

Updated distribution of the holothuroid *Synaptula reciprocans* (Forskål, 1775) in the Mediterranean: does it follow shallow-water circulation patterns?

Chryssanthi Antoniadou^{1*} and Dimitris Vafidis²

¹Aristotle University, School of Biology, Department of Zoology, Thessaloniki, Greece

E-mail: antonch@bio.auth.gr

²University of Thessaly, School of Agricultural Sciences, Dept. of Ichthyology and Aquatic Environment, Nea Ionia, Magnesia, Greece

E-mail: dvafidis@uth.gr

*Corresponding author

Received 3 March 2009; accepted in revised form 7 April 2009; published online 27 May 2009

Abstract

The Indo-Pacific holothurian, *Synaptula reciprocans*, entered the Mediterranean Sea through the Suez Canal and has spread along the Levantine coast. The present study reports the finding of flourishing populations off the Dodecanese and Cyclades islands, southeastern Aegean Sea. The species occurs on shallow rocky and sandy bottoms. Further research is needed to monitor its possible spread northwards and westwards and the ecological implications of its establishment.

Key words: *Synaptula reciprocans*, Aegean Sea, Eastern Mediterranean, alien, invasion, circulation patterns

558 metazoan species have been reported as alien to the Mediterranean Sea (Galil 2008), of which only five, *Asterina burtoni* (Gray, 1840), *Ophiactis parva* Mortensen 1926, *O. savignyi* (Müller and Troschel, 1842), *Diadema setosum* (Leske, 1778) and *Synaptula reciprocans* (Forskål, 1775), belong to the Echinodermata (Galil 2006; Yokes and Galil 2006).

Synaptula reciprocans (Figure 1) is distributed throughout the tropical Indo-Pacific, and it is common in the Red Sea (Clark and Rowe 1971). Its earliest records in the Mediterranean Sea were from the coasts of Cyprus and Israel (Cherbonnier 1986; Galil 2007). It was later reported from Lebanon, Syria and Turkey (Zibrowius and Bitar 2003; Bitar et al. 2003; Cinar et al. 2006; Galil 2006), and more recently from Rhodes and Megisti islands, Greece (Pancucci et al. 2005; Koukouras et al. 2007). In September 2005 and 2008, extensive populations have been sighted during a survey of the Dodecanese and the Cyclades, South Aegean Sea. Specimens were recorded off the coast of Symi, Tilos, Chalki, Alimia, Amorgos and

Antikeros islands (Figure 2). *S. reciprocans* was found on sandy bottoms with gravel and pebbles, as well as on gently sloping rocky shores mostly covered with the alga *Caulerpa racemosa* (Forsskål) J. Agardh 1873. The population density ranged from 0.1 to 0.6 individuals/m², with the highest values recorded at the depth of 4-8 m.



Figure 1. *Synaptula reciprocans*, Tilos Island, Dodecanese, South Aegean Sea (photo by C. Antoniadou, 27 September 2005)

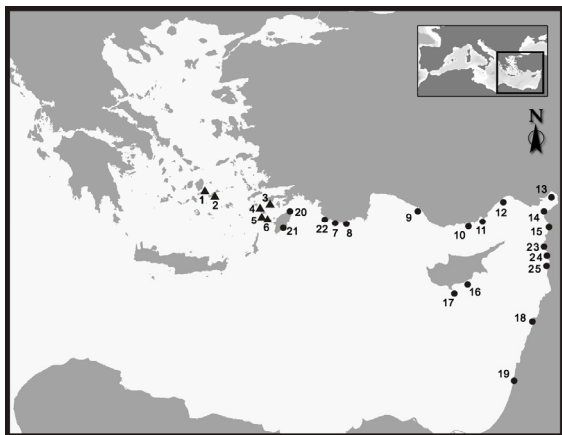


Figure 2. Up to day distribution of the species *Synaptula reciprocans* in the eastern Mediterranean (▲ present study, ● literature data)

Synaptula reciprocans has probably entered the Mediterranean Sea through the Suez Canal (Cherbonnier 1986) and spread northward along the Levantine coast and the southeastern Aegean Sea. The path of invasion seems to follow water circulation patterns and specifically the counter-clockwise circulation of Atlantic water masses in the eastern Mediterranean basin (Theocharis et al. 1999; Galil 2006; Hamad et al. 2006). The species occupies the shallow sublittoral zone, on rocky and sandy bottoms, where well established populations have been reported (Cinar et al. 2006; present data). It feeds upon diatoms, other micro-organisms and organic coated particles (Clark 1907; Cherbonnier 1986). There is no information on the impact of *S. reciprocans* on the native fauna and further study is required to assess the viability and evolution of the established populations, by gathering data on the population density and reproduction of this Lessepsian invasive alien species, as well as to determine potential competitors and predators. Such efforts should be carried out collaboratively, in order to assess the ecological implications of the establishment of alien species into the Mediterranean (Galil 2008).

Acknowledgements

We are grateful to the captains and the crew of the sponge fishing vessel “Themelis” for their help

during sampling. We also thank Dr A. Zenetos and the two anonymous reviewers for their useful comments that improved our manuscript.

References

- Bitar G, Dupuy de la Grandrive R, Foulquie M (2003) Second mission relating to the development of marine protected areas on Syrian coasts. Technical Report, 40 pp
- Cherbonnier G (1986) Holothuriens de la Méditerranée et du nord de la mer Rouge. Bulletin du Muséum National d'Histoire Naturelle 8: 43-46
- Cinar ME, Bilecenoglu M, Ozturk B, Can A (2006) New records of alien species on the Levantine coast of Turkey. Aquatic Invasions 1: 84-90 [doi:10.3391/ai.2006.1.2.6](https://doi.org/10.3391/ai.2006.1.2.6)
- Clark HL (1907) The Apodous Holothurians: a monograph of the Synaptidae and Molpadiidae. Smithsonian Contributions to Knowledge, Volume XXXV:2, Smithsonian Institution, Washington, 231 pp
- Clark AM, Rowe FEW (1971) Monograph of shallow-water Indo-West Pacific echinoderms. British Museum, Natural History, London, 238 pp
- Galil BS (2006) The marine caravan - The Suez Canal and the Erythrean Invasion. In: Gollasch S, Galil BS, Cohen AN (eds), Bridging divides maritime canals as invasion corridors. Springer, Netherlands, pp 207-300
- Galil BS (2007) Seeing Red: Alien species along the Mediterranean coast of Israel. Aquatic Invasions 2: 281-312 [doi:10.3391/ai.2007.2.4.2](https://doi.org/10.3391/ai.2007.2.4.2)
- Galil BS (2008) Alien species in the Mediterranean Sea – which, when, where, why? Hydrobiologia 606: 105-116 [doi:10.1007/s10750-008-9342-z](https://doi.org/10.1007/s10750-008-9342-z)
- Hamad N, Millot C, Taupier-Letage I (2006) The surface circulation in the eastern basin of the Mediterranean Sea. Scientia Marina 70: 457-503
- Koukouras A, Sinis AI, Bobori D, Kazantzidis S, Kitsos MS (2007) The echinoderm (Deuterostomia) fauna of the Aegean Sea, and comparison with those of the neighbouring seas. Journal of Biological Research 7: 67-92
- Pancucci-Papadopoulou MA, Zenetos A, Corsini-Foka M, Politou CY (2005) Update of marine alien species in Hellenic waters. Mediterranean Marine Science 6: 147-157
- Theocharis A, Balopoulos E, Kioroglou S, Kontoyiannis H, Iona A (1999) A synthesis of the circulation and hydrography of the South Aegean Sea and the Straits of the Cretan Arc (March 1994–January 1995). Progress in Oceanography 44: 469-509 [doi:10.1016/S0079-6611\(99\)00041-5](https://doi.org/10.1016/S0079-6611(99)00041-5)
- Yokes B, Galil BS (2006) The first record of the needle-spined urchin *Diadema setosum* (Leske, 1778) (Echinodermata: Echinoidea: Diademata: Diademata) from the Mediterranean Sea. Aquatic Invasions 1: 188-190 [doi:10.3391/ai.2006.1.3.15](https://doi.org/10.3391/ai.2006.1.3.15)
- Zibrowius H, Bitar G (2003) Invertébrés marins exotiques sur la côte du Liban. Lebanese Science Journal 4: 67-74

Distribution pattern of *Synaptula reciprocans* in Mediterranean

Annex 1

Records of *Synaptula reciprocans* in the Eastern Mediterranean

| Location | Coordinates | | Location in Figure 2 | Date of record | Habitat | Depth | Population density | Reference |
|-----------|---|---|----------------------|------------------|---------------------------------------|---------|--------------------------|---|
| | Latitude, N | Longitude, E | | | | | | |
| Antikeros | 36°47'56" | 25°44'81" | 1 | 2008 | coarse sand with gravel rocks | 2-6 m | 0.10 ind./m ² | present study |
| Amorgos | 36°47'56" 36°48'18" | 25°44'81" 25°44'98" | 2 | 2008 | surrounded with sand and gravel rocks | 2-4 m | 0.12 ind./m ² | present study |
| Tilos | 36°26'74" 36°25'71" 36°23'29" | 27°23'39" 27°23'71" 27°25'73" | 3 | 2005 | surrounded with sand and gravel rocks | 2-8 m | 0.28 ind./m ² | present study |
| Chalki | 36°13'01" | 27°38'77" | 4 | 2005 | coarse sand with gravel rocks | 2-8 m | 0.42 ind./m ² | present study |
| Alimia | 36°21'91" | 27°27'68" | 5 | 2005 | surrounded with sand and gravel rocks | 4-8 m | 0.45 ind./m ² | present study |
| Symi | 36°31'13" 36°33'30" 36°37'13" 36°38'10" | 27°51'83" 27°52'82" 27°52'25" 27°48'98" | 6 | 2005, 2008 | surrounded with sand and gravel | 2-6 m | 0.60 ind./m ² | present study |
| Rhodes | 36°20'40" 36°06'30" | 28°12'50" 28°04'50" | 20-21 | 2004, 2007 | no data | 0-4 m | no data | Pancucci et al. 2005; Koukouras et al. 2007 |
| Megisti | 36°07'59" | 29°35'27" | 22 | 2007 | no data | 0-4 m | no data | Koukouras et al. 2007 |
| Cyprus | 34°39'56" 34°43'29" | 33°02'07" 33°20'14" | 16-17 | 1986, 2004, 2007 | no data | 0-4 m | no data | Cherbonnier 1986; Koukouras et al. 2007 |
| Turkey | 36°19'30" 36°08'17" 36°42'15" 36°00'36" 36°54'22" 36°11'26" 36°32'13" 36°08'51" 36°18'51" | 35°47'00" 33°32'53" 34°28'00" 35°58'34" 35°58'05" 29°50'51" 31°59'54" 29°41'41" 33°51'47" | 7-15 | 1986, 2001-2005 | soft and hard substratum | 0-7 m | no data | Cinar et al. 2006; Galil 2006 |
| Lebanon | no data on the exact location in which the species has been found | | 18 | 2000 | no data | no data | no data | Zibrowius and Bitar 2003 |
| Syria | 35°55'18" 35°51'04" 35°31'63" | 35°53'86" 35°48'08" 35°45'64" | 23-25 | 2003 | soft and hard substratum | -9 m | no data | Bitar et al. 2003 |
| Israel | no data on the exact location in which the species has been found | | 19 | 1971 | no data | no data | no data | Cherbonnier 1986; Galil 2007 |