Excluding random walks in the foraging behaviour of the Portunid crab *Thalamita crenata*: modelisation and simulation based on real data

U. Grüters[1]⋆, S. Cannicci[2], M. Vannini[2] & F. Dahdouh-Guebas[3,4]⋆

[1]Dresden University of Technology (TU Dresden), Institute of Forest Growth And Computer Sciences, Postfach 1117, D-01735 Tharandt, Germany. E-mail: Uwe.Grueters@forst.tu-dresden.de
[2]Dipartimento di Biologia Evoluzionistica, Università degli Studi di Firenze, Via Romana 17, I-50125 Firenze, Italia.
[3]Laboratory of Systems Ecology and Resource Management, Département de Biologie des Organismes, Faculté des Sciences, Université Libre de Bruxelles – ULB, Campus du Solbosch, CP 169, Avenue Franklin D. Roosevelt 50, B-1050 Bruxelles, Belgium. E-mail: fdahdouh@ulb.ac.be
[4]Laboratory of Plant Biology and Nature Management, Mangrove Management Group, Faculteit Wetenschappen, Vrije Universiteit Brussel, Pleinlaan 2, B-1050 Brussel, Belgium.
⋆Equal contribution

Abstract

Thalamita crenata is a portunid crab present in a wide range of mangrove swamps in the Indo- Pacific region. In Mida Creek (Kenya) it is living on the intertidal flat in front of the *Sonneratia alba* mangroves. *T. crenata* has a home range of approximately 5 m and is able to return to its home burrow based on visual cues and underwater landmark memory, as evidenced by previous studies. We analysed different paths walked by *T. crenata* and investigated distances, distance ratios and directions. This paper was not meant to confirm or reject the ability of *T. crenata* to home, but to exemplify how during previous research undertakings we were able to reject the hypothesis of the species' random walk behaviour by simulating the behaviour of "random crabs". To exclude random behaviour we programmed different model versions that resampled observed 'turning angles' $(0 – 23°)$ and 'flight lengths' $(0 – 69$ cm) *at random* (called semi-random) or that used the full ranges $(360°$ turning angles and up to flight lengths of 2 m). Observed angles and flight lengths relied on detailed *in situ* recordings of foraging behaviour of real crabs. Using traditional and circular statistics we provided evidence of significant differences between the real and the random crabs for the distance to the home burrow as a function of distance from an experimental release point resulting from a dislocation of 5 m, for the ratios of total distance covered over shortest straight distance (the 'straightness index'), and for the homeward components, which reflect clustering around a certain direction. The simulation program that we used was written in NetLogo and analysis performed using NetLogo's BehaviourSpace and R-extension.

Keywords
Portunidae, random walk, circular statistics, NetLogo, R-extension, Kenya