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Short Communication

INTRA SPECIFIC VARIATION OF THE SPOTTED-WINGED FRUIT BAT *Balionycteris maculata* (THOMAS, 1893) (CHIROPTERA, PTEROPODIDAE) FROM SUMATERA, INDONESIA

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Abstract

*The spotted winged bat (*Balionycteris maculata*) is recorded for the first time in Sumatra, Indonesia. The morphology of 13 specimens from Sumatra was compared with that of specimens from Durian (Riau Archipelago) and Kalimantan-Indonesia. Univariate and multivariate analyses show that the Sumatran population is both significantly smaller in a number of characters and some differences in shape occur between Sumatran and Kalimantan specimens. The Sumatran population is similar in morphology to that of Durian Island. The Sumatran and Durian island specimens are referred to as* Balionycteris maculata seimundi.

Key words: Fruit bat-Chiroptera-Pteropodidae, *Balionycteris maculata*, Indonesia Sumatera.

Introduction

There is a high degree of intraspecific morphological variation in Indonesian chiroptera (Kitchener and Maharadatunkamsi 1991; Kitchener and Maryanto 1992; Kitchener *et al* 1993).

The spotted winged fruit bat *Balyonyoteris maculata* in Indonesia is reported to have a restricted distribution (Hill, 1961; Corbet and Hill, 1992). It is known from Kalimantan (Thomas, 1893), Durian island (Riau Archipelago) (Dammerman, 1926), Thailand (Lekagul and McNeely 1977), and in Malaya (Kloss 1921; Medway, 1978).

Kloss (1921) considered that the Malayan and Kalimantan populations were different subspecies. The Kalimantan form is the nominate subspecies (*B. m. maculata*) and that from Malaya is *B. m. seimundi.* Specimens from Durian, Galang and Bintang islands are referred to *seimundi* (Chasen 1940; Micklenburgh *et al.* 1992). Corbet and Hill (1992) considered *seimundi* a synonym of *maculata.*

This paper records for the first time *B. maculata* in Sumatra (Aceh 3°75'N 97°02'E, Leuser 3°45'N 97°ll'E, Siak 1°13'N 102°09'E, Seberida 0°43'S 102°31'E, Bengkulu 3°23'S 101°49'E, and compares the morphology of the Sumatran specimens with those from Kalimantan (Long Bangun 0°02'S 115°38'E, Barito Ulu 0°12'S 114°03'E) and Durian Island 0°43'N 103°40'E.

Materials and Methods

A total of 28 adult specimens were collected from Sumatra (males, 7; females, 5), Kalimantan (males, 4; females, 10) and Durian island (females, 2). The collection localities of all specimens are listed in the Specimens Examinated section and Figure 1.

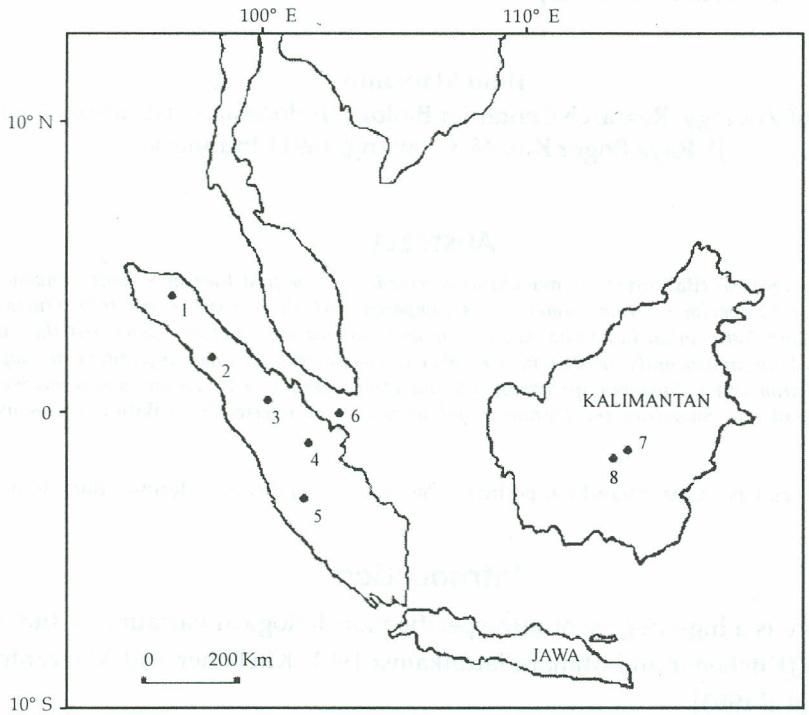

Figure 1. Localities of collected specimens.

1. Aceh (3°75'N 97°02'E)
2. Leuser (3°45'N 97°ll'E)
3. Siak (1°13'N 102°09'E)
4. Seberida (0°43'S 102°31'E)
5. Bengkulu (3°23'S 101°49'E)
6. Durian (Riau Archipelago) (0°43'N 103°40'E)
7. Long Bangun (0°02'S 115°38'E)
8. Barito Ulu (0°12'S 114°03'E)

Twenty-two measurements (in mm) of cranium, mandibulum, dentary and dental characters and 13 external body characters were taken using digital callipers. These measurements are similar to those taken by Kitchener and Maharadatunkamsi (1991). These characters are BB, braincase breadth; C_1-M_2, canine to second molar (alveoli mandible); C^1-C^1, upper outer canine width; CDL, Condilobasal length; CB, upper canine breadth; CPL, dentary condyle to tip of dentary; GSL, greatest skull length; LIB, least interorbital breadth; M^1B,upper first molar breadth (crown); M^2 B, upper second molar breadth (crown); M^1-M^1,upper outer first molar width; M^2-M^2,upper outer second molar breadth (alveoli); MFW, mesopterygoid fossa width; ONL, orbit to nasal length; P^3B, upper third premolar breadth; P^4B, upper forth premolar breadth (alveoli); P^3-P^3, upper outer premolar width; P^4-P^4 upper outer fourth premolar

width; PL, palatal length; POB, postorbital breadth; RAP, ramus angular processus; ZW, zygomatic width; E, ear length; FA, forearm length; TIB, tibia length; TL, total length; DIG1 to DIG5, metacarpal length of digits 1 to 5; DIG2P to DIG5P, digit 2 to 5 phalanx 1.

Multiple regression analysis was used to examine for all characters differences between sex locality and these interactions. Canonical variate analyses (discriminant function analysis) were used study the morphological differences between localities. All analyses were performed using SPSS. Where Pelage and skin colour descriptions follow Konerup and Wanscher (1983).

Specimens examined:

Kalimantan,:

Museum Zoologicum Bogoriense (MZB) Males:

13511(Coll: Boeadi & Yusuf, 26th May 1983, Alam River Samarinda, Long Bangun East Kalimantan, dry specimens), 13932 (Coll: A.Saim, 06th March 1984, DAS Manten, Pulau Malam East Kalimantan, dry specimens), 14725 (Coll: Boeadi, 24th Oct, 1988, Ma, Recut, Busong Joloi Riv, Barito Ulu, dry specimens), 14765. (Coll: Boeadi, 11th Nov, 1988, Cahoi River, Expl Camp III Barito Ulu, wet specimens, dry specimens).

Museum Zoologicum Bogoriense (MZB) Females:

9371, (Coll: Minin & Somadikarta, 20th Oct, 1968, Barito Ulu, dry specimen), 13510 (Coll: Boeadi & Yusuf, 26th May 1983, Alam river Samarinda KM 32, Long Bangun East Kalimantan, dry specimens), 13514 (Coll: Boeadi & Yusuf, 27th May 1983, Alam river Samarinda, Long Bangun East Kalimantan, dry specimens), 13933 (Coll: A.Saim, 06th March 1984, DAS Manten, Pulau Malam East Kalimantan, dry specimens), 14719 (Coll: Boeadi, 08th Oct, 1988, Ma, Rekut, Busong Joloi Riv, Barito Ulu, dry specimens), 14720, (Coll: Boeadi, 26th Oct, 1988, Ma, Rekut, Busong Joloi Riv, Barito Ulu, dry specimens), 14721, (Coll: Boeadi, 08th Oct, 1988, Ma, Rekut, Busong Joloi Riv, Barito Ulu, dry specimens), 14722, (Coll: Boeadi, 26th Oct, 1988, Ma, Rekut, Busong Joloi Riv, Barito Ulu, dry specimens), 14723, (Coll: Boeadi, 20th Nov, 1988, Pakong Expl Camp IV. Barito Ulu, dry specimens) 14726 (Coll: Boeadi, 26th Oct, 1988, Ma, Rekut, Busong Joloi Riv, Barito Ulu, dry specimens)

Sumatra

Museum Zoologicum Bogoriense (MZB), males:

11818 (Coll Boeadi,15th July, 1977, Tandun, Tapang Karnan, Siak, Riau dry specimens), 13830 (Coll Kamarudin & D. Wowor, 5th Feb, 1984, Krueng Ceuko, Lhok Sukon, N. Aceh dry specimens), 13831(Coll Kamarudin & D. Wowor, 5th Feb, 1984, Krueng Ceuko, Lhok Sukon, N. Aceh dry specimens), 15106, (Coll: Supriadi, 15th July, 1991, Air Putih , Ma Aman, N. Bengkulu dry specimens), 15551, (Coll: Boeadi, 13th Sept, 1993, Camp, Santan River, KM 37, Dirgahayu Rimba Road Ketaun Bengkulu dry specimens), 15553, (Coll: Boeadi, 8th Sept, 1993, Camp, Santan River, KM 37, Dirgahayu Rimba Road

Ketaun Bengkulu dry specimens), 15556. (Coll: Boeadi, 15th Sept, 1993, Camp, Santan River, KM 37, Dirgahayu Rimba Road Ketaun Bengkulu dry specimens).

Museum Zoologicum Bogoriense (MZB), females:
12980, (Coll: Yusuf, 3rd 1981, Leuser, Ketambe, Kuta Cane, South East Aceh, dry specimens), 12996, (Coll: Yusuf, 16th 1981, Leuser, Ketambe, Kuta Cane, South East Aceh, dry specimens), 15126, (Coll: Saim & I. Maryanto, 22nd July, 1991, Talang Langkat Siberida, Inhu, Riau, dry specimens). 15549, (Coll: Boeadi, 6th Sept, 1993, Air Megang, Siman river, Napal Putih Ketaun Bengkulu, dry specimens). 15558, (Coll: Boeadi, 8th Sept, 1993, Camp, Santan River, KM 37, Dirgahayu Rimba Road Ketaun Bengkulu dry specimens)

Durian, Riau Archipelago.
Museum Zoologicum Bogoriense (MZB), females:
545, 546 (Dammerman, 16th Nov, 1923, Durian Island, dry specimens).

Results

Color

The color of Sumatra and Kalimantan specimens was compared for both wet and dry specimens. The Kalimantan and Sumatran populations have head and nape black; shoulder and mid back mummy brown; rump and sides cinnamon brown; abdomen fur tipped with drabby white; ear and membranes black. The spots are also scattered irregularly over wing membranes and under surface of forelimb; membranes near body distinctly clad with whitish hairs.

Univariate statistics

The sample size, mean, and standard deviation of measurements of cranium, dentary, dental and external body characters of the Durian, Sumatra and Kalimantan specimens are presented in Table 1. This table shows that the population from Kalimantan has a larger average cranial, dental, dentary and external body character measurement than those from Sumatra, except for tibia length, post orbital breadth and upper third premolar breadth.

The results of multiple regression analysis is presented in Table 2. There is no significant ($P<0.05$) interaction between sex and location. There is no significant sexual dimorphism, however there are significant differences between measurements from different localities in some characters. These were canine to condylobasal length (CDL), greatest skull length (GSL), upper second molar tooth breadth (alveoli) (M^2B), orbit to nasal length (ONL), ear length (E), and total length (TL). However only canine to condylobasal length (CDL), upper second molar tooth breadth (alveoli) (M^2B) and ear length (E) were significant at $P< 0.01$, the remains are significantly different at $0.05<P<0.01$ (Table 2).

Table 1. Mean and standard deviation of male and female characters and weights from Sumatra, Kalimantan, and Durian Is.

Characters	Sumatra Male (5)	Female (7)	Kalimantan Male (4)	Female (10)	Durian Female (2)
BB	9.77±0.43 (9.04-10.23)	9.41±1.22 (6.69-10.14)	10.05±0.46 (9.60-10.81)	10.00±0.19 (9.73-10.34)	9.66±0.15 (9.55-9.77)
C^1M^2	7.20±1.18 (4.80-7.86)	7.58±0.32 (7.15-7.99)	7.83±0.28 (7.37-8.07)	7.83±0.43 (7.14-8.59)	7.69±0.39 (7.41-7.97)
C-C	4.86±0.32 (4.48-5.33)	4.79±0.18 (4.58-5.07)	4.87±0.27 (4.52-5.24)	4.77±0.27 (4.17-5.11)	4.67±0.07 (4.62-4.72)
CDL	20.48±0.18 (19.78-20.67)	20.04±0.64 (19.15-20.71)	20.62±0.65 (20.01-21.68)	20.79±0.34 (20.26-21.37)	19.83±0.11 (19.75-19.91)
CB	1.19±0.07 (1.10-1.28)	1.15±0.15. (0.90-1.34)	1.27±0.11 (1.11-1.38)	1.27±0.10 (1.11-1.48)	1.15±0.01 (1.15-1.16)
CPL	15.92±0.28 (15.55-16.36)	15.61±0.34 (15.19-16.02)	16.15±0.63 (15.23-17.00)	15.89±0.31 (15.41-16.22)	15.56±0.37 (15.30-15.83)
GSL	21.63±0.57 (22.20-20.56)	21.55±0.62 (20.76-22.49)	22.10±0.78 (21.41-23.39)	22.07±0.29 (21.63-22.40)	21.28±0.07 (21.10-21.18)
LIB	4.53±0.30 (4.16-5.01)	476±0.26 (4.45-5.19)	4.76±0.44 (4.37-5.35)	4.76±0.19 (4.48-5.02)	4.94±0.04 (4.91-4.93)
M^1B	0.80±0.08 (0.68-0.91)	0.78±0.08 (0.62-0.86)	0.88±0.06 (0.82-0.99)	0.86±0.16 (0.50-1.01)	0.79±0.01 (0.78-0.80)
M^1M^1	6.11±0.33 (5.54-6.43)	6.18±0.10 (6.01-6.35)	6.19±0.37 (5.54-6.48)	6.17±0.25 (5.88-6.59)	6.05±0.01 (6.04-6.06)
M^2B	0.43±0.06 (0.34-0.54)	0.42±0.02 (0.40-0.47)	0.50±0.06 (0.43-0.59)	0.49±0.05 (0.41-0.59)	0.42±0.02 (0.40-0.44)
M^2-M^2	5.27±0.31 (4.80-5.61)	5.37±0.15 (5.25-5.63)	5.55±0.28 (5.36-6.05)	5.35±0.20 (5.02-5.66)	5.33-+0.03 (5.31-5.36)
MFW	2.27±0.29 (2.23-3.05)	2.76±0.14 (2.47-2.91)	3.04±0.32 (2.69-3.33)	2.95±0.17 (2.65-3.24)	2.84±0.15 (2.74-2.95)
ONL	4.68±0.25 (4.33-4.99)	4.58±0.21 (4.31-4.85)	4.81±0.18 (4.64-5.12)	4.80±0.21 (4.51-5.11)	4.40+-0.02 (4.38-4.42)
P^3B	1.25±0.08 (1.15-1.35)	1.26±0.17 (0.95-1.48)	1.29±0.07 (1.23-1.39)	1.34±0.05 (1.21-1.43)	1.19±0.04 (1.16-1.22)
P^3-P^3	6.25±0.30 (5.76-6.55)	6.22±0.28 (5.84-6.55)	6.04±0.24 (5.64-6.3)	6.09±0.20 (5.78-6.48)	6.01±0.13 (5.92-6.11)
P^4B	1.14±0.05 (1.07-1.20)	1.15±0.90 (1.07-1.32)	1.22±0.10 (1.06-1.30)	1.22±0.14 (0.86-1.35)	1.12±0.12 (1.04-1.21)
P^4-P^4	6.48±0.33 (5.94-6.77)	6.63±0.31 (6.13-7.01)	6.51±0.20 (6.22-6.71)	6.63±0.31 (6.18-6.86)	6.55±0.14 (6.45-6.66)
PL	10.25±0.35 (9.67-10.55)	10.35±0.41(9.67-10.85)	10.66±0.62 (9.71-11.27)	10.57±0.38 (11.29-10.08)	10.31±0.08 (10.25-10.37)
POB	5.15±0.55 (4.35-6.00)	5.30±0.20 (5.06-5.66)	4.75±0.19 (4.54-5.01)	5.03±0.30 (4.58-5.48)	5.20±0.17 (5.08-5.21)
RAP	7.77±0.49 (7.07-8.23)	7.38±0.49 (6.58-8.06)	8.18±0.26 (7.92-8.55)	7.83±0.60 (7.13-8.65)	7.80±0.18.00 (7.67-7.93)
ZW	13.94±0.40 (13.48-14.41)	14.21±0.42 (13.67-14.95)	14.68±1.06 (13.36-15.99)	14.40±0.29 (13.96-14.82)	13.92±0.07 (13.87-13.92)
DIG1	5.52±0.24 (5.24-5.81)	5.45±0.49 (4.61-5.99)	5.72±0.63 (4.95-6.68)	5.36±0.56 (4.25-6.10)	5.55±1.33 (5.06-6.09)
DIG2	20.56±0.98 (19.3-22.23)	19.87±0.62 (19.22-20.82)	20.25±0.21 (20.00-20.56)	20.29±0.95 (18.56-21.84)	20.02±0.69 (19.42-20.51)
DIG2P	4.79±0.40 (4.04-5.13)	4.51±0.45 (3.79-5.04)	4.67±0.30 (4.31-5.00)	4.72±0.35 (4.02-5.32)	5.23±0.38 (4.44-5.34)
DIG3	29.34±1.41 (27.63-31.54)	28.58±0.75 (27.91-29.96)	28.78±0.95 (27.61-29.75)	29.38±1.44 (27.71-31.53)	29.00±1.06 (28.45-29.15)
DIG3P	20.02±1.09 (18.8-21.85)	20.16±0.99 (19.31-22.09)	20.83±0.70 (19.95-21.73)	20.08±1.58 (16.86-22.51)	19.93±0.53 (19.18-19.86)
DIG4	28.11±1.16 (26..36-29.58)	27.39±0.50 (26.84-28.44)	27.89±0.82 (26.53-28.43)	28.54±1.12 (26.72-30.36)	28.09-1.05 (27.27-28.19)
DIG4P	15.18±0.93 (14.05-16.57)	15.07±1.07 (13.65-17.17)	15.78±0.33 (15.35-16.15)	15.72±0.75 (14.8-16.72)	15.79±0.62 (14.63-16.2)
DIG5	28.68±1.28 (26.86-29.92)	28.24±0.95 (26.98-29.75)	28.52±0.70 (27.65-29.25)	29.16±1.08 (26.81-30.49)	29.38±1.04 (28.64-29.37)
DIG5P	13.67±0.75 (1.68-14.5)	13.32±0.85 (12.56-15)	13.60±0.41 (13.16-14.16)	13.87±0.82 (12.49-15.46)	13.93±0.91(13.28-14.28)
E	7.29±1.1(6.09-9.02)	7.13±0.62 (6.39-8)	8.99±1.45 (7.82-11.05)	8.22±0.92 (7.23-9.63)	7.11±0.48 (7.25-7.46)
FA	40.15±0.98 (38.45-40.97)	39.21±1.07 (37.88-40.66)	39.30±0.70 (38.25-39.84)	39.96±4.63 (38.33-43.41)	41.24±1.01 (40.52-40.43)
TIB	12.65±1.18 (10.66-14,2)	12.59±0.88 (11.83-14.19)	12.31±1.10 (10..94-13.33)	12.21±1.06 (10.39-3.56)	11.56±3.55 (12.74-13.83)
TL	60.28±5.92 (55.20-71.08)	60.92±6.32 (50.69-69.64)	68.39±7.04 (50.69-69.64)	65.67±3.84 (56.36-74.45)	65.50±3.75 (63.48-66.66)
Weight	12± 1.78 (9-14)	12.21±0.56 (12-13)	11.75±2.32 (12-14)	11.37±2.36 (11-14)	

Table 2. Multiple regression on sex and locality of *Balionycteris maculata for* cranial, dental, dentary and external variable. F values are presented for the main effects and their interaction. Probability levels are *) 0.05<P<0.01 and **) P< 001.

Variable	Main effect		Interaction
	Sex	Location	
BB	0.404	1.52	0.44
C^1M^2	0.945	1.59	0.39
C-C	1.053	0.34	0.06
CDL	0.502	5.29**	1.95
CB	0.196	3.05	0.29
CPL	3.657	2.19	0.32
GSL	0.067	4.05*	0.37
LIB	0.609	1.08	0.40
M^1B	0.091	2.07	0.05
M^1M^1	0.023	0.24	0.02
M^2B	0.010	5.72**	0.21
M^2-M^2	0.198	0.64	0.19
MFW	0.537	3.09	0.02
ONL	0.526	4.56*	0.56
P^3B	0.259	2.23	0.56
P^3-P^3	0.067	1.89	1.12
P^4B	0.022	2.09	0.22
P^4-P^4	0.145	0.44	0.77
PL	0.013	1.85	0.11
POB	0.611	2.83	0.33
RAP	2.326	2.00	1.06
ZW	0.027	2.32	0.40
DIG1	0.862	0.01	0.63
DIG2	1.156	0.11	1.03
DIG2P	0.058	2.05	1.91
DIG3	0.016	0.13	1.23
DIG3P	0.452	0.21	0.39
DIG4	0.007	1.18	2.18
DIG4P	0.005	2.19	0.14
DIG5	0.299	1.15	1.13
DIG5P	0.006	0.66	0.78
E	0.730	5.99**	0.01
FA	0.002	0.31	0.40
TIB	0.094	0.79	0.05
TL	0.013	4.10*	0.11
Weight	0.381	1.015	0.18

Discriminant analysis

The canonical discriminant analyses for cranial, dentary, dental and external body characters were run separately. The analyses was based on two groups only: Kalimantan and Sumatra. Durian island was unallocated because of its small sample

size (n = 2). The number of characters used was reduced to seven to reduce the effect of over fitting the data. These seven characters were selected to minimize the value of Wilk's lambda. The reduced set of characters provided a similar cluster of values in discriminant function space, as did the full set of characters. Consequently, results based on the reduced set characters are presented. The characters used in these subjects are listed in Table 3.

The DFA had shown that the specimens from Kalimantan and Sumatra separated completely on the extracted significant function for cranial, dental dentary and external. The Durian island specimens on cranial, dental and dentary allocated to the Sumatran population, however the external body characters were allocated to both in Sumatra and Kalimantan (Figure 2).

Table 3. Standard and standardized (in brackets) canonical discriminant function coefficients scores of (a) cranial, dental, dentary and (b) external body characters.

a. Skull		b. External	
Variable	**Function**	**Variable**	**Function**
M^2B	0.2903 (5.5071)	E	0.9706 (0.9331)
M^1-M^1	0.8959 (3.3413)	TL	1.2610 (0.2230)
CB	0.7015 (7.5587)	TIB	-0.7044 (-0.7432)
PL	1.1025 (2.8990)	DIG2P	-0.3950 (-0.5034)
CPL	0.3716 (0.9772)	DIG2	-0.4675 (-1.0004)
C^1-M^2	0.5132 (0.7905)	DIG3P	-0.5397 (-0.4409)
P^4-P^4	-2.1245 (-7.5592)	DIG5	1.5952 (0.1879)
Constant	-35.1931	Constant	-32.4598

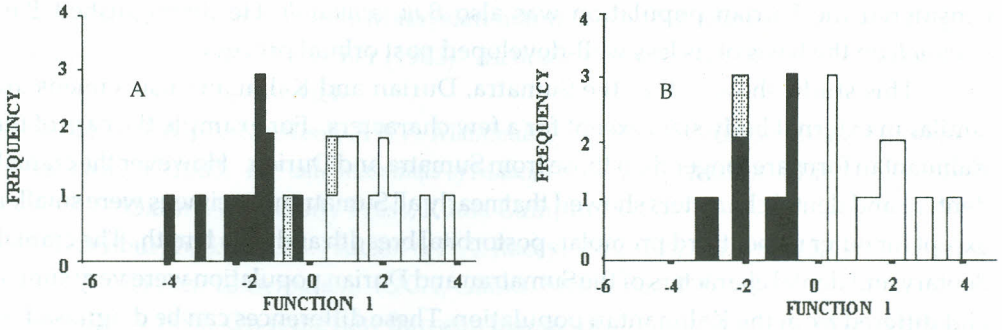

Figure 2. Histogram of function 1 coefficients from canonical variate analysis of male and female adult specimens *Balionycteris maculata* based on the population groups of Kalimantan, Sumatra and Durian (Unallocated). (A = external characters and B = skull characters)

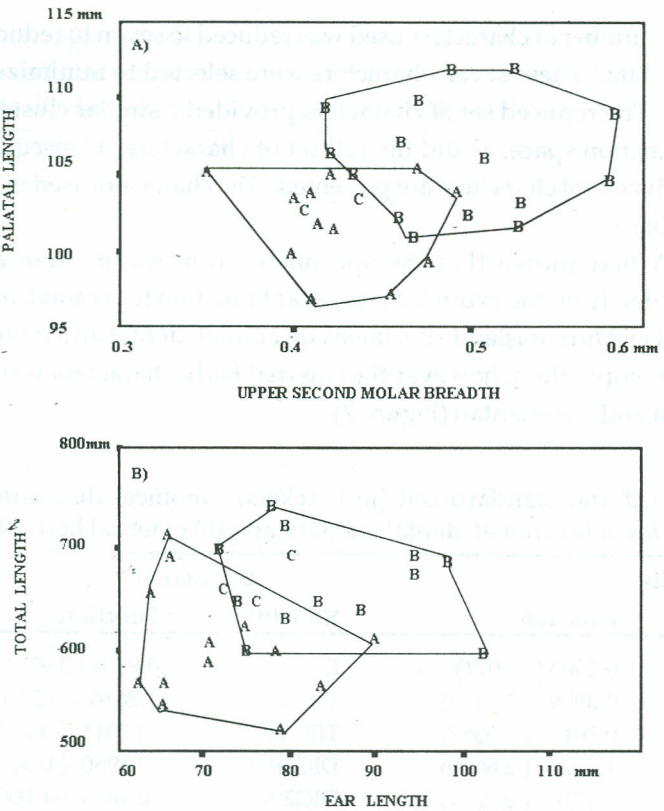

Figure 3. Plot of ratio palatal length and upper second molar breadth (a) and total length Vs. Ear length for male and female *Balionycteris maculata.* A. Sumatra (only 11 specimens), B. Kalimantan and C. Durian.

Discussion

Kloss (1921) described the Malaya form as *Balionycteris maculata seimundi*; he considered the Durian population was also *B.m. seimundi*. He distinguished *B.m. seimundi* on the basis of its less well-developed post orbital process.

This study showed that the Sumatra, Durian and Kalimantan specimens are similar in external body size, except for a few characters. For example the ears of the Kalimantan form are longer than those from Sumatra and Durian. However the cranial, dentary and dental characters showed that nearly all Sumatran specimens were smaller, except for outer upper third premolar, postorbital breadth and tibia length. The cranial, dentary and dental characters of the Sumatran and Durian population were very similar and differed from the Kalimantan population. These differences can be diagnosed by using the ratio of the character ratios palatal length and upper second molar 2 breadth, and ratios of ear length and total length. The Sumatran population based on the above observation is considered to be similar to *B.m. seimundi.*

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