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Intraspecific and interpopulation morphologic variation in the sharp-eared bat, *Myotis blythii* (Tomes, 1857) (Chiroptera: Vespertilionidae), from Greece

by

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Introduction

The sharp-eared bat *Myotis blythii* (Tomes, 1857) is represented in Greece by two subspecies, namely *M. b. oxygnathus* (Monticelli, 1885) on the Greek mainland and *M. b. omari* Thomas, 1906 which in Greece has a confirmed distribution only on the island of Crete (Iliopoulou-Georgudaki, 1979).

The specimens of the first subspecies are smaller and dark colored whereas those of the second are larger and pale.

The purpose of this work is to examine the intraspecific and interpopulation morphologic variation of the species in the Greek area of its range, as well as to study the population on the island of Lesvos.

Several investigators (Bate 1905, Miller 1912, Pohle 1953, Lanza 1957, Kahmann 1959, Niethammer 1962, V. van Laar & Daan 1964) have reported a number of specimens of the species from Greece as *Myotis oxygnathus*, without any detailed study. Strelkov (1972), based on bibliography, has supposed that the population of *M. blythii* on Crete must be assigned subspecifically to *omari*, together with the populations of the Greek islands in the east Aegean. Pieper (1977) recorded one *M. blythii* which he had collected from owl-pellets in Crete. Iliopoulou-Georgudaki (1979) studied specimens from Crete and confirmed the occurrence of *Myotis blythii omari* in that island. Felten et al. (1977) recorded *M. b. oxygnathus* in continental Greece, but these authors were unable to decide on a subspecific allocation of the insular populations of *M. blythii* from the eastern Mediterranean part of its range.

Material and methods

A total of 225 specimens of *Myotis blythii* from the localities in Greece indicated in Fig. 1 were studied. The number of individuals from different localities are as follows: 1) Macedonia: cave "Saranta Camares", Kilkis (3. 9. 1973) 1 ♀; 2) Sterea Hellas: Mona-

stiracion, Acarnania (3. 6. 1964) 3 ♂, 2 ♀; 3) N. Peloponnesus: cave "Limnon", Achaia (1. 10. 1967) 1 ♂, 1 ♀; same locality (17. 5. 1974) 3 ♂, 24 ♀; 4) S. Peloponnesus: Flomochorion, Laconia (20. 6. 1966) 64 ♀; 5) Lesvos: Mithymna (1. 7. 1965) 27 ♂, 65 ♀; Polychnitos (14. 4. 1980) 1 ♀; 6) Crete: cave "Micro Lavyrinthaki", Eracleion (8. 8. 1973) 15 ♂, 18 ♀. The main part of the material is in the Zoological Museum of the University of Patras, some reference specimens are deposited in the Museum Alexander Koenig, Bonn.

The following body and skull measurements were taken from each specimen: total length (TL), length of tail (T), hind foot length (HF), ear length (E), tragus length (Tr), forearm length (F), greatest length of skull (GLS), condylobasal length (CL), zygomatic breadth (ZB), breadth of braincase (BB), interorbital constriction (InCon), length of upper toothrow (CM^3), length of lower toothrow (CM_3), mandible length (M). All measurements were taken with dial calipers and recorded in millimeters.

Since no external measurements other than forearm length were available for the Cretan specimens, and also since the body measurements of the S. Peloponnesian sample are from specimens preserved in alcohol, forearm length alone among external measurements has been used in the final suite of characters (Table 4).

External observations made by the collector such as sex, date and localitiy of collection were recorded for each specimen.

For the determination of the coloration of the fur the colour table of Zimmermann (1952) was used.

For the comparisons, the specimens from the mainland were grouped into sample categories of North and South Peloponnesus; the small number of individuals from the specific localities in each area were combined within these general groupings.

For the statistical treatment, a univariate analysis of variance (ANOVA) was employed to assess intergroup morphometric divergence on a character-by-character basis, and Student's t-test used for comparing the means between pair of samples. The ANOVA program was also used to calculate standard statistics such as Bartlett's test for homogeneity of variances and comparisons of treatment means. Subsequently the means of the metrical data were subjected to an Unweighted Pair Group Method clustering program (UPGM), using arithmetic averages, and phenograms were constructed based upon both correlation and distance matrices. The data analyzed, representing the means of 9 of the characters in the four geographical regions (the OTUs), are listed in table 4.

Observations

Pelage. The colour of the upper parts is not uniform: it is paler on the head and neck than on the back. This is due to the less extensive dark basal banding of the hairs on the head and neck. The general coloration of the fur provides a remarkable differentiation between the insular specimens (Lesvos) which are paler to fair, and those of continental Greece which are darker with brownish shades. In the Lesvos specimens an olive brown basal band and a dark olive buff upper band are distinguishable on the back, and an olive brown basal and a marguerite yellow upper band on the abdominal region. On the other hand, on the back of the specimens from the mainland a bister colour basal band and an upper band intermediate between buffy brown and verona brown are distin-

Fig. 1. Map of Greece showing the localities of the specimens of *Myotis blythii* studied in this paper. — 1, cave "Limnon", Achaia; 2, Flomochorion, Laconia; 3, cave "Micro Lavyrinthaki", Eracleion; 4, Mithymna; 5, Polychnitos; 6, Monastiracion, Acarnania; 7, cave "Saranta Camares", Kilkis.

Table 1. Measurements of *Myotis blythii* from North and South Peloponnesus.

	North Peloponnesus ♀					South Peloponnesus ♀				
	N	Range	$\bar{x}$	SD	CV	N	Range	$\bar{x}$	SD	CV
TL	19	126.0—138.0	131.10	3.31	2.52	61	119.0—135.0	128.31	3.40	2.65
T	19	56.0— 64.0	60.47	2.34	3.87	61	54.0— 62.0	58.07	2.30	3.96
HF	18	13.0— 15.0	13.86	0.48	3.46	62	11.0— 13.6	12.51	0.57	4.56
E	20	21.0— 25.0	22.20	1.06	4.77	61	20.1— 24.0	22.25	0.82	3.69
TR	20	10.0— 12.0	10.90	0.47	4.31	62	9.2— 12.8	10.93	0.61	5.58
F	21	56.0— 60.7	58.03	1.21	2.09	62	56.5— 61.2	58.81	1.36	2.31
GLS	22	20.5— 22.0	21.07	0.37	1.76	66	20.2— 22.0	21.11	0.43	2.04
CL	21	19.6— 21.0	20.16	0.38	1.88	65	19.5— 21.3	20.26	0.40	1.97
ZB	18	13.2— 14.1	13.64	0.22	1.61	36	13.1— 14.1	13.65	0.26	1.90
BB	21	9.1— 10.0	9.53	0.24	2.52	64	9.0— 10.0	9.56	0.20	2.09
InCon	25	4.9— 5.5	5.08	0.15	2.95	66	4.7— 5.3	5.04	0.12	2.38
CM^3	24	8.2— 9.0	8.60	0.23	2.67	66	8.2— 9.3	8.62	0.20	2.32
CM_3	23	9.0— 9.7	9.30	0.22	2.37	66	8.8— 9.9	9.33	0.21	2.25
M	23	15.6— 16.8	16.15	0.30	1.86	64	15.2— 17.0	16.24	0.33	2.03
				$\overline{CV}$ =	2.76				$\overline{CV}$ =	2.84

Table 2. Measurements of *Myotis blythii* from Lesvos.

	♀					♂				
	N	Range	$\bar{x}$	SD	CV	N	Range	$\bar{x}$	SD	CV
TL	64	121.0—140.0	129.41	3.76	2.91	27	122.0—138.0	129.00	4.43	3.43
T	64	55.0— 65.0	59.69	2.61	4.37	27	54.0— 65.0	59.22	2.59	4.38
HF	64	12.0— 14.6	13.16	0.61	4.64	27	12.0— 14.6	13.35	0.78	5.79
E	64	20.0— 23.8	21.76	0.90	4.14	27	20.1— 22.8	21.54	0.95	4.42
TR	64	9.3— 12.6	10.55	0.60	5.69	27	9.8— 12.3	10.60	0.61	5.75
F	60	57.0— 64.4	60.10	1.56	2.60	27	55.1— 60.3	57.94	1.43	2.45
GLS	43	20.1— 22.4	21.34	0.47	2.20	21	20.9— 22.6	21.60	0.48	2.22
CL	41	19.5— 21.4	20.58	0.46	2.23	21	19.9— 21.7	20.73	0.47	2.27
ZB	23	12.9— 14.3	13.82	0.39	2.82	14	13.6— 14.4	14.02	0.26	1.85
BB	49	9.0— 10.1	9.59	0.24	2.50	23	9.4— 10.0	9.74	0.18	1.85
InCon	52	4.8— 5.6	5.18	0.19	3.67	24	5.1— 5.7	5.32	0.16	3.00
CM^3	58	8.3— 9.1	8.74	0.21	2.40	26	8.5— 9.3	8.83	0.20	2.26
CM_3	59	9.0— 9.9	9.37	0.19	2.03	23	9.0— 10.0	9.46	0.24	2.54
M	57	15.8— 17.3	15.56	0.32	1.93	23	16.0— 17.6	16.72	0.46	2.75
				$\overline{CV}$ =	3.15				$\overline{CV}$ =	3.21

guishable, whereas in the abdominal region a mummy brown basal band and a light buff coloured upper band are discernible. Unfortunately no skin from Crete was available for a study of coloration.

Dental differentiation. Variability has been noted in the shape of the margin of the crown of the lower premolar, which fluctuated between the two extreme forms A and B, shown in fig. 2. One or other form was present in different pro-

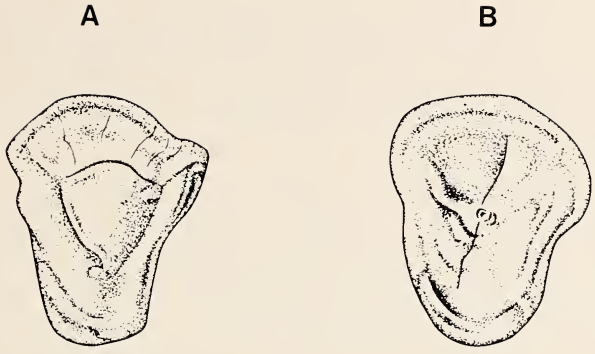

Fig. 2. Extreme variants of the margin of the second lower premolar (PM_2) of *Myotis blythii* in Greece.

portions between the samples: in the male and the female specimens from Lesvos 68 % were similar to the A and 32 % to the B form. A greater proportion of the A form was also noted among the female specimens of the N. Peloponnesus sample where 87.5 % have been identified as to the A form and only 12,5 % as B. On the other hand, the opposite has been noted among the female specimens from the S. Peloponnesus with 27 % placed in the A form and 73 % in B. It must be mentioned that the A form is characteristic of *Myotis myotis* whereas the B form is particularly abundant in *Myotis blythii omari* from Crete with 84.5 % against 15.5 % of the A form.

Sexual variation. A t-test was used to test for significant differences between adults of each sex in the Lesvos and Crete samples (Table 5); in both samples males averaged larger in all variables except forearm length. For the Lesvos sample, F and InCon were significantly different ($P < 0.01$), BB differed at a signifi-

Table 3. Measurements of *Myotis blythii* from Crete.

	♀					♂				
	N	Range	$\bar{x}$	SD	CV	N	Range	$\bar{x}$	SD	CV
F	18	56.0– 62.4	59.17	1.79	3.03	15	54.0– 60.0	56.75	1.47	2.59
GLS	18	21.2– 22.4	21.81	0.33	1.51	14	21.6– 22.7	22.11	0.32	1.45
CL	18	20.4– 21.6	20.95	0.36	1.72	14	20.8– 21.9	21.30	0.37	1.74
ZB	18	13.7– 14.7	14.17	0.23	1.62	13	14.2– 15.0	14.54	0.28	1.93
BB	18	9.4– 10.2	9.73	0.21	2.16	15	9.5– 10.2	9.89	0.22	2.22
InCon	18	4.9– 5.4	5.30	0.15	2.83	15	5.2– 5.5	5.30	0.13	2.45
CM^3	18	8.6– 9.1	8.89	0.24	2.70	15	8.9– 9.5	9.11	0.19	2.09
CM_3	18	9.4– 10.0	9.67	0.17	1.76	15	9.6– 10.2	9.81	0.19	1.94
M	18	16.3– 17.3	16.69	0.28	1.68	15	16.7– 17.5	17.04	0.28	1.64

cance of $P < 0.05$, but in the rest of the variables (GLS, CL, ZB, CM^3, CM_3, M) there was no significant difference. For the Crete sample F, ZB, CM^3, M were significantly different ($P < 0.01$); GLS, CL, BB, CM_3 differed at a level of $P < 0.05$, and only InCon did not differ. That is why the sexes are studied separately in each sample.

Individual variation. According to the CV of which values are given in tables 1, 2 and 3, the lowest degree of variation is displayed by the North Peloponnesus ♀ population on the basis of the BB, and the highest by the Lesvos ♂ population on the basis of the hind foot. Generally, the CV of the body measurements was greater than that of the skull for all the samples, F was the least variable of the body characters. InCon and CM^3 were the most variable skull measurements and GLS and ZB the least variable. The specimens from Crete were the least variable with $\overline{CV} = 2.00$, whereas those from Lesvos were the most variable with $\overline{CV} = 3.21$.

Results

Univariate analysis. Significant geographic variation is shown by each of the 9 characters used (Table 6). Mandible length, condylobasal length, greatest length of skull, length of lower toothrow, zygomatic breadth, and forearm length ex-

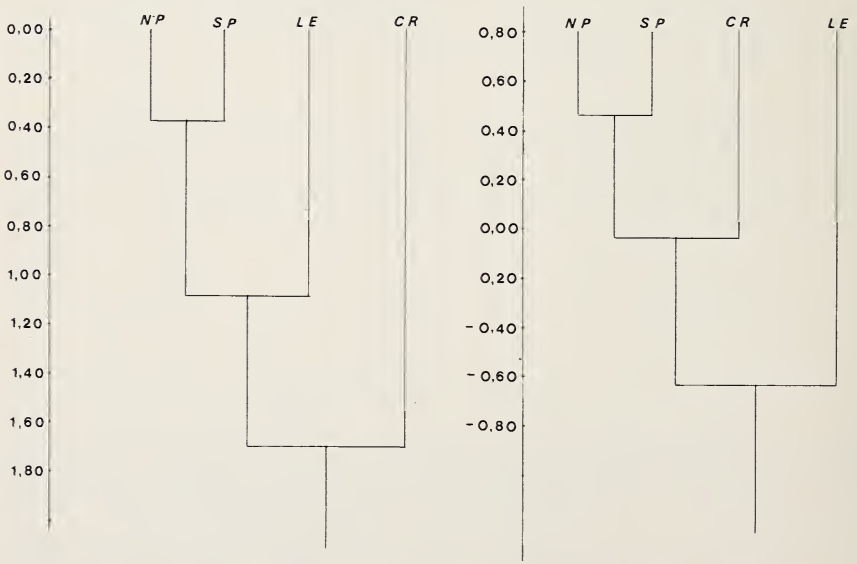

Fig. 3. Phenograms of samples of *Myotis blythii* (taxonomic distance phenogram to the left, and correlation phenogram to the right).

Table 4. Data used in cluster analysis of the populations of *Myotis blythii*; these represent mean values from the female specimens.

Characters	N. Pelop.	S. Pelop.	Lesvos	Crete
F	58.0	58.8	60.1	59.2
GLS	21.1	21.1	21.4	21.8
CL	20.2	20.3	20.6	21.0
ZB	13.6	13.6	13.8	14.2
BB	9.5	9.6	9.6	9.7
InCon	5.1	5.0	5.2	5.3
CM^3	8.6	8.6	8.7	8.9
CM_3	9.3	9.3	9.4	9.7
M	16.2	16.2	15.6	16.7

Table 5. Comparisons of *Myotis blythii* populations by t-test. Significant values at $P < 0.05$ are indicated by an asterisk.

	♀ N.Pelop.– S.Pelop.	♀ N.Pelop.– Lesvos	♀ S.Pelop.– Lesvos	♀ Lesvos– Crete	Lesvos ♂ – ♀	Crete ♂ – ♀
TL	—	1.77	—	—	0.45	—
T	—	1.77	—	—	0.79	—
HF	—	4.49*	—	—	1.25	—
E	—	1.83	—	—	1.05	—
TR	—	2.39*	—	—	0.36	—
F	2.33*	5.52*	4.87*	2.16*	6.18*	4.19*
GLS	0.39	2.61*	2.97*	3.95*	1.83	2.58*
CL	1.01	3.60*	4.14*	3.02*	1.21	2.70*
ZB	0.14	1.75	2.01	3.37*	1.70	4.04*
BB	0.57	0.96	0.72	2.18*	2.66*	2.13*
InCon	1.32	2.31*	4.88*	2.43*	3.13*	0.00
CM^3	0.40	2.67*	3.23*	2.56*	1.84	2.88*
CM_3	0.58	1.43	1.11	6.00*	1.79	2.23*
M	1.14	5.28*	5.40*	13.43*	1.77	3.38*

hibited the greatest interlocality variation; breadth of braincase had the lowest F-value.

Cluster analysis. The cluster on the left of the taxonomic distance phenogram in Fig. 3 is composed of the mean values of specimens from North and South Peloponnesus and represents all the animals from the mainland. Insular specimens from Lesvos appear intermediate between the mainland cluster and that of bats from Crete.

In the phenogram using correlation coefficients a change in the arrangement of the insular samples is noted, as the specimens from Crete are intermediate between the mainland cluster and the animals from Lesvos.

Table 6. Interlocality variation in 9 characters in *Myotis blythii* derived from a single-classification analysis of variance.

Character	d.f.	F ratio
Forearm length	3,161	13.67
Greatest skull length	3,145	15.28
Condylobasal length	3,141	18.01
Zygomatic length	3,91	14.78
Breadth of braincase	3,148	3.51
Interorbital constriction	3,158	8.62
Length of upper toothrow	3,162	10.30
Length of lower toothrow	3,161	15.24
Mandible length	3,158	20.59

P <0.05 for F ratios exceeding 2.60

Conclusions

I interpret the univariate and cluster analysis as well as the coloration of the fur and the comparative dental morphology, as revealing that *Myotis blythii* is represented in Greece by three forms. Among them are the two currently recognized subspecies from the mainland and from Crete. *M. b. oxygnathus* from the mainland represents the smallest and darkest coloured specimens examined. *M. b. omari* is characterized by large cranial size and is known from Crete.

The bats from Lesvos are pale coloured, with measurements intermediate between those of the two recognized subspecies, except that they have a larger forearm length in the females and show the largest variation among the sample of the species. Moreover, after the estimation of the differences between populations, as expressed by the phenograms, the Lesvos sample may represent an undescribed taxon or new geographic variant with a distribution extending from Lesvos to the neighboring area of Asia Minor and the adjacent insular groups of the East Aegean. I therefore propose a new name,

Myotis blythii lesviacus Iliopoulou n. subsp.

Holotype: ZMPU 3377, ♀ ad. Mithymna, in a cave, Lesvos, Greece; J. Ondrias 1—7—65; Skin and skull.

Distribution: In the island of Lesvos and in the neighboring area of Asia Minor and the adjacent insular groups of the East Aegean as well.

Diagnosis: An intermediate (see table 4), pale-colored representative of *M. blythii*. Measurements of the holotype are toward the upper limits of variation in

the sample we have measured. Following are measurements of the type, followed first by the mean values of the female specimens from Lesvos and then the extremes in parentheses: total length, 132.0, 129.41 (121.0—140.0); tail length, 62.0, 59.69 (55.0—65.0); hind foot length, 13.8, 13.16 (12.0—14.6); ear length, 22.6, 21.76 (20.0—23.8); tragus length, 11.0, 10.55 (9.3—10.6); forearm length, 62.0, 60.10 (57.0—64.4); greatest length of skull, 21.5, 21.17 (20.1—22.0); condylobasal length, 20.8, 20.48 (19.5—21.4); zygomatic breadth, 14, 13.82 (12.9—14.3); breadth of braincase, 9.8, 9.58 (9.0—10.1); interorbital constriction, 5.1, 5.18 (4.8—5.6); length of upper toothrow, 8.4, 8.71 (8.2—9.2); length of lower toothrow, 9.3, 9.14 (8.7—9.6); length of mandible, 16.9, 16.83 (16.0—17.5).

Remarks: Compared with *M. b. oxygnathus* and *M. b. omari*, *M. b. lesviacus* is intermediate in most mensural variates, except forearm length, and distinguishable in color at least from *M. b. oxygnathus*.

The name *lesviacus* alludes to the distribution region of the new subspecies.

Specimens examined: (total number of 27 ♂ and 66 ♀). Lesvos. In a small cave of Mithymna (1—7—1965) 27 ♂, 65 ♀; Polychnitos, in an old mine tunnel (14—4—80) 1 ♀ (Fig. 1). Five paratypes in the Museum Alexander Koenig, Bonn.

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Summary

Intraspecific and interpopulation morphologic variation in *Myotis blythii* from Greece is assessed. Univariate and cluster analysis, as well as the study of coloration and dental differentiation reveal that *M. blythii* is represented in Greece by three races: *M. b. oxygnathus* on the mainland, *M. b. omari* on Crete and a new geographic variant on Lesvos which is named *M. b. lesviacus*.

Zusammenfassung

Die intraspezifische und interpopulare morphologische Variation wurde bei Fledermäusen der Art *Myotis blythii* aus Griechenland untersucht. Univariate und Clusteranalysen sowie das Studium von Färbungsvariation und Zahndifferenzierung zeigen, daß die Art *Myotis blythii* in Griechenland mit drei Rassen vertreten ist: *M. b. oxygnathus* auf dem griechischen Festland, *M. b. omari* auf Kreta, und einer neuen geographischen Rasse von der Insel Lesbos, die als *M. b. lesviacus* beschrieben wird.

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