

First record of Six Species of Ascidians (Tunicata: Ascidiacea) from Chabahar Bay (Gulf of Oman), Iran

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ABSTRACT

Ascidians or tunicates are dominant members of many sessile marine communities throughout the world. They are sedentary, efficient filter feeders having hermaphrodite gonads, rapid generation times and growth rate, their larval stages are planktonic contributing to dispersal of species. In this study specimens of ascidians, were collected on intertidal zones of Chabahar Bay (Gulf of Oman) in 2014-15. Six solitary ascidians are recorded for the first time in this region. Also, a literature review on the distribution of ascidians revealed that this is the first report of ascidians from the Gulf of Oman. A note on the Taxonomic and morphological features of these specimens are discussed in the present study.

KEYWORDS: Ascidiacea; Tunicata; Chabahar Bay; Gulf of Oman; Iran

INTRODUCTION

Ascidians (Phylum: Chordata, Class: Ascidiacea), or sea squirts, are the largest and most diverse class of the subphylum Tunicata (also known as Urochordata). They comprise approximately 3,000 accepted species found in all marine habitats (Shenkar et al., 2012; Shenkar, 2012).

Ascidians are an important group for the study of invasive species biology due to rapid generation times, potential for biofouling, and role as filter feeders in an ecosystem (Vandepas et al., 2015). In marine systems, ascidians contains an increasing number of widely- distributed invasive species. Many non-indigenous ascidians are able to tolerate wide fluctuations in temperature, salinity and pollution, have a rapid growth rate, and reach sexual maturity a few weeks after settlement. A unique characteristic of ascidians is their short-lived, non-feeding planktonic larvae, which represents the only dispersal phase of their life cycle and results in extremely restricted dispersal. Ascidians have repeatedly shown their ability to out-compete sessile organisms and alter ecosystem functioning in numerous ways in both temperate and tropical environments. The introduction of these organisms affects human activities, with aquaculture being one of the most heavily impacted activities (Riusa and Shenkar, 2012).

Ascidians not traditionally exploited as fisheries resources, have recently attracted increased attention because of their great economic potential as regards the production of compounds with pharmaceutical properties (Carballo et al., 2000; Rinehart, 2000; Gab-Alla, 2008). Hundreds of new compounds have been isolated from ascidians, the majority of which are amino acid derivatives. It is the biological activity associated with many of these natural products that are responsible for research focus on these marine organisms. To date, the most notable examples of bioactive ascidian compounds include didemnin B, dehydrodidemnin B, ecteinascidin-743, sulcatin, stolonin acids A&B, bistrimides A,B,C,D & K (Gopalakrishnan et al., 2011). For example the tunic of *P. nigra* contains many vesicles filled with a strong acid (with pH near 1), containing mostly sulphate (SO₄²⁻) and chloride (Cl⁻) anions. The vesicles are concentrated towards the outer surface and are easily ruptured by contact; they are believed to protect the animal from predation and fouling (Euichi et al., 2001). Substances extracted from the dried tunic with methanol have been found to have cytotoxic, antibacterial, antipyretic, analgesic, and histamine-like activity (Gopalakrishnan et al., 2011; Jaffarali Abdul et al., 2008). *Ecteinascidia thurstoni* have potent cytotoxic properties, a compound with a most original anti-tumoral activity. It is today considered to be one of the most promising substances effective against various solid-type tumors (Rinehart et al., 1990; Garcia- Rocha et al., 1996; Jimeno et al. 1996; Gab-Alla, 2008). It has recently come onto the market under the trade name of Yondelis for the treatment of sarcomas and related tumors; it is also undergoing clinical trials (phases II/III) for other kinds of tumors (Pharmamar, 2008; Gab-Alla, 2008).

Ascidians are threat to marine biodiversity due to highly invasive. They can spread rapidly to new habitats (Lambert, 2002; Lambert and Lambert, 2003; Tamilselvi et al., 2011), damage coastal installation (Spanier and Galil, 1991; Tamilselvi et al., 2011), displace the local species (Rilov et al., 2004; Tamilselvi et al., 2011) and affect community structure (Blum et al., 2007; Tamilselvi et al., 2011). For the very same reason this work has

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been focused on the intertidal ascidians of Chabahar Bay (northern of the Gulf of Oman). Although the Chabahar Bay is considered as a 'hotspot' of biodiversity, but the ascidian fauna (Chordata, Ascidiacea) of the region has not been studied at now. Only one study from Iranian coast of Persian Gulf was carried out by Fatan (Fatan, 2010) and two reports have been done related to the southern shores of the Persian Gulf which in Bahrain (Monniot and Monniot,1997) and Qatar (Al-Khayat and Al-Ansi, 2008). The current survey is the first of its kind at this region.

MATERIALS AND METHODS

Study area

Chabahar Bay is a small semi-enclosed bay on the southeastern coasts of Iran (from 25° 17' 45"N- 60° 37' 45" E). This Bay is connected to the Indian Ocean by the Oman Sea. The Bay surface area is 290 km² with 14 km wide located between of Chabahar and Konarak (Fig.1). The average depth of this Bay is 12 m (ranges from 8- 22m).

Data collection

For species identification of the intertidal ascidians, the samplings were carried out seasonal at three stations (Fig.1) in rocky substrates of Chabahar Bay, at the Gulf of Oman in one year (2014-2015). The specimens were collected by hand during low tide. The specimens preserved in 10% formaldehyde-seawater solution for subsequent examination (Davis and Davis, 2008) and transferred to the laboratory. Identification was based on the literature and comparison with well identified specimens from other regions and valid Identification keys (Kondilatos et al., 2010; Rocha et al., 2010; Shenkar and Loya, 2009; Kott, 2005; Monniot, 2002; Goodbody, 2000; Monniot and Monniot, 2001; Monniot et al., 1991; Kott, 1985; Monniot, 1983a,b; Monniot and Monniot, 1972; 1994; 1997; Millar, 1970; Berrill, 1950;).

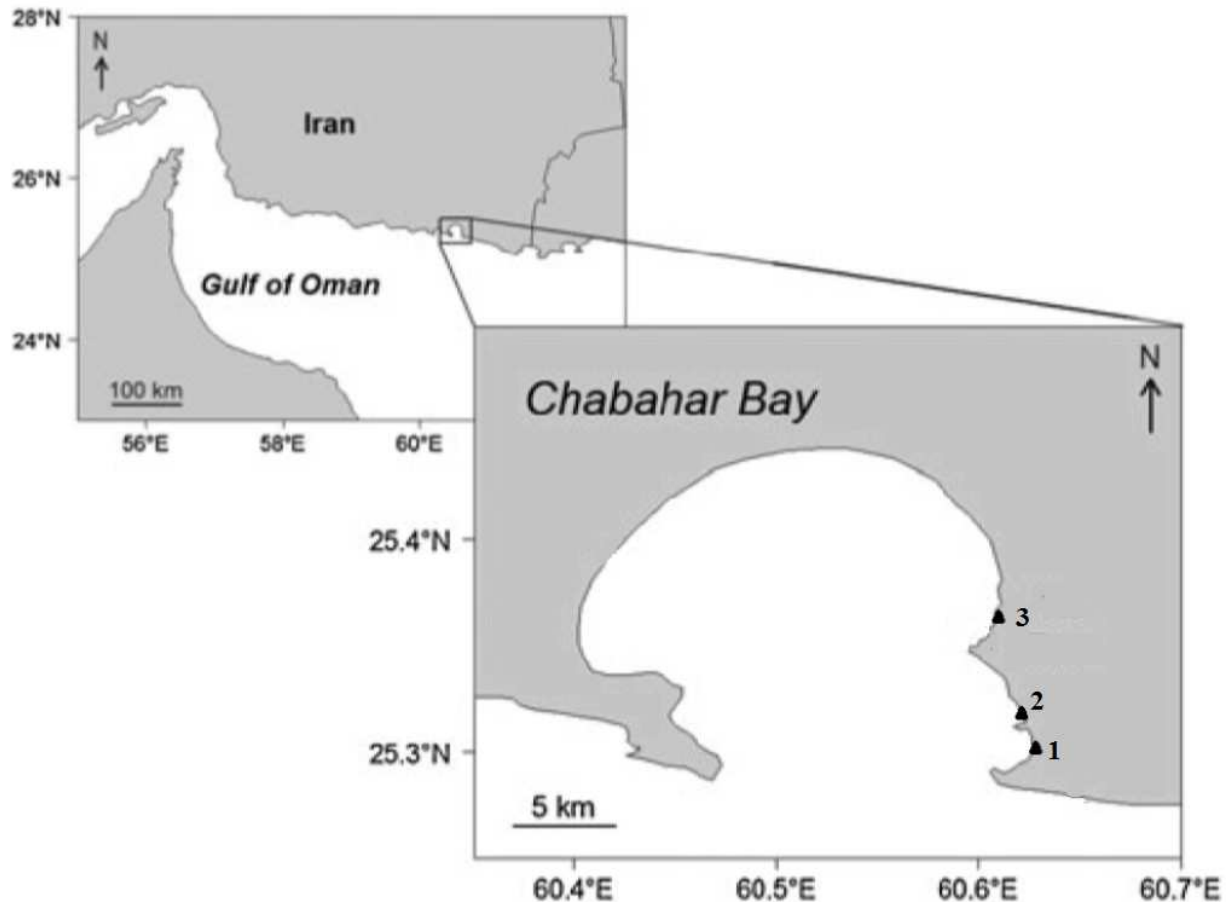


Fig. 1: Study site of Chabahar Bay

RESULTS

The current study provides a list of six ascidians species that are currently found along the Chabahar Bay coast of Iran: *Phallusia nigra*, *Ecteinascidia thurstoni*, *Styela canopus*, *Styela plicata*, *Ascidia sp.*, *Cnemidocarpa sp.*.

General systematic



Fig.2. *Phallusia nigra*

- **Kingdom:** Animalia
- **Phylum:** Chordata
- **Subphylum:** Tunicata
- **Class:** Ascidiacea
- **Order:** Phlebobranchia
- **Family:** Ascidiidae
- **Scientific name:** *Phallusia nigra* (Savigny, 1816) (Fig.2)
- **Common name:** Black sea squirt

Description: This common large solitary ascidian is a velvety black. Specimens adhere to the substrate by its posterior left region. It has a thick, cartilaginous, smooth tunic with prominent blood vessels. The siphons are separated by a third to half the body length. Branchial siphons taller than atrial siphon and has 40-50 tentacle. The Branchial sac has been lacking flod. The digestive tract is on the left side of branchial.

Common in harbors and embayments, *P. nigra* lives in shallow water attached to any available hard substrate such as rocks, mangroves, sea walls, coral reefs, buoys, pier pilings, ship hulls, floats and man-made structures. Its original range is unclear; the range of *P. nigra* extends from Florida to Brazil and Bermuda in the tropical Western Atlantic Ocean, the Red Sea, Gulf of Mexico, Jamaica, the US Virgin Islands, Curacao and the Indian Ocean.



Fig.3. *Ecteinascidia thurstoni*

- **Kingdom:** Animalia

- **Phylum:** Chordata
- **Subphylum:** Tunicata
- **Class:** Ascidiacea
- **Order:** Phlebobranchia
- **Family:** Perophoridae
- **Scientific name:** *Ecteinascidia thurstoni* (Herdman, 1890) (Fig.3)
- **Common name:** sea squirt

Description: Colonies of small rounded zooids (11-12 mm) joined by stolons from the postero-ventral part of the body. The test is thin and glassy with a distinct yellow-orange ring around the rim of the apertures. Branchial sac has 15-17 stigmata. Digestive tract is at the bottom of branchial sac and gonads are entirely within the intestinal ring.

Specimens found on both artificial and natural substrate at shallow depth. *Ecteinascidia thurstoni* has been reported along the Red Sea, Gulf of Suez and Port Said on the Mediterranean coast of Egypt.



Fig. 4. *Styela canopus*

- **Kingdom:** Animalia
- **Phylum:** Chordata
- **Subphylum:** Tunicata
- **Class:** Ascidiacea
- **Order:** Stolidobranchia
- **Family:** Styelidae
- **Scientific name:** *Styela canopus* (Savigny,) (Fig.4)
- **Common name:** Rough Tunicate

Description: It is a simple solitary tunicate. Its body shape is subglobose. The tunic is thin and leathery, with distinct warts. Specimens attach to substrate at its base. Its color is dark brown. The oral and atrial siphons are positioned anteriorly, and the short tips are ringed in alternating light and dark stripes and there are two gonads on the left side and 2-5 on the right.

S. canopus, commonly known as the Rough Sea Squirt, is widely distributed in temperate and tropical coastal waters. It was first described from the Red Sea in 1816, but its native region is thought to be the Indo-West Pacific. It has been documented in Europe, Africa, both sides of North America, Hawaii, Guam, the Caribbean, Brazil, Japan, Australia, and the tropical Indo-Pacific. It is found on ships, buoys, piers, docks, mangroves and coral reefs, but no economic or ecological impacts have been documented for this species.

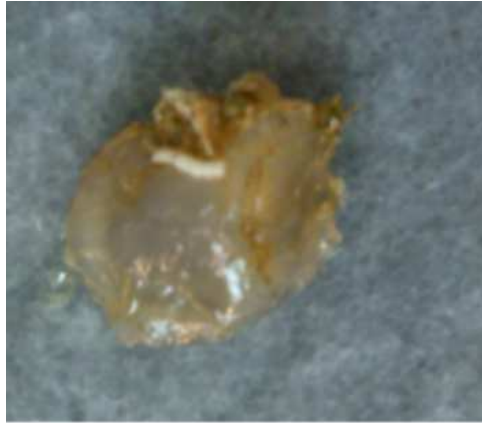


Fig. 5. *Styela plicata*

- **Kingdom:** Animalia
- **Phylum:** Chordata
- **Subphylum:** Tunicata
- **Class:** Ascidiacea
- **Order:** Stolidobranchia
- **Family:** Styelidae
- **Scientific name:** *Styela plicata* (Savigny, 1816) (Fig.5)
- **Common name:** sea squirt

Description: This species is a single ascidian with a thick and leathery, warty or smooth test and its color is tannish white to yellowish-brown. Its body shape is oval. Dividing the tunic is a membrane which allows fluid to flow up one side and down the other. Specimens have an incurrent siphon that intakes water into the pharyngeal basket where food particles are filtered out; the waste is then excreted through the excurrent siphon. The two short siphons have brown or black stripes on the inside of the siphons and four lobes. It is protandric hermaphrodite and has small testes that attached along most of the length of each ovary, with two gonads on the left side of the body and five on the right and Gonads are beside to the branchial sac. This species lacks the kidney and hepatic diverticula.

Styela plicata is a tropical to temperate tunicate that has invaded the Gulf of Mexico by hitching a ride on ships' hulls. *S. plicata* also live in coral reef habitats, coarse woody debris, docks and hard rocky substrates.



Fig.6. *Ascidia sp.*

- **Kingdom:** Animalia
- **Phylum:** Chordata
- **Subphylum:** Tunicata
- **Class:** Ascidiacea
- **Order:** Phlebobranchia
- **Family:** Ascidiidae

- **Scientific name:** *Ascidia sp.* (Linnaeus, 1767) (Fig.6)

Description: It is solitary species with a transparent- gelatinous tunic. The digestive pouch has been smooth stigmata and papilla has longitudinal vessels. The branchial sac is without folds. Digestive tract on the left side of the branchial sac and the gonads completely inside the intestine ring. The oral siphon is long and the atrial siphon is shorter and emerges from the posterior half of body.

It was first discovered in 1983 in San Diego and San Francisco Bays in California and subsequently became common in fouling communities along the California coast from San Diego to San Francisco Bay.



Fig. 7. *Cnemidocarpa sp.*

- **Kingdom:** Animalia`
- **Phylum:** Chordata
- **Class:** Ascidiacea
- **Order:** Stolidobranchia
- **Family:** Styelidae
- **Scientific name:** *Cnemidocarpa sp.* (Huntsman, 1913) (Fig.7)

Description: This species is a simple, solitary ascidian with a red tunic. Branchial sac have a longitudinal stigmata. Digestive duct is on the left side of branchial sac and has a longitudinal folds. It is hermaphrodite and gonads are on both sides of the body. Small parts of the male and female attach to dense gonads and is surrounded by a membranous. Each gonad has a sperm duct and its length ovary is three times than its width.

DISCUSSION

The ascidians species collected in the Chabahar Bay, Gulf of Oman, on 2014-15 were identified. The current study is the first attempt to compile species list of the ascidians found along the Iranian coasts of Gulf of Oman. Six species from two families were currently identified. These include: *Phallusia nigra*, *Ecteinascidia thurstoni*, *Styela canopus*, *Styela plicata*, *Ascidia sp.*, *Cnemidocarpa sp.*. Ascidiaceae species, belonging to 5 families. One of species records is of colonial species, as typical of tropical regions.

There is a few studies regarding to ascidians in the Persian Gulf and Oman Sea. Just, Al-Khayat and Al-Ansi during year 2008 has studied on three species of ascidians in Qatar waters and Another study was done in Bahrain waters in depths of 3 to 12 meters. Also, in year 2010, Fatan indentified 24 species of ascidians in Lengeh Port.

All of species have been recorded for the first time from this region. This list is certainly incomplete and emphasizes the need to increase the sampling effort for this group, and for additional taxonomic studies of the ascidian fauna of this highly diverse and rich region.

The growing awareness to the importance of the class Ascidiaceae in marine ecosystems (Lambert 2001; Shenkar and Swalla 2011; Shenkar, 2012) emphasizes the need for additional studies of this group in diverse ecosystems such as tropical coral reefs.

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