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Rapid Regeneration of the Body Wall of the Aboral Central Disc in the Sea Star *Luidia clathrata*

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SHORT PAPERS AND NOTES

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RAPID REGENERATION OF THE BODY WALL OF THE ABORAL CENTRAL DISC IN THE SEA STAR *LUIDIA CLATHRATA*.—Regeneration is a general process that is displayed in many representatives of the phylum Echinodermata (Wilkie, 2001). However, to date the regeneration of the body wall associated with the aboral disc has been associated strictly with the class Ophiuroidea (brittlestars) [Wilkie, 2001 (and references within)]. On 16 June 2009, adult individuals of the sea star *Luidia clathrata* (Say) (mean $R = 7.4$ cm; $n = 60$) were collected by hand from shallow (1–2-m depth) sandy substrates along the Courtney Campbell Causeway of Tampa Bay, FL (27°58'N 82°39'W). Sea stars were immediately transported in coolers in ambient seawater to the University of Alabama at Birmingham and placed individually into 10-gallon aquaria divided into two separate 5-gallon sections containing a 2-cm layer of sand. Presumably as a result of the stress associated with high ambient seawater temperatures in Tampa Bay at the time of collection (J. Lawrence, pers. comm.), a number of the individuals autotomized distal portions of their arms the day following their collection. Moreover, one of these individuals ($R = 6.0$ cm; mean wet weight = 13.75 grams) also spontaneously discarded a circular segment of the body wall that covered a large portion of the aboral region of the disc (Fig. 1A). The autotomization of the body wall over the central aboral disc (with autotomy defined in this case as strictly the spontaneous loss of healthy tissue) exposed the intact pyloric stomach, and several pouches of the stomach extended slightly above the central disc. Despite the loss of the body wall over the central disc and a portion of two of its arms, the autotomized *L. clathrata* appeared healthy. This individual was subsequently followed over a 1-mo period to document regeneration of the body wall over the region of the disc. During this time period the individual was maintained in artificial seawater (Instant Ocean®) that was filtered by an aquarium pump (Aqueon Power Filter 10) and was provided a constant supply of air via an air stone powered by an air pump (CORALIFE® SL-65). Light was maintained on a regular 12:12 light:dark cycle, and the seawater temperature and salinity were held at 24°C and 32 ppt, respectively. A food ration of 0.2 g dry weight of a

formulated feed developed specifically for *L. clathrata* (A. Lawrence) was presented to the individual on alternating days. The regenerating individual was periodically photographed with a digital camera (Panasonic Lumix DMC-FZ7) in order to facilitate a description of regeneration of the body wall in the disc region.

Despite the fact that the regenerating sea star initially remained buried in the sand and lacked a feeding response to daily food rations, repair of the body wall over the central disc proceeded rapidly. After a period of 10 d, the circular hole in the aboral body wall tissue over the central disc had elongated, and the pouches of the pyloric stomach had become internalized (Fig. 1B). By day 14, the individual began to move about the aquarium and initiated normal feeding behaviors. After 18 d, the oblong hole in the body wall tissue over the central disc had narrowed sufficiently enough to seal itself completely closed (Fig. 1C). By day 29, the body wall tissue over the central disc had completely regenerated, likely through a combination of tissue regrowth and a muscularly induced cinching closed of the existing body wall (Fig. 1D).

To the best of our knowledge this represents the first documentation of the loss and regeneration of the body wall in the aboral region of the central disc in a sea star. *Luidia clathrata* commonly exhibits partial or complete autotomization of its arms in the field, which is considered to be the result of either sublethal predation or a response to an environmental stress (Lawrence, 1990; Lawrence and Ellwood, 1991; Lawrence and Vasquez, 1996; Pomory and Lares, 2000). There are significant consequences associated with regeneration of the arms with regard to the allocation of materials and energy to somatic and gonadal growth in *L. clathrata* (Lawrence et al., 1986; Lawrence and Ellwood, 1991). Similarly, regeneration of the body wall in the central disc region in *L. clathrata* could be expected to have consequences for bioenergetics. This may particularly be the case if feeding ceases for some period of time during regeneration, as noted during our observation period. The rate of arm regeneration in *L. clathrata* is measured on the order of 6–12 mo in the field and is rapid compared to the rate of regeneration in other sea stars (Pomory and Lares, 2000). However, the regeneration of the body wall covering the aboral disc is an order of magnitude more rapid than that of the arms (essentially only 18 d), perhaps because regeneration of the

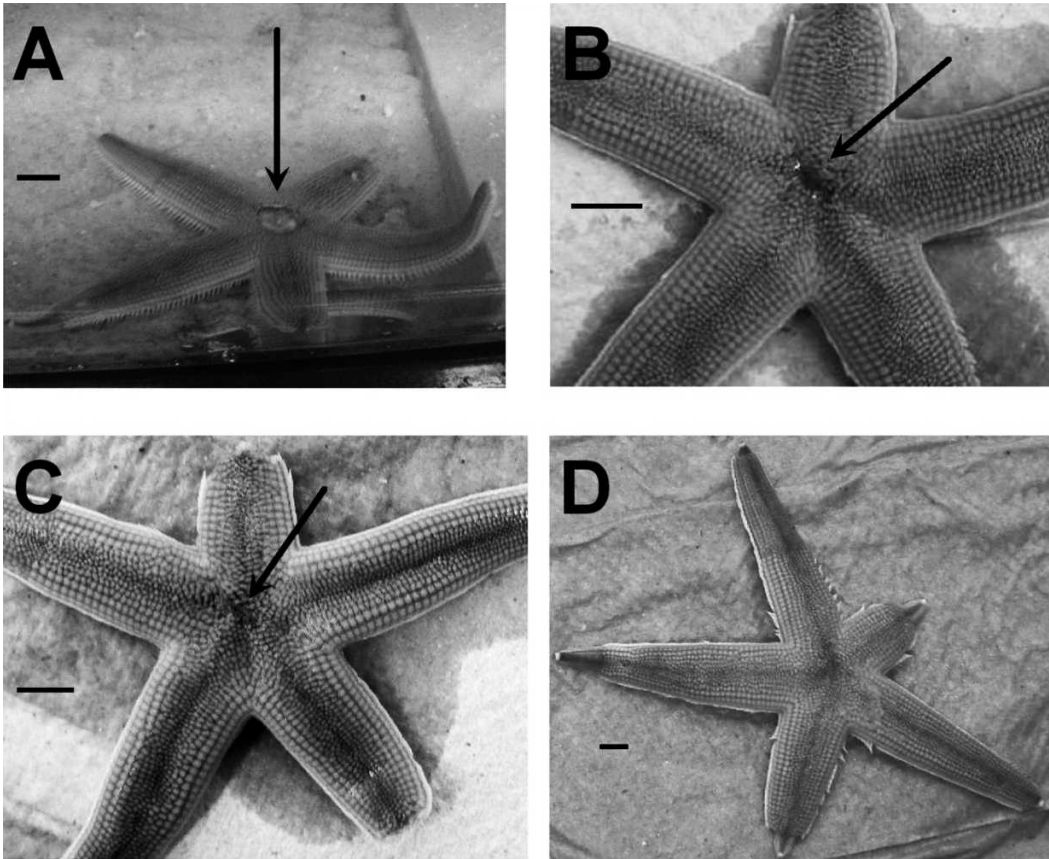


Fig. 1. Photographs depicting the loss and regeneration of the body wall over the central aboral disc in an adult individual of the sea star *Luidia clathrata* ($R = 6.0$ cm). (A) Twelve hours post-loss of body wall over central region of disc. (B) Day 10. Elongation and narrowing of the body wall surrounding the region of disc autotomization. (C) Day 18. Body wall of aboral disc resealed; irregular pattern of body wall ossicles at zone of regeneration. (D) Day 29. Regeneration of body over aboral disc complete. All scale bars represent 1 cm.

body wall requires only the regeneration of the body wall tissue and not of the ossicles, the pyloric ceca, or the gonads. Rapid regeneration of the body wall over the aboral disc in *L. clathrata* would be advantageous, as it allows for the protection of vulnerable internal organs.

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