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The Paleoecology Of The Continental Early Pliocene Of The Eastern Mediterranean, A Construction Based On Rodents

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Abstract: The composition of the successive rodent assemblages -Maritsa, İğdeli, Babadat, Dinar-Akçaköy, Çalta, Taşova, Ortalıca/Tozaklar- from the Early Pliocene (MN14-15) of the Eastern Mediterranean is interpreted in terms of paleoecology with the assumption that the composition of the faunas is independent of geographical influences. A taxon-free method is applied: nine ecological groups have been defined. The relative frequency of the species allocated to these groups in each locality is used as a measure for the climatic parameters - humidity, temperature, seasonality and predictability - of the paleoenvironment. The conclusion is that the assemblage from Çalta represents relatively the driest biotope of our series, and the assemblage from Ortalıca the most humid. The assemblage from Taşova represents the relatively coldest and the one from Maritsa represents the warmest environment. The assemblage from Çalta represents an environment with relatively the highest wet-dry seasonality and the assemblage from Ortalıca with the relatively highest cold-warm seasonality. Moreover, the assemblage from Çalta represents relatively the least and the one from Ortalıca the most predictable environment. The MN15 correlative faunas of Ortalıca and Taşova may suggest that Anatolia was not arid as a whole during this time period but that there was rather a humid climate, in the north.

Key words: Rodents, taxon-free method, Ruscinian, eastern Mediterranean.

Anadolu Erken Pliyosen Küçük Memeli Fauna İstifinin Paleoekolojisi

Özet: Anadolu Erken Pliyoseninden Maritsa, İğdeli, Babadat, Dinar-Akçaköy, Çalta, Taşova, Ortalıca/Tozaklar lokalitelerinden tanımlanan rodent topluluklarının bileşimi, faunaların coğrafik

etkilerden bağımsız oldukları ön görülerek, paleoekolojik açıdan yorumlanmıştır. Bir taxon-free metodu uygulandı: dokuz ekolojik grup tanımlandı. Her bir lokalitede gruplara ayrılan türlerin nispi frekansları paleoortamın iklimsel parametreleri – nemlilik, sıcaklık, mevsimsellik ve geçirgenlik – için bir ölçüt olarak kullanıldı. Çalta'dan elde edilen topluluğun serimizin nispeten en kuru biyotopunu sergilemekte olduğu ve Ortalıca'dan elde edilen topluluğun ise en nemli topluluk olduğu sonuçlarına ulaşılmıştır. Taşova'dan elde edilen topluluk nispeten en soğuk ortamı, Maritsa'dan elde edilen ise en ılıman ortamı yansıtmaktadır. Çalta'dan tanımlanan topluluk nispeten en yüksek-ıslak-kuru mevsimselliği yansıtırken, Ortalıca topluluğu nispeten en yüksek soğuk-ılık mevsimselliği sergilemektedir. Ayrıca, Çalta'dan tanımlanan topluluk nispeten en az geçirgenliğe ve Ortalıca topluluğu ise en yüksek geçirgenliğe sahiptir. Taşova ve Ortalıca faunalarının MN15 korelâsyonu Anadolu'nun bu zaman diliminde tamamıyla kurak olmadığını fakat daha ziyade Kuzeyde oldukça ılık bir iklime sahip olduğunu ortaya çıkarmaktadır.

Anahtar Kelimeler: Rodentia, taxon-free metod, Russiniyen, Anadolu.

1. Giriş

The composition of the successive rodent assemblages -Maritsa, İğdeli, Babadat, Dinar-Akçaköy, Çalta, Taşova, Ortalıca, Tozaklar- from the Early Pliocene (MN14-15) of the Eastern Mediterranean (Fig. 1) is interpreted in terms of paleoecology based on a taxon-free method, as a possible method to reconstract the mechanism behind the observed faunal change. Our work should be considered an experiment based on some not very certain assumptions. Our aim is to estimate the variables of humidity (humid/arid), temperature (warm/cold), predictability (high/low) and seasonality (cold-warm seasonality/humid-arid seasonality).

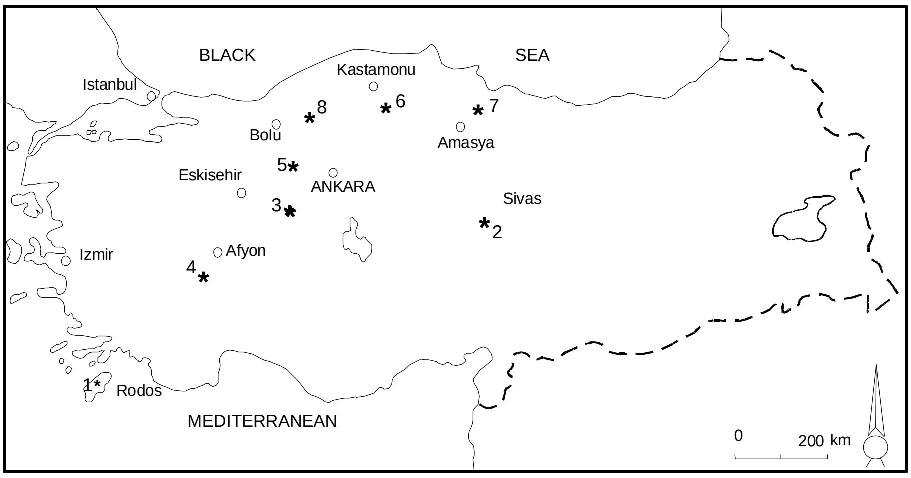

Figure 1. Sketch map showing the approximate positions of the Early Pliocene localities of Eastern Mediterranean selected. 1. Maritsa, 2. İğdeli, 3. Babadat, 4. Dinar-Akçaköy, 5. Çalta, 6. Ortalıca, 7.Taşova, 8.Tozaklar.

The composition of the faunas within the study area is supposed to be independent of geographical influences. The relative ages of the assemblages have been inferred from the stage-of-evolution of the rodent and lagomorph species ([1] Fig. 2). The oldest fauna, Maritsa is considered to be of latest Miocene or earliest Pliocene age (MN13/14, Late Turolian/Early Russinian). The youngest fauna studied, the one from Tozaklar, is considered to be latest early Pliocene age (MN 15b, Late Russinian).

	Early Pliocene							
	Ruscinian							
	MN14				MN15			
	a		b		a	b		
	Maritsa	İğdeli	Babadat	Akçaköy	Çalta	Ortalıca	Taşova	Tozaklar
Promimomys insuliferus		X						
Promimomys sp.			X					
Promimomys enginae				X				
Mimomys davakosi					X			
Mimomys gracilis						X		
Mimomys sp.							X	
Mimomys occitanus								X
Dolomys sp.						X		
Pliomys sp.						X		
Apodemus cf. *dominans*	X		X					
Apodemus dominans		X			X	X	X	
Apodemus cf. *atavus*				X			X	X
Rhagapodemus vandeweerdi	X							
Rhagapodemus frequens							X	
Rhagapodemus n. sp.								X
Occitanomys (*Rhodomys*) *debruijni*	X							
Occitanomys (*Rhodomys*) *vandami*		X						
Occitanomys (*Rhodomys*) sp.			X	X				
Occitanomys (*Occitanomys*) sp.					X			
Paraethomys anomalus	X							
Muridae gen. et sp. indet.		X						
Orientalomys galaticus					X			
Centralomys magnus					X			
Pelomys europeus	X							
Micromys bendai		X						

Cricetus lophidens	X							
Cricetus cf. *lophidens*		X						
Cricetus aff. *kormosi*			X	X				
Mesocricetus primitivus	X							
Mesocricetus cf. *primitivus*		X			X	X		X
? Cricetulus	X							
Cricetulus migratorius		X						
Allocricetus bursae		X						
Calomyscus minor	X							
Kowalskia sp.		X						
Cricetidae indet.		X						
Myomimus maritsensis	X							
Myomimus enginae		X						
Myomimus n. sp. II			X					
Myomimus sp.				X				
Myomimus div. sp.							X	
Myomimus cf. *maritsensis*						X		X
Glirulus n. sp.			X					
Glirulus sp.						X		
Glirulus cf. *pusillus*							X	
Glis minor							X	
Dryomimus eliomyoides					X			
Dryomimus cf. *eliomyoides*						X		
Dryomys tosyaensis						X		
Dryomys sp.							X	
Eliomys aff. intermedius	X							
Tamias sp. 1		X						
Tamias sp. 2		X						
Atlantoxerus rhodius	X							
Spermophilinus giganteus	X							
Sciurus sp.								X
Sciurus cf. *wartae*							X	
Keramidomys carpathicus	X							
Keramidomys cf. *carpathicus*		X						
Keramidomys sp.			X					
Eomyidae gen. et sp. indet.				X				
Hylopetes hungaricus							X	
Blackia sp.						X		

Pliopetaurista cf. *pliocaenica*						X		
Pliospalax sotirisi	X							
Pliospalax macoveii					X			
Pliospalax sp.							X	X
Spalacidae gen. et sp. indet.		X		X				
Pseudomeriones rhodius	X							
Pseudomeriones hansi		X						
Pseudomeriones sp.			X					
Pseudomeriones tchaltaensis					X			
Ochotona sp.	X							
Ochotona mediterranensis		X						
Ochotonoma ortalicensis			X	X	X	X	X	
Prolagus sp.		X						
Trischizolagus maritsae	X							
Trischizolagus dumitrescuae								X
Pliopentalagus sp.			X	X				

Figure 2. List of the rodent and lagomorph taxa recognized in the eight Lower Pliocene assemblages of the Eastern Mediterranean and their biochronology. The relative position of the localities Ortalıca and Taşova is arbitrary.

2. Methods

I followed [2] in part and divided the rodents in my succession into ecological groups estimating the (adaptations)/preferences of these groups to the climatic parameters humidity (humid/dry), temperature (warm/cool), seasonality (cold-warm and humid-dry seasonality), predictability (high/low). (Adaptations)/preferences to these parameters are scored as positive (+), neutral (0) or negative (-) corresponding to high, intermediate/mixed, and low values of these climatic parameters. In order to arrive at relative climatic values for each locality we combined positive (+), neutral (0) and negative (-) preferences resulting in three groups for humidity, for temperature, for seasonality and for predictability separetely. I, then calculated the number of species with these scores for each locality.

I based the climatic estimates on the number of species and have not included fossorial and aquatic species since their adaptations are assumed to be independent of environments [3]. Summary of the methodology [4 and 2]:

a) Humidity

Humidity preferences and adaptations are inferred on the basis of actualistic data and on functional morphological interpretations of dentition and locomotion. For example, various dental chracteristics (hypsodonty, brachyodonty, lophodonty etc.) are interpreted as adaptations to certain diets which in turn are interpreted as characteristics of certain habitats. Knowledge of extant habitats and phylogenetic relations are used to infer the habitats of fossil relatives.

b) Temperature

Temperature preferences are inferred from the paleobiogeographic distributions of the taxa in the period considered.

c) Seasonality

Seasonality adaptation levels (wet-dry or cool-warm seasonality) are inferred from diversities in present day climate/vegetation zones and the ability of extant relatives to hibernate.

d) Predictability

Infererence of adaptations to climatic (un) predictability is done on the basis of demographic patterns and associated life-history strategies. A demographic tripartition of rodents [5, 4, 2] in terms of adaptations to (un) predictability is used: The extremely production oriented species with low survival rates of demographic group 1 (Murinae) are optimally adapted to unpredictable environments. Efficiency-oriented taxa with high survival and low reproduction rates of group 3 (Gliridae, Sciuridae, Petauristidae, Zapodidae and Eomyidae) are well adapted to predictable environments. Group 2 (Cricetidae) are intermediately adapted with regard to predictability.

3. Ecological assignments of rodents

My ecological groups and the species forming these groups are somewhat different from that of [2] since my research area and the time period considered are different, but the same reasoning is adopted. The ecological groups and the scores assigned to them are:

3.1. High crowned-rodents I (Arvicolidae): *Promimomys insuliferus, Promimomys* sp., *Promimomys enginae, Mimomys davakosi, Mimomys gracilis* and *Mimomys occitanus* form this group in my succession. Since the recent representatives of Arvicolidae are most diversified in the temperate zones of Eurasia a positive score for humidity, a neutral score for temperature, a positive score for seasonality and a positive score for predictability is assigned.

3.2. High-crowned rodents II (Gerbillidae): *Pseudomeriones rhodius, Pseudomeriones tchaltensis, Pseudomeriones hansi* and *Pseudomeriones* sp. form this group. Because of their hypsodonty a negative score for humidity, because of their Asian and circum- Mediterranean distribution a neutral score for temperature is assigned. Their seasonality and predictability preferences are assumed to be identical to those of the relatively low-crowned Cricetidae (see below) therefore a neutral score for seasonality and for predictability is assigned.

3.3. Relatively low-crowned Cricetidae: In my faunal succession *Cricetus, Cricetulus, Mesocricetus, Allocricetus, Calomyscus, Kowalskia* and Cricetidae indet form this group. A neutral score is assigned on humidity because different genera of this group prefer different kinds of habitats ranging from open to closed. A neutral temperature preference is assigned because while some genera such as *Calomyscus, Cricetus, Cricetulus, Mesocricetus,* and *Allocricetus* had an Eastern European and Asiatic distribution others like *Kowalskia* were common in Europe. A neutral score for seasonality type is assigned because extant Cricetinae are successful in Asiatic steppes with a wet-dry as well as a cold-warm seasonality and because *Cricetus* and *Mesocricetus* hibernate weakly. Because they are the members of the demographic group 2 a neutral score on predictability is given.

3.4. Ground-dwelling Gliridae: This group has relatively a low number of crests in their molars. Extant ground dwelling *Myomimus* and many extinct representatives of Myomiminae have this character and are therefore assumed to have lived on the ground in an open, relatively dry habitat [6, 7] so, a negative score for humidity is assigned. Since *Myomimus* is documented both in Europe and in Asia a neutral score for temperature is assigned. On the basis of the occurrence of hibernation in *Myomimus* a preference for cool-warm seasonality and on the basis of its membership to the demographic group 3 a positive score on predictability are assigned.

3.5. Arboreal/scansorial Gliridae: *Glis, Glirulus,* and *Dryomim*us which have relatively more crested molars form this group in our faunal succession. Because of their assumed arboreal-scansorial way of life [8, 6 and 7] a positive score is assigned for humidity. A negative score on temperature is assigned because they are less common in the Eastern Mediterranean then in the more northern areas. Since they are more diverse in the temperate zones of Eurasia and hibernate deeply a preference for cool-warm seasonality is supposed and since they belong to the demographic group 3 a positive predictability
score is assigned.

3.6. Muridae I, *Occitanomys-Stephanomys* groups of murids: Stephanodonty characterizes this group which includes of *Occitanomys, Rhodomys, Orientalomy*s and *Centralomys* in my faunal succession. van Dam [9, 2] suggested that the group is adapted to relatively open and dry environments because they have a relatively large width-length ratio of the molars and well developed longitudinal valleys indicating a strong power stroke and so, a diet with fibrous component at least in part which in turn may suggest relatively dry and open environments. Therefore, a negative score for humidity is assigned. Because they are documented in Europe and in Asia during the Ruscinian a neutral score for temperature is assigned. Seasonality and predictability scores are the same as those of Muridae II (see below).

3.7. Muridae II: *Apodemus, Rhagapodemus, Micromys, Paraethomys, Pelomys* and Muridae indet form this group in our faunal succession. Since most of its extant members have frugivorous to omnivorous diets, but do not graze a neutral humidity score is assigned since they were relatively abundant in southern Europe during the Ruscinian a neutral temperature preference, since they reach the highest present day diversities in vegetation zones characterized by a wet-dry monsoon seasonality, such as savannas a negative score on seasonality type and since they belong to the demographic group 1 a negative predictability score are given.

3.8. Sciuridae I (ground squirrels of Xerini): *Atlantoxeru*s forms this group in our succession. Two extant *Xerus* species live in the drier savannas and *Atlantoxerus getulus* lives in arid mountainous areas therefore a negative humidty, a positive temperature scores and wet-dry seasonality are assigned. Because Sciuridae belong to the demographic group 3 a positive predictability score is given.

3.9. Sciuridae II (ground squirrels of Tamiini), Petauristidae and Eomyidae: These taxa are grouped together because of their assumed preference of forested, closed environments and the low abundances of each individual subgroup. *Spermophilus, Tamias, Sciurus. Hylopetes, Blackia, Pliopetaurista* and *Keramidomys* form this group in our faunal succession. A positive humidity score is given.Today Tamiini are successful in cool environments a negative temperature score is assigned. Eomyidae are well represented at high latitudes in the Russinian and Petauristidae are today diverse in tropical South East Asia, but were diverse in forested areas in northern latitudes when it was warm there so, neutral score is given to seasonsality type. Since Sciuridae belong to the demographic group 3 a positive predictability score is assigned.

4. Conclusions

4.1. Humidity

Locality: Maritsa

	+ (humid)	- (arid)	0 (intermediate)
Gerbillidae		1	
Cricetidae II			4
Gliridae I		1	
Gliridae II	1		
Muridae I		3	
Muridae II			3
Sciuridae I		1	
Sciuridae II, Eomyidae, Petauristidae	2		

N: 16 % 18.75 % 37.5 % 43.75

Locality: İğdeli

	+ (humid)	- (arid)	0 (intermediate)
Arvicolidae		1	
Gerbillidae		1	
Cricetidae II			6
Gliridae I		1	
Muridae I		1	
Muridae II			3
Sciuridae II, Eomyidae, Petauristidae	3		

N: 16 % 18.75 % 25 % 56.25

Locality: Babadat

	+ (humid)	- (arid)	0 (intermediate)
Arvicolidae		1	
Gerbillidae		1	
Cricetidae II			1
Gliridae I		1	
Gliridae II	1		
Muridae I		1	
Muridae II			1
Sciuridae II, Eomyidae, Petauristidae	1		

N: 8 % 25 % 50 % 25

Locality: Akçaköy

	+ (humid)	- (arid)	0 (intermediate)
Arvicolidae		1	
Gerbillidae		1	
Cricetidae II			1
Gliridae I		1	
Muridae I		1	
Muridae II			1
Sciuridae II, Eomyidae, Petauristidae	1		

N: 7 % 14.28 % 57.14 % 28.57

Locality: Çalta

	+ (humid)	- (arid)	0 (intermediate)
Arvicolidae		1	
Gerbillidae		1	
Cricetidae II			1
Gliridae I		1	
Muridae I		2	
Muridae II			2

N: 8 % 0 % 62.5 % 37.5

Locality: Ortalıca

	+ (humid)	- (arid)	0 (intermediate)
Arvicolidae		3	
Cricetidae II			1
Gliridae I		2	
Gliridae II	2		
Muridae II			1
Sciuridae II, Eomyidae, Petauristidae	2		

N: 11 % 36.36 % 45.45 % 18.18

Locality: Taşova

	+ (humid)	- (arid)	0 (intermediate)
Arvicolidae		1	
Gliridae I		2	
Gliridae II	3		
Muridae II			3
Sciuridae II, Eomyidae, Petauristidae	2		

N: 11 % 45.45 % 27.27 % 27.27

Locality: Tozaklar

	+ (humid)	- (arid)	0 (intermediate)
Arvicolidae		(1) 4	
Cricetidae II			(1) 2
Gliridae I		(1) 5	
Muridae II			(2) 22
Sciuridae II, Eomyidae, Petauristidae	(1) 5		

N: 6 % 16.66 % 33.33 % 50

4.2. Temperature

Locality: Maritsa

	+ (warm)	- (cool)	0 (intermediate)
Gerbillidae			1
Cricetidae II			4
Gliridae I			1
Gliridae II		1	
Muridae I			3
Muridae II			3
Sciuridae I	1		
Sciuridae II, Eomyidae, Petauristidae		2	

N: 16 % 6.25 % 18.75 % 75

Locality: İğdeli

	+ (warm)	- (cool)	0 (intermediate)
Arvicolidae		1	
Gerbillidae			1
Cricetidae II			6
Gliridae I			1
Muridae I			1
Muridae II			3
Sciuridae II, Eomyidae, Petauristidae		3	

N: 16 % 0 % 25 % 75

Locality: Babadat

	+ (warm)	- (cool)	0 (intermediate)
Arvicolidae		1	
Gerbillidae			1
Cricetidae II			1
Gliridae I			1
Gliridae II		1	
Muridae I			1
Muridae II			1
Sciuridae II, Eomyidae, Petauristidae		1	

N: 8 % 0 % 37.5 % 62.5

Locality: Akçaköy

	+ (warm)	- (cool)	0 (intermediate)
Arvicolidae		1	
Gerbillidae			1
Cricetidae II			1
Gliridae I			1
Muridae I			1
Muridae II			1
Sciuridae II, Eomyidae, Petauristidae		1	

N: 7 % 0 % 28.57 % 71.42

Locality: Çalta

	+ (warm)	- (cool)	0 (intermediate)
Arvicolidae		1	
Gerbillidae			1
Cricetidae II			1
Gliridae I			1
Muridae I			2
Muridae II			2

N: 8 % 0 % 12,5 % 87.5

Locality: Ortalıca

	+ (warm)	- (cool)	0 (intermediate)
Arvicolidae		3	
Cricetidae II			1
Gliridae I			2
Gliridae II		2	
Muridae II			1
Sciuridae II, Eomyidae, Petauristidae		2	

N: 11 % 0 % 63.63 % 36.36

Locality: Taşova

	+ (warm)	- (cool)	0 (intermediate)
Arvicolidae		1	
Gliridae I			2
Gliridae II		3	
Muridae II			3
Sciuridae II, Eomyidae, Petauristidae		2	
N: 11	% 0	% 54.54	% 45.46

Locality: Tozaklar

	+ (warm)	- (cool)	0 (intermediate)
Arvicolidae		1	
Cricetidae II			1
Gliridae I			1
Muridae II			2
Sciuridae II, Eomyidae, Petauristidae		1	
N: 6	% 0	% 33.33	% 66.66

4.3. Seasonality

Locality: Maritsa

	+ (in temperature)	- (in humidity)	0 (intermediate)
Gerbillidae			1
Cricetidae II			4
Gliridae I	1		
Gliridae II	1		
Muridae I		3	
Muridae II		3	
Sciuridae I		1	
Sciuridae II, Eomyidae, Petauristidae			2
N: 16	% 12.5	% 43.75	% 43.75

Locality: İğdeli

	+ (in temperature)	- (in humidity)	0 (intermediate)
Arvicolidae			1
Gerbillidae			1
Cricetidae II			6
Gliridae I	1		
Muridae I		1	
Muridae II		3	
Sciuridae II, Eomyidae, Petauristidae			3
N: 16	% 6.25	% 25	% 68.75

Locality: Babadat

	+ (in temperature)	- (in humidity)	0 (intermediate)
Arvicolidae			1
Gerbillidae			1
Cricetidae II			1
Gliridae I	1		
Gliridae II	1		
Muridae I		1	
Muridae II		1	
Sciuridae II, Eomyidae, Petauristidae			1

N: 8 % 25 % 25 % 50

Locality: Akçaköy

	+ (in temperature)	- (in humidity)	0 (intermediate)
Arvicolidae			1
Gerbillidae			1
Cricetidae II			1
Gliridae I	1		
Muridae I		1	
Muridae II		1	
Sciuridae II, Eomyidae, Petauristidae			1

N: 7 % 14.28 % 28.57 % 57.14

Locality: Çalta

	+ (in temperature)	- (in humidity)	0 (intermediate)
Arvicolidae			1
Gerbillidae			1
Cricetidae II			1
Gliridae I	1		
Muridae I		2	
Muridae II		2	

N: 8 % 12.5 % 50 % 37.5

Locality: Ortalıca

	+ (in temperature)	- (in humidity)	0 (intermediate)
Arvicolidae			3
Cricetidae II			1
Gliridae I	2		
Gliridae II	2		
Muridae II		1	
Sciuridae II, Eomyidae, Petauristidae			2

N: 11 % 36.36 % 9.09 % 54.54

Locality: Taşova

	+ (in temperature)	- (in humidity)	0 (intermediate)
Arvicolidae			1
Gliridae I	2		
Gliridae II	3		
Muridae II		3	
Sciuridae II, Eomyidae, Petauristidae			2
N: 11	% 45.45	% 27.27	% 27.27

Locality: Tozaklar

	+ (in temperature)	- (in humidity)	0 (intermediate)
Arvicolidae			1
Cricetidae II			1
Gliridae I	1		
Muridae II		2	
Sciuridae II, Eomyidae, Petauristidae			1
N: 6	% 16.66	% 33.33	% 49.99

4.4. Predictability

Locality: Maritsa

	+ (high)	- (low)	0 (intermediate)
Gerbillidae			1
Cricetidae II			4
Gliridae I	1		
Gliridae II	1		
Muridae I		3	
Muridae II		3	
Sciuridae I	1		
Sciuridae II, Eomyidae, Petauristidae	2		
N: 16	% 31.25	% 37.5	% 31.25

Locality: İğdeli

	+ (high)	- (low)	0 (intermediate)
Arvicolidae		1	
Gerbillidae			1
Cricetidae II			6
Gliridae I	1		
Muridae I		1	
Muridae II		3	
Sciuridae II, Eomyidae, Petauristidae	3		
N: 16	% 25	% 31.25	% 43.75

Locality: Babadat

	+ (high)	- (low)	0 (intermediate)
Arvicolidae		1	
Gerbillidae			1
Cricetidae II			1
Gliridae I	1		
Gliridae II	1		
Muridae I		1	
Muridae II		1	
Sciuridae II, Eomyidae, Petauristidae	1		
N: 8	% 37.5	% 37.5	% 25

Locality: Akçaköy

	+ (high)	- (low)	0 (intermediate)
Arvicolidae		1	
Gerbillidae			1
Cricetidae II			1
Gliridae I	1		
Muridae I		1	
Muridae II		1	
Sciuridae II, Eomyidae, Petauristidae	1		
N: 7	% 28.57	42.85	% 28.57

Locality: Çalta

	+ (high)	- (low)	0 (intermediate)
Arvicolidae		1	
Gerbillidae			1
Cricetidae II			1
Gliridae I	1		
Muridae I		2	
Muridae II		2	
N: 8	% 12.5	% 62.5	% 25

Locality: Ortalıca

	+ (high)	- (low)	0 (intermediate)
Arvicolidae		3	
Cricetidae II			1
Gliridae I	2		
Gliridae II	2		
Muridae II		1	
Sciuridae II, Eomyidae, Petauristidae	2		
N: 11	% 54.54	% 36.36	% 9.09

Locality: Taşova

	+ (high)	- (low)	0 (intermediate)
Arvicolidae		1	
Gliridae I	2		
Gliridae II	3		
Muridae II		3	
Sciuridae II, Eomyidae, Petauristidae	2		
N: 11	% 63.63	% 36.36	% 0

Locality: Tozaklar

	+ (high)	- (low)	0 (intermediate)
Arvicolidae		1	
Cricetidae II			1
Gliridae I	1		
Muridae II		2	
Sciuridae II, Eomyidae, Petauristidae	1		
N: 6	% 33.33	% 50	% 16.66

Table 1. The locality based total percentages for each variations of the climatic parameters -humidity, temperature, seasonality and predictability- estimated on the basis of the ecological groups (numbers in columns refers to the number of species).

The obtained scores lead to the conclusion that the assemblage from Çalta represents relatively the driest biotope of our series, and the assemblage from Ortalıca the most humid (Fig. 3A). The assemblage from Taşova represents the relatively coldest and the one from Maritsa represents the warmest environment (Fig. 3B). The assemblage from Çalta represents an environment with relatively the highest wet-dry seasonality and the assemblage from Ortalıca with the relatively highest cold-warm seasonality (Fig. 3C). The assemblage from Çalta represents relatively the least and the one from Ortalıca the most predictable environment (Fig. 3D). The other localities represents different intermediate values between these extremes. It also appears that the most arid Çalta assemblage suggests the least predictable environment with relatively the highest wet-dry seasonality as well and the most humid Ortalıca assemblage suggests the most predictable environment with relatively the highest cold-warm seasonality as well in my faunal succession.

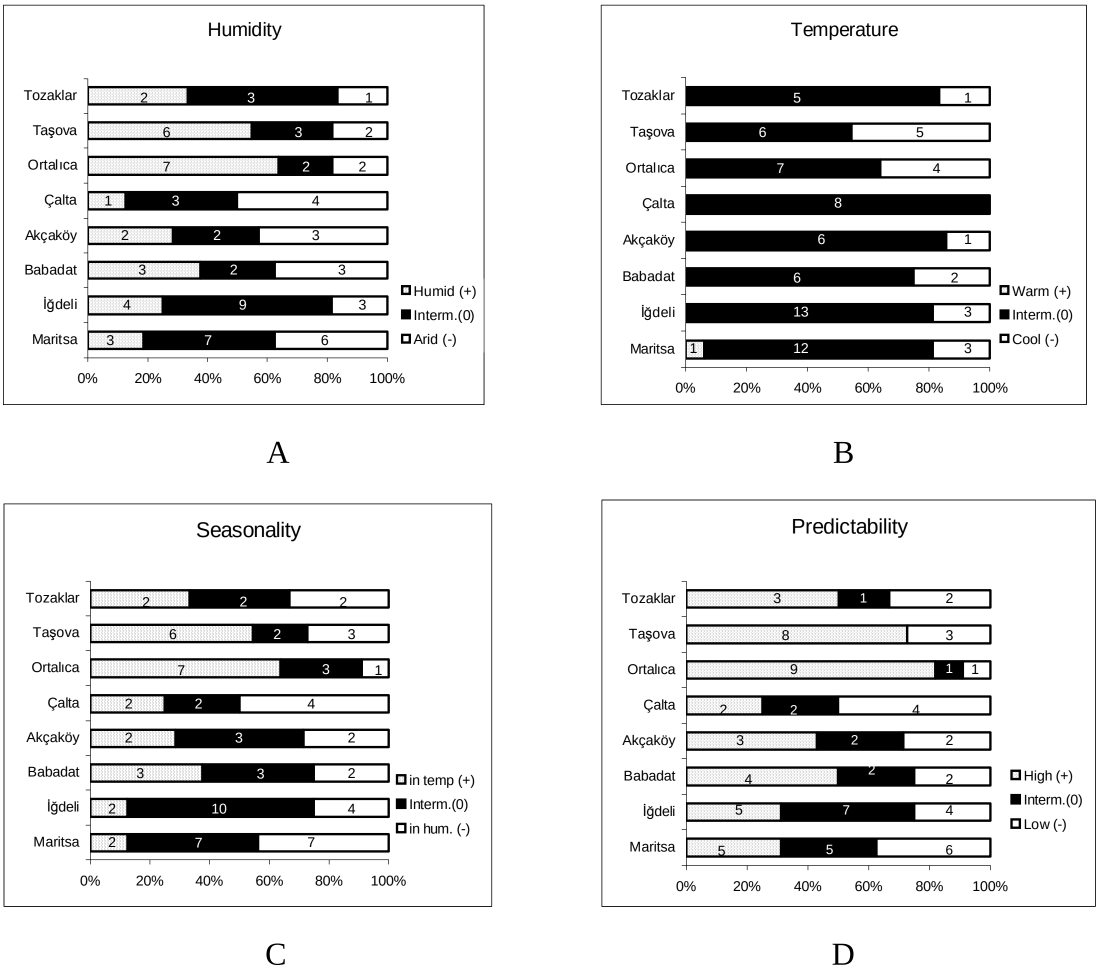

Figure 3. Relative frequencies of the ecological groups of rodents of the Lower Pliocene assemblages from the Eastern Mediterranean for the variations of humidity (Fig. 3A), temperature (Fig. 3B), seasonality (Fig. 3C), predictability (Fig. 3D) based on the number of rodent species. Numbers refer to the number of rodent species.

According to [3] the lowest precipitation values (less than 400 mm/year) occur during the Pliocene in southern and eastern Europe in the late Neogene and that aridity peaks around 4 Ma (MN15 correlative) in Anatolia, Black Sea region, Rumania and perhaps also Poland. This assumption for Anatolia seems correct when only the Çalta locality is taken as representative for that period of time. As it is seen from the humidty diagram Fig.3A, the MN15 correlative faunas of Ortalıca and Taşova however may suggest the presence of a more humid climate in the north at about the same time period in Anatolia. The contemporary localities Ortalıca and Taşova have different faunal compositions and are geographicly far apart, but situated on the same latitude and representing the same enviroment may suggest that the applied method works.

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