Painel

Oceanografia Biológica - Ecologia Geral

1.9.381 - SPATIAL DISTRIBUTION OF THE MANGROVE CRAB *Ucides cordatus* ALONG AN ESTUARINE GRADIENT: AN ANALYSIS AT THE LANDSCAPE CONTEXT

LUCIANA CAVALCANTI MAIA SANTOS, MARCELO ANTONIO AMARO PINHEIRO, NICHOLAS KRIEGLER, MARISA DANTAS BITENCOURT

Contato: LUCIANA CAVALCANTI MAIA SANTOS - SANTOS.LUCIANACM@GMAIL.COM

Keywords: Estuary, Ucides cordatus, GIS

INTRODUCION

Ucides cordatus (Linnaeus, 1763) is a mangrove endemic crab with a semi-terrestrial life and is distributed along the tropical and sub-tropical mangrove coasts of the eastern Americas from southern Florida to southern Brazil (MELO, 1996, PINHEIRO et al., 2016). *Ucides cordatus* is considered a key species of mangroves for its high biomass, its role in nutrient cycling and in the trophic structure of these ecosystems (KOCH & WOLFF, 2002; SCHORIES et al., 2003; NORDHAUS et al., 2006). In Brazil, due to its large size and tasty meat, *U. cordatus* has been extensively exploited (RODRIGUES et al., 2000) and holds a major socio-economic importance for artisanal fishery in estuarine systems (SANTOS et al., 2017).

Despite its importance, declines of *U. cordatus* have been reported in many regions of Brazil and were related to mangrove destruction, diseases and overfishing (BOEGER et al., 2005; DIELE et al., 2005). Therefore, since 2004 it has been included in the Brazilian National List of aquatic invertebrates species threatened with overexploitation and at risk of becoming extinct (PINHEIRO and RODRIGUES, 2011). In the end of 2014, *U. cordatus* was listed in the 'near threatened' (NT) category (PINHEIRO et al., 2016) and in 2015, it has been included in the National Conservation Action Plan of Endangered Species and of Socioeconomic Importance in Mangrove Ecosystems (BRASIL, 2015) as one of the nine species in the regional list of endangered species (SANTOS et al., 2016).

This context highlights the importance of studies in the landscape level about the spatial distribution of this species, information which can contribute to elaborate conservation and management strategies. Therefore, the present study aims to characterize the spatial distribution of the population structure of *Ucides cordatus* an estuarine mangrove landscape, and discuss the implications of the ecological pattern found for conservation of this species.

METHODS

The study area is part of the São Francisco River Basin, one of the most important Brazilian water resources, and is located in the coastal zone of the Sergipe State (Northeastern Brazil). The study area corresponds to the southern part of the São Francisco River Estuary (10º30'27"S, 36º23'45"W) and covers approximately 192.35 km², showing a mangrove extent of 31.9 km², and a coastline of 25 km extent (SANTOS et al., 2014).

In the present study we used a geographical database produced in our previous study (SANTOS et al., 2014), as base to produce the maps of *U. cordatus* spatial distribution. All the spatial analysis was carried out at the IDRISI geographical information system. The initial geodatabase for this was a land use and cover map of the study area produced based on visual and supervised classification of satellite images (SANTOS et al., 2014). In this map, we applied a Boolean analysis (reclassification in two class wherein for the class of interest was attributed the value 1, and all other classes were grouped in one single class with the value 0) to produced a map of the mangrove areas.

To produce the spatial distribution maps of *U. cordatus* population structure, the map of the mangrove areas was submitted to a group analysis and reclassification, and six areas of mangrove were discriminated. The group analyses identify contiguous groups of pixels in an image, thus delimiting areas and bounders with geographic similarity (ESATMAN, 2012). A field work was carried out wherein these six mangrove areas were sampled in order to collect the crab population parameters as diameter of the crab burrow entrances and number of burrows (SANTOS et al., 2016). The number of burrows was used to estimate the crab density (number of burrow/m²), and the diameter of the burrow entrance used as a proxy crab size (e.g. WUNDERLICH et al. 2008). These data were statistically analyzed in Graph Pad Prism and the final parameters of the crab population structure were determined: mean crab size, frequency and density of crabs in commercial and non-commercial sizes. These parameters were spatialized matching the six areas of mangrove where they were collected, by a reclassification function in IDRISI and thus producing the maps of

spatial distribution of *U. cordatus* in the mangrove estuarine gradient habitats.

RESULTS AND DISCUSSION

The spatial distribution of *U. cordatus* population structure showed a different pattern along the 25 km extent of the estuarine gradient, from the São Francisco River mouth (initial part of the estuary: 0 km) to the farthest mangrove area from this mouth (final part of the estuary: 25 km). For example, *U. cordatus* mean size increase with the distance from the river mouth. Therefore, biggest crabs (mean burrow size ≥ 56.33 mm) are distributed in mangrove areas from the intermediate to final portion of the estuary (from 8.5 to 25 km estuarine gradient).

The highest crab size (mean burrow size = 64.06 mm) was found about 19 km from the river mouth in the farthest mangrove forest. An opposite pattern was found for *U. cordatus* density which decreases with the distance from the river mouth. As a result, higher crab densities (≥ 1.09 burrow/m^2) are distributed in mangrove areas at the initial portion of the estuarine gradient. The highest crab density (1.73 burrow/m^2) was found about 4.9 km from the river mouth.

The spatial distribution of *U. cordatus* fishery parameters followed the pattern described above. Therefore, the density and frequency of non-commercial sized crabs (burrow size diameter < 51 mm, Santos et al., 2016) increased in direction to the mangroves locate near to the river mouth, where the smallest crabs are distributed. Thus, the highest density (0.53 burrow/m^2) and frequency (47.5%) of non-commercial sized crabs were found in the mangrove areas from 2.5 km from the river mouth. By the contrary, the density and frequency of crabs in commercial size (burrow size diameter ≥ 51 mm) increase in the opposite direction (from the final of the estuary to the mouth). Consequently, higher densities and frequency of commercial sized crabs are distributed far from the estuary mouth, from intermediate to the final portion of the estuary, where the biggest crabs are more found. This different spatial patter has impact in conservation strategies, which should focus in mangrove areas near to the estuary mouth, in order to protect populations of juvenile crabs. In this study, we found a threshold distance of 8.5 from the river mouth in which should be prioritized protecting management efforts against fishery activity.

In summary, our results indicated that bigger crabs at lower densities are distributed in mangrove areas at the intermediate and final portion of the estuary (higher salinities) while smaller crabs at high density are distributed in mangrove areas near to the estuary mouth (lower salinities). Apart form the differences in the salinity found in the estuarine gradient, we found differences in the mangrove vegetation composition. In the intermediate and final portion of the estuary are composed by mono-specific or dominated mangrove forest of *Rhizophora mangle* while in the initial part of the estuary besides the occurrence of *R. mangle*, there are also the occurrence of *Laguncularia racemosa*, associated with *Acrostichum aureum* L. Therefore, differences in the spatial distribution of *U. cordatus* along the estuarine gradient can be correlated to differences in vegetation composition, as found by Wunderlich et al. (2008, Piou et al. (2009) and Gomes et al. (2013). According to Gomes et al. (2013) some mangrove crab characteristics, such as abundance and weight/size, can be significantly correlated with vegetation type.

CONCLUSION

We conclude that *U. cordatus* shows different spatial distribution patter along the São Francisco River estuarine gradient, which is highly affected by the distance from the river mouth and the mangrove vegetation composition. A positive relationship was found between the distance of the river mouth and the crab density. By contrast, a negative relationship was found between the distance of the river mouth and the crab size. These patterns generates different spatial distribution on *U. cordatus* fishery parameters, wherein high densities and frequencies of non-commercial sized crabs are distributed in mangrove near to the river mouth, where conservations strategies should be focused to protected the juvenile stocks against the fishery activity.

REFERENCES

BOEGER, W.A.; PIE, M.R.; OSTRENSKY, A.; PATELLA, L. 2005. Lethargic crab disease: multidisciplinary evidence supports a mycotic etiology. Memórias do Instituto Oswaldo Cruz, 100:161-167.

BRASIL (2015) Ministério do Meio Ambiente. Portaria n8 9/2015. Aprova o Plano de Ação Nacional para Conservação das Espécies Ameaçadas e de Importância Socioeconômica do Ecossistema Manguezal – PAN Manguezal. Diário Oficial da União 21, 140–141.

DIELE, K.; KOCH, V.; SAINT-PAUL, U. 2005. Population structure, catch composition and CPUE of the artisanally harvested mangrove crab *Ucides cordatus* (Ocypodidae) in the Caeté estuary, North Brazil: Indications for overfishing? Aquat. Living Resour. 18, 169-178.

EASTMAN, J. R. 2012a. IDRISI Selva Manual. Worcester: Clark University, 324p.

GOMES, J.D.; ABRUNHOSA, A.; SIMITH, D.J.B. ASP, N.E. 2013. Mangrove sedimentary characteristics and implications for crab *Ucides cordatus* (Crustacea, Decapoda, Ucididae) distribution in an estuarine area of the Amazonian region. Acta Amazonica 43(4): 481 - 489.

KOCH, V.; WOLFF, V. M. 2002. Energy budget and ecological role of mangrove epibenthos in the

Caeté estuary, North Brazil. Mar Ecol Prog Ser 228:119–130.

MELO, G.A.S. 1996. Manual de identificação dos Brachyura (caranguejos e siris) do litoral brasileiro. São Paulo, Ed. Plêiade/FAPESP, 604p.

NORDHAUS, I., WOLFF, M., DIELE, K., 2006. Litter processing and population food intake of the mangrove crab *Ucides cordatus* in a high intertidal forest in northern Brazil. Estuar. Coast. Shelf Sci. 67, 239–250.

PINHEIRO, M.A.A. and RODRIGUES, A.M.T., 2011. Crustáceos sobre-explotados e o Plano Nacional de Gestão dos caranguejos uçá (*Ucides cordatus*), guaiamú (*Cardisoma guanhumi*) e do siri-azul (*Callinectes sapidus*): uma estratégia para evitar que passem ao "status" de ameaçados de extinção. Revista CEPSUL - Biodiversidade e Conservação Marinha, 2, 50-57.

PINHEIRO, M.A.A.; SANTOS, L.C.M.; SOUZA, C.A.; JOÃO, M.C.A.; DIAS-NETO, J. & IVO, C.T.C. 2016. Avaliação do Caranguejo-uçá, *Ucides cordatus* (Linnaeus, 1763) (Decapoda: Ucididae). Cap. 33: p. 441-458. In: Pinheiro, M. & Boos, H. (Org.). Livro Vermelho dos Crustáceos do Brasil: Avaliação 2010-2014. Porto Alegre, RS, Sociedade Brasileira de Carcinologia - SBC, 466 p.

PIOU, C., BERGER, U., FELLER, I.C., 2009. Spatial structure of a leaf-removing crab population in a mangrove of North-Brazil. Wetlands Ecol. Manag. 17, 93–106.

RODRIGUES, A.M.T.; BRANCO, E.J.; SACCARDO, A.S.; BLANKENSTEYN, A. 2000. A explotação do caranguejo *Ucides cordatus* (Decapoda: Ocypodidae) e o processo de gestão participativa para normatização da atividade na região Sudeste- Sul do Brasil. Boletim do Instituto de Pesca 26(1):63-78.

SANTOS, L.C.M.; GASALLA, M.A.; DADOUH-GUEBAS, F.; BITENCOURT, M.D. 2017. Socioecological assessment for environmental planning in coastal fishery areas: A case study in Brazilian mangroves. Ocean & Coastal Management, 138, 60-69.

SANTOS, L.C.M.; MATOS, H.R.; SCHAEFFER-NOVELLI, Y.; CUNHA-LIGNON, M.; BITENCOURT, M.D.; KOEDAM, N.; DAHDOUH-GUEBAS. F. 2014. Anthropogenic activities on mangrove areas (São Francisco River Estuary, Brazil Northeast): a GIS-based analysis of CBERS and SPOT images to aid in local management. Ocean & Coastal Management 89: 39-50.

SANTOS, L.C.M.; PINHEIRO, M.A.A.; DADOUH-GUEBAS, F., BITENCOURT, M.D. 2016. Population status and fishery potential of the mangrove crab, *Ucides cordatus* (Linnaeus, 1763) in Northeastern Brazil. Journal of the Marine Biological Association of the United Kingdom: 1-11. DOI: https://doi.org/10.1017/S0025315416001259.

SCHORIES, D., BARLETTA-BERGAN, A., BARLETTA, M., KRUMME, U., MEHLIG, U., RADEMAKER, V., 2003. The keystone role of leaf-removing crabs in mangrove forests of North Brazil. Wetlands Ecol. Manag. 11, 243–255.

WUNDERLICH, A.C.; PINHEIRO, M.A.A.; RODRIGUES, A.M.T. 2008. Biologia do caranguejo-uçá, *Ucides cordatus* (Crustacea: Decapoda: Brachyura), na Baía da Babitonga, Santa Catarina, Brasil. Revista Brasileira de Zoologia 25 (2): 188–198.

SPONSORS

FAPESP (process number 2010/20028-9)