Biodiversity and pollination services provided by bees in natural and anthropogenic landscapes of the Arava Rift Valley

Thesis submitted towards the M.Sc. degree in Ecology & Environmental Quality
at Tel-Aviv University

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August 2008

Abstract

In the last 50 years, numerous changes in the world's biodiversity have occurred as a result of human activities such as conversion of natural habitats, pollution, overexplotation and more. Biodiversity supports all life systems on earth and its reduction might be irreversible. Changes inearth's biodiversiry result in damage to "ecosystem services", functions provided by nature that improve and sustain human wellbeing. One of the most important ecosystem services is pollination,
which provided mainly by bees in both natural and agricultural ecosystems.
Modern agriculture relies on a small number of commercial pollinators (mainly honey bee and bumble bee), although wild bees provided substantial pollination services in some ecosystems. Depending on commercial pollinators in agriculture is expensive and might be risky for two main reasons. First, in the last 50 years a 50-70% decline in both domesticated and feral honeybee colonies has been observed. Secondly, the extensive use of honey bees (and bumblebees) for crop pollination has caused their widespread introduction into natural ecosystems that might effect the native pollinator community. This has lead to growing concerns over the last decades about the loss
of pollinators and the services they provide and to renewed interest in native, unmanaged bee populations as potential pollinators to various crops.
In the Araba/Arava Valley, little has been previously studied on bee diversity and species composition in natural and anthrophgenic environments, and any potential contribution of wild bees to agriculture in this area has only been preliminarily examined. Agriculture in this region is a major land use and income source for local communities on both sides of the Israeli-Jordanian border.
However, this arid, low-productivity ecosystem is expected to be seriously affected by agricultural activities. Exploring ways to ensure and enhance pollination services may have important implications for both agriculture production and biodiversity conservation in this region. In this research we studied temporal and spatial diversity patterns of bees in four natural

and anthropogenic habitats across the Israeli-Jordanian border in the Arava Rift Valley and explored the potential pollination services they provide to agriculture. The study was conducted in four potential habitats for wild bees in the central Araba/Arava Valley: natural (Israel), settlement gardens (Israel), open agricultural fields (Jordan) and covered agricultural fields ("tunnels", Israel), with 4 study plots for each habitat type. All plots were 2500m² in size. The crop grown in all agricultural plots was watermelon (*Citrullus lanatus*), which demand insect pollination for fertilization. The two agriculture habitats represent different farming types: traditional agriculture in Jordan, growing in open fields with very low density of honey bee hives, and intensive agriculture in Israel, growing in tunnels or net houses with high hives density. We sampled bees and plants from March to July (2007 and 2008), using nets and pan traps. Every year we conducted 6 samplings.

The results show significant differences in wild bee abundance, species richness and composition between habitats and along season. In both sampling years we found similar trends but bee abundance was substantial higher in 2008 than in 2007. Honey bees were dominant mainly in gardens and in agriculture fields. Bumble bees were sampled only in gardens. Wild bees were sampled in all four habitats. Wild bee abundance and species richness were high early at the season in natural habitats and declines later on but increased in gardens along the seasons. Wild bee abundance was relatively low in agricultural habitats, mainly in tunnels, across the activity season.

Wild bee species richness was highest in natural habitats and abundance was highest in gardens. Species richness and abundance were lowest in the tunnels. Most species show specific habitat preferences, some species were sampled only in natural habitats while others were samples in gardens only. Wild bee species composition was significantly different in gardens and in natural habitat along season and the results show habitat preferences in time and space: early at the season wild bee prefer the natural habitat and later on wild bee move to the gardens. Both in 2007 and 2008, gardens supply the highest flower abundance along season. In natural habitat and in the open watermelon fields flower abundance decreasing along season. Watermelon

tunnels supply relatively low abundance of flowers along season. We found significant relationship between flower resources and wild bee richness and abundance in gardens and in natural habitat. The result show significant differences between wild bee pollination potential in 2 agricultural habitats, wild bee constitute a substantial portion from all bees in the open fields comparing to tunnels. Most species that were sampled in both agriculture habitats were sampled also in natural

habitats and gardens. These results are important for indicating that those habitats can serve as pollination services resource for the agricultural fields. Our results emphasize the importance of conserving natural habitats in this region for supporting

wild bee natural populations, especially considering future plans of converting more natural areas for agriculture pracrices. Natural habitats serve as important habitat for wild bees especially early at the season. Gardens constitute main habitat in the summer period but not surely able to support wild bee population along all activity season. It seems that wild bees have the potential to provide significant pollination services in our ecosystem, but their actual contribution is very limited in the current agricultural management.