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| **Potential of Remote Sensing for quantifying multi-taxon biodiversity in Mediterranean mountain forests** |
| **Introduction:** Biodiversity monitoring represents a major challenge to support proper forest ecosystem management and biodiversity conservation. The latter is indeed shifting in recent years from single-species to multi-taxon approaches. In this context, remote sensing is a powerful tool, continuously providing consistent and open access data at different spatial and temporal scales. Particularly, Landsat Time Series (TS), Sentinel-2 (S2) and Airborne Laser Scanning data (ALS) have great potential to produce reliable proxies for biological diversity.  **Methods:** In 140 plots of beech and silver fir forests in central Italy, we sampled the beetle fauna, breeding birds, epiphytic lichens, and Tree related Microhabitats (TreMs).  First study area consists of four monitoring sectors in a Mediterranean-managed beech forest located in the Apennines (Molise, Italy). The second area located in beech forests of two Italian National Parks (Gran Sasso and Cilento National Parks), and the third study area located in the Nature Reserve of Vallombrosa (Tuscany, Italy).  **Results:** In all areas we calculated Shannon’s entropy and Simpson’s diversity. In the first area, the capability of Landsat Temporal Metrics in predicting the richness of saproxylic beetles family and trophic categories was assessed in terms of Pearson's product-moment correlation. The alpha diversity and species richness analysis indicate dissimilarities across the four monitored sectors (Shannon and Simpson's index ranging between 0.67 to 2.31 and 0.69 to 0.88, respectively), with Landsat TS resulting in effective predictors for estimating saproxylic beetle richness.  In the second area, we assessed the correlation with S2 harmonic metrics, biodiversity indices, and forest structural variables. The diversity indices were higher for the multi-taxon community compared to single taxa. The highest correlation values between S2 data and biodiversity indices were recorded in Cilento for multi-taxon and beetle communities (|r| = 0.52 and 0.38, respectively), and in Gran Sasso for lichen and beetle communities (|r| = 0.34 and 0.26, respectively). RMSE% ranged between 2.53 and 9.99, and between 8.1 and 16.8 for the Simpson and Shannon index, respectively.  In the third area, 240 ALS-derived metrics were calculated: 214 derived from the point cloud, 14 derived from a rasterized canopy height model, and 12 consisting of RGB spectral statistics. The final models were used to produce wall-to-wall maps of each biodiversity index. The RMSE% of the final models ranged between 8.5% (birds’ Shannon index) and 50.2% (epixylic TreM types’ Shannon index). The dependent variable that obtained the best performance was the Shannon index for each group considered, except for the epixylic TreMs, with a mean difference of -6.7%. Likewise, the highest R2 was for the Shannon index (0.17, against 0.14 for the richness).  **Conclusion:** Our results confirm and strengthen the importance of Remote Sensing data to assess forest biodiversity indicators that are relevant for monitoring forest habitat and predicting environmental complexity despite the many factors influencing multi-taxon biodiversity. The proposed methods support quantifying and monitoring the measures needed to implement better forest stand and multi-taxon biodiversity conservation. |