



## Goats: a threat to biodiversity in the United Arab Emirates

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### Abstract

Goats have a severe negative impact on the environment since they graze on native vegetation, preventing regeneration. To examine the effect of goats and other grazing animals on local flora, a study was conducted at Wadi Ghalilah in the emirate of Ra's al-Khaimah. For the purpose, five abandoned, but fenced, farms and two unfenced farms were studied to determine the number of plant species growing there. In the enclosed farms, 74 plant species were noted that represent more than 9% of the recorded United Arab Emirates (UAE) flora, while in the open farms only two taxa were recorded.

Two of the recorded species from the area are rare, while four species have only recently been recorded in the UAE for the first time. The fenced plots can be described as islands of biodiversity, with between 20 and 44 species of flora present, thus helping to protect the wild plant species of the region. The surrounding area is dominated by *Tephrosia apollinea*, a poisonous plant species disliked by goats and other browsing mammals. Controls on the numbers of goats present may help to ensure the survival of the local flora, contributing to preservation of biodiversity in the region.



Picture 1. Goats feeding in Wadi Ghalilah

### Introduction

Unrestrained grazing by goats (*Capra hircus* L.) can have a serious impact on native plants and wildlife. Goats have been identified as a serious pest in many parts of the world and are included in a list of the 100 worst invasive species (Lowe *et al.* 2000). Goats have a major impact on local flora through soil damage and overgrazing of native plants. This over-browsing leads to soil erosion (Bayne *et al.* 2004) and prevents plant regeneration (Harrington, 1979).

In many parts of the United Arab Emirates (UAE), people raise goats for meat and milk. In some areas of the northern emirates, farmers may have herds of between 20-100 goats which are generally left to roam freely, feeding on the natural vegetation (Picture 1). In areas where the goats are free to move around, most of the native flora

has been consumed, with only plants unpalatable to goats surviving. The goats also have an indirect impact on native fauna.

Thus, for example, they compete for food and water with Arabian tahr, *Arabitragus jayakari*, a near-endemic species classified as Endangered by the International Union for the Conservation of Nature, IUCN, whose numbers have fallen to an estimated 50 in the UAE. Tahr eat only the upper parts of plants, while goats browse plants to such an extent that they do not regenerate.

Wadi Ghalilah, part of the emirate of Ra's al-Khaimah, is situated in the Hajar Mountains, which stretch from the UAE into north-eastern Oman, and opens onto the coastal plain around five kilometres from the Arabian Gulf coast. Within the wadi are numerous small farms (Picture 2), with







Picture 2. Farms in Wadi Ghalilah



Picture 3. Fence around a farm in Wadi Ghalilah to exclude grazing animals

**Table 1. Information on fenced and open farms that were studied for wild flora in Wadi Ghalilah, Ra's al-Khaimah**

S.N.	Farm type	Coordinates		Elevation (ft)	Area (m <sup>2</sup> )
		N	E		
1	Fenced 1	25°59.102	056°08.316	403	1,200
2	Fenced 2	25°58.373	056°09.034	543	2,400
3	Fenced 3	25°58.626	056°09.057	590	1,500
4	Fenced 4	25°58.380	056°07.240	290	1,400
5	Fenced 5	25°58.377	056°08.556	531	2,750
6	Open 1	25°58.225	056°09.082	813	1,000
7	Open 2	25°58.361	056°09.053	590	750







an area of between 700-5,000 sq.m. The majority of these are fenced, to keep grazing animals, in particular goats, away from the crops. At present, many of the farms are not being actively cultivated, allowing wild plant species areas in which to grow.

The presence of farms which are fenced and abandoned or unfenced allows an assessment to be made on the impact of grazing animals, primarily goats, on local wild flora.

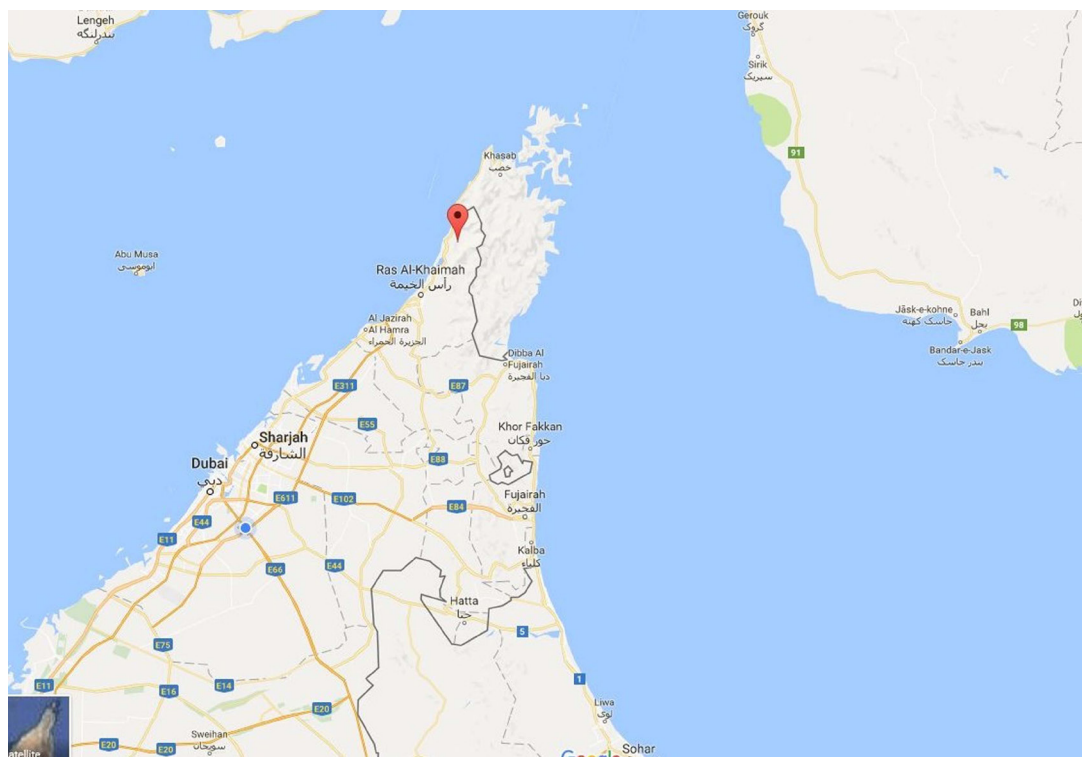
**Materials and Methods**

Five enclosed farms which have been used for the growing of crops in the past or are still being used were selected for the study (Table 1). Where necessary, new fences were erected, to prevent access by goats (Picture 3). For control, two unfenced farms were also studied to see the effect of browsing on plant species (Table 1).

The study was carried out during February-May, 2017. Specimens of different plant species growing in the open and fenced plots were collected, using Jongbloed, 2003 and Karim and Fawzi, 2007 for identification. Observation of the populations of the plant species were also made. A Garmin GPS 72H was used to record the co-ordinates of each location.

**Results and Discussion**

The botanical exploration of Wadi Ghalilah with emphasis on the five enclosed and two open abandoned farms provides an indication of the biodiversity that may have existed in the region without goats. Goat numbers are believed to have increased considerably in recent years. The study of the fenced farms indicated the presence of a rich native flora while the paucity of flora in unfenced plots exposes the threat to biodiversity in the valley.





## Fenced Farms

### Farm 1

Thirty-nine plant species were found, belonging to 20 different families (Table 2; Picture 4). With 11, the Poaceae family had the largest number of species in the plot followed by the Asteraceae, with 5. The dominant species in the plot was *Malva parviflora*. Two of the species, *Melanocentris abyssinica* and *Rostraria cristata*, found in the farm are rare in the UAE (Jongbloed, 2003), and may require proper documentation and protection.



Picture 4. The enclosed Farm 1 is dominated by *Malva parviflora*

Table 2. Plant species found in fenced Farm 1

	Species	Family	S.N.	Species	Family
1	<i>Periploca aphylla</i>	Asclepiadaceae	21	<i>Acacia tortilis</i>	Mimosaceae
2	<i>Senecio glaucus</i>	Asteraceae	22	<i>Plantago ovata</i>	Plantaginaceae
3	<i>Reichardia tingitana</i>	Asteraceae	23	<i>Brachypodium distachyum</i>	Poaceae
4	<i>Launaea capitata</i>	Asteraceae	24	<i>Cenchrus setigerus</i>	Poaceae
5	<i>Launaea nudicaulis</i>	Asteraceae	25	<i>Aristida adscensionis</i>	Poaceae
6	<i>Pulicaria edmondsonii</i>	Asteraceae	26	<i>Erograstis barrelieri</i>	Poaceae
7	<i>Helitropium calcareum</i>	Boraginaceae	27	<i>Echinochloa colona</i>	Poaceae
8	<i>Erucaria hispaniaca</i>	Brassicaceae	28	<i>Panicum antidotale</i>	Poaceae
9	<i>Farsetia aegyptica</i>	Brassicaceae	29	<i>Cynodon dactylon</i>	Poaceae
10	<i>Sisymbrium irio</i>	Brassicaceae	30	<i>Eragrostis ciliaris</i>	Poaceae
11	<i>Polycarpon tetraphyllum</i>	Caryophyllaceae	31	<i>Rostraria cristata</i>	Poaceae
12	<i>Chenopodium murale</i>	Chenopodiaceae	32	<i>Melanocentris abyssinica</i>	Poaceae
13	<i>Citrullus colocynthis</i>	Cucurbitaceae	33	<i>Cenchrus ciliaris</i>	Poaceae
14	<i>Cyperus rotundus</i>	Cyperaceae	34	<i>Zizyphus spina-christi</i>	Rhamnaceae
15	<i>Trigonella hamosa</i>	Fabaceae	35	<i>Gaillonia aucheri</i>	Rubiaceae
16	<i>Tephrosia apollinea</i>	Fabaceae	36	<i>Lycium shawii</i>	Solanaceae
17	<i>Medicago lanciniata</i>	Fabaceae	37	<i>Solanum nigrum</i>	Solanaceae
18	<i>Erodium laciniatum</i>	Geraniaceae	38	<i>Forsskaolea tenacissima</i>	Urticaceae
19	<i>Asphodelus tenuifolius</i>	Liliaceae	39	<i>Fagonia bruguieri</i>	Zygophyllaceae
20	<i>Malva parviflora</i>	Malvaceae			

### Farm 2

This plot had the maximum number of wild plant species of all farms studied, a total of 44 species, from 21 plant families (Table 3; Picture 5). The Poaceae had the largest number of species (10) followed by the Asteraceae, with 5 (Table 3). Three of the species found in the farm were recorded quite recently for the first time from the UAE including *Helitropium lasiocarpum* and *Convolvulus fatmensis*, from the Convolvulaceae (Shahid and Rao, 2016a) and *Eleusine indica* of the Poaceae (Shahid and Rao, 2016b). Two taxa, *Valantia hispida* and *Malva parviflora*, were particularly abundant.



Picture 5. Different plant species growing in fenced Farm 2







**Table 3. Plant species found in fenced Farm 2**

S.N.	Species	Family	S.N.	Species	Family
1	<i>Calendula arvensis</i>	Asteraceae	23	<i>Malva parviflora</i>	Malvaceae
2	<i>Filago desertorum</i>	Asteraceae	24	<i>Acacia tortilis</i>	Mimosaceae
3	<i>Pentanema divaricatum</i>	Asteraceae	25	<i>Prosopis juliflora</i>	Mimosaceae
4	<i>Senecio glaucus</i>	Asteraceae	26	<i>Ficus carica</i>	Moraceae
5	<i>Sonchus tenerrimus</i>	Asteraceae	27	<i>Moringa peregrina</i>	Moringaceae
6	<i>Helitropium calcareum</i>	Boraginaceae	28	<i>Plantago ovata</i>	Plantaginaceae
7	<i>Helitropium lasiocarpum</i>	Boraginaceae	29	<i>Avena fatua</i>	Poaceae
8	<i>Erucaria hispaniaca</i>	Brassicaceae	30	<i>Brachypodium distachyum</i>	Poaceae
9	<i>Sisymbrium irio</i>	Brassicaceae	31	<i>Cenchrus ciliaris</i>	Poaceae
10	<i>Arenaria deflexa</i>	Caryophyllaceae	32	<i>Cenchrus setigerus</i>	Poaceae
11	<i>Polycarpon tetraphyllum</i>	Caryophyllaceae	33	<i>Eleusine indica</i>	Poaceae
12	<i>Chenopodium album</i>	Chenopodiaceae	34	<i>Eragrostis barrelieri</i>	Poaceae
13	<i>Chenopodium murale</i>	Chenopodiaceae	35	<i>Eragrostis cilianensis</i>	Poaceae
14	<i>Convolvulus fatamensis</i>	Convolvulaceae	36	<i>Panicum antidotale</i>	Poaceae
15	<i>Citrullus colocynthis</i>	Cucurbitaceae	37	<i>Phalaris minor</i>	Poaceae
16	<i>Euphorbia granulata</i>	Euphobiaceae	38	<i>Setaria verticillata</i>	Poaceae
17	<i>Medicago lanciniata</i>	Fabaceae	39	<i>Emex spinosa</i>	Polygonaceae
18	<i>Melilotus indicus</i>	Fabaceae	40	<i>Rumex vesicarius</i>	Polygonaceae
19	<i>Tephrosia apollinea</i>	Fabaceae	41	<i>Zizyphus spina-christi</i>	Rhamnaceae
20	<i>Trigonella hamosa</i>	Fabaceae	42	<i>Valantia hispida</i>	Rubiaceae
21	<i>Erodium laciniatum</i>	Geraniaceae	43	<i>Ammi majus</i>	Umbelliferae
22	<i>Geranium mascatense</i>	Geraniaceae	44	<i>Forsskaolea tenacissima</i>	Urticaceae

**Farm 3**

Twenty species belonging to 14 plant families were documented (Table 4; Picture 6). Two grass species, *Digitaria sanguinalis* and *Brachypodium distachyum*, were abundant, while the Brassicaceae were the most common family (Table 4).



Picture 6. A view of Farm 3 with various wild plant species

**Table 4. Plant species found in fenced Farm 3**

	Species	Family	S.N.	Species	Family
1	<i>Reichardia tingitana</i>	Asteraceae	11	<i>Geranium mascatense</i>	Geraniaceae
2	<i>Helitropium calcareum</i>	Boraginaceae	12	<i>Acacia tortilis</i>	Mimosaceae
3	<i>Brassica napus</i>	Brassicaceae	13	<i>Brachypodium distachyum</i>	Poaceae
4	<i>Erucaria hispaniaca</i>	Brassicaceae	14	<i>Digitaria sanguinalis</i>	Poaceae
5	<i>Sisymbrium irio</i>	Brassicaceae	15	<i>Rumex vesicarius</i>	Polygonaceae
6	<i>Convolvulus fatamensis</i>	Convolvulaceae	16	<i>Anagallis arvensis</i>	Primulaceae
7	<i>Chrozophora oblongifolia</i>	Euphobiaceae	17	<i>Zizyphus spina-christi</i>	Rhamnaceae
8	<i>Medicago lanciniata</i>	Fabaceae	18	<i>Galium setaceum</i>	Rubiaceae
9	<i>Tephrosia apollinea</i>	Fabaceae	19	<i>Valantia hispida</i>	Rubiaceae
10	<i>Erodium laciniatum</i>	Geraniaceae	20	<i>Forsskaolea tenacissima</i>	Urticaceae





#### Farm 4

This farm had 24 plant species from 15 different families (Table 5; Picture 7). One of the species, *Arenaria deflexa*, was identified as a first record for the UAE by the author one year ago (Shahid and Rao, 2016b). Interestingly, it was also the most abundant species in the farm. Fabaceae and Poaceae both were represented by 4 species each, the maximum number of taxa for any family found there.



Picture 7. The most abundant species in Farm 4 was *Arenaria deflexa*

Table 5. Plant species found in fenced Farm 4

	Species	Family	S.N.	Species	Family
1	<i>Launaea capitata</i>	Asteraceae	13	<i>Erodium laciniatum</i>	Geraniaceae
2	<i>Sonchus oleraceus</i>	Asteraceae	14	<i>Erodium laciniatum</i>	Geraniaceae
3	<i>Erucaria hispaniaca</i>	Brassicaceae	15	<i>Asphodelus tenuifolius</i>	Liliaceae
4	<i>Sisymbrium irio</i>	Brassicaceae	16	<i>Malva parviflora</i>	Malvaceae
5	<i>Arenaria deflexa</i>	Caryophyllaceae	17	<i>Plantago ovata</i>	Plantaginaceae
6	<i>Convolvulus fatamensis</i>	Convolvulaceae	18	<i>Cenchrus ciliaris</i>	Poaceae
7	<i>Citrullus colocynthis</i>	Cucurbitaceae	19	<i>Brachypodium distachyum</i>	Poaceae
8	<i>Euphorbia granulata</i>	Euphobiaceae	20	<i>Aristida adscensionis</i>	Poaceae
9	<i>Melilotus indicus</i>	Fabaceae	21	<i>Eragrostis cilianensis</i>	Poaceae
10	<i>Trigonella hamosa</i>	Fabaceae	22	<i>Emex spinosa</i>	Polygonaceae
11	<i>Tephrosia apollinea</i>	Fabaceae	23	<i>Zizyphus spina-christi</i>	Rhamnaceae
12	<i>Medicago lanciniata</i>	Fabaceae	24	<i>Parietaria alsinifolia</i>	Urtiaceae

#### Farm 5

Thirty-two plant species from 22 families were observed (Table 6; Picture 8). This uncultivated plot had the greatest diversity of plant families of the five enclosed plots that were studied. *Malva parviflora* was the most common species while the Poaceae had more species (5) than any other plant family growing in the farm.



Picture 8. A panoramic view of Farm 5







**Table 5. Plant species found in fenced Farm 5**

	Species	Family	S.N.	Species	Family
1	<i>Adiantum capillus-veneris</i>	Adiantaceae	17	<i>Plantago ovata</i>	Plantaginaceae
2	<i>Sonchus oleraceus</i>	Asteraceae	18	<i>Brachypodium distachyum</i>	Poaceae
3	<i>Urospermum picroides</i>	Asteraceae	19	<i>Cynodon dactylon</i>	Poaceae
4	<i>Helitropium calcareum</i>	Boraginaceae	20	<i>Eragrostis cilianensis</i>	Poaceae
5	<i>Erucaria hispaniaca</i>	Brassicaceae	21	<i>Panicum antidotale</i>	Poaceae
6	<i>Sisymbrium irio</i>	Brassicaceae	22	<i>Setaria verticillata</i>	Poaceae
7	<i>Chenopodium murale</i>	Chenopodiaceae	23	<i>Emex spinosa</i>	Polygonaceae
8	<i>Citrullus colocynthis</i>	Cucurbitaceae	24	<i>Rumex vesicarius</i>	Polygonaceae
9	<i>Tephrosia apollinea</i>	Fabaceae	25	<i>Ochradenus arabicus</i>	Resadaceae
10	<i>Medicago laciniata</i>	Fabaceae	26	<i>izyphus spina-christi</i>	Rhamnaceae
11	<i>Erodium laciniatum</i>	Geraniaceae	27	<i>Valantia hispida</i>	Rubiaceae
12	<i>Geranium mascatense</i>	Geraniaceae	28	<i>Scrophularia arguta</i>	Scrophulariaceae
13	<i>Asphodelus tenuifolius</i>	Liliaceae	29	<i>Lycium shawii</i>	Solanaceae
14	<i>Malva parviflora</i>	Malvaceae	30	<i>Ammi majus</i>	Umbelliferae
15	<i>Acacia tortilis</i>	Mimosaceae	31	<i>Forsskaolea tenacissima</i>	Urticaceae
16	<i>Ficus carica</i>	Moraceae	32	<i>Parietaria alsinifolia</i>	Urticaceae

### Open Farms

Exploration of the two open (unfenced) farms found only two plant species. In unfenced Farm 1, *Tephrosia apollinea* and *Polycarpon tetraphyllum* were noted (Picture 9), while in Farm 2, only *T. apollinea* was found (Picture 10). In Farm 1, *P. tetraphyllum* covered the greater part of the land surface. Goats were the only grazing mammals seen moving freely in the open farms. It appeared that plants of *P. tetraphyllum* were too small to be browsed by goats while the other species, *T. apollinea*, is unpalatable. The lack of plant diversity in the open farms provides an indication of the impact of goats on the species found in Wadi Ghalilah.

A total of 74 different plant species were recorded from all the five enclosed and two open deserted farms, representing more than 9% of the UAE wild flora. A total of 30 families were recorded, representing over 33% of all plant families found in the UAE.

In the last year, records of four plant species previously unrecorded in the Emirates were made within a small part of the area. Further unrecorded species may be present.

Outside the fenced agriculture farms, most of the vegetation was comprised of poisonous or inedible plant species, which are disliked by the browsing goats. The majority of the plants growing in these areas were *Tephrosia apollinea* (Photo 11), a perennial legume

species, which is toxic and is not grazed (Ghazanfar and Fisher, 1998). Other plant species found in small numbers included *Asphodelus tenuifolius* (Liliaceae), *Calotropis procera* (Asclepidiaceae), *Citrullus colocynthis* (Cucurbitaceae), *Emex spinosa* (Polygonaceae), *Fagonia bruguieri* (Zyophillaceae), *Forsskaolea tenacissima* (Urticaceae), *Polycarpon tetraphyllum* (Caryophyllaceae), and *Schweinfurthia papilionacea* (Scrophulariaceae).

### Conclusions

These findings demonstrate that goats have a serious effect on biodiversity. If goat numbers are controlled, there may be a rejuvenation of native plant life that may help to preserve a healthy ecosystem.

The data above are based on one year of research in a small area. Study of a larger area over a longer period may provide evidence of more undocumented plant species in Wadi Ghalilah.





Picture 9. A large part of the open Farm 1 was covered with small plants of *Polycarpon tetraphyllum*



Picture 10. In open Farm 2, only one species, *Tephrosia apollinea*, was growing



Picture 11. The toxic plant species *Tephrosia apollinea* growing outside a fenced farm in Wadi Ghallah







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