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Living on Less: Miniaturization in Duckweed

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Miniaturisation, or an extreme reduction in body size, is present in both the plant and animal kingdoms. This process has been associated with novel morphological innovations and functional adaptations. Whilst miniaturisation has been studied in a wide variety of animal lineages, we lack an understanding of the morphological changes associated with miniaturisation in plants. The Araceae exhibit a striking evolutionary breadth, encompassing both the smallest flowering plants and some of the largest herbaceous species known, making it an ideal family with which to explore the concept of miniaturisation. We focused on duckweeds, investigating the morphogenesis and homology of their fronds with those of other Aroids. Duckweeds measure just a few millimetres. Their aerial body plan consists of a single frond or thallus, which divides asexually through clonal reproduction. We followed morphogenesis in *Lemna minor* fronds and observed that cell division was tightly constrained to a narrow time window during early organogenesis, suggesting that the early cessation of division constrains final frond size. Transcriptional dissection of the duckweed frond revealed that it comprised distinct zones with homology to either leaves or petioles in Aroids, suggesting that the duckweed frond is a hybrid organ consisting of a fused stem and leaf. Collectively, our data support the hypothesis that while, in animal lineages such as tardigrades, miniaturisation has arisen through the loss of body plan components, in duckweeds, it has arisen through a restriction in cell division and fusion, rather than the loss of organs.

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References

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