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Monitoring Bee Diversity in Natural Systems – Novel Aerial and Classical Ground Methods to Evaluate Biotic and Abiotic Indicators / DI PIETRA, Vincenzo; Dabove, Paolo; Mandelik, Yael; Mishael, Yael; Levy, Karmit; Dor, Maoz. - ELETTRONICO. - (2021). (Intervento presentato al convegno EGU General Assembly tenutosi a Virtual nel 19-30 Aprile 2021) [10.5194/egusphere-egu21-2178].

*Availability:*

This version is available at: 11583/2935654 since: 2021-11-05T12:29:59Z

*Publisher:*

Copernicus Meetings

*Published*

DOI:10.5194/egusphere-egu21-2178

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## Monitoring Bee Diversity in Natural Systems – Novel Aerial and Classical Ground Methods to Evaluate Biotic and Abiotic Indicators

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Bees provide essential pollination services to natural ecosystems and agricultural crops. However, managed and wild (unmanaged) bee populations are in decline worldwide. In order to better manage and restore bee populations, long-term monitoring programs are required. Direct bee monitoring is costly, labor intensive, and requires high expertise. Therefore, cost-effective indicators for bee diversity and community composition are essential.

Here we propose to test the cost-efficacy of novel aerial techniques along with classical ground methods to collect biotic and a-biotic indicators of bee diversity and community composition. We will couple classical ecological monitoring approach with advanced photogrammetric tools, in order to develop a multi-scale and multi-temporal platform for monitoring bees. To this end, we formed a complementary, interdisciplinary research group of a pollination ecologist, soil chemists, environmental engineer, geomatics engineer, and topography surveyor. The study will include field work in two complimentary study systems in central Israel, light sandy vs heavy vertisol soils. In each study system we will concurrently conduct bee, flower, bee nesting substrates and soil surveys using classical tools/approaches, as well as apply advanced photogrammetric tools, based on RGB images, with thermal, multispectral data. The indicative ability for bee diversity and community composition of the different biotic and a-biotic measures collected, will be tested using advanced statistical tools. Our findings may be instructive to other insects and plant groups, thus provide a novel generic approach towards the ecological monitoring of terrestrial systems.