Plant Archives Volume 20 No. 2, 2020 pp. 7309-7320 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

CHARACTERIZATION AND MAPPING OF RANGELANDS VEGETATION OF WADI UMM ASHTAN AT NORTH WESTERN COAST OF EGYPT

Mahmoud A. Gomaa[1], Essam E. Kandil[1], Asmaa A. Farouk[2], Ahmed H. Mohamed[3] and Abdalsamad Aldabaa[4]

[1]Plant Production Department, Faculty of Agriculture, Saba Basha, Alexandria University, Egypt.
[2]Sustianable Development Center of Matrouh Resources, Desert Research Center, Matrouh, Egypt.
[3]Department of Plant Ecology and Rangeland Management, Desert Research Center, Cairo, Egypt.
[4]Department of Pedology, Desert Research Center, Cairo, Egypt.

Abstract

Rangelands in Egypt are located in arid environments and being degraded as animal numbers expand to meet a growing human population on a shrinking resource base. The object of this study was to map rangeland area in Wadi Umm Ashtan using high resolution satellite imagery and characterize rangeland vegetation in these studied areas using ground vegetation survey at wet and dry seasons. This study was carried out during the extended period from spring 2017 to autumn 2017 at Wadi Umm Ashtan area in the North Western Coast of Egypt. Rangeland attributes were estimated in wet and dry seasons, and rangelands vegetation measurements in seven representative sites were included plant density, coverage, frequency, and importance value. Sentinel 2 high-resolution satellite imagery was used to map the major land cover and rangelands area in the studied area. NDVI and supervised classification were implemented and accuracy assessment of the produced classified map was conducted. The results indicated that there were significant differences in rangelands vegetation characteristics as affected by the interaction between the different studied sites of Wadi Umm Ashtan and dry and wet seasons during 2017. The highest value of the plant coverage percentage of 47.8 % was recorded under site number seven, while the minimum value was obtained under the fourth studied site at the study area. Significant differences were found between the different studied locations and growth seasons in plant frequency, plant density, plant cover, and importance value. Overall accuracy of 83.57 % and Kappa Coefficient of 0.82 were achieved for the supervised classification of Sentinel 2 satellite image of the study area. The highest value of user's accuracies of 100% was recorded in Water class, followed by 95 % and 85 % for rangelands and winter crops, respectively. These finding could be valuable for the development of sustainable management plans of rangelands and Wadis and arid lands.

Key words: Desert rangeland vegetation, Sentinel 2, NDVI, Plant Cover, Supervised classification, importance value

Introduction

The rangelands in Egypt located in four main areas: the North West Coast, the North East Coast, Sinai, Halaib and Shalatin. The causes of rangeland degradation in the Mediterranean coastal region of Egypt are mixes of environmental, socio-political and socioeconomic conditions .The North coast of Egypt is stretch from the west coast of Alexandria in the east and the Egyptian-Libyan borders at Salloum in the west of Egypt. The grazing pattern in Egypt's rangelands is continuous grazing. The nomadic tribes move behind the grass and the water, and with the development of some of these communities, especially in the North West Coast, the rate of stability has increased and grazing has become a higher center near the residential communities of these tribes.

The Western Mediterranean Coastal land covered about 2.3 million hectares is one of the richest phyto-geographical regions in Egypt because of its relatively high rainfall. It contains 50% of the total flora of Egypt (El-Hakeem, 2017) and considered as one of the richest grazing areas in the Egyptian costal region. This region has more than 1000 species of Egypt flora (Boulos, 1995; Tackholm, 1974), which vary in their physiological needs and therefore their natural environments, which is reflected in their distribution in different desert ranges. Accordingly, natural vegetation of the North West Coast of Egypt is considered the most important source of animal feed in this area. Grazing considered the most important activity which represent the main economic source of many Bedouins along the North West Coast Unfortunately now this area under consideration suffers from decreased rates of rain, and the replacement of natural flora with other crops, overgrazing, urbanization, which led to eliminate most of grazing areas in the North West Coast. The common livestock types in the area including goats, camels and sheep. Livestock in the study area depend mainly on the natural vegetation to provide their nutrient requirements. Rangeland productivity depends on various factors including climate, soil, botanical composition and rangeland management practices such as grazing patterns, stocking rates and livestock grazing distribution.

Remote sensing has long been an important and effective means for monitoring land cover with its ability to quickly support broad, precise, impartial and easily available information regarding the spatial variability of the land surface (Hansen *et al.,* 2000; Liu *et al*., 2003). Moreover, remote sensing has potential for monitoring rangeland production at different scales (Hunt Jr *et al*., 2003) whereas its advantage is that actual production for an entire area can be estimated, which is easier and less expensive than ground sampling with small plots. There is evidence that remote sensing manifest excellent to conventional ground measurement methods, therefore (Booth *et al*., 2005) enumerated four reasons: (1) it facilities inclusive data collection by reducing that labor demands for monitoring, (2) it minimize human bias by limiting the effect of human judgment, (3) it is more accurate and (4) it provides a permanent record of information that can be retained for future scrutiny. Therefore, all kinds of remote sensing were widely applied in monitoring of rangeland production (Jansen *et al*., 2018; Reeves *et al*., 2006; Sibanda *et al*., 2016; Xu *et al*., 2007), land use and land cover (Langner *et al*., 2007; Pan *et al*., 2011; Tang and Zhang, 2002). Providing pertinent data to ranchers and land manager to enhance management outcomes has proved difficult using traditional in-field monitoring approaches (Washington-Allen *et al*., 2006). Qualitative methods are highly subjected and cannot strongly be compared over time and between areas or observers (Pyke *et al*., 2002). In-field quantitative methods have been critiqued because data acquisition is costly, data may not be representative of conditions

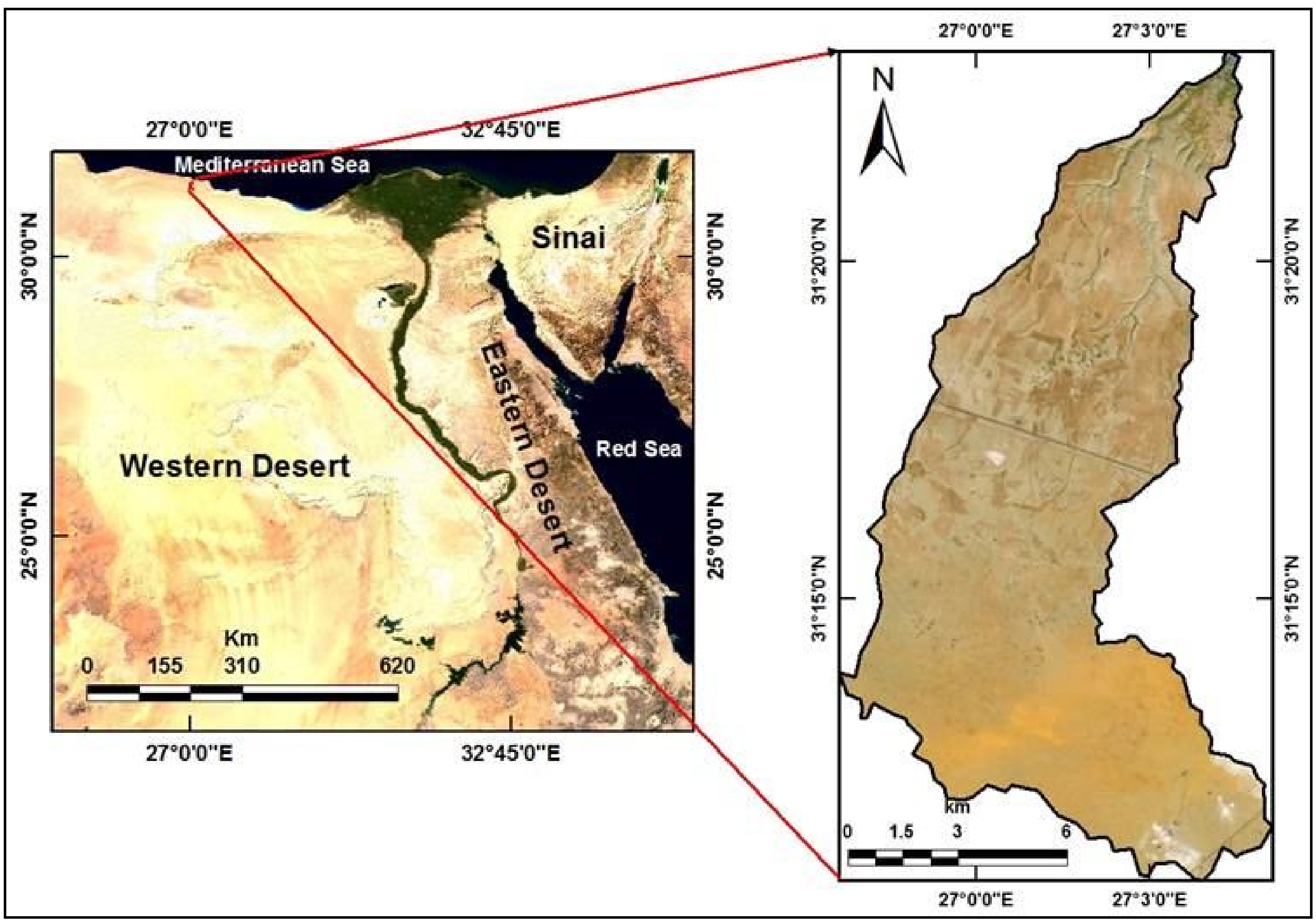

Fig. 1: Location of Wadi Umm Ashtan study area at the North Western Coast of Egypt.

Table 1: The average meteorological data of the period from 1999 to 2018 in Matrouh station, Marsa Matrouh, Egypt.

Month	Temperature (c°) Max.	Min.	Mean	Relative Humidity (%)	Rai-nfall (mm)	Evapo-ration (mm)	Wind Speed (m/s)
January	19.05	9.79	14.23	63.52	15.82	7.11	5.51
February	20.34	10.94	15.61	63.41	8.12	8.37	5.35
March	22.84	12.77	17.75	63.01	6.13	10.22	5.27
April	25.18	15.41	20.37	64.86	4.22	13.20	4.88
May	27.66	18.63	23.29	68.81	0.00	17.03	4.80
June	29.65	21.68	25.85	71.32	0.00	20.2	5.09
July	30.70	22.72	26.87	70.74	0.00	21.05	4.83
August	30.14	21.96	26.21	67.65	0.00	19.67	4.35
September	28.30	19.42	23.91	65.00	3.20	16.79	4.19
October	24.90	15.8	20.27	64.33	17.89	13.18	4.23
November	21.20	12.36	16.56	65.35	29.49	9.82	4.87
December	18.58	9.86	14.01	67.68	39.17	7.93	5.02
Average rainfall	—	—	—	—	124.04	—	—

Table 2: Rangelands vegetation attributes of the different sites and seasons in Wadi Umm Ashtan study area during year of 2017.

Treatments	Frequency	Density	Cover
Sites			
Site 1	8.27 cd	47.50 g	28.50 c
Site 2	6.92 de	119.3 d	29.60 c
Site 3	5.80 e	86.50 f	30.80 c
Site 4	9.34 c	95.17e	25.70 d
Site 5	13.61 ab	371.3 a	45.36 a
Site 6	12.40 b	202.3 c	37.38 b
Site 7	15.70 a	218.5 b	47.80 a
LSD at 0.05	1.67	6.92	2.70
Season			
Spring	13.89 a	222.1 a	45.39 a
Autumn	6.62 b	103.8 b	24.65 b
LSD at 0.05	0.89	3.70	1.45

Table 3: The interaction effect between the different sites and seasons of rangelands vegetation attributes in Wadi Umm Ashtan study area during year of 2017.

Sites	Frequency		Density (plant/m^2)		Cover (%)	
	Seasons					
	Spring	Autumn	Spring	Autumn	Spring	Autumn
Site 1	10.90 de	5.63 gh	63.67 g	31.33 ha	30.70 e	26.30 fg
Site 2	10.50 de	3.33 hi	214.7 d	24.0 ij	29.65 ef	29.55 ef
Site 3	8.60 ef	2.99 i	154.3 e	18.67 j	47.85 c	13.75 h
Site 4	14.70 c	3.98 hi	149.3 e	41.0 h	37.45 d	13.95 h
Site 5	15.60 bc	11.61 d	366.7 a	376.0 a	57.35 b	33.38 e
Site 6	17.60 ab	7.20 fg	250.67 c	154.0 e	49.50 c	25.25 g
Site 7	18.8 a	12.59 d	355.67 b	81.33 f	65.25 a	30.35 ef
LSD at 0.05	2.37	9.79	3.82			

outside of sampling locations, and the scale of data collection rarely agrees with the spatial and temporal scales of management, (Weltz *et al.*, 2003). On contrary, remotely sensed data are spatial ant temporally proportionate and objective, overcoming these critiques, and can provide valuable information on rangeland condition when coupled with field data (Hagen *et al.*, 2012).

The main objective of mapping vegetation cover is to accurately determine the distribution of different plant species in a specific area. The first step in any monitoring and inventory program involves development of a vegetation map (Holechek, 2011). The resulting maps can be considered as an essential resource to assist natural resources or maintenance management and land use planning. Depending on the scale and geographical context, vegetation can be described by its physiological-ecological characteristics leading to so-called formations such as grassland, shrubs or forests, (McDermid *et al.*, 2005). Conducting field surveys to map natural vegetation requires high cost and labour intensity, especially in remote areas such as Polar Regions or many arid ecosystems; land mapping becomes more logistically difficult. In recent decades, remote sensing has contributed significantly to the mapping of vegetation cover of remote areas and to specific plant maps worldwide in global, regional and local scales (Cihlar, 2000; McDermid *et al.,* 2005; Oldeland *et al.*, 2010; Mohamed, 2018). The primary object of this study was to map rangeland area in Wadi Umm Ashtan using high resolution satellite imagery and characterize rangeland vegetation in these study areas using ground vegetation survey at wet and dry seasons.

Materials and Methods

Description of the study area:

The study area, Wadi Umm Ashtan, is located at 18 km west of Matrouh city. It is located between 26° 57' 36.4" to 27" 05' 09" E and 31° 10' 50.2" to 31° 23' 7.5" N, covering an area of about 130.44 km^2. It is bounded by the watershed of Wadi Abu Guidata, the watershed of Wadi Senab, Mediterranean Sea, and the Libyan plateau from west, east, north, and south respectively, Fig. 1. The area under investigation as a part of north western coastal zone of Egypt is distinguished by three agro-ecological districts. District I extends up to 15 km from the coast with the deepest soils and higher rainfall. Agricultural production systems

Table 4: Characterization of rangelands vegetation attributes of Wadi Umm Ashtan study area during spring season of 2017.

Scientific Name	Frequency (%)	Density (%)	Cover (%)	Relative Frequency (%)	Relative Density (%)	Relative Cover (%)	Importance Value
Site 1							
Aristida adscensionis	0.60	1.00	0.25	5.50	1.57	0.81	7.89
Astragalus boeticus	0.60	0.67	0.1	5.50	1.05	0.33	6.88
Astragalus hamosus	0.30	0.33	0.05	2.75	0.52	0.16	3.44
Centaurea solstitialis L.	0.30	0.33	0.15	2.75	0.52	0.49	3.76
Deverra tortuosa	1.00	2.33	0.25	9.17	3.66	0.81	13.65
Echinopus spinosissimus	0.30	0.33	0.1	2.75	0.52	0.33	3.60
Filago desetorum	0.30	0.33	0.05	2.75	0.52	0.16	3.45
Garhadiolus hedypnais	0.30	0.67	0.05	2.75	1.05	0.16	3.96
Gymnocarpos decandrus	0.60	2.33	0.4	5.50	3.66	1.30	10.47
Haloxylon salicornicum	0.60	1.33	0.7	5.50	2.09	2.28	9.88
Hordeum marinum	0.30	0.67	0.1	2.75	1.05	0.33	4.13
Lotus polyphyllus	0.60	24.00	2	5.50	37.69	6.51	49.71
Malva parviflora	0.30	0.67	0.1	2.75	1.05	0.33	4.13
Medicago littoralis	0.60	1.67	0.2	5.50	2.62	0.65	8.77
Plantago cylindriea	0.60	0.67	0.1	5.50	1.05	0.33	6.88
Salvia egyptiaca	1.00	5.67	0.75	9.17	8.90	2.44	20.52
Scorzonera alexandrina	0.60	15.00	1.1	5.50	23.56	3.58	32.65
Sonchus oleraceus	1.00	2.33	0.45	9.17	3.66	1.47	14.30
Thymelaea hirsuta	1.00	3.33	23.8	9.17	5.24	77.52	91.93
Total	10.90	63.67	30.7	100.00	100.00	100.00	300.00
Site 2							
Adonis dentatus	0.30	0.33	0.25	2.86	0.16	0.84	3.86
Astragalus boeticus	1.00	14.00	1.45	9.52	6.52	4.89	20.94
Centaurea solstiialis L.	0.30	0.33	0.1	2.86	0.16	0.34	3.35
Conyza linifolia	0.30	0.33	0.05	2.86	0.16	0.17	3.18
Cutandia dichotoma	1.00	41.67	1.4	9.52	19.41	4.72	33.66
Echinopus spinosissimus	0.60	1.00	0.2	5.71	0.47	0.67	6.85
Erodium hirtum.	0.30	0.33	0.05	2.86	0.16	0.17	3.18
Filago desetorum	0.30	1.67	0.3	2.86	0.78	1.01	4.65
Gymnocarpos decandrus	1.00	12.33	9.6	9.52	5.75	32.38	47.65
Haloxylon salicornicum	1.00	2.67	8.4	9.52	1.24	28.33	39.10
Legeum spartum	0.30	1.00	0.1	2.86	0.47	0.34	3.66
Lotus polyphyllus	1.00	52.67	2.1	9.52	24.53	7.08	41.14
Noaea mucronata	1.00	1.33	0.45	9.52	0.62	1.52	11.66
Paronychia argentea	0.30	0.33	0.05	2.86	0.16	0.17	3.18
Plantago cylindriea	0.30	1.67	0.25	2.86	0.78	0.84	4.48
Salvia egyptiaca	0.30	0.33	0.05	2.86	0.16	0.17	3.18
Scorzonera alexandrina	0.60	80.00	4.5	5.71	37.27	15.18	58.16
Sonchus oleraceus	0.60	2.67	0.35	5.71	1.24	1.18	8.14
Total	10.50	214.67	29.65	100.00	100.00	100.00	300.00
Site 3							
Adonis dentatus	0.60	21.00	3.6	6.98	13.61	7.52	28.11
Astragalus boeticus	0.30	4.00	0.2	3.49	2.59	0.42	6.50

Table 4 Continued..........

in this Zone are predominately trees (fig, olive and scattered almond and pomegranate) with some cereal, small ruminant and limited rainfed vegetables. District II extends from 5 to 15 km inland and the production system have fewer trees and more cereal and livestock. Last, district III extends greater than 15 km inland and it production system is dominated by livestock with some cereal.

Climate in the study area:

The climate of NWCZ is characterized as Mediterranean climate. The main characteristic of the Mediterranean climate is that it has two well defined seasons in the year, with the rain period coinciding with low temperatures (winter) while summers are hot and almost completely dry. The same climate condition is observed in the NWCZ; and this zone is considered as an arid zone. This area is distinguishes by a rainy unstable winter and stable warm and dry summer. The other two seasons are also characterized by unstable climatic conditions, e.g., some storms during spring and occasional sudden heavy rainfall during autumn. Table 1 shows the average meteorological data (1999-2018) in Matrouh station. The average rainfall is around 124.04mm/year (Matrouh airport climate station). The total amount of rainfall received on the study area from November, 2016 to April 2017 was about 98 mm.

Rangeland vegetation measurements:

This investigation was conducted in spring and autumn seasons of 2017. At the beginning of the study, seven sites were selected along the valley that were representing the rangelands vegetation of Wadi Umm Ashtan area and measurements were taken, 3 quadrates 4×5 m (20 m²) were selected randomly in each site, in each season. Plant species and families were fully identified to the families level and named according to Täckholm (1974) updated by Boulos (2005). The following measurements were done in each time of this study.

Plant Coverage percentage:

It is defined as the percentage of the ground covered by the canopy of each plant species. It was calculated according to the following equation was described by Hanson

Table 4 Continued..........

Cutandia dichotoma	1.00	25.00	1.2	11.63	16.20	2.51	30.33
Haloxylon salicornicum	1.00	2.67	27.2	11.63	1.73	56.84	70.20
Hordeum marinum	0.30	0.33	0.05	3.49	0.22	0.10	3.81
Legeum spartum	0.60	4.00	0.25	6.98	2.59	0.52	10.09
Lotus polyphyllus	0.30	3.00	0.15	3.49	1.94	0.31	5.75
Malva parvilora	1.00	7.67	0.45	11.63	4.97	0.94	17.54
Medicago littoralis	0.30	0.33	0.1	3.49	0.22	0.21	3.91
Plantago cylindriea	1.00	59.67	3.6	11.63	38.66	7.52	57.81
Salvia egyptiaca	0.30	2.00	0.2	3.49	1.30	0.42	5.20
Scorzonera alexandrina	0.60	20.00	0.6	6.98	12.96	1.25	21.19
Sonchus oleraceus	0.30	1.00	0.15	3.49	0.65	0.31	4.45
Thymelaea hirsuta	1.00	3.67	10.1	11.63	2.38	21.11	35.11
Total	8.60	154.33	47.85	100.00	100.00	100.00	300.00
Site 4							
Anacychus alexandrinus	0.30	0.33	0.05	2.04	0.22	0.13	2.40
Astragalus boeticus	0.30	1.00	0.05	2.04	0.67	0.13	2.84
Astragalus hamosus	1.00	6.67	0.7	6.80	4.46	1.87	13.14
Centaurea solstiialis L.	0.30	0.67	0.1	2.04	0.45	0.27	2.75
Cutandia dichotoma	1.00	14.33	0.95	6.80	9.60	2.54	18.94
Deverra tortuosa	0.30	0.33	0.05	2.04	0.22	0.13	2.40
Echinopus spinosissimus	0.60	1.33	0.4	4.08	0.89	1.07	6.04
Erodium hirtum	0.60	1.33	0.2	4.08	0.89	0.53	5.51
Garhadiolus hedypenais	0.30	0.33	0.05	2.04	0.22	0.13	2.40
Gymnocarpos decandrus	1.00	9.33	4.5	6.80	6.25	12.02	25.07
Haloxylon salicornicum	1.00	2.33	8.4	6.80	1.56	22.43	30.80
Helianthemum lippii	0.30	1.00	0.4	2.04	0.67	1.07	3.78
Iflago spicata	0.30	1.33	0.1	2.04	0.89	0.27	3.20
Legeum spartum	0.60	0.67	0.1	4.08	0.45	0.27	4.80
Lotus polyphyllus	1.00	8.33	0.65	6.80	5.58	1.74	14.12
Malva parvilora	0.30	0.33	0.05	2.04	0.22	0.13	2.40
Medicago littoralis	0.30	0.67	0.05	2.04	0.45	0.13	2.62
Moltkiopsis ciliata	1.00	1.00	0.35	6.80	0.67	0.93	8.41
Paronychia argentea	0.30	0.67	0.1	2.04	0.45	0.27	2.75
Plantago cylindriea	1.00	73.00	4.45	6.80	48.89	11.88	67.57
Salvia egyptiaca	1.00	10.00	0.9	6.80	6.70	2.40	15.90
Scorzonera alexandrina	0.60	9.00	0.5	4.08	6.03	1.34	11.44
Sonchus oleraceus	0.30	3.33	0.15	2.04	2.23	0.40	4.67
Thymelaea hirsuta	1.00	2.00	14.2	6.80	1.34	37.92	46.06
Total	14.70	149.33	37.45	100.00	100.00	100.00	300.00
Site 5							
Aegilops kotschyi	1.00	190.00	5.4	6.41	51.82	9.42	67.64
Anacychus alexandrinus	0.60	4.67	0.35	3.85	1.27	0.61	5.73
Asphodeius microcarpus	1.00	12.67	5.2	6.41	3.45	9.07	18.93
Avena fatua	0.60	1.67	0.15	3.85	0.45	0.26	4.56
Bromus rabens	0.30	13.33	0.9	1.92	3.64	1.57	7.13
Calendula micrantha	0.30	4.00	0.5	1.92	1.09	0.87	3.89
Capparis spinosa	0.30	0.33	6.5	1.92	0.09	11.33	13.35
Brassica tourneforttii	0.30	2.00	1.2	1.92	0.55	2.09	4.56
Carricatera annua	1.00	9.00	0.9	6.41	2.45	1.57	10.43
Centaurea solstiialis L.	0.30	6.67	6.5	1.92	1.82	11.33	15.08

Table 4 Continued..........

(1965).

Coverage (%) =

$$\frac{Total\ of\ quadrat\ area\ for\ a\ species}{Total\ quadrat\ area\ (in\ units)}$$

$\times 100$

a. Frequency percentage:

It was calculated according to the following equation was described by Hanson (1965) as the following:

Frequency (%) =

$$\frac{Number\ of\ sampled\ quadrats\ in\ which\ species\ occurs}{Total\ number\ of\ quadrates\ sampled}$$

$\times 100$

b. Plant Density: Number of plants/m^2 was calculated according to the following equation was described by Hanson (1965).

Plant Density (plant/m²) =

$$\frac{Number\ of\ individual\ species}{Area\ sampled\ (in\ unit)} \times 100$$

c. The importance value (IV):

It calculated for different species according to,(Ludwig, 1988) by calculating sum of relative density, relative cover and relative frequency for different species as follows : Importance value = Relative density +þ Relative cover + Relative frequency.

Relative Density (%) =

$$\frac{Density\ for\ a\ species}{Total\ density\ for\ all\ specie} \times 100$$

Relative cover (%) =

$$\frac{Total\ of\ Quadrat\ area\ for\ a\ species}{Total\ of\ quadrat\ area\ for\ all\ species}$$

$\times 100$

Relative Frequency (%) =

$$\frac{Frequency\ value\ for\ a\ species}{Total\ of\ quadrat\ area} \times 100$$

The satellite images and reference data:

The Sentinel satellite images obtained were downloaded from USGS Earth Explorer. The image which covers the study area was extracted from these images. The other data

Table 4 Continued..........

Deverra tortuosa	0.30	0.33	0.4	1.92	0.09	0.70	2.71
Didesmus bipinnatus	1.00	1.67	0.2	6.41	0.45	0.35	7.21
Echinopus spinosissimus	1.00	3.00	4.2	6.41	0.82	7.32	14.55
Erodium hirtum.	0.60	1.33	0.15	3.85	0.36	0.26	4.47
Garhadiolus hedypenais	0.30	2.33	0.3	1.92	0.64	0.52	3.08
Haloxylon salicornicum	0.60	2.00	3.5	3.85	0.55	6.10	10.49
Hordeum marinum	0.60	29.33	1.8	3.85	8.00	3.14	14.98
Limonium thouini	0.30	0.33	0.05	1.92	0.09	0.09	2.10
Lotus polyphyllus	0.60	9.33	0.6	3.85	2.55	1.05	7.44
Lycium shawii	0.60	5.00	9.5	3.85	1.36	16.56	21.77
Mathiola longipetala	0.60	1.33	0.15	3.85	0.36	0.26	4.47
Medicago littoralis	1.00	9.00	1.50	6.41	2.45	2.62	11.48
Noaea mucronata	0.30	1.33	0.80	1.92	0.36	1.39	3.68
Phalaris minor	0.30	2.67	0.20	1.92	0.73	0.35	3.00
Schismus barbatus	0.60	4.00	0.30	3.85	1.09	0.52	5.46
Silybium marianum	0.30	5.33	2.00	1.92	1.45	3.49	6.86
Sonchus oleraceus	0.30	1.33	0.10	1.92	0.36	0.17	2.46
Trifolium resupinatum	0.30	40.00	3.60	1.92	10.91	6.28	19.11
Trigonella stellate	0.30	2.67	0.40	1.92	0.73	0.70	3.35
Total	15.60	366.67	57.35	100.00	100.00	100.00	300.00
Site 6							
Adonis dentatus	0.60	2.33	0.20	3.41	0.93	0.40	4.74
Aegilops kotschyi	0.60	9.67	0.70	3.41	3.86	1.41	8.68
Anacychus alexandrinus	1.00	18.67	1.35	5.68	7.45	2.73	15.86
Anagallis arvensis	0.30	0.67	0.10	1.70	0.27	0.20	2.17
Arisarum vulgare	0.60	4.67	0.35	3.41	1.86	0.71	5.98
Aristida adscensionis	0.30	2.00	1.10	1.70	0.80	2.22	4.72
Asphodeius microcarpus	1.00	9.33	9.60	5.68	3.72	19.39	28.80
Cardaria draba	0.60	0.67	0.05	3.41	0.27	0.10	3.78
Carricatera annua	0.60	5.33	0.55	3.41	2.13	1.11	6.65
Centaurea solstiialis L.	0.30	1.00	0.25	1.70	0.40	0.51	2.61
Deverra tortuosa	1.00	1.00	1.05	5.68	0.40	2.12	8.20
Didesmus bipinnatus	0.60	2.33	0.30	3.41	0.93	0.61	4.95
Echinopus spinosissimus	1.00	5.00	4.70	5.68	1.99	9.49	17.17
Erodium hirtum	0.30	1.00	0.10	1.70	0.40	0.20	2.31
Garhadiolus hedypenais	0.30	0.33	0.15	1.70	0.13	0.30	2.14
Gymnocarpos decandrus	0.60	2.00	1.90	3.41	0.80	3.84	8.05
Haloxylon salicornicum	0.60	3.67	4.30	3.41	1.46	8.69	13.56
Hordeum marinum	1.00	52.33	4.60	5.68	20.88	9.29	35.85
Lycium shawii	0.30	1.33	4.50	1.70	0.53	9.09	11.33
Mathiola longipetala	1.00	11.00	0.80	5.68	4.39	1.62	11.69
Medicago littoralis	1.00	31.67	3.20	5.68	12.63	6.46	24.78
Noaea mucronata	1.00	3.00	1.10	5.68	1.20	2.22	9.10
Onobrychis crista-galli	0.30	0.33	0.05	1.70	0.13	0.10	1.94
Phalaris minor	0.30	3.00	0.15	1.70	1.20	0.30	3.20
Plantago cylindriea	0.60	64.33	2.65	3.41	25.66	5.35	34.43
Sonchus oleraceus	0.60	10.00	0.90	3.41	3.99	1.82	9.22
Thymelaea hirsuta	0.60	1.67	4.60	3.41	0.66	9.29	13.37
Trigonella stellate	0.60	2.33	0.20	3.41	0.93	0.40	4.74
Total	17.60	250.67	49.50	100.00	100.00	100.00	300.00

Table 4 Continued..........

used in this study for reference and analyses mainly include: digitized topographic maps, at scale of 1:25,000 and ground reference data obtained from land survey with hand held GPS to determine the characteristics of sampling points. The existence of ground-truth data is needed for mapping and accuracy measurement in the study area. ERDAS IMAGINE software was used for performing the digital image processing and analysing such as geometric, radiometric correction and classification. Meanwhile, ArcGIS is also used to compliment the display and to process of the data.

Supervised classification:

Supervised classification is a more comprehensive procedure which uses experienced human image analyst to recognize and group pixels into class categories of interest to user. The analyst picks several samples of homogeneous pixel patterns on the image calling training sites. Analysts identify these sites by actually visiting the ground location and making filed observation (ground truthing) or by using past experience and skill. In this study training set was established using the "polygon" method by drawing polygons around area representing a particular cover class. A number of 7 classes were defined (water body, beach sand, orchard tress, rangeland, winter crops, man-made surface, and rocky area). Accuracy assessment was conducted and overall accuracy and other accuracy assessment measurements were calculated.

Results and discussion

Rangelands vegetation attributes of Wadi Umm Ashtan:

a. Frequency:

Data presented in table 2 indicate the effect of the different sites and seasons on rangelands plant frequency of Wadi Umm Ashtan study area during spring and autumn of 2017. Results showed a great fluctuation in plant frequency of studied locations in both seasons, and there were significant differences in plant frequency among the seven studied sites and between the two studied seasons. The highest plant frequency value of 15.7 was

Table 4 Continued..........

Site 7							
Adonis dentatus	0.30	0.33	0.05	1.60	0.09	0.08	1.77
Aegilops kotschyi	0.60	155.67	4.90	3.19	43.77	7.51	54.47
Arisarum vulgare	0.30	0.33	0.20	1.60	0.09	0.31	2.00
Aristida adscensionis	0.30	1.00	0.35	1.60	0.28	0.54	2.41
Artemisisa herba-alba	0.60	4.00	8.40	3.19	1.12	12.87	17.19
Asphodeius microcarpus	1.00	3.67	2.80	5.32	1.03	4.29	10.64
Bromus rabens	0.60	12.33	0.75	3.19	3.47	1.15	7.81
Calendula aegyptiaca	0.30	0.33	0.20	1.60	0.09	0.31	2.00
Teucrim polium	0.60	0.67	1.10	3.19	0.19	1.69	5.06
Carricatera annua	0.60	4.67	0.90	3.19	1.31	1.38	5.88
Centaurea solstiialis L.	0.60	6.00	3.20	3.19	1.69	4.90	9.78
Conyza aegyptiaca	0.30	2.00	1.90	1.60	0.56	2.91	5.07
Deverra tortuosa	0.30	5.00	0.40	1.60	1.41	0.61	3.61
Echinopus spinosissimus	0.60	1.00	3.20	3.19	0.28	4.90	8.38
Eragrostis sp.	0.30	1.67	1.20	1.60	0.47	1.84	3.90
Erodium hirtum	0.60	2.00	1.00	3.19	0.56	1.53	5.29
Gymnocarpos decandrus	1.00	7.67	9.10	5.32	2.16	13.95	21.42
Haloxylon salicornicum	0.30	0.33	2.20	1.60	0.09	3.37	5.06
Hordeum marinum	0.30	3.33	0.30	1.60	0.94	0.46	2.99
Legeum spartum	1.00	28.00	4.30	5.32	7.87	6.59	19.78
Limonium thouini	0.60	23.00	1.55	3.19	6.47	2.38	12.03
Mathiola longipetala	0.60	1.33	0.20	3.19	0.37	0.31	3.87
Medicago littoralis	1.00	6.67	1.20	5.32	1.87	1.84	9.03
Noaea mucronata	1.00	4.67	3.50	5.32	1.31	5.36	12.00
Onobrychis crista-galli	0.60	29.67	1.80	3.19	8.34	2.76	14.29
Panicum turgidum	0.30	0.33	0.40	1.60	0.09	0.61	2.30
Phalaris minor	0.60	9.33	0.65	3.19	2.62	1.00	6.81
Plantago albicans	0.60	1.00	0.50	3.19	0.28	0.77	4.24
Plantago cylindriea	0.60	9.33	0.90	3.19	2.62	1.38	7.19
Schismus barbatus	0.30	14.33	1.10	1.60	4.03	1.69	7.31
Sonchus oleraceus	0.60	7.00	0.90	3.19	1.97	1.38	6.54
Spergularia marina	0.30	2.00	0.70	1.60	0.56	1.07	3.23
Stipagrostis lanata	0.30	1.00	0.70	1.60	0.28	1.07	2.95
Suaeda vermiculata	0.60	5.67	4.50	3.19	1.59	6.90	11.68
Thymelaea hirsuta	0.30	0.33	0.20	1.60	0.09	0.31	2.00
Total	18.80	355.67	65.25	100.00	100.00	100.00	300.00

recorded in site 7 of Umm Ashtan study area, and the lowest plant frequency value of 5.8 was observed at site 3. This may be due to the changing of climatic condition from season to another and from year to another. Similar results were discussed by El-Shesheny (2007). Concerning the effect of growth seasons on plant frequency, results in table 2 revealed that, the highest value of frequency percentage was noticed in spring season, while the lowest value was recorded during the autumn season.

b. Plant density (number of plants/m^2):

Results in table 2 showed the effect of the different sites and seasons on rangelands plant density (plant/ m^2) of Wadi Umm Ashtan study area during spring and autumn of 2017. Results obtained revealed that, plant density was significantly affected by the different studied locations of the study area and growing season. The highest value plant density of 371.3 plant/m2 was observed in site 5 of Umm Ashtan study area, and the lowest plant density value of 47.5 plant/m2 was observed at site 3. Plant density was greater in case of the last four studied sites as compared with that of the other four studied sties. Concerning the effect of growth seasons on plant density, results in table 2 revealed that, the highest value of plant density was noticed in spring season, while the lowest value was recorded during the autumn season. This indicate that spreading of plant per unit area depends mainly on the edaphic factors effect such as soil texture and soil depth, this could in turn reflect on more plant growth and number. These results are in agreement with those obtained by El-Monayeri *et al.,* (1979), El-Shesheny (2007) and El- Morsy & Ahmed (2010).

c. Plant coverage percentage:

Results in table 2 showed that the performance of coverage percentage of the natural vegetation which found through the survey during the two studied seasons under the different seven sites. Regarding the effect of the seven different studied sites on plant coverage percentage, results indicated that, there was a significant effect of the studied locations on the coverage percentage in both seasons. The maximum value of the plant coverage percentage of 47.8 % was recorded under site number seven, while the minimum value was obtained under the fourth studied site at the study area. Concerning the effect of growth seasons on plant coverage percentage, results revealed that, there was significant difference in coverage percentage between spring and autumn seasons. The highest value of plant coverage percentage was recorded in spring season while the lowest value was obtained in autumn season. It could be concluded that the more rainfall and soil depth react together to induce more plant growth and cover. These results are in accordance with those obtained by El- Toukhy *et al*., (2002) and El- Morsy (2010).

Results presented in table 3 show that there were

Table 5: Characterization of rangelands vegetation attributes of Wadi Umm Ashtan study area during autumn season of 2017.

Scientific Name	Frequency (%)	Density (%)	Cover (%)	Relative Frequency (%)	Relative Density (%)	Relative Cover (%)	Importance Value
Site 1							
Anabsis aticulata	0.33	2.33	3.00	5.86	7.45	11.41	24.72
Asparagus stipularis	0.33	0.33	0.10	5.86	1.06	68.44	110.67
Astragalus boeticus	0.33	0.33	0.10	5.86	1.06	0.38	7.31
Centaurea solstitialis L.	0.66	7.33	0.60	11.72	23.41	1.90	8.83
Deverra tortuosa	1.00	3.00	1.50	17.76	9.58	8.37	48.81
Echinopus spinosissimus	0.33	0.33	0.10	5.86	1.06	5.70	33.04
Gymnocarpos decandrus	0.33	0.33	0.10	5.86	1.06	0.38	7.31
Haloxylon salicornicum	0.33	0.33	0.50	5.86	1.06	2.28	37.41
Noaea mucronata	0.66	9.00	2.20	11.72	28.73	0.38	7.31
Thymelaea hirsuta	1.00	7.67	18.00	17.76	24.47	0.38	7.31
Verbascum letourneuxii	0.33	0.33	0.10	5.86	1.06	0.38	7.31
Total	5.63	31.33	26.30	100.00	100.00	100.00	300.00
Site 2							
Anabsis aticulata	1.00	5.67	17.50	30.03	23.61	59.22	112.86
Gymnocarpos decandrus	1.00	12.33	2.50	30.03	51.39	8.46	89.88
Noaea mucronata	0.33	0.33	0.05	9.91	1.39	0.17	11.47
Thymelaea hirsuta	1.00	5.67	9.50	30.03	23.61	32.15	85.79
Total	3.33	24.00	29.55	100.00	100.00	100.00	300.00
Site 3							
Anabsis aticulata	1.00	3.00	3.50	33.44	16.07	25.45	74.97
Gymnocarpos decandrus	0.66	8.67	2.80	22.07	46.42	20.36	88.86
Noaea mucronata	0.33	0.33	0.05	11.04	1.79	0.36	13.19
Thymelaea hirsuta	1.00	6.67	7.40	33.44	35.71	53.82	122.97
Total	2.99	18.67	13.75	100.00	100.00	100.00	300.00
Site 4							
Anabsis aticulata	1.00	5.67	3.40	25.13	13.82	24.37	63.32
Deverra tortuosa	0.33	1.00	0.10	8.29	2.44	0.72	11.45
Gymnocarpos decandrus	0.66	11.00	1.20	16.58	26.83	8.60	52.01
Haloxylon salicornicum	0.33	1.00	1.00	8.29	2.44	7.17	17.90
Noaea mucronata	0.66	10.67	2.10	16.58	26.02	15.05	57.65
Thymelaea hirsuta	1.00	11.67	6.15	25.13	28.46	44.09	97.67
Total	3.98	41.00	13.95	100.00	100.00	100.00	300.00
Site 5							
Asparagus stipularis	0.33	0.33	0.03	2.84	0.09	0.07	3.01
Asphodeius microcarpus	1.00	13.33	1.50	8.61	3.55	4.49	16.65
Capparis spinosa	1.00	1.33	0.85	8.61	0.35	2.55	11.51
Centaurea solstitialis L.	0.66	2.33	0.35	5.68	0.62	1.05	7.35
Cynodon dactylon	1.00	200.00	8.50	8.61	53.19	25.46	87.27
Deverra tortuosa	1.00	2.67	0.50	8.61	0.71	1.50	10.82
Echinopus spinosissimus	0.33	8.33	0.50	2.84	2.22	1.50	6.56
Gymnocarpos decandrus	0.33	1.00	0.20	2.84	0.27	0.60	3.71
Haloxylon salicormicum	1.00	1.67	0.55	8.61	0.44	1.65	10.70
Lycium shawii	1.00	5.33	3.20	8.61	1.42	9.59	19.62

Table 5 Continued..........

significant differences in rangelands vegetation characteristics as affected by the interaction between the different studied sites and seasons during 2017. The highest frequency value of 18.8 was achieved in site number 7 at the spring season, while the lowest frequency value of 2.99 was recorded in site number 3 at the autumn season. However, the highest density value of 376 18.67 plant/m^{2}was achieved in site number 5 at the autumn season, while the lowest density value of 18.67 plant/m^2 was recorded in site number 3 at the autumn season. Regarding cover percentage it was noticed that the highest cover value of 65.25 % was achieved in site number 7 at the spring season, while the lowest cover value of 13.75 was recorded in site number 3 at the autumn season.

d. Importance value (IV):

Detail characterization of rangeland vegetation attributes in the seven surveyed sites represented the vegetation types in Wadi Umm Ashtan study area during spring and autumn of 2017 are presented in tables 4 and 5. Importance values are the efficiency method to compare among species by studying the relative density, relative coverage and relative frequency for each species. Importance value provides information could help in determining which species from which habitat type is the most adaptive and tolerant one to environment stresses. Results showed the highest importance values of plant species of 91.93, 58.16, 70.2, 67.57, 67.64, 35.85 and 54.47% were achieved by *Thymelaea hirsuta*, *Scorzonera alexandrina*, *Haloxylon salicornicum*, *Plantago cylindriea*, *Aegilops kotschyi*, *Hordeum marinum* , and *Aegilops kotschyi* for site from 1 to 7, respectively in spring season of 2017. While in autumn season of 2017, the highest importance values of plant species of 110.67, 112.86, 122.67, 97.67, 87.27, 75.95 and 36.93% were achieved by *Asparagus stipularis*, *Anabsis aticulata*, *Thymelaea hirsuta*, *Thymelaea hirsuta*, *Cynodon dactylon*, *Thymelaea hirsuta*, and *Thymelaea hirsuta* for site from 1 to 7, respectively

Rangelands vegetation and land use of Wadi Umm Ashtan:

The classification of target classes was

Table 5 Continued..........

Malva parvilora	0.33	50.00	0.60	2.84	13.30	1.80	17.94
Mathiola longipetala	0.33	16.67	1.00	2.84	4.43	3.00	10.27
Panicum repens	0.33	16.67	7.00	2.84	4.43	20.97	28.25
Peganum harmala	0.33	0.33	0.05	2.84	0.09	0.15	3.08
Polygonum senegalense	0.33	0.33	0.05	2.84	0.09	0.15	3.08
Rumex vesicarius	0.33	6.67	0.50	2.84	1.77	1.50	6.11
Silybium marianum	0.33	1.67	0.40	2.84	0.44	1.20	4.48
Sonchus oleraceus	0.33	6.67	0.50	2.84	1.77	1.50	6.11
Thymelaea hirsuta	0.66	0.67	0.10	5.68	0.18	0.30	6.16
Trifolium resupinatum	0.33	33.33	2.00	2.84	8.87	5.99	17.70
Varthemia candicans	0.33	6.67	5.00	2.84	1.77	14.98	19.59
Total	11.61	376.00	33.38	100.00	100.00	100.00	300.00
Site 6							
Arisarum vulgare	0.60	43.33	5.00	8.33	28.14	19.80	56.27
Asphodeius microcarpus	1.00	12.00	1.20	13.89	7.79	4.75	26.43
Capparis spinosa	0.60	1.00	0.45	8.33	0.65	1.78	10.76
Centaurea solstitialis L.	0.30	0.33	0.05	4.17	0.22	0.20	4.58
Cynodon dactylon	0.60	56.67	1.20	8.33	36.80	4.75	49.88
Deverra tortuosa	0.60	7.00	0.75	8.33	4.55	2.97	15.85
Gymnocarpos decandrus	1.00	7.33	2.75	13.89	4.76	10.89	29.54
Haloxylon salicormicum	0.60	2.00	0.35	8.33	1.30	1.39	11.02
Lycium shawii	0.30	0.67	0.40	4.17	0.43	1.58	6.18
Marrubium alysson	0.30	1.00	0.10	4.17	0.65	0.40	5.21
Noaea mucronata	0.30	3.33	0.50	4.17	2.16	1.98	8.31
Thymelaea hirsuta	1.00	19.33	12.50	13.89	12.55	49.50	75.95
Total	7.20	154.00	25.25	100.00	100.00	100.00	300.00
Site 7							
Arisarum vulgare	0.66	4.67	0.30	0.85	5.74	0.99	7.57
Aristida Adscensionis	0.33	1.67	0.20	0.42	2.05	0.66	3.13
Artimisia herba- alba	0.66	10.67	4.10	84.69	13.12	13.51	27.47
Asparagus stipularis	0.33	0.33	0.05	0.42	0.41	0.16	1.00
Asphodeius microcarpus	1.00	13.33	3.70	1.28	16.39	12.19	29.87
Atriplex halimus	0.33	0.33	2.50	0.42	0.41	8.24	9.07
Capparis spinosa	0.66	0.67	0.30	0.85	0.82	0.99	2.66
Centaurea solstitialis L.	0.33	0.67	0.10	0.42	0.82	0.33	1.57
cynodon dactylon	0.33	3.33	0.25	0.42	4.10	0.82	5.35
Deverra tortuosa	0.66	1.33	1.20	0.85	1.64	3.95	6.44
Haloxylon salicormicum	0.66	1.00	0.15	0.85	1.23	0.49	2.57
Helianthemum lippii	1.00	3.67	0.55	1.28	4.51	1.81	7.60
Herniaria hemistemon	1.00	4.67	0.50	1.28	5.74	1.65	8.67
Lycium shawii	0.33	0.67	2.80	0.42	0.82	9.23	10.47
Noaea mucronata	0.66	1.33	0.20	0.85	1.64	0.66	3.15
Panicum turigdum	0.66	13.67	0.60	0.85	16.80	1.98	19.63
Phalaris minor	0.33	0.67	0.30	0.42	0.82	0.99	2.23
Suaeda vermiculata	1.00	5.33	0.80	1.28	6.56	2.64	10.48
Teucrium polium	0.33	0.33	0.05	0.42	0.41	0.16	1.00
Thymelaea hirsuta	1.00	3.00	9.70	1.28	3.69	31.96	36.93
Thymus vulgaris	0.33	10.00	2.00	0.42	12.30	6.59	19.31
Total	12.59	81.33	30.35	100.00	100.00	100.00	300.00

achieved using thresholds of normalized difference vegetation index (NDVI) and mean of spectral features of the original bands *i.e.* blue, green, red, and near infrared. Then, reference data were collected and supervised classification was implemented to classify the study area into the major land cover/land use types. Fig. 2 shows classified land cover map produced using NDVI algorithm which was calculated from Sentinel 2 satellite image. As reported by Kindu *et al*., (2013), NDVI values were used in Landsat images segmentation and to classify land into vegetation and non-vegetation classes.

Results of accuracy assessments of the classified map are shown in table 6 and Fig. 3. A confusion matrix was produced summarizing all tabular out but data from ArcGIS rendering Table showing how the random points within each class were classified, the producers and user's accuracies, overall accuracy, overall Kappa statistic for all classes are presented in table 6. Overall accuracy of 83.57 % and Kappa Coefficient of 0.82 were achieved for the supervised classification of Sentinel 2 satellite image of the study area. The highest value of user's accuracies of 100% was recorded in Water class, followed by 95 % and 85 % for rangelands and winter crops, respectively. Regarding the producer's accuracies all beach sand, rangelands, and man-made (urban areas) recorded 100 %. Our finding regarding accuracy assessment values of classified high resolution satellite images are in accordance with Mohamed *et al*., (2011) and Kux and Souza (2012). Most of rangelands area with high cover was located to the south of the study area, while heading toward the north of the Wadi much agriculture lands of orchard tress were mapped, which was located mainly in the main stream of the Wadi. Results indicated that Sentinel 2 satellite imagery combined with field rangeland vegetation survey have great potential in mapping land cover/land use and rangelands areas at arid lands.

Conclusion

Characterization and mapping native plant species at the north western coast of Egypt indicated

Table 6: Error matrix generated from classified map and reference data for spring of 2017 Sentinel 2 satellite image of Wadi Umm Ashtan study area at NWC of Egypt.

Classification data	Reference data									
	Predicate	Water	Beach Sand	Orchard Trees	Rangeland	Winter Crops	Man-made	Rocky area	Total	User Accuracy
Water	1	20	7	0	0	0	0	0	27	74.07
Beach Sand	2	0	13	0	0	0	0	0	13	100.00
Orchard Trees	3	0	0	14	1	0	0	0	15	93.33
Rangeland	4	0	0	0	19	0	0	0	19	100.00
Winter Crops	5	0	0	0	0	17	0	2	19	89.47
Man- made	6	0	0	0	0	0	16	0	16	100.00
Rocky area	7	0	0	6	0	3	4	18	31	58.06
Total	20	20	20	20	20	20	20	117		
Producer Accuracy	100	65.00	70.00	95.00	85.00	80.00	90.00			
Overall Accuracy	83.57%									
Kappa value	0.82									

that there are several plants species with multipurpose usage including animal feed and medicinal use are common on the region. During the spring season rangeland of Wadi Umm Ashtan showed high values of plant frequency, plant density, and plant coverage compared to autumn season. Results indicated that supervised classification of high resolution Sentinel 2 satellite imagery combined with field rangeland vegetation survey showed great potential in mapping land cover/land use and rangelands areas at arid lands. Efforts to improve degraded rangeland and conservation of native plants species could include collecting of natural seeds of some valuable forage shrubs such *Medicago arborea*, *Periploca angustifolia, Atriplex nummularia, Retama raetam and Thymus capitatus,* and propagation of native plants though seedling production, in addition to the development of sustainable rangeland management plans, and controlling livestock numbers.

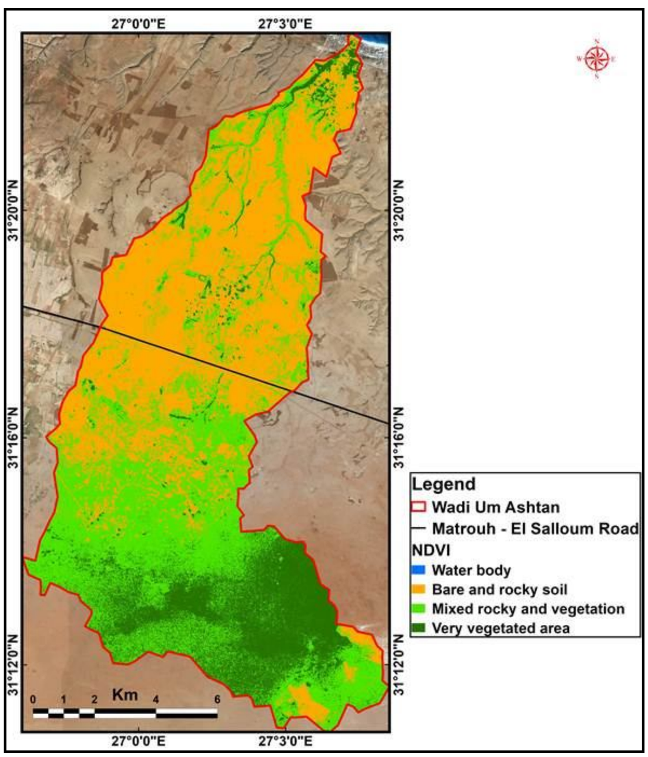

Fig. 2: Classified map based on Normalized Difference Vegetation Index (NDVI) algorithms for Wadi Umm Ashtan study area at Northwestern Coast, Egypt produced from Sentinel 2 satellite image acquired at spring, 2017.

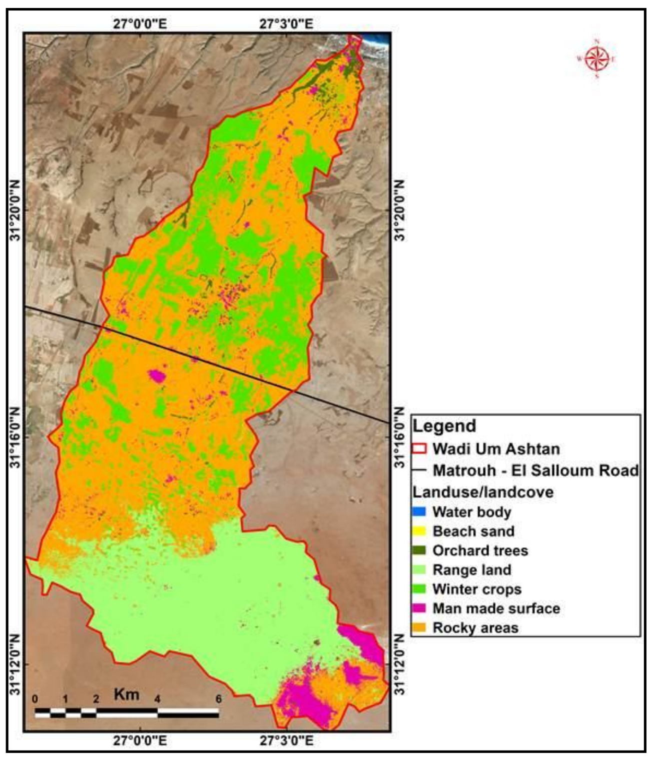

Fig. 3: Classified map of Wadi Umm Ashtan study area at Northwestern Coast, Egypt produced from supervised classification of Sentinel 2 satellite image acquired at spring, 2017.

References

Booth, D. Terrance, S.E. Cox, C. Fifield, M. Phillips and N. Williamson (2005). Image analysis compared with other methods for measuring ground cover. *Arid Land Research and Management*, **19(2):** 91-100.

Boulos, L. (1995). Check list Flora of Egypt. Vol. I. Al-Hadara Publishing, Cairo, Egypt.

Cihlar, J. (2000). Land cover mapping of large areas from satellites: status and research priorities. *International journal of remote sensing,* **21:** 1093-1114.

El-Hakeem, M.S. (2017). Sustainable development of the Egyptian Rangelands to combat desertification. Desert Research Center, Cairo, Egypt, P68.

El-Monayeri, M.O., K.L. Hammadi and S.A. Al- Jasim (1979). Ecophysiological studies of some plants of Safwan desert area, Iraq. 1- Natural vegetation and mineral accumulation. Desert Inst. *Bull.,* **29(2):** 527-542.

El-Morsy, M.H. (2010). Relative importance of salt marshes as range resources in the North Western Mediterranean Coast of Egypt. *J. Phytology,* **2(3):** 39-50.

El-Morsy, M.H.M. and S.Th. Ahmed (2010). Studies on plant cover of Wadi UMM El- Rakham in the North Western Coast of Egypt. *J. Phytology,* **2(2):** 73-86.

El-Shesheny, M.A. (2007). Seasonal variation of the natural vegetation and range development in the North Western Coast of Egypt. Ph. D. Thesis, Faculty of Agric. Ain Shams. Univ.

El-Toukhy, Salwa, A.M., K.M. Ahmed and S.H. Hendawy (2002). Productivity and nutritive value of some association at Wadi El-Natron- El- Alameen road in the North Western Coast. *J. Agric. Sci. Mansoura Univ.,* **27(1):** 233-244.

Hagen, S.C., P. Heilman, R. Marsett, N. Torbick, W. Salas, J. Van Ravensway and J. Qi (2012). Mapping total vegetation cover across western rangelands with moderate-resolution imaging spectroradiometer data. *Rangeland Ecology Management,* **65:** 456-467.

Hansen, M.C., R.S. DeFries, J.R. Townshend and R. Sohlberg (2000). Global land cover classification at 1 km spatial resolution using a classification tree approach. *International journal of remote sensing,* **21:** 1331-1364.

Hanson, H.C. and C.D. Churchill (1965). Plant community affiliated East-West Press Privat. LTD.

Holechek, J.L., R.D. Pieper and C.H. Herbel (2011). Range management: principle and practices. (Ed. 5). Prentice-Hall.

Hunt Jr., E.R., J.H. Everitt, J.C. Ritchie, M.S. Moran, D.T. Booth, G.L. Anderson, P.E. Clark and M.S. Seyfried (2003). Applications and research using remote sensing for rangeland management. *Photogrammetric Engineering and Remote Sensing*, **69(6):** 675-693.

Jansen, V., C. Kolden and H. Schmalz (2018). The Development of Near Real-Time Biomass and Cover Estimates for Adaptive Rangeland Management Using Landsat 7 and Landsat 8 Surface Reflectance Products. *Remote Sensing,* **10:** 1057.

Kindu M., T. Schneider, D. Teketay and T. Knoke (2013). Land Use/Land Cover Change Analysis Using Object-Based Classification Approach in Munessa-Shashemene Landscape of the Ethiopian Highlands. *Remote Sens,* **5(5):** 2411-2435; doi:10.3390/rs5052411.

Kux H.J. and Ul. D.V. Souza (2012). Object-Based Image Analysis of Worldview-2 Satellite Data for the Classification of Mangrove areas in the City of São Luís, Maranhão State, Brazil. ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume I-4, XXII ISPRS Congress, 25 August – 01 September 2012, Melbourne, Australia.

Langner, A., J. Miettinen and F. Siegert (2007). Land cover change 2002–2005 in Borneo and the role of fire derived from MODIS imagery. *Global Change Biology,* **13:** 2329-2340.

Liu, J., D. Zhuang, D. Luo and X.M.J.O.R.S. Xiao (2003). Land-cover classification of China: integrated analysis of *AVHRR imagery and geophysical data,* **24:** 2485-2500.

Ludwig, J.A. and J.F. Reynolds (1988). Statistical Ecology: a primer on methods and computing. New York, USA.

McDermid, G.J., S.E. Franklin and E.F. LeDrew (2005). Remote sensing for large-area habitat mapping. *Progress in Physical Geography,* **29:** 449-474.

Mohamed A.H. (2018). Using high spatial resolution satellite imagery to evaluate the impact of mesquite invasion on desert rangeland at Southeastern Egypt. *J. Bio. Env. Sci.,* **13(3):** 167-176.

Mohamed, A.H., J.L. Holechek, D.W. Bailey, C.L. Campbell and M. DeMers (2011). Mesquite encroachment impact on southern New Mexico Rangelands: A Remote sensing and GIS approach. *Journal of Applied Remote Sensing,* **5:** 053514 doi:10.1117/1.3571040.

Mohamed, A.H., M.A. El Shesheny, S.H. Hendawy, and H.S. Mahmoud (2015). Assessing Mesquite Cover Change in Southeastern Egypt using High Resolution Satellite Images. *Current Science International,* **4(3):** 351 – 357.

Oldeland, J., W. Dorigo, L. Lieckfeld, A. Lucieer and N. Jürgens (2010). Combining vegetation indices, constrained ordination and fuzzy classification for mapping semi-natural vegetation units from hyperspectral imagery. *Remote Sensing of Environment,* **114:** 1155-1166.

Pan, W., C. Zhang, H. Chen, Y. Cai, J. Chen and L. Li (2011). Application research of MODIS data in monitoring land use change in Fujian. *In* "Proceedings 2011 IEEE International Conference on Spatial Data Mining and Geographical Knowledge Services", pp. 413-416. IEEE.

Pyke, D.A., J.E. Herrick, P. Shaver and M.J. Pellant (2002). Rangeland health attributes and indicators for qualitative assessment. 584-597.

Pyke, D.A., J.E. Herrick, P. Shaver and M. Pellant (2002). Rangeland health attributes and indicators for qualitative assessment. *Rangeland Ecology & Management/Journal of Range Management Archives*, **55(6):** pp.584-597.

Reeves, M.C., M. Zhao, S.W. Running and Management (2006). Applying improved estimates of MODIS productivity to characterize grassland vegetation dynamics. *Rangeland Ecology Management,* **59:** 1-10.

Sibanda, M., O. Mutanga and M. Rouget (2016). Discriminating rangeland management practices using simulated hyspIRI, landsat 8 OLI, sentinel 2 MSI and VENμs spectral data. *IEEE Journal of Selected Topics in Applied Earth Observations Remote Sensing,* **9:** 3957-3969.

Tackholm, Vivi (1974). Students Flora of Egypt. 2th Ed. Published by Cairo Univ. 888pp.

Tang, J. and S. Zhang (2002). Application research of MODIS data in monitoring land use change. *Remote Sensing Technology,* **17:** 104-107.

Washington-Allen, R.A., N.E. West, R.D. Ramsey and R.A. Efroymson (2006). A protocol for retrospective remote sensing–based ecological monitoring of rangelands. *Rangeland Ecology Management,* **59:** 19-29.

Weltz, M.A., G. Dunn, J. Reeder and G. Frasier (2003). Ecological sustainability of rangelands. *Arid Land Research Management,* **17:** 369-388.

Xu, B., X. Yang, W. Tao, Z. Qin, H. Liu and J. Miao (2007). Remote sensing monitoring upon the grass production in China. *Acta Ecologica Sinica,* **27:** 405-413.