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An Entomological Survey of Camp Arifjan, Kuwait Comparing Species Richness
Between Different Areas and Degrees of Human Use

Ronald Hirzel

University of Nebraska, Lincoln

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Picture 1. Satellite View of Kuwait.

Abstract

The insect fauna of Camp Arifjan, Kuwait was sampled to determine species richness and how it was impacted by human development and activities. Insects were sampled at twelve sites representing three each of work, public use, residential and vacant brownfield areas. Sampling was conducted using net, sticky trap and pit traps for 60 days. Sticky traps were discarded as unworkable. The first of each species captured from each site was retained as a voucher specimen. Specimens were determined to lowest level possible using a dissecting microscope, available literature and the internet. Collecting and trapping obtained 355 specimens representing 170 species. 170/492 species is 34.56% of known insect species diversity in Kuwait. Insect species richness was tied to plant community richness which was in turn driven by soil and water conditions. Most sites had small “drainpipe oases” of ephemeral annual plant communities concentrated around drainpipes and runoff. Only sites 4, 5 and 6 retained any perennial native plants. Work areas had fewest plants and fewest insect species. Due to time and operational restrictions no off-post control areas were surveyed and the survey was of limited duration. A yearlong study including wild off-post areas would provide a better evaluation and baseline for future diversity studies and environmental programs.

Introduction/background

The State of Kuwait is located in the North East corner of the Arabian Peninsula. The country has an extensive eastern coastline on the Persian Gulf and is bordered on the North and West by Iraq and on the South by Saudi Arabia. It lies between latitudes 28°30' and 30°05' N and longitudes 46°33' and 48°30' E. Kuwait covers 11,073 square miles/17,818 square kilometers. Kuwait's topography is characterized by rocky and sandy plains, scattered hills and low relief. Elevation ranges from 248 meters in the west to sea level along the coast. (Omar et al. 2000, El Gamily 2007) Kuwait is almost completely arid or semi-arid with an average rainfall of 4.2 inches but this varies by location and from year to year. Annual temperatures range from 21 to 129 degrees Fahrenheit (WMO).

During and after the Gulf War Kuwait suffered major environmental damage from a number of human driven events. After the Iraqi invasion and during the liberation campaign thousands of heavy vehicles crisscrossed the desert compacting soil and increasing runoff; extensive fortifications and minefields were dug along Kuwait's southern and western borders, disrupting soil layers, killing plants and increasing soil loss. Millions of tons of explosives were detonated during the course of the war and its aftermath leaving residues. A total of 1,646,926 landmines were cleared from Kuwait by September 2000 including 1,078,966 anti-personnel mines and 567,960 anti-tank mines. (Kuwait Landmine Report) Engineer teams exploded 95.7% of

anti-personnel mines and 91.4% of anti-tank mines in the field. (Misak et al., 1999)

During the war Iraqi forces blew up over 800 oil wells, storage tanks, refineries and other petroleum facilities 753 of which ignited. They also ignited fire trenches and oil lakes. Before the last well fire was extinguished and capped on 6 November, 1991, about one billion barrels of oil had been burned or spilled. Approximately 40 million tons of soil across almost 400 square kilometers were saturated and oil soot plumes had covered 64% of the country's surface to varying degrees. (El Gamily 2007)



Camp Arifjan is located in South East Kuwait in Al Ahmadi province at 28° 54' N, 48° 11' E 6 kilometers west from the coast. The terrain of Camp Arifjan is an almost flat desert plain. Camp elevation is 10-15 meters above sea level. Soils are sandy and dry and lack organic components; the upper layers are

Picture 2. Oil fires, 7 April 1991

constantly blown by wind. Two plant communities mix

in the vicinity of the camp area. The dominant plant community to the northwest is the *Cyperus conglomeratus* community with pockets of *Rhanterium epapposum* communities in protected areas. The plant community to the southeast used to be *Rhanterium epapposum* but was eradicated due to camping, overgrazing and habitat damage and replaced with ruderal species. Camp Arifjan was constructed from 1999 to 2002. The substrate of all living,

administrative and work areas of the post is composed of packed compressed sand and gravel mix with a wind-blown sand covering with the notable exception of site #3. Due to habitat disturbance most vacant areas on post are sparsely covered with *Salsola imbricata*, *Kali* ssp. and other ruderal species. (Omar 2000) Currently most plant communities are landscaping, ephemeral annual or ruderal species. One small degraded *Rhanterium epapposum* community of approximately 600 square meters survives on post.

Methods and materials

12 sites were selected. Three sites were public use areas, three were residential/barracks areas, three were recovering brownfields and three were heavy work areas. Public use sites: #1 - vicinity of the hospital and medical complex; #2 - main dining facility (DFAC) area; #8 – zone 6 Post Exchange (PX) area. Residential sites: #3 – guest worker residences, zone 6; #9 – barracks, zone 6; #12 – senior office quarters, zone 1. Vacant/brownfield sites: #4 - zone 6; #5 in zone 4 - (contained *Rhanterium* community); #6 – zone 4. Work sites: #7 – container lot, zone 4; #10 – motor pool, zone 6; #11 – vehicle repair yard, zone 4. All sites were at least 150 meters from other sites and covered approximately 100 by 50 meters with buildings included. Vacant areas had no buildings although site 4 had a concrete foundation present.

Sites were to be surveyed/field collected and traps checked every three days, with evening visits to light sources. Collecting was done with a standard insect net. 2 Pit traps constructed out of 1 liter water bottles were emplaced in each site. Traps were dug in away from



Pictures 3, 4, 5. From top left: Vegetation behind hospital at site #1, Officer Housing, site #12, Vehicle Repair yard, site #11.

foot traffic, vehicle traffic and runoff areas; traps were placed at least 12 inches from walls and 36 inches from footpaths. Pit traps were checked, emptied and reset or replaced every visit.

Sites were visited at random times during the day to prevent a late afternoon bias.

2 traps in area 10 were run over by vehicles; 2 subsequent traps were parked upon. 4 traps in area 8 were removed by litter details, even after signs were placed. Area 8 traps were subsequently moved to new locations but 2 more were removed a week later. 2 traps in area 1 were buried by landscapers and subsequently relocated. 2 traps, one each in areas 5 and 6 in were dug up by Fennec foxes. Some loss of small non-ant specimens occurred from trapped Tenebrionid beetles. All traps in all sites were washed away or buried in mud during flooding on 25 March and not replaced.

Sticky traps were attempted but were ineffective due to dust and sand in all outside locations. After first placement they were discontinued. Indoor traps were problematic and unobserved due to local contractors and language/cultural barriers. I was unable to convince workers I needed to see occupied traps every 3 days. Workers believed I was a health inspector so workers showed me new freshly placed traps. If a trap collected any insects or a mouse, workers discarded and replaced the trap. I have excluded data from sticky traps. Specimens were determined as far as possible using a dissecting microscope, Borror and DeLong's *Introduction to the Study of Insects*, 7th Edition, Al-Houty's *Insect Fauna of Kuwait* and multiple websites including Dipterainfo, Wiki-ants and Atlas Hymenoptera.

During the planning and preparation phase of the project my duties allowed for several hours daily to survey. After start of the project my duties changed and daylight hours were rarely

available. Operations prevented me from surveying each site every three days. Sampling became haphazard with unequal time for each location.

Results

355 specimens were collected from the sites representing 170 species. See Table 1 for details.

Species	Order: Family	Species	Site	1	2	3	4	5	6	7	8	9	10	11	12
Col 1	Coleoptera: Tenebrionidae	<i>Adesmia stockleini</i>	P	P	P	P	p	p	p	p		P	p		p
Col 2	Coleoptera: Tenebrionidae	<i>Pimelia arabica</i>	p							p					
Col 3	Coleoptera: Tenebrionidae	<i>Adesmia lacunosa</i>	p		P										
Col 4	Coleoptera: Chrysomelidae	<i>Colaphellus apicalis</i>	p		p										P
Col 5	Coleoptera: Tenebrionidae	<i>Adesmia cancellata</i>	p		p			P	p	p		P			P
Col 6	Coleoptera: Tenebrionidae	<i>Alphitobius diaperinus</i>		P	p	P			P		P				
Col 7	Coleoptera: Tenebrionidae	<i>Trachyderma philistina</i>			P	p									
Col 8	Coleoptera: Carabidae	<i>Amara glenni</i>				p									
Col 9	Coleoptera: Tenebrionidae	<i>Adesmia carineta</i>				p									
Col 10	Coleoptera: Tenebrionidae	<i>Mesostena rathjensi</i>		P	P	p		p	p	p	P				
Col 11	Coleoptera: Tenebrionidae	<i>Pimelia zhenzhurist</i>							p				P		
Col 12	Coleoptera: Tenebrionidae	<i>Pimelia longula</i>							p						
Col 13	Coleoptera: Scarabaeidae	<i>Pentodon algerium</i>										P			p
Col 14	Coleoptera: Curculionidae	<i>Alloxantha talhouki</i>			P										p
Col 15	Coleoptera: Oedemeridae	<i>Trachyderma hespida</i>									P				P
Col 16	Coleoptera: Tenebrionidae	<i>Gonocephalum prolixus</i>							P	p					
Col 17	Coleoptera: Tenebrionidae	<i>Gabronthus maritimus</i>			P	P		P							
Col 18	Coleoptera: Staphylinidae	<i>Carpophilus hemipterus</i>			P						P				
Col 19	Coleoptera: Nitulidae	<i>Calosoma imbricatus</i>													
Col 20	Coleoptera: Carabidae	<i>Anthrenus coloratus</i>													
Col 21	Coleoptera: Dermestidae	<i>Akis elevata</i>				P		P							
Col 22	Coleoptera: Tenebrionidae	<i>Zophosis punctata</i>				P									
Col 23	Coleoptera: Tenebrionidae	<i>Bothynoderes anxius</i>								P					
Col 24	Coleoptera: Curculionidae	<i>Coccinella undecimpunctata</i>													
Col 25	Coleoptera: Coccinellidae	<i>Chrysoma</i>	p	p	p	P		P	p	p	p	P		P	P

		<i>albiceps</i>											
		<i>Ischiodon</i>											
Dip 2	Diptera: Syrphidae	<i>aegypticus</i>	p				P		P	P	P		P
		<i>Eumerus</i>											
Dip 3	Diptera: Syrphidae	<i>turcmenorum</i>	p		p	P	P						
		<i>Musca</i>											
Dip 4	Diptera: Muscidae	<i>domesticus</i>	p	p	p		P			p			P
		<i>Sarcophaga</i>											
Dip 5	Diptera: Sarcophagidae	<i>carnaria</i>	p		p	P							
Dip 6	Diptera: Calliphoridae	<i>Calliphora vicina</i>		P	p	P				p	P		P
Dip 7	Diptera: Muscidae	<i>Lipse pygmaea</i>	P	p	p				P	p			
		<i>Physiphora</i>											
Dip 8	Diptera: Otitidae	<i>olceae</i>			p								
Dip 9	Diptera: Muscidae				p								
		<i>Metasyrphis</i>											
Dip 10	Diptera: Syrphidae	<i>corolla</i>	P	p									
Dip 11	Diptera: Ephydriidae	<i>Ephydra flavipes</i>	P										
		<i>Sarcophaga</i>											
Dip 12	Diptera: Sarcophagidae	<i>haemorrhoidalis</i>				P	P						
Dip 13	Diptera: Syrphidae		P										P
		<i>Polypedilum</i>											
Dip 14	Diptera: Chironomidae	<i>nubifer</i>									P		P
		<i>Anastoechus</i>											
Dip 15	Diptera: Bombyliidae	<i>exalbidus</i>					P						
Dip 16	Diptera: Odiniidae	<i>Odinia?</i>			P	P	P	P					
Dip 17	Diptera: Bombyliidae	<i>Usia aurata</i>			P								
Dip 18	Diptera: Muscidae	<i>Coenosia tigrina</i>		P									
Dip 19	Diptera: Mythicomyiidae			P									
Dip 20	Diptera: Drosophilidae	<i>Drosophila?</i>		P									
Dip 21	Diptera: Muscidae	<i>Helina?</i>		P									
Dip 22	Diptera: Tephritidae	<i>Trupanea stellata</i>	P		P					P			p
		<i>Wohlfahrtia</i>											
Dip 23	Diptera: Sarcophagidae	<i>nuba</i>					P						
Dip 24	Diptera: Tephritidae	<i>Trupanea auger</i>											P
Dip 25	Diptera: Cecidomyiidae												P
Dip 26	Diptera: Scathophagidae												P
Dip 27	Diptera: Agromyzidae												P
Dip 28	Diptera: Agromyzidae		P										
Dip 29	Diptera: Drosophilidae	<i>Scaptomyza sp</i>	P										
Dip 30	Diptera: Ephydriidae				P								
Dip 31	Diptera: Heleomyzidae				P	P							
		<i>Cricopterus</i>											
Dip 32	Diptera: Chironomidae	<i>undescribed</i>											p
		<i>Procladus</i>											
Dip 33	Diptera: Chironomidae	<i>apicalis</i>											p
		<i>Chironomous sp</i>											
Dip 34	Diptera: Chironomidae	<i>(golden)</i>							P				p
Dip 35	Diptera: Aulacigastridae									P			
Dip 36	Diptera: Muscidae	<i>neomyia indica</i>								P			
Dip 37	Diptera: Syrphidae				P								
		<i>Limnophyes</i>											
Dip 38	Diptera: Chironomidae	<i>natalensis</i>											p
Dip 39	Diptera: Ceratopogonidae												P
Dip 40	Diptera: Dilichopodidae		P		P		P			P			P
Dip 41	Diptera: Fanniidae	<i>Fannia canicularis</i>			P					P			
Dip 42	Diptera: Lauxanidae		P										
Dip 43	Diptera: Tachinidae				P								
Dip 44	Diptera: Sciaridae												P
Dip 45	Diptera: Agromyzidae												P
Eph 1	Ephemeroptera: Baetidae	<i>Cleoen sp</i>				P							
		<i>black, w heavy</i>											
Het 1	Heteroptera: Aphidae	<i>vein</i>	p	P	P		P			P	P		P
Het 2	Heteroptera: Rhopalidae		P	P									
Het 3	Heteroptera:						P			P	P		P
Het 4	Heteroptera: Cicadellidae	<i>Hecalus</i>	P				P	P		P	P		P

32		<i>areniphilum</i>							
Hym									
33	Hymenoptera: Adrenidae								
Hym		<i>Cardiocondyla</i>							
34	Hymenoptera: Formicidae	<i>shuckardi</i>	P						
		<i>Lepisota sp.</i>							
Hym		<i>Golden</i>							
35	Hymenoptera: Formicidae	<i>transparent</i>	P						
Hym		<i>Campsomeriella</i>							
36	Hymenoptera: Scoliidae	<i>thoracica</i>	P						
Hym									
37	Hymenoptera: Sphecidae		P						
Hym		<i>Trichomyrex</i>							
38	Hymenoptera: Formicidae	<i>destructor</i>	P						
Hym		<i>Tapinoma</i>							
39	Hymenoptera: Formicidae	<i>karavaievi</i>	P						
Hym		<i>Monomorium</i>							
40	Hymenoptera: Formicidae	<i>venustum</i>			P				
	Hymenoptera:								
Hym41	Perilampidae		P						
Hym	Hymenoptera:								
42	Megaspilidae		P						
Hym									
43	Hymenoptera: Diapriidae		P						
Hym									
44	Hymenoptera: Adrenidae					P			
Hym									
45	Hymenoptera: Mymaridae					P			
Hym									
46	Hymenoptera:								
Hym									
47	Hymenoptera: Braconidae							P	
Hym		<i>Monomorium</i>							
48	Hymenoptera: Formicidae	<i>salomonis</i>						p	
Hym	Hymenoptera:								
49	Ichneumonidae?								P
Hym									
50	Hymenoptera: Halictidae	<i>Dufourea sp.</i>							p
Hym									
51	Hymenoptera: Apidae	<i>Apis mellifera</i>	P				P	P	
Hym	Hymenoptera:					P			
52	Perilampidae								
Hym	Hymenoptera:								
53	Perilampidae	VOID # Hym 52				P			
Hym	Hymenoptera:								
54	Ichneumonidae?					P			
Hym		<i>Nomioides</i>							
55	Hymenoptera: Halictidae	<i>variegata</i>	P						
Hym									
56	Hymenoptera: Cynipidae								P
Hym									
57	Hymenoptera: Adrenidae								P
Hym									
58	Hymenoptera: Braconidae		P						
Hym	Hymenoptera:								
59	Perilampidae								P
Hym	Hymenoptera:								
60	Perilampidae								P
Hym									
61	Hymenoptera: Mymaridae					P			
Hym	Hymenoptera:								
62	Sphecidae?					P			
Hym	Hymenoptera:								
63	Tenthredinidae					P			
Hym	Hymenoptera:								
64	Ichneumonidae					P			

Hym 65	Hymenoptera: Halictidae														P
Hym 66	Hymenoptera: Ichneumonidae														P
Hym 67	Hymenoptera: Colletidae							P							
Iso 1	Isoptera: Rhinotermitidae	<i>Psammotermes hybostoma</i>	P	P	P	p	P	p	p	P	P	P	P	P	P
Iso 2	Isoptera: Hodotermitidae	<i>Anacanthotermes vagans</i> <i>Hyles lineata livornica</i>			P							P			
Lep 1	Lepidoptera: Sphingidae	<i>Cynthia cardui</i>	p												P
Lep 2	Lepidoptera: Nymphalidae			P	p		P								
Lep 3	Lepidoptera:				p										
Lep 4	Lepidoptera: Lycaenidae	<i>Zizeeria karshandra</i>				p									
Lep 5	Lepidoptera: Pyralidae	<i>Nomophylla noctuella?</i>						P							p
Lep 6	Lepidoptera: Noctuidae	<i>Autographa gamma</i> <i>Heliothis peltigera</i>	P												
Lep 7	Lepidoptera: Noctuidae				P										
Lep 8	Lepidoptera: Pterophoridae				P										
Lep 9	Lepidoptera:				P										p
Lep 10	Lepidoptera: Crambidae				P										
Lep 11	Lepidoptera: Tortricidae?				P										
Lep 12	Lepidoptera:						P								p
Lep 13	Lepidoptera: Arctiidae	<i>Utetheisa pulchella</i>													
Lep 14	Lepidoptera:				P										
Lep 15	Lepidoptera:									P					
Ort 1	Orthoptera: Gryllidae														
Spr 1	Collembola:				P										
Spr 2	Collembola:		p												
Thp 1	Thysanoptera: Aelothripidae	<i>black/white bands</i>				p				p	P				
Thp 2	Thysanoptera: Aelothripidae	<i>Thrips tabaci</i>				P									
Thy 1	Thysanura: Nicoletiidae?					P	P	p							
Thy 2	Thysanura: Lepismatidae	<i>Lepisma saccharina</i>				p	p								
TOTAL			43	24	73	38	39	17	19	25	17	10	4	49	
			Pub	Pu b	Re s	Va c	Va c	Va c	wr k	pu b	re s	wr k	wr k	re s	

Table 1. Species collected per Site.

Plants were catalogued at each site and recorded in Figure 2.

Plants		Site1	Site2	Site3	Site4	Site5	Site6	Site7	Site8	Site9	Site10	Site11	Site12
<i>Nerium Oleander</i>	Apocyanaceae		P	P									
<i>Bougainvillea sp.</i>	Nyctaginaceae		P	P									
<i>Tecoma stans</i>	Bignoniaceae		P										
<i>Conocarpus erectus</i>	Combretaceae	P	P	P									
<i>Launea mucronata</i>	Asteraceae			P									P
<i>Moltkiopsis ciliata</i>	Boraginaceae		p		P	P					P		
<i>Fagonia bruquieri</i>	Zygophyllaceae	P	p	P	P	P	P	P	P	P	P		P
<i>Medicago laciniata</i>	Fabaceae			P									
<i>Tribulis terrestris</i>	Zygophyllaceae	P	P	P	P	P		P	P	P	P		P
<i>Brassica tournefortii</i>	Brassicaceae	P		P									P
<i>Senecio glaucus</i>	Asteraceae	P	P	P	P	P	P	P	P	P	P	P	P
<i>Caphile arabica</i>	Brassicaceae	P	P	P	P	P		P	P	P			P
<i>Citrullus colocynthis</i>	Curcubitaceae	P											P
<i>Salsola imbricata</i>	Amaranthaceae	P		P	P	P	P	P	P				
<i>Salsola kali</i>	Amaranthaceae	P		P	P	P	P	P	P		P		
<i>Grass 1</i>	Poaceae	P											
<i>Grass 2</i>	Poaceae	P							P				P
<i>Rumex vesicarius</i>	Polygonaceae	P		P	P			P	P	R		P	P
<i>Solanum nigrum</i>	Solanaceae								P				P
<i>Rhanterium epapposum</i>	Asteraceae					P	P						
<i>Scrophularia deserti</i>	Scrophulariaceae					P							
<i>Coriandrum sativum</i>	Apiaceae	P		P					P				P
<i>Phoenix dactylifera</i>	Arecaceae								P				
<i>Ocimum basilicum</i>	Lamiaceae			P					P				P
<i>Calendula persea</i>	Asteraceae			P									
<i>Calendula officinalis</i>	Asteraceae			P									
<i>Tagetes erecta</i>	Asteraceae			P									
<i>Solanum lycopersicum</i>	Solanaceae			P									
<i>Cucumis sativus</i>	Curcubitaceae	P		P									
<i>Allium cepa</i>	Amaryllidaceae			P				P					
<i>Alcea rosea</i>	Malvaceae			P									
<i>Petunia x hybrida</i>	Solanaceae			P									
<i>Cuscuta pedicellata</i>	Convolvulaceae									P			
<i>Citrus limon</i>	Rutaceae			P									
<i>Cardus pycnocephalus</i>	Asteraceae			P									P
<i>Sonchus oleraceus</i>	Asteraceae			p									p
<i>Lagenaria siceraria</i>	Curcubitaceae			p									
<i>Phaseolus vulgaris</i>	Fabaceae			P									
<i>Ziziphus spina-christi</i>	Rhamnaceae				p			p					
Total Plant species per site.		14	9	26	9	9	6	9	12	6	5	2	14

Table 2. Plant species present at each site.

Discussion

355 specimens comprising 170 insect species were collected. In addition all species of plants were identified at each site. Insect species counts ranged from 73 at site 3 to 4 at site 11.

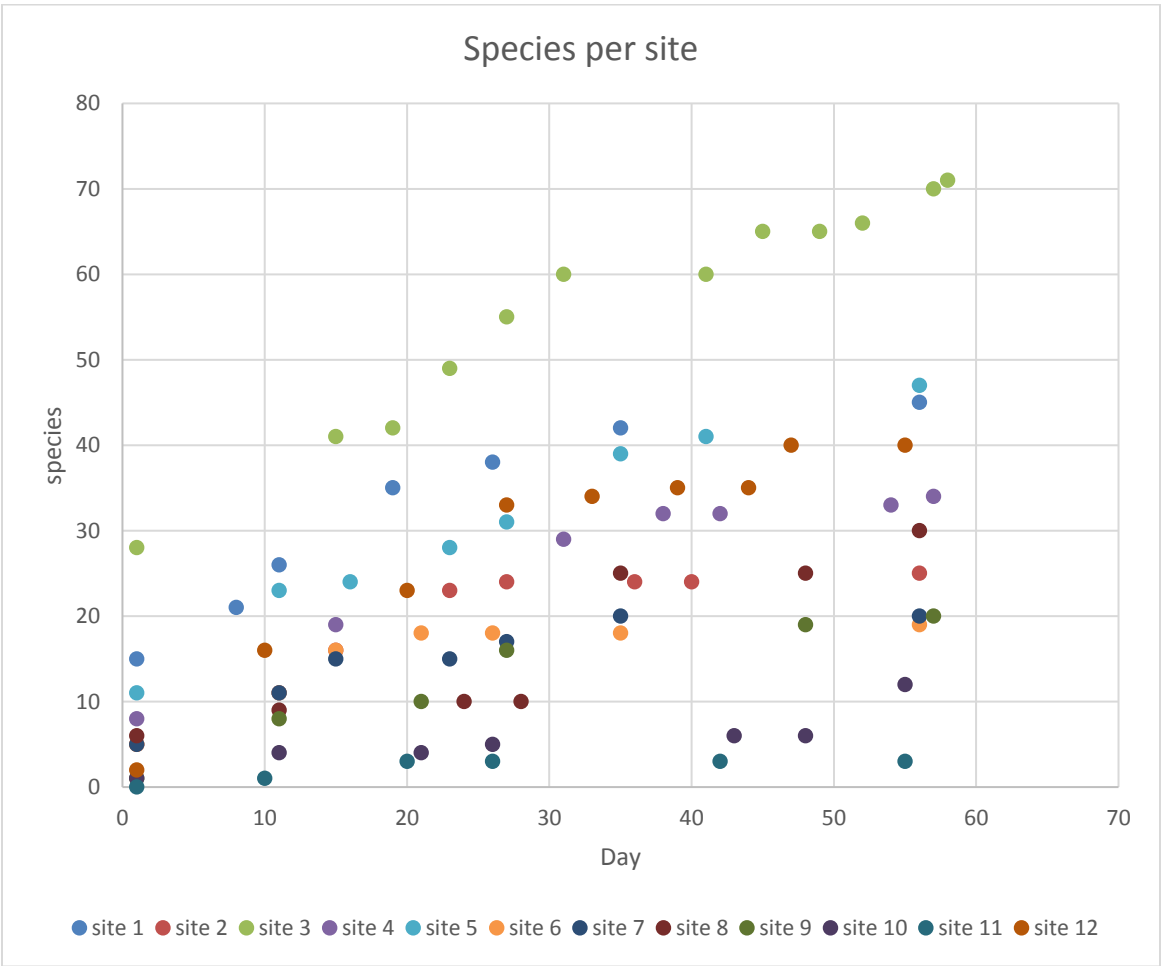


Table 3. Species captured daily per site.

The breakdown per residential areas was: 73 species for site 3, 17 species from site 9 and 49 species from site 12. Public areas breakdown was 43 species from site 1, 24 species from site 2

and 25 species from site 8. Vacant areas breakdown was 38 species from site 4, 39 species from site 5, and 17 species from site 6. Work areas breakdown was 19 species from site 7, 10 species from site 10 and 4 species from site 11.

Generally the defining factor for species richness was the amount and quality of each area's plant growth, and which use an area was put to influenced its plant growth. In most sites growing and flowering plants were confined to small areas around drain spouts, roof edges or air conditioning units. The concentrated runoff from these created small plant communities I call "drain spout oases". "Oases" plant communities were exclusively ephemeral annuals comprised of *Senecio glaucus*, *Caphile arabica*, *Rumex vesicarius* and additional rarer species.

Sites	3	5	1	12	4	8	2	7	9	6	10	11
Insects	73	37	43	49	39	25	24	19	17	17	10	4
Plants	26	9	14	14	9	12	9	8	6	6	5	2

Table 4. Insect and plant species by site.

Sites 1, 2, 7, 8, 9, and 12 had drain spout oases. Insects were found in conjunction with them but were sparse to absent elsewhere with the exception of ants which foraged everywhere. While site 1 and 2 had exotic plants in landscaping; these were rarely sought out by local insects. When landscapers weed whacked all vegetation around Site 12 on 15 March all subsequent captures were nocturnal species at lights. Not many nocturnal insects were collected due to predation by house sparrows. All areas of the camp are well lit at night for security reasons. House sparrows are active at all hours taking insects around bright light

sources. Zone 12 had horizontal fluorescent lights the sparrows could not access and half of the nocturnal specimens came from these.

Sites 4, 5, and 6 all had native vegetation and perennials with some crucial differences: Site 5 had a small stand of flowering *Rhanterium epappasum*, *Scrophularia deserti*, *Moltkiopsis ciliata* and an “ephemeral oasis” with *Senecio glaucus* and *Caphile arabica* blooming along a road. This was the closest to untouched native area left on post and had a large number of insect species with 39 captured. Site 4 had no *Rhanterium* present and was primarily a *Salsola* community but it had an ephemeral oasis along a foundation runoff; 38 species were captured there. Site 6 had *Salsola* and 3 non-blooming *Rhanterium* but no ephemeral annuals and no nectar sources. 17 species were captured there, roughly 44% of those present at site 4 and site 5.

Work areas had little to no vegetation and correspondingly low insect richness. Site 7 had some ephemeral oases, Site 10 bordered on the southeastern boundary and was adjacent to a few plants along the fence but had few insects in spite of that. Site 11 had almost no vegetation and was surrounded by other work areas in the center of the camp. Only 4 species were captured there.

Site 3 gets special mention. As the drainage system for the SE corner of Camp Arifjan it did not have a gravel layer and had adequate water to sustain plants. The stream bed and catch basin had ephemeral annuals along its length. Indian and Bangladeshi workers planted trees, flower gardens and a vegetable garden along the stream bed. This created three overlapping habitats

and 73 species were captured in the edge effects. Once again, exotic plants didn't draw as many insects as local species did but there was considerable overlap. The stream and catch basin were flooded and all vegetation uprooted or inundated on 25 March.

170 species is 34.56% of the 492 species known from Kuwait and more than I anticipated. In addition there were at least 17 species including 3 Odonata, Asilid flies, numerous wasps and Dictyophora that were observed but not captured due to lack of speed on my part.



Pictures 6 and 7 Site 3 catch basin showing ephemeral plants and stream bed with trees.

New species were emerging on a daily basis; on 26 March 4 species were captured for the first time at simultaneously at multiple sites. Site 11's accumulation curve reached asymptote but new captures continued at all other sites until the end of the survey.

Ants were notable for their variety, 25 species or 16% of all species captured were ants. 2 species, *Lepisota species* and *Tapinoma karavaievi* are recorded from Kuwait for the first time pending confirmation of determination. In addition a large (20 mm) black *Campanotus?* with

red legs was captured. This ant appears to be solitary and nocturnal, all daytime captures were individuals in small individual burrows under objects.

Kuwait and various Kuwaiti groups currently have several multi-year studies in progress as well as many remediation and conservation projects. A yearlong study on Camp Arifjan would establish another baseline for future studies but the post itself is a poor candidate for habitat restoration; however site 5 could easily be set aside and protected. As there are no grazing animals on the camp fencing to prevent vehicle intrusion would be sufficient. Dunes form against *Rhanterium* shrubs, deepening soil layers and providing better chances to establish new plants.

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Figure 1. Jacques Desclotres, MODIS Land Rapid Response Team, NASA/GSFC. Cropped from: http://visibleearth.nasa.gov/view_rec.php?id=2252

Figure 2. NASA. <http://eol.jsc.nasa.gov/scripts/sseop/photo.pl?mission=STS037&roll=152&frame=91>

All others Ron Hirzel



Campanotus xerces nest



Tecoma stans



Packed gravel substrate covers Camp Arifjan



Pit trap



Scropholaria deserti



Moltkiopsis ciliata



Dodder (Cuscuta)



Caphile arabica



Rumex vesicarius



Drain pipe oasis



Senecio glaucus



Alloxantha talhouki on *Caphile Arabica*



Tribulis terrestris



Alloxantha talhouki Coleoptera: Oedemeridae



Eumerus turcmenorum Diptera: Syrphidae



Ischiodon aegypticus Diptera: Syrphidae



Salsola kali



Pimelia Arabica Coleoptera: Tenebrionidae



Adesmia stockleini Coleoptera: Tenebrionidae *Adesmia cancellata* Coleoptera: Tenebrionidae



Medicago linciata



Calendula officinalis



Floor of catch basin



Sonchus oleraceus



Salsola imbricata



Fagonia brugieri



Rhanterium epapposum



Rhanterium epapposum



Cyperus conglomeratus



Enlisted barracks with drain spout oases



Fly Trap



Utetheisa pulchella Lepidoptera: Arctiidae



Chrysoma albiceps Diptera: Calliphoridae



Mesostoma rathjensi Coleoptera: Tenebrionidae



Akis elivata Coleoptera: Tenebrionidae



Ziziphus spina-christi and palm tree