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Learning from the present, understanding the past: drill hole recognition for the fossil record

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Drill holes in echinoids produced by carnivorous cassid gastropods are often found in dead sea urchin tests recovered from both ancient and Recent sediments. In many cases the aragonite snail shells show a poor preservation potential in the fossil record thereby often making their predatory drill holes in the echinoid skeletons the only indicator of their former presence. Understanding the predation traces that cassids leave in echinoids of Recent environments can fundamentally improve the knowledge of ancient predator-prey interactions and can advance the predator recognition in the fossil record by the traces the predators leave.

The Caribbean sand dollar *Leodia sexiesperforata* is often drilled by the cassid *Cassis tuberosa* around the island of San Salvador, The Bahamas. Drill hole morphology and predatory patterns are described to identify characters that are specific for *Cassis tuberosa* drill holes in *Leodia sexiesperforata*. Drill holes are typically subcircular to elliptical in shape with an average width of 3.5 mm. The drill hole profile can be concave parabolic in regions where the stereom is thick, or, sigmoidal in areas where the stereom is thin. The acid-supported drilling technique can expose the inner of the stereom in areas around the drill hole and drill holes can also feature notches on the drill hole margin. Stereom protrusions reaching into the drill hole lumen are also indicative for acid-supported drilling. *Cassis tuberosa* prefers the oral anterior part of the sand dollar as drilling site, drill holes also occur in other areas on the echinoid test, but in statistically lower numbers. Analyses also revealed that the cassid gastropod might show a preference for larger prey. The results indicate that some drill hole characters and drilling patterns can be used for predator recognition in both ancient and Recent environments, other drill hole characters and patterns are more likely to reflect the substrate or the anatomy of the prey.