The biodiversity value of olive groves in Palestine

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ABSTRACT

Traditional olive groves and other forms of agriculture are a dominant feature of the Palestinian landscape. However, the biodiversity value of these areas needs to be better understood. This study compares the tree and bird richness of olive groves and field agricultural sites in Beit Sahour of Bethlehem, Palestine. A total of sixteen bird species were recorded, with fourteen species observed in olive groves and¬ six species observed in the field agricultural sites. Olive groves had significantly higher tree and bird richness than field agricultural sites. Our results corroborate other studies that suggest olive groves have biodiversity value as a cultural landscape.

Key words: Agriculture, Birds, Cultural landscapes, Olive groves, Palestine.

INTRODUCTION

Cultural landscapes have the potential to contribute to biodiversity conservation, as most of the world's biodiversity exists outside of nature preserves and protected areas (Farina, 2000; Dudley et al, 2005). Cultural landscapes are areas of cultural and heritage importance that have a long-term history of human interactions with the environment, which has dictated species distribution and assemblages (Farina, 2000; UNESCO, 2011). Traditional, low-impact agriculture is often the major activity in cultural landscapes that shapes the environment, energy flow, and habitat structure (Farina, 2000; Harrop, 2007). In contrast to other forms of agriculture, areas of traditional agriculture may mimic some aspects of more natural habitats by acting as corridors between natural areas and containing habitat structures that allow some wildlife to persist (Beaufoy, 2001; Chape et al, 2005; Dudley et al, 2005; Davy et al, 2007; Attum et al, 2011; Rey, 2011). The Mediterranean landscape, including historic Palestine, has a long history of human habitation and agriculture that have been sustained by cultural systems, which has resulted in a landscape that consists of a mosaic of natural and semi-modified landscapes (Naveh, 1975; Beaufoy, 2001; Biondi et al, 2007). Olive groves (*Olea europaea*) are dominant features of the Palestinian landscape and have evolved as a product of efficient use of energy, nutrients, and natural production cycles (Makhzoumi, 1997; Biondi et al, 2007).

Olive groves cover roughly 48% of the agricultural land in Palestine, with the majority of the trees found in the West Bank (UNDP, 2008). Olive trees are an important source of revenue, comprising 18% of the agricultural income, with most of the olive products consumed domestically (UNDP, 2008; United Nations, 2012). Olive trees, their fruits, and their harvest are symbolic and important features of Palestinian culture, history, and tradition (McLaughlin, 2006; Abufarha, 2008; UNDP, 2008). Given the widespread distribution of traditional olive groves and other forms of agriculture in Palestine, the biodiversity value of these areas needs to be better understood (Davy et al, 2007; Biondi et al, 2007; Rey, 2011).

This study compares the tree and bird richness of olive groves and field agricultural sites in Beit Sahour of Bethlehem, Palestine in order to better understand the biodiversity value of olive groves in comparison to other forms of agriculture. Birds were chosen as the focal species because birds are a valuable indicator of biodiversity, have an important role in ecological systems, and can be used in rapid assessment surveys (Martin et al, 2009).

MATERIALS AND METHODS

This study occurred in central and eastern suburbs of Beit Sahour in the Bethlehem district, which consists of rolling hills dominated by small-scale agriculture and surrounded by human housing. These rain fed groves are considered low-input traditional plantations with scattered trees, dominated by the olive tree, *Olea europaea* (Beaufoy, 2001). The olive groves were of different ages, ranging from fifty to several hundred years old, according to the local owners. The olive groves were harvested manually, without the use of machines or pesticides. The non-olive grove sites were field agricultural areas characterized by sparse tree density, in which crops such as wheat, barley, tomatoes, and striated cucumbers are planted. Tractors may be used for cultivation at these sites and vegetables are hand picked.

We sampled birds at randomly selected points in olive groves (n = 10, approximate mean area = 1.9 ha + SE 0.4) and field agricultural sites, (n = 15, approximate mean area = 2.5 ha + SE 0.7). Survey points were chosen by mapping potential sampling areas in Google Earth and then importing the polygons into GIS software to select random points. In order to not frighten the birds, we navigated to a location 50 m from each sampling point using a GPS unit, to observe birds using binoculars. Sampling points were separated by a minimum of 250 m (Rey 1993, 1995; Martin et al, 2009). We then recorded the number of individuals that were observed for each bird species within a thirty-meter radius of the original sampling point (Sensu Rey, 1995). We also recorded the species, canopy height, and maximum diameter of each tree within a 15 m radius of the original sampling point. Surveys occurred within two hours after sunrise for a duration of fifteen minutes in July 2010. We compared the bird and tree richness between olive groves and field agricultural sites through an ANOVA.

RESULTS

Six tree species, olive (*Olea europaea*), common almond (*Amygdalus communis*), fig (*Ficus carica*), spiny hawthorn (*Crataegus aronia*), Palestine Buckthorn (*Rhamnus palaestinus*), and Aleppo pine (*Pinus halepensis*), were recorded within our sampling points inside olive groves. The field agricultural sites contained two species of trees, olive and almond. A total of sixteen bird species were recorded, with fourteen species observed in olive groves and six species observed in the field agricultural sites (Table 1). There was a significant difference in species richness between olive groves and field agricultural sites (ANOVA: $F_{2, 22} = 46.05$, $P < 0.0001$). Olive groves had significantly higher tree (ANOVA: $F_{1, 25} = 40.51$, $P < 0.0001$) and bird richness (ANOVA: $F_{1, 25} = 9.68$, $P = 0.005$) than field agricultural sites (Fig 1).

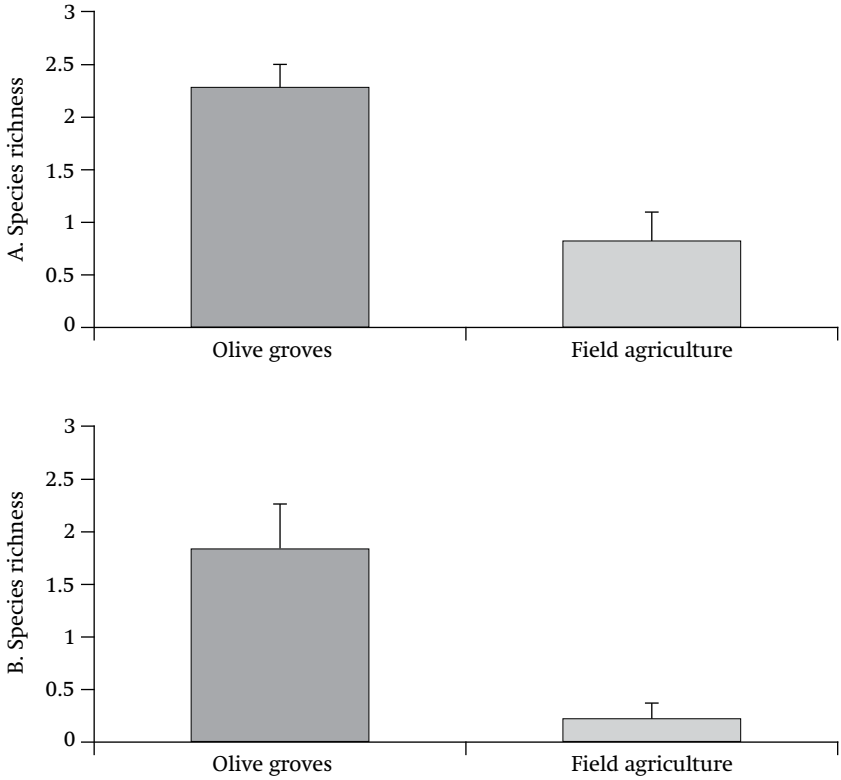

Figure 1. A comparison of bird (A) and tree (B) richness between olive groves and field agricultural sites.

DISCUSSION

Our results corroborate other studies that suggest olive groves have biodiversity value (Biondi et al, 2007; Carpio et al, 2015; Davy et al, 2007; Khoury et al, 2008; Rey 1993, 1995, 2011). Olive groves, like other forms of low-impact agriculture, may mimic some attributes of more natural systems and are associated with greater species diversity than other more intensive agricultural land uses (Beaufoy, 2001; Martin and Lopez, 2002; Dudley et al, 2005; Blondel, 2006; Davy et al, 2007; Rey, 2011). In addition, olive groves have a long history, often several hundred years or more, which allows species from neighboring natural habitats to colonize and utilize the semi-modified landscape (Rey, 1993, 1995, 2011; Davy et al, 2007; Khoury et al, 2008).

Species richness is often related to habitat heterogeneity and structural diversity, as more heterogeneous and structurally diverse habitats have more niches that could potentially be utilized by a greater variety of species for refuge, nesting, and foraging (MacArthur and MacArthur, 1961; Benton et al, 2003). The bird community observed in the olive groves included species found in disturbed and urban areas, Mediterranean forest, scrub, and open areas. The habitat heterogeneity of the olive groves was visually higher than the non-olive grove sites, as olive groves are an irregularly spaced tree community that included other agricultural and native tree species (Figure 1). The olive groves were found in areas in which trees were separated from one another by a matrix of open areas containing rock outcroppings, unmowed grasses, and native shrubs. Short, irregular rock hedgerows used to delineate olive grove borders from neighboring orchards and minimize soil erosion, also contribute to the habitat heterogeneity (Beaufoy, 2001). The leaves of olive trees also provide leaf litter that are used by wildlife as a thermal and habitat refuge, which allows wildlife to persist in semi-modified landscapes (sensu Manning et al, 2006; Attum et al, 2011). Also, older olive trees have irregularly shaped trunks with numerous cavities, which contribute to the microhabitat heterogeneity.

In contrast, non-olive grove sites typically had lower observed species richness and a bird community that consisted of disturbance-tolerant and urban species. The non-olive groves consisted of a more homogenous and structurally simpler landscape consisting of few trees and a monoculture of crops, which usually lacked the habitat structures found in olive groves (Manning et al, 2006; Davy et al, 2007; Martin et al, 2009; Fischer et al, 2010). In addition, the spatial arrangement of crops in non-olive grove sites are often distributed in a uniform fashion, with the vegetation structure being present during growing season and absent from other times of the year, which further contributes to a simpler landscape than olive groves. The biodiversity value of olive groves and non-olive sites could also be related

to factors that were not examined, which would explain the observation of the Palestine sunbird in the non-olive grove sites. For example, this study did not examine orchid age or size, habitat type of the neighboring patch, or pre-adaptive traits of the species community (Rey, 1993; 2011). Despite having presence-only data with no information on reproductive success, our results provide a meaningful comparison of biodiversity (Martin et al, 2009; Caula, 2010).

Our study suggests that olive groves in Palestine could be considered cultural landscapes or be designated as globally important agricultural systems because of the combination of their biodiversity, cultural, and economic values (Farina, 2000; Beaufoy, 2001; Biondi et al, 2007; Harrop, 2007). The biodiversity value of historic olive groves has been recognized in other parts of the Mediterranean, with some proposing these areas should receive protection because they are habitat used by some rare and threatened species and are important in maintaining regional biodiversity (Rey, 1995; Beaufoy, 2001; Biondi et al, 2007; Attum et al, 2011; Rey, 2011). The recognition and support for maintaining olive groves may assist in promoting biodiversity and support the local communities within Palestine, as occurs in other cultural landscapes (Farina, 2000; Beaufoy, 2001; Martin and Lopez, 2002; Harrop, 2007; Scherr and McNeely, 2008). Sustainable agricultural practices and some biodiversity conservation can be maintained when conservation objectives and local values are consistent (Farina, 2000; Beaufoy, 2001; Harrop, 2007; Martin et al, 2009). The designation of olive groves as cultural landscapes can be useful for educating the public and promoting tourist and local appreciation for the cultural, historical, and biological heritage of Palestine (Makhzoumi, 1997; Farina, 2000; Biondi et al, 2007).

However, olive groves in Palestine face numerous threats, which include destruction by the Israeli government and settlers to erase Palestinian cultural and ownership ties to the land, land confiscation, and the military occupation that prevents farmers from accessing their lands and disrupts cultural activities associated with the olive harvest season (Falah, 1996; Braverman, 2009; Oxfam, 2011; OCHA, 2012; UNDP, 2008). Strengthening traditional institutions and practices, such as community-based natural resource protection and the establishment of legal protection, may therefore likely preserve and maintain practices that allow biodiversity to exist in olive groves (Berkes, 2004; Davy et al, 2007; Harrop, 2007; Scherr and McNeely, 2008; Martin et al, 2009).

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Table 1. Species observed in olive groves (olive) and non-olive grove (non-olive) sites

Spec	Olive	on-olive
Alpine Swift, *Apus melba*		x
Black-eared Wheatear, *Oenanthe hispanica*	x	
(Eurasian) Collared Dove, *Streptopelia decaocto*		x
Graceful Prinia, *Prinia gracilis*	x	
Great Tit, *Parus major*	x	
(European) Green Finch, *Chloris chloris*	x	
(Eurasian) Hobby, *Falco subbuteo*	x	
Hooded Crow, *Corvus cornix*	x	x
House Sparrow, *Passer domesticus*	x	x
(Eurasian) Jay, *Garrulus glandarius*	x	
Masked Shrike, *Lanius nubicus*	x	
Orphean Warbler, *Sylvia hortensis*	x	
Palestine Sunbird, *Cinnyris osea*	x	x
Laughing Dove, *Streptopelia senegalensis*	x	x
Sardinian Warbler, *Sylvia melanocephala*	x	
White-spectacled Bulbul, *Pycnonotus xanthopygos*	x	