

Breakthrough Scientific News

A New Puzzle in Echinoderm Ecology:
Was the 2023 Disappearance of *Diadema Setosum* Infection-
Driven or Natural?

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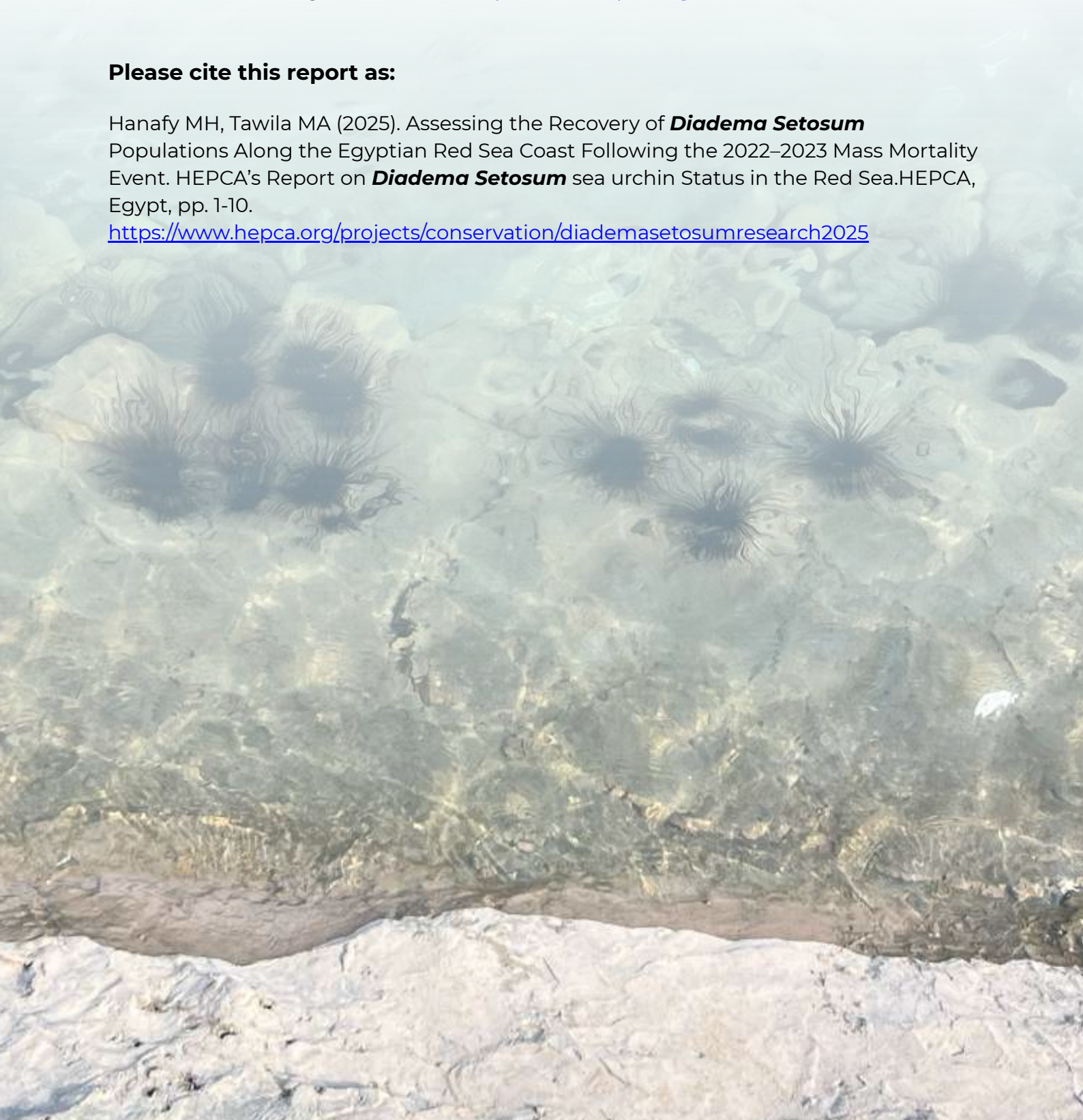
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Please note that the detailed data supporting this report are currently being prepared for scientific publication. For those interested in obtaining more detailed information, please feel free to contact the corresponding author of this report directly, or reach out to HEPCA through our website: <https://www.hepca.org/contact-us>

Please cite this report as:

Hanafy MH, Tawila MA (2025). Assessing the Recovery of ***Diadema Setosum*** Populations Along the Egyptian Red Sea Coast Following the 2022–2023 Mass Mortality Event. HEPCA's Report on ***Diadema Setosum*** sea urchin Status in the Red Sea. HEPCA, Egypt, pp. 1-10.

<https://www.hepca.org/projects/conservation/diademasetosumresearch2025>



In 2023, the Red Sea experienced an unusual and rapid disappearance of the long-spined sea urchin *Diadema Setosum*, a keystone herbivore known for its critical role in maintaining coral reef resilience. Within a few weeks, populations that once densely occupied reef crevices almost completely vanished across vast coastal areas. The sudden collapse of this important grazer raised considerable concern among marine scientists and reef managers, as it threatened the ecological balance of coral reef ecosystems that depend on continuous algal control.



Early explanations suggested that the mortality might have been caused by a protozoan parasite introduced through the Suez Canal. However, subsequent scientific analysis has shown that such a hypothesis is biologically implausible. No known parasite could spread over thousands of kilometers in such a short time, nor could it selectively affect a species that is in fact absent from the Suez Canal itself.

Rapid Scientific Response and Monitoring

Recognizing the seriousness of the event, the Hurghada Environmental Protection and Conservation Association (HEPCA) took the lead in organizing rapid monitoring and survey activities only months after the mortality was reported.

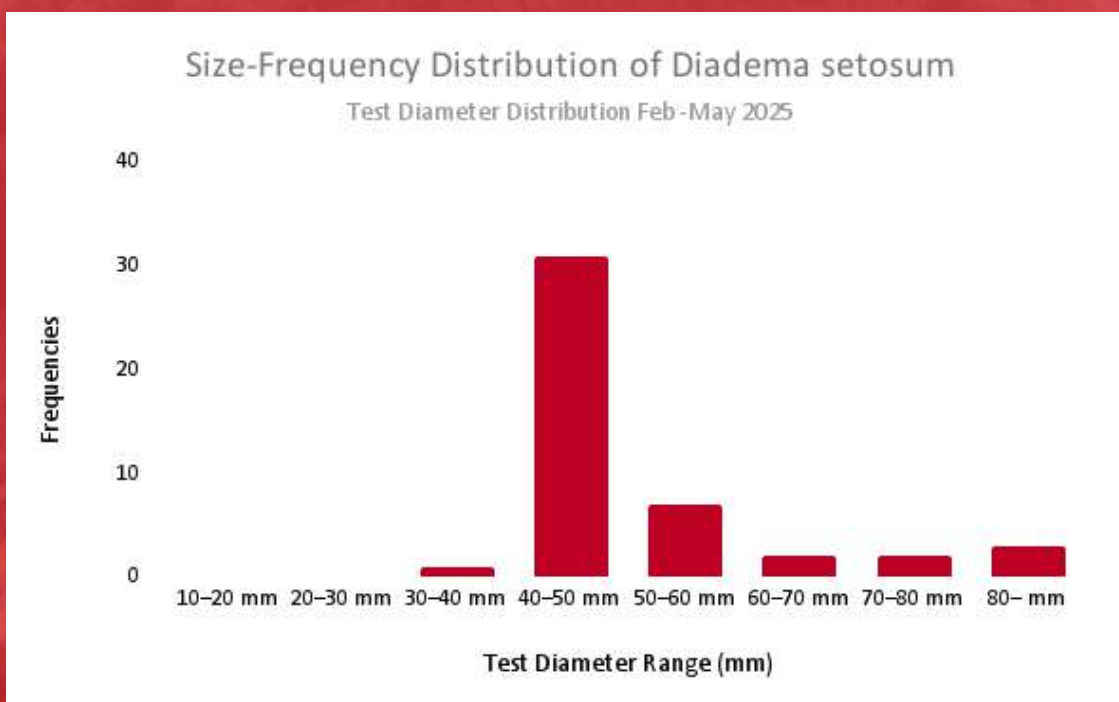
Between February and May 2025, a structured survey was conducted at thirteen representative sites extending from El Ain El Sokhna in the north to Marsa Alam in the south.

The surveys included quantitative assessments of population density, morphometrics, reproductive indices, and reef condition.



RESULTS

The results were both encouraging and scientifically significant. In less than two years, clear signs of population recovery were observed across several sites. The Gulf of Suez showed the strongest rebound, with densities exceeding 6.7 individuals per square meter, while moderate recovery was recorded at Hurghada and Port Ghalib.



Most individuals were between 40 and 50 mm in test diameter, indicating a dominant post-mortality recruitment cohort. Histological examinations confirmed the presence of both growing and mature gonads, signifying the re-establishment of reproductive activity.



Dead individuals of the sea urchin *Diadema Setosum* during sudden disappearance in 2023

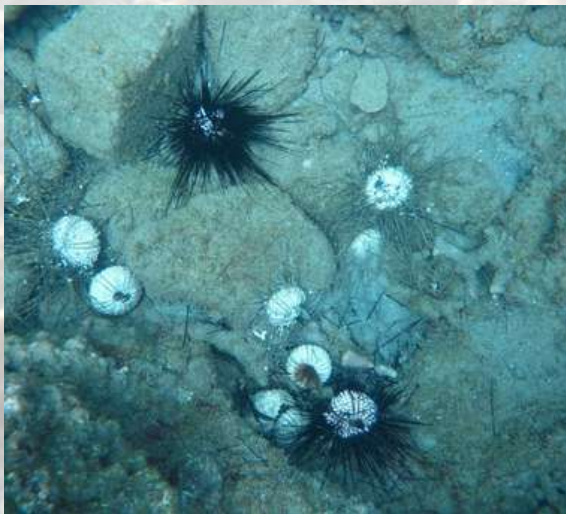


Signs of rapid early recovery of the sea urchin *Diadema Setosum* in late 2024

At the ecosystem level, algal cover remained stable throughout most of the surveyed reefs, with only limited turf algal increase (around 11%). This stability suggests that functional redundancy within the herbivore community—mainly through grazing fishes and other echinoids—helped to maintain ecological balance during the temporary absence of *Diadema*.

Reinterpreting the 2023 Event

The observed pattern of sudden disappearance of *Diadema* followed by rapid recovery does not correspond with a disease-driven collapse but rather with a natural population fluctuation. Similar cyclic dynamics are well documented among echinoderms, particularly in species such as the crown-of-thorns starfish (*Acanthaster planci*). In these cases, synchronized spawning, post-reproductive physiological stress, and abrupt environmental changes (e.g., temperature anomalies or local algal blooms) can collectively cause large-scale mortality.



Dying *Diadema Setosum* during Mass Die-off on the Egyptian Red Sea Coast in July 2023



Dead specimens of *Diadema* in Somal from the mass die-off in Feb. 2025

The presence of microorganisms and parasites in dying urchins should therefore be regarded as a secondary consequence of weakened immunity rather than the primary cause of death. The evidence from the Red Sea fits this ecological interpretation more accurately than the previously suggested Suez Canal infection route.

Evidence of Ecological Resilience

Perhaps the most important finding from this study is the evidence of resilience—both of the species and the reef ecosystem.



Within two years, *Diadema Setosum* populations had not only reappeared but also regained reproductive function and size structure typical of healthy populations.

The stable condition of algal communities and the continued structural integrity of coral reefs demonstrate the capacity of Red Sea ecosystems to absorb and recover from sudden biological disturbances.

These observations reinforce the need to interpret ecological crises within a broader natural context, rather than relying on single-cause explanations.

They also highlight the importance of long-term field monitoring and the rapid mobilization of local research capacity, as exemplified by HEPCA's leadership during this event.

Long-Term Research and Monitoring Initiative

Building on these results, HEPCA has committed to sponsoring a long-term scientific program to study the recovery dynamics of *Diadema Setosum* in the Egyptian Red Sea.

This multi-year initiative will focus on:

1. Measuring population recovery rates across inshore and offshore reef systems;
2. Investigating recruitment patterns and larval settlement success;
3. Monitoring reproductive cycles, including gonadal indices and spawning synchrony;
4. Assessing interactions between *Diadema* populations, reef condition, and other herbivores to evaluate ecological balance and resilience.



This long-term research will provide a valuable dataset for understanding how environmental variability influences echinoderm populations and for predicting future responses .

Conclusion

The disappearance of *Diadema Setosum* from the Red Sea in 2023 represents one of the most remarkable recent ecological events in the region. However, the rapid and structured recovery documented in 2025 clearly indicates that this was not a pathogen-driven catastrophe, but rather a natural fluctuation within a resilient marine ecosystem.

The work led by HEPCA and its collaborating scientists demonstrates how science-based investigation can transform crisis into understanding. By supporting long-term ecological research and continuous monitoring, HEPCA is ensuring that the Red Sea remains not only a site of biodiversity and beauty but also a living laboratory for studying resilience, recovery, and adaptation in coral reef ecosystems.

Acknowledgments

We extend our sincere gratitude to the Management of HEPCA for their unwavering commitment to advancing scientific research on the marine resources of the Red Sea through their Strategic Agenda. HEPCA's invaluable support encompassed funding for all expeditions and efficient management of logistics during field activities and data collection. As the sole sponsor of this work, HEPCA plays a pivotal role in monitoring the impact of climate change on the precious and distinctive living resources of the Red Sea.



This newsletter serves as a news update within the periodic reports issued by HEPCA on the status of the Red Sea natural resources on the Egyptian side.