



## First Evidence of Artificial Fission in two Mediterranean Species of Holothurians: *Holothuria tubulosa* and *Holothuria polii*.

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### Abstract

Holothurians, or sea cucumbers, are a common group of echinoderms occurring in most benthic marine habitats in temperate and tropical oceans. Sea cucumbers, already known as bioactive compounds producers, are increasingly seen as a new source of food worldwide. Actions to foster a sustainable development of the resource they represent are increasingly encouraged. Fission is a way of asexual reproduction reported in these organisms. This natural ability to split their body into two parts is generally shown by various tropical species of holothurians, but it has been never reported for Mediterranean species from Italian waters. Inducing fission in order to double individual numbers would be a promising option for culture and restocking purposes. The present study reports the first evidence of transverse induced fission, after experiments of fission stimulation, in two edible holothurian species from the Tyrrhenian Sea (Italy). Survival and regeneration times after being forced to undergo transverse fission are reported.

**Keywords:** Echinoderms, induced fission, regeneration, sea cucumber, commercial important species, sustainable exploitation.

### Introduction

The sea cucumber or holothurians are belongs to the class Holothuroidea, a common and diverse group of worm-like and usually soft-bodied echinoderm. Ecologically, these important deposit feeders are a key component in many littoral ecosystems playing an important functional role as bioturbators, in recycling nutrients and mixing the upper sediment layers redistributing food resources (Coulon and Jangoux 1993; Mac Tavish, Stenton-Dozey, Vopel, & Savage, 2012). Sea cucumbers are increasingly seen as a new source of food worldwide and they are also harvested to provide bio-extracts for pharmaceutical, nutraceutical, and cosmetic products (Bordbar, Anwar, & Saari, 2011; Purcell, 2014). As a consequence, holothurian stocks have been overfished in many countries as a result of ever-increasing market demand, uncontrolled exploitation and/or inadequate fisheries management (Conand, 2004). This is particularly true in tropical regions (Indo-Pacific). In the Mediterranean, sea cucumbers are a marine resource with a very low exploitation, except in Turkey where holothurian species (*Holothuria spp.*) are already commercially exploited (González-Wangüemert, Aydin, & Conand, 2014 and ref.

therein). More recently, in Italy, too, commercial fishermen have launched small-scale collections and transformations of sea cucumbers for export to Asiatic markets (Sicuro and Levine, 2011). In view of the growing economic importance of these organisms, it is necessary to undertake actions for the sustainable development of the resource they constitute (such as restocking strategies and farming projects), to counteract and/or prevent the damage of over-exploitation and the inevitable negative effects on the marine ecosystem at the local level. Some holothurians have long been known for their ability to reproduce asexually by fission (fissiparity), which brings about posterior and anterior parts through self-division (Conand, 1996; Crozier, 1917). After fission, anterior part of body complete with mouth and tentacles, as well as the posterior part with anus, regenerate lacking internal organs, such as intestine and respiratory tree, becoming new individuals (Dolmatov, 2014 and ref. therein). Because of the high commercial value of holothurians, researchers attempt to use their regenerative property and fission ability to develop cultivation methods and increase natural populations. In the last two decades literature have been enriched with data on the capacity of holothurians of fission, both naturally (asexual reproduction by fission) and induced (artificial