Pristine waters surrounding Rottnest Island. Photo: Angela Rossen, Artist-in-Residence, Oceans Institute, UWA

New beginnings – bottleneck in the cycle of seagrass life

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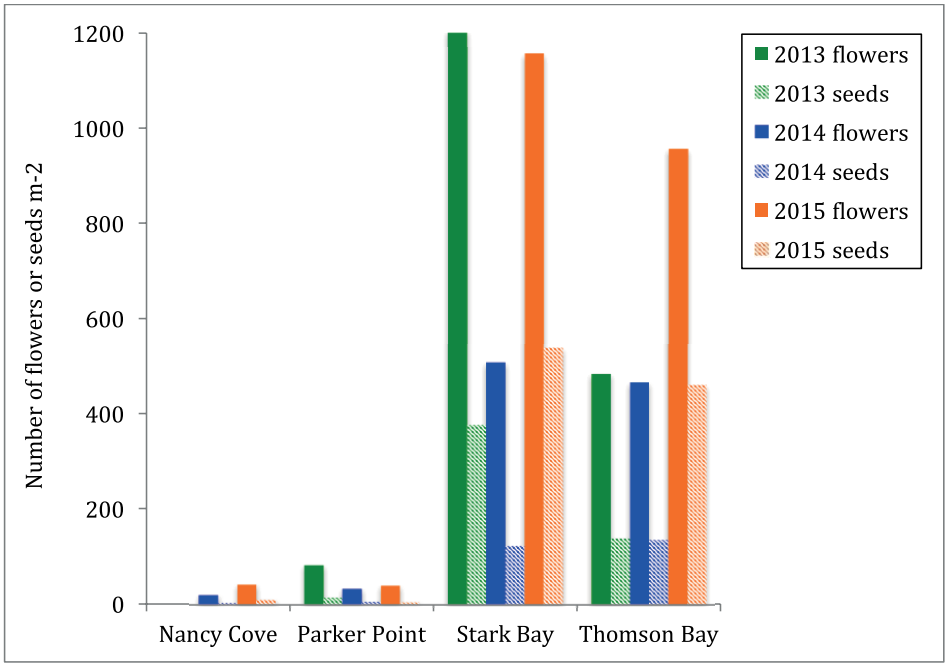
Seagrasses are clonal plants and therefore may persist for a long time. They are among some of the oldest plants on Earth, with some clones thought to be thousands of years old.

However, renewal, or the recruitment of new genetic individuals, also occurs in clonal species. This tends to be sporadic and patchy, and can be very difficult to quantify.

The Rottnest Island seagrass meadows are largely pristine and interact with visitors in many ways including as a background to the underwater scenes for snorkelers, interspersed with boat moorings and anchorages and protected in marine reserves. We can learn a lot about the local meadows, limits to natural seed dispersal and where natural recruitment of seedlings occurs.

Understanding natural recruitment in seagrasses is of importance to restoration activities – determining when to let nature recover on its own, and when to intervene through restoration activities to assist natural processes or when significant interventions are required (such as transplanting) is important.



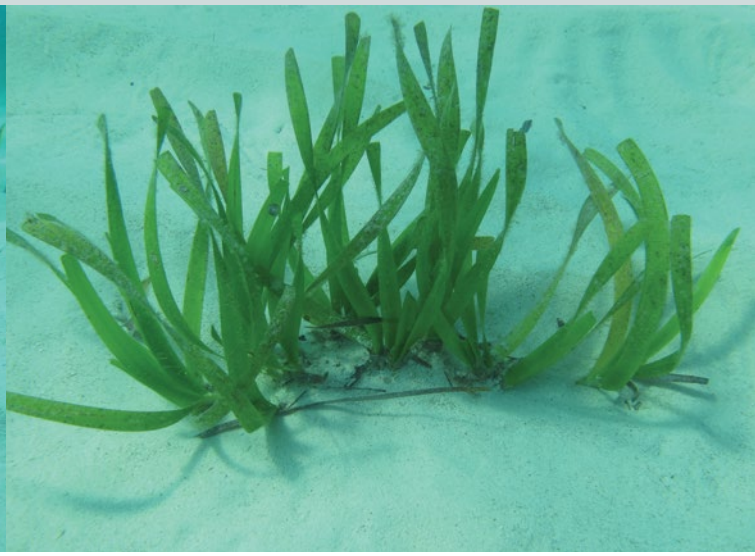
Flowering and seed production across four seagrass meadows at Rottnest Island between 2013 and 2015. Viable seeds are produced from successful pollination of between one third to one half of all flowers in productive meadows.

One of our local seagrasses, *Posidonia australis*, has extremely high levels of genetic diversity and prolific flowering and seed production, although this does vary annually across meadows.

But what happens to all these seeds? Many are damaged prematurely during the winter and spring storms, but huge numbers still mature and float to the sea surface. The spongy fruit are buoyant allowing them to be dispersed across the oceans by wind and waves, and many wash up on local beaches before being released. The fruit can float for up to a week before splitting open and releasing the single growing seed (or seedling). This new seedling drops to the sea floor and has the potential of growing into a new seagrass plant.

High seed production in a meadow at Thomson Bay, Rottnest Island. *Posidonia* infructescences sitting up above the dense leafy canopy. Photo: Angela Rossen, Artist-in-Residence, Oceans Institute, UWA

First year *Posidonia* seedlings growing at Thomson Bay, Rottnest Island. Photo: Gary Kendrick



Four to five-year-old established *Posidonia* plants at Thomson Bay, Rottnest Island. Photo: Gary Kendrick

Along this short, but dangerous journey, fruit are damaged or eaten by fish, crustaceans eat the seedlings and some lucky ones land on a sandy bottom and begin their life as new seedlings, but only a few will go on to establish.

Life is tough as a seedling. A root needs to grow quickly to hold the seedling in place and the new growing leaves need to stay off the radar of hungry, destructive crabs, while sand dollars (*Peronella lesueuri*) will dig up the new seedlings. The onset of autumn and winter brings new threats; storms can move the sandy bottom, quickly uprooting or completely burying many of the new recruits (they are less than 6 months old). In fact, survival in that first year is very low.

Our monitoring of seedling survival over three years in seagrass meadows at Rottnest Island shows that if seedlings survive the first year, then they are much more likely to grow into adult plants, expanding existing meadows or creating new ones. The recruitment of seedlings is difficult to quantify, but thought to be as low as 1%, and therefore regarded as a huge bottleneck in the life cycle of seagrasses generally (reviewed in Kendrick et al. 2016).

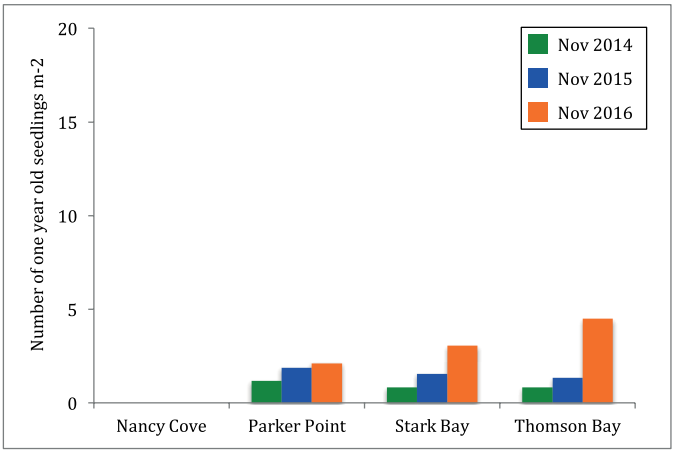
We are also interested in where the successful seedling recruits occur (inside or outside existing meadows) and where the seeds come from. Are they from plants in the nearest local meadow, or have they travelled from more distant meadows?

Developing a hydrodynamic model to explain how seed dispersal occurs showed that seeds can disperse tens of kilometres on the sea surface, but doesn't explain where seedlings were coming from. We used a set of genetic markers to genotype seedlings recruited into four meadows at Rottnest Island (2013 - 2015) and determined whether seeds were being recruited from the nearest meadow, or in fact travelling some distance from their parental plant. The markers showed that a high proportion of seeds were recruiting locally, that is, recruits were genetically assigned to the nearest meadow, from which we infer this is their origin.

However, we were also able to identify some recruits that had arrived from more distant meadows. Thus, some dispersing fruit were being moved via surface currents and wind before successfully landing in a new location. Survival of these recruits to reproductive maturity completes the life cycle, and demonstrates that seed dispersal is effective and contributing to contemporary gene flow among seagrass meadows at Rottnest Island. This also demonstrates seagrass meadows are able to naturally recruit and expand. ■

Additional reading

Kendrick GA, Orth RJ, Statton J, Hovey RK, Ruiz-Montoya L, Lowe RJ, Krauss SL, Sinclair EA (2016) Demographic and genetic connectivity: the role and consequences of reproduction, dispersal and recruitment in seagrasses. *Biological Reviews* doi: 10.1111/brv.12261.



Proportionately few viable seeds persist to become one-year-old seedlings (2014 - 2016) even in highly productive meadows, such as those at Thomson Bay and Stark Bay, Rottnest Island.