



## **TEMPORAL OCCURRENCE AND DISTRIBUTION OF TUNICATES IN MANDAPAM COASTAL WATER, INDIA**

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### **ABSTRACT**

Mandapam is located in Gulf of Mannar, a hot spot for rich biodiversity and also a National Marine Park area. This Mandapam water is always calm in nature, except in few seasons, with variety of substrata and experiences heavy traffic of fishing and defense vessels from various parts of Indian coastal water which tend to promote ascidian diversity. Ascidians, by virtue of their seasonal breeding and invasiveness, need continuous monitoring for their occurrence and distribution. A field study was conducted during 2013–2014 to update the occurrence and distribution of ascidians. The study revealed the occurrence of 18 species of ascidians belonging to 8 genera and 6 families. Out of 18 species, 16 species are new to this station. The most abundant colonial species were *Polyclinum fungosum*, *P. nudum*, *P. tenuatum* and *Ecteinascidia venui*. Only one solitary ascidian, *Microcosmus exasperates*, was reported in this station for the first time. Maximum representation was from the family Polyclinidae (8) followed by Didemnidae (4). As this preliminary survey after a decade recorded maximum of 16 ascidians are new to this station, a detailed and continuous sampling along with seasonal availability, succession at different depths etc., is sure to yield a rich diversity of ascidians in future.

**Key words:** Ascidians, Diversity, Gulf of Mannar, India, Mandapam, Tunicate.

### **INTRODUCTION**

Members of the Class Ascidiacea, commonly called as tunicates or ascidians belong to the

subphylum Urochordata, are the largest and most diverse groups among the macro fouling communities in marine ecosystem, that attach to

natural and artificial substrates in the intertidal and subtidal zones of coastal habitats throughout the world. Research on ascidians around the world is truly stunning as they contribute a major share to raise the world marine biodiversity, provide a fertile ground for a number of aquatic fauna, form a part of food chain, are prey for many marine animals, are store house of bioactive compounds and serve as indicators to assess the quality of water. Currently, more than 3000 ascidian species including both simple and colonial forms have been described in all marine habitats from the tropics (Hernandez Zanuy and Carballo, 2001) to the poles (Goodbody, 1993 and Sahade et al., 1998) and from shallow water to the deep sea (Cameron, 2000 and Kott, 2005). Hitherto, more than 400 species of ascidians have been recorded in Indian coastal waters by various researchers at different situations (Oka, 1915; Das, 1938 and 1945; Sebastian, 1954 and 1956; Renganathan, 1981, 1982 a & c, 1983 b & f and Kott, 2005)

Mandapam is located in Gulf of Mannar, a hot spot area for rich biodiversity and also a National marine park area. Mandapam coastal water is always calm in nature, except in few seasons, with variety of substrata which tend to promote ascidian diversity. Moreover, this station experiences heavy traffic of fishing and defense vessels from various stations along the Indian coastal water. Few species of ascidians have already been reported in Mandapam by Renganathan and Meenakshi (Abdul Jaffar Ali et

al., 2011; Renganathan, 1984; Meenakshi, 1997, 1998, 1999, 2002, 2003, 2006 and 2009). Hence the present study is an attempt to know the diversity and abundance of tunicates in Mandapam coastal water during 2013–2014.

## **MATERIALS AND METHODS**

### **AREA DESCRIPTION**

Mandapam (Latitude 9°16'N and Longitude 79°8'E), Gulf of Mannar, Tamil Nadu is situated in Southeast coast of India. Mandapam water is provided with a variety of suitable natural as well as artificial substrata for the settlement of ascidians. The Jetty installed in the Mandapam coast near the fishing area and presence of huge number of fishing vessels provide major substrates for the settlement of ascidians.

### **METHODS OF COLLECTION**

The present study was carried out during the period from October 2013 to September 2014 covering all the four seasons such as premonsoon (July-September), monsoon (October-December), post monsoon (January-March) and summer (April-June).

Intertidal sites were visited at low tides and a variety of collection methods were used to obtain the organisms. Hand tools were used to remove animals from solid surfaces like pillars of jetty, small rocks and hull of fishing vessels. Professional snorkelers were engaged to collect ascidians at 2-3 meter depth. Several other collection methods were also used such as hand picking, peeling off, dislodging of animal, etc.

**IDENTIFICATION**

All materials collected were narcotized with menthol and then preserved in 10% buffered formalin in seawater. The specimens were sorted and identified to species or the lowest practicable taxon, with dissection, compound and stereo microscopes using taxonomic keys (Kott , 2001).

**RESULT**

In the present survey, a total of 18 species under 8 genera and 6 families (Fig. 1), (Perophoridae, Styelidae, Pyuridae, Polyclinidae, Polycitoridae and Didemnidae) were recorded from Mandapam water (Table 1). Only one solitary ascidian, *Microcosmus exasperates* was reported in this station for the first time. In total of 18 species, 16 species with 4 genera and 3 families were recorded for the first time in Mandapam coastal water. Maximum representation was from the family Polyclinidae (8) followed by Didemnidae (4) and Polycitoridae (3)

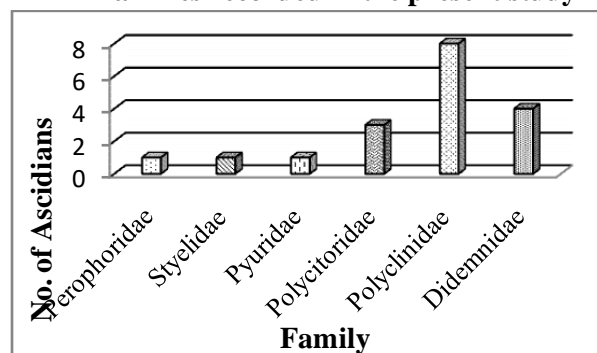
**Table 1: List of ascidians encountered during the present study**

Species	S/C	Status	Season			
			P	M	P	S
<b>ORDER : PHLEBOBRANCHIA</b>						
<b>FAMILY: PEROPHORIDAE</b>						
<i>Ecteinascidia venui</i> Meenakshi, 2000	C	N	a	x	-	x
<b>ORDER : STOLIDOBRANCHIA</b>						
<b>FAMILY: STYELIDAE</b>						
<b>SUB-FAMILY: POLYZOINAE</b>						
<i>Symplegma oceania</i> Tokioaka, 1961	C	C	x	-	x	x
<b>FAMILY: PYURIDAE</b>						
<i>Microcosmus exasperates</i> Heller, 1878	S	I	-	-	x	-
<b>ORDER : APLOUSOBRANCHIA</b>						
<b>FAMILY: POLYCITORIDAE</b>						

<i>*Eudistoma microlarvum</i> Kott, 1990	C	C	-	-	x	x
<i>E. pyriforme</i> (Herdman, 1886)	C	I	-	-	a	x
<i>E. viride</i> Tokioaka, 1955	C	EI	-	-	x	x
<b>FAMILY: POLYCLINIDAE</b>						
<i>*Polyclinum fungosum</i> Herdman, 1886	C	C	x	-	x	a
<i>P. glabrum</i> Sluiter, 1895	C	I	x	x	x	a
<i>P. indicum</i> Sebastian, 1954	C	N	x	x	x	x
<i>P. madrasensis</i> Sebastian, 1952	C	N	x	x	x	x
<i>P. nudum</i> Kott, 1992	C	C	x	-	x	a
<i>P. saturnium</i> Savigny, 1816	C	C	x	-	x	x
<i>P. solum</i> Kott, 1992	C	C	x	-	x	x
<i>P. tenuatum</i> Kott, 1992	C	C	x	x	x	a
<b>FAMILY: DIDEMNINIDAE</b>						
<i>Trididemnum caelatum</i> Kott, 2001	C	C	-	-	x	x
<i>T. cyclops</i> Michaelsen, 1921	C	C	-	-	x	x
<i>T. vermiforme</i> Kott, 2001	C	C	-	-	x	x
<i>Didemnum psammatoide</i> (Sluiter, 1895)	C	EC	x	x	a	x
<i>Didemnum psammatoide</i> (Sluiter, 1895)	C	EC	x	x	a	x

C: Colonial; S: Solitary; N: Native; C: Cryptogenic;  
 I: Invasive; EC: Established Cryptogenic;  
 EI: Established Invasive x: Present;a: Abundant; -: Absent  
 \*: Previously reported

**Figure 1. Representatives of the ascidian families recorded in the present study**



Highest number of species (8) was from the family Polyclinidae. Members of this family were distributed commonly in a variety of substrata in this station. Remarkable distribution of polyclinides was *Polyclinum glabrum* and *P. tenuatum* and can be considered as key species. *P. saturnium* and *P. tenuatum* were

found abundant and fouled the hull of boat. Next to Polyclinidae, four species such as *Didemnum psammathode*, *Trididemnum caelatum*, *T. cyclops* and *T. vermiforme* were reported from the family Didemnidae. *T. vermiforme* was found abundant and formed large colony on the hull of boat also. The family Polycitoridae was represented by three species: *Eudistoma microlarvum*, *E. pyriforme* and *E. viride*. Several colonies of *E. pyriforme* were found throughout the jetty. Remaining three families such as Perophoridae, Styelidae and Pyuridae were represented by single species each. All the species except *P. fungosum* and *E. microlarvum* were reported first time to this station and described briefly as below.

#### **ECTEINASCIDIA VENUI**

This species was commonly available and found abundant during August and September 2014. Bunches of colonies with 80-100 individuals were found attached to the pillars of jetty at a depth of about 1-2 meters. Zooids are transparent, cylindrical, up to 1.5 to 2 cm in height and with 0.7 to 0.9 cm wide branchial sac. Zooids are attached to a common branched stolon network with a short stalk at the posterior end of the zooid. Living colonies are light flesh coloured anteriorly with yellowish orange pigment spots on both siphons. However, the pigment spots cannot be seen in preservative. The test is thin, transparent and very delicate. Both the branchial and atrial siphons are orange coloured posteriorly. The body wall is thin and transparent with strong circular muscles in the

branchial sac and longitudinal muscles in the siphon.

#### **SYMPLEGMA OCEANIA**

This species was commonly available except monsoon season. Few small colonies were found in the pillars of jetty and hull of boats at a depth of about one meter. The species forms flattened colonies of dome shaped zooids with two colour morphs, pink and yellow. Seldom 4 branchial folds; no cloacal system; gonads large and few. Test is rough and hard but zooids are loosely bound. In Stigmata rows 8 to 14 and 10 to 16 stomach folds.

#### **MICROCOSMUS EXASPERATES**

This species was found very rare and a single specimen was observed in the pillar of jetty at one meter depth during post monsoon. The globular body is enclosed within a leathery and wrinkled tunic. The tunic is orange or purple, maintaining colour in formalin, and contains some sand and encrusting organisms on the surface. Both siphons are lobed with four triangular lobes. There are 12 large and 18 smaller branched oral tentacles arranged on a muscular ring. The pharynx has 8 folds on each side. Branchial line has numerous siphonal spines, characteristic feature of this species. The species are light brown, light yellowish brown and light radish brown in living condition.

#### **EUDISTOMA PYRIFORME**

A single large colony and several small colonies were found during post monsoon. The colony was attached to the pillar of jetty at a depth of two meters. Colonies are lobed and

robust with sand throughout the surface test. Common cloacal openings are absent. Colonies are 10 cm long and 1.5 – 2 cms thick. Zooids are linear and 2-3 cm in length. Short thorax with 3 rows of stigmata, pigment cells distributed throughout the thorax and a long stolon vessel at the end of the abdomen were observed.

#### **EUDISTOMA VIRIDE**

Few small colonies were found from submerged small rocks during post monsoon and summer. Colonies are Greenish yellow in colour free of epibionts. Lobes of the colonies are closely packed. Black spots on either side of the oral siphon's basal region are the characteristic marks. There are no distinct constriction between thorax and abdomen.

#### **POLYCLINUM GLABRUM**

Several medium sized colonies were present in pillars of jetty at a depth of 1-2 meters throughout the periods of study and found abundant during summer. The colony is dark black or dark brown in living condition and brown in preservative. There are no sands embedded in the surface of the test. No longitudinal folds in stomach, branchial lobes six, Ovary in post abdomen. Abdomen and post abdomen are separated by constriction. Gut loop twisted. The test is usually soft in preservative. Atrial languet originates from body wall anterior to the aperture. Distinct brachial papillae are present. Atrial lip is long and moderately wide with fine longitudinal muscles. Thorax is with 12 rows of up to 18 oval stigmata.

#### **POLYCLINUM INDICUM**

Few small colonies of this species also were present in pillars of jetty at a depth of 1-2 meters throughout the periods of study. The colony is greenish brown or brown in living condition. There are no longitudinal folds in stomach, branchial lobes six, Ovary in post abdomen, Abdomen and post abdomen are separated by constriction, Gut loop twisted. Colonies are larger, soft and mushroom shaped attached by a small part of the base of the colony. Sand encrusts the sides and under surfaces as in patch on the upper surface and is sparse internally. Zooids are narrow. Thorax is small with horizontal gut loop. The branchial sac is narrow with 13 rows of 14 short oval stigmata. Atrial languet originates from body wall anterior to the aperture.

#### **POLYCLINUM MADRASENSIS**

Very few colonies were found attached to the pillar of jetty at a depth of 1-2 meters during the study periods. The colonies are hard cushions to 5 cm in maximum dimension, usually sand free, but sand particles embedded at the bottom. The colonies are white or yellowish white in living condition and dark brown in preservative. There are no longitudinal folds in stomach, branchial lobes six, Ovary in post abdomen, Abdomen and post abdomen separated by constriction, Gut loop twisted. Zooids are long. Atrial lips long originated from the body wall anterior to the atrial opening. There are 12-14 rows of up to 14 relatively short oval stigmata.

**POLYCLINUM NUDUM**

Few medium sized colonies were recorded from pillars of jetty at a depth of 1-2 meters in premonsoon and post monsoon and found abundant in summer. The colony was greenish brown in living condition and turned brown on preservation. There are no longitudinal folds in stomach, branchial lobes six, Ovary in post abdomen, Abdomen and post abdomen are separated by constriction, Gut loop twisted. There are no sands on the either surface of the test or embedded within the colony. Atrial languet originates from the upper rim of the atrial aperture. Long club shaped posterior abdomen is present. Cloacal apertures are protruded from the surface on conical elevations.

**POLYCLINUM SATURNIUM**

This species was commonly available except monsoon season. Few small colonies were found attached to the hull of boats at a depth of 1-2 meters. Colonies are cushions up to 2.0 cm in diameter, with sand throughout the surface. The internal test is soft and translucent. Light brown in preservative. Zooids arranged throughout the test in a circular system. Zooids are about 2 mm long with relatively long thorax and a long neck joining the posterior abdomen to the abdomen. Long atrial languet with 5-6 minute pointed papillae. Atrial lip arises from the upper rim of the atrial aperture. Zooids have 12 rows of up to 16 closely packed short oval stigmata. Well matured embryo in the peribranchial cavity can be seen.

**POLYCLINUM SOLUM**

Small colonies were observed from hull of boat at a depth of 1-2 meters except monsoon season. The colonies are rounded cushions to 4 cm in greater extent and up to 1 m high. A layer of sand is distributed in surface test. The internal test is soft, transparent and free of sand grains. Zooids are arranged in double rows surrounding the cloacal apertures. Zooids are slender in shape and 5-6 mm long. Thorax is long, about half of the length of zooid. The posterior abdomen is narrow and relatively long, more or less club-shaped. Branchial sac is wide with 14-16 rows of about 10-12 oval stigmata. Atrial tongue is long and narrow extending from the body wall.

**POLYCLINUM TENUATUM**

Few small colonies of this species also were present in pillars of jetty at a depth of 1-2 meters throughout the periods of study. The colonies are fleshy cushion sheets up to 6 cm in maximum extent with rounded border. The colonies are fixed to the substrate by the whole of the under surface. The test is gelatinous. The thorax and abdomen are together about 3 mm long. Long atrial languet is produced forward from the upper rim of the atrial siphon. 5-6 minute pointed papillae form a fringe along the straight tip of the atrial lip. 13 rows of up to 12 relatively short oval stigmata with conspicuous conical branchial papilla. The gut loop is twisted and the distal part of the loop curves forward as it is a characteristic for the genus.

**TRIDIDEMNUM CAELATUM**

Few colonies of about 4 cm diameter were restricted to submerged rocks at 1-2 meter depth during post monsoon and summer. Thin Colony encrusting as sheet emerges with a single layer of sand externally. The surface test is thin without spicules are around the common cloacal aperture. Spicules uniformly distributed with conical rays. Zooids are small with short branchial siphon with its rim divided in 6 triangular lobes. Atrial siphon is posteriorly directed. Larvae are present in the basal test with long spherical larval trunk.

**TRIDIDEMNUM CYCLOPS**

Few colonies were encountered in submerged rocks at one meter depth during post monsoon and summer. Colony is thin as encrusting sheet, up to 1.0 cm long. A layer of bladder cells conspicuous around the outer margin of the colony. Spicules stellate are uniformly distributed and crowded with pointed rays. Orange coloured pigment cells throughout the test. Zooids are short, 1-1.5 mm long, with 3 rows of up to 6-7 stigmata. Retractor muscle is short. Branchial siphon is upright with 6 lobes.

**TRIDIDEMNUM VERMIFORME**

Few large colonies of this species were observed in submerged rocks at one meter depth during post monsoon and summer. Colony is thick and fleshy, up to 5 to 7 cm in maximum dimension. Conspicuous circular common cloacal apertures appear along the surface of the test. The surface test is folded forming the shape of lobes. Spicules are large and stellate with

conical pointed rays. Zooids are small, up to 1 mm line with relatively short branchial siphons. Orange- coloured embryos are crowded in the surface layer of the test.

**DIDEMNUM PSAMMATHODES**

Several medium sized colonies were present in pillars of jetty, submerged rocks and also in the hulls of boats throughout the periods of study and found abundant during post monsoon. This species is abundant in all the habitats. Colony forms thin encrusting sheet spreading over the substrates with characteristically restricted thoracic common cloacal center. The colony is muddy colour both in living and preserved condition. Fecal pellets are embedded throughout the colony. Spicules occur throughout the surface of the test and around the branchial apertures, but not crowded. Zooids are very small, less than 1 mm long with 4 rows of stigmata. Atrial opening is wide.

**DISCUSSION**

The present study reports a total of 16 new records of ascidians from the Mandapam water and suggesting that the diversity of ascidian in this station has been raised. Previously, a total of 20 species belonging to 6 genera covering 5 families have been reported (Abdul Jaffar Ali et al., 2011; Renganathan, 1984,b; Meenakshi, 1997, 1998, 1999, 2002, 2003, 2006 and 2009). This study after a long gap of about one decade reveals that out of 20 ascidians reported earlier, only two species (*Eudistoma microlarvum* and *Polyclinum fungosum*) were encountered again

whereas, 16 ascidian species were recruited for the first time in this station. This clearly indicates the occurrence and distribution of ascidians are increasing. Moreover changing of physico-geographical structures such as establishment of new jetty, heavy traffic of pleasure crafts, fishing vessels, coast guard vessels, etc. favor the entry of new ascidians from various coastal waters of India.

Physical, chemical and geographical parameters are considered to be the most important factors in ascidian communities influencing abundance and distribution of the species. The substrate type as well as the relationship between environment and larvae is added to the above elements(Kott,2001). The study area is located in Gulf of Mannar, a high mega biodiverse region and characterized by the high sea clarity and calm in nature except in few seasons. These features tend to promote ascidian diversity. This result could be justified with result of Moore who stated that ascidians recruit in clear sea water and uniform flow Naranjo *et. al*, 1996).

Ascidian diversity is influenced by coastal development patterns and environmental impacts. Ascidians are common inhabitants of harbours and marinas in both temperate and tropical waters (Carman *et.al.*, 2007). By virtue of sedentary nature of adult and motile larvae, they can easily be translocated by ships and boats and also through ballast waters. New entry of many ascidians to this station may be correlated with coastal traffics and establishment

of new jetty. Coastal shipping patterns determine dimension of ascidian diversity and also increasing invasive state of ascidians (Monniot *et. al.*, 1991).

*Ecteinascidia venui* and polyclinids were found abundant and predominant in shallow region and this could be substantiated with the fact that nutrient in the shallow water regions are readily available. High concentration of nutrients usually coincides with coastal development. Increasing anthropogenic development along the Mandapam coastline may contribute to a change in ascidian population as increasing coastal development is associated with entry of non-native ascidians.

It is noteworthy to observe at Mandapam water that there is relatively paucity of solitary species of ascidians and abundance of colonial ascidians. This station is type-locality for polyclinides and large number of the genus (8) considered here to be a key genus at Mandapam water.

Further detailed and continuous sampling along with seasonal availability, succession at different depths is sure to yield a rich diversity of ascidian in future. Since ascidians are potential producers of novel compounds and have nutrient value, this updated knowledge on occurrence and distribution of ascidians can be better utilized for human welfare.

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