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Spatio-temporal variability of faunal and floral assemblages in Mediterranean temporary wetlands

Variabilité spatio-temporelle des assemblages faunistiques et floristiques des zones humides temporaires méditerranéennes

Maya Rouissi [a,b,c], Dani Boix [d], Serge D. Muller [e], Stéphanie Gascón [d], Albert Ruhí [d], Jordi Sala [d], Ali Bouattour [f], Imtinen Ben Haj Jilani [b,g], Zeineb Ghrabi-Gammar [b,h], Samia Ben Saad-Limam [a,b], Amina Daoud-Bouattour [a,b,*]

[a] *Département de biologie, faculté des sciences de Tunis, université de Tunis El-Manar, 2092 Tunis, Tunisia*
[b] *UR99/UR/02-04 biogéographie, climatologie appliquée et dynamique érosive, faculté des lettres, des arts et des humanités de Manouba, université de la Manouba, 2010 Manouba, Tunisia*
[c] *Faculté des sciences de Bizerte, université de Carthage, 7021 Bizerte, Tunisia*
[d] *Institut d'Ecologia Aquàtica, Universitat de Girona, campus Montilivi, 17071 Girona, Spain*
[e] *Institut des sciences de l'évolution de Montpellier (ISE-M), université Montpellier-2/CNRS, case 061, 34095 Montpellier cedex 05, France*
[f] *Service d'entomologie médicale, institut Pasteur, laboratoire d'épidémiologie et de microbiologie vétérinaire, université de Tunis El Manar, BP n° 74, 1002 Belvédère, Tunis, Tunisia*
[g] *Institut supérieur des études préparatoires en biologie et géologie de la Soukra (ISEPBG) Choutrana II, université de Carthage, 2036 Soukra, Tunisia*
[h] *Institut national agronomique de Tunisie, université de Carthage, 43, avenue Charles-Nicolle, 1082 Cité Mahrajène, Tunis, Tunisia*

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ABSTRACT

Six temporary wetlands in the region of Sejenane (Mogods, NW Tunisia) were studied in order to characterize the aquatic flora and fauna and to quantify their spatio-temporal variability. Samplings of aquatic fauna, phytosociological relevés, and measurements of the physicochemical parameters of water were taken during four different field visits carried out during the four seasons of the year (November 2009–July 2010). Despite the strong anthropic pressures on them, these temporary wetlands are home to rich and diversified biodiversity, including rare and endangered species. Spatial and temporal variations affect fauna and flora differently, as temporal variability influences the fauna rather more than the plants, which are relatively more dependent on spatial factors. These results demonstrate the interest of small water bodies for maintaining biodiversity at the regional level, and thus underscore the conservation issues of Mediterranean temporary wetlands that are declining on an ongoing basis currently.

* Corresponding author.
E-mail address: daoudamina200@yahoo.fr (A. Daoud-Bouattour).

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RÉSUMÉ

Six zones humides temporaires de la région de Sejenane (Mogods, Tunisie du Nord-Ouest) ont été étudiées afin de caractériser leur faune et leur flore aquatiques, et de quantifier leur variabilité spatio-temporelle. Des échantillonnages de la faune aquatique, des relevés phytosociologiques, et des mesures de paramètres physicochimiques de l'eau ont été réalisés au cours des quatre saisons (novembre 2009–juillet 2010). Malgré la forte pression anthropique qui les affecte, ces milieux humides temporaires hébergent une biodiversité riche et diversifiée, avec des espèces rares et menacées. Les variations spatio-temporelles peuvent affecter différemment la faune et la flore, la faune étant relativement plus influencée par la variabilité saisonnière, alors que les plantes sont davantage dépendantes des facteurs spatiaux. Ces résultats révèlent l'intérêt des petits plans d'eau pour le maintien de la biodiversité à l'échelle régionale, et soulignent ainsi les enjeux de conservation des zones humides temporaires méditerranéennes, aujourd'hui en déclin continu.

1. Introduction

Mediterranean temporary wetlands are characterized by alternating phases of flooding and drying and by a very self-contained hydrology [1]. Their roles are important with respect to the landscape in terms of flood control, renewal of groundwater, retention of toxic products, and the recycling of nutrients [2,3]. They also provide various resources to the human population, including water availability, storage for grazing and agriculture, or harvesting of medicinal plants [4,5]. Last but not least, they host many rare and endangered taxa, even supporting species and communities that are not found in other water bodies [6]. These habitats there benefit from conservation policies in most European Mediterranean countries [7,8]. At the same time, the ecological relevance of these wetlands contrasts with the decline of Mediterranean temporary wetlands during the last decades, particularly in North Africa where the decline has been severe [9–13]. The temporary hydrology and reduced size of these ecosystems make them highly vulnerable to anthropogenic impacts and pressures from both agricultural practices and urban growth [1,3,4,14–16]. It is thus extremely timely to identify those factors controlling biodiversity in Mediterranean temporary wetlands and also the ultimate cross-taxon congruence patterns that could help determine priorities for their preservation.

The tremendous biodiversity found in wetlands has been attributed to their high spatio-temporal variability [17–19]. Changes in such environmental conditions as the duration of flooding, water depth [6,13,20–22] and surface area [8,23,24] are known to affect both faunal and floral assemblages [25–29]. These environmental characteristics may all vary in any given wetland during the hydroperiod and across wetlands, making it difficult to distinguish between the effects of spatial and of temporal variability. Moreover, none of the studies referred to have considered both flora and fauna at the same time. Only recently have some studies on Mediterranean temporary wetlands begun to consider both faunal and floral assemblages by means of cross-taxon congruence approaches (e.g., [27–31]). The scarcity of available information to date suggests that flora is relatively more determined by spatial variables, whereas faunal groups are probably more closely linked to temporal variability [19–30]. Nevertheless, there are overriding factors that determine biodiversity in local assemblages in some cases such as the size of the ecosystem: it is hypothesized that larger wetlands support more species than smaller ones regardless of the taxonomic group. Yet when tested in temporary habitats (e.g., [23,32,33]), this idea (see Theory of Island Biogeography [31]) has yielded contradictory outputs. The climate in which a wetland is located can be another overarching factor, since this large-scale environmental filter can disrupt the cross-taxon congruence relationships in small areas within a regional scale [34,35]. Overall, to improve the management and conservation strategies for these habitats, it is crucial to further identify the variability (spatial *vs.* temporal) affecting faunal and floral assemblages of Mediterranean temporary wetlands, and to identify the species-area and/or cross-taxon congruence relationships that may hold across larger scales.

Many temporary wetlands are located in Tunisia, essentially in the northern part of the country [36]. Scientific studies have focused to date on the great wetland complexes such as the Ichkeul National Park (e.g., [37–41]) and have more or less ignored the northern temporary Tunisian wetlands, with the exception of some late 19th century studies [42] and others carried out between 1930 and 1960 [43–46]. Since that time, no further research on Tunisian temporary wetlands has been undertaken until the appearance of several studies, which have focused primarily on vegetation (e.g., [36,47–54]), Crustaceans (e.g., [55,56]) and on amphibians (e.g., [57–60]). The present paper presents the first study integrating both aquatic faunal (amphibians and macroinvertebrates) and floral assemblages in North African temporary wetlands.

Our overarching aim was to characterize flora and fauna of six temporary wetlands in the Sejenane region of northern Tunisia and to quantify their spatio-temporal variability. As found in previous cross-taxon congruence studies in other Mediterranean climate areas, we predicted that: