Contribution of the Functional Feeding Groups (FFGs) of benthic insects to the Ecological Classification of Streams in Arid to Semi-Arid Regions: The Case of North African Wadis

Meradi Salah[1], Meradi Kenza[2], Benzina Imène[3], Si Bachir Abdelkrim[3]

[1] Laboratory of Environment, Health and Animal Production (LESPA), Department of Veterinary Sciences, University of Batna 1, Algeria.
[2] Laboratory of Biodiversity and Biotechnological Techniques and Valorization of Plants Resources, Department of Natural and Life Sciences, Mohamed Boudiaf University of M'sila, Algeria.
[3] Laboratory of Biodiversity, Biotechnology and Sustainable Development. Faculty of Natural and Life Sciences, University Batna 2, Algeria.

INTRODUCTION & AIM

North African wadis, though rare and often temporary, play a vital ecological and socio-economic role in arid to semi-arid regions. These fragile ecosystems face multiple natural and anthropogenic pressures, including prolonged droughts, irregular flows, water overexploitation, pollution, and habitat degradation (1 & 2). This study aims to analyze the structure and dynamics of FFGs of benthic insects to assess the ecological quality of four wadis located in the Aurès region (eastern Algeria) and to determine whether the functional patterns observed are comparable to those reported in streams from temperate and tropical regions.

RESULTS & DISCUSSION

In total,19,431 benthic insects belonging to 7 orders, 37 families, and 59 taxa, classified into 7 FFGs, were detected. In the unimpacted wadis, the benthic assemblages were characterized by the presence of several IBMWP-sensitive families, including Ephemeroptera (Baetidae, Caenidae), Trichoptera (Hydropsychidae, Sericostomatidae), and Coleoptera, which correspond functionally to shredders, filtering collectors, scrapers, and predators. These taxa are typically associated with good ecological status and stable habitat conditions in IBMWP-based assessments.

In contrast, impacted wadis were largely dominated by pollution-tolerant Diptera, particularly Chironomidae and Dixidae, which are classified as low-score taxa in the IBMWP system and correspond functionally to gathering collectors. The marked reduction or absence of sensitive IBMWP taxa in these sites is fully consistent with the functional diversity observed in temperate and tropical regions.

METHOD

Sampling design and Classification of FFGs

Sampling was conducted over a one-year period, from September 2021 to August 2022, in four wadis (two impacted by wastewater discharges and two unimpacted). Three sampling sites were established in each wadi, resulting in a total of 12 sites. These same sites were used for both insect sampling and physicochemical analyses. Identified taxa were assigned to seven functional feeding groups (3): gathering collectors (GC), filtering collectors (FC), herbivore shredders (HSH), detrital shredders (DSH), scrapers (SC), algal piercers (APC), and predators (Pr).

Use FFGs as surrogates for stream ecosystem attributes

Stream ecosystem attributes	FFGs surrogates' index	FFGs surrogates' ratios	Proposed thresholds and interpretations
Autotrophic vs. Heterotrophic Energetics	Autotrophy & Heterotrophy index	SC + HSH + APC to DSH + GC + FC	**> 0.75:** Autotrophic stream (Autochthonous DOM from algae and vascular plants) **< 0.75:** Heterotrophic stream (Allochthonous DOM from riparian vegetation or wastewater)
CPOM vs. FPOM	Shredder index	DSH + HSH to GC + FC	**> 0.25:** Availability of riparian vegetation for shredders
Suspended vs. Storage FPOM	Filtering collector index	FC to GC	**> 0.50:** Suspended FPOM (from riparian vegetation) **< 0.50:** Stored FPOM (from wastewater)
Stable vs. Unstable sediments	Habitat stability index	FC + SC + HSH to DSH + GC	**> 0.50:** Stable substrates are more abundant than unstable substrates
Top down vs. bottom up macroinvertebrate communities	Top-down predator index	Pr to total FFGs	Predators > 20% (either fast-reproducing predator species or presence of polyvoltine prey)

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CONCLUSION

Overall, the FFGs indices observed in the study area were found to be comparable to those reported from temperate and tropical regions. These indices proved effective in distinguishing ecological conditions and can serve as reliable tools for the biomonitoring of wadis exposed to arid climatic constraints.