EFFECT OF A ONE YEAR GRAZING MANAGEMENT ON POPULATION DENSITIES OF SOIL FAUNA IN AN AFRO-MEDITERRANEAN DESERT ECOSYSTEM

By

SAMIR I. GHABBOUR and ABD-EL-KHALEK M. HUSSEIN

Department of Natural Resources, Institute of African Research and Studies, Cairo University, Giza (Cairo), Egypt.

Summary

An area in the Mediterranean desert region at Omayed, 83 km west of Alexandria and about 10 km south of the sea shore was fenced off and protected from grazing for 3 years from 1974 to 1977. In part of this area 66% of the grazing pressure (G.P.) prevalent in the region was allowed; and two other plots were fenced-in and 66% and 33% of the prevalent grazing pressure was allowed. The soil mesofauna (which do not pass through a 1-mm mesh sieve) were sampled from under five species of shrubs *(Artemisia monosperma, Gymnocarpos decandrum, Thymelaea hirsuta, Anabasis articulata* and *Asphodelus microcarpus)* in each of these 4 treatments in addition to the free-grazing area outside (100% G.P.). A total of 294 samples were taken from autumn 1977 to summer 1978. Preliminary examination of these results indicates that the population density of the soil mesofauna is higher in the treatments : 3-year protection + 66% P.G., and no previous protection + 33% G.P. Comparing seasons, highest population densities are in summer. It is postulated that sheep and goats (consumers) have a beneficial effect on soil mesofauna by converting plant biomass into animal necromass (urine) and converted plant necromass (dung) which is more readily digestible and assimilable than non-converted plant necromass (litter). At intermediate grazing pressures, this beneficial effect seems to outweigh the harmful effect of trampling. Populations of soil mesofauna, however, are in the process of adjusting to changes in plant cover and producer-consumer relationships within the exclosure.

Introduction

Understanding the patterns of abundance and distribution of soil invertebrates in various ecosystems has become possible through a number of major studies that have been ably summarized by Wallowrk (1976). The number and scope of such studies in desert ecosystems, however, has not been on the same scale as in other more favoured ecosystems due to the difficulties posed by the nature of the terrain, the looseness of the soil and the distributional pattern of vegetation. Sampling soil fauna in deserts is made difficult by the extremely uneven spatial distribution of plants. Earlier studies on soil fauna in the Mediterranean desert of Egypt have shown that bare ground between the low desert shrubs is not a natural habitat for desert soil mesofauna. The overwhelming majority live in the litter/soil subsystem under shrubs. The term soil mesofauna in this and related studies refers to an arbitrarily chosen size group of soil invertebrates which do not pass through a 1-mm mesh size sieve. Those that pass through this sieve are termed microfauna, while the term macrofauna is reserved to soil vertebrates.

During a study on the effect of different degrees of grazing pressure on the structure of vegetation at the Omayed site (83 km west of Alexandria), within the scope of the SAMDENE Project (Ayyad and Ghabbour 1977), it was possible to conduct a simultaneous study on the effects of these grazing pressures on the soil mesofauna. Preliminary results on the abundance of these invertebrates are presented herewith.

Material and Methods

The Omayed site (Fig. 1) has been described by Ayyad and Ghabbour (1977) while the general climate of the coastal desert has been described by Ghabbour, Mikhail and Rizk (1977). The layout of the experimental plots fenced-in for controlling the different degrees of grazing pressure, is shown in Fig. 2. Five degrees, or categories, of grazing pressure were used :

F_0 = open free-grazing area with 100% grazing pressure (G.P.) estimated at about 1 sheep unit/2 hectares. No control is applied. This is given a rating of (1).

F_1 = three years of complete protection from grazing (0%). This was from 1974 to 1977. It was followed by 66% G.P. (related to that outside the exclosure) for one year. This is given a rating of (4).

F_2 = complete protection for 4 years, from 1974 to 1978. This is given a rating of (5).

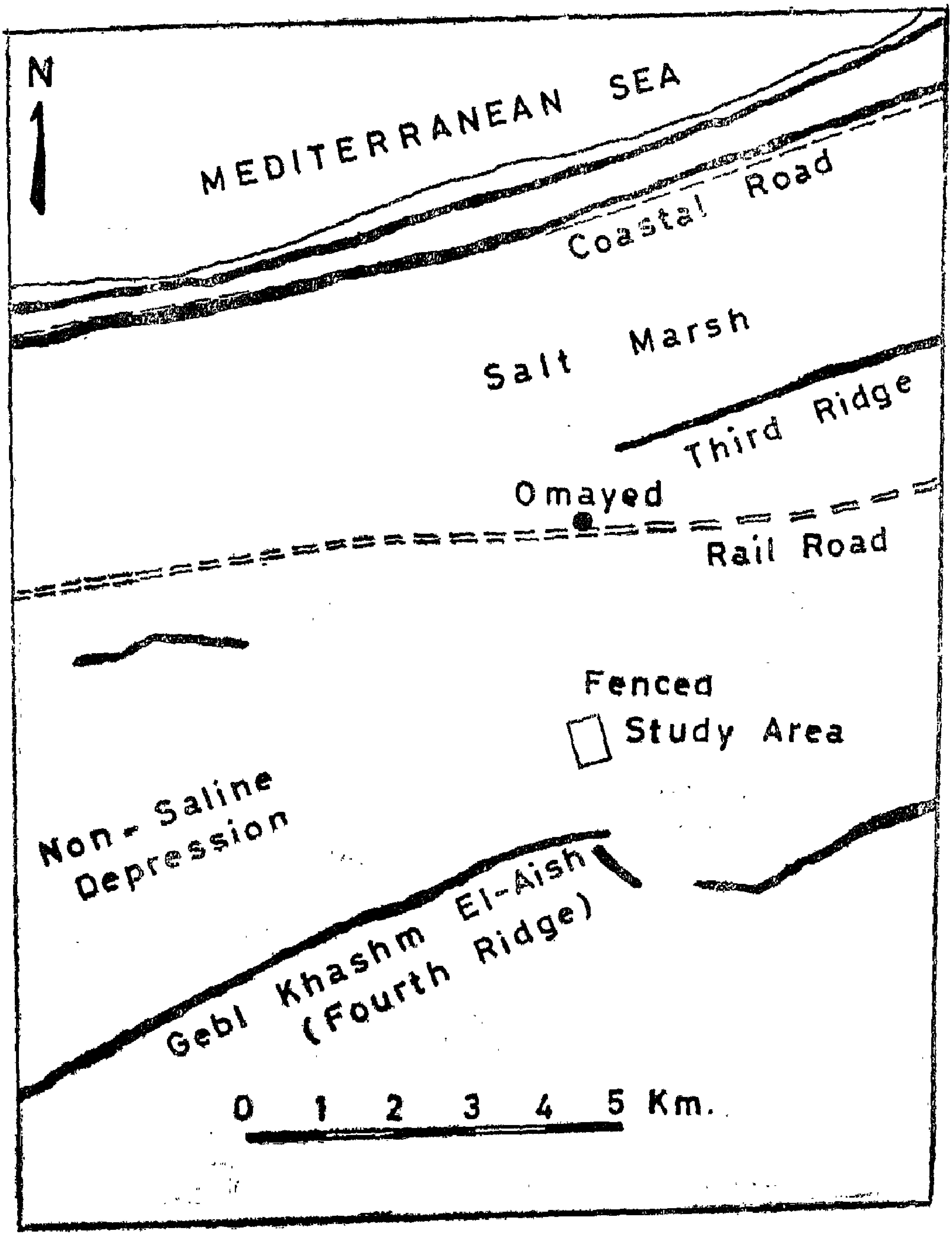

Fig. 1. Map of the Omayed area and the fenced exclosure.

F_3 = 66% G.P. in the period 1977-1978, preceded by no protection as in F_0. This is given a rating of (2).

F_4 = 33% G.P. in the period 1977-1978, with past history as F_0. This is given a rating of (3).

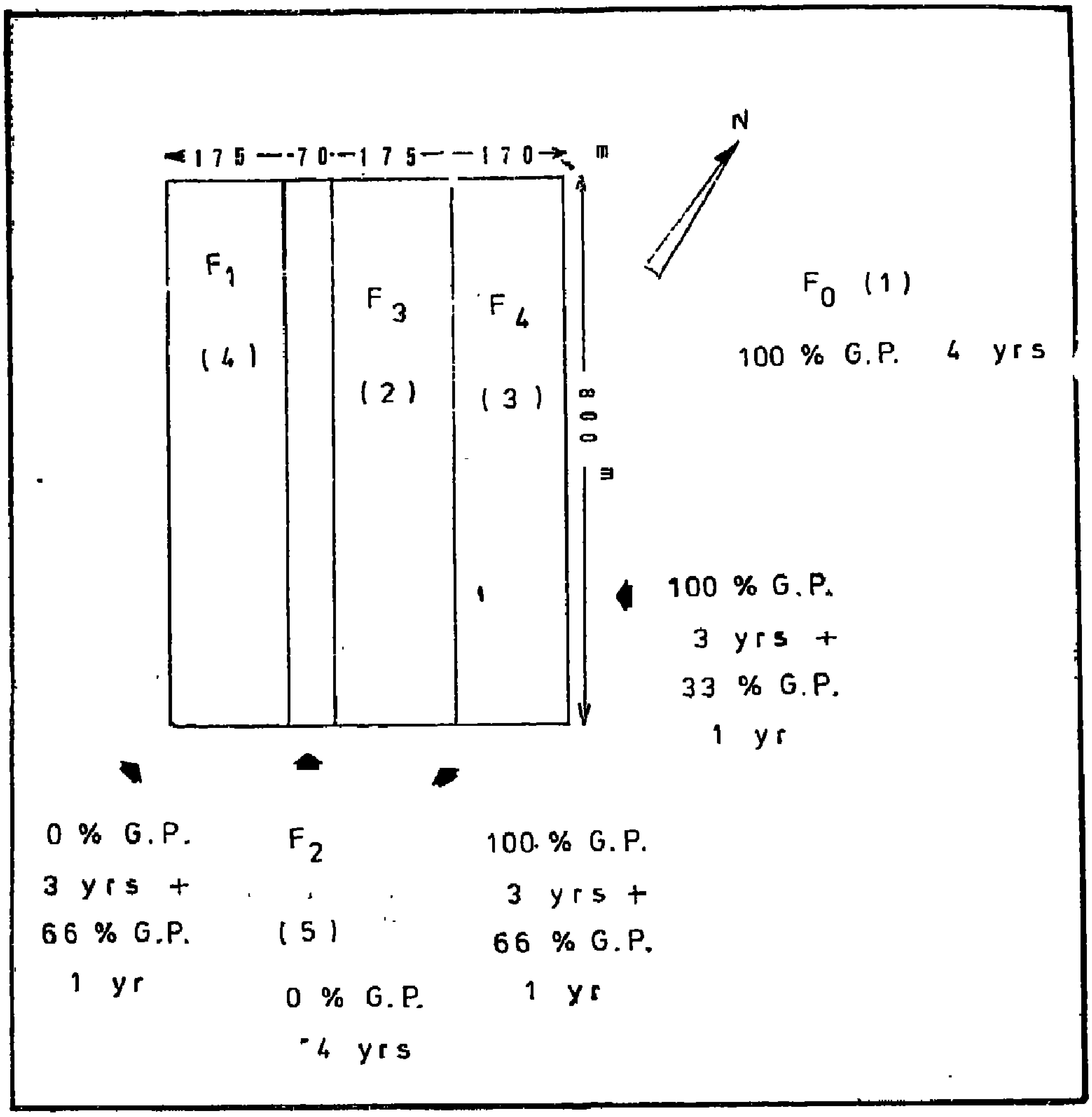

Fig. 2. Layout of the treatments of different degrees of grazing pressure at the Omayed validation site.

To avoid unnatural behaviour in the sheep and goats because of the small size of the flocks, the approach was to increase the size of flock and reduce the time allowed for grazing, according to a formula designed and managed by El-Ghonemy and El-Kady (1978). A flock of 10 units is used in a rotation of 10 days, 2 days corresponding to 33% G.P. in F_4 and 4 days corresponding to 66% G.P. in each of F_1 and F_3. The ratio of sheep to goats was kept close to that occurring under free grazing by the Bedouins (about 3 : 1).

With the establishment of the exclosure in 1974, some plants with an insignificant area of cover began to spread when protected from grazing, while others started to suffer and lose their vitality (Ayyad 1978). Earlier work had shown that most of the soil mesofauna in the open grazing area (F_0) of that ecosystem were associated with two shrub species : *Thymelaea hirsuta* (L.) Endl. and *Anabasis articulata* (Forssk.) Moq. (Ghabbour and Mikhail 1978, Ghabbour and Mikhail unpubl.). *Thymelaea* was one of the plants that began to decline inside the enclosure. At the same time, *Gymnocarpos decandrum* Forssk. and *Artemisia monosperma* Del. were prominent among those which began to spread when protected. Therefore it was decided to sample the two latter species in addition to the first two. These are the largest shrub species present in the ecosystem in terms of diameter. Shrubs with diameters less than about 30 cm do not generally yield specimens of soil mesofuna. In order to determine whether protection from grazing would help soil mesofauna to settle under such small shrubs, sampling in *Asphodelus microcarpus* Salzm. & Viv. was started, but was soon dropped because of very poor results. *Gymnocarpos* and *Artemisia* were not sampled in F_0 as their cover was too small to be sampled.

The method of sampling was described by Ghabbour, Mikhail and Rizk (1977). Briefly, this consists of digging the soil under the canopy of the shrub selected for sampling and passing the soil through a 1-mm mesh sieve. Digging and sieving are continued until animals and litter are no longer obtained. A few extra sievings are passed through to make sure that the soil core under the canopy has been completely sampled. The diameter of the shrub and maximum depth of digging that gave positive results are then recorded. Selection of shrubs is at random. Since density of shrubs of any given species is very low, the number of shrubs of the selected species within the experimental plots is very low. Selection for sampled shrubs was by walking along a transect whose direction is diagonal and with its starting point at the fence. The starting point was changed by toss for every sampling season taking care not to be repeated. Six shrubs are sampled from each plant species at a time. Only in the case of *Asphodelus microcarpus,* was the area of the soil sampled fixed at $1m^2$, with the plant in the centre of the square. This did not add, however, to the size of the mesofaunal population to a point comparable to other shrubs with real canopy areas less than $1m^2$.

Plant nomenclature is according to Täckholm (1974).

Results and Discussion

Table 1 gives the mean of population densities obtained from 294 samples taken from 5 plant species in all 5 treatments (F_0 to F_4) but not all in the same season. Samples from F_0 were taken in winter, from F_1 in

TABLE 1

Population density of total soil mesofauna/m2
(W = windward side, L = Leeward side)

Plant species	Treatment	Season		Mean	S.E.
Asphodelus	Fo	winter		3.7	1.1
Thymelaea			W	13.2	4.6
			L	15.1	6.0
Anabasis			W	41.0	12.1
			L	35.4	4.3
Asphodelus	F1	autumn		20.0	16.5
Thymelaea		,,	W	13.5	2.6
			L	26.7	4.2
Anabasis		,,	W	99.4	79.8
			L	48.0	18.4
Gymnocarpos		,,		77.5	27.7
Artemisia		,,		14.3	5.0
Thymelaea		winter	W	10.9	6.2
			L	20.7	6.1
Anabasis		,,	W	16.2	5.6
			L	25.0	4.1
Gymnocarpos		,,		29.6	4.9
Artemisia		,,		12.9	7.7
Thymelaea	F2	spring	W	3.1	1.1
			L	8.2	2.3
Anabasis		,,	W	13.4	1.8
			L	68.0	47.8
Gymnocarpos		,,		14.1	4.0
Artemisia		,,		12.6	2.6

TABLE 1 (*Contid.*)

Asphodelus	F3	autumn		1.0	0.3
Thymelaea		,,	W	21.0	7.7
			L	22.7	4.1
Anabasis		,,	W	14.8	3.4
			L	34.2	5.6
Gymnocarpos		winter		30.4	6.4
Artemisia		,,		35.8	11.7
Thymelaea		spring	W	5.0	2.8
			L	13.4	3.3
Anabasis		,,	W	14.8	3.4
			L	34.2	5.6
Gymnocapos		,,		32.8	9.7
Artemisia		,,		9.5	1.4
Asphodelus	F4	winter		0.7	0.2
Thymelaea		,,	W	7.9	5.6
			L	16.7	5.0
Anabasis		winter	W	31.4	10.0
			L	20.5	2.6
Gymnocarpos		winter		52.6	12.8
Thymelaeo		summer	W	9.1	2.7
			L	26.4	6.8
Anabasis		,,	W	77.8	53.1
			L	56.4	32.9
Gymnocarpos		,,		26.6	6.8
Artemisia		,,		19.0	4.4

Each figure for a mean is the result of 6 samples. W and L densities: *Thymelaea*, differnce significant at $p = 0.01$—0.001 (*Anabasis*, difference not significant. *t* test;).

autumn (fall) and winter, from F_2 in spring, from F_3 in autumn, winter and spring and samples from F_4 in winter and summer. From earlier studies on seasonality in that ecosystem (Ghabbour and Mikhail 1977 and 1978) it is apparent that transitional seasons are of shorter duration than summer and winter, and accordingly autumn is considered to comprise October and November while spring comprises April and May. Population densities are calculated as individuals/m^2 in all 294 samples and as individuals/m^3 in 210 samples out of the total (Table 2). The range of depth which gave positive results was 30-40 cm. The relationship between the population density of the soil mesofauna/m^2 and the average area of the shrub canopy for the plant species concerned is shown in the upper part of Fig. 3, while the relationship of density/m^3 to volume of soil excavated under shrubs is shown in the lower part of Fig. 3. The ranges shown in Fig. 3 are ranges of the means shown in Tables 1 and 2. The S.E. is also calculated for the means, the zero minima thus being eliminated.

If we disregard *Asphodelus,* for which a fixed area of 1 m^2 was arbitrarily chosen, we find that density/m^2 increases with area and density/m^3 increases with volume, with the exception of *Thymelaea.* It seems that density increases rapidly from the dimension class of *Artemisia* to that of *Gymnocarpos* but slowly from the dimension class of *Gymnocarpos* to that of *Anabasis.* It falls again to low levels in *Thymelaea* although the latter has the largest dimension class. *Artemisia, Gymnocarpos* and *Anabasis* are of hemispherical growth form with their lower branches touching the ground. The branching of *Thymelaea* is V-shaped with lower branches away from the soil surface. This is perhaps why *Thymelaea* does not conform, in terms of population density of soil mesofauna it harbours, with the pattern observed for the other three species.

Fig. 4 (based on Tables 3, 4 and 5), shows a comparison of densities/m^2 and per m^3 for the five treatments, and for seasons. The highest density is apparent in the F_1 treatment (3 years protection followed by 66% G.P.) and the lowest is in F_3 (no protection followed by 33% G.P. for 1 year). The difference is significant at $p = 0.01$ to 0.02. As regards density/m^3, there is significant difference between the highest value in F_4 and the lowest in F_1. It is to be noted, however, that F_3 is lowest and F_1 and F_4 are highest (Table 6). It can be concluded that although statistical significance is not high, F_1 and F_4 treatments may be more favourable for the soil mesofauna so far, and may be, equivalent to each other to some extent. Their ratings are 4 and 3 respectively, i.e. they are *a priori* considered intermediate between «no protection» and «complete protection». Although large quantities

TABLE 2

Popiulation Density of total soil mesofauna/m3
(W= windeward, sid L = leeward side;

Plant species	Treatment	Season		Mean	S.E.
Asphodelus	F0	winter		71.5	2.3
Thymelaea		,,	W	34.9	12.0
			L	40.9	16.5
Anabasis		,,	W	87.5	25.5
			L	74.3	7.5
Thymelaea	F1	winter	W	26.9	15.5
			L	51.0	15.2
Anabasis		,,	W	35.4	11.9
			L	55.7	7.2
Gymnocarpos		,,		76.9	12.9
Artemisia		,,		31.9	19.3
Thymelaea	F2	spring	W	10.0	3.7
			L	25.5	6.0
Adabasis		,,	W	32.1	4.4
			L	145.0	95.4
Gymnocarpos		,,		34.7	10.0
Artemisia		,,		43.7	7.1
Thymelaea	F3	spring	W	18.4	10.4
			L	47.3	11.0
Anabasis		spring	W	38.4	27.7
			L	25.9	6.9
Gymnocarpos		,,		69.1	20.1
		,,		22.2	3.5

TABLE 2 (*Contd.*)

Asphodelus	F4	winter		1.8	0.6
Thymelaea		,,	W	24.6	18.7
			L	46.5	12.5
Anabasis		winter	W	72.0	25.2
			L	47.6	7.7
Gymnocarpos		,,		112.0	26.8
Thymelaea		summer	W	32.9	9.1
			L	97.5	22.4
Anabasis		,,	W	188.2	133.9
			L	137.4	83.1
Gymnocarpos		,,		64.4	18.9
Artemisia				47.0	10.8

F0 = open free–grazing, area, 100% grazing pressure without protection, rating, (1).

F1 = three years 0% grazing, pressure followed by 66% grazing pressure for one year, rating (4).

F2 = complete protection for 4 years, rating (5).

F3 = 66% grazing pressure for one year, rating (2).

F4 = 33% grazing pressure for one year, rating (3).

W and L densities : *Thymelaea*, difference significant at $p = 0.01$—0.001 ; *Anabasis*, difference not significant. (t test).

of litter accumulated in F_2 due to complete protection for 4 years, it has generally low densities of soil mesofauna. By comparison with F_0 (free grazing), if the contributions by *Artemisia* and *Gymnocarpos* are subtracted, the densities of F_2 and F_3 would become much lower. Thus it can be concluded that free grazing in F_0 does not cause a lower population density of soil mesofauna, as could be theoretically expected, considering the effect of trampling by sheep and goats. This effect must be considered to be outweighed by the effect of dung production, which provides the soil animals with rich organic matter more readily digestible and assimilable than plant litter. Fig. 4 also shows that *Artemisia* and *Gymnocarpos* which yield no

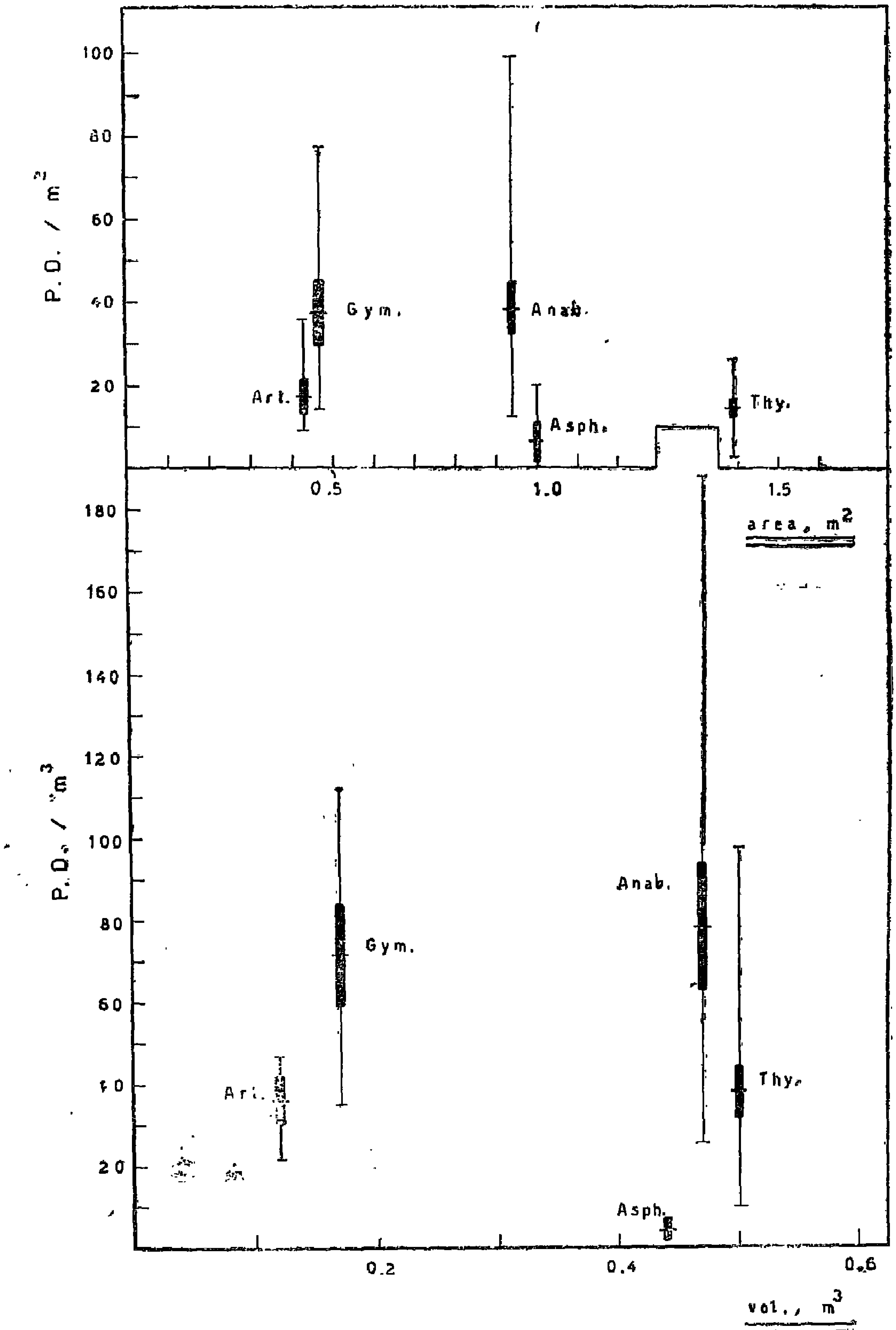

Fig. 3. Relationship between population density of soil mesofauna/m² under the canopies of different shrub species and the mean surface area of the canopies. Vertical line represents range; vertical bar one S.E., horizontal line, mean. Lower part of figure shows relationship between population density/m³ and mean volume of soil excavated under the shrubs.

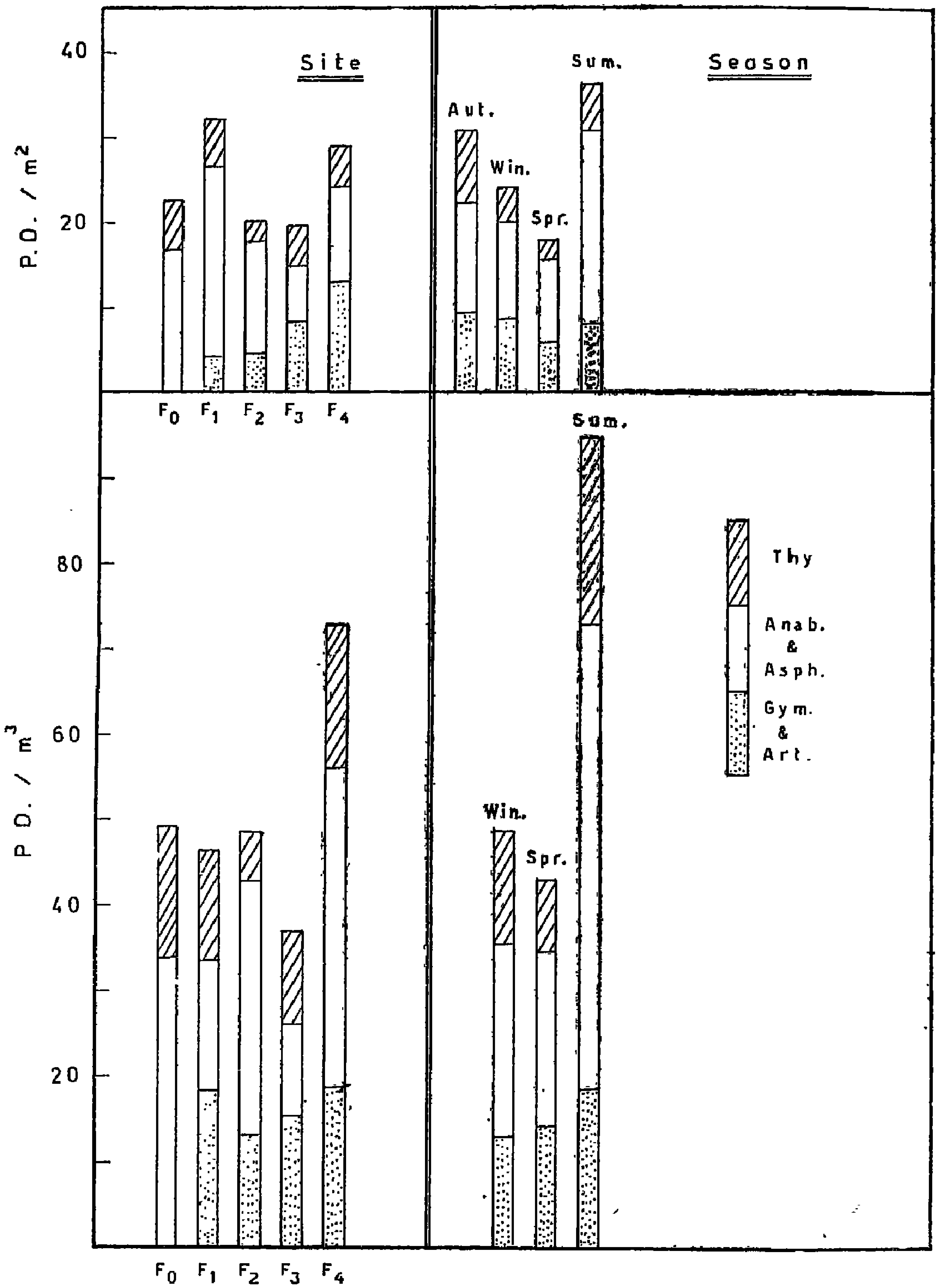

Fig. 4. Upper part : contribution of individual shrub species to soil mesofauna population density according to treatments (lef part) and season (right part). Lower part : Same as regards density/m³.

TABLE 3

Population density/m2. Comparisons of plants, sites and seasons

Plant species	Mean	Tretment and rating	Mean	Season	Mean
Asphodelus	6.3	F0,1	21.7	Autuman	30.8
Thymelaea	14.6	F1,4	31.9	Winter	23.9
Anabasis	38.4	F2,5	19.9	Spring	17.8
Gymnocarpos	37.7	F3,2	19.5	Summer	35.9
Artemisia	17.4	F4,3	28.7		

TABLE 4

Population density/m3. Comparisons of plants, sites and seasons

Plant species	Mean	Treatment and rating	Mean	Season	Mean
Asphodelus	4.6	F0,1	49.1	Winter	48.7
Thymelaea	38.0	F1,4	46.3	Spring	42.7
Anabasis	78.3	F2,5	48.5	Summer	94.6
Gymnocarpos	71.4	F3,2	36.9		
Artemisia	36.2	F4,3	72.7		

appreciable results in the unprotected area, contribute between 22 and 45% of the mesofauna population, in the protected plots. The long-term effects are expected to be more marked.

A steady decrease of population density is observed from autumn to spring followed by an increase in summer. The criteria for delimitation of seasons in the ecosystem under study are based on both meteorological and biological phenomena (Ghabbour, Mikhail and Rizk 1977, Ghabbour and

TABLE 5

Contribution of plant species to population density of soil mesofauna

A : contribution in various treatments

Plant species	F0	F1	F2	F3	F4
Asphodelus					
/ m2	0.7	1.5	—	0.1	0.1
%	3.4	4.8	—	0.4	0.2
/ m3	1.5	—	—	—	0.1
%	3.1	—	—	—	0.2
Thymelaea					
/ m2	5.7	5.5	1.9	4.8	5.0
%	26.1	17.3	9.4	24.5	17.4
/ m3	15.2	13.0	5.9	11.0	16.8
%	30.9	28.0	12.2	29.7	23.1
Anabasis					
/ m2	15.3	17.7	13.6	6.3	10.8
%	70.5	55.6	68.2	32.2	37.7
/ m3	32.4	15.2	29.5	10.7	37.1
%	66.0	32.8	60.9	29.1	51.1
Gymnocarpos and *Artemisia*					
/ m2	—	7.1	4.5	8.3	12.9
%	—	22.3	22.4	42.8	44.9
/ m3	—	18.1	13.0	15.2	18.6
%	—	39.2	26.9	41.3	25.6

TABLE 5. Cont'd.
B : Contributions in various seasons

Plant species	autumn 1977	winter 77—78	spring 1978	summer 1978
Asphodelus				
/ m2	6.8	1.0	—	—
%	2.1	0.2	—	—
/ m3	—	1.1	—	—
%	—	0.5	—	—
Thymelaea				
/ m2	27.5	18.6	13.9	16.5
%	8.5	4.4	2.5	5.9
/ m3	—	27.2	19.8	23.0
%	—	13.2	8.5	21.8
Anabasis				
/ m2	63.8	37.3	53.6	62.3
%	19.6	8.9	9.5	22.4
/ m3	—	45.0	47.1	57.4
%	—	21.9	30.1	54.3
Gymnocarpos and *Artemisia*				
/ m2	29.9	35.5	32.4	21.2
%	9.2	8.5	5.8	7.6
/ m3	—	26.7	33.1	19.6
%	—	13.0	14.1	18.5

Mikhail 1978). Moreover, reactions of the dominant soil invertebrate, the sand roach *Heterogamia syriaca* Sauss., to meteorological and edaphic factors, as reflected in variations in its chemical composition, lend support to these delimitations (Ghabbour and Mikhail 1977, Ghabbour 1978).

The plant which contributes most to the increase of summer populations is *Anabasis*, but the increase is apparent in the other plant species also.

TABLE 6

Comparison of population densities of soil mesofauna under the canopies of individual shrub species in different treatments. The highest mean is in blod type. The lowest mean is in itolics. Application of the *t* test between highest and lowest means is also shown.

Shrub species	Population density	Treatment F0	F1	F2	F3	F4	*t*	df	*p*
Asphodelus	/m2	3.7	**20.0**	—	1.0	**0.7**	1.17	10	ns
	/m3	**7.5**	—	—	—	**1.8**	2.47	10	0.05—0.02
Thymelaea	/m2	14.0	**17.9**	**5.7**	15.5	15.0	3.16	34	0.01—0.001
	/m3	37.9	38.9	**17.7**	32.8	**50.4**	2.32	34	0.05—0.02
Anabasis	/m2	38.2	**47.2**	40.7	**24.5**	46.5	1.29	46	ns
	/m3	80.9	45.6	88.5	**32.1**	**111.3**	1.41	34	ns
Gymnocarpos	/m2	—	**53.6**	**14.1**	31.6	39.6	1.79	16	ns
	/m3	—	76.9	**34.7**	69.1	**88.2**	2.10	16	ns
Artemisia	/m2	—	13.6	**12.6**	22.7	**19.0**	1.00	16	ns
	/m3	—	31.9	43.7	**22.2**	**47.0**	2.19	10	ns

As density/m^2, the increase is between 1.3 : 1 and 2.4 : 1; and as density/m^3 it varies between 1.3 : 1 and 2.7 : 1 for the plant species concerned. This seasonal pattern of density variation can be explained by the following sequence of peaks in fluctuations of the various forms of organomass in the ungrazed ecosystem, beginning with rainfall in Dec.-Jan. :

Rainfall → plant biomass → plant necromass → soil fauna, and in the grazed ecosystem :

Rainfall → plant biomass → plant necromass → soil fauna

↘ domestic animal biomass ↗

↘ domestic animal necromass (urine) and converted plant necromass (dung) ↗

The peak for plant biomass, following rainfall, is Feb.-Apr., for plant necromass Apr.-May., and for soil fauna June-July. When the additional loop in the sequence provided by domestic grazing animals (consumers) is present the input of urine and dung enhances the activity, numbers and variety of soil invertebrates. The regulating role of consumers in the ecosystem has been discussed by Chew (1974), Lee and Inman (1975) and Hunt (1977). Lee and Inman, in particular, simulated ecosystems with and without consumers and found that fluctuations in activity of primary producers were clearly damped in presence of consumers. Chew (1974) had argued that if there are alternating periods of heavy grazing and rest this will result in some increase in diversity. On the other hand Hunt (1977) showed by means of a simulation model that decomposition rates can be predicted from temperature, water tension and inorganic nitrogen concentration. It is well known that the effect of the first two factors (temperature and water tension) is decisive, but the direct effect of inorganic N concentration adds a new concept which was expressed before as the C/N ratio. It explains and emphasizes the role of consumers in the dynamics of decomposer activities, when they transform part of the plant biomass to animal necromass and converted plant necromass. In a heavily grazed ecosystem, it is estimated that more than 50% of the net primary production is consumed by domestic animals, 30-40% of this consumption becomes urine and dung (Odum 1975). This transformation has an effect on soil invertebrates (mostly decomposers). A mixture of excreta of soil animals and litter was shown to improve the soil nitrogen status more than either component alone (El-Ayouty, Ghabbour and El-Sayyed 1978).

It is also to be noted that differences between highest and lowest means of population density in individual plants are significant in the case of *Thymelaea* between the F_1 and F_2 treatments (Table 6). Because of its V-shaped branching, the difference in density between its windward and leeward sides is significant. Its growth form does not insulate its soil mesofauna from climatic and management effects.

Although the effect of varying degrees of protection is weakly demonstrated in the present preliminary results it is believed that the effect of the presence of a certain degree of grazing is beneficial to soil mesofauna as far as population density is concerned. We may conclude that in F_0 the soil mesofauna has attained an equilibrium between the negative factor of trampling by domestic animals and the positive factor of urine and dung production at maximum stocking rate. In the other treatments, this equilibrium has been disturbed by different degrees of protection and grazing pressure. The soil mesofauna in these experimental plots is in the process of adjusting to the new changes in plant cover, amount of litter, depth of soil, moisture regime, trampling by animals and urine and dung production.

Further evidence that soil moisture does not affect populations in a simple cause-effect relationship is that soil moistures recorded under the same sampling shrubs was 0.48, 1.00 and 1.38% in autumn (fall), 0.34, 3.01 and 4.74% in winter, and again 0.29, 1.56 and 2.40% in spring, at 0, 20 and 50 cm depth respectively. It appears that there is a lag between the wetting of the soil in winter and the response of animals manifested in higher population densities in summer.

Acknowledgements

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Effet d'une année de pâturage controlé sur la densité de la faune du sol dans un écosystème d'un desert afro-méditerranéen.

Résumé

Un programme de pâturage controlé a été effectué à Omayed, à 83 km à l'ouest d'Alexandrie et 10 km loin de la côte. Une parcelle de 21 ha fut strictement protégée depuis 1974 puis fut divisée en deux, l'une de 14 ha ou des moutons et des chèvres furent introduits à raison de 66% de la densité générale aux alentours, tandis que l'autre a demeuré en protection totale. En sus, deux autres parcelles chacune d'environ 14 ha ou les chèvres et les moutons sont introduits à raison de 33% et 66% de la densité pratiquée par les bedouins aux alentours. Ces pourcentages signifient introduire les animaux pour 2 (33%) ou pour 4 (66%) jours sur dix. Le nombre des animaux est 10 avec les moutons trois fois plus nombreux que les chèvres. Ce protocol a commensé en 1977. Parallèlement, une étude sur la faune du sol fut commencée. Les résultats préliminaires montrent que pour la première année du programme, la densité des populations de la mésofaune du sol (les animaux réténus par un tamis d'un mm) est plus haute dans les traitements ou le patûrage par une densité modérée d'animaux domestiques existe. Les populations de la mésofaune du sol, cependant, sont en cours de s'ajuster aux nouvelles conditions et changements du couvert végétal et des rélations entre producteurs et consommateurs à l'intérieur des parcelles protégées.

References

1. AYYAD, M.A. (1978) : A priliminary assessment of the effect of protection on the vegetation of Mediterranean desert ecosystems. *Vivi Täckholm Biological Symposium, Lund, Sweden. Bot. Notiser* 131 : 444-445.
2. AYYAD, M.A. and GHABBOUR, S.I. (1977) : Systems analysis of Mediterranean desert ecosystems of northern Egypt (SAMDENE). *Environm. Conserv.* 4 : 91-101.
3. CHEW, R.M. (1974) : Consumers as regulators of ecosystems : An alternative to energetics. *Ohio J. Sci.* 74 (6) : 359-370.
4. EL-AYOUTY, E.Y.; GHABBOUR, S.I. and EL-SAYYED, N.A.M. (1978) : Rôle of litter and excreta of soil animals in nitrogen status of desert soils. *J. Arid Environments* 1 (2) : 145-155.
5. EL-GHONEMY, A. and EL-KADY, H.F. (1978) : Range experiment. In : *SAMEDENE Progress Report* No. 4, vol. 1, Chapter 10 : 20 pp.
6. GHABBOUR, S.I. (1978) : Chemical composition of *Heterogamia syriaca* Sauss. (Polyphagidae, Dictyoptera) in relation to its nitrogen content. *Ecol. Biol. medit.* 5 : 103-112.
7. GHABBOUR, S.I. and MIKHAIL, W.Z.A. (1977) : Variations in chemical composition of *Heterogamia syriaca* Sauss. (Polyphagidae, Dictyoptera), a major component of the soil fauna in the Mediterranean coastal desert of Egypt *Ibid.* 4 : 89-104.

8. GHABBOUR, S.I. and MIKHAIL, W.Z.A. (1978) : Ecology of soil fauna of Mediterranean desert ecosystems in Egypt. II. Soil mesofauna associated with *Thymelaea hirsuta* (L.) Endl. *Rev. Ecol. Biol. Biol. Sol* 15 : 333-339.

9 GHABBOUR, S.I.; MIKHAIL W.Z.A. and RIZK, M.A. (1977) : Ecology of soil fauna of Mediterranean desert ecosystems in Egypt. I. Summer populations of soil mesofauna associated with major shrubs in the littoral sand dunes. *Ibid.* 14 (3) : 429-459.

10. HUNT, H.W. (1977) : A simulation model for decomposition in grasslands. *Ecology* 58 (3) : 469-484.

11. LEE, J.J. and INMAN, D.L. (1975) : The ecological role of consumers-an aggregated systems view. *Ibid.* 56 (6) : 1455-1458.

12. ODUM, E.P. (1975) : *Ecology : The Link between the Natural and the Social Sciences. Holt, Rinehart & Winston,* New York : 244 pp.

13. TACKHOLM, V. (1974) : *Students' Flora of Egypt.* 2nd ed., publ. Cairo University, Cooperative Printing Co. Beirut : 888 pp.

14. WALLWORK, J.A. (1976) : *The Distribution and Diversity of Soil Fauna.* Acad. Press, London : 355 pp.

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« تأثير تنظيم الرعى لمدة سنة على كثافة عشائر حيوانات التربة فى نظام بيئى أفرو ـ متوسطى صحراوى »

د . سمير ابراهيم غبور و عبد الخالق محمد حسين

ملخص

تقع منطقة البحث فى زملم بلدة العميد على بعد ٨٣ كم غرب الاسكندرية وعلى مسافة ١٠كم من شاطىء البحر المتوسط وهى منطقة يسود فيها رعى الأغنام والماعز . وقد سورت منطقة مساحتها حوالى ٢٠ هكتار ومنع فيها الرعى تماما لمدة ٣ سنوات من ١٩٧٤ الى ١٩٧٧ ثم قسمت الى جزءين أحدهما مساحتم حوالى ١٤ هكتار سمح فيه بالرعى بضغط رعوى قدرته ثلثى الضغط السائد فى المنطقة عموما واستمر المنع فى الجزء الآخر . وفى نفس الوقت أضيفت مساحتان أخريان كل منهما حوالى ١٤ هكتار أيضا سمح فى الأولى برعى قدره ثلثى الضغط السائد وفى الأخرى بضغط قدره ثلث السائد . واستمر الطور الثانى من التجربة لمدة عام من ١٩٧٧ الى ١٩٧٨ . وكان الضغط الرعوى الذى يمثل ٦٦٪ يعنى وجود عشر وحدات (خروف أو ماعز) لمدة ٤ أيام من عشرة فى المساحة المسورة والضغط الذى يمثل ٣٣٪ من السائد يعنى وجود هذه الوحدات العشر لمدة يومين فقط من عشرة فى المساحة المعينة . وكانت نسبة الخراف الى الماعز ٣ : ١ .

ويحلل هذا البحث نتائج الدراسة الموازية التى أجريت عن أثر هذه المعاملات على كثافة عشائر حيوانات التربة من اللافقاريات من المستوى متوسط الحجم أى الذى لا يقل عن ١ مم طولا . وقد أخذت العينات بغربلة التربة تماما من أسفل خمس أنواع من النباتات الشجيرية أو التحت شجيرية وهى المتنان والعجرم والشيح والعنصل والجرد من كل من هذه المعاملات الأربعة بالاضافة الى المنطقة الخارجية ذات الرعى الحر (أى حيث الضغط الرعوى ١٠٠٪) . وقد تم أخذ ٢٩٤ عينة من خريف ١٩٧٧ الى صيف ١٩٧٨ . ويدل الفحص الأولى للنتائج على أن كثافة عشائر حيوانات التربة مقدرة بوحدة المساحة أو وحدة الحجم من التربة تعلو فى المعاملتين : ٣ سنوات حماية تامة ثم ٦٦٪ ضغط رعوى أو ضغط رعوى ٣٣٪ عقب الرعى الحر ، عنها فى بقية المعاملات . وتعلو الكثافة فى الصيف عنها فى بقية المواسم . وتعزى النتيجة الأولى الى الأثر الطيب للأغنام والماعز (المستهلكات) فى تحويل الغذاء النباتى الفج الى غذاء مهضوم ومحول تستطيع حيوانات التربة تمثيله بالرغم من الأثر السىء لقطعان الرعى فى دهس التربة والذى يخف كثيرا فى المعاملتين اللتين ارتفعت فيهما كثافة عشائر حيوانات التربة . وتعزى النتيجة الثانية الى وجود فترة انفعال واستجابة طويلة بين سقوط المطر شتاءا وظهور أثر هذا المطر على تكاثر اللافقاريات التى تعيش فى التربة .

واجمالا تعتبر عشائر حيوانات التربة فى حالة تكيف لمعاملات الرعى المختلفة والتى ينتج عنها تغيرات فى الغطاء النباتى وكمية النثار وقوام التربة ومادتها العضوية وغير ذلك من العوامل التى تتحكم فى العلاقات بين المنتجات (النبات الأخضر) والمستهلكات (حيوانات الرعى) والمحللات (حيوانات التربة) . وما زال الوقت مبكرا على أى حال لانشاء نظرية عن العلاقات الموجودة فى مثل هذا النظام البيئى وعما يمكن أن يحدث لها نتيجة لهذه المعاملات وان كان المتوقع على الأقل أن يتغير التركيب النوى للعشائر فى المستقبل القريب .