

Pengamatan terakhir Bulu Babi eksotik berduri panjang (*Diadema setosum*) di Teluk Antalya

The last observation of the long-spined exotic Sea Urchin (*Diadema setosum*) in the Gulf of Antalya

Received: 07 October 2023, Revised: 17 October 2023, Accepted: 23 October 2023
DOI: 10.29103/aa.v10i3.12957

Mehmet Gökoğlu^a, Ferhat Çağiltay^{b*}, Mustafa Gürdal^c, and Alper Yıldız^a

^aDepartment of Aquaculture, Faculty of Fisheries, Akdeniz University Antalya Türkiye

^bFaculty of Aquatic Sciences, İstanbul University, İstanbul Türkiye

^cFaculty of Science, Akdeniz University, Antalya Türkiye

Abstrak

Diadema setosum, bermigrasi dari Laut Merah, pertama kali diidentifikasi di tepi Semenanjung Kaş Peninsula di Mediterania. Sekitar setahun setelah pengamatan ini, spesies yang sama dilaporkan untuk kedua kalinya dari Pantai Konyaalti di Teluk Antalya. Bulu babi ini dengan cepat berkembang biak dan memperluas penyebarannya di sepanjang pantai Laut Mediterania dan Laut Aegea, hingga mencapai Laut Marmara. Beberapa individu bulu babi ini, yang penyebarannya meluas ke wilayah pesisir yang berisiko bagi perenang, diamati mulai mati pada bulan-bulan musim panas tahun 2022. Survei penyelaman dilakukan di lima wilayah berbeda dengan struktur dasar laut berkarang dan berbatu di Teluk Antalya selama musim dingin (Tebing, Pantai Konyaalti, sekitar Pulau Sığan, wilayah Çaltıcak, dan Tanjung Kemer Ağva), dan diketahui bahwa 99% populasi *D. setosum* telah mati pada bulan Februari dan Maret. Tidak ada individu hidup yang ditemukan selama survei selam yang dilakukan di stasiun yang sama pada bulan April dan Mei. Kesimpulannya adalah kematian massal telah terjadi pada populasi *D. setosum* di daerah berbatu di Teluk Antalya, termasuk tebing, pantai Konyaalti, sekitar pulau Sığan, wilayah Çaltıcak, dan Tanjung Kemer Ağva. Penelitian ini menyajikan laporan pertama tentang kasus ini.

Kata kunci: Bulu babi; *Diadema setosum*; Teluk Antalya.

Abstract

Diadema setosum, a Red Sea migrant, was first identified on the shores of the Kaş Peninsula in the Mediterranean. Approximately a year after this observation, the same species was reported for the second time from Konyaalti Beach in Antalya Bay. This sea urchin rapidly multiplied and expanded its distribution along the coasts of the Mediterranean and Aegean Seas, reaching as far as the Marmara Sea. Some individuals of this sea urchin, which expanded distribution to coastal areas posing a risk to swimmers, were observed to start dying in the summer months of 2022. Scuba diving surveys were conducted in five different areas with rocky and stony seabed structures in the Gulf of Antalya during the winter season (Cliffs, Konyaalti Beach, Sığan Island surroundings, Çaltıcak region, and Kemer Ağva Cape), and it was determined that 99% of the *D. setosum* population had died in February and March. No living individuals were encountered during scuba diving surveys conducted in the same stations in April and May. In conclusion; mass mortalities have occurred in the *D. setosum* population in the rocky areas of the Gulf of Antalya, including the cliffs, Konyaalti beach, Sığan island surroundings, Çaltıcak region, and Kemer Ağva Cape. This study presents the first report on matter.

Keywords: *Diadema setosum*; Gulf of Antalya; Sea urchin.

1. Introduction

The Mediterranean Sea is connected to the Atlantic Ocean in the west naturally, and to the Red Sea through the man-made Suez Canal in the east. After the opening of the Suez Canal, many tropical organisms originating from the Red Sea migrated and settled in the Mediterranean. One of these migrating organisms is the long-spined sea urchin *Diadema setosum*. The first record of this echinoderm species in the Mediterranean was made by Yokeş and Galil (2006) along the coast of the Kas Peninsula. Approximately a year after this record, Gökoğlu et al. (2007) reported a second record of *D. setosum* from Antalya, Konyaalti Beach at a depth of 5-6 meters. Later, in 2009, it was

* Correspondence: Department of Aquaculture, Faculty of Fisheries, Akdeniz University Antalya Türkiye
Tel: +90-242 3101566
e-mail: gokoglu@akdeniz.edu.tr

observed in the coastal waters of Monsef town along the Lebanese coast (Nader & El Indary 2011), and in 2010, it was observed in the Gulf of Iskenderun, Yayladağı, on the southeastern coast of Turkey (Turan et al. 2011). After these reports, *D. setosum* rapidly proliferated in the Mediterranean and expanded its distribution along the coasts of Turkey, Greece, Lebanon, Israel, Egypt, and Libya (Zirler et al., 2023). *D. setosum*, which can be observed up to a depth of 2-3 meters in rocky and stony areas with wave action, has also started to pose a risk for local people.

D. setosum is a species of sea urchin belonging to the Diadematidae family. Its long spines are hollow and contain a mild venom. *D. setosum* differs from other Diadema species by having five characteristic white spots on its body. Additionally, a distinctive feature of this species is the presence of a bright orange anal sac around the periproctal cone of the sea urchin (Yokeş and Galil, 2006).

D. setosum, a species of sea urchin, is distributed in the Indian-Pacific regions from Australia and Africa to Japan and the Red Sea. The spines of this sea urchin can cause painful stings when stepped on, as they are poisonous. Although the toxin is not a deadly threat to humans, it mostly causes swelling and pain. Its long spines are easily broken and enable it to move very quickly (Nour et al. 2022). Mass mortality in sea urchins is a common occurrence. The best example of this can be demonstrated by the collapse of the *Diadema antillarum* population in the Caribbean and Western Atlantic. In the Caribbean, the sea urchin *D. antillarum*, which almost disappeared the early 1980s due to an unknown reason, experienced a similar mass mortality event again in 2022 (Hewson et al., 2023). These mass mortalities are reported to be caused by a pathogen (*Phylaster apodigitiformis*). Similarly, mass mortality events were observed in *Diadema africanum* populations in the Eastern Atlantic in 2009 (Zirler et al., 2023). It is reported that *Vibrio alginolyticus*, which increases due to abnormally rising water temperatures, is responsible for these mortalities (Clemente et al., 2020).

During the summer months (in 2022), while were scuba diving in the Gulf of Antalya, we encountered some deceased individuals of *D. setosum* and found shells and spines belonging to them. Initially, it was thought that the shells and spines belonged to sea urchins that had been consumed by fish or other organisms. However, after the winter season, mass deaths were observed among *D. setosum* individuals in the Gulf of Antalya. This study aims to determine the current status of *D. setosum* in the Gulf of Antalya.

2. Materials and Methods

This research was conducted between September 2022 and June 2023 in five different areas of the Gulf of Antalya with rocky and stony seabed structures (Cliffs, Konyaaltı Beach, Sığan Island surroundings, Çaltıcak region, and Kemer Ağva Cape) (Figure 1). The research was carried out through 50 scuba dives between depths of 2-30 m, and we used scuba tanks filled with 15 liters of air at 200 bars in our studies. A 50-litre canister and long tongs were used to collect sea urchin samples. For underwater photography, we used a Canon G12 camera and a housing. Dives in the research areas were conducted with 2, 4, and 6 individuals, following zigzag patterns. While some dives were from the shore, some boats were used for dives around Sığan Island (9m fishing boat) and in the Kemer region (diving boat belonging to Octopus Diving Centre).

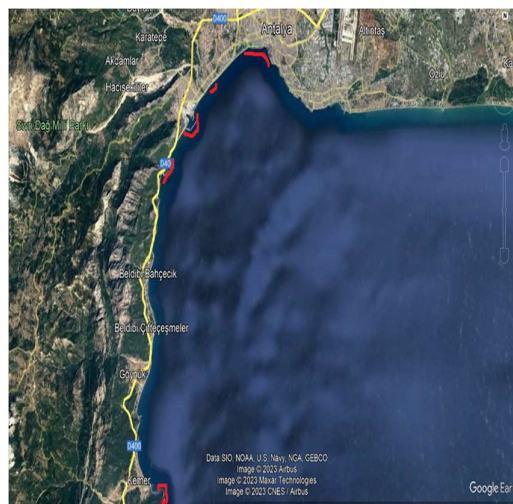


Figure 1. Areas (highlighted in red) where the presence of *D. setosum* is being investigated in the Gulf of Antalya.

3. Results and Discussion

D. setosum, a Red Sea migrant, has rapidly expanded its distribution along the Mediterranean and Aegean coasts of Turkey since its first record in 2006. One of the most densely populated areas of this species in the Mediterranean is the rocky shores of the Gulf of Antalya (Çağiltay et al. 2022).

The diving courses of Akdeniz University students is generally conducted in Antalya Cliffs, Konyaaltı Beach, Sığan Island, Çaltıcak Region, and Kemer Ağva Cape areas. Due to the excessive proliferation of *D. setosum* and the toxicity of its spines, sea urchins are observed and contact with them is avoided during these dives conducted throughout the year. During diving activities carried out in the summer months of 2022, it was observed that some individuals of *D. setosum* died. Initially, it was thought that these deaths were caused by fish or other organisms that consume sea urchins as food. Meanwhile, monthly samplings were conducted for a TÜBİTAK project related to *D. setosum*. It was observed during scuba dives conducted for these purposes that there was an increase in *D. setosum* mortality in the autumn months. These deaths continued to increase during the winter season, and meanwhile, a strong storm occurred in the Gulf of Antalya on January 27 - 28, 2023. Following this storm, during our scuba dives conducted in February and March, it was determined that 98-99% of the *D. setosum* population at diving and sampling stations had died. In all the areas where we dived, it was observed that the surviving sea urchins either shed their spines or had a decrease in their ability to move.



Figure 2. Density of *D. setosum* on the rocky and pebbly surface of Konyaaltı Beach (summer season of 2022).



Figure 3. The density of *D. setosum* in a rocky area during the summer season of 2022

In our diversings in April-May, which are still ongoing in 2023, no live individuals of *D. setosum* could be found, but the spines and shells of dead individuals were encountered (Figure 4-5).

Mass mortality incidents can occur on sea urchins. The best example of this is the collapse of the *Diadema antillarum* population in the Caribbean and Western Atlantic, as found in our literature research (Hewson et al. 2023; Zirlar et al. 2023). It has been reported that this species experienced recurring mass mortalities in the 1980s and 2022. Similarly, a similar situation was observed in a related species, *Diadema africanum*, in the Eastern Atlantic in 2009, where 65% of the population was lost, and in the Canary Islands in 2018, where 93% of the population was lost (Hernandez et al. 2020; Sangil and Hernandez 2022). The cause of death was identified as *Vibrio alginolyticus* in the study. A similar mass mortality event also occurred on the Pacific coast of Mexico, affecting *Diadema mexicanum*, which is one of the endemic species of this region (Benítez-Villalobos et al. 2009).

A similar mass death incident is also occurring with *D. setosum*, a Red Sea migrant. In the different regions of the Gulf of Antalya (Cliffs, Konyaalti Beach, Sican island regions, Calticak region, and Kemer Agva Cape), mass mortalities have been observed in the stations we determined, and no living *D. setosum* individuals have been encountered. In discussions with diving tourism centers in the region, it has been reported that these mortalities are also observed in Ucadalar, Beldibi, and Goynuk regions. Although these mass deaths in a foreign and invasive species may seem positive in a way, the pathogens causing them can also be a threat to native sea urchin species in the Mediterranean.



Figure 4. Shells of *D. setosum* found around rocks of Sican Island.

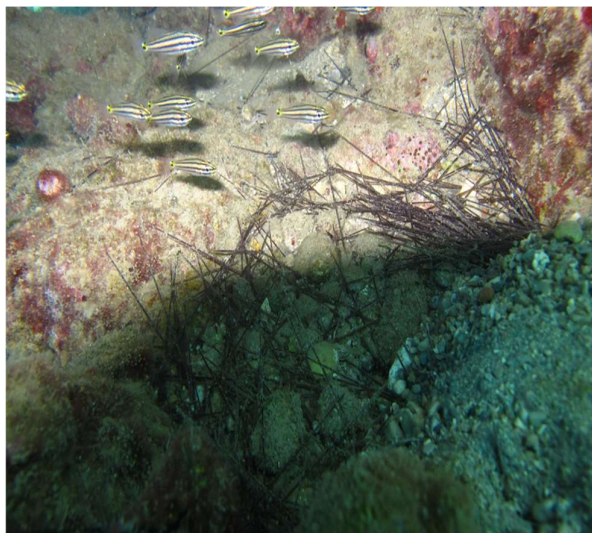


Figure 5. Spines belonging to *D. setosum*, which had died on Sican Island

4. Conclusion

In conclusion, this study provides information about the current status of *D. setosum* in the Gulf of Antalya. This is highly important in terms of whether the species will be able to regenerate its population in the future.

Bibliography

- Benítez-Villalobos, F., Díaz Martínez, J.P., and Martínez-García, M. 2009. Mass mortality of the sea urchin *Diadema mexicanum* in La Entrega at Bahías de Huatulco, Western Mexico. *Coral Reefs*, 28: 1017. (doi:10.1007/s00338-009-0541-5).
- Clemente, S., Lorenzo-Morales, J., Mendoza, J.C., López, C., Sangil, C., Alves, F., Kaufmann, M., and Hernández, J.C. 2014. Sea urchin *Diadema africanum* mass mortality in the subtropical eastern Atlantic: role of waterborne bacteria in a warming ocean. *Mar. Ecol. Prog. Ser.*, 506: 1–14. (doi:10.3354/meps10829).
- Çagiltay, F., Gokoglu, M., Yilmaz, R., and Yildiz, A. 2022. Some fish species showing commensalism traits with Long-spined Sea Urchin (*Diadema setosum* Leske, 1778) in Gulf of Antalya. *Ind. Fish. Res. J.*, 28(1): 33-39 DOI: <http://dx.doi.org/10.15578/ifrj.28.1.2022.%25p>.
- Hernández, J.C., Sangil, C., and Lorenzo-Morales, J. 2020. Uncommon southwest swells trigger sea urchin disease outbreaks in Eastern Atlantic archipelagos. *Ecol. Evol.*, 10: 7963–7970. (doi:10.1002/ece3.6260).
- Hewson, I., et al. 2023. A scuticociliate causes mass mortality of *Diadema antillarum* in the Caribbean Sea. *Sci. Adv.*, 9(16): eadg3200. (doi:10.1126/sciadv.adg3200).
- Gökoğlu, M., Balci, B.A., Çolak, H., and Banbul Acar, B.A. 2007. Akdeniz’de uzun dikenli denizkestanesinin (*Diadema setosum*; Leske 1778) ikinci kaydı. SBT 2007, 11, Underwater Science and Technology Meeting, Istanbul.
- Nader, M.R., and Indary S.I. 2011. First record of *Diadema setosum* (Leske, 1778) (Echinodermata, Echinoidea,

Diadematidae) from Lebanon, Eastern Mediterranean.
Aquat. Invas., 6: S23–S25.

- Nour, O.M., Al Mabruk, S.A.A., Adel, M., Corsini-Foka, M., Zava, B., Deidun, A., and Gianguzza, P. 2022. First occurrence of the needle-spined urchin *Diadema setosum* (Leske, 1778) (Echinodermata, Diadematidae) in the southern Mediterranean Sea. *BioInvasions Records*, 11(1): 199–205, <https://doi.org/10.3391/bir.2022.11.1.20>.
- Sangil, C., and Hernández, J.C. 2022 Recurrent largescale sea urchin mass mortality and the establishment of a long-lasting alternative macroalgae-dominated community state. *Limnol. Oceanogr.*, 67: S430–S443. (doi:10.1002/lno.11966).
- Turan, C., Erguden, D., and Uygur, N. 2011. On the occurrence of *Diadema setosum* (Leske, 1778) in Antakya Bay, Eastern Mediterranean Sea. *J. Black Sea/Mediterr Environ.*, 17: 78–82.
- Yokes, B., and Galil, B.S. 2006. The first record of the needle-spined urchin *Diadema setosum* (Leske, 1778) (Echinodermata: Echinoidea: Diadematidae) from the Mediterranean Sea. *Aquat. Invasions*, 1: 188–190. (doi:10.3391/ai.2006.1.3.15).
- Zirler, R., Schmidt, L-M., Roth, L., Corsini-Foka, M., Kalaentzis, K., Kondylatos, G., Mavrouleas, D., Bardanis, E., and Bronstein, O. 2023. Mass mortality of the invasive alien echinoid *Diadema setosum* (Echinoidea: Diadematidae) in the Mediterranean Sea. *R. Soc. Open Sci.*, 10: 230251. <https://doi.org/10.1098/rsos.230251>.