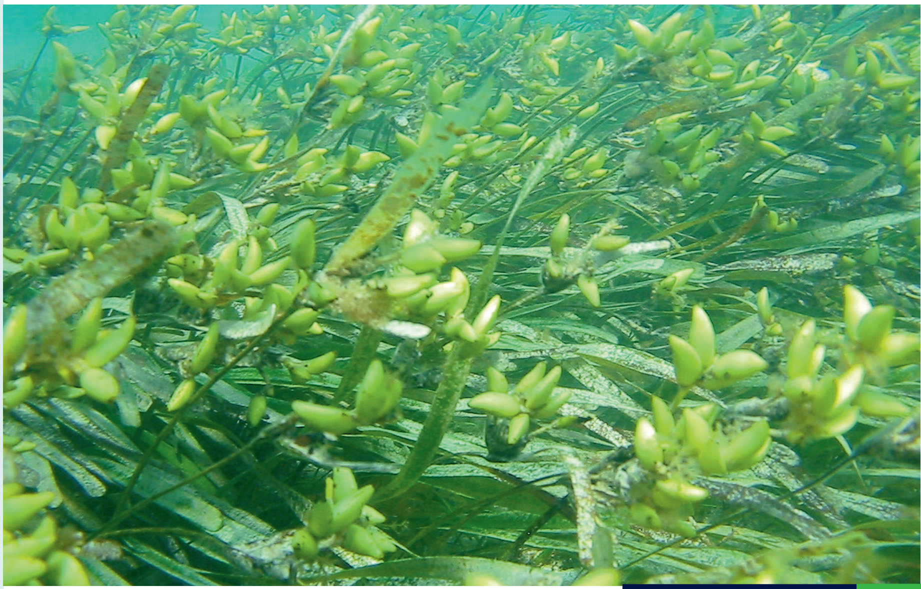

Fig. 1 Mass seed production in a *P. australis* meadow at Woodman Point. Photo: John Statton

Dispersal on the high seas

- the ecological genetics of seagrass seed dispersal

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Seagrasses are marine flowering plants, with Western Australia being home to more species than any other place on earth. However, seagrass meadows here, and elsewhere, are rapidly diminishing due to human impacts, and research is focusing on understanding genetic patterns and their ecological drivers. Each individual plant can grow via vegetative extension of rhizomes (same genetic plant) and reproduce sexually through seed production (different genetic combinations). Seagrass meadows vary dramatically in their levels of genetic diversity and hence their balance between vegetative and sexual reproduction. Some meadows produce vast numbers of seeds (Fig. 1) while others rarely record flowering events at all.

The production of seeds provides an opportunity for species to generate different combinations of genes and then physically disperse them across the landscape using different mechanisms such as wind, water, insects, birds and animals. Typically, the majority of seeds do not travel far from the parent plants. However, a few will travel much longer distances, and may successfully recruit into another population or start a new population of their own.

Long distance dispersal is a very difficult trait to measure in plants. However, the combination of field experiments and use of genetic markers is currently one of the best available tools. In a recent review paper, we highlighted a gap in the sampling distances for genetic studies for understanding long distance dispersal events in seagrasses. A strong relationship exists between genetic distance and geographic distance above about 150 km, suggesting that long distance seed dispersal and successful recruitment into a meadow occurs up to this distance (Kendrick *et al.* 2012).

We are focusing on Cockburn Sound, to understand dispersal in our local seagrass *Posidonia australis.* Flowers are observed in July/August and mature fruits are produced by

Fig. 2 Dissection of a mature *P. australis* fruit. The fruit is spongy, containing a single growing embryo with apical leaf forming. Photo: Janet Anthony

late November, at which point they are released from the parent plant and rise to the water surface (positively buoyant). While on the water surface, fruit are subject to movement forces – being pushed around by wind and wave action until the mature fruit splits open and releases a single embryo (Fig. 2). The embryos, already with growing shoot and root tips, are negatively buoyant, so rapidly drop to the sea floor. Some secondary dispersal may occur on the sandy floor depending on wave action. Recruitment of new plants can be very low with many of the seeds eaten by fish and crustaceans along the way, while others do not land in suitable habitat. Those seeds that successfully fall in a good place are able to grow into new plants – expanding an existing seagrass meadow if close to home, perhaps helping to restore damaged meadows, or starting an entirely new one.

Continued overleaf.

Fig. 3 Windrows of mature *Posidonia* fruits forming off Carnac Island.
Photo: John Statton

Fig. 4 Andrea Zavala, Liz Sinclair and Ilena Gecan sorting freshly collected floating fruit on the boat. Photo: John Statton

The distance a seed travels is determined by the time it takes for the fruit to split and the actions of wind, waves, and ocean currents moving the seeds around. The majority of seeds will be released rapidly as the fruit are generally ripe and split readily, however, others may take several days. It is these time and distance factors we are interested in – an ecological study measuring how far fruit can travel before the seeds are released and a molecular genetics study to determine from where the seeds were released. Thus, we can estimate how far the seeds have travelled and how much mixing occurs between seeds released from different meadows.

Under windy conditions, the fruit tend to collect in wind rows (Fig. 3) and are moved around. The seeds are released, and rotting fruit eventually get washed up on local beaches. We collected mature floating fruit (containing seeds) during the release in November 2011 (Fig. 4). The seeds were sorted by species (*Posidonia sinuosa* also releases seeds at the same time) and removed them from their fruit. We collected from sites close to where we have previously genotyped meadows (Sinclair 2009), and as we came across wind rows.

These seeds are now being genotyped and we will use genetic assignment procedures to determine the origin of the seeds (individuals and by collection groups) to determine how far seeds have dispersed. We plan to take this a step further, searching for newly established seedlings and genotype and assign them to a source population to begin to measure realized long distance dispersal of seed among seagrass meadows. Ultimately, this research will help us to better understand connectivity among seagrass meadows, with important implications for conservation and restoration.

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Other reading

Kendrick GA, Waycott M, Carruthers T, *et al.* (2012) “The central role of dispersal in the maintenance and persistence of seagrass populations.” *BioScience 62*, pp 56-65.

Sinclair EA (2009) “Restoration genetics of seagrass meadows”, Friends of Kings Park Quarterly Magazine *For People and Plants:* Summer: pp 20-21. Botanic Gardens and Parks Authority, West Perth.