

Full Length Research Paper

Diversity and seasonality of some of the ground dwelling invertebrates in the Eastern Region of Abu Dhabi, United Arab Emirates

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A study was conducted to understand the diversity, distribution, abundance and seasonality of ground dwelling invertebrate species in the eastern region of Abu Dhabi Emirate, from March 2010 to February 2011. Pitfall traps were used for this study in two sites with distinct micro - habitats in the Eastern Region of the Emirate. The site includes a wadi habitat at Jebel Hafit, Al Ain and another one is a gravel plain habitat at Mezyad, Al Ain. Beetles (Coleoptera) of the family Tenebrionidae (darkling beetles) are a conspicuous element of these arid and semi-arid environments. Variable stalker beetle (*Adesmia cancellata cothurnata*) was the most abundant Tenebrionid among twenty species collected using pitfall traps in the wadi of Jebel Hafit whereas opossum beetle (*Mesostena puncticollis*) was the most abundant Tenebrionid among twenty in the sandy gravel plain habitat of Um Ghafa, Mezyad.

Key words: Diversity, seasonality, Abu Dhabi Emirate, Jebel Hafit, Mezyad, darkling beetles, pitfall trapping, ground dwelling invertebrates.

INTRODUCTION

A definitive goal for invertebrate conservation would be the wide use of a set of relatively standardized sampling methods, to collect and study a relatively limited number of taxa (focal taxa) from many different habitats and ecosystems, with electronic access to a large amount of taxonomic and ecological data. Standardized and comparable data would be collected on species presence/absence, distribution patterns, habitat associations, diversity, rarity and abundance. These data are needed for effective conservation and monitoring of invertebrate species and their habitats (Kermen et.al, 1993). Although insect fauna of Jebel Hafit as a whole has been worked and previous studies were restricted to qualitative data collection and analysis and publication of checklists (Howarth and Gillett, 2004). The eastern region is

characterized by numerous wadis which offer a combination of climate, soil and water suitable for vegetation. The main objective is to evaluate the importance of these different habitats for biodiversity conservation in terms of invertebrates and also to provide knowledge on invertebrates that can be used for biodiversity conservation programmes of the Emirate.

In this study, we examined the abundance, diversity, seasonality, dominance and percentage of distribution of ground dwelling invertebrate species within the wadi habitat and gravel habitats in Eastern Region. Invertebrates were captured mainly by setting pitfall traps and the capture rate showed difference between sites and seasons. *Mesostena puncticollis* was the most abundant ground dwelling invertebrate species among the forty species

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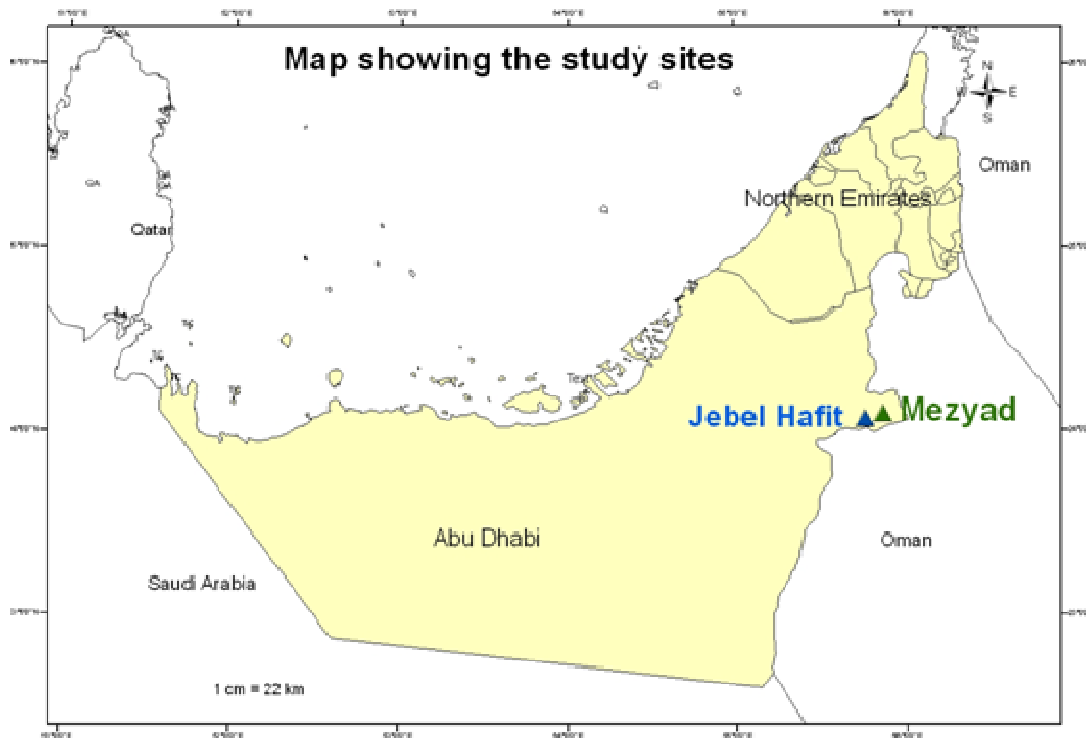


Figure 1. Satellite image of the study sites.

collected from Jebel Hafit and Mezyad.

Beetles (Coleoptera) play a significant role in most ecosystems (Ehrenfeld, 1988). Prominent epigeic examples are the Tenebrionidae that play a relatively major role in tropical and subtropical dry lands, more so with increasing aridity.

The study area

This study was carried out at two different sites of Al Ain, Eastern Region of Abu Dhabi Emirate which is located approximately 160 km east of the capital city of Abu Dhabi and about 120 km South of Dubai. The Eastern region covers an area of approximately 13,100 km². Two distinct sites with two distinct microhabitat sites were selected in Jebel Hafit and Mezyad-Um Ghafa in Al Ain. The satellite image of study sites are shown in Figure 1 and the photographs of study sites are given (Figures 2 to 5).

Jebel Hafit is the only mountain, and certainly the most prominent landscape feature, within the Emirate of Abu Dhabi. It is an isolated massif or inselberg (an isolated hill or mountain), lying just to the south of the city of Al Ain. It is aligned in a north to south direction and is approximately seventeen kilometers long, with its greatest altitude at about 1300 m above-sea-level. Jebel Hafit is the south most, and by far the largest series of mountain ridges which run north-south in the vicinity of Al Ain (Richard, 2004). The microhabitat identified as a wadi



Figure 2. Wadi-Jebel Hafit, Al Ain.

habitat is in close association with mountains and alluvial plains with distinct tree vegetation. The soil substrate consists of alluvial plains, gravel, pebbles and rocky material (Brown G, Sakkir, S (2004a).

The site chosen for pitfall trapping is unique in the wadi on account of the abundance of medium sized *Acacia tortilis* and other vegetation types include *Acridocarpus orientalis*, *Aerva javanica*, Foxtail grass



Figure 3. Acacia trees in Jebel Hafit pitfall site.



Figure 4. Um Ghafa, Mezyad.



Figure 5. Camel Camp in Um Ghafa, Mezyad.

(*Cenchrus ciliaris*), Incense grass (*Cymbopogon commutatus*), *Convolvulus virgatus*, *Dodonaea viscosa*, *Euphorbia alarica*, *Morettiaparviflora*, *Ochradenus arabicus*,

Iphiaea aucheri, *Indigofera colutea*, *Physorrhynchus chamaerapistrum*, *Tephrosia apollinea* and Christ's torn (*Ziziphus spina-christi*) (Brown and Böer, 2004). There is a considerable variation in the occurrence of plant species from one year to another and it was observed as the rainfall has influence on plant population. Majority of the above species were observed in winter months of 2010 and were absent in the same periods of 2011.

MATERIALS AND METHODS

Pitfall trap

Pitfall trapping is a sampling technique which is widely used in studies of seasonal occurrence, to examine spatial distribution patterns, to compare relative abundance in different micro-habitats, to study daily activity rhythms, and in community surveys. Pitfall trapping using small containers with preservatives is a standard invertebrate sampling method. Most ecological studies of beetles use approximately 10-20 pitfall traps per sample site (Driscoll, 2005; Baker et al., 2006; Martikainen et al., 2006). There are many variations of pitfall traps, but in its most basic form, a pitfall trap consists of some types of cup or other container (gallon bucket, for example) that is submerged in the soil and partially filled with a preservative. Insects and other organisms crawling about on the ground simply walk into the container and then cannot get out. In the current study, beetles were collected mainly by setting pitfall traps on two distinct sites of Abu Dhabi's Eastern Region over a period of 12 months, from March 2010 to February 2011. Twenty pitfall traps were placed randomly in an area of 40/40 m at each site. They were constructed using small plastic buckets (17 cm in length and 17 cm in diameter).

Pitfall traps were emptied on monthly basis and the data collected was recorded in the data sheets.

Species identification

Collected specimens were preserved; dry pinned or preserved in 70% ethanol. Voucher specimens (insect specimens collected from study sites and preserved for future reference) were identified to species level by comparing with identified specimens in the Environment Agency-Abu Dhabi (EAD)'s invertebrate reference collection. Majority of the beetle specimens are identified to species level. All the identified specimens were deposited in the Invertebrate Collection of EAD.

RESULTS

Average monthly air temperature, atmospheric humidity and rainfall data was noted (data recorded at weather stations, Water Resources Department, EAD) and the maximum temperatures observed are 37.5°C in the month of August and minimum temperatures observed is 19.5°C during February. Atmospheric humidity observed high during the month of December (73.01 %) and low during the month of May (32.61%). Rainfall occurred maximum during January (0.0131 mm) and rest of month it was 00 mm (Figure 6).

In the present study, pitfall trap data were used to study the invertebrate diversity, abundance, percentage of distribution and peak appearance of ground dwelling inverte-

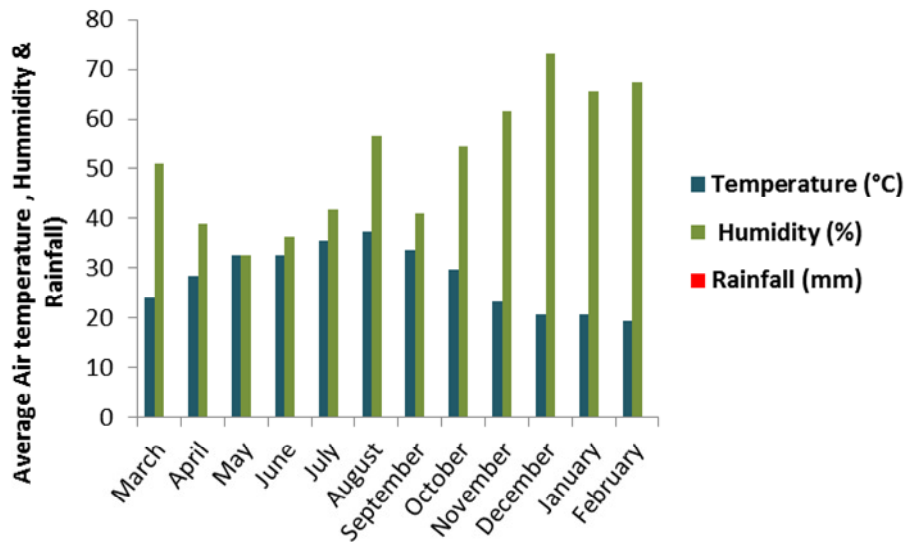


Figure 6. Monthly recorded average air temperatures, humidity and rainfall in the Eastern region.

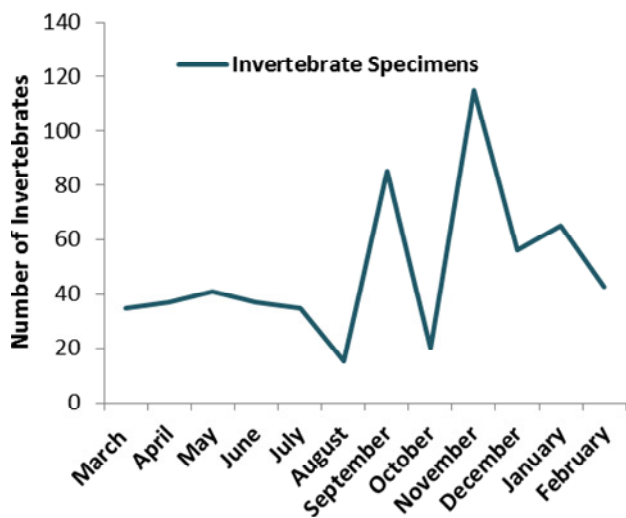


Figure 7. Seasonal abundance of invertebrates in Wadi Habitat - Jebel Hafit.

brates in two different habitats of Eastern Region of Abu Dhabi Emirate. A total of 3,502 specimens were captured in pitfall traps representing approximately 40 species. The majority of the species collected are beetles (Coleoptera) and ants (Hymenoptera). The total number of invertebrates, dominant species and seasonal patterns in the number of beetles at the two sites are presented in Figures (7 to 14 and in the Table 1.).

Invertebrates of Wadi Habitat – Jebel Hafit

A total of 584 specimens species were collected from the wadi habitat at Jebel Hafit site in pitfall traps. The most of

the pitfall trap capture species were beetles of the family Tenebrionidae, Scarabaeidae, ants (Formicidae), grasshoppers (Acrididae), ground mantis and praying mantis (Eremiaphilidae and Mantidae). The diversity and population dynamics of the invertebrate species in seasons of the site is shown in the Figure (7, 8 and 9).

There was a variation in the capture of invertebrates throughout seasons and their population densities throughout the season were gradual and two peak periods observed in wadi site. The number of collected invertebrates in March, April, May, June, and July were low and it showed a peak in the months of August and September and a drop in the month of October.

Four beetle species of *Adesmia cancellata cothurnata*, *Thiraptera kraatzi*, *Trachyderma philistina*, *Adesmia stoeckleini rasalkhymana* and two ant species *Monomorium wahibiensis* and *Monomorium tumairi* were trapped frequently among the twenty invertebrate species from this site. *A. cancellata cothurnata*, *A. stoeckleini rasalkhymana* and *M. wahibiensis* showed long period of activity and the changes in their population densities throughout the season were gradual.

In Jebel Hafit two species of beetles *A. cancellata cothurnata* and *A. stoeckleini rasalkhymana* trapped from March to February. *A. cancellata cothurnata* had relatively long period of activity and changes in their population densities throughout the season were gradual. *A. cancellata cothurnata* were the dominant species, characterized by a high rate of mobility and also were very active during the day. The first one showed peak in December and February and the later one reached a gradual increase in July and began to decline in August to October and increased in January and February. The ant species *M. tumairi* appeared in August and showed peaks in September and November. *T. philistina* and *T.*

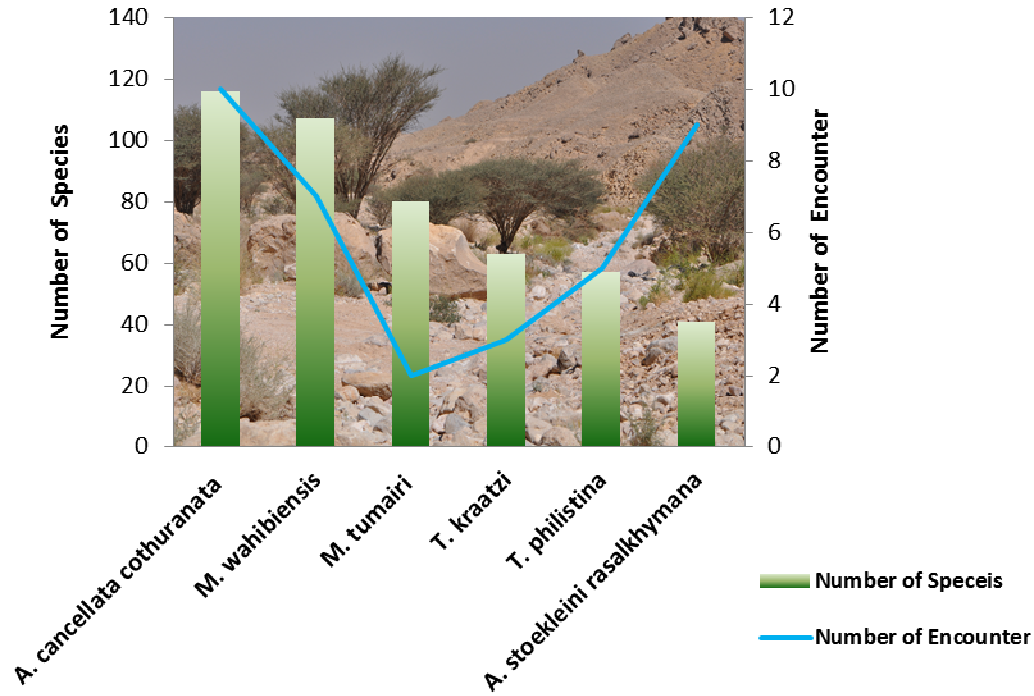


Figure 8. Capture frequencies of most abundant species in Jebel Hafit.

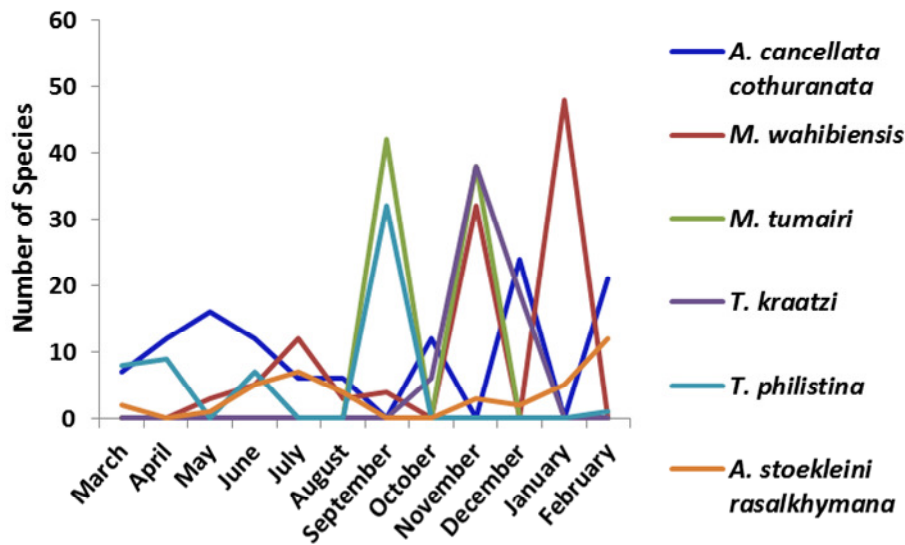


Figure 9. Seasonal abundance of abundant insect species in Jebel Hafit.

kraatzi had relatively short period of activity and population density of the species were peak in September and November Figure 9.

In addition to the six major recorded species, a beetle family named Hydraenidae was identified which is a new record from the Jebel Hafit wadi. They are very minute beetles with body length approximately 1.4 mm. The ant species *Cataglyphis falvobruneus* and *Camponotus xerxes*, beetle species *Apentanodes arabica*, *Mesostena*

puncticollis, *Adesmia arabica wittmeri* and Scarabid beetle *Scarabaeus baunensis* were found very infrequently.

Invertebrates of Mezyad – Al Ain

A total of 2918 specimens were collected from Mezyad Site in pitfall traps during the study period from March 2010 to February 2011 (Figure 10). Twenty species of invertebrates collected includes insect species (*A. arabica*,

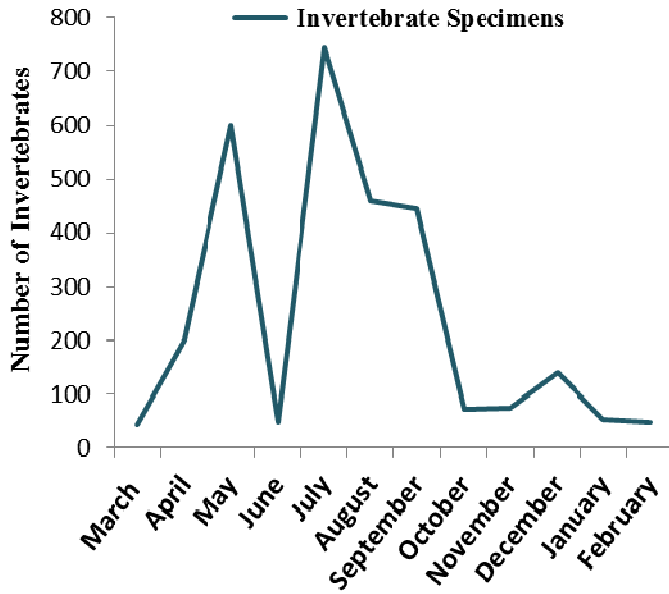


Figure 10. Seasonal abundance of Invertebrates in Mezyad.

throughout the season were sharp and two peak periods observed in Mezyad site. The numbers of pitfall trapped invertebrates were low in the month of March and showed a peak in the month of April. The number of invertebrates trapped was low in the month of May and it increased sharply in the month of July and in later months it showed a decreasing trend until the month of February.

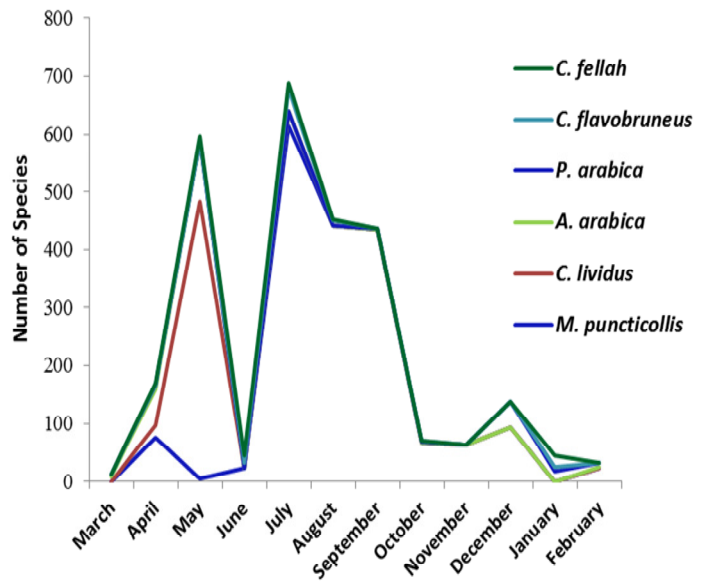


Figure 12. Seasonal abundance of dominant species at Mezyad from March 2010 to February 2011.

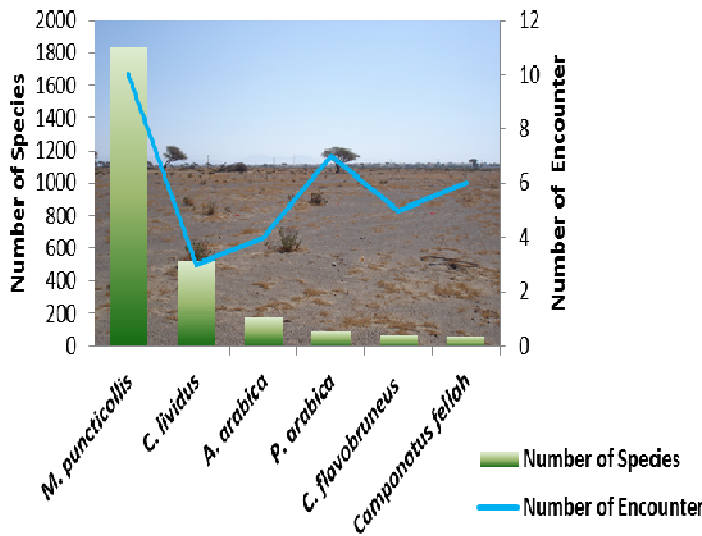


Figure 11. Capture frequencies of most abundant species in Mezyad.

Blaps kollari kollari, *Pimelia arabica*, *M. puncticolis*, *Trachyderma philistina*, *Zophosis pharaonis simplex*, *Zophosis complanata*, *Phaeotribon sp*, *Crosscherichia richteri*, *Capricephalinus bazmanicus*, *Camponotus fellah*, *Cataglyphis flavobrunneus* *Cataglyphis lividus*, *Monomorium tumairi*, *Monomorium wahibiensis*, *Thermobia domestica*, *Eremiaphila gene* and Arachnids include black fat tailed scorpion (*Androctonus crassicauda*) and camel spider species (*Rhagodes sp*).

There was a variation in the capture of invertebrates throughout seasons and their population densities

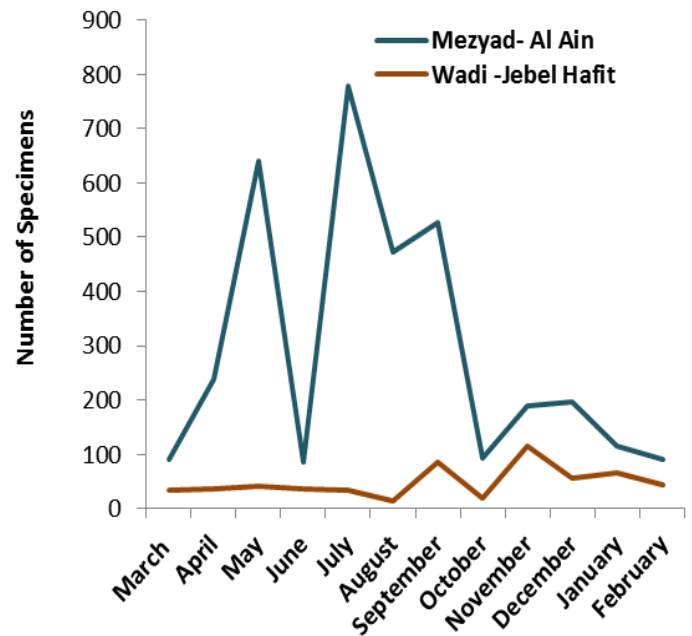


Figure 13. Number of invertebrates trapped in Wadi-Jebel Hafit and Mezyad from March 2010 to February 2011.

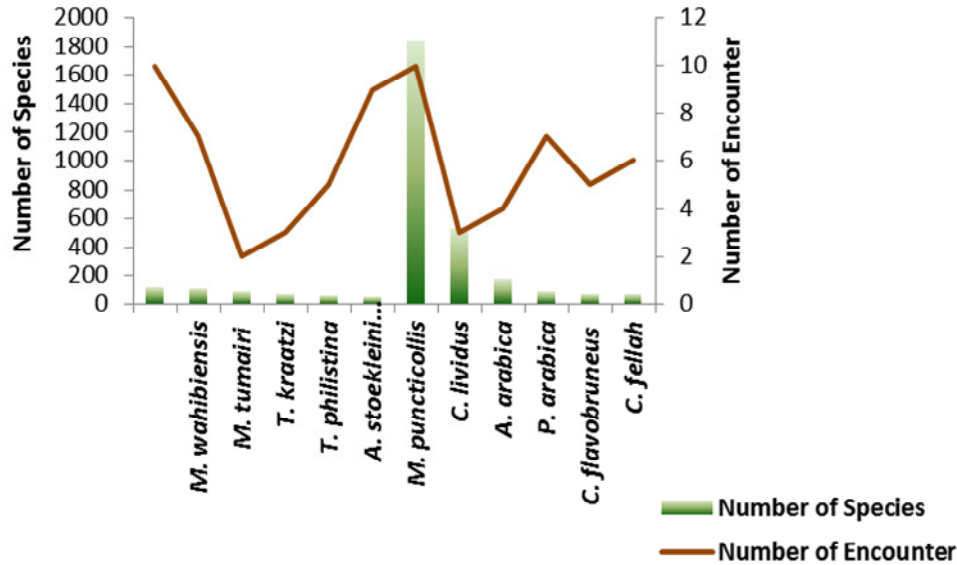


Figure 14. Dominant species recorded from two sites of Eastern Region.

Three beetle species. *M. puncticollis*, *A. arabica*, *Pimelia arabica* and three ant species *Cataglyphis lividus*, *Cataglyphis flavobrunneus* and *Camponotus fellah* were trapped frequently among the twenty invertebrate species from this site. *M. puncticollis* had a relatively long period of activity and in their population densities and were trapped from April to December and it declined in January. In contrast, *C. lividus*, *A. arabica* and *P. arabica* had relatively short periods of activity and their population fluctuations throughout the season were sharp. Species *C. lividus* and *A. arabica* showed peak densities in the month of May and almost disappeared in rest of the months. The seasonal pattern showing the number of major species in the site is presented in Figure 11.

The population of ant species *C. flavobrunneus* fluctuated considerably, forming peak in July and the other two species of ants *C. lividus* and *C. fellah* also showed comparatively medium capture rate in the same period. The ant species recorded from this site showed a decreasing trend from August to December. *M. puncticollis* is the most abundant species recorded from Mezyad site in terms of the number and number of encounter. Peak density of *M. puncticollis* was in July. *C. lividus* was noted to be the second abundant species in terms of number but this species appeared for a short period from April to July. The seasonal abundance of dominant species in the site is showed in Figure 12.

The other two abundant beetle species observed from the site are *A. arabica* and *P. arabica* of which first one showed peak appearance in April and the latter one in May. To summarize the results, we were able to show relationships between the physical parameters (temperature, humidity and rainfall) and the invertebrate occurrence. In Jebel Hafit, there is no correlation between invertebrate species occurrence and the physical parameters consi-

dered. But in Mezyad, no parameters except temperature have correlation between Invertebrate species' occurrence. The seasonal abundance of species trapped in two sites was different in the two sites. The number trapped in Wadi site was high in the month of November whereas in Mezyad site the numbers were high during the months of May, July, August and September (Figure 13). The seasonal abundance of Invertebrate species in the two sites of eastern region is shown in (Figure 13).

DISCUSSION

Invertebrates are now recognized as important components of biodiversity (Oliver and Beattie, 1996; Yen and Butcher, 1997). Invertebrate diversity and abundance were found to be relatively similar in Mezyad and Jebel Hafit with pitfall sampling method. The seasonal abundance of species trapped in two sites were different in the two sites. The number trapped in Wadi site was high in the month of November whereas in Mezyad site the numbers were high during the month of May, July, August and September.

In the current study, the distribution of ground dwelling invertebrate species varied in the different sites. Only five species were found in all sites but few species were strictly confined to particular habitats. The two beetle species *M. puncticollis*, *A. arabica*, and the ant species *M. tumairi*, *M. wahibiensis*, *C. flavobrunneus* were found in all sites. This indicates that these species are capable of existing in a wide range of habitats but the percentage of their distribution in each site shows that they have marked preferences to certain habitats. *A. cancellata cothurnata* were confined to Wadi site and they were scarce at Mezyad site. The Tenebrionid beetle species *M. puncticollis* were the dominant species, characterized by a high rate

Table 1. Total number, dominance and percent of distribution of Invertebrates in Eastern Region of Abu Dhabi Emirate.

Site wise species list	Distribution (%)		Dominance (%)	Abundance
	Jebel Hafit	Mezyad		
<i>Mesostena puncticollis</i>	1.1	62.9	52.6	1843
<i>Cataglyphis lividus</i>	0	17.9	14.9	525
<i>Apentanodes Arabica</i>	1.3	6.1	5.3	186
<i>Monomorium tumairi</i>	13.6	1.6	3.6	127
<i>Adesmia cancellata cothurnata</i>	19.8	0	3.3	116
<i>Monomorium wahibiense</i>	18.3	0.2	3.2	114
<i>Trachyderma philistina</i>	9.7	1.2	1.6	93
<i>Pimelia Arabica</i>	0	2.8	2.3	83
<i>Cataglyphis flavobrunneus</i>	2.7	2.1	2.2	80
<i>Thiraptrea kraatzi</i>	10.7	0	1.7	63
<i>Camponotus fellah</i>	0	2.0	1.6	59
<i>Crosscherichia richteri</i>	0	1.5	1.2	45
<i>Adesmia stoekleini rasalkhymana</i>	7.0	0	1.1	41
<i>Wadicosa fidelis</i>	2.7	0	0.4	16
<i>Zophosis pharaonis simplex</i>	0	0.5	0.4	15
<i>Camponotus xerxes</i>	2.3	0	0.3	14
<i>Adesmia cothurnata omanica</i>	2.2	0	0.3	13
<i>Adesmia arabica wittmeri</i>	1.8	0	0.3	11
<i>Sphingonotus rubescens</i>	1.3	0	0.2	8
<i>Dieuches mucronatus</i>	1.1	0	0.1	7
<i>Eremiaphila braueri</i>	1.0	0	0.1	6
<i>Paranysius fallaciosus</i>	1.0	0	0.1	6
<i>Phaeotribon sp.</i>	0	0.1	0.1	4
<i>Rhagodes sp</i>	0	0.1	0.1	4
<i>Scarabaeus baunuensis</i>	0.6	0	0.1	4
<i>Zophosis Complanata</i>	0	0.1	0.1	4
<i>Thermobia domestica</i>	0	0.1	0.0	3
<i>Androctonus crassicauda</i>	0	0.0	0.0	2
<i>Capricephalinus bazmanicus</i>	0	0.0	0.0	2
<i>Microthespis dimitriewi</i>	0.3	0	0.0	2
<i>Ochthebius (s.str) patergazellae</i>	0.3	0	0.0	2
<i>Prionothea coronata</i>	0	0.0	0.0	2
<i>Blaps kollari kollari</i>	0	0.0	0.0	1
<i>Eremiaphila gene</i>	0	0.0	0.0	1

of mobility. The least abundant beetle species such as *Prionothea coronata*, *Z. complanata*, *B. kollari kollari* and *S. baunuensis* were least active and, therefore, their capture rate was low. The number of pitfall trapped species of invertebrates in any habitat is well correlated not only with species abundance but also with activity (Aldryhim, et al., 1992; Saji and Al Dhaheri, 2011). However, the standardised and comparable data collected on species presence/absence, distribution patterns, habitat associations, diversity and abundance would be needed

for effective conservation and monitoring of invertebrate species and their habitats.

Conclusions

The pitfall traps have been considered as a reliable method for beetles (Ericson et al., 1985) and long-term trapping is required to understand the biodiversity, community composition and activity of different species in

different climatic conditions (Henschel et al., 2003). Our results indicate that there is an abundant, diverse assemblage of arthropod species, principally darkling beetles, associated with ant species in the Mezyad site at Eastern Region. It is important that most of the individuals associated with the ant-nest in Mezyad were Tenebrionid. This might be due to darkling beetles which are principally detritivorous (Crawford, 1979, 1991) and the darkling beetles and ants are the principal ground dwelling arthropods in the arid areas of eastern region in Abu Dhabi Emirate.

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