar Islands from September, 2013 to April, 2015 by Self Contained Underwater Breathing Apparatus (SCUBA) diving at 20 places (Fig. 1). Collected ascidian specimens were defecated and narcotized with Magnesium Sulphate and Menthol crystals respectively. After narcotization specimens were preserved in 4% sea water-formaldehyde solution. Specimens were dissected under Labomed CZM4 microscope and identification was

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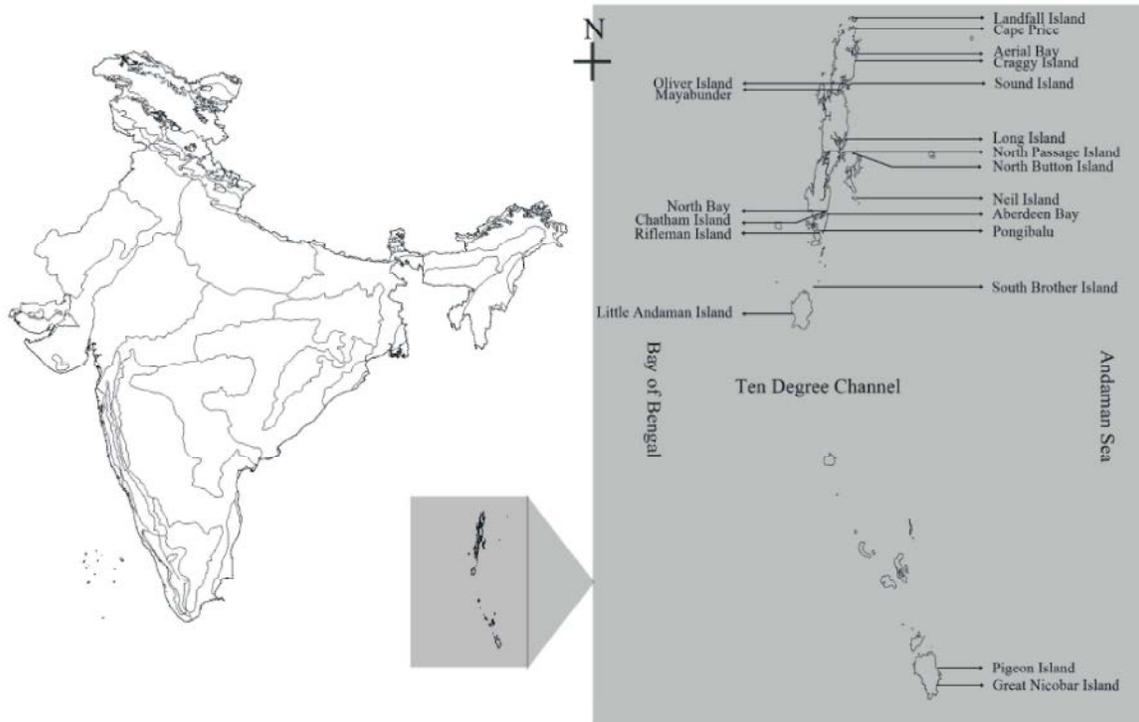


Fig. 1: Study areas in Andaman and Nicobar Islands [16]

made in consultation with Kott [8], Tokioka [9], Monniot [10], Berrill [11], Arnback [12], Monniot and Dubitus [13] and Bonnet and Rocha [14, 15]. Identified species were categorized as indigenous and non-indigenous.

RESULT AND DISCUSSION

During the surveys a total of eight non-indigenous species of ascidians were observed and collected from the different locations (Table 1) of Andaman and Nicobar Islands.

Taxonomical description of eight non-indigenous ascidian species of Andaman and Nicobar Islands are given below with their identifying characters.

Class: ASCIDIACEA Nielsen, 1995

Order: APLOUSOBRANCHIA Lahille, 1886

Family: DIDEMNIDAE Giard, 1872

Genus: *Lissoclinum* Verrill, 1871

***Lissoclinum fragile* (Van Name, 1902) (Fig. 2a):** Colonial species; colonies have flat and encrusting appearance. Colonies are about 1 mm thick. Field identification can be done easily by its bright yellow coloration of the abdominal region of individual zooids which is noticeable by tearing the test [17].

Till 2011 this species was treated as native [5] but in 2014, Jaffarali *et al.* considered the species as an invasive species [7]. This species is also considered as cryptogenic species [18].

Native Range: Bermuda Islands (As the type specimen locality) [19] (Fig. 4).

Order: PHLEBOBRANCHIA Lahille, 1886

Family: ASCIDIIDAE Herdman, 1882

Genus: *Ascidia* Linnaeus, 1769

***Ascidia sydneiensis* Stimpson, 1855 (Fig. 2b):** Large specimen, laterally flattened, longer than wide can be up to 20 cm long with 6 lobes on each sort siphons although, more than 6 lobes in branchial aperture can be found, branchial siphon is terminal and atrial siphon located at the two-third distant of the body length. Test thick and firm however, a translucent test also found in smaller specimens. Slate to black body colour can be seen through cloudy translucent test [8]. A border of short transverse mussels around the right side of the body with lobed anal border is present. The position of neural ganglion is close behind the dorsal tubercle. Asymmetrical dorsal lamina and fringed lobes are present around the apertures and a mud distended gut is visible.

Table 1: Distribution of non-indigenous ascidian species in different places of Andaman and Nicobar Islands

Sl.No.	Study areas	Latitude	Longitude	<i>Lissoclinum fragile</i>	<i>Ascidia sydneyensis</i>	<i>Phallusia nigra</i>	<i>Phallusia arabica</i>	<i>Phallusia mammillata</i>	<i>Herdmania pallida</i>	<i>Haedmania momus</i>	<i>Herdmania papietensis</i>
1.	Landfall Island	13°38.011'N	93°01.139'E		•			•	•		
2.	Cape Price	13°30.172'N	93°02.627'E					•			
3.	Aerial Bay	13°16.318'N	93°02.515'E	•							
4.	Craggy Island	13°13.516'N	93°03.406'E				•	•			
5.	Mayabunder	12°55.355'N	92°53.500'E		•						
6.	Sound Island	12°56.209'N	92°53.137'E	•					•		
7.	Oliver Island	12°59.542'N	92°59.119'E		•		•		•		
8.	Long Island	12°25.359'N	92°57.869'E					•			
9.	North passage Island	12°18.288'N	92°54.830'E					•			
10.	North Button Island	12°18.880'N	93°04.010'E					•			
11.	Neil Island	11°55.300'N	93°05.613'E				•				•
12.	North Bay	11°42.034'N	92°45.115'E		•	•		•			
13.	Chatham Island	11°41.195'N	92°43.207'E			•					
14.	Rifleman Island	11°30.837'N	92°98.767'E						•		
15.	Aberdeen	11°40.178'N	92°44.590'E			•					
16.	Pongibalu	11°30.565'N	92°39.124'E	•							
17.	South Brother Island	10°55.585'N	92°36.090'E				•	•	•		
18.	Little Andaman Island	10°35.386'N	92°33.477'E	•			•		•		
19.	Pigeon Island	07°04.420'N	93°54.150'E			•					
20.	Great Nicobar Island	06°59.419'N	93°56.460'E			•					

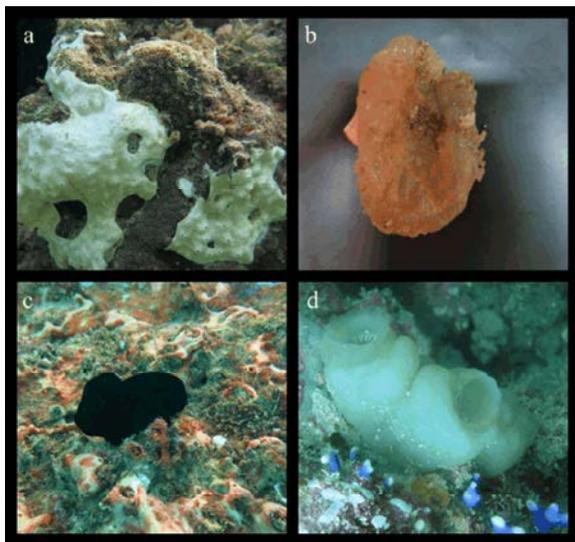


Fig. 2a: *Lissoclinum fragile* (Van Name, 1902), b: *Ascidia sydneyensis* Stimpson, 1855, c: *Phallusia nigra* Savigny, 1816, d: *Phallusia arabica* Savigny, 1816

In 2011, Tamilselvi *et al.* [5] considered the species as invasive/ alien species to the Indian coastal waters as the paper depicts its distribution in Indo-Pacific and Atlantic Ocean, Sub Antarctic region, East South America. Jaffarali *et al.* [7] considered the species as invasive species in Indian coastal waters. Although Kott stated it has pan-tropical range and the species is absent only from the eastern Pacific [8].

Native Range: First reported from Australia [8] (Fig. 4).
Genus: *Phallusia* Savigny, 1816

***Phallusia nigra* Savigny, 1816 (Fig. 2:c):** Test is smooth, opaque, thick shiny black in colour. However, grey coloured tunic also can be seen in young individuals. Branchial siphon are with 8 – 12 lobes and atrial siphon are with 8-10 lobes. One red spot is present between each two lobe in living animals [14]. The specimen is identified *in situ* by its glossy, blue-black coloured epibiont-free test although the external association with ctenophore (*Vallicula multiformis* Rankin, 1956) has been reported [17].

From 2011 it is considered as non-indigenous species and the Tamilselvi *et al.* reported its distribution records from Panama, USA, Indo-Pacific, Atlantic and the Mediterranean [5]. However, in 2014 Jaffarali *et al.* [7] considered this as cryptogenic species although, they also reported that the species has been found only in port installation. In Andaman and Nicobar Islands the species has been found on the both natural as well as artificial substrates.

Native Range: The species is native to Red Sea as it has been first reported from there [20] (Fig. 4). Shenkar [21] reported this species as non-indigenous to Mediterranean shores of Israeli coast and wrote the species have an extra-tropical Indo-Pacific distribution with a distributional restriction in the Eastern Mediterranean [22-25].

***Phallusia arabica* Savigny, 1816 (Fig. 2:d):** Shape of animal is almost cylindrical. The naked test surface has longitudinal creases or depressions. Conspicuous apertures has 8-9 lobes though 10 lobes also sometimes found on branchial siphon. Living animals are translucent and milky white in colour. Due to cryptic in nature the



Fig. 3a: *Phallusia mammillata* (Cuvier, 1815), b: *Herdmania pallida* (Heller, 1878), c: *Herdamaia momus* (Savigny, 1816), d: *Herdmania papietensis* (Herdman, 1882)

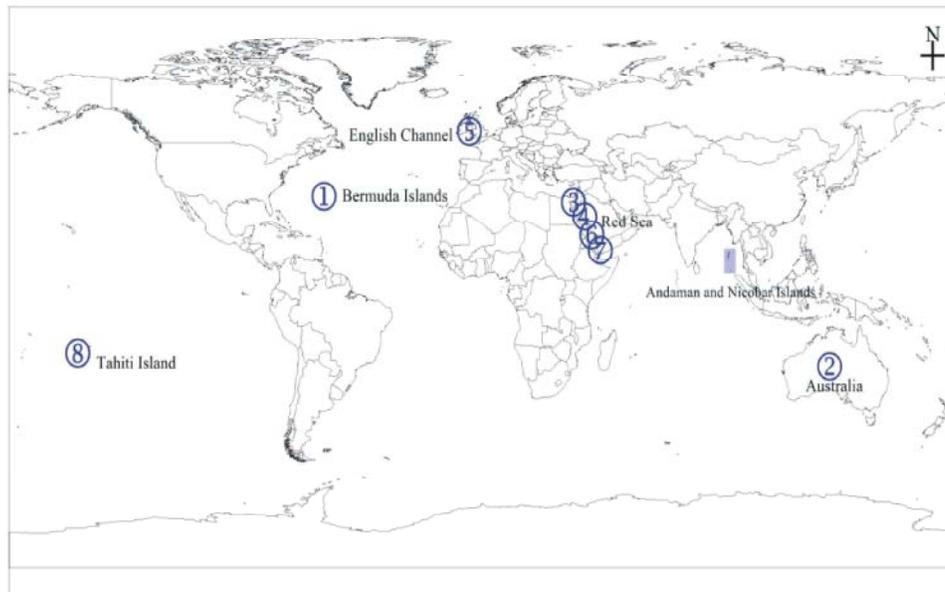


Fig. 4: Map showing the native range presently of reported non-indigenous ascidians from Andaman and Nicobar Islands [16]

open siphons are protrudes from the crevices [8]. It differs from other species by accessory openings of neural glands, numerous lobed anal border, distance between the siphons and pigmentation.

The species considered as invasive/ alien species to Indian waters by Tamilselvi *et al.* [5] as its distribution recorded from Indo West Pacific and North East Atlantic. Though, in 2014 Jaffarali *et al.* [7] considered this species as cryptogenic one and also described that the species are found only manmade offshore installations. The species reported from Sri Lanka by Heller in 1878 [8].

Native Range: Red Sea (type specimen reported from here) [8, 21] (Fig. 4).

***Phallusia mammillata* (Cuvier, 1815) (Fig. 3a):** Oblong-ovate body with light brown to milky white colour, depending on whether it is found in shallow or deeper water [11]. Test is smooth, thick and cartilaginous with prominent, large, regular rounded eminence and the posterior part of the branchial sac re-curved upon itself to the left side [12]. This species is observed in reef environment as well as on artificial substrate.

Native Range: English Channel [12] (Fig. 4).

The distribution of *Phallusia mammillata* is recorded and summarized by Arnback [12] in the English Channel along the south coast of England [26], west coast of France, in Mediterranean with an extension into the Sea of Marmora [27, 28, 29, 30], also recorded from Irish Sea and the west coast of Scotland although author was not confirmed regarding last two area. In 1950, Berrill [11] distinctly located in British waters i.e. Firth of Clyde, Isle of Man, the coast of Devon and Cornwall, Brest and supports the Mediterranean distribution stated by Arnback [12] and its range of Mediterranean from Banyuls to the Dardanelles. The species also recorded from Mediterranean coast of Israel [21].

Order: STOLIDOBRANCHIA Lahille, 1886

Family: PYURIDAE Hartmeyer, 1908

Genus: *Herdmania* Lahille, 1888

***Herdmania pallida* (Heller, 1878) (Fig. 3b):** The specimen has tough opaque test covered with epibionts and very small shell fragments or sediments with oval shaped body. Test of living specimens are red in colour. Straight, long gonad with simple and short genital papillae without multiple openings of sperm duct and absence of hood-like structure at the gonoduct openings are distinguishing characters of the species [10].

Herdmania pallida considered as invasive/ alien species by Tamilselvi *et al.* [5] as it has distributed in Atlantic Ocean, Indo-West Pacific and the Mediterranean; Sub Antarctic region and Jaffarali *et al.* [7] considered the species as cryptogenic and also mentioned that it only found in the port installation i.e. artificial structures not exist in natural condition. In Andaman and Nicobar Islands the species found on both natural and artificial substratum.

Native Range: Red Sea [5] (Fig. 4).

***Herdmania momus* (Savigny, 1816) (Fig. 3c):** Oval shaped body with soft and thin tunic, although the external appearance is highly variable. Living specimens are rosy-peach in colour. Epibionts are present on the test of aged specimens. Species is distinguished from others by having the multiple openings of sperm duct, presence of a large collar like membrane surrounding the oviduct openings and also by its shape and size of gonads [10]. Found in reef environment as well as on artificial substrate.

Native Range: Red Sea [21] (Fig. 4).

Shenkar [21] stated that the species is non-native to the Mediterranean shores of Israeli coast and wrote the species have an extra-tropical Indo-Pacific distribution with a distributional restriction in the Eastern Mediterranean [22-25]. The species has been reported from the Sri Lanka [8] and Kott [8] considered the distribution of species as pan-tropical.

***Herdmania papietensis* (Herdman, 1882) (Fig. 3d):** Oval shaped animal with reddish in colour at living condition although the colour can vary depend on thickness of test. Test is soft and gelatinous in nature. The characteristics features of the species are minute papillae present on the body wall and its gonoduct opening [13].

Native Range: Tahiti Island (As the location of type specimen) (Fig. 4), Central Pacific Ocean between 17° to 27° S [13].

As per the revision of Monniot and Debitus [13] the geographical distribution is restricted in Central Pacific Ocean between 17° to 27° Southern hemisphere from 6 m to 70 m depth. Present study reported this species from North Button Island of Andaman and Nicobar Islands. Therefore, the species can be considered as a non-indigenous species until the longitudinal distribution has been established.

Occurrence of bio-fouling non-indigenous species or bio-invasion is responsible for shipping services throughout the world. Many alive adult ascidians are found at the time of sampling at dry dock hulls after thousands of kilometres movement in the Pacific region by U.S. Navy [3]. Thus the occurrence of these eight species of Ascidiacea indicates that the non-indigenous species of ascidians found in Andaman and Nicobar Islands are may be due to the introduction through ship-hull fouling. Andaman and Nicobar Islands are oceanic islands which are separated from mainland India by Bay of Bengal with the average distance of 1200 km. and connected by mainly seaways like ships and boats (both passenger and cargo). Andaman and Nicobar Islands are close to the international shipping route. Besides the international navigational passage, all the major Indian ports receive port of all from various ships from different countries and also navigation between Indian mainland to these islands can be one of the causative factors for the occurrence of non-indigenous ascidians in these islands. Jaffarali *et al.* [7] reported 16

non-indigenous species of ascidians from V.O. Chidambaram port, Thoothukudi and Tamilselvi *et al.* [5] reported 22 species of non-indigenous ascidians from Tuticorin coast. A total of 27 non-indigenous species of ascidians were reported from India. Among the 8 species, 7 species were reported earlier except *Herdmania papietensis*. Here this species categorised as non-indigenous as the species distribution is in between 17° and 27° south of central Pacific Ocean [13]. Scientists worldwide exhibiting their concern regarding the non-indigenous species as, they can become invasive species due to their tolerance level of wide fluctuation in temperature, salinity and rapid adaptability to these changes. Non-indigenous ascidians also tolerate the various types of pollution including heavy metal pollution [3, 31]. Only a few long term comparative studies between non-indigenous and native species have been done world-wide [3, 21].

CONCLUSION

Eight non-indigenous ascidian species to India are found from the Andaman and Nicobar Islands. These species are suspected to introduce here unintentionally through the shipping from mainland of India and some contributions can be made by the international shipping route nearby these islands. Species are categorised as non-indigenous from the available literature although a further genetical analysis is required to confirm their native distribution and the regular monitoring on settlement of non-indigenous species is required to mitigate the invasive species.

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