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Modeling the influence of environmental features on wild honey bee colony density in South Africa

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Wild and unmanaged honey bee colonies face myriad challenges to survive in harsh environments. Without provisions from a beekeeper, colonies must obtain limited resources, such as pollen, nectar, water, propolis, and suitable nest sites. The dynamic availability of these resources influences where unmanaged colonies establish and persist. To conserve honey bees, the complex interactions between colonies and their environments must be understood. In turn, we can characterize colony survival strategies and ecosystem carrying capacities. Geographic Information Systems (GIS) provide powerful tools to explore environmental features relevant to colony establishment and survival. We aimed to identify environmental features influencing wild and unmanaged honey bee populations (Apis mellifera) in the Eastern Cape Province, South Africa. We surveyed 1 km by 1 km grids for wild and unmanaged honey bee colonies using beelining techniques. In each grid, we set up four stands of sugar water from which we followed foraging bees returning to their nest entrances. We used colony density data (colonies/km²) alongside environmental predictor variables to construct generalized linear mixed effect models and perform model selection. We explored vegetation type, water availability, and topography as environmental predictor variables using satellite imagery and digital elevation models. In total, we surveyed 16 km² across five field sites and located 105 colonies. Colony density ranged from 0 to 14 colonies per km². Our research associated the spatial distribution of environmental features with wild and unmanaged colony density over a limited study area. Future research should be conducted to monitor changes in resources and colony populations over larger spatial and temporal scales. Investigating the spatial ecology of wild and unmanaged honey bees informs conservation initiatives while providing beekeepers insights into optimal management practices.