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What happens when (plant) sex fails?

Many plant species reproduce using sexual and asexual methods – and this can vary depending on environmental and genetic conditions. A large amount of energy goes into producing flowers and seeds for sexual reproduction, while vegetative growth through continuous expansion of the original plant(s) requires much less energy. Sexual reproduction produces new combinations of genes which may be advantageous in changing environments. Yet vegetative growth may also be seen as advantageous through the persistence of the same locally adapted genetic individuals. Species living at the edges of their natural ranges usually survive at the extreme limits of their physiological tolerances. However, extreme and prolonged variations in environmental conditions often associated with climate change mean that stress is exacerbated in these populations and they are often under the most threat of extinction. They are often declining and/or in poor health, and sexual reproduction can be compromised.

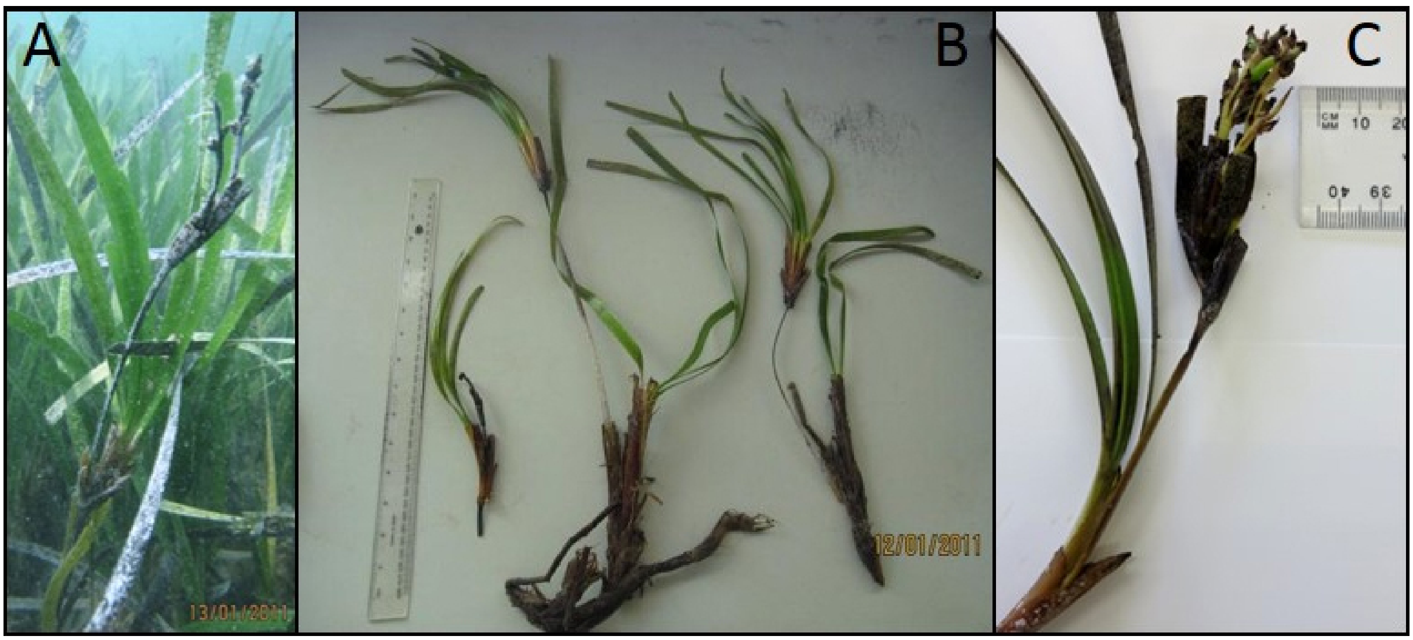

Fig. 1. Pseudovivipary in a Posidonia australis meadow from Shark Bay; (a) pseudoviviparous plantlet and flowers attached to parent plant, (b) harvested pseudoviviparous plantlets with inflorescence, basal rhizome with (maternal) shoot and inflorescence-derived plantlet attached via a thickened inflorescence stem, (c) close-up of an inflorescence with plantlet and immature fruit. Photos by R. Hovey and J. Statton.

Life under these extreme conditions can trigger alternative pathways to reproduction. One such method involves the ability of a plant to replace flowers (sexual organs) with vegetative growth (bulbils or plantlets) after a failed attempt at sexual reproduction (a process known as pseudovivipary), perhaps akin to a 'last ditch effort'. This strategy is frequently observed in extreme environments in some groups of land plants, such as the grasses, the terrestrial ancestors of marine plants or seagrasses. The widespread Australian seagrass (*Posidonia australis*) typically grows in coastal bays around the southern Australian coastline. It makes up one of the largest seagrass meadows in the world in the UNESCO World Heritage Site of Shark Bay, Western Australia. Conditions in Shark Bay at the northern range for the species are such that this seagrass is persisting in its upper water temperature and salinity limits.

This research reports on the first observations of plantlets observed growing within the floral stems of a meadow in Shark Bay during the late summer of 2010/11. The observations followed a series of unusual climatic events – cooler than average winter water temperatures, followed by a prolonged marine heat wave (Jan – April 2011), and 100% seed abortion during the summer of 2011/2012. The plantlets and their associated parent plants were collected (Fig. 1) and genotyped (using microsatellite DNA markers) to determine the genetic origin of the plantlets. The plantlets were genetically identical to the parent plant, and thus grown through a reversion process (pseudovivipary), rather than from germinated seed, while still attached to the parent plant (vivipary).

This study documents a physiological response at the species range edge, whereby the method of reproduction can adapt to variable conditions. This may have important long-term implications as both genetic and ecological constraints may limit sexual reproduction and the ability of this seagrass meadow to adapt to changing climate conditions or shift its range; this meadow in Shark Bay is already known to have low genetic diversity, no sexual reproduction and no seedling recruitment.

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Publication

Reproduction at the extremes: pseudovivipary, hybridization and genetic mosaicism in Posidonia australis (Posidoniaceae).
Sinclair EA, Statton J, Hovey R, Anthony JM, Dixon KW, Kendrick GA.
Ann Bot. 2016 Feb