Iranian Journal of Animal Biosystematics(IJAB)
Vol.4, No.1, 31-54, 2008
ISSN: 1735-434X

Biosystematic approach to geographic variations of house mouse group, *Mus musculus* L.1766

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The matrix of qualitative and quantitative data compiled from comparative measures of 14 dental and skull morphology and 17 dentally variable morphometric characters taken from samples of 18 populations of house mouse, *Mus musculus*, which were previously determined genetically, distributed over Eurasian and north African habitats of the species are used for uni-and-multivariate analysis, aiming to clarify and settle the status of taxonomy, and hence, biosystematic and phylogography of these populations. The genetic attributes, already worked on, are used simultaneously to check against, match, compare and analyze with those of morphology and morphometry. Efforts have been made to approach the geographic inter- and- intraspecies and population variations of house mouse, focusing on subspecies status or category.

Key words: House Mouse, subspecies, Eurasia, North Africa, Morphology and morphometry

INTRODUCTION

One of the aims of biosystematics is to determine and understand first how genetic information of species differentiates through time and space in foundation of subspecies and second how character evolution occurs for determination of the way of migration and foundation of secondary contact, sub-species and new speciation. Since the genetic information influences morphology and morphometry, especially the stable diagnostic characters as molars, it has often been approached in asking how are structured these stable diagnostic morphological characters. Only recently morphological species has been checked out by biochemical genetics and molecular markers (Darviche 1978; Darviche et. al. 1982; Darvish 1988; Darvish 1997; Darvish 2004; Boursot et. al. 1993; Sage et. al. 1993; Prager et .al. 1998; Darvish et. al. 2005). Accurate identification of house mouse specimens by molecular markers has enabled us to search for meaningful qualitative and quantitative features, for instance among dental and skull characters (Darviche 1978; Darviche et. al. 1982).Also, the use of molecular marker concerning house mouse encounter different perceptions regarding the taxonomic status of subgroup of a cosmopolitan species as house mouse species in Eurasia and north Africa. So the taxonomic status of peripheral and central populations of house mouse is a long debate between scholars who describe them as semispecies by emphasis on presence of introgression zone (Orsini et al., 1983, Bonhomme 1986), or presence of different species by emphasis on the narrow and permanent hybrid zone (Marshall and Sage 1981, Sage et al., 1993, Prager et al. 1998,) or more simply presence of different subspecies by emphasis on taxonomic validity of subspecies and presence of hybridization (Din et. al. 1996).

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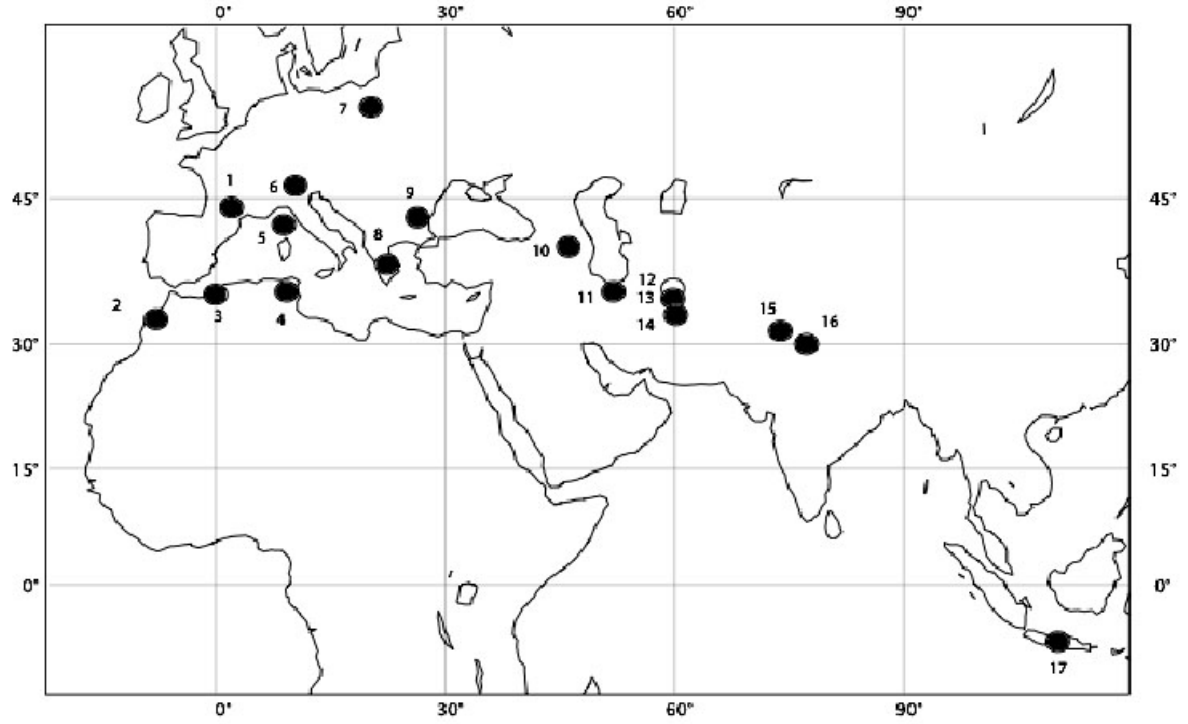


FIG.1. - Georaphic distibution of the studied specimens**.**
1. France – Languedoc; 2. Morocco – Azemmour; 3. Algeria – Oran; 4. Tunisia – Monastir; 5. France-Corsica; 6. Italy - Lumbardi; 7. Poland - Eastern part; 8. Greece – Prosotsani; 9. Bulgaria - Gal Toshevo; 10. Georgia - Eastern part; 11. Iran – Tehran; 12. Iran – Mashad; 13. Iran – Kakhk; 14. Iran – Birjand; 15. Pakistan – Islamabad; 16. India – Dehli; 17 Indonesia – Java.

Therefore based on genetic studies three peripheral geographic populations of house mouse are determined as *Mus musculus musculus*, *M.m.domesticus* and *M.m.castaneus* (Vanlerberghe et. al. 1986; Orth et. al. 1996; Vanlerberg et. al. 1986; Darvish et al. 2006; Rajabi Maham et. al. 2007). However, the exact routes, out of the cradle, in Iranian Plateau and the status of the central and intermediate populations in this region are subject of controversy (Bonhomme et. al. 1994). In this respect, Iranian plateau has an interesting position, because it encompasses one of the possible passages toward the West and North. The genetic study of house mouse from the northeastern Iranian Plateau shows the existence of transition zone between pure *M.m.musculus* in the North and animals related to *M.m.castaneus* in the south east of Iran (Darvish et. al. 2006). This is confirmed with the study of Rajabi et al. (2007) concerning the house mouse of south and west of Iranian plateau and also it is confirmed with the study of house mouse in Transcaucasia (Orth et al 1996). The aim of this study is to evaluate morphologic and morphometric traits of tooth and skull by use of univariate and multivariate analyses in house mouse as a biosystematic model for completing our knowledge in the fields which molecular studies are unable such as insular gigantism and nanism, variation of size and form and taxonomic characters. Paleontology, archeozoology and neontology are relaying more and more on morphology and morphometry in order to establish the diagnosis of species and genera than molecular phylogeny.

TABLE 1. - Geographic origin of the *Mus musculus* samples. N: number of specimens, Acr: acronym, Taxon, allocation according to the allozymic analysis of Darvish et al. (2006).

Area of origin and / or locality	N	Acr	Taxon allocation
Indonesia - JavaJakarta(Wilde) line CAS, Bogor+ Bangkok Bogor(Wilde)	21	Indo	*Castaneus*
India – Dehli	12	Indi	*Castaneus*
Pakistan – Islamabad,Rawalpindi,Gujarkhan	22	Paki	*Castaneus*
NE Iran – Birjand	30	Ir-B	close to *castaneus*
NE Iran – Mashad	13	Ir-M	close to *musculus*
NE Iran – Kakhk	10	Ir-K	close to *musculus*
North Iran – Tehran	7	Ir-T	close to *castaneus*
Tunisia – Tebumba	45	Tuni	*domesticus*
Algeria – Oran,Annaba,Bouzajan	15	Alge	*domesticus*
Morocco – Azemmour	16	Moro	*domesticus*
Greece – Prosotsani	23	Gree	*domesticus*
Italy – Lombardia	39	Ital	*domesticus*
France – Motpellier(USTL, Le Fajet INRA)	19	Fran	*domesticus*
France-Corse(Vaitella,Du pont Maison Cantnnier,Pont de pirio)	18	Fr-c	*domesticus*
Bulgaria - Gal Toshevo	13	Bulg	*musculus*
Poland – Bialowieza,Varsovie	11	Pola	*musculus*
Georgiea – Alazani,Lagodekhi Lissi, Kertzanissi,Vashlavan Chardakhi	17	Geor	*musculus*

MATERIAL AND METHODS

The area of origin and location of the samples are given in figure 1 and table 1 and appendix 1. These materials originated from the collection of ISE-M (Institut des Sciences de Evolution de Montpellier), University of Montpellier II (France) kindly handled by Dr J.-C. Auffray and the collection of NHMF (Natural History Museum of Ferdowsi), Ferdowsi University of Mashhad, Iran. Most of these specimens were previously identified by molecular markers (Boursot et al., 1996; Din et al., 1994). The eastern Iranian Plateau recently collected samples was typed from using the same techniques (Darvish et al.2006). The samples of Indonesia is very heterogeneous, part of samples belongs to CAS line from animal house of University of Montpellier and a part from Bogor and Jakarta (island of Java). Acronyms and the number of specimens by sample are given in table 1. The study is based on 17 morphometric and 14 discrete dental and skull characters (Fig. 2 and APPENDIX 1). Dental nomenclature is from Jacobs et. al. (1978) (Fig.3). The polarity of molars character states is from Misonne (1969) and Michaux (1972).

Different age classes were pooled because the considered dental characters do not change with age. All measurement was done in 1990, but the samples of Kakhk, Teheran and Georgeia to be added in 2003. Multivariate complete analysis was performed by Canonical Discriminate Analyses (CDA) of all specimens and Principle Component Analysis(PCA) and Clustering of all means of specimens, using SPSS Statistical Programs version 15 and PAST version 4. Finally, The Minimal Spanning Tree (MST) method (Kruskal, 1956) is performed using the PAST software.

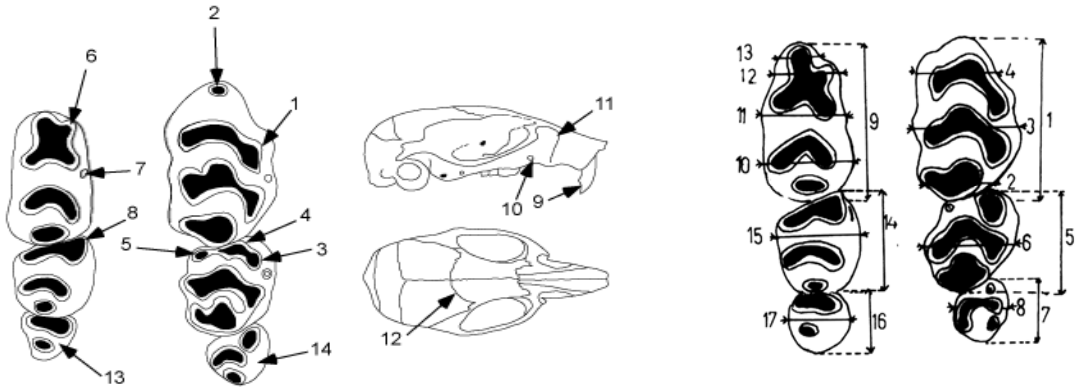


FIG. 2. - List of characters and character states used in analyses. States are given in brackets. Polarity of character states is discussed in the text. (*) according to Jacobs' (1978); (**) to Miller's (1912); (***) Michaux's (1971) (Darvish 1988, 1997).

1. Position of anterostyle on M1 (cusp t1*): (0) oblique; (1) intermediary; (2) linked with cusp t5; 2. Prestyle (*) on M1: (0) present; (1) absent; 3. Anterostyle of M2 (cusp t1**); 4. Enteroconule of M2 (cusp t1bis): (0) present; (1) absent; 5. Vestigial anterocone of M2 (cusp t3): (0) present; (1) absent; 6. Labial anteroconid on m1 (cusp tE***): (0) small; (1) medium; (2) large; 7. Labial cingulum on m1 (with or without labial accessory cusps): (0) absent; (1) present; 8. Labial anteroconid on m2: (0) present; (1) absent; 9. Upper incisor notch: (0) posterior position; (1) median; (2) absent; 10. Foramen on the zygomatic plate: (0) present; (1) absent; 11. Anterior border (in side view) of the zygomatic plate: (0) low and curved; (1) straight and low; (2) straight and high; (3) high and curved; 12. Fronto-parietal suture: (0) sigmoid; (1) divided; (2) curved; 13. M3: (0) absent; (1) present; 14. m3: (0) absent; (1) present.

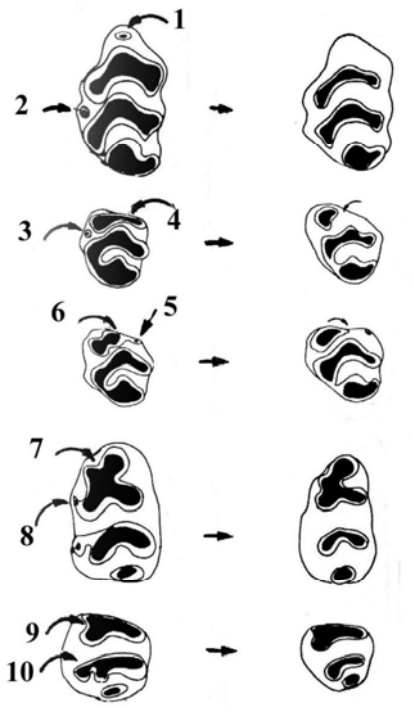


FIG.3.- List of complementary characters used for sub-specific comarison. They are considered in relation with their accepted polarity states in Murinae: (0) primitive and (1) derived (Darvish 2004).

1. Precingulum of M1: (0) present; (1) absent..
2. Lingual cingular conule of M1: (0) present; (1) absent.
3. Lingual anteroconule of M2: (0) present; absent.
4. Connection between anterostyle and anterocone on M2: (0) present; (1) absent.
5. Labial anterocone on M2 (cusp t3): (0) present; (1) absent.
6. Anteroconule on M2 (t2 bis): (0) present; (1) absent.
7. Anteroconulid on m1: (0) present ;(1) absent
8. Labial cingular conule on m1: (0) present; (1) absent.
9. Labial anteroconid on m2: (0): present; (1) small or absent.
10. Labial cingular conule on m2: (0) present; (1) absent.

RESULTS

A: Morphometric Studies

In order to determine a significant difference in morphometric characters, ANOVA was performed among the studied samples. Results of ANOVA tests exhibited significant differences ($P<0.01$) in all morphometric characters (table 2). Molar measurements of house mouse samples indicated in appendix table 2. The results show that in Asia, from Indonesia to Iran (Birjand and Kakhk),

TABLE 2.- Analysis of variance between all samples of house mouse.

		Sum of Squares	df	Mean Square	F	Sig.
Length of M1/	Between Groups	1,186	16	,074	14,871	,000
	Within Groups	1,321	265	,005		
	Total	2,507	281			
Width t8-t9M1/	Between Groups	,785	16	,049	14,134	,000
	Within Groups	,916	264	,003		
	Total	1,701	280			
Width t4-t6 M1/	Between Groups	,269	16	,017	7,698	,000
	Within Groups	,577	264	,002		
	Total	,847	280			
Width t1-t3 M1/	Between Groups	,287	16	,018	9,487	,000
	Within Groups	,500	265	,002		
	Total	,787	281			
Length M2/	Between Groups	,403	16	,025	10,135	,000
	Within Groups	,643	259	,002		
	Total	1,046	275			
Width M2/	Between Groups	,529	16	,033	17,785	,000
	Within Groups	,482	259	,002		
	Total	1,011	275			
Length M3/	Between Groups	,310	16	,019	7,929	,000
	Within Groups	,613	251	,002		
	Total	,922	267			
Width M3/	Between Groups	,248	16	,016	9,626	,000
	Within Groups	,405	251	,002		
	Total	,653	267			
Length M/1	Between Groups	,654	16	,041	15,421	,000
	Within Groups	,694	262	,003		
	Total	1,348	278			
Width tA-tB M/1	Between Groups	,322	16	,020	14,188	,000
	Within Groups	,371	262	,001		
	Total	,693	278			
Width tC-tD M/1	Between Groups	,376	16	,023	18,962	,000
	Within Groups	,323	261	,001		
	Total	,699	277			
Width tE-tF M/1	Between Groups	,330	16	,021	9,359	,000
	Within Groups	,562	255	,002		
	Total	,891	271			
Width tF M/1	Between Groups	,235	16	,015	7,610	,000
	Within Groups	,500	259	,002		
	Total	,736	275			
Length M/2	Between Groups	,525	16	,033	15,261	,000
	Within Groups	,552	257	,002		
	Total	1,077	273			
Width M/2	Between Groups	,245	16	,015	11,312	,000
	Within Groups	,348	257	,001		
	Total	,592	273			
Length M/3	Between Groups	,158	16	,010	3,943	,000
	Within Groups	,599	240	,002		
	Total	,757	256			
Width M/3	Between Groups	,106	16	,007	4,870	,000
	Within Groups	,324	239	,001		
	Total	,430	255			

the variables of LM1, lM1, LM2, lM2, LM3, lM3, Lm1, lm1, Lm2, lm2, and Lm3 increase gradually in size (Fig. 4). The large molars which are a primitive character (Misonne 1969) are remarkable in specimens from east of Iran than that of the Mediterranean basin and Indonisian house mouse. Corsica samples have the biggest size comparing to Mediterranean basin house mouse for the majority of variables due to insular gigantism which cannot be verified in molecular analysis (Fig 4). The smallest size of molar, especially M3/3 in Indonesian samples may be due to insular nanism and inbreeding.

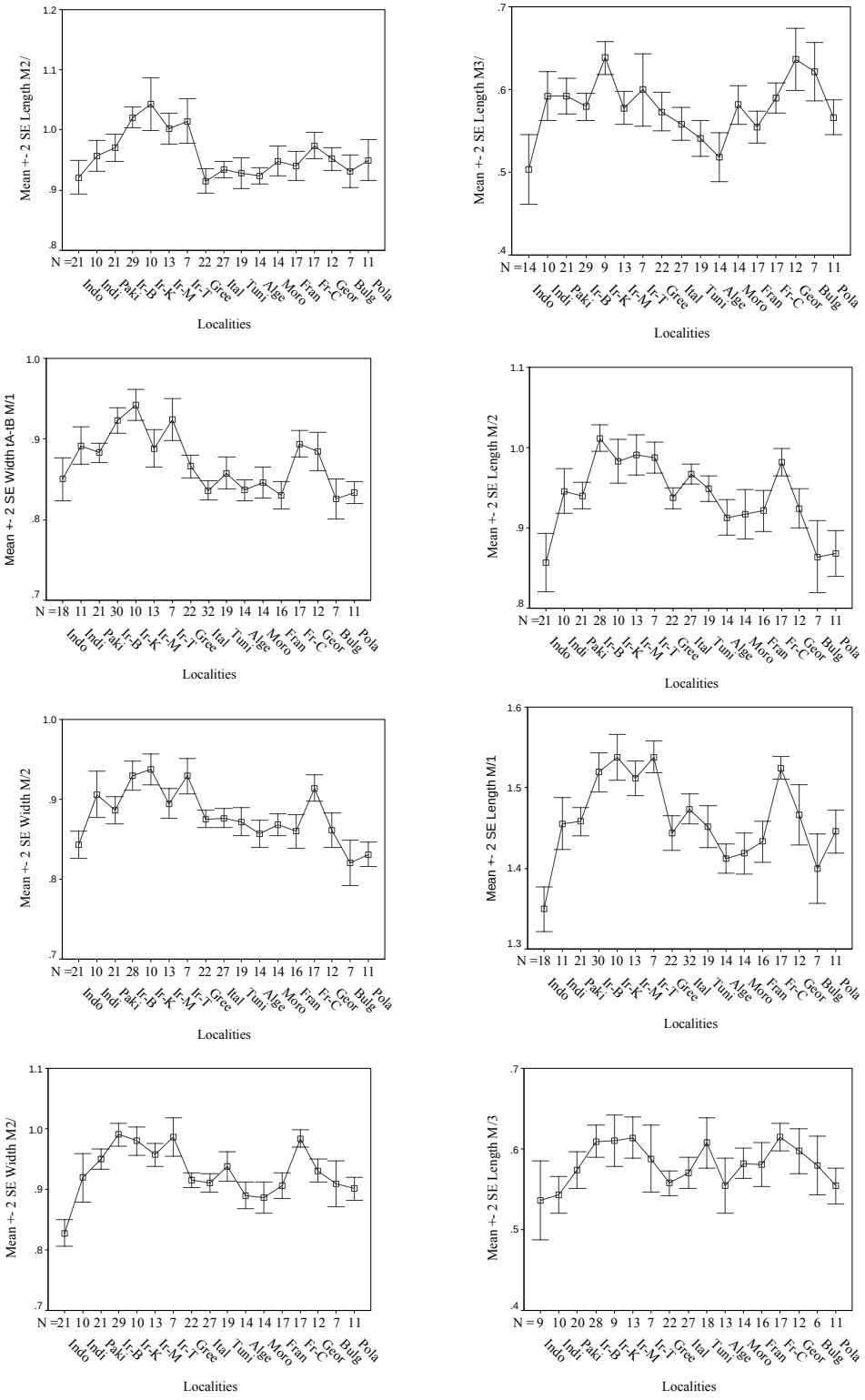


FIG. 4- Mean and standar error variation of 8 morphometric variables of upper and lower molars in house mouse of Idonisia(indo), India(Indi) Pakistan(Paki), Iran Birjand(Ir-B),Iran Kakhk(Ir-k) , Iran Mashad (Ir-M), Iran Tehran (Ir-T), Georgia (Geor), Greece (Gree), Bulgaria (Bulg), Poland(Pola), France (Fran) , France Corse(Fr-C) , Tunisia (Tuni), Algiria(Alge) and Morocco (Moro).

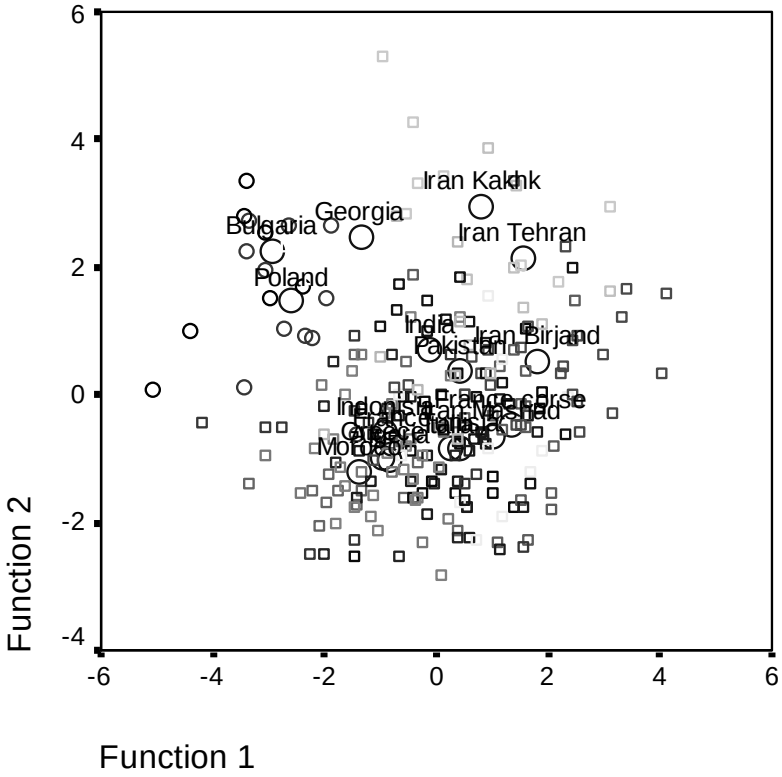


FIG. 5- Canonical Discriminant (CDA) based on First (1) and Second (2) Components.

Multivariate analysis

The Canonical Discriminate Analyses (CDA) of all samples was performed and Canonical Discriminant (CDA) based on First (1) and Second (2) Components is shown in Fig 5. The amounts of Wilks' Lambda confirm the significance of functions (Table 3). The Clustering tree based on the same variables confirms that the mice from Iran referred by molecular analyses(Darvish et al 2006) to as *M. m. musculus* (Kakhk and Mashhad), "*pro-castaneus* " type(Birjand) and M.m.domesticus (Tehran) clustered with the Indian and -Pakistan samples which remark the geographic position effects (Fig. 6).

TABLE 3. - Wilks' Lambda and Standards coefficients of discriminant equation

Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 8	,039	748,497	128	,000
2 through 8	,114	500,487	105	,000
3 through 8	,296	280,490	84	,000
4 through 8	,471	173,408	65	,000
5 through 8	,628	107,378	48	,000
6 through 8	,736	70,692	33	,000
7 through 8	,848	38,080	20	,009
8	,956	10,435	9	,316

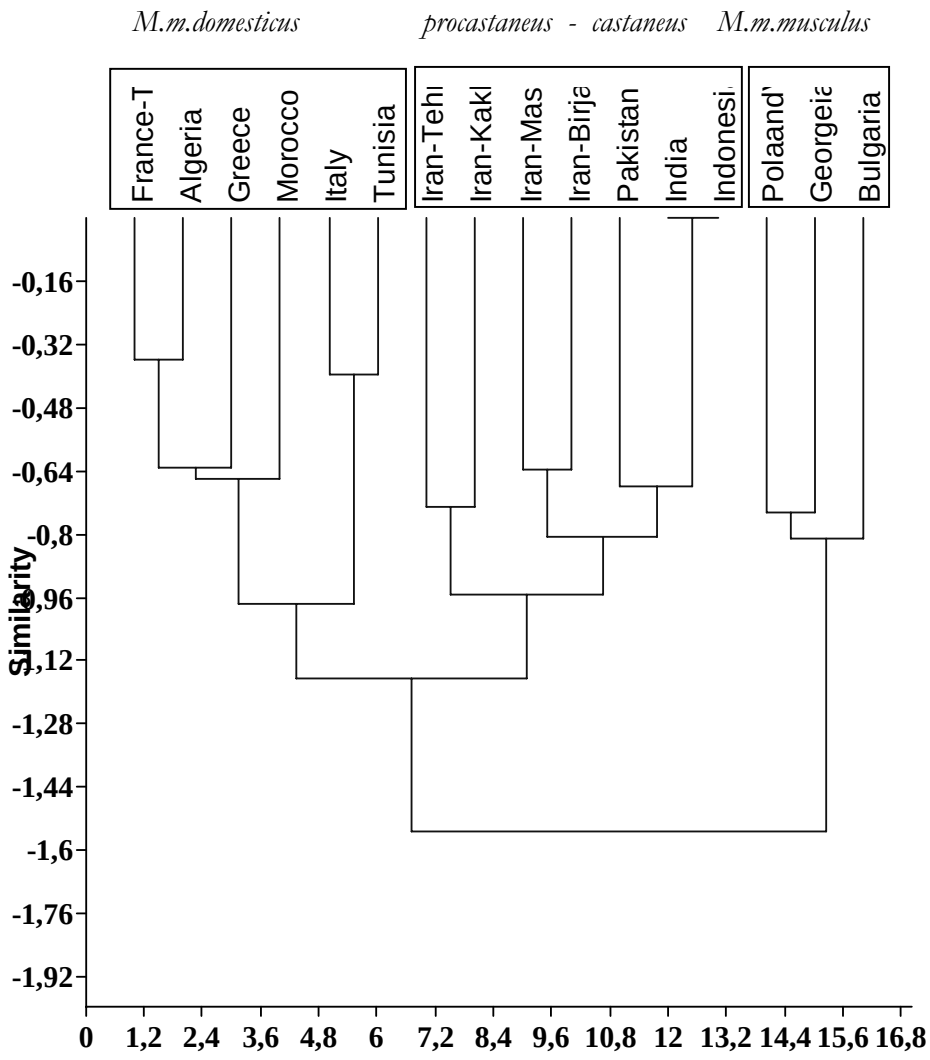


FIG .5- Clustering of morphometric centroid of all sample extracted from Canonical Discriminant Analyses.

The principal Component Analysis (PCA) of Euclidean distance of means performed from means of quantitative variables data and MST lines and eigenvalue scales and 95% elipses indicate that Indian subcontinent samples are regrouped. The Corsican sample due to insular gigantism moved near Iranian samples which have the greatest size (Fig.6, Table 4).

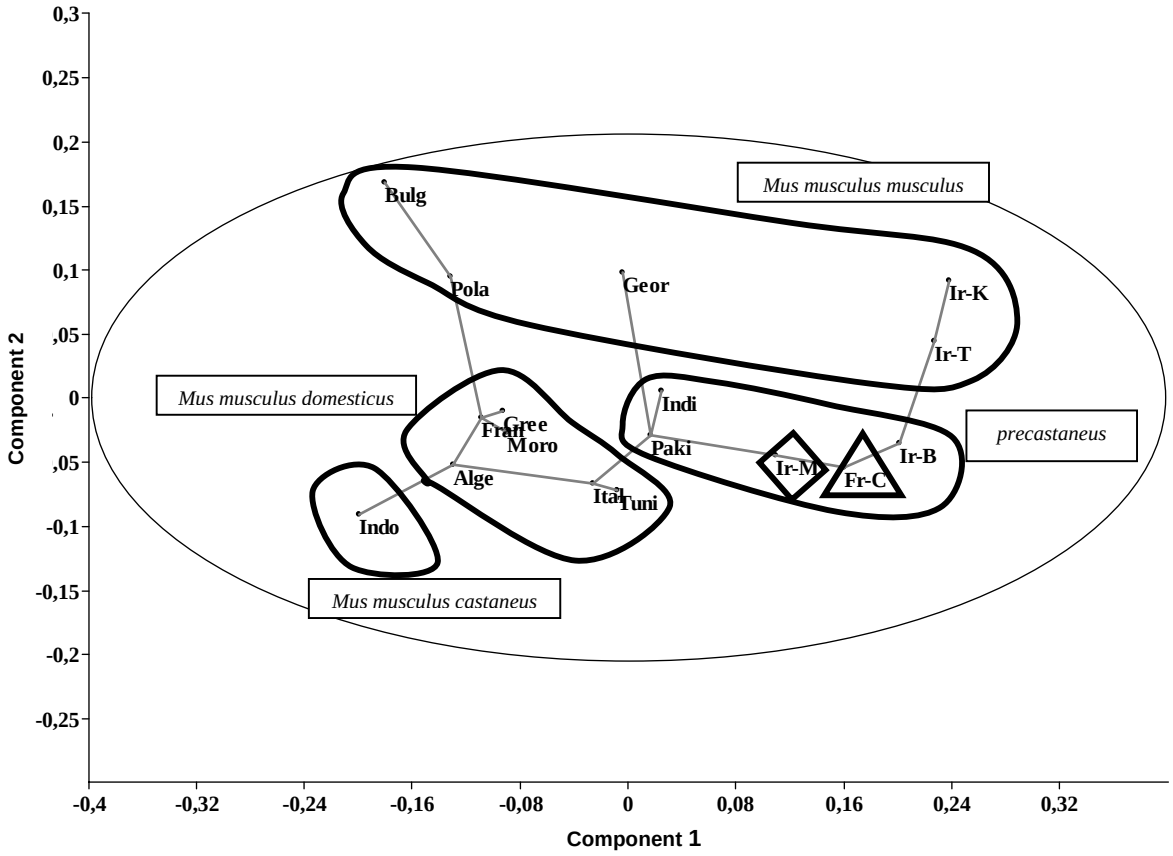


FIG.6. – Phenetic variation in house mouse. Results of principal component analysis of molar means of samples: projections of samples means scores on component 1(66% variance) and 2 (17.6 % variance), MST lines scales and 95% elipses.France Corsica sample (Gr-C) is in the range of procastaneus sapecimens due to insular gigantism.

Morphologic Studies

The frequencies of each character states for all samples and subspecies are shown in table 5. The descriptions of variation of the character states for each subspecies based on fig 2 and **APPENDIX TABLE 1** are as below:

١ - *Mus musculus* ssp. « Oriental type or pro-castaneus » (Boursot et al, 1996). Tail is equal or longer than head and body in this sample. The sample of South-East of Iran (Birjand) is genetically close to that from the Indian subcontinent (Darvish et al 2006) which belongs to an as yet unknown subspecies, provisionally called by Boursot et al. 1996 "Oriental type". In this sample the primitive character (Misonne 1969) of prestyle of the first upper molar (Ml) is present in most specimens. The anterior half of m1 has a symmetrical X pattern formed at the anterior portion of the tooth. It is a primitive character (Misonne 1969).The internal marginal conule is present between anterostyle and

TABLE 4. – PCA scores.

	Axe 1	**Axe 2**
Indo	-0,19996	-0,09128
Indi	0,024302	0,005754
Paki	0,016118	-0,0297
Ir-B	0,20061	-0,03537
Ir-K	0,2374	0,091567
Ir-M	0,10862	-0,04481
Ir-T	0,22652	0,043781
Gree	-0,09294	-0,01081
Ital	-0,026	-0,06719
Tuni	-0,00884	-0,07191
Alge	-0,12953	-0,05283
Moro	-0,08968	-0,0268
Fran	-0,10909	-0,01547
Fr-C	0,15992	-0,05432
Geor	-0,00484	0,097143
Bulg	-0,18046	0,16792
Pola	-0,13216	0,094334

enterostyle of M1 and rarely between enterostyle and posterostyle of M2(Fig 8).The Enterostyle of M2 has a loph directed toward the labial anterocone which sometimes is joined by a crest to a large labial anterocone. In some samples there is also a single marginal labial conulid in m1 as primitive character. The presence of m2 anteroconid is more significant. The marked expression of these characters in this sample may be explained by their ancientness as compared to that of the three other peripheral subspecies, which correspond to more recently established populations. The tip of upper incisor is dimorph with presence or absence of notch (Fig. 7). The zygomatic plate foramina are present at least on one side of skull; hence there is a case of an asymmetry in skull morphology. The anterior edge of zygomatic plate in mature forms is in vertical position. The anterior palatine foramen is relatively large and the slope of palatine plate toward chuan is sharp. The supraorbital ridges are contracted medially at the anterior level of the parietals so that the sloping squamosal is visible in dorsal view (Marshall and Sage 1981). The sagittal structures between frontal and parietal bones have the same direction. The external, molar and cranial characteristics of these samples together indicate their distinction from other subspecies of house mouse (Fig. 7).

2- *Mus musculus musculus:* Most adult specimens can be distinguished from all other subspecies from smaller tail than head and body and a broad anterior portion of zygomatic arch convexity curved anterior border of the zygomatic plate and the smooth outline of the lateral parietal wing (Marshall 1986). Antero-external cusp is prominent on upper and lower first molars. The anterior cingulum of M1/ is present up to 81 % of Iran Mashhad house mouse. This tubercle is not frequent in *M.musculus* of Georgeia and Central Europe. The anterostyle

of M1/ and M2/ is large and attached to protocone. The anterostyle of M2/ consists of a loph toward the labial anterocone that is attached in stylar position toward anterocone. The anteroconule is present in M2/. Anterior lob of M/1 is rather symmetrical (Ossini et al. 1982). The anteroconid of M/2 is reduced or absent. The upper incisor is dimorph with presence and absence of posterior notch. The foramina of zygomatic plate are present mostly in one side of skull. The anterior edge of zygomatic arc in mature specimens is thick and tall and mostly straight. The antero-ventral part of the parietal is bent down to form an angle (Marshall et al. 1981).The palatine slope toward choana is strong (Fig 7).

3- Mus musculus domesticus: The anterior cingulum of Ml is absent in quasi totality of specimens. Whereas it is present in specimes of prehistorie samples from Canary islands (Carrascosa et al, 1988), the M2 anterostyle loph is absent in the recent house mouse of Mediterranean basin, but it is frequent in subfossil samples of M2 from Fuerteventra Cave, in Canary Island belonging to 1000 to 1700 year ago (Carraacosa et al., 1988). The labial anterocone of M2 is very small or absent. The labial anteroconide of m1 is confluent and the anterior lobe of m1 is not clover-like in shape (Darvish et al., 1982). The molar shapes are simple, in comparison to the molars of house mouse from Eastern Iran and Indian subcontinent. The skull is the most angular and least rounded of all members of house mouse group species (Marshall 1986). The anterior edge of zygomatic plate in mature specimens is short and vertical (Fig. 7). The suture of the sagittal attachment of frontal and parietal bones in the axis of the skull in most cases shows tow projections. The samples of Corsican Island of France are morphologically uniform and similar to the house mouse from western part of Mediterranean continental area (Fig 7, Fig 8).

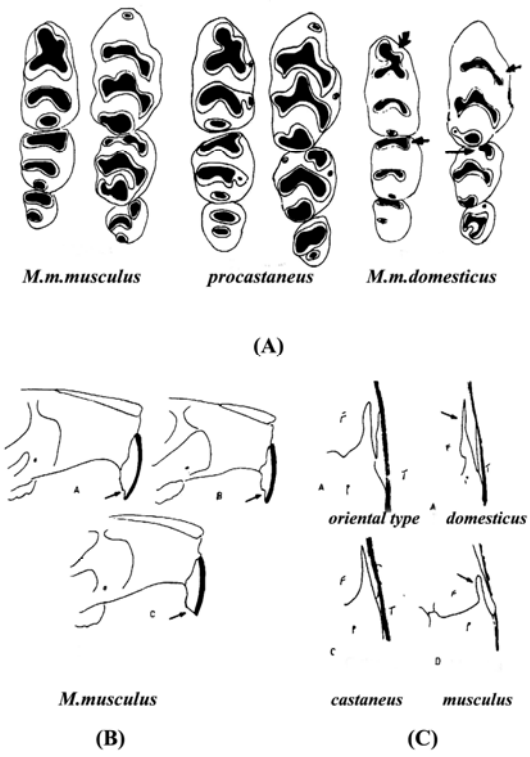


FIG.7- Comparison of character states in three subspecies and procastaneus samples of house mouse in Eurasia and North Africa. (Darvish 1997). A: upper and lower molars, B: incisor notch and zygomatic plate, C: frontoparietal suture. The number of characrcter states refers to Fig.2 and annex 2.

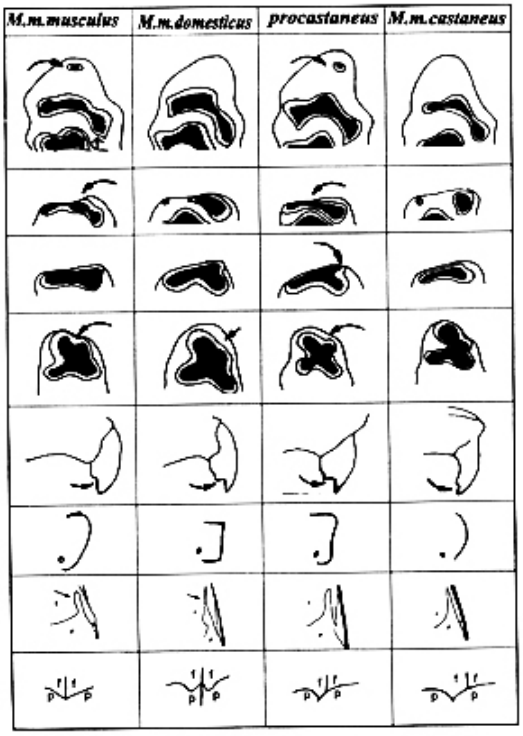


FIG.8- Comparison of character states in three subspecies and procastaneus samples of house mouse in Eurasia and North Africa (Darvish 1997).

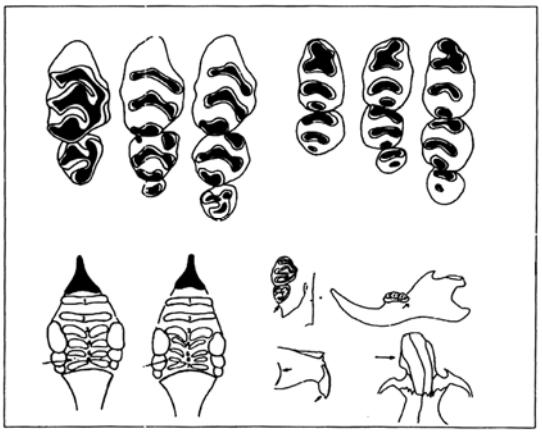


FIG. 9- Polymorphism of molars and skull characters in Indonisian house mouse. Reduction of intermolars palatine folds (IMPF) to 4 and absence of third molars and distortion of roster (Darvish 2004)

4- *Mus musculus castaneus:* The Indonesian samples belong to Jakarta and Bogor. There are specimens from Jakarta which was elevated in animal house of University of Montpellier called CAS. In these samples the zygomatic plate is curvilinear. Marshall (1986) overemphasized the importance of the peculiar anterior outline of the zygomatic plate as a diagnostic character of *castaneus* (Marshall 1977) in our specimens the anterior edge of zygomatic plate is semi lunar in mature forms. The foramina of zygomatic plate are present in two sides of 75% of the skulls. There are four pairs of intermolar palatine folds, whereas Marshall (op.cit.) reported 5 pairs. In one specimen there are abnormalities in antero-posterior position (Fig. 9).The molar teeth are simple, m2 anteroconid includes small projection and very small anterocone. The third molar is absent on most (Table 6) and when present, it is usually small (table 6). The variation in shape and size of third molar is thus great and influences our morphometrical analysis. So the house mouse specimens from Indonesia studied in these analyses are problematic and not apparently the typic specimens belong to *M.m.castaneus* subspecies (Marshal, 1977).

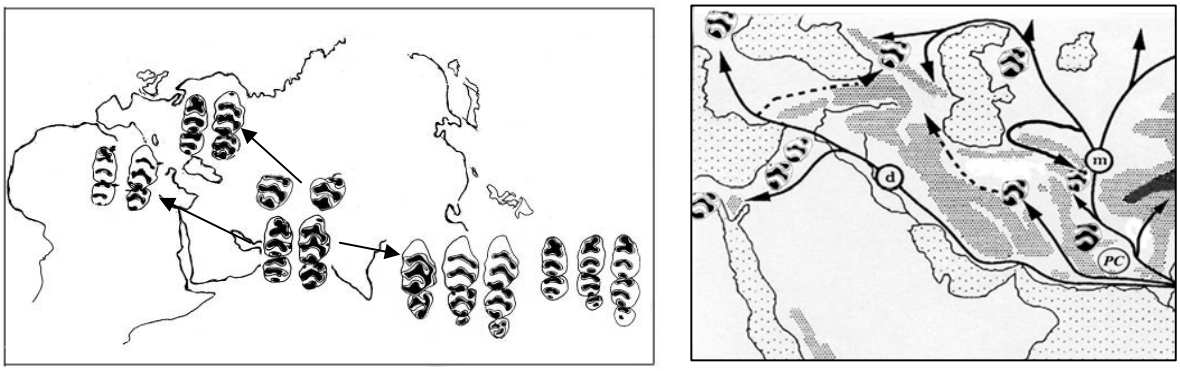
TABLE 6.- Variation in house mouse of Indonesia(Code: number of specimens, +: presence of M3 and m3, -: absent of M 3 and m3) .

Lab. Code of specimen	Locality	M3/	M/3
M8447	Bogor	-	-
M9448	=	-	-
2	=	Small	
3	Cas	+	+
4	=	+	+
5	=	-	-
6	=	-	-
7	=	-	-
8	=	-	-
9	=	-	-
10	=	-	-
11	=	-	-
12	=	Very small	
22	Jakarta	+	+
23	=	+	+
137	=	+	+
600	Bogor	+	+
601	=	+	-
602	=	+	+
603	=	-	-
604	+	+	-

The taxonomic statut of "*procastaneus*" in south east Iran.

The house mouse of southeast of Iran (Mokran region) could be determined with primitive character states as center of origin of another subspecies in Iranian Plateau describedby following traits:

1- Presence of a single prestyle on the first upper molar as a primitive character state, this character is frequent in south-eastern Iran and very rare in *M.m.domesticus* populations of Mediterranean basin.
2- Rarely presence of little single lingual conule on the first and second upper molars, which can only be seen in house mouse from east of Iran, it is not present in other *Mus musculus* populations in Asia, Europe and North Africa. This character is reported from *Mus spretus* from North Africa and southwest of Europe.
3- Presence of big anterostyle that is connected to labial anterocon of the second upper molar and that is one of the specifications of Mokran form in south east of Iran(Fig 10).
4- Presence of anterior big and quadrate labia on the first lower molar, as a result of having a big labial antroconid which is among the characteristics of south east of Iran house mouse . In the house mice of Mediterranean basin labial antroconid is small and somehow reduced.
5- Presence of a distinct labial anteroconid trace on the second lower molar. This primitive character state can be distinct and deserves the sub specific status.



a b

FIG. 10.- Directional variation of shape of upper and lower molars from Iran and Indian subcontinent to Europe North Africa and south east Asia (a)(darvish 2004) and direction of polymorphism of M2 antrocon chape from south east of Iran (Mokran region) to north and west of Iran,(map from Boursot 1993, with modification).

DISCUSSION

1- Problem of divergence between molecular and morpho-statistical characters

When the status of the house mouse is clarified by genetic studies, the value of morphological character states becomes evident and we can evaluate our samples taxonomically and vice versa to analyze the divergence between molecular and morphological, and morphometric characters.

According to genetic and archeological data, the house mouse progressed into the western Eurasia, in accordance with human historical patterns (Auffray et. al., 1988). In summary, from the Epipaleolithic to the Neolithic (ca 12000 to 8000BP.) *Mus* is found in the Middle East (Boursot 1993). During the Bronze Age (ca. 4000 to 2800 BP.) *Mus* is recorded from numerous sites around the Western Mediterranean Sea and in central and Northern Europe suggesting that two independent colonization routes were used. The northern route is interpreted as being the *Mus musculus musculus* continental inflow, while the southern one is attributed to *Mus musculus domesticus* Mediterranean inflow which confirms their morphologic results. Finally, it is only during the Iron age (ca 2800BP.) that the house mouse colonized Northern Europe. Thus the contact between the two subspecies could have occurred 6000-2800 BP in Eastern and Northern Europe respectively.

2 -Biological species approach to house mouse group,

The house mouse *Mus musculus* is a real case of biological species complex. Its description is first of all biological and its morphological definition (Mayr and Aschlok 1991) is not so easy due to great ecogeographic variations of diagnostic taxonomic characters. Presence of remarkable polymorphism complicates the definition of this polytypic species (Darviche 1978; and Marshall 1982). Our study confirms that the tip of upper incisor has a notch (Miller 1912), but this study indicates that its presence varies between 95% (in Indonesian samples) to 48% (in European samples) and when it is present the notch has a median or posterior position. Also, the zygomatic plate foramina are present at least on one side of skull and caused an asymmetry on the skull. The shape of Anterostyle on M2/ is variable, present with small or long notch, is linked with Anterocone and finally in some specimens Anteroconul is present. The samples of Corsica as a result of insular gigantism indicate the greatest mean size in Mediterranean basin house mouse population and in this case the biological

definition of species of house mouse guaranty the value of intraspecific variations, and delimitation of its subspecies for Corsican house mouse .

3- Senario of dispersion of house mouse

There are two proposed models for the origin and radiation of the house mouse. The first one is a centrifuge model which proposes an eastern origin of radiation. In this model oriental or procastaneus mice from Indian subcontinent moved to establish the *domesticus* and *musculus* ancestors within the range of central population or pro-castaneus house mouse (Bonhomme et al. 1994, Boursot et al. 1996).

The second model or linear model (Prager et al. 1998) proposes that the mice from southern Arabia moved eastward and northward to establish the *M.castaneus* and *M.musculus* ancestor. This model postulates a western origin within the range of present-day *domesticus*. As the Iranian plateau has a part of geographic distribution of the three subspecies of house mouse, with the greatest variation , the most primitive and closely-related forms of morphological character states, the remarkable of variation in size and proportion, presence of some local Iranian house mouse alleles we could conclude that Iranian Plateau is the center of second phase of migration to south of Persian Gulf , Central Asia, and Mesopotamia (Cain 1944). Iranian Plateau could postulate as the second center of dispersion of house mouse after its appearance in Indian Subcontinent. The reduction in size on peripheral populations of Mediterranean basin and Indonesia samples show that they are the terminal branches of dispersion of house mouse in the southern part of the zone of distribution. So, *M.m.domesticus* and *M.m.castaneus* could be the results of colonization by human activities during Neolithic. But the populations of central Asia and Northern Europe belong to *M.m.musculus* subspecies that has not the characteristic of terminal branches in size and proportion. And their morphological characteristics are more individualized than other two subspecies. Presence of *Mus musculus musculus* population in north east of Iran with anteroconule on the second upper molar could describe the long time separation for this population of house mouse from the house mouse of south east of Iran without anteroconule on the second upper molar and presenting the longest molars and tooth rows between other . Also, the polarity of character shows that this population may be more ancient comparing with those of Mediterranean basin and Indonesian house mouse. It can be presented as a hypothesis that the presence of some primitive character states (Misonne 1969) in the procastaneus house mouse on south east of Iran may be due to the primitiveness .

We suppose that in the first phase of progression the house mouse penetrated to eastern part of Iranian plateau from Indian Subcontinent via Baluchistan highlands before commensalisms and distributed as separated isolates. Then in the Iranian plateau the second step of distribution and radiation formed different centers in east and west of Zagros Mountain chains and also, in the south and north of Capet Dag and Hindokosh. One of the centers sub specification was the south of Hendoukosh in the north east of Iranian plateau which is the ancestor of *M.m.musculus* subspecies.

ACKNOWLEDGEMENT

The author thanks Professor F.Bonhomme Director of "Genome and population Laboratory of CNRS and Professor J.Michaux director of EPHE Montpelleirll University and Annie Orth that supplied me with kindly acceptance and help me for preparation of this paper.

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APPENDIX 1. List of the specimens examinined in this study.

Georgeia: (?10531), (Alazani10477), (Lagodekhi 10573), (Tbilissi 10587),(Alazani 10490),(Lagodekhi 10567), (Lagodekhi 10570), (Lissi 10514), (Lissi 10579), (Tbilissi 10489), (Lissi 10578), (?10448), (Kertzanissi 10542), (Lagodekhi 10571), (Lagodekhi 10568), (Vashlavan 10576), (Chardakhi 10536)

Bulgaria:(Toshevo 504), (Toshevo 512), (Toshevo 513), (Toshevo 527), (Toshevo 528), (Toshevo 529), (Toshevo 530)

Poland: (varsovie 6299), (varsovie 6300), (varsovie 6311), (varsovie 6312), (varsovie 6313), (varsovie 6314), (Bialowieza 10592), (Bialowieza 10595), (Bialowieza 10991), (Bialowieza 10593), (Bialowieza 10594).

Iran: (Tehran 1219), (Tehran 1220), (Tehran 1222), (Tehran 1223), (Tehran 1228), (Tehran 1230), (Tehran 1238), (Kakhk 1235), (Kakhk 1242), (Kakhk 1248), (Kakhk 1249), (Kakhk 1255), (Kakhk 1260), (Kakhk 1261), (Kakhk 1263), (Kakhk 1265), (Kakhk 1293)

Iran: (Birjand 1), (Birjand 2), (Birjand 3), (Birjand 4), (Birjand 5), (Birjand 6), (Birjand 7), (Birjand 8), (Birjand 9), (Birjand 10), (Birjand 11), (Birjand 12), (Birjand 13), (Birjand 14), (Birjand 15), (Birjand 16), (Birjand 17), (Birjand 18), (Birjand 19), (Birjand 20), (Birjand 21), (Birjand 22), (Birjand 23), (Birjand 24), (Birjand 25),(Birjand 26), (Birjand 27), (Birjand 28), (Birjand 29), (Birjand 30), (Mashhad 1), (Mashhad 2), (Mashhad 3), (Mashhad 4), (Mashhad 5), (Mashhad 6), (Mashhad 7), (Mashhad 8), (Mashhad 9), (Mashhad 10), (Mashhad 11), (Mashhad 12), (Mashhad 13)

Pakistan: (Rawalpindi 26), (Rawalpindi 27),(Rawalpindi 36), (Rawalpindi 10332),(Rawalpindi 10338), (Rawalpindi 10339), (Rawalpindi 10241),(Rawalpindi 10342),(Rawalpindi 10343),(Rawalpindi 10344), (Rawalpindi 10346), (Rawalpindi 10347), (Rawalpindi 10348), (Islamabad 10349),(Islamabad 10350), (Peshawar 10351), (Peshawar 10352), (Gujarkhan 10358), (Islamabad 10360), (Islamabad 10361), (Islamabad 10363)

India : (Delhi 9828), (Delhi 9833), (Delhi 9834), (Delhi 9835), (Delhi 9836), (Delhi 9837), (Delhi 9839), (Delhi 9842), (Delhi 9845), (Delhi 9846), (unknown 1)

Indonesia: (Jakarta(Wilde) 355),(line CAS, Bogor+ Bangkok 356), (line CAS, Bogor+ Bangkok 357),(line CAS, Bogor+ Bangkok 358),(line CAS, Bogor+ Bangkok 359), (Bogor(Wilde) 360),(Bogor(Wilde) 361),(Bogor(Wilde) 362),(line CAS, Bogor+ Bangkok 363),(Bogor(Wilde) 364), (Bogor(Wilde) 365), (Jakarta(Wilde) 366), (line CAS, Bogor+ Bangkok 368),(Line, Bogor+ Bangkok 367), Bogor(Wilde) 369), (line CAS, Bogor+ Bangkok 370)(line CAS, Bogor+ Bangkok 371), (line CAS, Bogor+ Bangkok 372),(Bogr(Wilde) 373),(Jakarta(Wilde) 374), (Bogor(Wilde) 375)

Algeria: (Oran 907),(Oran 908),(Oran 909), (Oran 911),(Oran 913),(Oran 958),(Annaba 938),(Bouzajan 939), (Bouzajan 940), (Bouzajan 941),(Bouzajan 943), (Bouzajan 948),(Bouzajan 949),(Bouzajan 639)

Tunisia: (Tebumba 335), (Tebumba 337), (Tebumba 351), (Tebumba 282), (Tebumba 283), (Tebumba 284), (Tebumba 285), (Tebumba 286),(Tebumba 287), (Tebumba 311),(Tebumba 312), (Tebumba 313), (Tebumba 318), (Tebumba 319),(Tebumba 320),(Tebumba 324), (Tebumba 329),(Tebumba 330),(Tebumba 331)

Morocco : (Azemmour 9848), (Azemmour 9849), (Azemmour 9859), (Azemmour 9860), (Azemmour 9861), (Azemmour 9868), (Azemmour 9872), (Azemmour 9882), (Azemmour 9883), (Azemmour 9884),(Azemmour 9885), (Azemmour 9887), (Azemmour 9888), (Azemmour 9889)

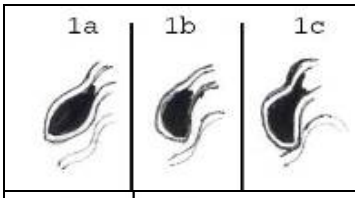
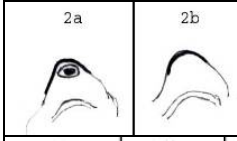
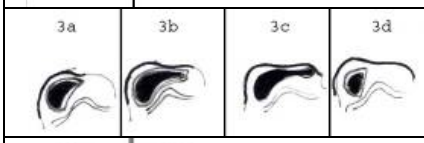
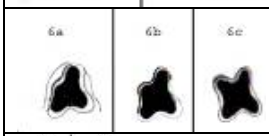
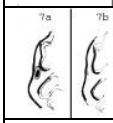
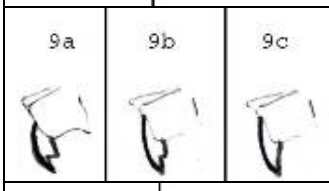
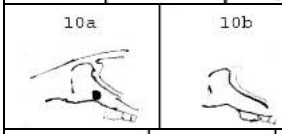
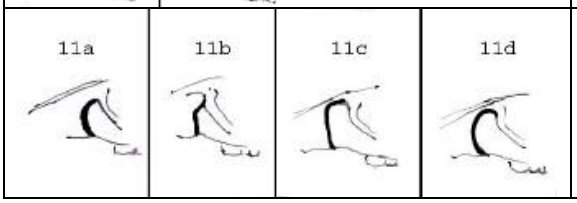
France Mintpellier : (INRA 261), (USTL 37 56), (USTL 128), (USTL 131), (USTL 132), (USTL 168), (USTL 243), (USTL 382)

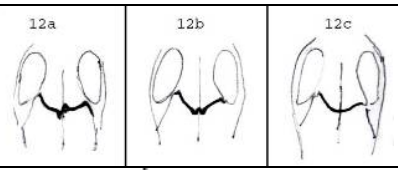
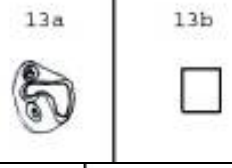
France Corsica : (Vaitella 678), (Vaitella 681), (Vaitella 684), (Vaitella 689), (Du pont 690), (Du pont 691), (Du pont 693) , (Du pont 696) , (Du pont 699) , (Du pont 700) , (Du pont 753) , (Du pont 754) , (Maison Cantonnier 755) , (Maison Cantonnier 756), (Pont de pirio 761), (Pont de pirio 763), (Pont de pirio 765)

Italy : (Lombardi 66),(Lombardi 68), (Lombardi 78), (Lombardi 86),(Lombardi 87),(Lombardi 89),(Lombardi 90), (Lombardi 92), (Lombardi 93),(Lombardi 94),(Lombardi 95), (Lombardi 96), (Lombardi 97), (Lombardi 98), (Lombardi 99),(Lombardi 101),(Lombardi 107),(Lombardi 149), (Lombardi 150),(Lombardi 151), (Lombardi 152), (Lombardi 153),(Lombardi 154), (Lombardi 155),(Lombardi 156),(Lombardi 158), (Lombardi 159), (Lombardi 160),(Lombardi 161),(Lombardi 162),(Lombardi 163),(Lombardi 164),(Lombardi 165)

Greece : (Doirani 159),(Prosotsani 39),(Prosotsani 42),(Prosotsani 64), (Prosotsani 65),(Prosotsani 69), (Prosotsani 72), (Doirani 431),(Prosotsani 432),(Doirani 433), (Doirani 434), (Doirani 435), (Prosotsani 463),(Prosotsani 464), (Prosotsani 465),(Prosotsani 466), (Prosotsani 467),(Prosotsani 468),(Prosotsani 469), (Prosotsani 470), (Prosotsani 471), (Prosotsani 472)

APPENDIX TABLE 1 – Shape and definition of studied characters states.

	Position of anterostyle on M1 (cusp t1*): (0) oblique; (1) intermediary; (2) linked with cusp t5
	Prestyle (*) on M1: (0) present; (1) absent
	Anterostyle of M2 (cusp t1**):
	Enteroconule of M2 (cusp t1bis): (0) present; (1) absent
	Vestigial anterocone of M2 (cusp t3): (0) present; (1) absent
	Labial anteroconid on m1 (cusp tE***): (0) small; (1) medium; (2) large.
	Labial cingulum on m1 (with or without labial accessory cusps): (0) absent; (1) present.
	Labial anteroconid on m2: (0) present; (1) absent.
	Upper incisor notch: (0) posterior position; (1) median; (2) absent.
	Foramen on the zygomatic plate: (0) present ; (1) absent.
	Anterior border (in side view) of the zygomatic plate: (0) low and curved; (1) straight and low; (2) straight and high ; (3) high and curved.

	Fronto-parietal suture : (0) sigmoid; (1) divided; (2) curved
	M3: (0) absent; (1) present.
 	m3: (0) absent; (1) present.

APPENDIX TABLE 2 Molar measurements of house mouse samples . Statistics given are N (number of spmesimens) X mean (in mm) and SD standard deviation. Description of each variable is in Fig. 2 of the text).

		V1		V2		V3		V4		V5		V6		V7		V8		V9	
	N	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Indo	19	1,733	0,086	0,7573	0,0410	1,0531	0,052	0,8189	0,0308	0,921	0,065	0,8276	0,0497	0,5035	0,077916	0,519286	0,066502	1,3494	0,058859
Indi	11	1,751	0,084	0,8463	0,0669	1,08	0,0737	0,8272	0,0456	0,957	0,0400	0,919	0,0641	0,592	0,047329	0,61	0,052068	1,4554	0,052984
Paki	21	1,796	0,061	0,7995	0,0598	1,0742	0,0384	0,7966	0,03	0,97	0,0522	0,9495	0,03801	0,5923	0,04999	0,611905	0,028217	1,4580	0,039827
Ir-B	30	1,865	0,089	0,863	0,0681	1,1243	0,0521	0,8523	0,036	1,021	0,0466	0,99069	0,0511	0,5793	0,043991	0,631034	0,039311	1,5193	0,067104
Ir-K	10	1,854	0,058	0,9797	0,0788	1,097	0,0492	0,845	0,0305	1,042	0,0693	0,9797	0,0371	0,6381	0,029157	0,615889	0,034276	1,537	0,044272
Ir-M	13	1,786	0,086	0,8238	0,0592	1,1253	0,033	0,8561	0,0359	1,002	0,0462	0,9569	0,0344	0,5776	0,036321	0,61	0,029155	1,5115	0,038264
Ir-T	7	1,858	0,075	0,9371	0,0612	1,0801	0,0337	0,8895	0,0782	1,014	0,0486	0,9861	0,0420	0,5995	0,057315	0,600857	0,046352	1,5381	0,02634
Grec	22	1,665	0,052	0,8063	0,0368	1,0486	0,0352	0,81	0,0424	0,915	0,0467	0,9154	0,02874	0,5731	0,054545	0,59	0,031472	1,4436	0,050478
Ital	33	1,785	0,068	0,7978	0,0417	1,0857	0,032	0,8266	0,0442	0,934	0,0368	0,91037	0,0402	0,5585	0,051493	0,588889	0,029914	1,47375	0,053385
Tuni	19	1,795	0,074	0,8026	0,058	1,0731	0,0776	0,8584	0,0393	0,927	0,0555	0,9378	0,0541	0,5410	0,046296	0,595789	0,042073	1,4515	0,056496
Alge	14	1,734	0,057	0,8	0,048	1,0614	0,0320	0,7864	0,0360	0,923	0,0261	0,89	0,0409	0,5178	0,055356	0,582857	0,037709	1,4121	0,034458
Moro	14	1,71	0,05	0,7985	0,065	1,0628	0,0423	0,8014	0,0361	0,948	0,0458	0,8857	0,0483	0,5814	0,044003	0,611429	0,036555	1,4185	0,047533
Fran	17	1,697	0,072	0,8023	0,0631	1,0517	0,0401	0,7852	0,0379	0,940	0,0505	0,9058	0,0435	0,5547	0,040484	0,588235	0,036269	1,433125	0,050691
Fr-C	17	1,846	0,044	0,8376	0,0569	1,1376	0,0403	0,8376	0,0311	0,974	0,044	0,9835	0,0295	0,59	0,037249	0,665882	0,031436	1,524706	0,028965
Geor	12	1,753	0,086	0,899	0,0465	1,0486	0,0328	0,763	0,0351	0,95	0,03	0,931	0,0332	0,6365	0,065408	0,628	0,054764	1,46675	0,064474
Bulg	7	1,619	0,070	0,9182	0,0678	1,0033	0,0403	0,7255	0,0414	0,931	0,0355	0,9095	0,0498	0,6215	0,045902	0,576857	0,02658	1,399571	0,056824
Pola	11	1,692	0,049	0,8986	0,0485	1,0302	0,0425	0,7635	0,0417	0,949	0,0555	0,9010	0,0311	0,5663	0,034171	0,590091	0,03734	1,445636	0,04383

V10		V11		V12		V13		v14		v15		v16		v17	
M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
0,85	0,055519	0,823333	0,03581	0,585556	0,038839	0,385	0,039145	0,856667	0,0827	0,8433	0,0391	0,536667	0,072973	0,546667	0,049244
0,891818	0,038941	0,878182	0,026389	0,668182	0,041429	0,401818	0,035726	0,946	0,0447	0,906	0,0462	0,543	0,035917	0,601	0,047011
0,882857	0,027045	0,8525	0,039587	0,623333	0,041392	0,395238	0,041185	0,94	0,037	0,886	0,0399	0,574	0,050825	0,596	0,035895
0,923333	0,043258	0,893667	0,042303	0,666333	0,055428	0,421333	0,040491	1,011429	0,0436	0,9292	0,0482	0,609643	0,051387	0,620357	0,037266
0,9421	0,02992	0,9287	0,032028	0,682857	0,04788	0,407875	0,048393	0,9827	0,0434	0,9376	0,0304	0,610444	0,047757	0,606875	0,048177
0,888462	0,0412	0,868462	0,03602	0,666923	0,047851	0,434615	0,037553	0,990769	0,0444	0,8946	0,0335	0,613846	0,045924	0,608462	0,039125
0,923857	0,034633	0,935714	0,02125	0,719143	0,032059	0,394429	0,026235	0,987429	0,0257	0,9294	0,0293	0,587571	0,054787	0,612571	0,032341
0,865909	0,03261	0,825455	0,026677	0,612273	0,039873	0,434091	0,045946	0,937273	0,0304	0,8754	0,0261	0,557727	0,036506	0,598182	0,025753
0,83625	0,033384	0,825	0,028055	0,598125	0,046102	0,386875	0,046032	0,966667	0,0321	0,8766	0,0311	0,570741	0,049531	0,565926	0,02832
0,857895	0,044294	0,831053	0,041217	0,607368	0,049311	0,389474	0,055123	0,948421	0,0345	0,8721	0,0379	0,607778	0,066382	0,590556	0,039329
0,836429	0,024995	0,809286	0,034522	0,574286	0,076431	0,402857	0,075185	0,912857	0,0419	0,8571	0,0317	0,554615	0,061592	0,562308	0,049016
0,845714	0,035673	0,805	0,034807	0,620714	0,032691	0,457857	0,038666	0,917143	0,0571	0,8678	0,0254	0,582143	0,035121	0,600714	0,032691
0,83	0,033267	0,82	0,039328	0,596875	0,043162	0,40125	0,043799	0,92125	0,0512	0,86	0,0417	0,580625	0,054095	0,596875	0,027741
0,894118	0,033177	0,877059	0,041195	0,655294	0,023748	0,474118	0,026939	0,981765	0,0350	0,9141	0,0341	0,614706	0,036076	0,619412	0,036992
0,884833	0,04085	0,831167	0,026502	0,6415	0,05175	0,369583	0,029274	0,924417	0,0420	0,8608	0,0373	0,597583	0,048194	0,58875	0,034526
0,825429	0,032659	0,786143	0,026959	0,6385	0,010279	0,365571	0,030561	0,864143	0,0592	0,8207	0,0378	0,579833	0,044557	0,579333	0,033025
0,833818	0,023025	0,791455	0,033925	0,606273	0,046396	0,350182	0,045716	0,868182	0,047	0,8309	0,0258	0,554	0,037462	0,563	0,026605

TABLE 5. - Frequencies of character states for all samples (Description of each characters state is in Appendix table 2).

Characters and states		1			2		3				4		5		6		7			8	
Origin	N	(0)	(1)	(2)	(0)	(1)	0	1	2	3	(0)	(1)	(0)	(1)	(0)	(1)	(2)	(0)	(1)	(0)	(1)
Indonesia - Java	21	0,00	0,00	1,00	0,00	1,00	0.38	0.62	0,00	0,00	0,00	1,00	0.71	0.29	0.9	0.1	0,00	0.24	0.76	0.84	0.16
India - Dehli	12	0,00	0.37	0.63	0.11	0.89	0,00	0.67	0.33	0,00	0,00	1,00	1,00	0,00	0.2	0.8	0,00	0.6	0.4	0.8	0.2
Pakistan - Islamabad	22	0,00	0.05	0.95	0.22	0.78	0.55	0.32	0.13	0,00	0,00	1,00	0.83	0.17	0.05	0.95	0,00	0.05	0.95	0.7	0.3
Iran - Birjand	30	0,00	0.17	0.83	0.73	0.27	0.1	0.43	0.43	0.04	0.03	0.97	1,00	0,00	0.43	0.57	0,00	0.32	0.68	0.76	0.24
Iran - Mashad	13	0,00	0.1	0.9	0.8	0.2	0.5	0.4	0.1	0,00	0.6	0.4	0.4	0.6	0.2	0.8	0,00	0.1	0.9	0.5	0.5
Iran - Kakhk	10	0,00	0,00	1,00	0.15	0.85	0.5	0.42	0.08	0,00	0,00	1,00	0.92	0.08	0,00	1,00	0,00	0.23	0.77	0.5	0.5
Iran - Tehran	7	0.71	0.29	0,00	0.57	0.43	0.58	0.14	0.28	0,00	0.15	0.85	0.72	0.28	0.45	.45	0,00	0.57	0.43	0.37	0.63
Tunisia - Monastir	45	0.91	0.09	0,00	0.16	0.84	0.46	0.34	0.08	0.12	0,00	1,00	0.49	0.51	1,00	0,00	0,00	0.05	0.95	0.73	0.27
Algeria - Oran	15	1,00	0,00	0,00	0,00	1,00	1,00	0,00	0,00	0,00	0,00	1,00	0.5	0.5	1,00	0,00	0,00	0.07	0.93	0.27	0.73
Morocco -Aemmour	16	0.94	0,00	0.06	0,00	1,00	0.44	0.18	0,00	0.38	0,00	1,00	0.31	0.69	1,00	0,00	0,00	0,00	1,00	0.5	0.5
Greece -	23	0,00	1,00	0,00	0,00	1,00	0.33	0.48	0.19	0,00	0.33	0.67	0.71	0.29	1,00	0,00	0,00	0.1	0.9	0.35	0.65
Italy - Lombardi	39	1,00	0,00	0,00	0,00	1,00	0.84	0.16	0,00	0,00	0,00	1,00	0.56	0.44	1,00	0,00	0,00	0.12	0.88	0.81	0.19
France - Languedoc	19	1,00	0,00	0,00	0.06	0.94	0.39	0.22	0.06	0.33	0,00	1,00	0.56	0.44	0.71	0.29	0,00	0.06	0.94	0.72	0.28
France-Corse(Vaitella)	18	1,00	0,00	0,00	0,00	1,00	0.6	0.13	0.2	0.07	0,00	1,00	0.67	0.33	1,00	0,00	0,00	0,00	1,00	0.67	0.33
Bulgaria - Toshevo	13	0,00	1,00	0,00	0.08	0.92	0,00	0.67	0.16	0.17	0.17	0.83	0.42	0.58	0,00	1,00	0,00	0,00	1,00	0.25	0.75
Poland - Eastern part	11	0.42	0.58	0,00	0.08	0.92	0.34	0.58	0.08	0,00	0.5	0.5	0.17	0.83	0.17	0.83	0,00	0.2	0.8	0.2	0.8
Georgiea	17	0.7	0.28	0.02	0.06	0.94	0.6	0.4	0,00	0,00	0.82	0.18	0.6	0.4	0.18	0.76	0.06	0.35	0.65	0.65	0.35

9			10		11				12			13		14	
(0)	(1)	(2)	(0)	(1)	(0)	(1)	(2)	(3)	(0)	(1)	(2)	(0)	(1)	(0)	(1)
0.71	0.24	0.05	0.57	0.43	1,00	0,00	0,00	0,00	0.12	0,00	0.88	0.67	0.33	0.38	0.62
0,00	0.92	0.08	0.67	0.33	0,00	0,00	1,00	0,00	0,00	0,00	1,00	1,00	0,00	1,00	0,00
0.1	0.9	0,00	0.87	0.13	0,00	0,00	1,00	0,00	0.05	0.5	0.45	1,00	0,00	1,00	0,00
0.07	0.3	0.63	1,00	0,00	0.5	0,00	0.5	0,00	0,00	0.48	0.52	1,00	0,00	1,00	0,00
0,00	0.5	0.5	0.9	0.1	0.1	0.6	0.3	0,00	0,00	0.3	0.7	1,00	0,00	1,00	0,00
0,00	0.58	0.42	1,00	0,00	0.23	0.77	0,00	0,00	0.1	0.23	0.67	1,00	0,00	1,00	0,00
0.46	0.4	0.14	0.72	0.28	0.2	0.65	0.14	0,00	0.22	0.78	0,00	1,00	0,00	1,00	0,00
0,00	0.78	0.22	0.8	0.2	0.09	0.91	0,00	0,00	0.02	0.98	0,00	1,00	0,00	1,00	0,00
0.07	0.84	0.07	0.87	0.13	0,00	1,00	0,00	0,00	0,00	1,00	0,00	1,00	0,00	1,00	0,00
0,00	0.75	0.25	0.87	0.13	0.06	0.94	0,00	0,00	0.13	0.81	0.06	1,00	0,00	1,00	0,00
0,00	0.83	0.17	0.91	0.09	0,00	1,00	0,00	0,00	0,00	1,00	0,00	1,00	0,00	1,00	0,00
0,00	0.9	0.1	0.98	0.02	0,00	1,00	0,00	0,00	0,00	1,00	0,00	1,00	0,00	1,00	0,00
0.11	0.58	0.31	1,00	0,00	0,00	1,00	0,00	0,00	0,00	1,00	0,00	1,00	0,00	1,00	0,00
0.11	0.83	0.06	1,00	0,00	0,00	1,00	0,00	0,00	0.33	0.67	0,00	1,00	0,00	1,00	0,00
0.4	0.6	0,00	0.83	0.17	0,00	0.92	0.08	0,00	1,00	0,00	0,00	1,00	0,00	1,00	0,00
0.75	0.16	0.09	0.83	0.17	0.33	0.17	0.33	0.17	1,00	0,00	0,00	1,00	0,00	1,00	0,00
0.41	0.53	0.06	0.94	0.06	0,00	0,00	0.53	0.47	0.76	0.24	0,00	1,00	0,00	1,00	0,00