The role of wind in hydrochorous mangrove propagule dispersal

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Although wind has been recognized to be an important factor in the dispersal of hydrochorous mangrove propagules, and hence in the quantification of (meta)population dynamics, the species-specific sensitivity to wind effects has not been studied. We combined observations from a controlled experiment (flume tank) and *in situ* experiments to understand wind and water current contributions to dispersal potential as well as to estimate real dispersal ranges due to immediate response to tidal currents (two outgoing tides). This was done for 5 species with propagules differing in morphological and buoyancy properties (i.e. *Rhizophora mucronata*, *Ceriops tagal*, *Heritiera littoralis* and *Xylocarpus granatum*). The flume experiments revealed that the influence of wind depends on the density of a propagule (and hence its buoyancy characteristics) and that typical morphological characteristics of the dispersal unit are additionally important. *H. littoralis* propagules were influenced most, because on the one hand their low density (613.58 g l^{-1}; n=10) enables them to float on top of the water surface, and on the other hand their 'sailboat-like' structure provides a relatively large surface area. The *X. granatum* fruits appeared to be the least influenced by ambient wind conditions, explained by the smooth surface and spherical shape of which, because of the fruit's high density (890.05 g l^{-1}; n=1), only a small part sticks above the water surface. Although the seeds of *X. granatum* are of a similar size class as *H. littoralis* propagules, they are (like the *X. granatum* fruits) largely submerged due to their high density (870.66 g l^{-1}; n=8), hence catching less wind than *H. littoralis* propagules. The influence of wind on the dispersal of the horizontally floating *C. tagal* and *R. mucronata* dispersal units was strong, comparable to that of *H. littoralis* propagules. A differential effect of wind was found within elongated propagules, which directly follows from the floating orientation of the propagules. While the dispersal path of vertically floating propagules was influenced by the strength and direction of the water currents and to a lesser extent by ambient wind conditions, the dispersal path of horizontally floating propagules was influenced by both strength and direction of the water currents and prevailing wind forces. To validate the flume results, propagules of *C. tagal* and *R. mucronata* were released during outgoing tide in a tidal creek in Gazi Bay (Kenya), followed by observation of their dispersal distance and direction, while knowing the actual dominant wind direction. In line with the flume results, this study showed that wind plays an important role in the dispersal distance of the propagules. The present study provides important mechanistic insight in the effect of wind on hydrochorous mangrove propagule dispersal, thereby yielding an essential step towards the construction and optimization of (particle based) hydrodynamic dispersal models.