

Modelling mangrove propagule dispersal: sensitivity analysis and implications for shrimp farm rehabilitation

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Abstract

Propagule dispersal of four mangrove species *Rhizophora mucronata*, *R. apiculata*, *Ceriops tagal* and *Avicennia officinalis* in the Pambala-Chilaw Lagoon Complex (Sri Lanka) was studied by combining a hydrodynamic model with species-specific knowledge on propagule dispersal behaviour. Propagule transport was simulated using a finite-volume advection-diffusion model to investigate the effect of dispersal vectors (tidal flow, freshwater discharge and wind), trapping agents (retention by vegetation) and seed characteristics (buoyancy) on propagule dispersal patterns. Sensitivity analysis showed that smaller propagules, like the oval-shaped propagules of *Avicennia officinalis*, dispersed over larger distances and were most sensitive to changing values of retention by mangrove vegetation compared to larger, torpedo-shaped propagules of *Rhizophora* spp. and *C. tagal*. Directional propagule dispersal in this semi-enclosed lagoon with a small tidal range was strongly concentrated towards the edges of the lagoon and channels. Short distance dispersal appeared to be the main dispersal strategy for all four studied species, with most of the propagules being retained within the vegetation. Only a small proportion (max. 5%) of propagules left the lagoon through a channel connecting the lagoon with the open sea. Irrespective of the retention scheme, wind had a significant influence on dispersal distance and direction once propagules enter the lagoon or adjacent channels.

In view of a wider implication of mangrove restoration ecology, simulation of the removal of certain parts of outer dikes of abandoned shrimp farms to promote propagule inflow from adjacent mangroves and consequently allow for natural regeneration, revealed that the specific location (with respect to the vicinity of mangroves and independently suitable hydrodynamic flows) of dike removal significantly affected the resultant inflow of propagules and hence the potential effectiveness of natural regeneration.

Keywords

buoyancy, hydrodynamics, Chilaw Lagoon, Sri Lanka, regeneration