GENESIS OF ISLETS IN BIZERTE LAGOON: SETTLEMENT OF PIONEER SPECIES

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ABSTRACT

This work aims to provide preliminary results on the formation of a new ecosystem incorporating a sebkha and sand islets (lido) along the shores of Bizerte Lagoon (North-eastern Tunisia). This neo-ecosystem is the result of hydrodynamic and geomorphological modification of the lagoon coastline in its north-eastern part near Menzel Jemil city. This last modification on the lagoon coast confirms the increasing anthropogenic activities, especially with the enlargement of the industrial zone in the area. This latter factor, coupled with the modification of the main river that feeds the lagoon (Oued Jedera river), have a direct consequence on the modification of the coastal drift (in terms of direction, amplitude and periodicity) in the north-eastern part of the lagoon, which resulted in the formation of littoral cords parallel to the lagoon shore. This new formation of a "lagoonar islet" has resulted into a whole coastal ecosystem, always dynamic and still in formation. This has allowed the settlement of new submarine biodiversity, and a noticeable terrestrial biodiversity of both flora and fauna. Among this, ornithological diversity was prominent. Thus, this work proposes to follow the genesis of this biodiversity new area, parallel to the process of the ecosystem dynamics in progress. Indeed, the consecutive two years of monitoring on fauna and flora, particularly the pioneer species dwelling on it, pointed out the regular presence of 17 bird species, among which *Sternula albifrons*. This bird species is using the islet as a nesting site. Studies are already underway to confirm the nesting of some others among these avifauna species. The preliminary list of plant species dwelling on the islet extends to 18 species. Among these species, five Chenopodiaceae, five Asteraceae, two Brassicaceae, two Fabaceae, two Poaceae, one Caryophyllaceae (*Rhodalsine geniculata*) and one Juncaceae (*Juncus maritimus*). The thanatocenosis seen on the sandy coast shows a large presence of *Tellina planata*, *Ruditapes decussatus*, *Pinna nobilis* and the invasive species *Pinctada radiata*, which biomass became increasingly important in the Bizerte Lagoon.

***Keywords*:** Bizerte Lagoon, biodiversity, birds, lagoonar islet, fauna, flora

INTRODUCTION

Studies on transitional coastal ecosystems are important to understand eco-biological functioning and eco-trophical positioning of species (GRIFFITHS *et al.* 2017). Responses from such studies can provide valuable tools to help the conservation of biodiversity and management of theses ecosystems (MEA, 2005; FAO, 2017). In fact, studies relevant to transitional ecosystems allow us to anticipate the anthropogenic impacts coming from the mainland to the lagoon and marine coastal ecosystems (MEA, 2005). This work aims to give preliminary results on the new formation of lagoonar ecosystem incorporating a sebkha and sand islets (lido) inside and along the shores of Bizerte Lagoon. It will help to better understand the chronology and process of the settling of pioneer species (fauna and flora). It will also suggest the links between these species and different human activities in order to better conserve biodiversity. Additionally, we can study some ecological processes such as natural selection, links and dynamic between preys and predators. In fact, in many ecosystems, natural selection can occur quickly enough to influence the population dynamics and thus future selection (GRIFFITHS *et al.* 2017). Such type of studies give us also the possibility to evaluate the classical population dynamics models as the eco-evolutionary processes (GILPIN et FELDMAN, 2017).

MATERIALS AND METHODS

The ecological evaluation was performed for the vegetation cover, birds and littoral biodiversity including insects, mainly over two years: 2016 and 2017; except for the vegetation cover which was monitored since 2010, in the early stages of the genesis of the islets. The bird identification was made during winter and summer seasons, focusing on the nesting species: *Charadrius alexandrinus*, *Glareola*

pratincola and mostly *Sternula albifrons* (MULLAMEY *et al.* 2000).

The field work to locate the nesting colonies of birds was based on nests positioning (using a GPS coordinates), eggs counting and morpho-anatomical measurements (length, width and weight) of eggs and chicks. Maps of the vegetation cover were also produced according to the chronological evolution of the islet during the period from 2010 to 2016. This last year is referred to as the present eco-physical situation of the study site (see maps, Fig. 1). Pitfalls were also used to collect and sample insect fauna. These samples were then sent to the lab for taxonomy.

The birds' nests distribution was geo-referenced and a map of nests distribution was produced for the entire surface of the islet (see map, Fig. 2). Finally, nests, vegetal cover, sebkhas and sandy parts were mapped to correlate the presence of colonies with the different ecosystems of the islet (plants, sand, sebkhas, etc.). The botanical survey resulted to a preliminary inventory of plant species. The identification was made by a botanical expert from the MAN association.

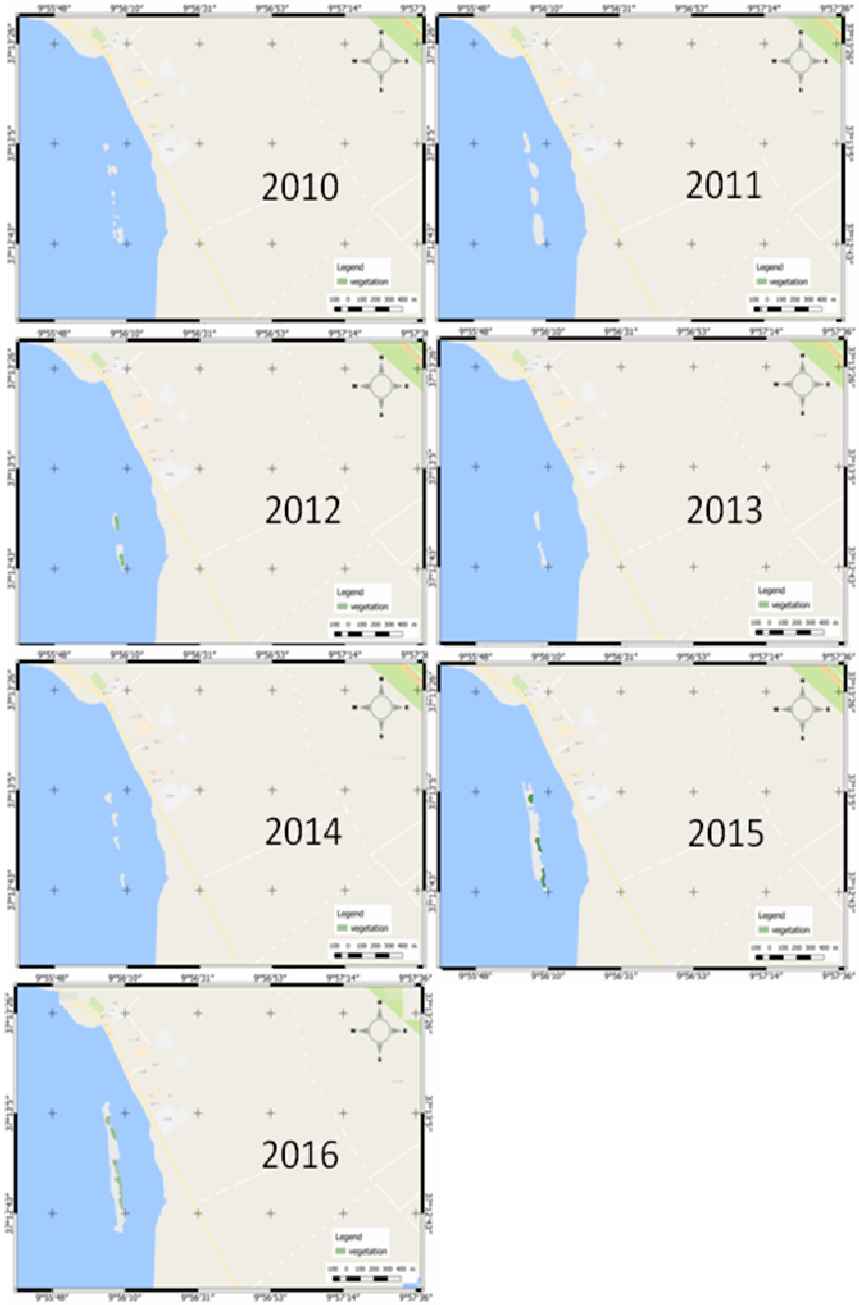

Fig. 1: Evolution of the geomorphology and vegetation cover on the islet(s) of Bizerte Lagoon from 2010 to 2016

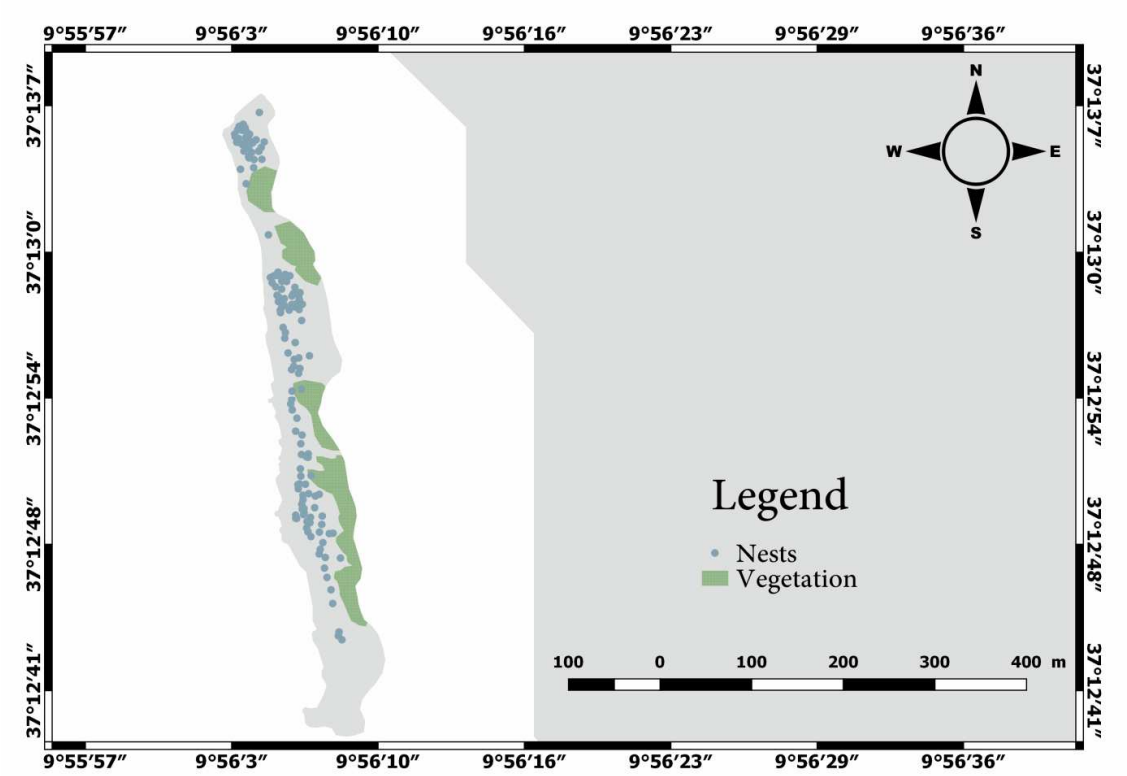

Fig. 2: Birds' nests on the islet of Bizerte Lagoon in June 2017; the nests were for three species: *Charadrius alexandrinus*, *Glareola pratincola* and *Sternula albifrons*. Most nests were for the latter species.

RESULTS AND DISCUSSION

The last two years (2016 and 2017) of monitoring of both fauna and flora confirmed a remarkable biodiversity in the site. The rapid transformation of the ecosystem will require a regular and continuous temporal and spatial monitoring. Among the species observed on the site, we noted 17 bird species: *Ardea cinerea*, *Bubulcus ibis*, *Burhinus oedicnemus*, *Charadrius alexandrinus*, *Chroicocephalus genei*, *Chroicocephalus ridibundus*, *Circus aeruginosus*, *Egretta garzetta*, *Glareola pratincola*, *Hydroprogne caspia*, *Limosa lapponica*, *Phalacrocorax aristotelis*, *Phoenicopterus roseus*, *Pluvialis fulva*, *Podiceps cristatus*, *Sternula albifrons* and *Tringa ochropus*; among them three are nesting: *Charadrius alexandrinus*, *Glareola pratincola* and *Sternula albifrons* (MULLAMEY *et al.* 2000).

The preliminary inventory of plant species includes 18 species: *Atriplex portulacoides*, *Cakile maritima*, *Carduus* sp., *Cotula coronopifolia*, *Glebionis coronaria*, *Juncus maritimus*, *Lagurus ovatus*, *Matthiola* sp., *Medicago littoralis*, *Melilotus* sp., *Polypogon maritimus*, *Rhodalsine geniculata*, *Salicornia ramosissima*, *Salsola kali*, *Salsola* sp., *Sarcocornia fruticosa*, *Sonchus oleraceus* and *Symphyotrichum squamatum* (POTTIER-ALAPETITE, 1979; POTTIER-ALAPETITE, 1981; BURNIE, 2005). The specific richness of faunal and floral species was noticeable. Among these species, some were patrimonial (mainly plants) and others were listed in the IUCN Red List: the Little Tern (*Sternula albifrons*) and the Kentish Plover (*Charadrius alexandrines*) are also listed in Annex II "List of Endangered or Threatened Species" to the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (UNEP/MAP, 1995) of the Barcelona Convention. On the other hand, some marine species were exotic and present invasive tendency; Among these: the Chlorophyta *Caulerpa racemosa* and *Caulerpa prolifera;* and the Bivalvia *Pinctada radiata* (WoRMS, 2015; GISD, 2016). These species were considerably abundant in the aquatic environment around the islets.

We propose that an ecological monitoring programme of the site is established to observe the ecosystem evolution. Other kinds of studies such as functional ecology, structure and functioning of trophic webs or genetics could be developed as well. Among the biodiversity aspect, birds were significant; settlement of patrimonial and protected species such as *Sternula albifrons* gives us a further argument to monitor the site closely. Thus, this species will be monitored through an ecological follow-up within the framework of the MAN NGO activities. Seasonal variations in individuals counting, evolution of the nesting colony, and bird tagging (ringing) will be among the main activities for the following

reproduction seasons (starting from the month of April/May).

CONCLUSION

The new islets and sebkha of Bizerte Lagoon as a neogenesis ecosystem was the result of transformation on the coastal drift of sediment. The new ecosystem was characterized as higher dynamic and evolutionary. Study of these ecosystems allow for understanding the settlement of pioneer fauna and flora species. Thus, provide better understanding of the species role in the ecosystem. Holistically, these species can be considered as tools to monitor the ecosystems and eventually better conserve biodiversity.

Acknowledgements

We thank the Specially Protected Areas Regional Activity Centre (SPA/RAC) for supporting Méditerranée Action-Nature association (MAN, NGO) during all the steps of this work.

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