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A NEW MOUSE-EARED BAT SPECIES, FROM NEPAL, WITH STATISTICAL ANALYSES OF SOME OTHER SPECIES OF SUBGENUS LEUCONOE (CHIROPTERA, VESPERTILIONIDAE)

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A description of a new bat species *Myotis csorbai* sp. n., from Nepal, related to *Myotis longipes* (DOBSON, 1872) is given. Results of statistical analyses, along with those on samples from Kashmiri and Afghan populations of the other species and on some other members of the *Leuconoe* subgenus are presented.

Key words: Mammalia, Vespertilionidae, *Myotis*, *Leuconoe*, Nepal, taxonomy, systematics

INTRODUCTION

The species *Myotis longipes*, a member of the subgenus *Leuconoe*, has been known from Kashmir for almost one and a half centuries. BLYTH's *M. theobaldi* (1856) was probably the first name which referred to this fairly small-sized mouse-eared bat from the vicinity of Islamabad (CORBET & HILL 1992). The same authors (CORBET & HILL op. cit.) reviewed the synonymy, taxonomy, as well as the known distribution data of the species. KOOPMAN (1993) did not mention any subspecies of *Myotis longipes* and recorded it only from Afghanistan and Kashmir. SINHA (1994) also mentioned the species from Siju Cave, Meghalaya. GAISLER (1970*b*) treated *Myotis longipes* as "nearly endemic or endemic" to Afghanistan, with a small range in the border between the Palaearctic and the Oriental Regions. OSGOOD's (1932) record from Vietnam was based most probably on a misidentification of *M. laniger*. FINDLEY (1972), as a result of his numerical taxonomical work based both on external and craniological features, found clear proof for its membership of the *daubentoni–capaccinii* group within the subgenus *Leuconoe*.

The uncertainty about the systematics of the *daubentoni–capaccinii* group and its Palaearctic and Oriental members has appeared in all major and comprehensive works (TATE 1941, ELLERMANN & MORRISON-SCOTT 1951, CORBET 1978, CORBET & HILL 1992).

Besides the closely related *M. longipes*, other members of the *daubentoni–capaccinii* group: the well-known *M. daubentoni* and *M. capaccinii*, and the

much less studied and therefore systematically uncertain species *M. laniger* (CORBET & HILL op. cit.) were used here for comparisons.

Description of a medium sized sample, two adult males and eight adult females of a new species of *Myotis* from Nepal is given below. The specimens from the type locality are also listed by BATES and HARRISON (1997) but as *M. longipes*.

MATERIAL AND METHODS

External measurements (forearm length and tibia length) of 51, as well as cranial and mandibular measurements of 46 adult specimens of *M. longipes* deposited in the Mammal Collection of the Hungarian Natural History Museum, Budapest were used. The material from a population estimated to number about four thousand, was collected by the present author the Bumzov Cave, at about 2000 m a.s.l. on the north-south route between Pahalgam and Anantnag, Kashmir, India, on 9 June, 1967. According to KOUL (1965, p. 51), an earlier name for Anantnag was Islamabad. Thus, the type locality could be close by or even at the same place as for the present material. The shortest distance between the currently well-known Islamabad, N of Rawalpindi, Pakistan and Anantnag is about 200 kilometres, and the one between Anantnag and the localities of *M. csorbai* sp. n. in Nepal is about 1040 km to the southeast of Anantnag. Specimens of more than 37 percent of the Bumzov population had some irregularly placed small albinotic spots of various extension on the upper as well as on the under part of their pelage.

The mandible and the badly damaged skull of an alcoholic specimen, ZMB 4864, in the Zoological Museum of Humboldt University Berlin, with locality "Ost-Indien" and collected by JERDON was also included in the present study. It is worth noting that the specimen had the same peculiar albinism, as was mentioned for the Bumzov population.

Mandibular and cranial measurements of the No 76.3.10.4. male cotype specimen of *M. longipes* from the Caves of Bhima Devi, Kashmir, deposited in The Natural History Museum, London were also included, along with those of five other specimens also stored there: 68.458 male, 68.460 male, 68.466 female, 68.471 male and 68.472 female collected in Afghanistan on 18 April, 1967 and presented by J. GAISLER (see GAISLER 1970*a*).

For some analyses the cranial and mandibular measurements of 34 and 36 specimens of *M. daubentoni* were used, respectively, mostly from Hungary and partly from other European countries, deposited in the Mammal Collection of Hungarian Natural History Museum.

In total 12 specimens of *Myotis laniger* were studied, including specimen number ZMB 4146, Amoy, China, the holotype of the species deposited in the Museum of the Humboldt University, Berlin. Three specimens, HNHM 92.108.1. female, HNHM 92.108.2. male, HNHM 92.108.3. male were from near Cherrapunjee, Meghalaya, India, HNHM 93.57.1. female came from Ta Phinh, North Vietnam (all four collected by the author and deposited in the Mammal Collection of Hungarian Natural History Museum). In addition to the above holotype, there are also two more specimens deposited in the Museum of Humboldt University, Berlin: a female with no registration number from Macao, China and a male ZMB 43312 from Kwantung, China, all of which had the almost complete set of measurements. The following specimens had been studied earlier by taking fewer measurements: a female 1948–371 (MA 283) Binh-du, Chapa, N Vietnam, in the Muséum National d'Histoire Naturelle, Paris, ZMB 54087 sex?, ZMB 54158 female, ZMB 54161 female, all from Tonkin and ZMB 54162 unknown sex from Annam, all in the Berlin collection.

Sixty *Myotis capaccinii* (45 from northern Yugoslavia, Dalmatia and Macedonia, 15 from Iraq) deposited in the Mammal Collection of Hungarian Natural History Museum, Budapest were also included for cranial and mandibular data analyses.

Two external measurements (forearm length and tibia length, taken in the field by a caliper up to 0.1 mm accuracy) were analysed for a comparison of the Kashmiri *M. longipes* and Nepalese

M. csorbai sp. n. samples. Forty-nine cranial and 35 mandibular characters were measured. The characters, with their definitions where necessary, are listed in Tables 2 and 3. Measurements were collected by a Mitutoyo digital caliper to 0.01 mm accuracy – using a binocular microscope and a Mitutoyo communication adapter MRS 100. For descriptive statistics, Shapiro-Wilk normality test, Kolmogorov-Smirnov two-sample test, t-test for independent samples, discriminant, canonical, and cluster analysis were used. All statistical analyses were performed using the Statistica 5.1 software.

Myotis csorbai sp. n.

Holotype – adult female: HNHM 97.2.4. (collector's No. CSORON 103), 4 km E of Syangja, 1300 m a.s.l., Syangja District, about 30 km S of Pokhara town, Nepal. Collected on 23 July 1995, by Dr. G. CSORBA. Alcoholic specimen, skull extracted. Deposited in the Department of Zoology, Hungarian Natural History Museum, Budapest.

Paratypes – four adult females: HNHM 97.2.1., 97.2.2., 97.2.3., 97.2.5. (collector's Nos CSORON 100, CSORON 101, CSORON 102, and CSORON 104, respectively), collected by Dr. G. CSORBA from the same locality and same date, deposited in the Department of Zoology, Hungarian Natural History Museum, Budapest. Further five specimens collected by A. BORISSENKO and S. KRUSKOP, at Bhurungdi river, about 30–40 km NW of Pokhara, Nepal. Alcoholic specimens, with extracted skull, deposited in the Zoological Museum of the Moscow University, Moscow: S–164481 female, S–164487 male, vicinity of Tirkhedunga, 1700 m, 14 May 1996, S–164483 female, S–164484 female, S–164490 male, vicinity of Sudame, 1500 m, 15–16 May 1996.

Diagnosis. Dark brownish black above, and dull grayish below, with smoky translucent grayish ears and membranes. Evidently darker than the species *M. longipes* from Kashmir. A small form, with shorter forearm and tibia and generally smaller cranial and mandibular measurements than in the species *M. longipes*.

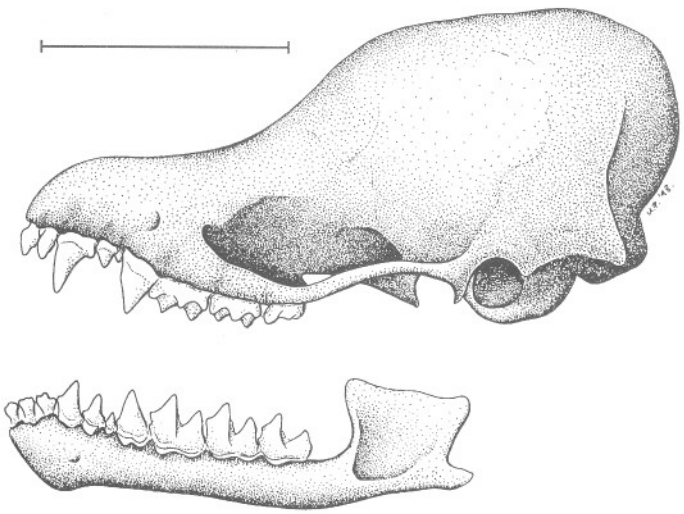

Fig. 1. Sketches of the skull and the mandible of *M. csorbai* sp. n..

Measurements with descriptive statistical data for external characters are included in Table 1, those of the skulls of the type series are given in Table 2, and for mandibles in Table 3. The skull and mandible of *M. csorbai* sp. n. are depicted in Fig. 1.

STATISTICAL COMPARISON

Comparison of external characters of Myotis csorbai *sp. n. and of* M. longipes

The descriptive statistics of external characters (forearm length and tibia length) of the Kashmiri *M. longipes*, as well as for the sample of the new species from Nepal are given separately for males and females, in Table 1. Brief results of the Kolmogorov-Smirnov test and the t-test, are reviewed here for pairs of samples. As regards forearm length, the Kolmogorov-Smirnov test unexpectedly showed significant ($p < 0.001$) difference of means between the males and females of the Kashmiri sample. The t-test at 0.001 alpha level gave the same result. There was no significant difference between the Kashmiri males and the Nepalese sample in the Kolmogorov-Smirnov test ($p < 0.01$). The difference in forearm length between the Kashmiri females and the Nepalese sample was highly significant ($p < 0.001$) by the Kolmogorov-Smirnov test. The t-test (at alpha level 0.001) gave the same result. There was a significant difference ($p < 0.005$) in forearm length between the Kashmiri *M. longipes* (sexes combined) and the Nepalese *M. csorbai* sp. n. by the Kolmogorov-Smirnov test. The means of the tibia lengths did no differ significantly between the slightly smaller males and the slightly larger females from Kashmir but showed significant differences both in the Kolmogorov-Smirnov test and the t-test when compared with those of the new species from Nepal. Standard discriminant analysis of the two external

Table 1. Descriptive statistics, forearm length and tibia length of *Myotis longipes*, Kashmir, and those of *Myotis csorbai* sp. n., Nepal (m = males, f = females)

Variable name	Species	Sex	N	Mean	min.	max.	std. dev.
Forearm length	*M. longipes*	m	33	37.20000	36.10	38.70	0.668954
		f	18	38.46667	36.60	39.70	0.926727
	M. csorbai	m	2	34.96000	34.80	35.12	0.226274
		f	8	36.30500	35.50	37.50	0.734769
Tibia length	*M. longipes*	m	33	16.68788	15.70	17.60	0.515847
		f	18	17.02778	16.00	17.80	0.501534
	M. csorbai	m	2	15.14500	14.84	15.45	0.431335
		f	8	15.48000	15.10	15.80	0.258844

measurements showed some overlap between individuals of the two species. The measurements of almost all overlapping individuals of the species *M. longipes*, however, were taken after prolonged storage in alcohol.

Comparison of cranial and mandibular characters of males and females of Myotis longipes*, Kashmir and Afghanistan*

The descriptive statistics of the cranial measurements of the studied material of the species *M. longipes*, males and females respectively, are given in Table 2. Out of 49 cranial characters the means of females were slightly greater than males in 28, although the males had greater mean values in 11 measurements. Other 9 means were equal up to two decimals. According to the Kolmogorov-Smirnov test, there was no significant difference ($p > 0.10$) between the males and females in any cranial character. The same conclusion was drawn from the results of a t-test for independent samples.

Descriptive statistics of the mandibular measurements of the studied material of *M. longipes*, males and females, respectively, are given in Table 3. Out of 35 mandibular characters, in 19 the females had greater mean values, in 7 the males were larger, while in the other 9 the means were practically equal. In the Kolmogorov-Smirnov test and the t-test at 0.001 alpha level, there was no significant difference between the males and the females.

Comparison of M. csorbai *sp. n. and* M. longipes

Cluster analyses of data of all individuals were performed as exploratory studies. One of these, produced a tree diagram (Fig. 2) which was based on 14 cranial and 10 mandibular characters and included both sexes of *M. longipes*, and the new species. The unweighted pair-group average linkage method using Eucledian distances in this analysis linked the two clumps at 100 $(D_{link}/D_{max})*100$ distance, while each cluster was divided at less than 50 distances. Only one of the 10 specimens of *M. csorbai* sp. n. was placed in the cluster of *M. longipes*.

Descriptive statistics of cranial characters of *M. csorbai* sp. n. Nepal are given in Table 2. There was no overlap between the maximum values of the new species and the minimum values of *M. longipes* (*M. csorbai* sp. n. had absolutely smaller values) in the following measurements: condylobasal length, outer distance of C–C crowns, zygomatic width, mastoid width, nasal notch length, M^1–M^3 crown length, C–M^3 alveolar length and M^1–M^3 alveolar length.

Descriptive statistics of mandibular measurements of *M. csorbai* sp. n. are shown in Table 3. Measurements in which there was no overlap between the maximum values of the new species and the minimum values of *M. longipes* were: mandibular length and C–M_3 alveolar length.

The present sample of the Nepalese species was generally smaller than *M. longipes* (sexes combined) from Kashmir and Afghanistan. The differences ap-

Table 2. Descriptive statistics, cranial measurements of *Myotis longipes*, Kashmir-Afghanistan, and those of *Myotis csorbai* sp. n., Nepal (m = males, f = females)

Variable name	Species	Sex	N	Mean	min.	max.	std. dev.
Total skull length (distance between I1 anterior alveolus margin and occiput)	*M. longipes*	m	33	14.10394	13.52	14.53	0.220567
		f	19	14.24526	13.80	14.74	0.245546
		f	8	13.15625	12.81	13.64	0.238803
Condylobasal length (distance between I1 anterior alveolus margin and condyli)	*M. longipes*	m	33	13.30242	12.77	13.72	0.225874
		f	18	13.40333	12.89	13.76	0.261759
		f	8	12.36125	12.11	12.71	0.224336
Basal length (distance between anterior edge of palate and skull base edge)	*M. longipes*	m	33	10.45303	9.92	10.82	0.230576
		f	18	10.51444	10.04	10.85	0.230402
		f	8	9.71000	9.43	9.93	0.158745
Palatal length (distance between anterior and posterior edges of palate without spine)	*M. longipes*	m	32	5.93500	5.38	6.20	0.171521
		f	18	5.99889	5.70	6.24	0.158035
		f	8	5.50250	5.19	5.70	0.153413
Palato-maxillary length (distance between anterior edge of palate and palato-maxillary sinus)	*M. longipes*	m	33	5.03121	4.64	5.31	0.140396
		f	19	5.09211	4.81	5.35	0.170084
		f	8	4.66750	4.54	4.78	0.079955
Inner distance of M2-M2 (measured between talons)	*M. longipes*	m	33	2.75273	2.59	2.97	0.095140
		f	18	2.74722	2.47	2.88	0.109319
	M. csorbai	m	2	2.38500	2.37	2.40	0.021213
		f	8	2.57875	2.49	2.67	0.065124
Outer distance of C-C crowns (including cingula)	*M. longipes*	m	32	3.66438	3.52	3.89	0.085796
		f	18	3.68944	3.53	3.84	0.085024
	M. csorbai	m	2	3.33500	3.33	3.34	0.007071
		f	8	3.36625	3.21	3.50	0.107960
Outer alveolar distance of C-C	*M. longipes*	m	33	3.58848	3.41	3.79	0.081514
		f	18	3.57889	3.42	3.71	0.078582
	M. csorbai	m	2	3.17500	3.16	3.19	0.021213
		f	8	3.30125	3.13	3.43	0.099202
Outer distance of M3-M3 crowns	*M. longipes*	m	33	5.66061	5.47	6.04	0.107265
		f	18	5.64944	5.41	5.91	0.135320
	M. csorbai	m	2	5.02000	4.97	5.07	0.070711
		f	8	5.35750	5.25	5.47	0.091768

Table 2 continued

Outer alveoli of M3-M3 (measured between exteriormost edges)	*M. longipes*	m	33	5.58727	5.38	5.97	0.119511
		f	18	5.58500	5.39	5.89	0.134175
		f	8	5.25500	5.13	5.41	0.105153
Zygomatic width	*M. longipes*	m	33	8.60667	8.31	8.90	0.143018
		f	18	8.69500	8.36	9.02	0.173790
	M. csorbai	m	2	7.66500	7.59	7.74	0.106066
		f	8	7.95125	7.81	8.19	0.134848
Braincase width	*M. longipes*	m	33	7.05242	6.66	7.34	0.144850
		f	18	7.04222	6.79	7.29	0.113891
	M. csorbai	m	2	6.44500	6.38	6.51	0.091924
		f	8	6.46500	6.31	6.72	0.139386
Mastoid width	*M. longipes*	m	33	7.24455	7.00	7.56	0.136659
		f	18	7.26167	7.01	7.44	0.117386
	M. csorbai	m	2	6.50500	6.49	6.52	0.021213
		f	8	6.75250	6.59	6.97	0.121626
Interorbital constriction	*M. longipes*	m	33	3.48970	3.26	3.69	0.104866
		f	18	3.45167	3.29	3.59	0.091475
	M. csorbai	m	2	3.20000	3.13	3.27	0.098995
		f	8	3.21750	3.07	3.43	0.113861
Lachrymal bridge width (that is anteorbital bridge width)	*M. longipes*	m	33	1.02152	0.87	0.22	0.076368
		f	19	1.03474	0.85	1.32	0.113987
	M. csorbai	m	2	0.91500	0.89	0.94	0.035355
		f	8	0.91500	0.77	0.99	0.092273
Lachrymal width	*M. longipes*	m	33	4.74848	4.54	4.93	0.107300
		f	18	4.78444	4.59	5.04	0.125099
	M. csorbai	m	2	4.16500	4.13	4.20	0.049497
		f	8	4.37750	4.21	4.54	0.102365
Nasal notch width	*M. longipes*	m	32	1.72187	1.45	1.87	0.090605
		f	19	1.73526	1.55	1.86	0.082622
	M. csorbai	m	2	1.59000	1.53	1.65	0.084853
		f	8	1.60750	1.52	1.66	0.044960
Nasal notch length	*M. longipes*	m	32	1.87156	1.75	2.07	0.072695
		f	18	1.86211	1.72	2.03	0.096585
	M. csorbai	m	2	1.66500	1.59	1.74	0.106066
		f	8	1.69625	1.63	1.73	0.037009

Table 2 continued

Anterior palatal emargination width	*M. longipes*	m	31	1.53645	1.41	1.64	0.061403
		f	19	1.53526	1.38	1.66	0.073210
	M. csorbai	m	2	1.37000	1.35	1.39	0.028284
		f	8	1.46375	1.42	1.53	0.040333
Anterior palatal emargination length	*M. longipes*	m	31	1.29097	1.00	1.41	0.087649
		f	19	1.32579	1.08	1.44	0.086943
	M. csorbai	m	2	1.03500	1.01	1.06	0.035355
		f	8	1.21375	1.03	1.28	0.079271
Palatal width behind toothrows (measured at narrowest part)	*M. longipes*	m	33	2.34667	2.24	2.46	0.049854
		f	18	2.35167	2.26	2.45	0.056906
	M. csorbai	m	2	2.06500	2.01	2.12	0.077782
		f	8	2.22250	2.05	2.30	0.083623
Width between cochleae (width of skull base)	*M. longipes*	m	33	1.35000	1.18	1.60	0.106125
		f	18	1.34722	1.22	1.49	0.082875
	M. csorbai	m	2	1.14500	1.14	1.15	0.007071
		f	8	1.19375	1.11	1.30	0.077263
Braincase height (from base of skull to top including sagittal crist)	*M. longipes*	m	33	5.48697	5.25	5.73	0.112208
		f	18	5.50389	5.22	5.78	0.132049
		f	8	5.12000	4.96	5.32	0.120475
C-M3 crown length	*M. longipes*	m	33	5.39485	5.11	5.56	0.105745
		f	19	5.41526	5.19	5.57	0.104900
	M. csorbai	m	2	4.83000	4.72	4.94	0.155563
		f	8	5.06000	4.93	5.19	0.087505
C-P4 crown length	*M. longipes*	m	33	2.39364	2.22	2.59	0.087957
		f	19	2.39263	2.25	2.55	0.078588
	M. csorbai	m	2	2.17000	2.07	2.27	0.141421
		f	8	2.25500	2.13	2.41	0.089762
Shortest distance between C and P4 (inner distance of crowns)	*M. longipes*	f	19	0.58263	0.41	0.65	0.056945
		f	19	0.58263	0.41	0.65	0.056945
		f	8	0.51750	0.41	0.59	0.070660
M1-M3 crown length	*M. longipes*	m	33	3.32273	3.21	3.46	0.074594
		f	19	3.33789	3.17	3.44	0.069248
	M. csorbai	m	2	2.91000	2.85	2.97	0.084853
		f	8	3.08750	2.95	3.16	0.075923

Table 2 continued

P4-M3 crown length	*M. longipes*	m	33	4.02727	3.86	4.23	0.099758
		f	19	4.03368	3.83	4.15	0.093227
	M. csorbai	m	2	3.61000	3.52	3.70	0.127279
		f	8	3.78750	3.61	3.91	0.095282
C basal length	*M. longipes*	m	33	0.85333	0.78	0.91	0.033973
		f	19	0.85263	0.81	0.90	0.026213
	M. csorbai	m	2	0.75500	0.74	0.77	0.021213
		f	8	0.82125	0.76	0.86	0.033991
P2 basal length	*M. longipes*	m	33	0.37364	0.32	0.45	0.029455
		f	19	0.38211	0.33	0.43	0.029170
	M. csorbai	m	2	0.33500	0.32	0.35	0.021213
		f	8	0.38875	0.35	0.45	0.031820
P4 basal length	*M. longipes*	m	33	1.06152	0.89	1.13	0.051728
		f	19	1.07579	0.96	1.15	0.050035
	M. csorbai	m	2	0.97000	0.94	1.00	0.042426
		f	8	1.03250	0.91	1.12	0.082245
M1 antero-posterior length	*M. longipes*	m	33	1.29424	1.22	1.38	0.042722
		f	19	1.31000	1.23	1.42	0.050222
	M. csorbai	m	2	1.10500	1.07	1.14	0.049497
		f	8	1.20625	1.14	1.24	0.037773
M2 antero-posterior length	*M. longipes*	m	33	1.28121	1.23	1.34	0.032669
		f	19	1.27632	1.18	1.36	0.039329
	M. csorbai	m	2	1.08500	1.04	1.13	0.063640
		f	8	1.21375	1.17	1.25	0.028754
M3 antero-posterior length	*M. longipes*	m	33	0.75727	0.71	0.82	0.026253
		f	19	0.75579	0.71	0.81	0.029120
	M. csorbai	m	2	0.67000	0.64	0.70	0.042426
		f	8	0.71000	0.67	0.75	0.032071
C crown width	*M. longipes*	m	33	0.66788	0.62	0.72	0.028368
		f	19	0.66842	0.64	0.70	0.017083
	M. csorbai	m	2	0.60500	0.59	0.62	0.021213
		f	8	0.61375	0.59	0.65	0.020659
P2 crown width	*M. longipes*	m	33	0.40879	0.36	0.45	0.020880
		f	19	0.40263	0.36	0.45	0.020774
	M. csorbai	m	2	0.37500	0.34	0.41	0.049497
		f	8	0.39000	0.36	0.43	0.025635

Table 2 continued

P4 crown width	*M. longipes*	m	33	0.92030	0.85	0.99	0.034685
		f	19	0.92053	0.85	0.98	0.040889
	M. csorbai	m	2	1.00000	0.97	1.03	0.042426
		f	8	0.94000	0.81	1.15	0.127839
M1 mesostylar width (distance between outer edge of mesostyl and innermost edge of talon)	*M. longipes*	m	33	1.43182	1.34	1.53	0.039879
		f	19	1.45474	1.37	1.54	0.037024
		f	8	1.33000	1.30	1.37	0.022678
M2 mesostylar width (distance between outer edge of mesostyl and innermost edge of talon)	*M. longipes*	m	33	1.63879	1.54	1.72	0.042994
		f	19	1.65789	1.58	1.73	0.036603
		f	8	1.53375	1.51	1.55	0.016850
M3 crown width	*M. longipes*	m	33	1.51515	1.44	1.62	0.040398
		f	19	1.51263	1.44	1.58	0.033140
	M. csorbai	m	2	1.34000	1.33	1.35	0.014142
		f	8	1.43000	1.37	1.47	0.035857
Tympanic bulla opening height	*M. longipes*	m	32	1.41750	1.22	1.58	0.095377
		f	19	1.46474	1.32	1.62	0.083757
	M. csorbai	m	2	1.32000	1.28	1.36	0.056569
		f	8	1.31250	0.94	1.50	0.197176
C-M3 alveolar length	*M. longipes*	m	29	5.26241	5.11	5.47	0.100983
		f	17	5.25706	5.04	5.48	0.128149
	M. csorbai	m	2	4.68000	4.55	4.81	0.183848
		f	8	4.91625	4.73	5.01	0.089911
C-P4 alveolar length	*M. longipes*	m	29	2.29966	2.18	2.51	0.084027
		f	17	2.32353	2.22	2.45	0.075576
	M. csorbai	m	2	2.08000	1.99	2.17	0.127279
		f	8	2.14500	2.02	2.29	0.091496
P4-M3 alveolar length	*M. longipes*	m	29	3.90966	3.74	4.09	0.102312
		f	17	3.88294	3.71	4.07	0.102394
	M. csorbai	m	2	3.43500	3.39	3.48	0.063640
		f	8	3.67250	3.47	3.77	0.089881
M1-M3 alveolar length	*M. longipes*	m	29	3.12828	3.01	3.25	0.066658
		f	17	3.11118	2.99	3.22	0.070168
	M. csorbai	m	2	2.71000	2.65	2.77	0.084853
		f	8	2.88250	2.78	2.96	0.062735

Table 2 continued

C alveolus length	*M. longipes*	m	29	0.71138	0.57	0.87	0.065341
		f	17	0.69706	0.61	0.77	0.047271
	M. csorbai	m	2	0.66000	0.62	0.70	0.056569
		f	8	0.68375	0.58	0.79	0.082104
P2 alveolus length	*M. longipes*	m	29	0.32828	0.28	0.39	0.030363
		f	17	0.34176	0.29	0.39	0.030462
	M. csorbai	m	2	0.31500	0.31	0.32	0.007071
		f	8	0.33000	0.29	0.39	0.041748
P4 outer alveolar length (distance between anteriormost and posteriormost edges)	*M. longipes*	m	29	0.94897	0.85	1.06	0.055507
		f	17	0.96765	0.88	1.03	0.047635
		f	8	0.89125	0.80	0.97	0.051391
Maxillary height at M2	*M. longipes*	m	33	0.67667	0.56	0.86	0.069402
		f	19	0.69895	0.61	0.81	0.057047
	M. csorbai	m	2	0.61500	0.59	0.64	0.035355
		f	8	0.59250	0.50	0.65	0.049785

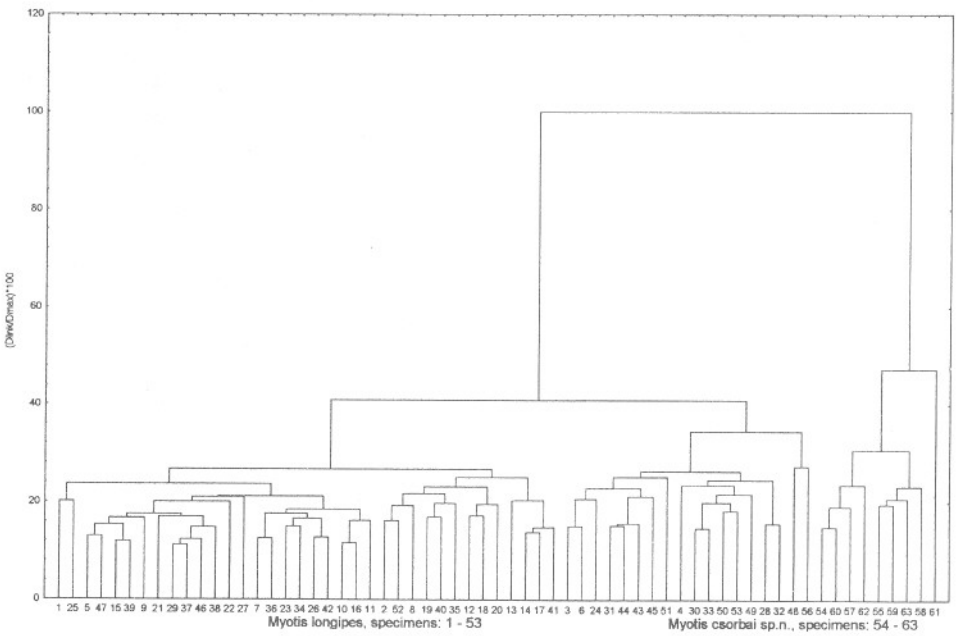

Fig. 2. Dendrogram by the unweighted pair-group linkage, Eucledian distances, processed from 24 cranial and mandibular data of *M. longipes*, Kashmir–Afghanistan (specimens 1–53), and *Myotis csorbai* sp. n., Nepal (specimens 54–63)

Table 3. Descriptive statistics, mandibular measurements (in mm) of *Myotis csorbai* sp. n., Nepal, and those of *M. longipes*, Kashmir–Afghanistan; m = males, f = females

Variable name	Species	Sex	N	Mean	min.	max.	std. dev.
Mandibular length (between I1 anterior alveolar edge and articular process)	*M. longipes*	m	33	10.35182	9.96	10.58	0.156214
		f	19	10.44316	9.93	10.78	0.238538
		f	8	9.57000	9.32	9.90	0.193317
C-M3 length (crowns)	*M. longipes*	m	33	5.70394	5.42	5.87	0.100993
		f	19	5.72421	5.46	5.88	0.124691
	M. csorbai	m	2	5.13000	4.97	5.29	0.226274
		f	8	5.34125	5.20	5.46	0.101339
C-P4 length (crowns)	*M. longipes*	m	33	2.18333	2.05	2.30	0.062733
		f	19	2.17526	2.03	2.32	0.073361
	M. csorbai	m	2	1.93500	1.87	2.00	0.091924
		f	8	2.06875	1.97	2.16	0.064683
Distance between C-P4 (shortest distance between crowns)	*M. longipes*	m	33	0.78182	0.65	0.91	0.065310
		f	19	0.77053	0.61	0.85	0.062135
		f	8	0.72500	0.55	0.85	0.088156
P4-M3 length (crowns)	*M. longipes*	m	33	4.23576	4.05	4.37	0.081969
		f	19	4.25526	4.12	4.35	0.068017
	M. csorbai	m	2	3.86500	3.77	3.96	0.134350
		f	8	3.97250	3.85	4.09	0.074210
M1-M3 length	*M. longipes*	m	33	3.53758	3.30	3.68	0.082312
		f	19	3.56105	3.31	3.69	0.092189
	M. csorbai	m	2	3.22000	3.13	3.31	0.127279
		f	8	3.34875	3.18	3.48	0.093264
C basal length	*M. longipes*	m	33	0.71970	0.58	0.78	0.043264
		f	19	0.72789	0.65	0.82	0.034088
	M. csorbai	m	2	0.65500	0.64	0.67	0.021213
		f	8	0.67875	0.63	0.79	0.048825
P2 basal length	*M. longipes*	m	33	0.45424	0.41	0.52	0.026696
		f	19	0.44316	0.39	0.49	0.027699
	M. csorbai	m	2	0.40500	0.39	0.42	0.021213
		f	8	0.45125	0.41	0.49	0.025319
P3 basal length	*M. longipes*	m	33	0.34000	0.24	0.40	0.035355
		f	19	0.32000	0.24	0.38	0.037417

Table 3 continued

	M. csorbai	m	2	0.32500	0.29	0.36	0.049497
		f	8	0.32250	0.28	0.39	0.034538
P4 basal length	*M. longipes*	m	33	0.73091	0.61	0.81	0.049077
		f	19	0.73895	0.69	0.80	0.034624
	M. csorbai	m	2	0.67500	0.66	0.69	0.021213
		f	8	0.68750	0.64	0.73	0.028158
M1 antero-posterior length	*M. longipes*	m	33	1.25788	1.15	1.35	0.04471
		f	19	1.26105	1.13	1.33	0.050321
	M. csorbai	m	2	1.14500	1.10	1.19	0.063640
		f	8	1.21625	1.13	1.29	0.055790
M2 antero-posterior length	*M. longipes*	m	33	1.26030	1.16	1.35	0.038445
		f	19	1.27421	1.20	1.36	0.040182
	M. csorbai	m	2	1.17000	1.12	1.22	0.070711
		f	8	1.20625	1.15	1.26	0.039978
M3 antero-posterior length	*M. longipes*	m	33	1.15788	1.07	1.24	0.035157
		f	19	1.15842	1.10	1.26	0.036157
	M. csorbai	m	2	1.05500	1.02	1.09	0.049497
		f	8	1.10625	1.06	1.15	0.029246
C-M3 alveolar length	*M. longipes*	m	29	5.60448	5.44	5.77	0.088825
		f	17	5.60176	5.39	5.78	0.124862
	M. csorbai	m	2	5.04000	4.89	5.19	0.212132
		f	8	5.25000	5.08	5.40	0.117716
C-P4 alveolar length	*M. longipes*	m	29	2.09966	1.95	2.26	0.060148
		f	17	2.10882	1.97	2.24	0.076066
	M. csorbai	m	2	1.94000	1.93	1.95	0.014142
		f	8	1.96750	1.89	2.04	0.061586
P2-P3 alveolar length	*M. longipes*	m	29	0.70138	0.62	0.79	0.043484
		f	17	0.71647	0.63	0.83	0.056451
	M. csorbai	m	2	0.65000	0.62	0.68	0.042426
		f	8	0.67250	0.64	0.73	0.034538
P4-M3 alveolar length	*M. longipes*	m	29	4.20483	4.00	4.34	0.086173
		f	17	4.21000	4.07	4.33	0.071502
	M. csorbai	m	2	3.78500	3.70	3.87	0.120208
		f	8	3.90750	3.80	4.07	0.095581
M1-M3 alveolar length	*M. longipes*	m	29	3.40862	3.21	3.54	0.079450
		f	17	3.41824	3.23	3.56	0.070377

Table 3 continued

	M. csorbai	m	2	3.06500	2.99	3.14	0.106066
		f	8	3.22250	3.13	3.31	0.061354
C alveolus length	*M. longipes*	m	29	0.55241	0.45	0.65	0.045877
		f	17	0.57765	0.50	0.66	0.043521
	M. csorbai	m	2	0.50000	0.47	0.53	0.042426
		f	8	0.52250	0.45	0.64	0.069847
P2 alveolus length	*M. longipes*	m	29	0.37276	0.31	0.42	0.032612
		f	17	0.39059	0.33	0.43	0.025365
	M. csorbai	m	2	0.33500	0.31	0.36	0.035355
		f	8	0.35250	0.30	0.38	0.027646
P3 alveolus length	*M. longipes*	m	29	0.27690	0.22	0.34	0.025788
		f	17	0.28824	0.22	0.34	0.036612
	M. csorbai	m	2	0.26000	0.26	0.26	0.000000
		f	8	0.25500	0.21	0.28	0.022039
P4 alveolar length	*M. longipes*	m	29	0.66759	0.59	0.72	0.031013
		f	17	0.67529	0.61	0.76	0.036592
	M. csorbai	m	2	0.59500	0.58	0.61	0.021213
		f	8	0.60625	0.53	0.70	0.057802
C crown width	*M. longipes*	m	33	0.54939	0.51	0.59	0.019516
		f	19	0.55263	0.53	0.59	0.017589
	M. csorbai	m	2	0.51500	0.51	0.52	0.007071
		f	8	0.50875	0.48	0.54	0.018077
P2 crown width	*M. longipes*	m	33	0.45030	0.41	0.50	0.017045
		f	19	0.44684	0.41	0.48	0.018872
	M. csorbai	m	2	0.41500	0.41	0.42	0.007071
		f	8	0.42875	0.40	0.46	0.021671
P3 crown width	*M. longipes*	m	33	0.32848	0.26	0.38	0.028736
		f	19	0.31526	0.22	0.42	0.042605
	M. csorbai	m	2	0.32000	0.30	0.34	0.028284
		f	8	0.33000	0.25	0.38	0.041404
P4 crown width	*M. longipes*	m	33	0.55576	0.51	0.61	0.026579
		f	19	0.55474	0.51	0.60	0.023657
	M. csorbai	m	2	0.52500	0.52	0.53	0.007071
		f	8	0.53375	0.50	0.57	0.021998
M1 talonid width	*M. longipes*	m	33	0.84091	0.77	0.92	0.038435
		f	19	0.83105	0.79	0.87	0.020520

Table 3 continued

	M. csorbai	m	2	0.76500	0.73	0.80	0.049497
		f	8	0.78625	0.73	0.85	0.041036
M2 talonid width	*M. longipes*	m	33	0.84394	0.78	0.92	0.032301
		f	19	0.84158	0.80	0.89	0.023396
	M. csorbai	m	2	0.76000	0.73	0.79	0.042426
		f	8	0.78500	0.77	0.80	0.011952
M3 trigonid width	*M. longipes*	m	33	0.75485	0.71	0.85	0.031337
		f	19	0.75947	0.71	0.81	0.021978
	M. csorbai	m	2	0.67000	0.65	0.69	0.028284
		f	8	0.70750	0.67	0.75	0.027646
M3 talonid width	*M. longipes*	m	33	0.62000	0.57	0.67	0.021794
		f	19	0.61789	0.57	0.66	0.023233
	M. csorbai	m	2	0.53500	0.53	0.54	0.007071
		f	8	0.58500	0.56	0.61	0.016036
Mandibular body height under M1	*M. longipes*	m	33	1.29913	1.08	1.45	0.082015
		f	12	1.34250	1.20	1.49	0.093917
	M. csorbai	m	2	1.10500	1.07	1.14	0.049497
		f	8	1.17375	1.00	1.31	0.100276
Mandibular body height behind M3	*M. longipes*	m	33	1.31667	1.18	1.40	0.049223
		f	19	1.32000	1.25	1.38	0.037712
	M. csorbai	m	2	1.24500	1.24	1.25	0.007071
		f	8	1.18875	1.13	1.28	0.049407
Processus coronoideus height (from lower sinus of mandibular body to top of process)	*M. longipes*	m	33	2.72182	2.57	2.86	0.076504
		f	19	2.74632	2.58	2.89	0.092749
		f	8	2.50625	2.34	2.68	0.109144
Symphysis length	*M. longipes*	m	33	2.07217	1.89	2.24	0.097045
		f	11	2.14091	1.98	2.26	0.086540
	M. csorbai	m	2	1.81000	1.73	1.89	0.113137
		f	8	1.88500	1.70	2.03	0.101559
Processus articularis width	*M. longipes*	m	33	1.24545	1.02	1.43	0.075667
		f	19	1.28105	1.06	1.45	0.082455
	M. csorbai	m	2	1.11500	1.11	1.12	0.007071
		f	8	1.16750	1.11	1.22	0.037321

peared in the Kolmogorov-Smirnov test as highly significant ($p < 0.001$) in 34 and significant ($p < 0.005$) in five out of 50 cranial characters. However, the following measurements did not differ significantly: shortest distance between C–P^4, C basal length, P^2 basal length, P^4 basal length, M^3 antero-posterior length, P^2 crown width, P^4 crown width, tympanic bulla opening height, upper C alveolus length, P^2 alveolus length, P^4 outer alveolar length. The t-test at 0.001 alpha level gave significant differences also in means of lachrymal bridge width, width between cochleae, C basal length, M^3 antero-posterior length and P^4 outer alveolar length.

In the Kolmogorov-Smirnov test, 11 out of 35 mandibular characters did not differ significantly: distance between C–P_4, P_2 basal length, P_3 basal length, M_1 antero-posterior length, P_2–P_3 alveolar length, lower C alveolus length, P_2 alveolus length, P_3 alveolus length, P_2 crown width, P_3 crown width and P_4 crown width. Besides these, in the t-test P_4 basal length and M_1 talonid width did not differ significantly, however, at the 0.001 alpha level the test produced significant difference also in P_2 crown width.

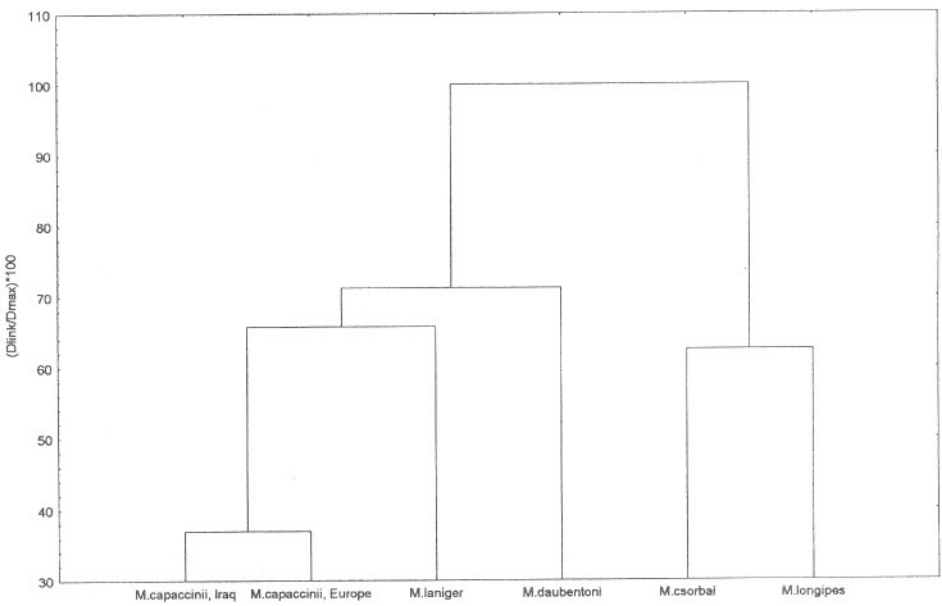

Fig. 3. Dendrogram by the unweighted pair-group average method, Eucledian distances of group centroids after discriminant analysis, standard method and canonical analysis, roots 1–5 of 13 cranial measurements (normally distributed in *M. csorbai* sp. n. as shown by Shapiro-Wilk test) of *Myotis csorbai* sp. n., Nepal; *M. longipes*, Kashmir–Afghanistan; *M. laniger*, Vietnam–India (Meghalaya)–China; *M. daubentoni*, Europe; *M. capaccinii*, Europe; *M. capaccinii*, Iraq

Comparison of M. csorbai *sp. n. and* M. daubentoni

As regards the cranial characters, the Kolmogorov-Smirnov test showed highly significant ($p < 0.001$) differences in 34 out of 49 measurements (i.e. in total skull length, condylobasal length, basal length, inner distance of M^2–M^2, outer distance of C–C crowns, outer alveolar distance of C–C, outer distance of M^3–M^3 crowns, outer alveoli of M^3–M^3, zygomatic width, braincase width, mastoid width, interorbital constriction, lachrymal bridge width, lachrymal width, nasal notch width, nasal notch length, anterior palatal emargination width, anterior palatal emargination length, palatal width behind toothrows, width between cochleae, braincase height, C–M^3 crown length, shortest distance between C and P^4, M^1–M^3 crown length, P^2 basal length, M^1 antero-posterior length, M^3 antero-posterior length, C crown width, P^2 crown width, M^1 mesostylar width, tympanic bulla opening height, C–M^3 alveolar length, C–P^4 alveolar length, and maxillary height at M^2). Significant difference ($p < 0.005$) was observed in palato-maxillary length and P^2 alveolus length. Besides, the t-test showed significance at 0.001 alpha level in 36 measurements (in almost all – except palato-maxillary length – of the above measurements as in Kolmogorov-Smirnov test, further in C–P^4 crown length). In most of the above characters except lachrymal bridge width, the means of *M. daubentoni* were greater, with high significance ($p < 0.001$), furthermore, in P^4 basal length and P^4 crown width where *M. csorbai* sp. n. had (however, not significantly) the greater means. Other cranial characters with no significantly different means were: palatal length, palato-maxillary length, P^4–M^3 crown length, C basal length, M^2 antero-posterior length, M^2 mesostylar width, M^3 crown width, P^4–M^3 alveolar length, M^1–M^3 alveolar length, C alveolus length and P^4 outer alveolar length.

In the Kolmogorov-Smirnov test high significance ($p < 0.001$) was shown for differences between Nepalese *M. csorbai* sp. n. and the European *M. daubentoni* in 11 mandibular characters: mandibular length, C–M_3 length, C crown width, M_1 talonid width, M_2 talonid width, M_3 trigonid width, M_3 talonid width, mandibular body height under M_1, mandibular body height behind M_3, height of coronoid process and symphysis length, and good significant differences ($p < 0.005$) in further four. According to the t-test at alpha level 0.001, means of other five characters (C–P_4 length, M_1–M_3 length, M_1 antero-posterior length, C–M_3 alveolar length, P_3 width,) were significantly different too. In almost all of these variables, *M. daubentoni* was greater than the Nepalese form. In P_4 basal length ($p < 0.005$), then in M_1 antero-posterior length, M_2 antero-posterior length, and P_4 alveolar length, however, the new species had greater values.

Comparisons of M. csorbai *sp. n. and* M. laniger

Based on the results of the Kolmogorov-Smirnov test, the two samples differed with high significance ($p < 0.001$) in 18 of 49 characters: total skull length, condylobasal length, inner distance of M^2–M^2, outer distance C–C crowns, outer alveolar distance of C–C, outer alveoli of M^3–M^3, braincase width, mastoid width, nasal notch width, nasal notch length, braincase height, C–M^3 crown length, C–P^4 crown length, shortest distance between C and P^4, C basal length, P^2 basal length, C–M^3 alveolar length and P^2 alveolus length, rather significantly ($p < 0.005$) in 13 cranial characters (basal length, palatal length, palato-maxillary length, zygomatic width, interorbital constriction, lachrymal width, palatal width behind toothrows, M^1–M^3 crown length, M^1 antero-posterior length, P^2 crown width, M^1 mesostylar width, C–P^4 alveolar length and maxillary height at M^2). Besides the above listed, the t-test at 0.001 alpha level showed also significant difference for outer distance of M^3–M^3 crowns, anterior palatal emargination width and anterior palatal emargination length, however, not so for M^1–M^3 crown length and M^1 antero-posterior length. In almost all of these measurements the species *M. laniger* was somewhat larger than the new *M. csorbai* sp. n. The latter had greater means in lachrymal bridge width, width between cochleae, P^4 basal length and P^4 crown width, however, not significantly. In P^4 outer alveolar length the means of the two species agreed up to two decimals. Unfortunately, both samples were limited in size, thus the results of the t-test were less conclusive.

In mandibular characters the Kolmogorov-Smirnov test resulted in highly significant differences ($p < 0.001$) in 7 characters (mandibular length, C–M_3 length, C–P_4 length, C–M_3 alveolar length, C–P_4 alveolar length, P_2–P_3 alveolar length and P_3 alveolus length). There were significant differences ($p < 0.005$) in further ten characters (distance between C–P_4, P_4–M_3 length, C basal length, P_2 basal length, P_3 basal length, P_2 crown width, P_3 crown width, mandibular body height behind M_3, processus coronoideus height and processus articularis width). According to the t-test at 0.001 alpha level, almost all the above listed characters were also significantly different (except C basal length), here the P_4–M_3 alveolar length and symphysis length were added. In all mandibular measurements studied, *M. laniger* had the greater means.

Comparison of M. csorbai *sp. n. and of* M. capaccinii

As a result of the Kolmogorov-Smirnov test and t-test at 0.001 alpha level, there were highly significant differences in the means of almost all cranial characters. However, the P^4 basal length, P^4 crown width and P^4 outer alveolar length – according to the Kolmogorov-Smirnov test – did not differ significantly, but in the t-test the P^4 outer alveolar length was also significantly different. In lachrymal bridge width the sample of Nepalese *M. csorbai* sp. n. had significantly greater values, *M. capaccinii* evidently so in the other measurements.

As regards the mandibular characters, all measurements were found with significantly different means in the Kolmogorov-Smirnov test and the t-test combined. The means of *M. capaccinii* had the greater values.

Comparison of M. longipes *and* M. daubentoni

The Kolmogorov-Smirnov test comparing Kashmiri and Afghan population of *M. longipes* and *M. daubentoni* resulted in highly significant differences in means ($p < 0.001$) in 33 out of 49 cranial characters (total skull length, palatal length$^+$, palato-maxillary length$^+$, inner distance of M^2–M^2, zygomatic width, braincase width, mastoid width, interorbital constriction, lachrymal bridge width$^+$, nasal notch length, anterior palatal ematgination width, anterior palatal ematgination length, palatal width between toothrows, width between cochleae, C–M^3 crown length$^+$, shortest distance between C and P^4, M^1–M^3 crown length$^+$, P^4–M^3 crown length$^+$, P^2 basal length, P^4 basal length$^+$, M^2 antero-posterior length$^+$, P^2 crown width, M^1 mesostylar width$^+$, M^2 mesostylar width$^+$, M^3 crown width$^+$, tympanic bulla opening height, C–M^3 alveolar length$^+$, P^4–M^3 alveolar length$^+$, M^1–M^3 alveolar length$^+$, P^2 alveolus length, P^4 outer alveolar length$^+$ and maxillary height at M^2, or good difference of means ($p < 0.005$) in lachrymal width$^+$). In 16 characters (marked with $^+$) the species *M. longipes* was large, whereas in other 17 measurements *M. daubentoni* had significantly greater means. There were no significant differences in other 13 measurements (the markings as above: condylobasal length, basal length$^+$, outer distance of C–C crowns, outer alveolar distance of C–C, outer distance of M^3–M^3 crowns, outer alveoli of M^3–M^3, nasal notch width, braincase height$^+$, C–P^4 crown length$^+$, C basal length$^+$, M^1 antero-posterior length$^+$, M^3 antero-posterior length and P^4 crown width$^+$). The means in C crown width, C–P^4 alveolar length and C alveolus length means were equal in the two species up to two decimals. The t-test at 0.001 alpha level resulted in exactly the same results.

The Kolmogorov-Smirnov test and the t-test showed highly significant ($p < 0.001$) differences between means of *M. longipes*, and *M. daubentoni* in the following mandibular characters: mandibular length, C–M_3 length, P_4–M_3 length, M_1–M_3 length, P_4 basal length, M_1 antero-posterior length, M_2 antero-posterior length, M_3 antero-posterior length, C–M_3 alveolar length, C–P_4 alveolar length, P_4–M_3 alveolar length, M_1–M_3 alveolar length, P_4 alveolar length, lower C crown width^, P_2 crown width (but in t-test), P_3 crown width^, processus coronoideus height^, symphysis length^, or good ($p < 0.005$) differences for M_3 talonid width^ and P_2 crown width^. There were no significant differences (the two species were least different) in C–P_4 length, P_2 basal length, P_3 basal length^, P_2–P_3 alveolar length^, C alveolus length, P_2 alveolus length, P_3 alveolus length, P_4 crown width, M_1 talonid width^, M_2 talonid width, M_3 trigonid width^, mandibular body height under M_1^, mandibular body height behind M_3^ and in processus

articularis width. *M. daubentoni* was somewhat smaller with overlaps in the majority of cases (practically in the longitudinal measurements), but in characters marked with ^ it was more or less greater (in the width measurements and strengths of mandible).

Comparison of M. longipes *and* M. laniger

Among the 49 cranial characters 7 were highly significantly different in means between the two samples ($p < 0.001$) (lachrymal bridge width, C–P^4 crown length^, shortest distance between C and P^4^, P^2 basal length^, M^3 crown width, C–P^4 alveolar length^ and P^2 alveolus length^), or rather ($p < 0.005$) significantly different means in 11 characters (total skull length^, inner distance of M^2–M^2^, anterior palatal emargination width^, C–M^3 crown length^, M^1–M^3 crown length, P^4 basal length, M^2 antero-posterior length, P^2 crown width^, M^2 mesostylar width, C–M^3 alveolar length^ and C alveolus length^). Measurements proved to be also significantly different in the t-test at 0.001 alpha level in condylobasal length^, outer distance of C–C crowns^, width between cochleae, C basal length^ P^4 crown width. In characters marked with ^ the species *M. laniger* had

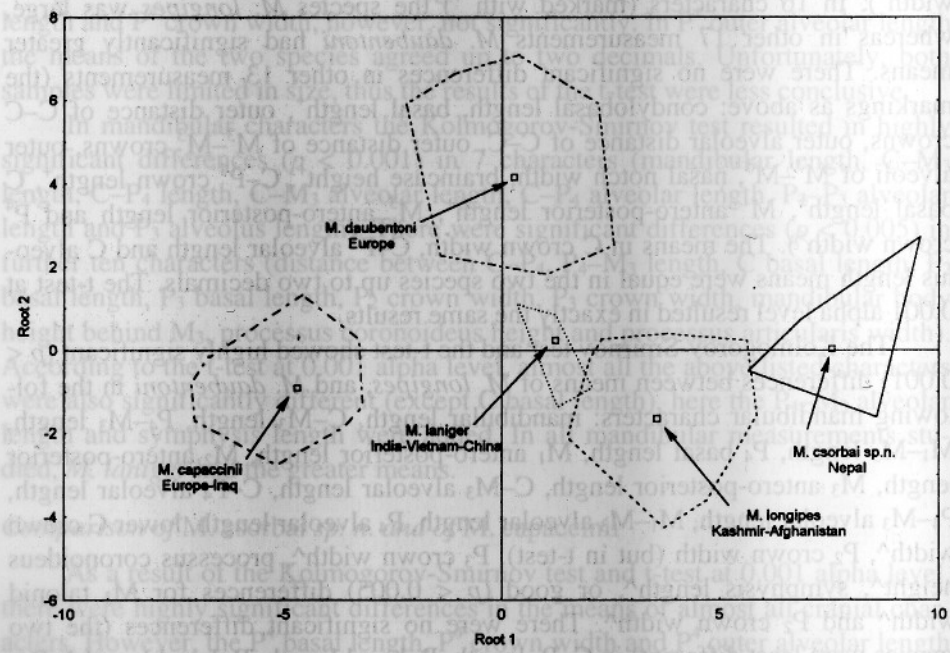

Fig. 4. Root 1 vs root 2, scatterplot with group centroids (arrows) after discriminant analysis, standard method and canonical analysis from 11 cranial and mandibular measurements (normally distributed in *M. longipes* as shown by Shapiro-Wilk test) of *Myotis csorbai* sp. n., Nepal; *M. longipes*, Kashmir–Afghanistan; *M. laniger*, Vietnam–India (Meghalaya)–China; *M. daubentoni*, Europe; *M. capaccinii*, Europe, Iraq

significantly greater means. Whereas in lachrymal bridge width, width between cochleae, M^1–M^3 crown length, P^4 basal length, M^2 antero-posterior length, M^2 mesostylar width and M^3 width *M. longipes* was significantly greater, as shown above. There were no significant differences in other 22 characters (9 of them was greater in *M. longipes*), and in two (C crown width and M3 antero-posterior length) the means agreed up to two decimals.

As regards the mandibular characters, in 9 out of 35 highly significant differences were found in the Kolmogorov-Smirnov test ($p < 0.001$), all in favour of *M. laniger* (C–M_3 length, C–P_4 length, P_2 basal length, P_3 basal length, C–M_3 alveolar length, C–P_4 alveolar length, P_2–P_3 alveolar length, P_3 alveolus length and P_3 crown width). Moderate significance ($p < 0.005$) was found for two: distance between C–P_4 and P_2 crown width. The t-test at 0.001 alpha level also showed all of the above listed characters as significantly different, so the results of the two tests were practically equal. Regarding the means of mandibular characters of the two species, *laniger* had greater ones in 20 (out of these 11 were significantly different). Means of 9 measurements were greater in *longipes* than in *laniger* (but not significantly so). Means of 6 characters were equal (up to two decimals). To sum up, the species *M. longipes* seemed to have shorter anterior portion of the lower dentition, and its one rooted premolars were also narrower, than in *M. laniger*. The length of mandible, the P_4–M_3 row and the mandibular characters defining its strength did not differ significantly from those of *M. laniger,* however, they did so in the comparison of *M. csorbai* sp. n. and *M. laniger*.

Comparison of Kashmiri and Afghan M. longipes *and* M. capaccinii

It was seen that there were highly ($p < 0.001$) significant differences between the two species in 41 out of 49 cranial characters using the Kolmogorov-Smirnov test (the t-test gave exactly the same results). Besides, the means of *M. capaccinii* had the greater values except the lachrymal bridge width where the mean value of *M. longipes* significantly was greater. Although not significantly, also in M^1 antero-posterior length, M^1–M^3 alveolar length and P^4 outer alveolar length *M. longipes* had greater means. Other characters where no significant differences were found are the following: M^1–M^3 row length, P^4 basal length, M^2 antero-posterior length, M^3 crown width and P^4–M^3 alveolar length.

There were found highly significant differences ($p < 0.001$) in almost all (32) of the 35 mandibular characters, furthermore, significant difference ($p < 0.005$) in M_2 talonid width by the Kolmogorov-Smirnov test. There were no significant differences in M_1 talonid width and processus articularis width by the same test. The t-test at 0.001 alpha level gave similar result with the exception that the means of M_1 talonid width also significantly differed in the two species. The species *M. capaccinii* had generally much greater measurements and means than *M. longipes* did.

Comparison of M. daubentoni *and* M. laniger

There are old controversies regarding the conspecifity of this two species (ELLERMANN & MORRISON-SCOTT op. cit., CORBET op. cit., CORBET & HILL op. cit.). A highly significant difference ($p < 0.001$) between the means of cranial characters of the two species was shown by the Kolmogorov-Smirnov test in braincase width, interorbital constriction, lachrymal bridge width^, width between cochleae, C–M^3 row length^, C basal length^, C–M^3 alveolar length^ and C–P^4 alveolar length^ and good significant difference ($p < 0.005$) in palatal length^, palato-maxillary length^, mastoid width, C–P^4 crown length^ and tympanic bulla opening height. The t-test at 0.001 alpha level showed significant differences also in shortest distance between C–P^4^, P^2 basal length^, P^4–M^3 alveolar length^, upper C alveolus length^, P^2 alveolus length^ and maxillary height at M^2. The characters marked with ^ had greater values in means of *M. laniger*, while in the other measurements *M. daubentoni* was significantly greater.

A highly significant difference ($p < 0.001$) between the means of mandibular characters of the two species was shown by the Kolmogorov-Smirnov test in 12 out of 35 mandibular characters (C–M_3 length, C–P_4 length, distance between C–P_4, P_2 basal length, P_3 basal length, P_4 basal length, C–M_3 alveolar length, C–P_4 alveolar length, P_2–P_3 alveolar length, P_3 crown width and processus coronoideus height). Rather good significance ($p < 0.005$) was found in P_4–M_3 length, P_4–M_3 alveolar length and C crown width. In the t-test other significant differences were shown in mandibular length, M_1 antero-posterior length, M_2 antero-posterior length, however not for C crown width. Almost all significantly different characters – except C crown width and processus coronoideus height – had greater means in *M. laniger*. Of the other measurements without significantly differing means the following averaged larger in *M. laniger*: M_1–M_3 length, C basal length, M_3 antero-posterior length, M_1–M_3 alveolar length, C alveolus length, P_2 alveolus length, P_4 alveolar length and processus articularis width, while the others: M_1 talonid width, M_2 talonid width, M_3 trigonid width, M_3 talonid width, mandibular body height under M_1, mandibular body height behind M_3 and symphysis length were greater in *M. daubentoni*.

Comparison of M. daubentoni *and* M. capaccinii

The statistical analysis of these two well-known European species by the Kolmogorov-Smirnov test (and exactly the same in t-test) brought also some results which were useful in the present series of statistical work. In most of the cranial characters (in 43 out of 49) the species *M. daubentoni* had significantly ($p < 0.001$) smaller means, although in the case of interorbital constriction the mean was significantly greater in *M. daubentoni* than in *M. capaccinii*. Among the characters with no significant differences: nasal notch length, anterior palatal

emargination length, width between cochleae, M^1 antero-posterior length and maxillary height at M^2, but the last one was slightly stronger in *M. daubentoni*.

As regards the mandibular characters, the Kolmogorov-Smirnov test showed high significance ($p < 0.001$) in 26 and moderate significance ($p < 0.005$) in one (C crown width) out of the 35 characters, all in favour of *M. capaccinii*. Besides these, according to the t-test at 0.001 alpha level, mandibular body height behind M_3 was also significantly greater in *M. capaccinii* than in *M. daubentoni*. Among the characters with no significant differences: M_1 talonid width, M_2 talonid width, M_3 trigonid width, M_3 talonid width, processus coronoideus height, symphysis length and processus articularis width, but the symhysis length seemed to be stronger in *M. daubentoni* in the present study material.

Comparison of M. laniger *and* M. capaccinii

The present studies made it clear that there are clear differences between these two species. Out of 49 cranial characters, in 30 there were found highly significant ($p < 0.001$) differences in means by the Kolmogorov-Smirnov test. (*M. capaccinii* was significantly greater in: total skull length, condylobasal length, basal length, outer distance of C–C crowns, outer alveolar distance of C–C, outer distance of M^3–M^3 crowns, outer alveoli of M^3–M^3, zygomatic width, braincase width, mastoid width, interorbital constriction, palatal width behind toothrows, width between cochleae, braincase height, C–M^3 crown length, M^1–M^3 crown length, P^4–M^3 crown length, C basal length, M^3 antero-posterior length, M^1 mesostylar width, M^2 mesostylar width and M^3 crown width.) Moderately significant difference ($p < 0.005$) was found in further three characters: C–P^4 crown length, P^4 basal length and P^4 crown width. The t-test at 0.001 alpha level showed all the same measurements, and in addition palatal length, inner distance of M^2–M^2, lachrymal width, nasal notch length, M^2 antero-posterior length, C–P^4 alveolar length and P^4 outer alveolar length as significantly different too. All the measuremens with significantly different means were greater in *M. capaccinii*. The means of lachrymal bridge width and shortest distance between C and P^4 were larger (not significantly) in *M. laniger*. Finally, the means of nasal notch width agreed up to two decimals in the two species.

Of the 35 mandibular characters the means of 10 had highly significant differences ($p < 0.001$) in favour of *M. capaccinii* (mandibular length, C–M_3 length, P_4–M_3 length, M_1–M_3 length, M_2 antero-posterior length, M_3 antero-posterior length, C–M_3 alveolar length, P_4–M_3 alveolar length, C alveolus length and C crown width). Six measurements had moderate significant differences ($p < 0.005$) (P_4 basal length, M_1 antero-posterior length, M_1–M_3 alveolar length, M_3 talonid width, mandibular body height behind M_3 and processus coronoideus height). The t-test at 0.001 alpha level – besides the characters listed above – also gave significant differences for means of C basal length, M_1–M_3 alveolar length,

P_3 alveolus length, P_4 alveolar length, C crown width, P_4 crown width and mandibular body height under M_1. The reason for the rather different results of the Kolmogorov-Smirnov test and that of t-test was probably because of the comparatively small sample size of *M. laniger*. The majority of the means were greater in *M. capaccinii*, however, greater in *M. laniger* in P_2 basal length and processus articularis width. The means were more or less equal (up to two decimals) in shortest distance of C and P_4, as well as of P_3 crown width of the two species.

Comparison of European and Iraqi samples of M. capaccinii

To help clarify the relation of the European (*M. c. capaccinii*) and the West Asian (*M. c. bureschi*) populations, it was possible to compare a rather good South European and a medium-sized Iraqi sample. Strong significant differences ($p < 0.001$) and significant differences ($p < 0.005$) appeared in nine, and two cranial characters, respectively (palato-maxillary length>, inner distance of M^2–M^2>, zygomatic width>, braincase width>, mastoid width>, lachrymal width>, anterior palatal emargination width, width between cochleae>, shortest distance between C–P^4>, M^3 antero-posterior length>, P^4 crown width and M^1 mesostylar width), of the studied 35. Moreover, the t-test at alpha level 0.001 showed four more: the total skull length>, condylobasal length> and outer distance of C–C crowns and P^4 outer alveolar length to be significantly different.

Of the 35 mandibular characters only two (mandibular length, and processus coronoideus height) had highly significant ($p < 0.001$) differences, in addition one (P_2 basal length) had a moderate ($p < 0.005$) difference as based on the Kolmogorov-Smirnov test. The t-test also showed the same (with the exception of P_2 basal length) and also M_1 antero-posterior length, M_2 antero-posterior length and symphysis length as significantly different. The European *M. capaccinii* had greater means in 16 characters, reversely, the Iraqi sample was greater in 15 (M_1–M_3 length, P_2 basal length, P_4 basal length, M_1 antero-posterior length, M_2 antero-posterior length, C–M_3 alveolar length, P_4–M_3 alveolar length, M_1–M_3 alveolar length, P_2 alveolus length, P_3 alveolus length, P_4 alveolar length, P_2 crown width, P_3 crown width, M_1 talonid width and M_2 talonid width). In three measurements (P_4–M_3 length, P_3 basal length and C crown width) the means equalled up to two decimals in the two samples.

DISCUSSION

There were found to be significant differences in the means of the external measurements of the Kashmiri sample of *M. longipes* and the sample of *M. csorbai* sp. n. from Nepal.

According to the present analyses of *M. longipes* from Kashmir and Afghanistan, there were no significant differences between the sexes in any cranial characters. In mandibular characters, however, the females had significantly greater values in some measurements.

The present sample of *M. csorbai* sp. n. from Nepal was generally smaller than *M. longipes* (sexes combined) from Kashmir and Afghanistan. The two species differed evidently and significantly in almost all longitudinal cranial characters and length of the mandible, as well as in the width measurements of the rostrum and the skull, respectively. They also differed significantly in most of the upper and lower toothrow lengths, upper and lower C crown widths, width of upper molars, talonid width of the lower molars, the braincase height, strength of maxilla, and all the mandibular features expressing the strength of mandible. All in all, there were found differences especially in the ratios of various parts of dentition and some parts of the skull combined with the overall size of each species. The smaller, however not significantly smaller, measurements could mean relatively greater values in the smaller animal, in *M. csorbai* sp. n.

When the species *M. longipes* and *M. daubentoni* were compared, the former had greater values in numerous characters, while in others *M. daubentoni* showed significantly greater values, thus the ratios of characters differed considerably. Anyhow, the European species seemed to be rather distantly related to the other one.

The measurements of *M. csorbai* sp. n. were significantly shorter than those of *M. daubentoni*, with shorter toothrow, mostly because of the small size of the upper one-rooted premolars, narrower crowns, smaller rostral width and braincase width, less inflated bulla and lowered maxillary height. However, it had significantly higher values in the lachrymal bridge width, lower fourth premolar and the first molar length, and relatively greater large upper premolar as compared to the species *M. daubentoni*. The European species was stronger in the length of mandible, also in the width of canine, the talonid width of molars, and the mandibular body strength, including the processus coronoideus height and symphysis length.

As compared with *M. laniger*, a similar-sized species, *M. longipes* had a weaker anterior portion of the dentition. From the P^4 on, however, through the strength of the molars in the posterior portion of the toothrow, *M. longipes* appeared significantly longer and stronger, with wider teeth. *M. longipes* also had a significantly wider anteorbital (lachrymal) bridge.

The species *Myotis laniger* was significantly greater than *M. csorbai* sp. n. in all of the important longitudinal characters, including the toothrows. It had greater width measurements of rostrum and stronger mandible, and especially greater one-rooted premolars.

In some earlier authors' views (e.g. TATE op. cit., ELLERMAN & MORRISON-SCOTT op. cit.) the species *M. longipes* was placed with *M. capaccinii*. Later it was considered a distinct species (HANAK & GAISLER 1969, CORBET op. cit., CORBET & HILL op. cit.). While the sample of *M. longipes* was significantly smaller in most of the cranial characters, it differed from *M. capaccinii* in some respects. Regarding the mandibular characters *M. longipes* had strongly different means as compared with those of *M. capaccinii*. These results certainly expressed differences in ratios when the generally larger species (*M. capaccinii*) was compared to a small one (*M. longipes*). The smaller, however, not significantly smaller, measurements meant also relatively greater measurements in the smaller species, in this case in *M. longipes*. The phenetic distance of the two species (*M. longipes* and *M. capaccinii*) seemed to be greater than that of *M. longipes* either to *M. laniger* or to *M. daubentoni*.

The Nepalese *M. csorbai* sp. n. had strongly different measurements as compared with those of the much larger *M. capaccinii*. The large upper premolar appeared relatively larger, and the lachrymal bridge absolutely wider, however, in the new species.

In most of the cranial and mandibular characters the species *M. daubentoni* had significantly smaller means, although in the case of the interorbital constriction, the mean was significantly greater in *M. daubentoni* than in *M. capaccinii*. Among the characters with no significant differences the maxillary height and the symhysis length seemed to be stronger in *M. daubentoni*.

The rather long-lasting controversies regarding the conspecifity of *M. daubentoni* and *M. laniger* and the systematic position of the latter are still not over (CORBET and HILL op. cit.). The present analyses showed *M. laniger* to be farther from *M. daubentoni* than from *M. capaccinii*. Its distance to the latter, however, is also large enough to regard it as a separate member of the subgenus *Leuconoe* at species level.

The present studies have made it clear that there are clear differences between *M. laniger* and *M. capaccinii*, as most of the cranial and mandibular characters are different in the two species. *M. capaccinii* was significantly greater in all longitudinal measurements of the skull and the mandible including most of the toothrow lengths and individual teeth, nasal notch length, the posterior width measurements of rostrum and the width characters of the skull and braincase, braincase height, strength of the mandibular body and processus coronoideus height, the width of the upper great premolar and molars, lengths and width of the lower great premolar, length of lower molars and talonid width of lower M_3. Only one of the cranial characters P^4 outer alveolar length, was significantly greater in *M. laniger*.

For the study the relation of the European and the West Asian populations of *M. capaccinii* of which the only available name is probably *M. capaccinii bu-*

reschi (HEINRICH, 1936)(see HARRISON 1964, KOOPMAN op. cit.), it was possible to compare a rather good South European and a medium-sized Iraqi sample. Significant differences have found in 15 cranial and 6 mandibular characters.

* * *

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