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Malacofauna Report of SEKEM Desert Farm in Bahariya Oasis, Egypt

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Abstract: This research examines the diversity of malacofauna in reclaimed and un-reclaimed areas of the SEKEM Desert Farm at Bahariya Oasis in the Western Desert of Giza Governorate, Egypt. The farm employs organic farming methods to cultivate crops and medicinal plants. Initially, only three species: *Cerastoderma glaucum*, *Corbicula fluminalis*, and *Bellamya unicolor* were found in the un-reclaimed desert area. However, after reclamation and agricultural development, the species richness of molluscs increased significantly. In the area reclaimed in 2008, 15 molluscs species were identified, while the area reclaimed in 2018/19 harboured 11 species. Most of these species are native to the Nile region, with the exception of two marine-origin species recorded in the nearby Mediterranean regions. The study also identified three species: *Eobania vermiculata*, *Theba pisana*, and *Xeropicta krynickii* that are considered harmful to crops.

Key words: Malacofauna, biodiversity, bahariya oasis, Egypt.

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Molluscans are the second largest phylum next to Arthropoda (Zhang, 2013). They occupy a wide range of habitats (Cuttelod *et al.*, 2011); they can be found on every continent, right up to the edge of Antarctica (Linse *et al.*, 2006). This group of animals are extremely diverse, the two main classes being Gastropods and Bivalves. The gastropods as grazers can control ephiphyton and algal blooms (Hily *et al.*, 2004) whereas bivalves as filter feeders can help purify silted marine waters (Greenberg, 2013). Mollusca communities play a significant role in the public health, livestock and agriculture (Abd El-Wakeil *et al.*, 2013). Some terrestrial species belonging to Helicidae and Hygromiidae are also known to be major agricultural crop pests (Ali and Ramdini, 2020). Conversely, freshwater mollusca communities are important indicator of

ecosystem health (Macías-Mayorga *et al.*, 2015). The malacological fauna of Egypt is extensively studied (Sattmann and Kinzelbach, 1988; Abd El-Wakeil *et al.*, 2013; Ali and Ramdini, 2020). In desert areas, the remains and broken shells of molluscs provide insight into the diversity of mollusk species, local fauna, estimated distribution pattern and ecology of species and climate (Budka, 2020).

Land reclamation by involving activities like growing seedlings for cultivation, compost application, irrigation, and interculture can have serious impact on the dispersion of malacofauna. The present study was carried out on the SEKEM desert farm in the Bahariya oasis, which is characterized by dry weather conditions, lack of water, strong winds, poor soils and sparse vegetation. Impact of activities like cultivation production, including compost, irrigation, and grown seedlings can impact the dispersion of malacofauna.

Material and Methods

The research work was carried out in the desert farm of SEKEM Wahat that is reclaimed area at the edge of the Bahariya oasis (Wahat El Bahariya) in the Western Desert, Giza Governorate, 370 km southwest of Cairo and 180 km west of the Nile Valley (28°15′12.3″N 29°06′33.4″E). It is natural depression surrounded by hills. The climate is hyper-arid, with less than 50 mm per annum rainfall (Masoud and El Osta, 2016). Regarding to Bahariya oasis, it characteristic by low-latitude and arid hot climate conditions (ClimaTemps, 2017). The annual average temperature is 21.9°C. The average monthly temperatures vary by 17.1°C. July is the hottest month with average temperature of 29.5°C, while January is the coldest month with an average temperature of 12.4°C. The average temperature in the winter months starting from November to March is 12.4-18°C, while in the summer months starting from April and October is 22.5-29.5°C. The average daylight hours vary from 10:11 hrs in winter (21 of December) to 13:48 hrs in summer (22 of June). Recently, these oases have garnered the attention of government authorities as potential additions to Egypt's cultivated areas.

SEKEM desert farm of around 2500 feddan (One Feddan is equal to 4200 m^2) divided into (a) old farm (572.82 feddan) which cultivated since 2008 and is surrounded by wind breakers such as *Casuarina equisetifolia* and is equipped with drip irrigation **(**b) new farm (1850 feddan) that cultivated since 2018/2019 and is irrigated by centre pivot irrigation system and (c) preserved desert area where human activity has not started so far (Fig. 1 and 2).

The plant life in these oases and depressions comprises four main types of vegetation: reed swamp vegetation, salt marsh vegetation, sand formation vegetation, and desert plain vegetation. Halophytic plants, which are adapted

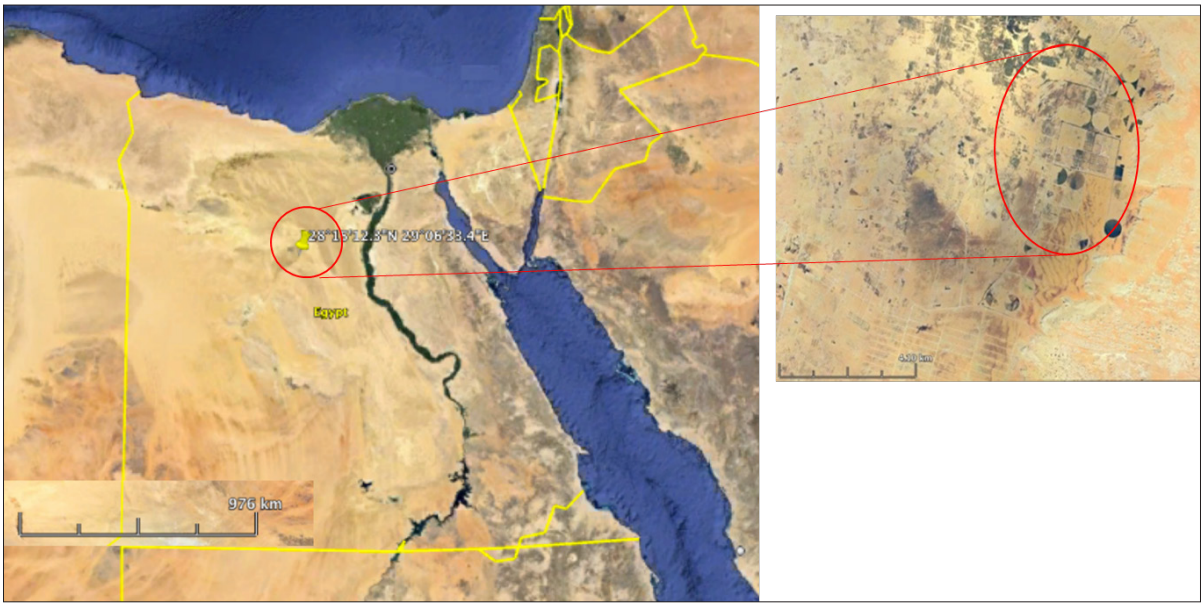

Fig. 1. Map of SEKEM desert farm location (2500 feddan) (28°15′12.3″N 29°06′33.4″E).

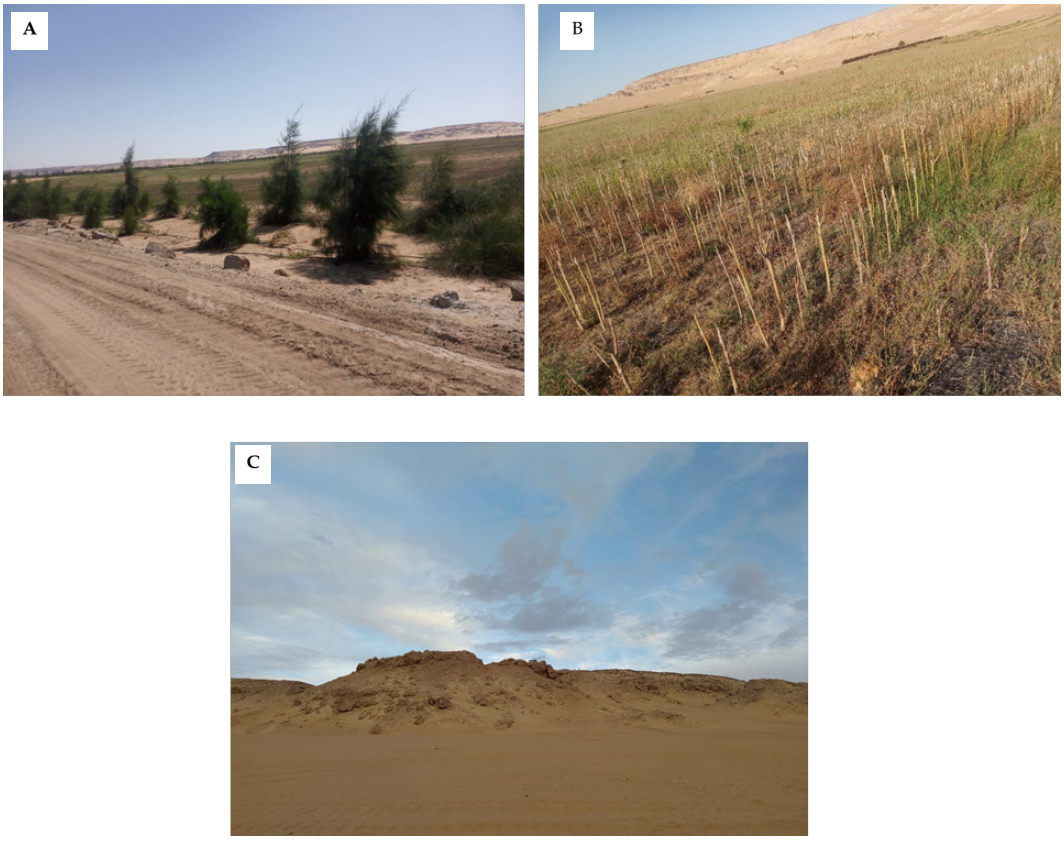

Fig. 2. The location under study is Bahariya oasis (Wahat El Bahariya showing the three different plots under study. A. old farm B. new farm. C. desert area.

to saline conditions, are particularly dominant in these habitats. Some common species include *Juncus rigidus*, *Cyperus laevigatus*, *Juncus acutus*, *Suaeda aegyptiaca*, *Suaeda monoica*, *Cressa cretica*, *Aeluropus lagopoides*, *Imperata cylindrica*, and *Tamarix nilotica*.

The reclaimed areas are better endowed in terms of irrigation, soil enriched by compost and organic fertilizers, lower wind speed, moisture and temperature stability. The farmland had low to dense vegetative cover. Major cultivated crops at the farm are cotton *Gossypium barbadense* (L.), peanuts *Arachis hypogaea* (L.), tomato *Solanum lycopersicum* (L.), watermelon *Citrullus lanatus* (Thunb.). Many herbal and medicinal plants i.e. marjoram *Origanum majorana* (L.), jojoba (*Simmondsia chinensis* (Link), and mint *Mentha spicata* (L.); besides shrubs like alder buckthorn *Frangula alnus* Mill, palm trees (*Phoenix* sp.) and coastal she-oak *Casuarina equisetifolia* L. Besides planted crops wild plants of 49 different species have been recorded in farm area. Of these the major ones are apple of sodom *Calotropis procera* (Aiton), eastern prickly-pear *Opuntia humifusa*, spiny sowthistle *Sonchus asper* (L.), stink grass *Eragrostis cilianensis* (All.), summer cypress *Bassia scoparia* (All.), and common purslane *Portulaca oleracea* L. (Fig. 3).

Molluscans were observed and located by sight. The search for molluscs were close to the irrigation tubes, cultivated crops, wild plants and compost; the individuals were attached to organic matter, manure or compost. The specimens were collected by hand, separated and were kept in labeled bags.

In laboratory, specimens were examined under a binocular microscope equipped with an ocular eye piece micrometer. The collected species was examined and described as mentioned in Abd El-Wakeil *et al.* (2013). Identified specimens are deposited in Faculty of Organic Agriculture, Heliopolis University.

Shells were studied macroscopically for surface structures under magnification (5-10 fold) using a stereomicroscope (Nikon SMZ25). Taxonomic description as well as information on ecology and geographic distribution were thoroughly analyzed according to relevant

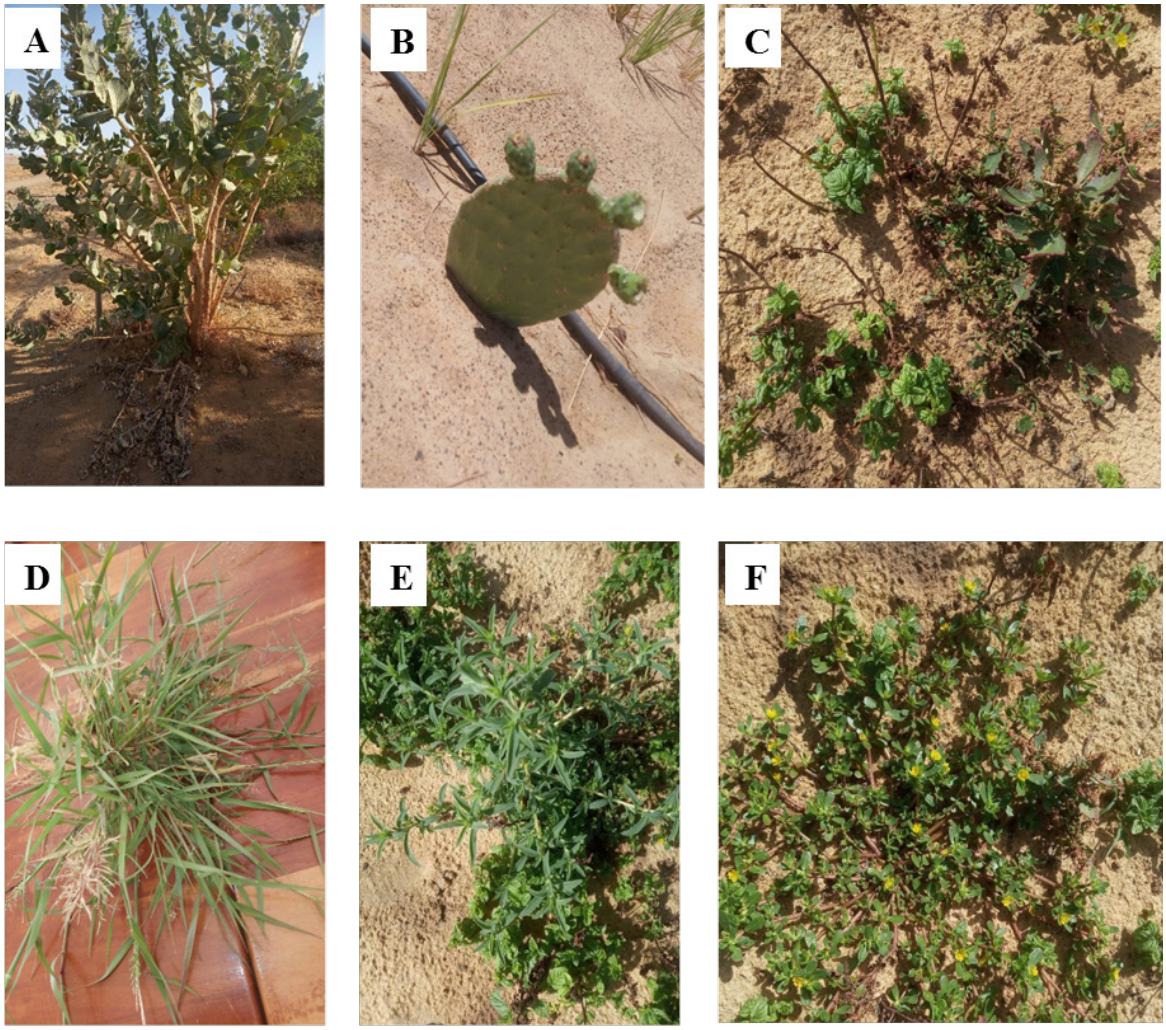

Fig. 3. Major vegetation in SEKEM farm. A. Calotropis procera B. Opuntia humifusa C. Sonchus asper D. Eragrostis cilianensi E. Bassia scoparia F. Portulaca oleracea.

previous literature on mollusk fauna and freshwater snails in Egypt (Van Damme, 1984; Brown, 1994; Van Damme and Van Bocxlaer, 2009; Ali and Ramdini, 2020).

The shells were counted and identified according to Brown (1980); Brown *et al.* (1984) and Abd El-Wakeil *et al.* (2013). The data from this study were compared with the data recorded in previous studies of this area. The collected mollusks samples were classified according to Bouchet *et al.* (2017) and MolluscaBase (eds. 2022).

Results and Discussion

In all two marine, eight freshwater and five terrestrial species were recorded in the study area. Two marine species were *Pirenella conica*, and *Cerastoderma glaucum*. Out of eight freshwater mollusca species, six belonged to class Gastropoda viz. *Bellamya unicolor*, *Melanoides tuberculata*, *Theodoxus jordani*, *Lanistes boltenianus*, *Planorbella duryi*, and *Cleopatra bulimoides* and the two belonged to class Bivalvia *viz. Corbicula fluminalis* and *Chambardia rubens*. Five terrestrial species recorded were *Monacha obstructa*, *Xeropicta krynickii*, *Eremina desertorum*, *Theba pisana*, *Eobania vermiculata*. Total 15 species were identified belonging to two classes (Gastropoda and Bivalvia). The density and distribution of each species in Sekem farm are shown in Table 1. Photographs of these mollusks are given in Figure 4 and 5. Results presented in Table 1 clearly suggest that all the fifteen were present in the old farm, but only 10 in the new farm. Only thre species namely *Cerastoderma glaucum*, *Corbicula fluminalis*, *Bellamya unicolor* were present in the un-reclaimed desert area. These results clearly

Table 1. Density and distribution of each gastropod species inside the SEKEM farm.

Family	Species	Type of farm	Species density for each plot	Average
Cardiidae	*Cerastoderma glaucum* (Bruguière, 1789)	Old farm	2	3.0
			2	
			5	
		New farm	1	4.0
			10	
			1	
			4	
			5	
			3	
		Desert area	2	2.0
Iridinidae	*Chambardia rubens* (Lamarck, 1819)	Old farm	1	1.0
		New farm	1	1.0
		Desert area	0	0.0
Cyrenidae	*Corbicula fluminalis* (O. F. Müller, 1774)	Old farm	6	3.6
			9	
			1	
			4	
			2	
			1	
			4	
			2	
		New farm	6	6.0
			9	
			6	
			4	
			5	
		Desert area	2	2.0
Ampullariidae	*Lanistes boltenianus* (Röding, 1798)	Old farm	2	1.5
			1	
		New farm	3	3.0
		Desert area	0	0.0
Paludomidae	*Cleopatra bulimoides* (Olivier, 1804)	Old farm	1	1.7
			1	
			2	
			2	
			1	
		New farm	8	8.0
		Desert area	0	0.0
Potamididae	*Pirenella conica* (Blainville, 1829)	Old farm	3	3
		New farm	0	0
		Desert area	0	
Thiaridae	*Melanoides tuberculate* (O.F. Müller, 1774)	Old farm	1	1.0
		New farm	1	1.5
			2	
		Desert area	0	0.0

Table 1. Contd..

Family	Species	Type of farm	Species density for each plot	Average
Viviparidae	*Bellamya unicolor* (Olivier, 1804)	Old farm	2	5.1
			4	
			4	
			7	
			9	
			9	
			5	
		New farm	1	2.3
			4	
			2	
		Desert area	2	2.0
Neritidae	*Theodoxus jordani* (G. B. Sowerby I, 1836)	Old farm	1	1.0
		New farm	1	1.0
		Desert area	0	0
Planorbidae	*Planorbella duryi* (Wetherby, 1879)	Old farm	2	1.5
			1	
		New farm	0	0.0
		Desert area	0	0.0
Geomitridae	*Xeropicta krynickii* (Krynicki, 1833)	Old farm	1	1.0
		New farm	1	1.0
		Desert area	0	0.0
Helicidae	*Eobania vermiculata* (O. F. Müller, 1774)	Old farm	1	1.0
		New farm	0	0
		Desert Area	0	0
	Eremina desertorum (Forskål, 1775)	Old farm	1	1.0
		New farm	1	1.0
		Desert Area	0	0.0
	Theba pisana (O. F. Müller, 1774)	Old farm	1	0.0
		New farm	0	0.0
		Desert Area	0	0.0
Hygromiidae	*Monacha obstructa* (L. Pfeiffer, 1842)	Old farm	3	2.2
			4	
			2	
			1	
			1	
		New farm	3	3.0
			1	
			6	
			2	
		Desert Area	0	0.0

show that farming improves the diversity of the mollusk population.

Most of the species belong to the local fauna of the Nile, with the exception of two of marine origin and recorded in the adjacent regions of the Mediterranean. *Theodoxus niloticus*, *Melanoides tuberculata*, *Cleopatra bulimoides* as well as the bivalves *Corbicula consobrina* and *Chambadìa rubens* are widely distributed in the Nile of Egypt and recorded from adjacent regions in the Mediterranean as Nile fauna (Damme and Bocxlaer, 2009; Budka, 2020).

Fig. 4. Terrestrial gastropods. a-c. Eobania vermiculata (O. F. Müller, 1774); d-f. Eremina desertorum (Forskål, 1775); g-i. Xeropicta krynickii (Krynicki, 1833); j-l. Monacha obstructa (L. Pfeiffer, 1842); m-o Theba pisana (O. F. Müller).

Fig. 5. Freshwater and Marine Shell: a-b. Cerastoderma glaucum (Bruguière, 1789); c. Chambardia rubens (Lamarck, 1819); d. Corbicula fluminalis (O. F. Müller, 1774); e-f. Lanistes boltenianus (Röding, 1798); g-h. Cleopatra bulimoides (Olivier, 1804); i-j. Pirenella conica (Blainville, 1829); k-l. Melanoides tuberculata (O. F. Müller, 1774); m-o. Planorbella duryi (Wetherby, 1879); p. Theodoxus jordani (G. B. Sowerby I, 1836); q-r. Bellamya unicolor (Olivier, 1804).

Some species found in the sampling station such as *Eobania vermiculata*, *Theba pisana* and *Xeropicta krynickii* are considered harmful to crops (Däumer *et al.,* 2012). During surveying freshwater snails in Egypt, around twenty species of Mollusca found (14 gastropods and 6 bivalves) between Esna and El-Kanater El Kharia (Ramadan *et al.,* 2000), while nineteen molluscs species recorded at the River Nile from Aswan to Cairo (Fisher and Williams, 2006, 2008).

Many studies have recorded snails in all the governorates of Egypt; for example, 13 species of snail have been recorded in the rivers of seven governorates: Greater Cairo, Giza, Qalioubiya, Ismailiya, Baheria, Damietta and El-Menia (El-Khayat *et al.,* 2011) and thirteen species in the governorate of Qena (Hussein *et al.,* 2011).

Conclusion

This research reports malacofauna diversity in a reclaimed and un-reclaimed area of SEKEM Desert Farm at Bahariya oasis, in the western desert in Giza Governorate, Egypt. The farm utilizes organic farming approaches for cultivating crops and medicinal plants. Only three species namely *Cerastoderma glaucum*, *Corbicula fluminalis* and *Bellamya unicolor* were present in the un-reclaimed desert area. But after reclaiming the area and bringing it under agriculture, the species richness of the mollusks increased. 15 mollusk species were found present in the farm area that was reclaimed in 2008 and 11 species in the farm reclaimed in 2018/19. Most of the species belong to the local fauna of the Nile, with the exception of two of marine origin and recorded in the adjacent regions of the Mediterranean. The study also showed the presence of three species *Eobania vermiculata*, *Theba pisana* and *Xeropicta krynickii* that are considered harmful to crops

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