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Priorities and gaps in Mediterranean bat research evidence: a systematic review for the early twenty-first century

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Bat conservation is one of the top global concerns for research today; however, conservation efforts may still be limited and impotent due to inadequacy and scarcity of data. Hence, identifying research trends, threatening factors, species status, and geographical priorities is an essential tool for future conservation attempts. Here, we conduct a comprehensive systematic review to identify current research priorities, trends, general patterns, and gaps regarding Mediterranean bat research. A total of 97 studies were found in the years spanning between 2000 and 2021. There were 18 studies with sufficient data for qualitative statistical analysis to investigate the impact of habitats and land management on bat activity and species richness. A yearly average of 4.6 articles was published, with a slight increase post-2010. Out of 61 identified species, 21% of species are threatened. Approximately 65 % of studies were conducted in the Mediterranean European region, primarily in Spain (29 %), Italy (15.5 %), and Portugal (10.3 %), primarily focusing on forest habitats (38%). We found that Mediterranean bat species received uneven research efforts, with only 15% of research allocated to threatened bats. Around half of the studies focused on the following bat species; *Pipistrellus pipistrellus*, *Pipistrellus kuhlii*, *Miniopterus schreibersii*, *Rhinolophus hipposideros*, *Pipistrellus pygmaeus*, *Myotis myotis*, and *Rhinolophus ferrumequinum*. Our statistical analysis revealed that riparian areas had higher bat activity than forest and agricultural areas. Bat populations responded positively to forest management and organic agriculture practices. To reduce future research misalignment between current local research status and future global conservation priorities, we strongly advocate for urgent and additional collaborative efforts to target under-researched species and areas. Finally, our review will hopefully provide a general overview and an objective synthesis of the status of bats in the Mediterranean and serve as a baseline for further effective research.

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Contrasting Influence of Vegetation, Landscape, and Abiotic Factors on Bat Activity Across Different Mediterranean Habitats

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Mosaic landscapes are anticipated to hold a higher abundance and diversity of Mediterranean bat species. However, the magnitude in which vegetation structure at local and landscape scales, the presence of livestock, anthropogenic structures such as buildings and roads, and abiotic factors influence bat activity and richness still need to be better investigated. Here, we used acoustic monitoring over two years to explore the seasonal response of bat activity and species compositions across four different habitats (forest, shrubland, olive grove, and pastureland) inside a natural reserve in Sicily, Italy, and understand the effects of vegetation structure, landscape scales and abiotic factors on the bat activity and species richness. We identified a total of 15 bat species and phonic groups from 10,957 calls. *Pipistrellus kuhlii*, *Pipistrellus pipistrellus* and *Pipistrellus pygmaeus* were the most prevalent species. We found no significant variations in bat activity among the studied habitats. However, overall, higher bat activity was associated with areas exhibiting trees with higher diameter at breast height (i.e., forest habitats). A negative correlation was noted between open and narrow bat guild species activity and road proximity, while dung density positively influenced narrow bat activity. Abiotic factors, such as elevation and moonlight illumination intensity, had a positive impact on overall bat activity. Our results reflect the significant role of mosaic landscapes in shaping bat communities, influencing bat activity and species distribution while providing diverse landscape and vegetation compositions that can support different bat species and guild groups.

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