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Anthropogenic Impacts of Irrigation on the Arthropod Community Structure of a Coastal Sage Scrub Habitat in Los Angeles

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Preliminary Report

Anthropogenic impacts of irrigation on the arthropod community structure of a coastal sage scrub habitat in Los Angeles

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Abstract. We evaluated the effects of an irrigation system on the community structure of arthropods in a coastal sage scrub chaparral habitat. We placed 5 traps in the irrigated site and 5 traps in control site, for a total of 10 sticky traps (using Tree Tanglefoot) in an area adjacent to Ballona Wetlands in Los Angeles, California. The traps were set at the irrigated and non-irrigated site on Telegraph Weed for one week. Results showed that morphospecies richness, relative abundance, and taxonomic order representation were higher at the control site than at the irrigated site. Our study documents how anthropogenic impacts in a coastal sage scrub habitat can alter the community composition of invertebrates in the fringe habitats surrounding the last wetlands in Los Angeles County.

Introduction

Insects provide essential and critical ecological system services in both natural and human dominated environments (Kearns and Oliveras, 2009). To characterize insect communities is important because greater species diversity ensures a natural dynamic of ecosystem processes (Naeem et al., 1995). Descriptive studies of species richness in urban habitats suggest that urban areas support rich insect faunas (Frankie and Ehler, 1978). An urban environment is a heterogeneous mosaic of residential dwellings, commercial properties, parks, and other land-use types that provides an array of habitat types that can be used by arthropods (McIntyre, 2000). In addition to being important for residents, urban green areas have intrinsic ecological value (Niemela, 1999). The diversity of human activities in cities creates and maintains a variety of habitats ranging from natural to modified which do not occur elsewhere. Many cities are traditionally built upon productive heterogeneous patches of land, leading to naturally high productivity and plant diversity (Kühn et al., 2004). Due to the variety of habitat types, urban landscapes often have a high species diversity that includes rare and threatened species (Shepherd, 1994). Therefore, species richness in single habitat patches is often high in urban habitats. A contributing factor is that many species of different natural habitats find suitable conditions in the anthropogenic habitats (Ranta et al., 1997). Sites that are cleared and left undeveloped attract different species as they undergo vegetative succession (McIntyre, 2000). As the last wetland in Los Angeles County, studies on arthropod community dynamics are needed in the Ballona Wetlands (33-57′56″ N, 118-26′42″ W). Our objective is to characterize arthropod commu-

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nity structure in irrigated and control sites in the Ballona Wetlands, specifically insect diversity, estimating morphospecies richness, relative abundance, and taxonomic Orders. Estimating morphospecies richness refers to richness estimators that were used to predict morphospecies richness at sites based on our sampling data. We predicted greater arthropod diversity at the irrigated Coastal sage scrub site.

Materials and Methods

We selected an irrigated and control site in the Coastal sage scrub surrounding the Ballona Wetlands on November 8, 2011. Coastal Sage Scrub is a drought-tolerant plant community common to the low elevation Mediterranean woodlands of coastal California, which is characterized by cool and moist winters and hot and dry summers. The irrigated site contains a sprinkler system and is closest to urban development while the control site is without irrigation and is closest to the freshwater section of the Ballona Wetland. We set five (approximately 20 cm x 25 cm) transparency sheets with Tree Tanglefoot within both sites. We placed traps on telegraph weed (*Heterotheca grandiflora* Nutt.), which was common to both sites. Although common to both sites, plants were chosen based on if they were flowering and disregarded distance between one another. The traps were in the field for 7 days and insects trapped were digitally photographed using a MiniVid Digital Camera for Microscope (DCM310). All arthropods were classified by morphospecies and identified to taxonomic Order. Classification by morphospecies is defined as distinguishing a species based on its morphology, such as shape, structure, or color. This classification method was chosen due to limitations and restraints of the research team and deadlines. Morphospecies diversity was calculated using Shannon-Weiner diversity index via software program EstimateS Version 8.2 (Colwell, 2005). The Shannon values were compared using rarefaction technique, which is a sub-sampling methodology that allows for the comparison of indices (i.e. Shannon diversity index) based on the same number of samples (i.e. number of individuals). Morphospecies richness was estimated in irrigated and control sites using the following predictors: ICE, ACE, CHAO1, JACK 1, and BOOTSTRAP in EstimateS. These values provide an estimate for the number of species predicted to be found at the irrigated and control sites. Rank abundance curves were used to compare equitability of species abundance at both sites. The distribution of taxonomic order representation, in terms of the number of arthropods captured on the sticky traps, was compared between irrigated and control sites using a 2-factor Chi Square (Contingency table).

Results

Rarefaction curves revealed that morphospecies diversity was greater at the control site than the irrigated site (Figure 1). The estimated species richness for the control site ranged between 27-38, while the irrigated sited ranged between 18-23 (Figure 2a). Based on rank abundance curves the species from the control site had greater species abundance and equitability than the species at the irrigated site (Figure 3). Taxonomic orders revealed greater numbers of Hymenoptera and lower numbers of Diptera at the control site than irrigated site (Figure). The representation of taxonomic orders was significantly different between irrigated and control sites (χ^2=44.6456, df=7, P<0.001). There were 29% more Hymenoptera observed in the irrigated sites (Table 1). There were 10% more Diptera and 11% more Thysanoptera observed in the control sites (Table 1).

Discussion

Our study suggests that irrigation leads to changes in the arthropod community structure in the coastal sage scrub. Our study evaluates the differences between morphospecies between irrigated and control sites of Ballona Wetlands, however future studies need to look at a larger scope of arthropod structure in other Mediterranean communities. Morphospecies diversity

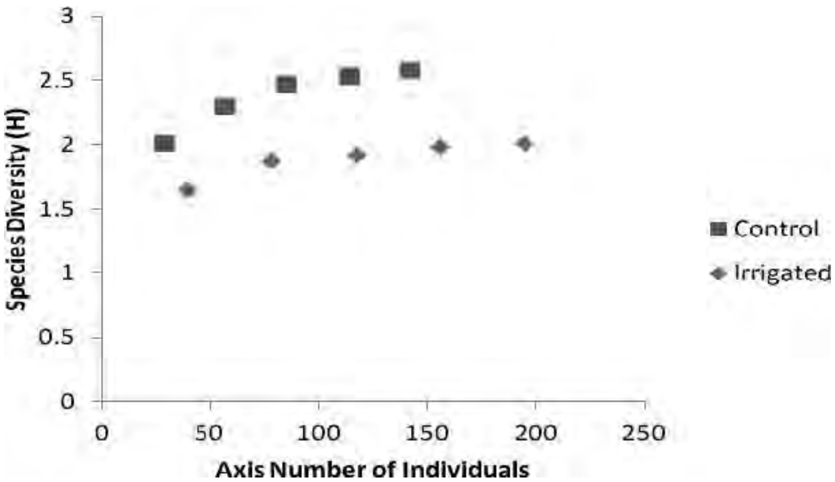

Figure 1. Shannon index graph displaying the morphospecies diversity at the control and irrigated sites.

and species richness were greater at the control site. We observed between 63%-89% morphospecies at the control site and 108-125% of the estimated morphospecies at the irrigated site. Rank abundance curves show greater species evenness, better representation, and more equitability at the control site than at the irrigated site (Figure 3). This curve cannot be used to identify morphospecies. All of these curves on Figure 3 settle into a narrow range. The curves reach an asymptote which is indicative of a good sampling effort and a good handle of species being predicted. This graph is used to evaluate the nature of the curves and how they increase in steepness and how they drop. Steep lines indicate less species evenness, representation, and equitability. While shallow lines indicate greater species evenness, better representation, and more equitability.

Our results showed that 60% of the orders of insects at the irrigated site were Hymenoptera while only 30% were Hymenoptera at the control site (Figure 3). Since Hymenoptera were more common in the irrigated site, this suggests

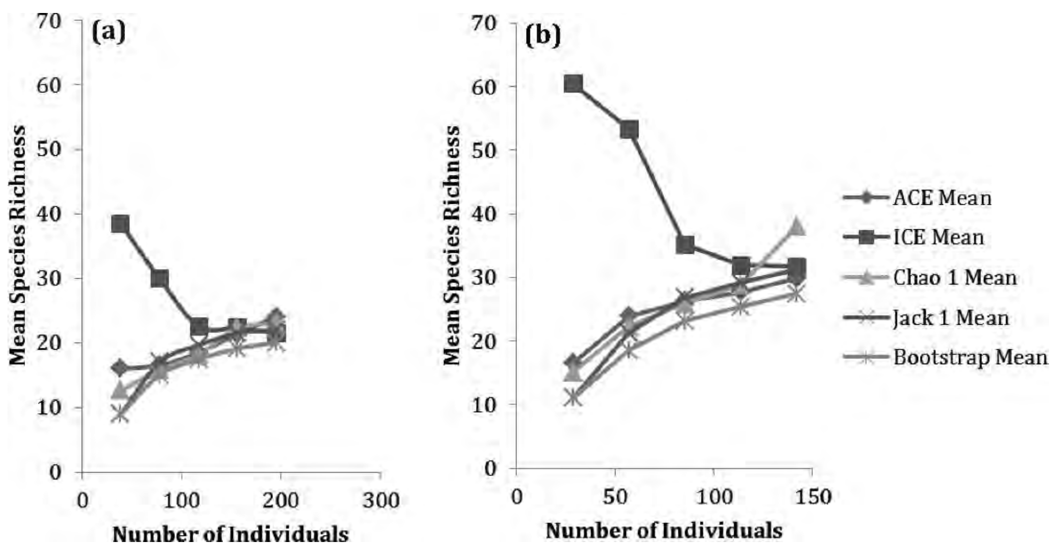

Figure 2. Estimates of species richness at (a) irrigated and (b) control sites.

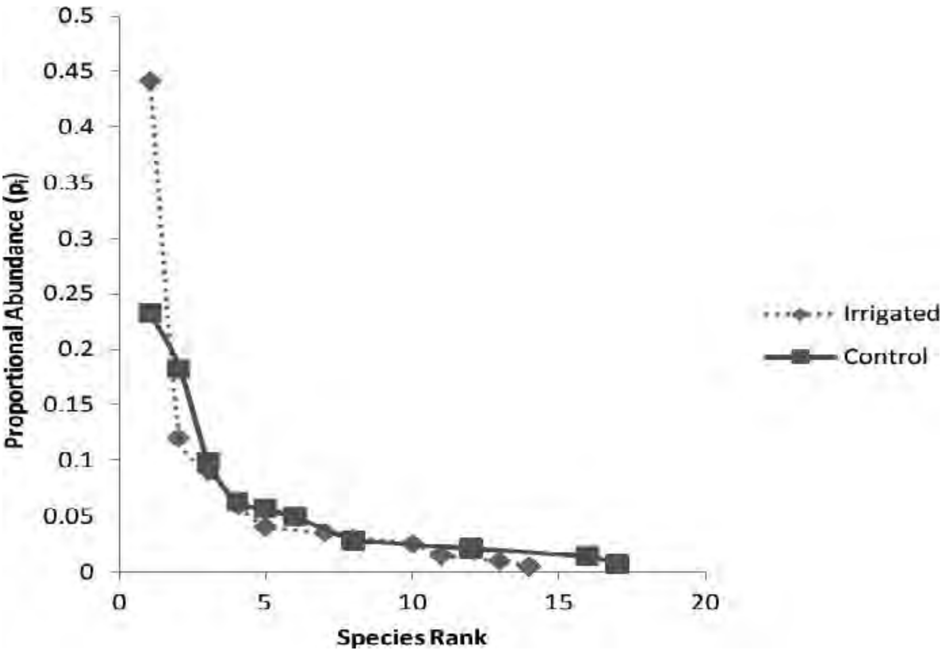

Figure 3. Proportional abundances of insects at the irrigated and control sites.

that interspecific interaction with plants and Hymenoptera would be favored in an irrigated environment. Results showed that 17% of the orders at the irrigated site were Diptera, while there was 28% at the control site. 12% of the orders at the irrigated site were Thysanoptera, while there was 23% at the control site. This suggests that interspecific interactions between the plants and Diptera and Thysanoptera would be favored in the control environment.

Our study documents how arthropod diversity in a coastal sage scrub habitat is impacted by an irrigation system, and how anthropogenic changes alter community structure of arthropod species in the native habitats surrounding Ballona wetlands. Future research should evaluate changes in the arthropod community structure between

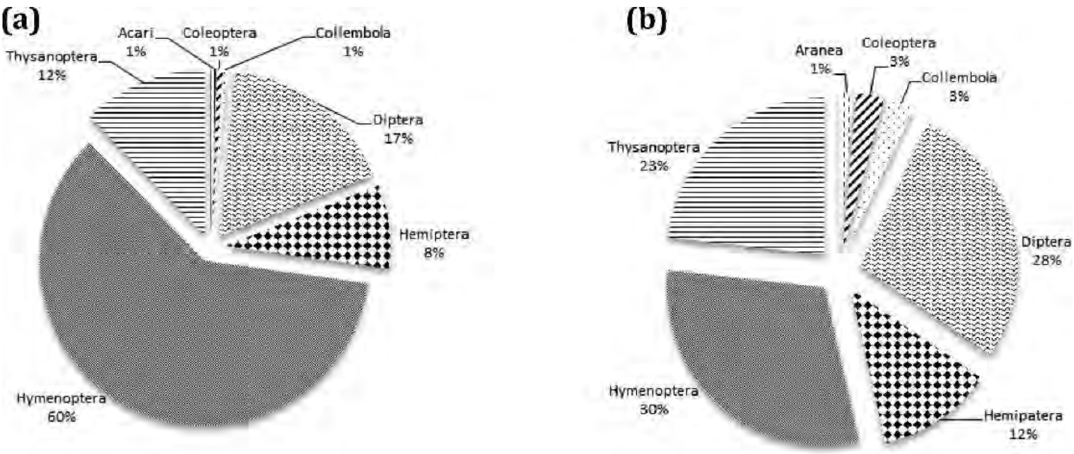

Figure 4. Taxonomic Orders represented in the (a) irrigated and (b) control sites.

Table 1. Taxonomic orders represented by morphospecies sampled at irrigated and control sites.

Taxonomic order	Irrigated sites	Control sites
Aranea	0%	1% (2)
Coleoptera	1% (1)	3% (4)
Collembola	1% (1)	3% (4)
Diptera	17% (34)	27% (39)
Hemiptera	8% (16)	12% (17)
Hymenoptera	61% (118)	30% (43)
Thysanoptera	12% (24)	23% (33)
Acari	1% (1)	0%
	195	142

the control and irrigated sites and if these changes alter interspecific interactions, such as pollination, seed dispersal, and herbivory.

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