

## Forests, the Sanctuaries to Specialist and Rare Wild Native Bees at the Foothills of Western Himalayas

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**Abstract :** With 50% decline in managed honey bee hives in the continents of Europe and America, farmers and landscape managers are turning to native wild bees for their essential ecosystem services of pollination. Wild bees population are too under danger due to the rapid land use changes from anthropogenic activities. With an escalating population reaching 9.0 billion by 2050, human-induced land use changes are predicted to further deteriorate the habitats of numerous species by the turn of this century. The status of bees are uncertain, especially in the tropical regions of the world, which also questions the crisis of global pollinator decline and their essential services to wild and managed flora. Our investigation collectively compares wild native bee diversity and their status in forests and agroecosystems in Doon Valley landscape, situated at the foothills of Himalayan ranges, Uttarakhand, India. We seek to ask whether (1) natural habitat are refuge to richer and rarer bees communities than the agroecosystems, (2) Are agroecosystems closer to natural habitats similar to them than agroecosystems farther away; hence support richer bee communities and hence, (3) Do polyculture farms support richer bee communities than monoculture. The data was collected using observation and pantrap sampling from February to May, 2012 to 2014. We recorded 43 species of bees in Doon Valley. They belonged to 5 families; Megachilidae, Apidae, Andrenidae, Halictidae and Colletidae. A multinomial model approach was used to classify the bees into 2 habitats, in which forests demonstrated to support greater number of specialist (26%, n= 11) species than agroecosystems (7%, n= 3). The valley had many species categorized as the rare (58%, n= 25) and very few generalists (9%, n=4). A linear regression model run on our data demonstrated higher bee diversity in agro-ecosystems in close proximity to forests ( $H'$  for  $< 200\text{ m} = 1.60$ ) compared to those further away ( $H'$  for  $> 600\text{ m} = 0.56$ ) ( $R^2=0.782$ ,  $SE=0.148$ ,  $p\text{ value}=0.004$ ). Organic agriculture supported significantly greater species richness in comparison to conventional farms (Mann-Whitney U test,  $n_1 = 33$ ,  $n_2 = 35$ ;  $P = 0.001$ ). Forests ecosystems are refuge to rare specialist groups and support bee communities in nearby agroecosystems. The findings of our investigation demonstrate the importance of natural habitats as a potential refuge for rare native wild bee pollinators. Polyculture in the valley behaves similar to natural habitats and supports diverse bee communities in comparison to conventional monocultures. Our study suggests that the farming communities adopt diverse organic agriculture systems to attract wild pollinators beneficial for better crop production. Forests are sanctuaries for bees to nest, forage, and breed. Therefore, our outcome also suggests landscape managers not only preserve protected areas but also enhance the floral diversity in semi-natural and urban areas.

**Keywords :** native bees, pollinators, polyculture, agroecosystem, natural habitat, diversity, monoculture, specialists, generalists

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