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Interactive comment on "Modelling drivers of mangrove propagule dispersal and restoration of abandoned shrimp farms" *by* D. Di Nitto et al.

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Anonymous Referee 1 Received and published: 4 February 2013

1) The concept of abandoned shrimp aquaculture ponds is appropriately reviewed with one exception. The authors should review and cite Lewis et al (2006) 5 Steps to Successful Ecological Mangrove Rehabilitation (EMR) (available for download at www.mangroverestoration.com download 38, see in particular pages 34-38) which describes the EMR approach to hydrologic rehabilitation of ponds through tidal prism analyses and connecting a number of ponds together to achieve the optimum tidal

prism to keep berm breaches open over time (strategic breaching).

Ecological Mangrove Rehabilitation (EMR):

We agree to incorporate reference to Lewis et al. (2006) within the manuscript, as suggested. In addition, we also include reference to Bosire et al. (2008), which further expands on the critical steps towards of successful Ecological Mangrove Rehabilitation (EMR) of Lewis et al. (2006). Key ingredients of EMR, including auto ecology, hydrology, disturbance, hydro rehab design and mangrove planting, are addressed in the introduction as follows:

'When considering the rehabilitation or restoration of disused shrimp farms back to a productive mangrove forest, is it important to first restore the normal tidal flooding regime that is typically blocked existing farm infrastructure. Secondly, the availability of propagules or seedlings from adjacent mangrove stands is crucial to assure natural regeneration within these ponds. Only when natural recovery is not initiated after investigating the latter potential stresses, should actual planting of propagules, collected seeds or cultivated seedlings occur (Lewis 1999; Stevenson et al. 1999; Lewis et al. 2006; Bosire et al. 2008). Furthermore, the understanding of mangrove auto ecology, more specifically the patterns of reproduction, propagule distribution and establishment, as well as the human-mangrove relationships, is vital within the design and implementation of any successful mangrove restoration project (Lewis and Marshall 1998; Lewis 1999; Stevenson et al. 1999; Bosire et al., 2008). In addition monitoring the success of restoration is an essential step in each restoration project in order to understand floristic succession, faunistic recruitment, environmental factors and so forth (Bosire et al., 2008).'

Additional references: Bosire, J.O., F. Dahdouh-Guebas, M. Walton, B.I. Crona, R.R. Lewis III, C. Field, J.G. Kairo N. Koedam, 2008. Functionality of restored mangroves: a review. Aquatic Botany 89(2): 251-259.

Lewis, RR, A Quarto, J Enright, E Corets, J Primavera, T Ravishankar, OD Stanley

and R Djamaluddin (eds). 2006. Five Steps to Successful Ecological Restoration of Mangroves. YARL and the Mangrove Action Project. Yogyakarta, Indonesia. 64 p.

Strategic breaching:

In line with recommendations made by Lewis et al. (2006) we simulated rehabilitating disused shrimp ponds in our model by the creation of a few “strategic breaches” in the dike walls. Limiting the number of breaches is considered critical as the tidal prism (the amount of water that can enter an opened pond between high and low tide) needs to be channelled through a few key openings to mimic the normal operation of tidal streams in mangroves. Fewer openings produce greater velocities as the flow is restricted, which in turn produces ’self-’scouring, keeping the man-made openings open and reducing the chances of siltation and closure (Lewis et al., 2006). Strategic breaching in this study has been restricted to locations in the outer dikes surrounding the individual shrimp ponds as (1) the objective was to investigate whether removal of certain parts of outer dikes can assure propagule inflow from adjacent mangroves and consequently secondary succession in the shrimp farm areas. More importantly we wanted to see which locations could assure the highest inflow of propagules. And, (2) a more detailed channelling throughout the individual shrimp ponds was not possible as the grid cells of these type of modelling allows for a certain detail in the bathymetry that is not finer that the model grid cells.

Some additional comments to emphasize the critical importance of tidal prism analysis and strategic breaching were added to the text in the conclusion section of our manuscript, as follows:

‘In addition to the selection of the most suitable locations to breach the outer dikes of abandoned shrimp pond areas, we emphasize the importance of the number of breaches (see Lewis et al., 2006). Limiting the number of breaches is considered critical as the tidal prism (the amount of water that can enter an opened pond between high and low tide) needs to be channelled through a few key openings to mimic the normal

operation of tidal streams in mangroves. Fewer openings produce greater velocities as the flow is restricted, which in turn produces ’self-’scouring, keeping the man-made openings open and reducing the chances of siltation and closure (Lewis et al., 2006).

2) One technical comment: Lewis (2005) is cited in the manuscript but the citation to the publication is not included in the literature cited section. The correct citation is Lewis, R.R. III. 2005. Ecological engineering for successful management and restoration of mangrove forests. Ecol. Eng. 24(4 SI): 403-418.

Full citation details of Lewis (2005) will be included in the ‘References’ section.

Interactive comment on Biogeosciences Discuss., 10, 1267, 2013.