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Abstract

This study aimed to assess floristic diversity and vegetation structure in the riparian ecosystem of Oued El Kharouaa, located in the Sétif region of northeastern Algeria. This semi-arid riparian ecosystem plays an important role in riverbank stabilization, biodiversity conservation, and ecological connectivity. Field surveys were conducted between August and December 2025 across six sampling stations distributed along the longitudinal gradient of the wadi using a stratified random sampling design, with a total of 60 plots established to investigate tree, shrub, and herbaceous vegetation layers. The floristic inventory recorded 41 plant species belonging to 23 families, with Asteraceae representing the dominant family. Biological and chorological analyses revealed the predominance of therophytes and hemicryptophytes, reflecting adaptation to Mediterranean climatic conditions and anthropogenic disturbance. Floristic diversity, assessed using Shannon and Simpson indices, showed marked spatial variation among stations and vegetation strata, with the herbaceous layer exhibiting the highest diversity values, whereas shrub communities displayed lower diversity and stronger species dominance. Among woody species, ***Populus alba*** was identified as the most frequent tree species within the study area. Vegetation structure was evaluated using dendrometric parameters and the diameter-to-height (D/H) ratio, and statistical analysis revealed highly significant differences among woody species (ANOVA, $\mathbf{p} < 0.0001$), indicating distinct structural strategies. ***Tamarix*** exhibited the highest D/H ratio, suggesting a particular adaptation to riparian environmental conditions. The observed structural patterns were influenced by hydrological conditions as well as anthropogenic pressures, including agriculture, livestock grazing, and waste deposition. Overall, the results highlight the ecological importance of Oued El Kharouaa and emphasize the need for conservation and sustainable management strategies to preserve this vulnerable riparian ecosystem.

Keywords: Riparian ecosystem, Floristic diversity, Vegetation structure, D/H ratio, Shannon index, Semi-arid environment, Algeria.

Résumé

Cette étude a pour objectif d'évaluer la diversité floristique et la structure de la végétation de l'écosystème riparien de l'Oued El Kharouaa, situé dans la région de Sétif au nord-est de l'Algérie. Cet écosystème riparien semi-aride joue un rôle essentiel dans la stabilisation des berges, la conservation de la biodiversité et la connectivité écologique. Les prospections de terrain ont été réalisées entre août et décembre 2025 au niveau de six stations d'échantillonnage réparties le long du gradient longitudinal de l'oued, selon un plan d'échantillonnage aléatoire stratifié comprenant un total de 60 placettes couvrant les strates arborée, arbustive et herbacée. L'inventaire floristique a permis de recenser 41 espèces végétales appartenant à 23 familles, dont les Asteraceae constituent la famille dominante. Les analyses biologique et chorologique ont révélé une prédominance des thérophytes et des hémicryptophytes, traduisant une adaptation aux conditions climatiques méditerranéennes ainsi qu'aux perturbations d'origine anthropique. La diversité floristique, évaluée à l'aide des indices de Shannon et de Simpson, a montré une variabilité spatiale marquée entre les stations et les différentes strates de végétation. La strate herbacée a présenté les valeurs de diversité les plus élevées, tandis que la strate arbustive s'est caractérisée par une diversité plus faible et une dominance spécifique plus prononcée. Parmi les espèces ligneuses, ***Populus alba*** a été identifiée comme l'espèce arborée la plus fréquente dans la zone d'étude. La structure de la végétation a été évaluée à partir des paramètres dendrométriques et du rapport diamètre/hauteur (D/H). L'analyse statistique a mis en évidence des différences hautement significatives entre les espèces ligneuses (ANOVA, $\mathbf{p} < 0{,}0001$), révélant des stratégies structurales distinctes. ***Tamarix*** a présenté le rapport D/H le plus élevé, suggérant une adaptation particulière aux conditions environnementales ripariennes. Les structures observées sont influencées à la fois par les conditions hydrologiques et par les pressions anthropiques, notamment l'agriculture, le pâturage du bétail et l'accumulation des déchets. Dans l'ensemble, les résultats soulignent l'importance écologique de l'Oued El Kharouaa et mettent en évidence la nécessité de mettre en œuvre des stratégies de conservation et de gestion durable afin de préserver cet écosystème riparien vulnérable.

Mots-clés : écosystème riparien, Diversité floristique, Structure de la végétation, Rapport D/H, Indice de Shannon, Environnement semi-aride, Algérie.

الملخص

تهدف هذه الدراسة إلى تقييم التنوع النباتي وبنية الغطاء النباتي في النظام البيئي النهري لوادي الخروعة الواقع بولاية سطيف في شمال شرق الجزائر. ويؤدي هذا النظام البيئي شبه الجاف دورًا مهمًا في تثبيت ضفاف الوادي، والمحافظة على التنوع البيولوجي، وتعزيز الترابط البيئي. أُنجزت الأعمال الميدانية خلال الفترة الممتدة من شهر أوت إلى شهر ديسمبر 2025 على مستوى ست محطات موزعة على طول الوادي وفق تصميم عشوائي طبقي، حيث تم إنجاز 60 مربعًا نباتيًا شملت الطبقات الشجرية والشجيرية والعشبية. أسفر الجرد النباتي عن تسجيل 41 نوعًا نباتيًا تنتمي إلى 23 عائلة نباتية، الأكثر تمثيلًا. كما أظهرت التحاليل البيولوجية والكورولوجية سيادة النباتات (Asteraceae) وكانت عائلة المركبات ، مما يعكس تكيفها مع الظروف المناخية المتوسطية (Hemicryptophytes) ونصف الخفية (Therophytes) الحولية والضغوط البشرية. وقد بيّنت دراسة التنوع النباتي باستخدام مؤشري شانون وسيمبسون وجود تباين واضح بين المحطات والطبقات النباتية المختلفة، حيث سجلت الطبقة العشبية أعلى قيم التنوع، في حين أظهرت الطبقة الشجيرية تنوعًا أقل هو أكثر الأنواع ***(Populus alba)*** وهيمنة أكبر لبعض الأنواع. ومن بين الأنواع الخشبية، تبيّن أن **الحور الأبيض** الشجرية تكرارًا في منطقة الدراسة. كما تم تقييم بنية الغطاء النباتي بالاعتماد على المعايير الدندرومترية ونسبة القطر إلى **p <**، ANOVA) ، وأظهرت التحاليل الإحصائية وجود فروق معنوية عالية بين الأنواع الخشبية(D/H) الارتفاع ، وهو ما D/H أعلى قيمة لنسبة ***(Tamarix)*** مما يدل على اختلاف استراتيجياتها البنيوية. وسجل جنس **الأثل** (**0.0001** يشير إلى تكيف خاص مع الظروف البيئية السائدة في الأوساط النهرية. وقد تأثرت البنية النباتية بالظروف الهيدرولوجية من جهة، وبالضغوط البشرية من جهة أخرى، والمتمثلة أساسًا في النشاطات الزراعية والرعي وتراكم النفايات. وتؤكد النتائج المتحصل عليها الأهمية البيئية لوادي الخروعة، كما تبرز ضرورة تبني إجراءات للحفاظ عليه وتسييره بشكل .مستدام من أجل حماية هذا النظام البيئي النهري الهش

الكلمات المفتاحية: النظام البيئي النهري، التنوع النباتي، بنية الغطاء النباتي، نسبة القطر إلى الارتفاع (D/H)، مؤشر شانون، البيئة شبه الجافة، الجزائر.

INTRODUCTION

Introduction

Riparian zones are the interface between aquatic and terrestrial systems along inland watercourses. They have a disproportionate ecological role in the landscape considering their narrow extent, which makes them a good example of small natural features (sensu Hunter, 2017). Watercourse riparian zones, or riparian forests, are hotspots of biodiversity and constitute corridors for migratory species (Décamps, 2003). They play a major role in regulating the dynamics of biological diversity (Décamps & Décamps, 2002). In fluvial landscapes, riparian ecosystems occupy a small proportion of the territory, but they harbor more biodiversity than adjacent terrestrial ecosystems (Naiman et al., 1993; Naiman & Décamps, 1997). Their interface position gives them particular ecological characteristics, including elasticity, permeability, biodiversity, and habitat connectivity (Piégay, 1994).

Despite their ecological importance, riparian zones are increasingly threatened by human activities such as land-use change, agriculture, and urbanization. These pressures lead to habitat fragmentation, biodiversity loss, and degradation of ecosystem functions. Preserving biodiversity in these areas has therefore become a critical challenge for maintaining ecological processes and the ecosystem services they provide (Hunter et al., 2017). Understanding the composition, density, and structural characteristics of riparian vegetation is essential for evaluating the ecological condition, resilience, and conservation status of these fragile ecosystems (Mueller-Dombois & Ellenberg, 1974; Kent & Coker, 1992).

Riparian zones in Algeria represent some of the most important ecosystems because they support biological diversity and maintain essential ecological functions (Benkelfat et al., 2020). They occur across diverse landscapes and are characterized by high species richness (Benkelfat et al., 2020). Algerian riparian ecosystems play an important role in the conservation of flora and fauna and contribute to maintaining ecological processes that support natural habitats and surrounding communities.

The study area corresponds to the watershed of Oued El Kharoua, situated in northeastern Algeria within the Sétif region on the High Setifian Plains of the Tell Atlas. It is characterized by a continental Mediterranean semi-arid climate, with cold winters and hot, dry summers. This climatic context influences vegetation dynamics by affecting plant distribution, growth, and community organization. In semi-arid environments, variations in environmental

conditions strongly influence plant community composition, species abundance, and vegetation structure (Whittaker, 1975; Grime, 1977). Along Oued El Kharoua, the specific environmental conditions of riparian habitats allow the development of particular plant communities compared with surrounding terrestrial ecosystems. However, variations in environmental conditions and anthropogenic disturbances may influence plant species composition, abundance, density, and structural organization (Naiman & Décamps, 1997; Lite et al., 2005).

The riparian ecosystem of Oued El Kharoua represents an important habitat within the semi-arid landscape of the Sétif region. However, these ecosystems remain sensitive to environmental changes and human pressures, which can modify the organization and diversity of plant communities. The study of floristic composition, vegetation density, and structural characteristics provides valuable information for assessing ecosystem condition, regeneration capacity, and ecological resilience (Mueller-Dombois & Ellenberg, 1974; Kent & Coker, 1992).

Therefore, this study aims to characterize the riparian vegetation of Oued El Kharoua through the analysis of floristic composition, species diversity, vegetation density, and structural organization of plant communities. Vegetation structure and species diversity are widely used as ecological indicators to evaluate the functioning and conservation status of plant communities (Magurran, 2004).

This work seeks to identify the main vegetation patterns and evaluate the ecological characteristics of this riparian ecosystem in a semi-arid environment. In this context, our report is structured into four parts: the first part is dedicated to a literature review; the second part concerns a description of the study site; the third part presents the study methodology; and the final part presents the main results and their discussion