34415

National Library of Canada / Bibliothèque nationale du Canada

CANADIAN THESES ON MICROFICHE

THÈSES CANADIENNES SUR MICROFICHE

NAME OF AUTHOR / *NOM DE L'AUTEUR* James Andrew McDonald

TITLE OF THESIS / *TITRE DE LA THÈSE* Structural Variation Within Populations of Tupaia glis Diard 1820

UNIVERSITY / *UNIVERSITÉ* Alberta

DEGREE FOR WHICH THESIS WAS PRESENTED / *GRADE POUR LEQUEL CETTE THÈSE FUT PRÉSENTÉE* MA

YEAR THIS DEGREE CONFERRED / *ANNÉE D'OBTENTION DE CE GRADE* 1977

NAME OF SUPERVISOR / *NOM DU DIRECTEUR DE THÈSE* D. Gentry Steele

DATED / *DATÉ* May 9, 1977 SIGNED / *SIGNÉ* [signature]

PERMANENT ADDRESS / *RÉSIDENCE FIXE* Department of Anthropology
Univ. of Alberta
Edmonton

THE UNIVERSITY OF ALBERTA

STRUCTURAL VARIATION WITHIN POPULATIONS OF *Tupaia glis* DIARD 1820

by

© JAMES ANDREW McDONALD

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF ARTS

DEPARTMENT OF ANTHROPOLOGY

EDMONTON, ALBERTA

FALL, 1977

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled STRUCTURAL VARIATION WITHIN POPULATIONS OF *Tupaia glis* DIARD submitted by James Andrew McDonald in partial fulfilment of the requirements for the degree of Master of Arts.

Supervisor

Date 21 April 1977

D E D I C A T I O N

to

M. SQUIDIVITZ

ABSTRACT

The common tree shrew (Tupaia glis Diard 1820) has a range of structural diversity which makes it difficult to interpret as one polytypic species or more than one. Consequently, several classifications have been proposed. The present study examines the diversity in the area of the Malay Peninsula through an analysis of variation within populations from local geographic areas and also within the total study sample. A sample of 397 specimens is analyzed in this way for variation contributed by the individual specimens and for variation associated with the sex groups. Twenty-three measurements of the cranium and body are used in the statistical analysis.

The analysis of variation, which is based upon the calculation of the coefficient of variation, reveals a considerable homogeneity within the samples from local geographic areas, and within the complete study sample of specimens from all parts of the geographic region. This is not in accordance with previous taxonomic studies which were unanimous in describing distinct forms in the northern and southern extremes of the study area. A possible explanation for the unexpected results could be that the statistical analysis provided by the coefficient of variation underestimates the biological importance of the variation within the entire sample.

The analysis of the variation within the sexes, also based upon the coefficient of variation, leads to the generalization that the male samples have slightly greater homogeneity within sites and slightly greater variability between sites than do the female samples. Accordingly, future studies on geographic variation are advised to choose samples of male specimens, or be designed with this sexual difference in variability in mind.

The differences between the sexes are tested for significance and the results show that most of the characters exhibit significant sexual dimorphism in at least some of the collecting sites, the entire sample, or both. This then documents sexual dimorphism for the common tree shrew, and must be taken into account by future studies.

The complete statistical analysis, which includes descriptions of the means, standard deviations, range of measurements, coefficients of variation and significance tests, is intended to provide a basis for future studies on geographic variation and for a classification of the common tree shrew.

ACKNOWLEDGEMENTS

It is impossible to acknowledge all of the friends and colleagues whose support, advise, and encouragement contributed to the completion of this project. This being the case, I must restrict my comments of appreciation to those individuals who made a formal contribution to the thesis. Those most involved were the members of my thesis committee, Gentry Steele (committee chairman and principal advisor), Linda Fedigan, Charlie Schewger, and David Young. The stamp of their meticulous and professional scrutiny is to be found throughout the thesis. I wish to thank George Ball for his participation as an external examiner, and for his comments on the thesis. Preliminary drafts were read by Sandi Pentland, Val Ockert, and Ken Luckhardt. The comments which they made and the discussions which we had greatly facilitated the process of writing. Susan McDonald worked with me to compile and proof all of the tables, a job which can only be described as horrible. Susan McDonald, Larraine Mehlenbacher and Jehanne Hillyard assisted in proofing various drafts. R. Weingardt assisted my understanding of the assumptions underlying some of the statistics. Finally, I would like to thank my typists who did an excellent job and made my work that much easier: Sonia Shaw typed the bulk of the tables and Mary Yohemas typed the text. To all of these people, I extend my sincere appreciation.

Computer facilities of the University of Alberta were made available through the sponsorship of the Department of Anthropology.

TABLE OF CONTENTS

		Page
DEDICATION		iv
ABSTRACT		v
ACKNOWLEDGEMENTS		vii
TABLE OF CONTENTS		viii
LIST OF TABLES		x
LIST OF FIGURES		xii
CHAPTER		
I	INTRODUCTION	1
	Former classifications	4
II	METHOD	16
	The sample	16
	Sources	16
	Selection criteria	17
	Characters and measurements	20
	Statistics	23
	The statistics	26
	Problems associated with sample size	32
III	RESULTS	38
	Variation in total length	39
	Variation in tail length	40
	Variation in head and body length	42
	Variation in foot length	42
	Variation in condylobasal length	43
	Variation in palatal length	44
	Variation in cranial length	45
	Variation in the maximum length of the skull	46
	Variation in bizygomatic width	47
	Variation in biauricular width	49
	Variation in interorbital width	50
	Variation in orbital length	51
	Variation in orbital width	52
	Variation in the height of the brain case	52
	Variation in the distance from ophisthion to opisthocranion	53
	Variation in the length of the maxillary molar row	54

Table of Contents -- continued

CHAPTER		Page
	Variation in the bimolar width at the second maxillary molars	55
	Variation in the width between the second maxillary incisors	56
	Variation in the length of the mandibular molar row	57
	Variation in the length of the jaw	58
	Variation in the height of the ascending ramus	59
	Variation in the height of the mandibular condyle	6[illegible]
	Variation in the length of the maxillary tooth row	62
	The entire sample	62
	Variation in the site samples	65
	Sexual dimorphism	66
IV	CONCLUSIONS	69
FIGURES		76
BIBLIOGRAPHY		86
APPENDIX A	List of Sites	89
APPENDIX B	Tables	96

LIST OF TABLES

TABLE		Page
1	Histogrammes of each character taken by sex over the entire sample	97
2	Variation in total length	111
3	Variation in tail length	117
4	Variation in body length	123
5	Variation in foot length	129
6	Variation in condylobasal length	135
7	Variation in palatal length	140
8	Variation in cranial length	144
9	Variation in maximum width of the skull	148
10	Variation in bizygomatic width	153
11	Variation in biauricular width	158
12	Variation in interorbital width	162
13	Variation in orbital length	165
14	Variation in orbital width	169
15	Variation in the height of the brain case ...	173
16	Variation in the distance between opisthion and opistocranion	177
17	Variation in the length of maxillary molar row (M^1 - M^3)	181
18	Variation in the bimolar width (M^2 - M^2)	185
19	Variation in incisor width (I^2 - I^2)	189
20	Variation in length of mandibular molar tooth row (M_1 - M_3)	193
21	Variation in jaw length	197
22	Variation in the height of the ascending ramus	201

TABLE		Page
23	Variation in the height of the mandibular condyle	205
24	Variation in the length of the maxillary tooth row	209
25	Variation in each character over the entire sample	212
26	Average coefficient of variation of sites where the sample was greater than five	215
27	Results of the F - test for sexual dimorphism	216

NOTE: Tables 2 to 25 follow a standard format. The organization of this format is given once as a format note preceeding Table 2.

LIST OF FIGURES

FIGURE		Page
1	Regional map showing location of all sites ..	77
2	Regional map showing the location of the sites used in the tables found under "RESULTS"	79
3	An illustration showing the position of the measurements of the skull	81
4	Regional map showing the location of the sites with 10 or more specimens	84

Chapter 1

INTRODUCTION

The common tree shrew (Tupaia glis Diard 1820)[1,2] has a range of structural diversity which makes it difficult to interpret as one polytypic species or more than one. Consequently, several classifications have been proposed to describe it. Marcus Ward Lyon published a major study in 1913 which compared samples drawn from all parts of the geographic range of this species. The breadth of this study enabled Lyon to achieve a broader understanding of the variation in the larger sample by observing the biological variation within local geographic populations. The emergence of several overall patterns within the animal's total range led him to suggest a classification based upon a division into several taxa at the level of species. Since then, Lyon's interpretation and classification has been substantially modified. The end result of this process of modification was a single species classification with the nomen *T. glis* which was considered sufficient to encompass the variatio . Chasen 1940, Ellerman and Morrison-Scott 1951). More recent , the ingle species interpretation as een criticized as inadequat t basis of new materials (e.g. M in 1966,

---

[1]Common tree shrews are small, active eutherian mammals with a superficial appearance similar to small North American squirrels. Their behaviour in the wild is poorly understood, but they appear to be diurnal, quadrupeds living on or near the ground. Their diet is omnivorous, emphasizing insects and fruit.

[2]This classification follows Napier and Napier, 1967.

Elliot et al 1969). As a result, the classification of T. glis and our understanding of the variation within the taxon must be re-evaluated.

Unfortunately, there are several problems confronting this task. The studies which revised Lyon's classification and the research which led to a criticism of the revisions were not as comprehensive as Lyon's original work and suffer from limited scope, lack of detail, or poor design. Consequently, it is impossible to properly evaluate any of the interpretations or classifications. It is clearly necessary to initiate a series of new studies which would, ideally, utilize all the available specimens from the animal's entire range, and employ as many characters as would be necessary to establish a classification. In this way some of the existing problems would be alleviated and a clearer understanding of the biological variation in T. glis would be gained.

A comprehensive research strategy for this problem would involve detailed analysis at three levels of discussion:

(1) the variation found within populations from local geographic areas (collecting sites) and from the entire geographic range (the entire population from all locales),

(2) the variation between the locales within the geographic range, and

(3) the taxonomic classification.

The present study analyzes variation within populations of T. *glis* (level 1).

This study is important in itself as a new analysis of intra-populational variation, but its greater value is in providing a crucial base for discussions of variation between populations and a classification of the common tree shrew (levels 2 and 3). Since these latter levels of discussion are concerned with the degree of similarity and dissimilarity between populations, the study of intra-populational variation is a necessary starting point for two reasons. First, no two natural populations of animals can be identical because of the nature of genetic inheritance. Thus, an understanding of the range of variation which is present in the populations being compared will allow an estimation of the variation expected between similar populations. Second, since closely related populations cannot be entirely dissimilar because of the factors involved in their evolutionary history, the study of variability within the populations aids the interpretation of the differences found between them. An important aspect of this second point is the actual degree of divergence and how it is explained by evolutionary and classificatory theory. In other words, the interpretation of the relationships between populations should not be attempted until it can be placed into the context of the variation within the same populations.

The present study begins this task of establishing a context in which variation can be discussed by analyzing a sample of preserved skeletal material from museum sources. Although it would be valuable to utilize all the available specimens from the entire geographic range of T. *glis*, the extensive nature of such a study would be substantially beyond the scope of this thesis. Also, since there appear to be several distinct geographic areas where the relationships between the populations of T. *glis* are especially problematic (Steele, pers. comm.), it would seem useful to concentrate on these areas. Accordingly, this study was restricted to one such area, the Malay Peninsula.

The method of analysis is as follows. The range of individual variation within each sex is examined and tested for significant sexual dimorphism. The affect which the differences in variability between the sexes might have on a study of geographic variation is considered. In addition, statistical summaries of the samples of males, females, and the combined sexes are presented. These operations are performed on each character separately, as it is represented in the entire sample of all specimens and the samples from local collecting sites. The purpose of this is to determine whether one sex should be preferred for taxonomic studies.

Former Classifications

The taxonomic history of the common tree shrew has been dominated by three broad classificatory trends. The first trend, which followed the first descriptions of the new forms by Diard and Raffles, was a period of description and identification, beginning in the early part of the 19th century and lasting until the early part of the 20th century. Before this initial period ended, a second trend towards incorporating many of the known taxa had developed. The culmination of this second trend was the suggestion that the common tree shrew belonged to a single species, T. glis. This has recently been criticized as an extreme interpretation and a third trend is developing in which some researchers are again recognizing more than one species.

Lyon's major review and revision of the Tupaiidae (1913), which was done towards the end of the period of discovery and identification of new forms, greatly reduced the number of taxa recognized within the family. On the Malay Peninsula, the revision proposed three species of the common tree shrew: T. glis, T. lacernata, and T. belangeri. A fourth species, T. chinensis, was also recognized in the area immediately adjacent to, and north of, the peninsula. (Lyon also recognized another member of the genus, T. minor, the pygmy shrew, as being sympatric with the common tree shrews in the southern portion of the peninsula.) As a matter of convenience, and as a result of fairly well marked similarities, Lyon separated T. glis and T. lacernata from T. belangeri and T. chinensis, placing the species pairs into a Glis group, and a Chinensis group, respectively (1913:34-35). (Both groups contained other species outside of the geographic area under consideration in this study.) Members of the Chinensis group are described as generally greyish or olivaceous in colour, without bright markings, and with three pairs of mammae (ibid:35). Members of the Glis group are generally dark, ferrugineous, with a variably coloured tail, and two pairs of mammae (ibid:35). Although it will be useful to maintain these division in this discussion, Lyon never regarded them as natural groups (ibid:34).

There are problems with Lyon's taxonomic descriptions which make his reasons for adopting the classification unclear. His diagnostic characters, and also the characters used in his key (ibid:38-39), include the colour of the pelt, the number of mammae, and certain relative differences in the size of the specimens. A close comparison of his description of the diagnostic characters, and of the more general descriptions which he provides for each species, reveals a considerable amount of overlap so that the forms seem to grade into one another. The most southerly form, T. glis ferruginea, as described by Lyon, is clearly different from the northern T. chinensis; however, in the descriptions of the species between these forms there appears a gradual change in the characters. For example, the actual distinguishing features of the pelage in the allopatric species T. glis and T. lacernata were described in the subspecies of both groups. The same is true of the non-discrete cranial characters described by Lyon. The range of measurements for T. lacernata were well within the individual range of specimens of T. glis. These similarities in the allopatric species of the peninsula eventually led other taxonomists to abandon Lyon's classification and to reduce the number of recognized species on the peninsula.

This process began when Kloss reported on new specimens (1918, 1919) and concluded that there was a "complete gradation between the southern brightly coloured long snouted tupaias [sic] with 4 mammae ("ferruginea" forms) and the northern, dull short snouted animals with 6 mammae ("belangeri" forms)" (1919:356). Kloss' ferruginea form referred to Lyon's Glis group, and the belangeri form referred to Lyon's T. belangeri. This conclusion led Kloss to

> "regard all of them as merely subspecies of one species, T. glis of Penang, rather than to establish the specific distinctiveness of the other animals" (ibid.)

Kloss now had a classification with two species: 1) T. glis, consisting of Lyon's T. glis, T. lacernata, and T. belangeri, and 2) T. chinensis, which was Lyon's former species. This transferred some specimens from Lyon's Chinensis group to the Glis group, but left out many specimens which were transferred some 30 years later. Given the overlap between Lyon's allopatric species, this breaking up of the Chinensis group is surprising. Kloss' reason for excluding the rest of the Chinensis group was th[illegible] great reduction of the coloured neck strip in the specimen[illegible]); but Lyon, who did not consider this a diagnostic character [illegible]d in his descriptions that the reduction was gradual [illegible] to north ([illegible]3). Kloss did not explain why he believed [illegible] s[illegible]p could [illegible] used to identify species, and it is unclear why he made a distinction where he did. Kloss neglected to discuss the gradation in the character which was found in Lyon's specimens. He also neglected to discuss the other characters used by Lyon or why they were not useful in establishing the new classification. An important example of a character that should have been discussed was the number of mammae, since Kloss no longer used this as a diagnostic character for the southern animals. In the new classification, the northern subspecies of T. glis had the same number of mammae as the Chinensis group, but they differed in this character from the other subspecies of T. glis. Since Kloss did not explain why this character was not diagnostic, later taxonomists (e.g. Martin 1966) again suggested, without the benefit of his criticisms, that mammae counts were an important indicator of taxonomic relationships.

The inclusion of other groups into the T. glis taxon was continued by Chasen (1940) and by Ellerman and Morrison-Scott (1951). Chasen's work, while informative about the range of variation within T. glis only confirmed Kloss' conclusions of 1918 and 1919. Chasen was using the hypothesis that peninsular species usually exhibit a gradation of forms along the length of the peninsula, and he attempted to show this for a fauna which included the species T. glis (as recognized by Kloss); however, he concentrated on the animals pelage, while admitting that he did not understand the pelage changes and distribution, except in a very broad manner (1940:8). His main contribution to the taxonomy of peninsular T. glis was to affirm the gradations in pelt colour and to comment on the difficulties of using this character to distinguish the various groups in the peninsular region. The study by Ellerman and Morrison-Scott incorporated the remainder of Lyon's Chinensis group into the T. glis taxon, commenting that there was

> "no certain colour distinction between belangeri [i.e. the Chinensis group] and races referrable [sic] to glis ... and it seems that there is little essential difference between the southern glis races and the northern belangeri and its allies" (1951:9).

Unfortunately, they did not discuss this further and the superficiality of their statement contributed very little to our understanding of the common tree shrew. The revision appears to be a further exaggeration of the use of pelt colour as a major character for reducing the number of species, yet Ellerman and Morrison-Scott do not discuss their use of it to establish the subspecies. Although this revision represents a further de-emphasis of Lyon's taxonomic characters, it does not discuss the rationale behind the choice of characters. Two fundamental criticisms of Ellerman and Morrison-Scott's revision of T. glis are that they do not document their analysis of the specimens, and their references to the works of Lyon, Kloss and Chasen are inaccurate.

Throughout these years of revision, Lyon (1913) remained the chief authority on the common tree shrew, although his classification was altered substantially. Over the years, new information has been published on specific collections or groups but there has been no study comparable to Lyon's well documented work.

In 1960 this changed with the appearance of Hill's highly quantified analysis of pelt variation in _T. glis_. His study showed a rather smooth clinal variation in pelt colouration along the peninsula and into Indochina. The northern form was clearly distinct from the southern form, but a series of geographically intermediate specimens showed the change to be gradual. The allopatric subspecies of _T. glis_ were shown to vary within a standard deviation of their neighbours, and island populations also followed the cline, although on slightly staggered isophenes. The study concluded that the taxonomic use of pelt colouration was not justified for the erection of subspecific taxa. Since pelage was the prime diagnostic character for the taxonomic subdivision of _T. glis_ in the revisions of Lyon's classification, Hill's conclusion was sufficient to throw the basis of the new classification into question.

A study of tupaiid reproduction by Martin (1966) further eroded the acceptability of the revised classification. Based upon his study of the tree shrew's absentee maternal system, Martin suggested that mammae count is a very important taxonomic character. His study reported that the mother permitted the young tree shrews very short (10 minute) periods of suckling, followed by a long (48 hour) intersuckling period during which the mother was absent from the est. Martin also reported a correlation between litter size and the number of mammae in which the northern animals, which possessed three pairs of mammae, more frequently had triplet births than did the southern animals which possessed two pairs of mammae and exhibited a more frequent pattern of twinning. These observations led Martin to suggest that

> "in light of the extreme suckling mechanism demonstrated in this paper ... it would appear that this character [number of mammae] may be of great [taxonomic] importance. Until the whole question has been re-examined in a field study, no binding decision can be made about speciation of Tupaia on the Malayan Peninsula."

Martin goes on to suggest that it would be best to maintain the distinction between a northern species which corresponds to Lyon's Chinensis group, possessing three pairs of mammae and a southern group, T. glis, with only two pairs of mammae (Martin 1966:415). Martin was cautious in his taxonomic statements; however, in returning to Lyon's classification, he misinterpreted it greatly by identifying Lyon's Glis and Chinensis groups as species. Lyon felt these groupings were arbitrary divisions and never indicated that they might eventually be recognized as separate species. This single error by Martin left unanswered many questions concerning the nature of the variation within his two species. Just as other taxonomists had ignored Lyon's use of mammae numbers as a taxonomic character (ibid.), Martin in turn ignored the rest of Lyon's characters. Thus, Martin's cautious suggestion to return to a former classification is not a clear solution either, and his main contribution must be restricted to his insights regarding the value of the suckling mechanism and mammae counts as an important taxonomic complex.

Another source of difficulty for the single species classification arises from several karyological studies (summarized in Arrighi _et al_ 1969 and Elliot _et al_ 1969) which point to a problem of chromosomal variation in the peninsula _T. glis_. The variation is expressed as a diploid count of 60 chromosomes in specimens from Kuala Lumpur, Malaya, and a count of 62 for specimens from Thailand. Napier and Napier atribute the differences "to polymorphism or to unrecognized speciation" (1967:333); however, Elliot _et al_ are more definite and support the contention that there are two species involved:

> "_T. glis ferruginea_ (Raffles 1821) of Malaya and _T. chinensis_ (Anderson 1879) of Thailand are separate species, the former having 60 diploid chromosomes, and the latter 62 chromosomes. Evidence has not yet been presented that disagrees with the above statement, and at the same time documents the source of the specimens" (1969:156).

Unfortunately, data is only available from two locations and it would be premature to reach any conclusions until there is more information from intervening areas.

The conclusions in Arrighi _et al_ (1969) are unsatisfactory in a different manner. These authors correctly note that the chromosomal variation can be used to substantiate taxonomic classifications, and then go on to use the evidence which they present to support Lyon's 1913 classification of the species _T. chinensis_ and _T. glis_; however, they support it without discussion of the important revisions which occurred after 1913, and without commenting on the effect these revisions had on reference work used by the authors.

Thus, they fail to convince the reader that the classification which they accept is valid. This, in turn, creates doubt over their use of the chromosomal variation as an indicator of species identification. The authors complicate the situation further by correcting the classification used in a previous study on the basis of their own taxonom[illegible] assumptions (1969:206). Again, this type of classificatory revision is inadequate until more is known about the variation in intervening areas.

Finally, another study of variation which, like that of Hill was well quantified and used a broad data base for its results was carried out on the dental variability of the Tupaiidae by Steele (1973). Steele was not concerned with the problem of the classification of the common tree shrew specifically, but his results provide another illustration of the problem with such classifications. Using the technique of simple matching coefficients, Steele constructed a dendrogram to show levels of similarity within the family (ibid:fi[illegible]). The highest level of similarity in this figure which did not mix other species with T. glis included all of the peninsular forms of T. glis in one phenetic group. This appears to support the single species classification; however, the same level of similarity did not include all the forms of T. glis from the Oriental Region of Asia that were utilized in the study, thus contradicting the single species classification as it is understood in other parts of the animal's range. The phenetic group which did include all these forms of T. glis also include other species of Tupaia.

So the phenetic dendrogram cannot be used to clearly support a multiple species classification anymore than it can be used for a single species classification.

This critique has mentioned the three main trends in the taxonomic history of the common tree shrew, as they pertained to the Malay Peninsula. It has also discussed some of the major sources of confusion that have led to a situation in which taxonomists feel uncertain about the systematic relationships between populations of the common tree shrew, and consequently, differ on what is the proper way to represent the relationships in a classification. From the discussion it is clear that the scope and design of the taxonomic studies, with the exception of Lyon's revision, have left them with major problems. Studies such as those of Chasen (1940) and Ellerman and Morrison-Scott (1951) did not present an exhaustive criticism of Lyon's conclusions, nor did they present their own data for evaluation and criticism. This made their treatment of the material appear superficial and prevented future taxonomists from using the studies to properly evaluate later criticisms of the single species classification or the alternatives suggested. Other studies such as those of Martin (1966) and Elliot et al (1969) base their classificatory criticisms and suggestions on geographically limited samples. Although this created problems for extending the interpretations to other geographic areas, in fairness it should be noted that neither study was primarily concerned with the taxonomic problem of T. glis. Nonetheless, it was these studies which brought the single species classification into question.

The remainder of this presentation is intended to begin the process of clarifying the relationships between the various populations of <u>T. glis</u>. It is hoped that by utilizing a large sample from many parts of the Malay Peninsula, and by carefully documenting the statistical analysis, the presentation will avoid the problems inherent in the previous studies. The results of this specific study of a circumscribed geographic area should be useful to later taxonomists in the development of a more accurate classification of the common tree shrew.

Chapter 2

METHOD

The Sample

The sample consisted of 397 adult skeletal specimens of common tree shrews which would be included in the taxon T. glis as recognized by Napier and Napier (1967). The specimens, which were collected by a number of field workers on the Malay Peninsula, have a fairly wide distribution in both time (over a century) and space (Thailand, Burma, and West Malaysia). As the author did not have direct access to the original specimens, all the measurements used here were taken by other researchers.

Sources of the Sample

Data on the sample were drawn from the materials of Dr. D. Gentry Steele and Lyon (1913). Steele measured 108 specimens in the collections of the United States National Museum, Smithsonian Institution. He recorded data for 21 characters from each of those individuals: three measurements of gross body length, and 18 of cranial characteristics. All his measurements were in millimetres. Since these specimens are the most completely describe members of the study sample, they form the basis of the data used in this study; however, since Steele's material was not collected with the present problem in mind and, therefore, did not contain many sites with large individual sample sizes, it was necessary to supplement the sample with specimens from other sources. Lyon's revision of the family (1913) provided data on an additional 289 specimens which were appropriate for this study. This increased the sample sizes of many sites and offset the limitations of Steele's data. Unfortunately, Lyon did not provide measurements for all of the characters used by Steele and the completeness of the data available on his specimens varies. Lyon measured an additional dental character (the length of the maxillary tooth row) and this raised the total number of characters to 22. One of the collections measured by Lyon came from the Smithsonian Institution and Steele duplicated some of the measurements taken earlier by Lyon. Occasionally, Lyon provided a measurement on one of those specimens which was blank in Steele's records. These were added to the data. Measurements taken by both workers on the same specimen were compared for accuracy. The main difference was found to be in the degree of precision: Lyon's measurements were generally rounded off more than those taken by Steele. The general rule followed in this study was to give preference to Steele's work because it formed an important core of measurements carried out by a single observer. Fortunately, disparities between Lyon and Steele were minimal and did not create any concern over the acceptability of any measurement.

Selection Criteria

Four criteria were used in selecting specimens for the study sample. First, only adult specimens were chosen. Age status was determined by either an actual record (e.g., the museum or collection card) which stated that the animal had been adult; or, by some other information (usually the presence of all the permanent teeth) that indicated a mature specimen. Normally a study of variation would include all age classes in order to document developmental variation; however, in the present sample there was insufficient information to make divisions among the immature animals. Furthermore, the few non-mature individuals that were available were widely dispersed and could not be grouped into a significant study sample. Since mammalian adulthood is partially defined by the cessation of growth this criterion of adulthood provided a sample of animals that were all in the same relative stage of osteological development. This criterion established a developmental standard.

Second, the measurements of the accepted specimens had to be in the metric system. If specimens had original measurements taken in the English system, the specimens were rejected. This criterion reduced the possibility of compounding rounding errors. First, all measurements are approximate and the older ones recorded in Lyon (1936) seemed to be less precise than those made by Steele. Second, conversions between the two systems usually entail some rounding off of the final result. The effect of these two sources of error (estimation) could be an undesirable element of imprecision. Therefore, the criterion increased the confidence in the data by minimizing the number of times a measurement was rounded.

The third criterion required every specimen to be geographically located by a collection site which could be identified in a gazetter (United States Board on Geographic Names, 1966a, 1966b, 1970). Preferably, the location was a town or a hill; however, a few specimens were only identified at a more general level such as a political division or geographic region. If no specific collection sites were identified within one of these divisions, then the specimens from the area were admitted into the sample as if they belonged to a single collection site. In cases where the specimens were identified by a broad area (e.g., a state) and also from specific collection sites within that area, only the latter, more precisely identified specimens were accepted. In every case information was required to describe the location by an official spelling, and an official latitude and longitude. Appendix A lists all the official names and locations of the sites.

The fourth and final criterion was that the location site had to be in an area relevant to the taxonomic problem (as discussed in Chapter one). Since the controversy centres on the northern portion of the Malay Peninsula, it was reasonable to choose sites from the peninsula and the Indochina mainland to the north of it (Fig. 1). As it happened, the distribution of most of the available sampled sites was restricted to the countries of Burma, Thailand, and (West) Malaysia. Some sites lay outside this designated area but their inclusion was inappropriate for several reasons. North of the study area, the sites were very few and scattered with samples consisting of only one or two individuals. Furthermore, most of these specimens came from Lyon (1913) who provided few measurements. The same problem occurred to the immediate east.

Still further to the east and in Vietnam, there were many sites, with good representation of specimens and measurements. This was especially so in the south. Two problems made it preferable to exclude this sample from the study. First, the Vietnam tree shrews appear to be in a région with another particular taxonomic problem (Steele, pers. comm.) and should be studied in detail. Second, a geographic break in the continuity of collecting sites occurred between the study area and the Vietnam sites and this artificially separated the two samples. Both these problems could distort an analysis and obscure the relationships of the populations on the peninsula. Therefore, the specimens from the east were excluded. To the south of the study area some of the sites were well sampled island sites, but insular isolation is a major potential source of variation and samples from the more distant islands were not used. For example, the large island of Sumatra is suspected to have its own pattern of variation (Steele, pers. comm.). Again, this would cause difficulties for a study of the peninsula. The smaller islands laying near the peninsula were included in the study area because of their close proximity to the mainland. Fig. 1 is a map of the area illustrating the locations of each selected site. Fig. 2 shows only those sites named in the tables.

Characters and Measurements

The measurements of the following standard structural characters were used (see Fig. 3). They were not available for all specimens.

1. Total length (taken at death).

2. Tail length (taken at death).

3. Body length (derived by subtracting the tail length from the total length.

4. Foot length.

5. Condylobasal length (measured from the condyles to the alveolar border of the first incisor).

6. Palatal length (measured in the midline from the posterior aspect of the palate to the alveolar border of the first incisor).

7. Cranial length (obtained by subtracting the palatal length from the condylobasal length).

8. Maximum width of the skull (taken at points above the auditory meatus).

9. Bizygomatic width (measured at the point where the post-orbital bar joins the zygoma).

10. Biauricular width (measured from the inferior aspect of the external auditory meatus).

11. Interorbital width (measured at the narrowest point).

12. Orbital length (measured as the maximum length of the orbit).

13. Orbital width (measured at the narrowest point).

14. Height of the brain-case (taken anterior to the auditory bullae).

15. The distance from opisthion to opisthocranion (measured from the median point on the posterior margin of the occipital foramen to the most posterior point of the skull away from glabella in the mid-sagittal plane, excluding inion).

16. Molar row length (measured from the first molar to the third molar of the maxilla).

17. Bimolar width (measured at the alveolar border of the second maxillary molars).

18. Incisor width (measured at the alveolar border of the second maxillary incisors).

19. Length of the molar rooth row of the jaw (measured from the first to the third molars of the mandible).

20. Jaw length (measured from the alveolar border of the first incisor to the posterior aspect of the angle).

21. Height of the ascending ramus of the mandible.

22. Height of the mandibular condyle.

23. Length of the maxillary tooth row.

Lyon (1913) did not provide descriptions of his measurements, but it is assumed that they followed the traditional procedures described above and followed by Steele.

The following differences were discovered between the set of measurements used by Lyon and by Steele. (1) Lyon used tail length, and head and body length while Steele used tail length and total length. To maintain a standard computer card format, Lyon's two measurements were added together for the total length and the measurements for head and body length were discarded. This allowed the use of a computer programme which could then work on both Lyon's and Steele's data in a single run. The programme subtracted tail length from total length to reproduce head and body length. The entire procedure gave more information than was available from each source separately. (2) For one character Lyon used the term "hind food length" while Steele used "foot length." (3) For another character Lyon used the term "zygomatic width" while Steele used "bizygomatic width." (4) Again, Lyon used the term "width of the brain-case" while Steele used "maximum width of the skull." Lyon's terms in these last three points are considered to be synonymous with the corresponding terms used by Steele. (Steele, pers. comm.). Furthermore, where both researchers measured the same specimen, the measurements reported by Steele coincide well with those of Lyon. (5) Only Lyon lists "the length of the maxillary tooth row" (character 23).

Steele described measurements 1, 2, and 4 to 22; while Lyon provided data on measurements 2 to 5, 9, and 23. The computer produced measurement number 3.

All measurements are in millimetres. Measureme[illegible]ber 1 to 4 are accurate to the decimal point; measurements nu[illegible]o 23 are accurate to one place to the right of the decimal.

Statistics

Parametric statistics were utilized in analyzing the present data since they are considered more powerful than non-parametric statistics. However, before parametric statistics can be utilized, it must be shown that the sample being examined was randomly selected from a normally distributed population.

Randomness is a basic technique of controlling bias in statistical samples. It refers to a process which ensures that each selection made during the sampling of a population is independent of all other selections. In this way, any systematic bias in collection is avoided. Random selection also permits the use of probability statistics to make inferences from the sample to the population (Freeman 1965:143). Usually this technique involves the definition of a population, the identification of individuals in the population by numbered lists, and the selection of specimens by means of a randomized list of numbers which correspond to the identification system.

In the biological sampling of wild animals it is often impossible to proceed in this manner. In the present study, for example, a total collection of all animals would have been impractical because of the large geographic size of the problem area, and ethically undesirable Fortunately, there are other methods of sampling wild populations which can accomplish the most important effect of random sampling, that is independent selection of individual specimens. One method is the utilization of controlled trapping techniques which was obviously impossible for the present study, since it relied on secondary sources of data. Nonetheless, an examination of the history surrounding the sample does indicate that the collection of individuals was largely independent and that the assumption of randomness is justified. The study collection was accumulated over a century of field work: Lyon's oldest specimen was accessioned by the British Museum in the 1860's, while Steele utilized specimens from the 1960's. Lyon examined the collections from the Smithsonian Institution and ten other museums (Lyon 1913:1), while all of Steele's specimens belong to the Smithsonian Institution. The number of research personnel involved in compiling the collections of 11 museums over the span of a century must have been high. Therefore, it is very likely that any individual bias would have been obliterated. Natural bias, such as a propensity for one type of animal to be captured more easily, cannot be ruled out so easily; yet the nature of such behaviour makes it a problem that even a systematically random collection method would find difficult to avoid. However, the long duration of the collecting and the variety of collection techniques tend to work against such a bias.

There are several ways to demonstrate the second assumption of parametric statistics: that the sample has a normal distribution. It is particularly important to demonstrate this because of the suspicion that the sample may be composed of individuals from more than one species, and probably from more than one population (as defined at levels below the species category). The question concerns the normality of a statistical population for the purpose of statistical testing. It is a separate issue whether the statistical population belongs to only one biological population or not. Both problems are ultimately linked, but for this stage of analysis it is only necessary to provide a rationale for the use of a certain type of statistic. This was accomplished by constructing histogrammes of each character by sex groupings over the entire sample (Table 1). The histogrammes demonstrate the properties of a normal distribution (Peatman 1963:66-67). (1) The distributions appear to be unimodal. (2) They are nearly bilaterally symmetrical. (3) The means are central in the distribution and many means are in the exact centre. (4) The values of the mean, mode, and median are very close. (5) The tail of the curve resembles a hypothetical normal curve which is asymtotic with respect to the abscissa axis. (6) The mean ± 2.5 standard deviations account for approximately 99% of the area of a normal curve. Three standard deviations (99.7%) should and do account for the entire range of measurements.

The statistics

The following statistics were used: (1) sample size (N); (2) mean values ($\overline{X}$); (3) standard deviations (S.D.); (4) minimum-maximum values; (5) coefficient of variation (C.V.); (6) Fisher's ratio (F - ratio).

Most of these statistics require little discussion as they are widely used and well known. The method of calculation will simply be noted with certain comments.

(1) N is a straight forward description of the number of individual measurements being used in calculating the statistics for each character. Comments on the problems associated with the size of the samples are made in a later section.

(2) Mean values:

$$X = \frac{\sum_{i=1}^{N} X_i}{N}$$

where X is an individual measurement.

(3) Standard deviations:

$$S.D. = \sqrt{\frac{\sum_{i=1}^{N} X_i^2}{N}}$$

This is an index of variation appropriate to metric data. It reveals how widely the distribution varies around the mean; thus, providing an index of the value of the mean as a summary of the distribution (Freeman 1965:60). It also provides a basis for other more complex statistics, such as the coefficient of variation.

(4) Minimum-maximum values provide the absolute limits of the distribution of values in the sample. This provides useful information on the observed range and it is important in establishing classes of individuals. It must be remembered that the value of these statistics as measures of dispersal and variation is limited by three factors: i) they have an obvious dependency on sample size (e.g., where N = 1 the range and variability is 0); ii) any collection of more than one specimen has a minimum and maximum value, but there is no reason to extrapolate that they are representative of a population; iii) the chances of collecting determine these values; it is unlikely that the largest or smallest individuals of the population would be represented (Simpson, Roe, and Lewontin 1960:79-82).

(5) Coefficient of variation: $C.V. = \frac{100\ S.D.}{\overline{X}}$

This provides a relative measure of variability. The S.D. is an absolute measure interpreted in the original units of measurement. It cannot be compared to anything other than measurements taken in the same units, on the same class of individuals and for the same character. The equation for C.V. cancels out the unit of measurement, providing a measure of dispersal that allows comparison of different characters and/or different taxa. It assumes that absolute dispersal (represented by S.D.) is relative to the mean. The equation effectively uses this to transform the absolute into a comparative statistic. (Ibid.:89-91)

(6) Fischer's ratio belongs to a family of F statistics. All serve the function of testing for significant differences between populations. A well known example from this group is Student's t - test, which is a special case of the F statistics (Freeman 1965:209). The computer programme which calculated the F - ratio used here (Dixon 1968) does not provide a formula. The calculated statistic was observed to actually be the ratio of the mean square of variance between samples over the mean square of variance within the sample. The programme provided both squares while a hand calculator proved that the ratio provided the F statistic.

F statistics are the only appropriate tests of significance for data arranged in nominal (sex classes) and interval (millimetres) scales (Freeman 1965:209). There are several such statistics available that could perform as well as the one used here. This particular F - ratio was picked on account of its availability in a pre-packaged programme. One alternative, Student's t - test, is the usual test when only two nominal classes are being considered while the F - ratio is more often reserved for comparisons of many nominal classes. They are not really different tests, and provide equally good results. Freeman describes the t - test as merely being a special case of F where $t^2 = F$ (op cit).

Peatman gives the following assumptions for the use of F statistics: i) obser ations (specimens) are independent of one another; ii) the sample comes from a normally distributed population; iii) the populations to be compared (the sexes) have the same variance; iv) measurements are in the interval scale (1960:319 ff). The first two assumptions have already been discussed and accepted. The fourth is obviously valid. The evidence for the third, a homogeneity of variances, derives from a comparison of the C.V.'s of the two sexes (see Tables 1 - 24). Since the coefficients are very similar, the assumption is justified.

The form that the significance test will take is as follows (after Freeman's suggestion, Ibid:208).

(1) Hypothesis, H_1: There is a sexual dimorphism in character X in sample Sy at site Y. Where X = the particular character being tested, Sy = the particular sample at site Y and to which the individuals exhibiting X belong, Y = the collection site of Sy.

(2) Null hypothesis, H_0: There is no significant difference between the sexes for X in Sy.

(3) Test: The F - ratio, for reasons already stated.

(4) Significance level: Let $\alpha = 0.05$ when testing the sample sites, and for the comparison of each to the entire sample.

(5) Sampling distribution: F is distributed according to the appropriate table in Freeman (<u>Ibid.</u>, Table H).

(6) R[illegible]n of rejection: The region of rejection consists of all one-tailed values of F which are so large that they are likely to occur: i) less than once in 100 samples when H_o is true and where $\alpha = 0.01$; ii) less than 5 times in 100 samples when H_o is true and where $\alpha = 0.05$. The degrees of freedom (Df) are set by the computer according to these formulae: Df for variation between samples (Df_b in Freeman's tables) = 1; Df for variation within samples (Df_w in Freeman's tables) = N - 2.

Certain features of this test form require further explanation:

(1) The significance level is set to avoid two types of error. Type I is the rejection of a true H_o, Type II is the failure to reject a false H_o. The first is alleviated by setting a high alpha level of significance, e.g., 0.01, so that the mistake might happen in only 1 case out of 100. (The probability of a Type I error is approximately equal to alpha (<u>ibid</u>:154).) The probability of a Type II error is difficult to determine but is reduced with the level of alpha (<u>ibid</u>:154-155). When the risk of a Type II error is suspected to be great then alpha should be small. The risks of either types of error are inversely related to one another and dependent on N (<u>ibid</u>:156). When N is small a Type II error is greatest. When N is increased the chance of a Type I error becomes greater. The N of the entire sample of <u>T. glis</u> may be considered large; hence, a Type I error is the greater risk and alpha is set

at 0.01. The N of the site samples is small, often very small. A Type II error is avoided by setting $\alpha = 0.05$. For the sake of comparison with the sites, a second alpha at 0.05 is applied to the entire sample.

(2) F is used as a one tailed test only when the direction of the significant difference is known. The descriptive statistics provide this information by showing which sex is larger. It should be justified and more accurate to rephrase H_1 and H_o as in the following examples:

"H_1 : Males are larger than females in character X ...
H_o : Males are not larger than females for X in Sy."

(3) Df_b is defined as C - 1, with C being the number of nominal classes involved. Here C = 2, the two sexes. Since the number of sexes are consistant, Df_b is always 1.

(4) Df_w is an accumulative degree of freedom for each class taken individually (N1 - 1) + (N2 - 1) + (N3 - 1) + ... Here only two classes are involved and Df_w = (Nfemale - 1) + (Nmale - 1), or (Ncombined - 2).

Calculations

Calculations were done by computer programming and the use of a hand calculator. The Biomedical Computer Program BMD:07D (Dixon 1968) was run on the IBM 360/70 computer housed at the University of Alberta. This programme provided the $\overline{X}$, S.D., minimum-maximum for the combined sexes, N, F - ratio, and histogrammes used here. Minimum - maximum values for each sex separately were taken from the data through personal observation. Coefficients of variation were found using a Commodore GL 987R electronic calculator.

Problems associated with Sample Size

Statistical procedures used here obviously depend upon the size of the sample which is being described or from which inference is being made. The size of the available samples create an important problem for the analysis used in this research because of the limitations placed on the statistics.

Sample size and the effect of chance bias seem inversely related: as N increases, the effect of bias should decrease; although, the actual sample size does not need to be large to obtain reasonable results. Simpson and Roe found an N of 10 (and sometimes even N = 5) acceptable so long as it was realized that it is a less accurate estimate of the population then N = 30, or N = 100 (1939:99).

The size of the sample available at any one site for this research varies considerably. Out of the 99 sites used in the entire sample, 44 are represented by 1 specimen, 14 by 2 specimens (sometimes of only one sex), 30 sites have no more than 9 specimens, 10 have from 10 to 20 specimens, and only 1 has more than 20 (N = 24) specimens. Obviously the very small samples require caution. The limitations must be kept in mind, and alternative methods of alleviating the difficulties examined.

The problem with the sample size is most acute for the F - ratio. It tests the significance of differences found amongst groups and the effect of N is more obscure than for the other statistics. It is useful to note here that a significant result from the F - ratio is reliable no matter the sample size (R. Weingardt, analyst, Computing Services, University of Alberta, pers. comm.). This is because the probability of rejecting a true H_0 is determined by α and not N (a Type I error). Unfortunately, the reliability of non-significant results decreases with N, i.e., the probability of a Type II error increases. Therefore, the problem of N most severly affects the conclusions that can be drawn about an insignificant F - ratio.

There are several ways to deal with the problem of sample size; the four major ones will be discussed.

The first involves ignoring small sites (e.g., only sites with N of 10 or more could be analyzed). There are 11 such sites: 4 have N equal to or greater than 15, 1 is larger than 20, and none are larger than 30. They are spread out across the sample area with a major break in the northern peninsular area (see Fig. 4). This is the potentially important geographic area for this study of _T. glis_, and it would be unfortunate not to have it represented. The method would test the north - south extremes of the distribution but most of the sites are located on islands. Island variation could be influenced by geographic isolation from the mainland population.

The high proportion of such samples would reduce the future value of the analysis. Another drawback is that the procedure reduces the amount of information available from F tests. Significant results of samples with less than 10 specimens would not be reported. These shortcomings made the method unacceptable.

Secondly, sites could be grouped by dividing the area into arbitrary sections. A prime example of this method would transect the area latitudinally, e.g., to take all specimens located between two successive latitudes. Another example would be to establish a grid, using the latitudes and longitudes as the axis, and to take all specimens found within each square as a single sample. The advantages of this mode of lumping are: i) it is objective once the size of the grid is established; ii) it does increase the size of each sample. The disadvantages are: i) it cuts across known ecological and geographical boundries, e.g., mountain ranges and coastal plains; ii) some units lump mainland sites with potentially variable island sites; and iii) it does not result in a very marked increase in sample size. As an example, a large grid of 2 degrees latitude by 2 degrees longitude and with one co-ordinate at 2° North, 100° East was established. There were 12 squares with a sample of more than 10 specimens. This is an improvement of only 1 over the original collection site units. The specific breakdown of these squares is: 8 had at least 15 specimens, 4 had at least 20 specimens, and 1 had more than 30. Comparing this to the figures given before, it can be seen that there is a slight improvement, but it may not be worth the mixing of specimens from very different environments.

Thirdly, given the concern that there might be strong environmental influences adding variability to arbitrarily grouped samples, it was logical to examine ecological information for criteria that might provide more control. The objective was to develop a rationale for grouping sites by ecological similarities. Unfortunately, the precision and the usefulness of the information was limited. Single, isolated research stations usually provided the data for specific areas. These stations rarely correlated with the particular sample sites used here, or even to their immediate vicinities. It was necessary to make assumptions about the applicability of the nearest station's reports, and since most sites had no station close by, this weakened the assumptions. Further, the stations primarily reported on the weather, making possible the estimation of only very simple grouping criteria. The best work (Holdenridge, et al 1971) allowed sites to be pin-pointed to a fairly detailed description of vegetation, weather and soils; however, this work only covered a small number of sites and a comprehensive scheme could not be developed. Accounts of large areas were available from atlases and government reports. These provided a rationale for tying major regions together but the congruity between the sites was imprecise. These problems made it impossible to delineate ecological zones that were reliable. An attempt to use the environmental information would itself become arbitrary. It would not remedy the problems of the methods discussed above.

A fourth method would examine each locale separately, irrespective of sample size, although the analysis would use small samples cautiously. This is the chosen method. It provides statistics for the entire sample (Table 25) and analyzes the variability at each site in comparison to the whole. Even though not all sites are useful to the analysis of individual variation, it is clear that even a site with just 2 - 3 individuals will provide a more complete picture, especially for later studies of geographic and taxonomic variation. For example, significant results for the F - ratio are useful in this study no matter the sample size and should be included.

The following groups are exceptional cases where two or more sites were lumped into one sample. The justifications for permitting these exceptions to the method are included in the list below.

(1) Singapore, because Steele's sample was already lumped, and all specimens came from a single island.

(2) Pulau (P.) Batam, because adequate identification locations were not available for the collecting sites, and P. Batam is a single, small island.

(3) P. Terutau, because it may have already been lumped to some extent, and the specimens came from a single small island. Also, the site of Udang, Terutau could not be identified any closer than to the island itself.

(4) Kawthaung area, because all locales were within a small radius (ca. 10 miles) of each other, and it is a point of land without any noticable feature to break up its uniformity (Nuttonson 1963b).

(5) Moulmein area, because all locales were within a small radius (ca. 20 miles) of each other on the road to Moulmein, and there was no evidence that this section of road passed through diverse terrain (Nuttonson 1963a).

Chapter 3

RESULTS

The data are analyzed in 27 tables. Table 1 provides histogrammes of the data for each character, and was discussed in Chapter 2. Tables 2 - 24 summarize the data and give the results of the statistical analysis of each character for the individual sites and Table 25 does the same for the entire sample. Table 26 presents the average coefficients of variation for each sex and for the combined sexes, and Table 27 presents the results of the F - test separately from the rest of the statistical analysis in Tables 2 - 25.

A standard format for Tables 2 - 25 is followed as outlined here:

(1) The sample is subdivided into three categories: "Females", "Males", and the "Combined" sexes. The first line of each column has a sample mean for the measurement under consideration, and its standard deviation. The second line gives the minimum and maximum measurements for each sample. The third line lists the sample size and the coefficient of variation.

(2) A fourth column records the value of the F - ratio as computed on the sexes at a particular site (for Tables 2 - 24) or character (Table 25). An asterisk indicates a significant test result at the 0.05 level of confidence, while double asterices

indicate significance at the 0.01 level.

Variation in Total Length

Four sites show significant sexual dimorphism for Total Length (Table 2): Pulau Langkawi, Dan Sai, Chiang Mai, and Myitkyina. This is a relatively high incidence of significant dimorphism in the site samples (see Table 27), but, surprisingly, the entire sample is not significantly dimorphic for this character (Table 25). In the majority of the sites and in the entire sample, sexual variation is expressed as a tendency for the males to be larger than the females, although in all cases there is overlap between the range of measurements for the sexes.

The significant results for the tests for dimorphism have been described as being reliable (see Chapter 2), however, sample size remains a problem for the sites and some qualification should be added to the test results. This can be done by using as guidelines the suggestions made by Simpson, Roe, and Lewontin that (1) the samples have at least five specimens in them (1960:169), and (2) when the value of the coefficient of variation is below four then it is likely that the sample being tested is too small to adequately represent the variability which is present in the population (ibid:90). These guidelines will be used throughout this chapter to qualify the use of the significant results for small samples. In Table 2 the female samples of Chiang Mai and Myitkyina are inadequate according to the first guideline. At Pulau Langkawi the coefficient of variation for the male sample is low; however, the sample is relatively large and the low variability may be a reflection of the generally low variability which is found in many of the sites. Of the four significant results, only the one for Dan Sai needs no qualification.

The average coefficients of variation for the samples with at least five specimens (Table 26) show that the males have less intra-site variability than the females, and should be preferred as indicators of geographic variation. This preference is supported by the observation that the males have a greater variation in the entire sample than do the females (Table 25) and the females, while more variable within sites, are more conservative over the entire sample. Pooling the sexes together into a single combined sample does not result in a more variable sample despite the sexual dimorphism that has been noted. In fact, the coefficient of variation for the combined sample is less than the coefficient for the most variable sex by itself. This is true for both the entire sample (Table 25) and for the individual site samples (Table 26). Consequently, the sexual dimorphism that shows up when the sexes are compared, is masked in the combined sample which does not control for sexual variation.

Variation in Tail Length

Four sites show significant sexual dimorphism for Tail Length (Table 3): Trang, Letsok-aw Kyun, Ko Lak, and Dan Sai. This is a relatively high incidence of significant dimorphism for the samples (see Table 27), and corresponds to a significant dimorphism for the entire sample (Table 25). In the majority of the sites, and in the entire sample, sexual variation is expressed as a tendency for the males to have longer tails than the females, although, in all cases the range of measurements for each sex overlaps and in many sites the statistical means for the females are larger than for the males.

It is necessary to qualify the significant results of the F - test for this character. Ko Lak and Letsok-aw Kyun have samples that are inadequately small. Dan Sai has a female sample which is also small, and its corresponding coefficient of variation is small, suggesting that the sample is inadequate. The overall size of the combined sample at Dan Sai may be some compensation for the small female sample. Of the four significantly dimorphic sites only Trang needs no qualifications.

Tail Length is the most variable character is this study. It has the highest coefficients of variation that were calculated on the entire sample (Table 25) and has some of the highest average coefficients of variation for the site samples that have at least five specimens (Table 26). The average coefficients of variation show that the females have less intra-site variability than the males, and on this basis should be preferred as indicators of geographic variation. This difference in variability in the sexes is maintained in the entire sample as well (Table 25). Pooling the two sexes together into a single combined sample does not result in a more variable sample, despite the sexual dimorphism that has been noted. In fact, the coefficient of iation for the combined sample is less than the coefficient of variation for the most variable sex. This is true for both the entire sample (Table 25) and for the individual site samples (see Table 26). Consequently, the sexual dimorphism that shows up when the sexes are compared is masked in the combined sample which does not control for sexual variation.

Variation in Head and Body Length

There is no significant sexual dimorphism for Head and Body Length in any of the sites (Table 4) or in the entire sample (Table 25). The males are larger than the females in a majority of the sites.

The average coefficients of variation for the site samples with at least five specimens (Table 26) are relatively high for this study and this corresponds to the condition in the entire sample (Table 25).

Variation in Foot Length

None of the sites exhibit significant sexual dimorphism for Foot Length (Table 5), although the entire sample is significantly dimorphic at the 0.05 level of confidence (Table 25). In the majority of the sites, and in the entire sample, sexual variation is expressed as a tendency for the males to be larger than the females. In all of the samples there is considerable overlap of the range of measurements for the sexes.

The average coefficients of variation for the site samples with at least five specimens (Table 26) show that the males have less intra-site variability than the females, and should be preferred as indicators of geographic variation. This sexual difference in variability is maintained in the entire sample as well (Table 25). Pooling the sexes together into a single combined sample does not result in a more variable sample. In fact, the coefficient of variation for the combined sample is less than the coefficient of variation for the most variable sex. This is true for both the entire sample (Table 25), despite the sexual variation that has been noted, and for the individual site samples (Table 26). Consequently, the sexual dimorphism that shows up in the entire sample when the sexes are compared is masked in the combined sample which does not control for sexual variation.

Variation in Condylobasal Length

Two sites show significant sexual dimorphism for Condylobasal Length (Table 6): Bucki Besi and Chiang Mai. There is no significant dimorphism for this character over the entire sample (Table 25). In the majority of the sites, and in the entire sample, sexual variation is expressed as a tendency for the males to have a greater condylobasal length than the females, although in most cases there is overlap of the range of measurements for the sexes.

It is necessary to qualify the significant results of the F - test for this character. The sample at Bucki Besi is very small and inadequate by the guidelines. At Chiang Mai the female sample is also inadequately small. In view of the results for the entire sample, it seems likely that the significant sexual dimorphism to be found in these two sites could be biased by the sample's size.

The average coefficients of variation for the samples with at least five specimens (Table 26) show that the males have less intra-site variability than the females, and should be preferred as indicators of geographic variation. This prefer[illegible]nce is supported by the observation that the males have a greater variation in the entire sample than do the females (Table 25), and that the females, while more variable within sites, are more conservative over the entire sample. Pooling the sexes together into a single combined sample does not result in a more variable sample. In fact, the coefficient of variation for the combined sample is less than the coefficient for the most variable sex by itself. This is true for both the entire sample (Table 25) and for the individual site samples (Table 26). Consequently, the sexual dimorphism that shows up when the sexes are compared (including non-significant dimorphism), is masked in the combined sample which does not control for sexual variation.

Variation in Palatal Length

There is no significant sexual dimorphism for Pala[illegible] Length in any of the sites (Table 7) or in the entire samp[illegible] [illegible]able 25). [illegible] most of the sites and in the entire sample the mean size for the [illegible]ales is [illegible]ger than the females, the only exceptions being several sites [illegible] a [illegible]ngle specimen of one sex and Wet Kyun which also has an inadequate sample for one sex.

Variation in Cranial Length

Three sites show significant sexual dimorphism for Cranial Length (Table 8): Pulau Langkawi, Ko Tao, and Nakhon Sawan. The entire sample is also significantly dimorphic (Table 25). In the majority of sites and in the entire sample sexual variation is expressed as a tendency for the males to have a greater cranial length than the females, although in all cases the range of measurement for each sex overlaps, and in some sites the statistical means for the females are larger than for the males.

It is necessary to qualify the significant results of the F - test on this character. The female sample at Pulau Langkawi and both the male and female samples at Ko Lak are small and their corresponding coefficients are also small, suggesting that the samples are inadequate. The coefficients of variation at Nakhon Sawan are low but this may be a reflection of the generally low variability of this character in the sites (see Table 26).

The average coefficients of variation for the site samples with at least five specimens (Table 26) show that the males have less intra-site variability than the females, and on this basis should be preferred as indicators of geographic variation. The sexual difference in variability is maintained in the entire sample as well (Table 25). Pooling the sexes together into a single combined sample does not necessarily result in a more variable sample. In fact, for the entire sample, the coefficient of variation for the combined sample is less than for the most variable sex (Table 25), despite the sexual dimorphism that has been noted. Consequently, the sexual variation that shows up when the sexes are compared, is masked in the combined sample where sexual variation is not under control. In the individual site samples the sexual dimorphism is more apparent in the combined sample of males and females, and the average coefficient of variation for the combined sample is greater than that of either sex taken separately (Table 26).

Variation in the Maximum Width
of the Skull

Two sites show significant sexual dimorphism for the Maximum Width of the Skull (Table 9): Ko Tarutao, and Wet Kyun. The entire sample is not significantly dimorphic (Table 25). The sexual variation is not consistently expressed as any obvious size difference. In any one site either sex could have the greater statistical mean for this character, although in the entire sample it is the females which tend to have wider skulls. Furthermore, there is no consistent overlapping of the range of measurements for each sex in the site samples.

It is necessary to qualify the significant results of the F - test on this character. Wet Kyun has very small samples and low coefficients of variation, suggesting that the samples are inadequate. Ko Tarutao also has low coefficients although the samples are large enough to be accepted. The low coefficients may be reflecting the generally low variability that is found in this character (see Table 26), but the total lack of variation in the male sample is unusual for any sample.

The average coefficients of variation for the site samples with at least five specimens (Table 26) show that the males have less intra-site variability than the females, and should be preferred as indicators of geographic variation. This difference in variability is maintained in the entire sample (Table 25). Pooling the sexes together into a single combined sample does not result in a more variable sample, despite the sexual dimorphism that has been noted. In fact, the coefficient of variation for the combined sample is less than the coefficient for the most variable sex. This is true for the entire sample (Table 25) and for the individual site samples (see Table 26). Consequently, the sexual dimorphism that shows up when the sexes are compared is masked in the combined sample which does not control for sexual variation.

Variation in Bizygomatic Width

Three sites show significant sexual dimorphism for Bizygomatic Width (Table 10): Ko Tarutao, Ko Tao, and Nakhon Sawan. The entire sample shows a significant dimorphism at the 0.01 level of confidence (Table 25). In the majority of the sites and in the entire sample the sexual variation is expressed as a tendency for the males to have greater bizygomati widths than the females, although in most cases there is an overlap of the range of measurements for the sexes.

It is necessary to quality the significant results of the F - test on this character. All the site samples have low coefficients of variation, suggesting that the samples are too small to represent the variation present in the population; however, this may only be true for the very small samples at Ko Tao. Since the samples at Ko Tarutao and Nakhon Sawan satisfy the guidelines being used here, the low variability found in these sites may correspond to the generally low variability this character has in all the sites (see Table 26).

The average coefficients of variation for the site samples with at least five specimens (Table 26) show that the males have less intra-site variation than the females, and on this basis should be preferred as indicators of geographic variation. This difference in variability in the sexes is maintained in the entire sample (Table 25). Pooling the sexes together into a single combined sample does not necessarily result in a more variable sample. In the entire sample, the coefficient of variation for the combined sample is just equal to that of the most variable sex, despite the significant sexual dimorphism that has been noted. Consequently, the sexual variation that shows up when the sexes are compared is masked in the combined sample where sexual variation is not controlled; however, whereas the previous characters showed less variability in the combined sample relative to the most variable sex, this character has equal amounts of variability within the combined sample and the most variable sex. In the individual site samples the sexual dimorphism is more apparent in the combined sample of males and females, and the average coefficient of variation is greater than that of either sex taken separately (Table 26).

Variation in Biauricular Width

Two sites show significant sexual dimorphism for Biauricular Width (Table 11): Singapore and Nakhon Sawan. The entire sample is also significantly dimorphic (Table 25). In the majority of the sites and in the entire sample the sexual variation is expressed as a tendency for the males to have greater width than the females, although in most cases the range of measurements for each sex overlap.

It is necessary to qualify the significant results of the F - test on this character. At Singapore the sample is very small and the coefficients of variation are also low, suggesting that the sample is inadequate. Nakhon Sawan has a low coefficient of variation for the male sample but since the sample size is acceptable the coefficient may be explained by the generally low variability that is found in this character (see Tables 25 and 26).

The average coefficients of variation for the site samples with at least five specimens (Table 26) show that the males have less intra-site variability than the females, and on this basis should be preferred as indicators of geographic variation. This preference is supported by the observation that the males have greater variation in the entire sample than the females (Table 25) and the females, while more variable within sites, are more conservative over the entire sample. Pooling the sexes together into a single combined sample results in a more variable sample only in the case of the entire sample (Table 25). The same is not true for the individual site samples where the combined sample is less variable than the most variable sex (see Table 26). In the site samples the sexual dimorphism that shows up when the sexes are compared is masked in the combined sample which does not control for sexual variation.

Variation in Interorbital Width

Three sites show significant sexual dimorphism for Interorbital Width (Table 12): Pulau Tioman, Kanchanaburi, and Myitkyina. The entire sample is significantly dimorphic at the 0.01 level of confidence (Table 25). In all samples sexual variation is expressed as a tendency for the males to have greater interorbital width than the females, although in most cases there is an overlap of the range of measurements for the sexes.

It is necessary to qualify the significant results of the F - test for this character because the samples at all sites are very small and the coefficient of variation are all low. In light of this, none of the sites have samples that are adequate.

The average coefficients of variation for the site samples with at least five specimens (Table 26) show that the females have less intra-site variability than the males, and should be preferred as indicators of geographic variation. This difference in the variability of the sexes is maintained in the entire sample as well (Table 26). Pooling the sexes together into a single combined sample does not necessarily result in a more variable sample. For the entire sample the coefficient of variation for the combined sample is not quite equal to that of the most variable sex, despite the significant sexual dimorphism that has been noted. Consequently, the sexual variation that shows up when the sexes are compared is masked in the combined sample which does not control for sexual variation. In the individual site samples the average coefficient of variation for the combined samples is greater than that of the most variable sex, and the sexual variation is more apparent.

Variation in Orbital Length

One site shows significant sexual dimorphism, Ko Tao (Table 13), and the entire sample is not significantly dimorphic (Table 25). In most sites, but not in the entire sample, sexual variation is expressed as a tendency for the females to have longer orbits than the males, although there is overlap in the range of measurements for the sexes in most of the sites.

The significant result of the F - test on the sample from Ko Tao must be qualified because the sample is very small and the coefficients of variation are all very low. This suggests that the sample is probably inadequate.

The average coefficients of variation for the site samples with at least five specimens (Table 26) show that the males have less intra-site variability than the females, and on this basis should be preferred as indicators of geographic variation. This difference in variability between the sexes is maintained in the entire sample (Table 25). Pooling the sexes together into a single combined sample does not result in a more variable sample. In fact, the coefficient of variation for the combined sample is less than the coefficient for the most variable sex. This is true for both the entire sample (Table 25) and the individual site samples (Table 26). Consequently, the sexual dimorphism that might be present when the sexes are compared is masked in the combined sample which does not control for sexual variation.

Variation in Orbital Width

There is no significant sexual dimorphism for Orbital Width in any of the sites (Table 14) or in the entire sample (Table 25). The males tend to have wider orbits in most of the samples, but this is not consistent through all the sites.

Variation in the Height of the Brain-case

Two sites show significant sexual dimorphism in the Height of the Brain-case (Table 15): Pulau Tioman and Chiang Mai. The entire sample is not significantly dimorphic (Table 25). In the majority of the sites and in the entire sample, sexual variation is expressed as a tendency for the males to have higher brain-cases than the females, although there is overlap of the ranges of measurements for the sexes.

It is necessary to quality the significant results of the F - test for this character. Both sites have a sample with a single specimen and this is inadequately small.

The average coefficients of variation for the site samples with at least five specimens (Table 26) show that the males have less intra-site variability than the females and on this basis should be preferred as indicators of geographic variation. This difference in [illegible]y in the sexes is maintained in the entire sample as wel[illegible]. Pooling the sexes together into a single comb[illegible]does not result in a more variable sample. In fact, the co[illegible]cient of variation for the combined sample is less than for the most variable sex. This is true for the entire sample (Table 25) and for the individual site samples (Table 26). Consequently, the sexual dimorphism that shows up when the sexes are compared is masked in the combined sample which does not control for sexual variation.

Variation in the Distance from Opisthion to Opisthocranion

Five sites show significant sexual dimorphism for the Distance from Opisthion to Opisthocranion (Table 16): Bucki Besi, Singapore, Ko Tao, Nakhon Sawan, and Khon Kaen. This is the greatest incidence of significant dimorphism for all the characters considered here, and it is reflected in the entire sample by a dimorphism that is significant at the 0.01 level of confidence (Table 25). In nearly all of the sites and in the entire sample, sexual variation is expressed as a tendency for the males to have a greater distance between opisthion and opisthicranion than the females, although in most cases there is overlap of the range of measurements for the sexes.

It is necessary to qualify the significant results of the F - test for this character. Singapore, Bucki Besi and Ko Tao all have samples with fewer than five specimens, and the corresponding coefficients of variation are low, suggesting that the samples are inadequate. Nakhon Sawan and Khon Kaen have larger samples but their coefficients are low; however, this could be a function of the generally low variability that is found for this character.

The average coefficients of variation for the site samples with at least five specimens (Table 26) show that the females have less intra-site variability than the males, and on this basis should be preferred as indicators of geographic variation. This difference in the variability of the sexes is maintained in the entire sample as well. The coefficients of variation for the combined sexes is greater than the coefficient for either sex taken alone, as would be expected for a character with significant sexual dimorphism. This observation holds true for both the entire sample (Table 25) and for the individual sites (Table 26).

Variation in the Length of the
Maxillary Molar Row

Two sites show significant sexual dimorphism for the Length of the Maxillary Molar Row (Table 17): Pulau Langkawi and Kanchanaburi. There is no significant dimorphism in the entire sample (Table 25). In the majority of the sites and in the entire sample, sexual variation is expressed as a tendency for the males to have longer molar rows than the females, although in all cases there is overlap between the range of measurements for the sexes.

It is necessary to qualify the significant results of the F - test for this character. Both Pulau Langkawi and Kanchanaburi have a sample consisting of a single specimen, which is inadequate, although in both cases the other sample is adequate.

The average coefficients of variation for the site samples with at least five specimens (Table 26) show that the females have less intra-site variability than the males, and on this basis should be preferred as indicators of geographic variation. This difference in variability in the sexes is maintained in the entire sample as well (Table 25). Pooling the sexes together into a single combined sample does not necessarily result in a more variable sample. In fact, for the entire sample, which was not significantly dimorphic, the coefficient for the combined sample is less than the coefficient for the most variable sex. In the individual site samples the sexual dimorphism is more apparent and the average coefficient of variation for the combined sample is larger than that of either sex alone (Table 26).

Variation in the Bimolar Width at the Second Maxillary Molars

There is no significant sexual dimorphism for Bimolar Width in any of the sites (Table 18) or on the entire sample (Table 25). The males tend to have a greater distance between the molars than the females, but in some sites the opposite is true.

Variation in the Width between the
Second Maxillary Incisors

Four sites show significant sexual dimorphism in the Width between the Second Maxillary Incisors (Table 19): Sungei Endau, Bucki Besi, Si Chon and Nakhon Sawan. This is a relatively high incidence of significant dimorphism for the samples (see Table 27), and corresponds to a significant dimorphism at the 0.01 level of confidence for the entire sample (Table 25). In most of the sites and in the entire sample, sexual variation is expressed as a tendency for the males to have a greater width between the second maxillary incisors than do the females, although in most of the samples the range of measurements for the sexes overlap.

It is necessary to qualify the significant results of the F - test for this character. Sungei Endau, Bucki Besi and Si Chon all have small, possibly inadequate samples. The coefficients of variation for the samples at Nakhon Sawan are low, but this is definitely a function of the amount of variability the character has in general since the coefficients for the entire sample are comparably low.

The average coefficients of variation for the site samples with at least five specimens (Table 26) show that the females have less intra-site variability than the males, and on this basis should be preferred as indicators of geographic variation. This difference in the variability of the sexes is maintained in the entire sample (Table 25).

When the sexes are pooled together, there results a more variable sample, as indicated by the coefficient of variation for the combined sample, which is larger than the coefficients of either sex taken separately. This is true for the entire sample (Table 25) and for the individual site samples (Table 26).

Variation in the Length of the Mandibular Molar Row

Only one site, Kanchanburi, shows significant sexual dimorphism for the Length of the Mandibular Molar Row (Table 20). There is no significant dimorphism in the entire sample (Table 25). In the majority of the sites, sexual variation is expressed as a tendency for the males to have a greater length than the females, although there is overlap in the range of measurement and many exceptions to the tendency. In the entire sample it is the females which have the higher statistical mean for this character (Table 25).

The significant result of the F - test at Kanchanaburi must be qualified because there is only a single specimen in the male sample and this makes it inadequate.

The average coefficients of variation for the site samples with at least five specimens (Table 26) show that the females have less intra-site variability than the males, and on this basis should be preferred as indicators of geographic variation. This preference is supported by the observation that the females have a greater variation in the entire sample than do the males (Table 25), and that the males, while more variable within sites, are more conservative in the entire sample. Pooling the sexes into a single sample does not result in a more variable sample. In fact, the coefficient of variation for the combined sample is less than that of the most variable sex by itself. This is true for both the entire sample (Table 25) and for the individual site samples (Table 26). Consequently, the sexual dimorphism that shows up when the sexes are compared is masked in the combined sample where sexual variation is not under control.

Variation in the Length of the Jaw

Two sites show significant sexual dimorphism in the Length of the Jaw (Table 21): Singapore and Sungei Endau. The entire sample is significantly dimorphic at the 0.05 level of confidence (Table 25). In most of the sites and in the entire sample, sexual variation is expressed as a tendency for the males to have longer jaws than the females, although in most cases there is overlap of the range of measurements for the sexes.

It is necessary to qualify the significant results of the F - test on this character since both sites consist of very small samples and low coefficients of variation. This suggests that the samples are inadequate.

The coefficients of variation for the site samples with at least five specimens (Table 26) show that the males have less intra-site variability than the females, and on this basis should be preferred as indicators of geographic variation. This difference in the variability of the sexes is maintained in the entire sample (Table 25). Pooling the sexes together into a single combined sample does not necessarily result in a more variable sample. In fact, the average coefficient of variation for the combined sample in th[illegible]es i[illegible] less than the average coefficient for the most variab[illegible] sex [illegible]able 26). Consequently, the sexual variation that exists [illegible] the sexes are compared is masked [illegible] the combined sample. In the case of the entire sample the coefficient for the combined sample is greater than that of either sex, and it thus reflects the significant sexual dimorphism that is present in the sample.

Variation in the Height of the Ascending Ramus of the Mandible

Two sites show significant sexual dimorphism for the Height of the Ascending Ramus (Table 22): Singapore, and Si Chon. The entire sample is also significantly dimorphic, at the 0.01 level of confidence (Table 25). In the majority of the sites and in the entire sample, sexual variation is expressed as a tendency for the males to have greater height in the ascending ramus than the females, although in most of the sites there is overlap of the range of measurements for the sexes.

It is necessary to qualify the significant results of the F- test for this character. In both sites the samples are very small and the coefficients of variation are low. This suggests that the samples are inadequate.

The average coefficient of variation for the site samples with at least five specimens (Table 26) show that the males have less intra-site variability than the females, and on this basis should be preferred as indicators of geographic variation. This difference in the variability of the sexes is maintained in the entire sample (Table 25). Pooling the sexes together into a single combined sample does not result in a more variable sample. In fact, the average coefficient of variation for the combined sample in the sites is less than the average coefficient for the most variable sex (Table 26). Consequently, the sexual variation that exists when the sexes are compared is masked in the combined sample. In the case of the entire sample, the coefficient for the combined sample is greater than that of either sex taken separately, and the coefficient for the combined sample thus reflects the significant sexual dimorphism that is present in the entire sample.

Variation in the Height of the Mandibular Condyle

Two sites show significant sexual dimorphism for the Height of the Mandibular Condyle (Table 23): Pulau Langkawi and Nakhon Sawan. The entire sample is also significantly dimorphic, at the 0.01 level of confidence (Table 25). In most sites and in the entire sample, sexual variation is expressed as a tendency for the males to have greater height on the mandibular condyle than do the females, although in most of the sites there is overlap of the range of measurements of the sexes.

It is necessary to qualify the significant results of the F - test for this character. Pulau Langkawi has a sample with a single specimen in it, and this is inadequate. At Nakhon Sawan the coefficient of variation for the male sample is low, but this could be a reflection of the generally low variability found in this character.

The average coefficients of variation for the site samples with at least five specimens (Table 26) show that the males have less intra-site variability than the females, and on this basis should be preferred as indicators of geographic variation. This difference in the variability of the sexes is maintained in the entire sample. Pooling the sexes together into a single combined sample does not necessarily result in a more variable sample. In fact, the coefficient of variation for the combined sample of all the specimens is less than the coefficients of either sex taken separately, despite the significant sexual dimorphism that has been noted for the entire sample. Consequently, the dimorphism that exists when the sexes are compared is masked in the combined sample which does not control for sexual variation. The same is not true for the individual sites. In this case, the average coefficients of variation for the combined sample are larger than the most variable sex taken separately (Table 26) as would be expected when there is sexual dimorphism.

Variation in the Length of the Maxillary Tooth Row

There is no evidence of significant sexual dimorphism in the Length of the Maxillary Tooth Row in any of the sites (Table 24) or in the entire sample (Table 25). The males tend to be longer than the females, but in many cases the opposite is true.

The Entire Sample

Table 25 lists the results of the statistical analysis carried out on the entire sample for each of the characters. Since it does not exclude sites on the basis of their sample size, there are more specimens represented in Table 25 than from the total for all the sites in Tables 2 - 24. Table 25 follows the same format as the previous tables.

The coefficients of variation indicate that there is not a lot of individual variation within the entire sample. Simpson, Roe, and Lewontin observed that the great majority of values for the coefficient of variation in mammalian populations lie between four and ten (1960:122). They suggested that values which are lower usually indicate that the sample was not adequate to show variability, while values that are much higher indicate that the sample was not homogeneous (ibid.). Most of the values for the coefficient in Table 25 are low, as if the sample had been inadequate to show the variability in the population; however, since a sample of 30 or more is usually considered a large sample for statistical purposes (see Peatman 1963:194, e.g.), and since the smallest sample in Table 25 has 74 specimens in it, it follows that none of the samples in the table should be considered too small. This leaves the results of the coefficient to stand as being accurate approximations of the true variation in the population, and leads to the obvious conclusion that the characters have little variability. In actual counts, eleven of the female samples, eleven of the male samples, and twelve of the samples of the combined sexes fall below Simpson, Roe, and Lewontin's range of values for the coefficient. The characters which are least variable when all three sample groups (Female, Male, Combined) are considered together are: Condylobasal Length, Cranial Length, the Maximum Width of the Skull, Biauricular Width, Orbital Length, Orbital Width, the Height of the Brain-case, the distance from Opisthion to Opisthiocranion, the Length of the Maxillary Molar Row, Bimolar Width at the Second Maxillary Molars, Incisor Width at the Second Maxillary Incisors, the Length of the Mandibular Molar Row, and Jaw Length. Only one character, Tail Length has a high coefficient of variation, and it should be considered to be a highly variable character. The remaining eight characters have an average amount of variability.

The F - test revealed a considerable amount of significant sexual dimorphism in the characters of Table 25. The results for six of the characters are significant at the 0.01 level of confidence, and an additional five characters have results that are significant at 0.05. The remaining twelve characters are not significantly dimorphic. The mean sizes for the males are generally greater than those of the females, although in two characters the females are slightly larger, and in one character the sexes have the same means. The coefficients of variation tend to be similar for each sample category for a character, although in most cases, the coefficient for the combined sexes is less than that of the most variable sex, as was the case when the characters were compared over the individual sites. In the characters where the dimorphism is significant at the 0.01 level of confidence, the coefficient for the combined sexes sometimes exceeds that of the most variable sex, but never by much, and sometimes (i.e., in the case of the height of the Mandibular Condyle) it is lower than the coefficient for either sex. Once again, the pooling of the sexes masks the sexual variation that is apparent when the sexes are compared.

The following characters can be isolated as having little variation, either individual or sexual: Condylobasal Length, the Maximum Width of the Skull, Orbital Length, Orbital Width, the Height of the Brain-case, the Length of the Maxillary Molar Row, Bimolar Width at the Second Maxillary Molar, the Length of the Mandibular Molar Row. These may be considered the most conservative characters. The following characters have no significant sexual dimorphism but relatively high coefficients of variation: Total Length, Head and Body Length, Palatal Length, and the Length of the Maxillary Tooth Row. They are probably the most sensitive to local, non-sexual selection processes. The following characters have significant sexual dimorphism but low coefficients of variation: Cranial Length, Biauricular Length, the Distance from Opisthion to

Opisthiocranion, Incisor Width at the Second Maxillary Incisors, and Jaw Length. These are probably subject to stronger sexual selection processes than the other characters. The remaining characters are the most variable for the entire sample: Tail Length, Foot Length, Bizygomatic Width, Interorbital Width, the Height of the Ascending Ramus of the Mandible, and the Height of the Mandibular Condyle.

Variation in the Site Samples

Table 26 presents the average coefficients of variation for each sex and for the combined sexes. The average is derived from all the sites where the sample for a given sample group (that is, Female, Male, or Combined) is greater than or equal to five specimens. Since the sample size varies for each column and row of the Table, the lists of sites used in each of the calculations are not necessarily identical, but this should not detract from the value of the Table.

The average coefficients of variation in Table 26 provide a summary of the variation to be found within local populations where geographic variation is minimal. As would be expected, the values of the average coefficients are lower than the values of the corresponding coefficients for the entire sample (Table 25) where geographic variation is not under control. Relative to the coefficients for other mammalian groups (as discussed by Simpson, Roe, and Lewontin 1960:122), the average coefficients for the sites in Table 26 are small and suggest that the samples used for their calculation are inadequate; however, small values are also found in the entire sample where there is no question of the adequacy of the samples. It may be, therefore, that the average coefficients of variation for the sites are simply reflecting the low variation that is present in the entire sample. The lower values for the average coefficients would be expected as a result of removing the influence of geographic variation from the corresponding coefficient that was calculated on the entire sample. The small values of the average coefficients in Table 26 can then be explained as resulting from an extremely low variability within the site population, rather than by suggesting that the samples used for the calculations were too small. This conclusion is supported by the low variability which is evident in many of the larger site samples.

Sexual Dimorphism

Table 27 presents the results of the F - test separately from the rest of the statistical analysis that is provided in Tables 2 - 25. Dashes indicate a non-significant test result, 'x' indicates a significant test result (with alpha set at 0.05), and an underlined 'x' indicates a significant test result with no qualifications (refer to the discussion of the specific character for information on the nature of the qualifications). All of the information that is presented in Table 27 has been discussed with the previous tables (Tables 2 - 25); however, but juxtaposing all of the results of the F - test some further observations can be made.

The underlined 'x's show that few of the test results do not require some qualifications arising from the nature of the samples upon which they were calculated. The only ones which stand alone are grouped in five sites: Ko Tarutau, Trang, Nakhon Sawan, Khon Kaen, and Dan Sai. The inclusion of the qualified test results is justified on the basis that they provide additional information which, if it is used with the stated qualifications in mind, allows a more complete comparison of the entire sample to the individual site samples.

There are several differences between the overall dimorphism of the entire sample compared to the individual sites. The entire sample has eleven significantly dimorphic characters (when alpha is set at 0.05) which is a greater incidence than is found in any one of the sites. At the alpha level which is more appropriate for the large entire sample, 0.01, there are six significantly dimorphic characters. This is comparable to the results for some of the individual sites; however, different sets of characters are involved in each case. Tail Length, for example, has a relatively high incidence of significant sexual dimorphism in the sites yet is not significantly dimorphic in the entire sample. Conversely, some of the characters which are significantly dimorphic in the entire sample when alpha is set at 0.01, have a low incidence of significance in the sites, and Foot Length which is significant in the entire sample (alpha equals 0.05) is never significantly dimorphic in the sites. In cases where there is greater dimorphism in the sites than in the entire sample, there must be strong geographic variation in the expression of sexual differences, and the cumulative effect of all the sites and specimens is to produce a fairly homogeneous sample with no significant dimorphism. The opposite effect also occurs in some of the characters when there is an amplification of sexual dimorphism so that it is greater in the entire sample than in any of the individual sites. A partial explanation, other than geographic variation, for these differences between the results for all the sites and the entire sample is the absence of data on some of the characters for many of the sites. No character is represented in every site, and this establishes a limit on some of the comparisons. Some of the cranial characters, especially, are restricted to just a few sites. If all the data were filled in, there might be greater comparability between the sites and the entire sample.

Chapter 4

CONCLUSIONS

The classifications of the common t shrew, Tupaia glis are presently in a state of confusion and uncertainty. Some authors (e.g., Chasen 1940, Ellerman and Morrison-Scott 1951) recognize a single species classification for the common tree shrew on the mainland, while others (e.g. Martin 1966, Elliot et al 1969) state that more than one species should be recognized. Therefore, it is necessary to undertake a review of the variation which is present in the taxon in order to understand the taxonomic relationships within the group. The present work initiated this process by documenting a museum sample of common tree shrews collected along the Malay Peninsula and its adjoining areas. The documentation divided the entire sample down into three sex-based groups: Female, Male, and the Combined Sexes. This provided a means by which individual variation and sexual variation could be studied separately. In order to control for variation caused by the geographic dispersal of the entire sample, there was also a similar analysis of the individual collecting sites. This approach clarified, to some extent, the nature of the variation within the study group.

Individual variation was examined with the standard deviation and the coefficient of variation. Both statistics measure character variability within samples and allow comparisons between the samples. The standard deviation was less useful than the coefficient of variation but it is listed in the Tables primarily because it forms a building block for other more c statistics, including the coefficient of variation. The coefficient of variation is more useful because it can be compared to a wider range of samples. While the standard deviation is limited to comparisons between similar samples, the coefficient can also compare the variability of different characters. This gave it greater applicability to the present study. Furthermore, the coefficient of variation allows comparison of the samples of tree shrews to other groups of mammals. Thus, it could be determined whether the study sample was more or less variable than samples from other mammalian populations.

All of the values of the coefficient of variation for the cranial characters examined in the present study are very low, suggesting a great deal of homogeneity in the sample. This is a surprising result, since previous ta ic studies unanimously agreed that the common tree shrew had distinct northern and southern forms. These studies did not appear to use cranial characters to the extent found in the present work; nonetheless, they indicated that any study which mixed the forms together as a single sample would find marked heterogeneity. Thus, the expectation was that the values of the coefficient of variation would be high. In fact, the contrary condition is exhibited and, in some samples the homogeneity is extreme.

With regard to the coefficients for the body characters for the entire sample, the values are average or slightly higher than the average for mammals in general. Still, none are sufficiently high, that is, greater than the value of ten (Simpson, Lewontin, and Roe 1960:122), to suggest non-homogeneity of the sample. At the same time, the coefficients for the most variable character (tail length), when taken over the entire sample, are so much higher than the coefficients for the other characters that geographic variation must be affecting tail length. This suggestion is supported by the observation that the values for the coefficient of variation for tail length for the collecting sites are much lower than those for the entire sample.

The preceding observation has the following implications for future studies. The collecting sites used in this study are geographically localized, and it can be assumed that they are minimally influenced by geographic variation. On the other hand, the entire sample extends over a large area, and a certain amount of diversity should be expected in this sample. The variation as represented by the statistical measures indicates that the entire sample is very homogeneous, but this may not adequately represent important geographic variation in a biological sense. It may be better to examine the geographic variation for the individual collecting sites to those for the entire sample. The differences between these two values will indicate the relative extent of geographic variation on the entire sample. The result of this procedure is the observation that, although the values of the coefficient are low compared to other mammalian groups, the values for the entire sample are often relatively high in comparison to those for the collecting sites. Thus, in a statistical sense these values indicate homogeneity; yet, for the common tree shrew, these values may indicate a heterogeneous sample. Further study, on the geographic variation in the entire sample of all specimens, is necessary to test this observation and to determine the affect of geographic variation.

Sexual variation is documented in the separate sex-based columns of the Tables. The F - ratio tested the samples for significant sexual dimorphism with results which revealed a surprising degree of dimorphism. This has never been reported for T. glis, and obviously reveals an important source of populational variation that has hitherto gone undocumented. The discovery of significant sexual dimorphism could have important consequences for the structure of the classification of T. glis. Unfortunately, the expression of the dimorphism is variable and the interpretation of the results of the F - ratio must be done with a certain amount of caution. The results reported here only show that most of the characters exhibit a significant dimorphism in at least some of the collecting sites, the entire sample, or both. No clear pattern emerges from the present study. The gross body characters show a relatively high incidence of significant dimorphism in the site samples, but this is only weakly reflected in the results for the entire sample. There are six cranial characters which are significantly dimorphic at the 0.01 level of confidence (bizygomatic width, interorbital width, distance from opisthion to opistocranion, incisor width, height of the ascending ramus of the mandible, height of the mandibular condule) and an additional three that are dimorphic at the 0.05 level (cranial length, bi-auricular width, jaw length), both taken over the entire sample. This is matched in the sites where fifteen of the cranial characters exhibit significant dimorphism (condylobasal length, cranial length, maximum width of the skull, bizygomatic width, interorbital width, orbital length, height of the braincase, distance from opisthion to opistocranion, molar row length, incisor width, length of the molar row of the jaw, jaw length, height of the ascending ramus of the mandible, height of the mandibular condyle). In all of the characters the differences between the results for the site samples and the entire sample suggests some kind of geographic influence on the nature of the sexual variation. This influence makes it difficult to establish any clear conclusions within the limits of the present analysis, and it is best to restrict speculation on the taxonomic importance of the dimorphism until the geographic variation in T. glis has received closer review. It is possible, though, to generalize that the males would be better indicators of geographic variation and taxonomic relationships. The basis of this generalization is the slightly lower variability of the samples of males compared to the female samples from individual collecting sites.

The female samples, with their greater variability within sites, or a combined sample of both sexes, with its intrinsic sexual variability, would add unnecessary confusion to the taxonomic analysis. It is interesting to note, though, that the combined samples are not necessarily more variable than the sex samples taken separately. The coefficients of variation are usually smaller in the combined sex sample than the most variable sex. This is true even in many of the samples which had significant sexual dimorphism. The overlapping ranges and close association of the character's means are such that there is no increase in overall variability in most of the combined samples. However, this does not affect the findings of sexual dimorphism since the F - ratios show that the population variances and means are such that it is unlikely that the sex samples share a common variance and mean. The overall effect that this situation creates within the combined sample may explain why previous taxonomists, who did not rely on statistical tests, failed to notice sexual variation.

The results and conclusions presented here provide an analysis of the structural variation within populations of the common tree shrew. This forms a basis from which the geographic variation of the characters can be studied. The present research did not answer all the important taxonomic questions which were raised in the introductory chapter; however, this was not the intention. Rather, the intention was to make a contribution to renewed discussions of the classification of the common tree shrew.

Future research must now continue the analysis and examine the problems of geographic variation in order to, eventually, arrive at a classification which adequately represents a fuller understanding of the common tree shrew.

F I G U R E S

Figure 1

Regional map showing the location of all the sites. The numbering on the map corresponds to the numbering of the sites in Appendix A.

(Map by Cartography Division, Department of Geography, University of Alberta.)

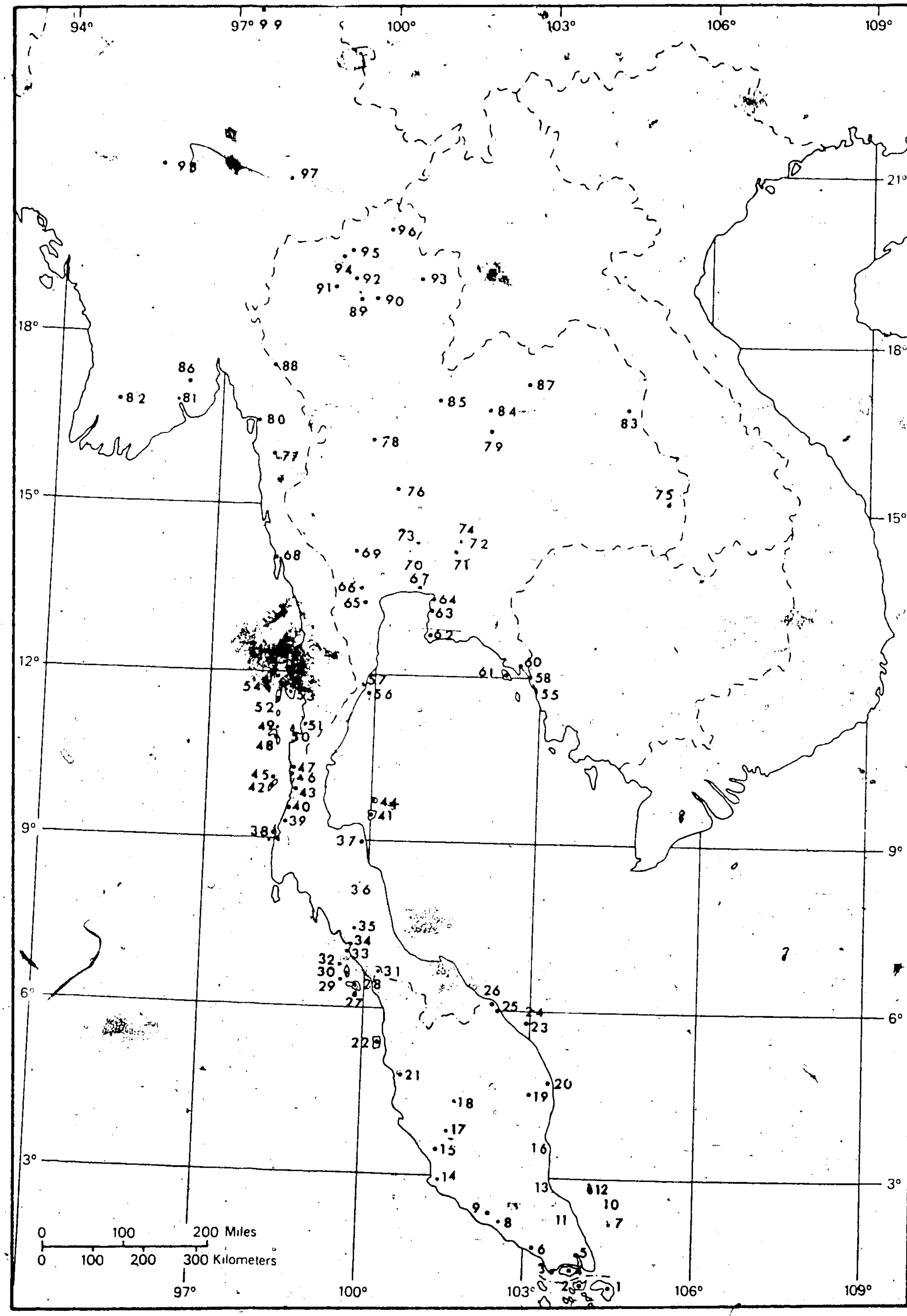

94°
97°
100°
103°
106°
109°
21°
18°
15°
12°
9°
6°
3°
0 100 200 Miles
0 100 200 300 Kilometers

Figure 2

Regional map showing the location of the sites used for Tables 2?- 24.
The numbering on the map corresponds to the numbering of the sites in Appendix A.

(Map by Cartography Division, Department of Geography, University of Alberta.)

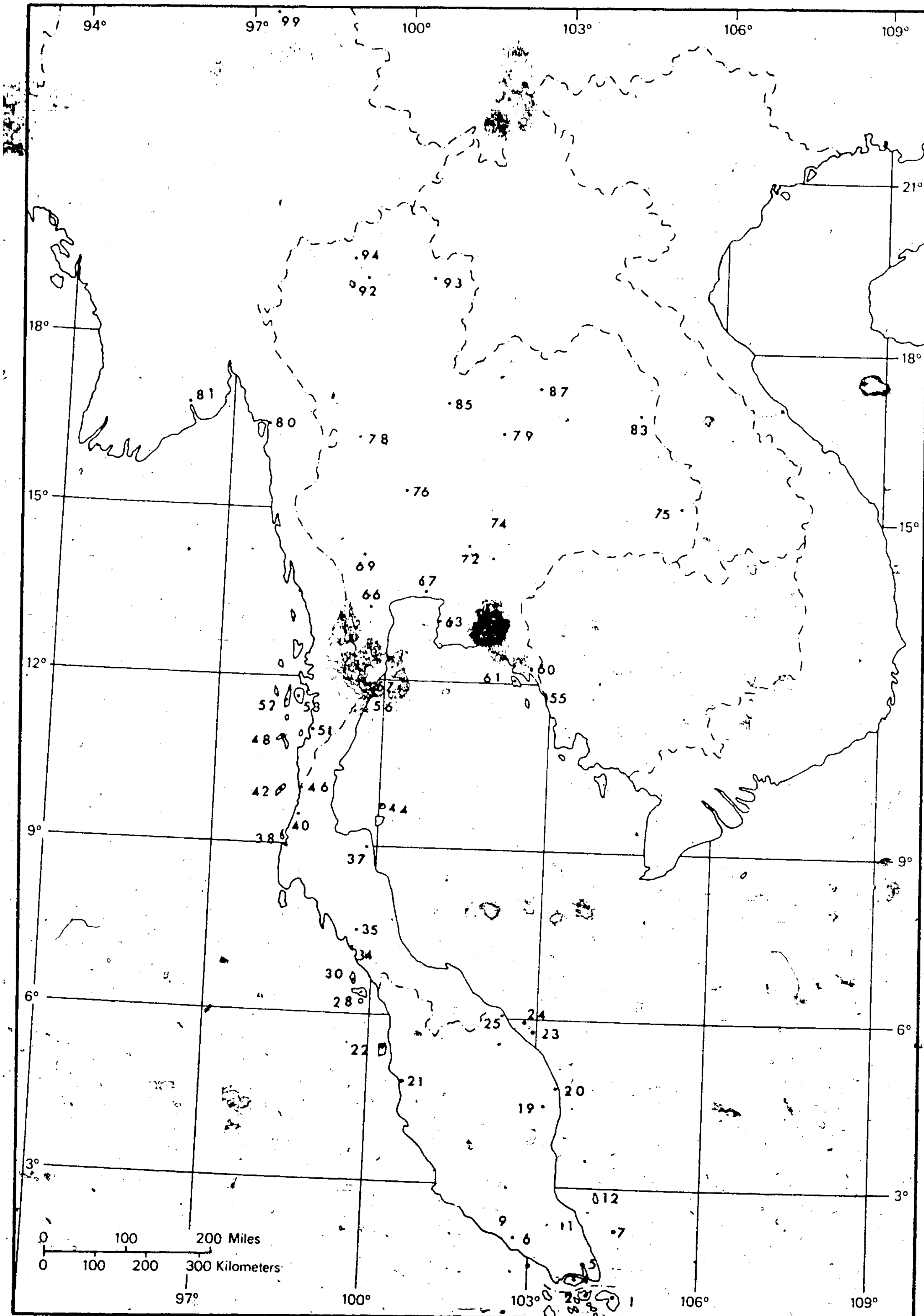

94°
97°
99
100°
103°
106°
109°
21°
18°
15°
12°
9°
6°
3°
94
92
93
81
80
78
85
87
79
83
76
74
75
72
69
67
66
63
61
60
55
57
56
52
53
51
48
42
46
44
40
38
37
35
34
30
28
25
24
23
22
21
20
19
12
11
9
7
6
5
2
1
0
100
200 Miles
0
100
200
300 Kilometers

Figure 3

An illustration showing the positions of the measurements of the skull. The numbering of the measurements in this figure correspond to the numbering of the measurement list in the text (page 21).

Figure 3a -- dorsal view of skull
Figure 3b -- basal view of skull
Figure 3c -- lateral view of skull
Figure 3d -- lateral view of mandible

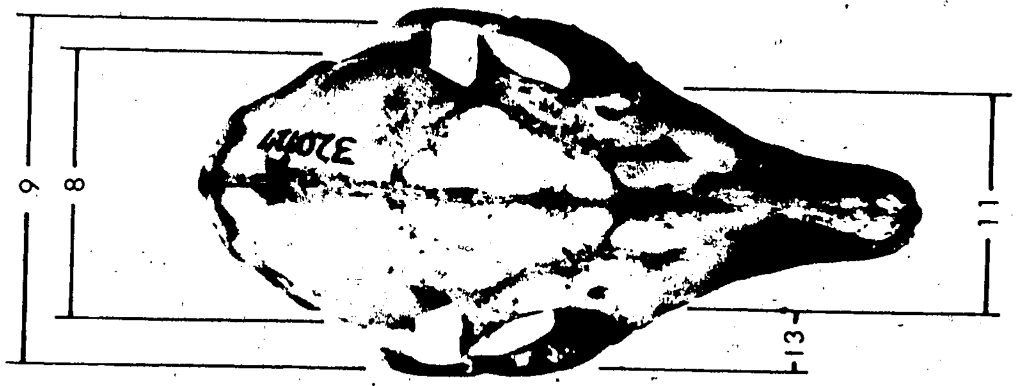


Fig. 3a

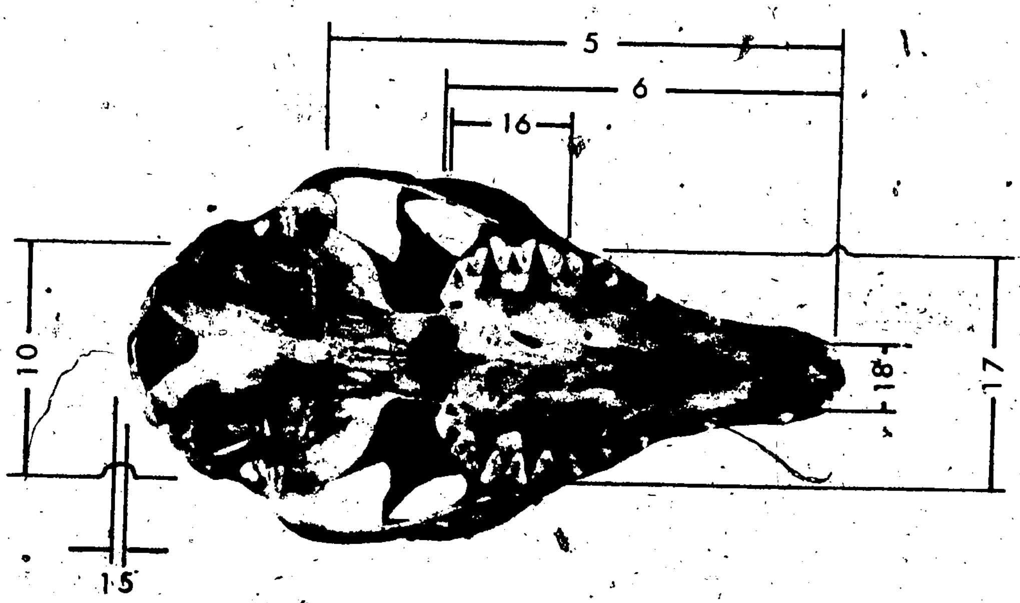


Fig. 3b

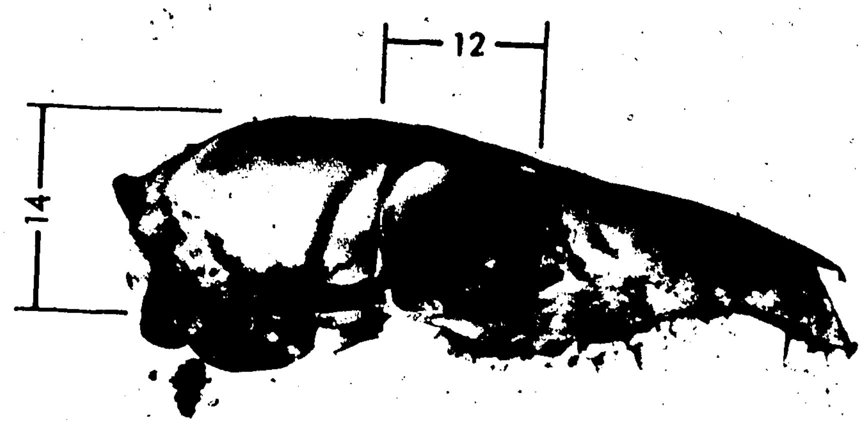


Fig. 3c

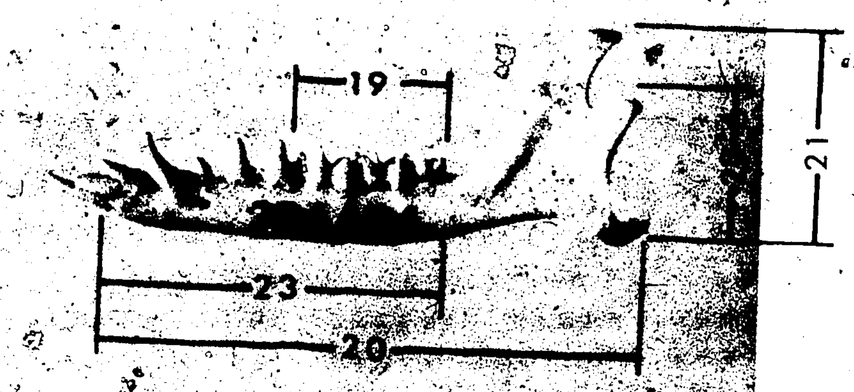
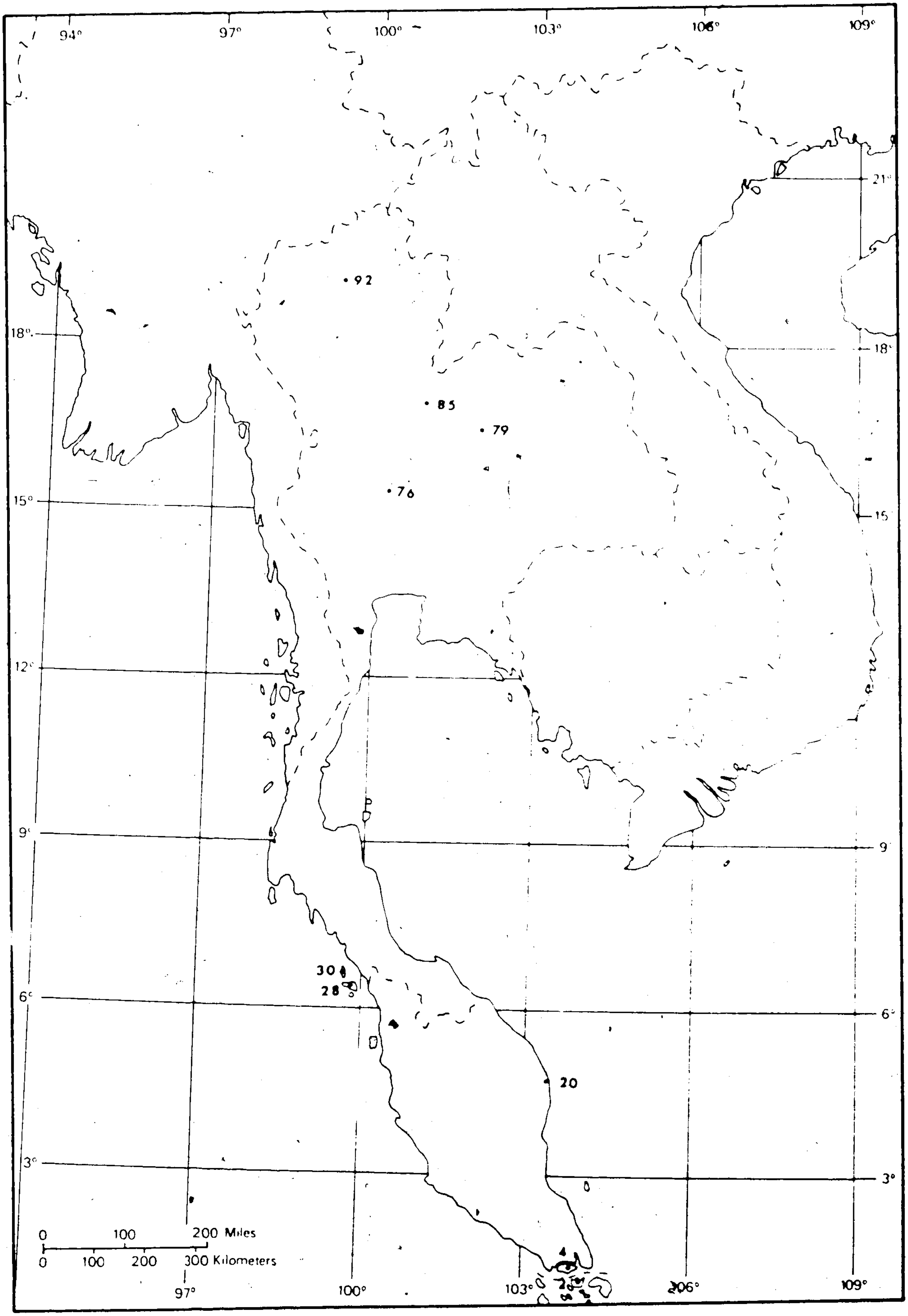


Fig. 3d

Figure 4

Regional map showing the location of sites with ten or more specimens.
The numbering on the map corresponds to the numbering of the sites in Appendix A.

(Map by Cartography Division, Department of Geography, University of Alberta.)


94°
97°
100°
103°
106°
109°
21°
18°
15°
12°
9°
6°
3°
92
85
79
76
30
28
20
4
0 100 200 Miles
0 100 200 300 Kilometers

BIBLIOGRAPHY

Arrighi, F.E., M.W. Sorenson, and L.R. Shirley
1969 Chromosomes of the tree shrews (Tupaiidae), in Cytogenetics, 8:199-208.

Chasen, F.N.
1940 A handlist of Malaysian mammals. Bulletin of the Raffles Museum, Singapore, 15:1-209.

Davis, D.D.
1962 Mammals of the lowland rainforest of North Borneo. Bulletin of the Natural Museum, Singapore, 31:1-129.

Dixon, W.J. (ed.)
1968 BMD Biomedical computer programs. University of California Publications in automatic computation #2, University of California Press.

Ellerman, J.R., and T.C.S. Morrison-Scott
1951 Checklist of Palaeartic and Indian mammals 1758 to 1946. British Museum (Natural History), London.

Elliot, O.S., M. Wong, and D.S. Borgaonkar
1969 Karyological study of Tupaia from Thailand. Journal of Heredity, 60:3:153-157.

Freeman, L.
1965 Elementary applied statistics for students in behavioural science. J. Wiley and Sons, Inc.

Hill, J.E.
1960 The Robinson collection of Malaysian mammals. Bulletin of the Raffles Museum, 29:1-112.

Holdenridge, L.R., W.C. Grenke, W.H. Hatheway, T. Liang and J.A. Tosi, Jr.
1971 Forest environments in tropical life zones, a pilot study. Pergamon Press.

Kloss, C.B.
1911 On new mammals from the Trengganu Archipelago. Annals and magazine of Natural History, Series 8, 7:115-119.

1916 On a collection of mammals from the coast and islands of Southeast Siam. Proceedings of the Zoological Society of London, 1916:27-76.

1918 On a fourth expedition of Siamese mammals. Journal of the Natural History Society of Siam, 3:49-69.

1919 On mammals collected in Siam. Journal of the Natural History Society of Siam, 3:4:33-407.

1920 On a small collection of mammals from Cambodia. Journal of the Natural History Society of Siam, IV: 2:99-102.

Lyon, M.D., Jr.
1913 Treeshrews: an account of the mammalian family Tupaiidae. Proceedings of the United States National Museum #1976, Smithsonian Museum, Vol. 45:1-288.

Martin, R.D.
1966 Reproduction and ontology in tree shrews (Tupaia belangeri) with reference to their general behaviour and taxonomic relationships. Z. Tierphyschol., 5:409.

Mayr, E.
1963 Animal species and evolution. Belknap Press.

Medway, Lord
1961 The status of Tupaia splendidula Gray (Primates, Tupaiidae). Tueubia, 25:3:269-272.

Napier, J.R., and P.H. Napier
1967 A handbook of living primates: morphology, ecology, and behaviour of non-human primates. Academic Press.

Nuttonson, M.Y.
1963a The physical environment and agriculture of Burma, with a supplement. American Institute of Crop Ecology.

1963b The physical environment of and agriculture of Thailand. American Institute of Crop Ecology.

Peatman, J.C.
1963 Introduction to applied statistics. Harper and Row.

Simpson, G.G., and A. Roe
1939 Quantitative zoology. McGraw-Hill.

Simpson, G.G., A. Roe, and R.C. Lewontin
1960 Quantitative zoology. Harcourt, Brace & Co.

Steele, D.G.
1973 Dental variability in the Tree Shrews (Tupaiidae), in Symposia of the 4th International Congress of Primatology, Vol 3: Craniofacial biology of primates, 154-179.

United States Board on Geographic Names

1966a Burma, official standard names gazetter.

1966b Thailand, official standard names gazetter.

1970 Malaysia, official standard names gazetter.

APPENDIX A

List of Sites

The following list of sites provides the standardized spellings, exact map co-ordinates, synonymous spellings of site names used in reference works or on reference materials, sample sizes at each site, and indications of type localities.

The following format was used throughout the Appendix for each site:

Line 1 - site name map co-ordinates
Line 2 - (synonymous spellings and names) sample size

An asterix (*) beside Line 1 indicates type localities.

The standardized names and spellings, and map co-ordinates are derived from the United States Board on Geographic Names gazetters (1966a, 1966b, 1970). The synonymous spellings and names are those encountered in the literature listing a specimen that was used for data, and also those listed by Steele in his data sheets. Type localities are of _T. glis_ (in the sense of Chasen 1940 and Ellerman and Morrison-Scott 1951) and its synonyms. The type localities were identified from the information in Lyon (1913), Chasen (1940), Ellerman and Morrison-Scott (1951), Napier and Napier (1967), and Steele's own data sheets (made up from specimens at the Smithsonian Institution).

All sites in the Appendix are listed in order according to their latitude from south to north, and secondarily from west to east.

1.	Bintan, Pulau (P.) (Bintan Is.)	1 05N 104 30E	5	*
2.	Batan, P. (Batan Is.)	1 05N 104 3E	15	*
3.	Pulai, Sungei (Pulai)	1 20N 103 33E	1	
4.	Singapore (Singapore, Singapore Botanic Gardens, Woodlands, West Singapore Is.)	1 22N 103 48E	24	*
5.	Pelepah, Sungei	1 44N 103 52E	3	
6.	Sembrong, Sungei	1 52N 103 3E	1	
7.	Melaka (Malacca)	2 12N 102 15E	4	
8.	Aor, P. (Aur Is.)	2 27N 104 31E	2	*
9.	Silantai, Tanjong	2 35N 101 54E	1	
10.	Pemanggil, P. (Pemanggil Is.)	2 35N 104 20E	1	*
11.	Endau, Sungei (Endau R.)	2 40N 103 38E	7	
12.	Tioman, P. (Tioman Is.)	2 48N 104 11E	8	*
13.	Rompin, Sungei (Pumpin R., Pahang)	2 49N 103 29E	2	
14.	Kuala Lumpur	3 10N 101 42E	1	

15.	Kuala Selangor (Selangor)	3 21N 101 15E	1	
16.	Pahang, Sungei (Pahang R.)	3 32N 103 28E	1	
17.	Ginting Perah, Bukit (Ginting Bidai)	3 33N 101 25E	3	
18.	Mount Brinchang	4 30N 101 25E	1	
19.	Bucki Besi	4 46N 103 11E	5	
20.	Dungun, Tanjong (Tanjong Dungan)	4 47N 103 26E	11	
21.	Maxwell, Buckit (Maxwell Hill)	4 52N 100 48E	2	
22.	Pinang, P. (Penang Is., Koh Penang)	5 24N 100 14E	5	*
23.	Redang, P. (Great Redang Is.)	5 47N 103 1E	2	*
24.	Perhentian Kechil, P. (East Perhentian Is.)	5 55N 102 44E	2	*
25.	Kampong Gunong (Gunong Tahan, Pahang)	5 59N 102 21E	2	
26.	Kelantan, Sungei (Kelantin)	6 13N 102 14E	1	
27.	Borau, Sungei (Boru)	6 21N 99 40E	1	
28.	Langkawi, P. (Is. of Lankawi)	6 22N 99 48E	15	*
29.	Butang, Ko (Butang, P. Adang)	6 32N 99 12E	2	
30.	Tarutao, Ko (P. Terutau, S. Udang, Terutau, Terutau, Ko)	6 35N 99 40E	15	
31.	Kaki Bukit	6 39N 100 12E	2	

32.	Rawi, Ko	6 33N	99 14E	1	*
33.	Talibong, Ko (Trang)	7 15N	99 23E	1	*
34.	Trang	7 33N	99 36E	12	
35.	Mae Nam (Tarang)	7 19N	99 30E	4	
36.	Ban Kasom Nua (Bankasum)	8 2N	99 41E	1	
37.	Si Chon (Si Chong)	9 00N	99 54E	6	
38.	Chong, Ko (Chong)	9 13N	98 21E	6	
39.	Ban Mong Klang (Muang Klang)	9 37N	98 33E	2	
40.	Lamae, Khlong (Lamra, Trang)	9 47N	99 8E		
41.	Phangan, Ko (Koh Pangan Is.)	9 47N	100 00E	1	*
42.	Zadetykyi Kyun (St. Mathews Is.)	9 58N	98 13E	8	
43.	Kawthaung (Victoria Point and area-- Tanjong Badak, Telok Besar)	9 59N	98 33E	7	
44.	Tao, Ko	10 5N	99 52E	5	*
45.	Zadetkale Kyun (St. Luke's Is.)	10 8N	98 12E		
46.	Cheokling (Cheonkhon)	10 17N	98 36E	1	
47.	Baleigh, Sungei (Sungei Balik)	10 28N	98 30E	1	
48.	Wet Kyun (James Is., Buda Is.)	10 30N	93 32E	10	

49.	Lanbi Kyun (Sullivan Is.)	10 50N 98 15E	2	
50.	Clara Is.	10 54N 97 55E	1	
51.	Bokpyin	11 16N 98 46E	2	
52.	Letsθk-aw Kyun (Domel Is.)	11 37N 98 15E	5	
53.	Kanmaw Kyun (Kisseraing Is.)	11 40N 98 28E	5	
54.	Bentinck Is.	11 45N 98 03E	1	
55.	Khlong Yai	11 46N 102 54E	2	*
56.	Lak, Ko (Ko Lak)	11 48N 99 49E	3	*
57.	Prachuap Khiri Khan	11 49N 99 48E	4	
58.	Khao Khlong Menao	11 57N 102 48E	1	
59.	Tenasserim	12 5N 99 1E	4	
60.	Trat	12 14N 102 30E	3	
61.	Chan, Ko (Koh Chang Is.)	12 31N 100 58E	2	*
62.	Sattahip, Khao	12 42N 100 55E	1	
63.	Nong Kho, Khlong (Nong Kho)	13 07N 101 2E	3	
64.	Chon Buri	13 22N 100 59E	2	
65.	Pak Tho	13 23N 99 51E	3	

66.	Rat Buri	13 32N 99 48E 1
67.	Bangkok	13 45N 100 31E 6
68.	Tavoy	14 5N 98 12E 2
69.	Kanchanaburi	14 1N 98 32E 7
70.	Chaiyo	14 39N 100 28E 2
71.	Pak Chong	14 42N 101 25E 1
72.	Lat Bua Khao, Sathani (Lat Bua Khao)	14 52N 101 36E 3
73.	Lop Buri	14 48N 100 37E 2
74.	Nakhon Ratchasima (Nakon Ratchasima)	14 58N 102 7E 5
75.	Ubon Ratchathani	15 14N 104 54E 3
76.	Nakhon Sawan (Nakon Sawan)	15 41N 100 7E 11
77.	Thakahta (Thagatta)	16 4N 98 27E 1
78.	Khlong Khlung	16 12N 99 43E 3
79.	Khon Kaen	16 26N 102 50E 14
80.	Moulmein	16 30N 97 38E 8
81.	Rangoon	16 47N 96 10E 2
82.	Kyaukkyi (Kaukarit)	16 50N 94 24E 1

83.	Sakon Nakhon (Nakon Sawan)	17 10N 104 9E 1	
84.	Phu Kradung	16 53N 101 53E 1	
85.	Dan Sai	17 17N 101 9E 12	
86.	Pegu	17 20N 96 29E 2	*
87.	Udon Thani (Udonthani)	17 26N 102 46E 3	
88.	Thaungyin R. (Thaungyeen R.)	17 50N 97 42E 1	
89.	Khun Tan, Sathani (Khun Tan)	18 30N 99 16E 1	
90.	Bang Pang La	18 33N 99 52E 1	
91.	Inthanon, Doi (Doi Anka Mtn.)	18 35N 98 29E 1	
92.	Chiang Mai (Chieng Mai)	18 47N 98 59E 10	
93.	Nan	18 47N 100 47E 9	*
94.	Pai (Mung Pai)	19 19N 98 27E 2	
95.	Chieng Dao	19 22N 98 58E 1	
96.	Chiang Ra	19 54N 99 50E 1	
97.	Nammai	20 59N 98 4E 1	
98.	Zibugon (Zibugaung, Lower Chindwin)	22 15N 95 54E 1	*
100.	Myitkyina	25 23N 97 24E 7	

APPENDIX B

TABLES

Table 1

Histogrammes of each character taken by sex over the entire sample.

The standard format of each row from left to right is: Interval, Female, Male.

Total length:

```
395.000 ) *
390.000 ) **        ***
385.000 ) *         **
380.000 ) *         ****
375.000 ) *         **
370.000 ) ****      **********13
365.000 ) ********  **********
360.000 ) **********  **********13
355.000 ) *******   **********13
350.000 ) **********13**********17
345.000 ) **********13********
340.000 ) **********12**********19
335.000 ) **********19*********
330.000 ) **********18**********19
325.000 ) *******   ********
320.000 ) **********  **********12
315.000 ) ********  ****
310.000 ) ***       *****
305.000 ) *         **
300.000 )
295.000 ) *
290.000 ) **        *
```

Tail length:

```
204.000 )
200.000 ) **        *****
196.000 ) *         *
192.000 ) **        *****
188.000 ) ***       ********
184.000 ) *********  **********11
180.000 ) ********  **********18
176.000 ) ******    ***
172.000 ) **********11**********14
168.000 ) *********  **********14
164.000 ) **********11**********12
160.000 ) **********15**********14
156.000 ) **********11**********11
152.000 ) **********25**********21
148.000 ) **********18**********14
144.000 ) *******   ******
140.000 ) *******   ****
136.000 )           ***
132.000 ) ***       ***
128.000 )           *
124.000 )
120.000 )
```

Body length: ♀

```
215.000 )
210.000 )            *
205.000 ) *
200.000 ) *******    ****
195.000 ) ********   *********11
190.000 ) *********16*********22
185.000 ) *********21*********16
180.000 ) *********17*********35
175.000 ) *********17*********23
170.000 ) *********23*********29
165.000 ) *********15*********13
160.000 ) *********** ******
155.000 ) ******     *
150.000 )            **
145.000 )
140.000 ) *
135.000 )
130.000 )
125.000 )
120.000 )            *
115.000 )
110.000 )
```

Foot length:

```
48.750 )
48.000 ) *.         **
47.250 )
46.500 ) *          ********
45.750 ) *********  *********
45.000 ) *********27*********33
44.250 )
43.500 ) *********15*********19
42.750 ) *********23*********36
42.000 ) *********35*********19
41.250 )
40.500 ) *********20**********
39.750 ) *********18*********21
39.000 ) **         **
38.250 )
37.500 ) **         *
36.750 )
36.000 )
35.250 )
34.500 ) *
33.750 ) *
33.000 )
```

Condylobasal length:

```
52.000 )
51.500 )*
51.000 )
50.500 )*
50.000 )****               **
49.500 )*****           ********
49.000 )*******         *********11
48.500 )*******         *********11
48.000 )*********       *********13
47.500 )*********       *********19
47.000 )*********20*********15
46.500 )*********14*********17
46.000 )*********22*********12
45.500 )*********18*******
45.000 )*********12*********12
44.500 )*****           *****
44.000 )***             **
43.500 )***             ***
43.000 )*               **
42.500 )*
42.000 )                *
41.500 )
```

Palatal length:

```
29.400 )
29.100 )*
28.800 )           *
28.500 )           *
28.200 )**         ****
27.900 )**         ******
27.600 )****       ****
27.300 )***        *****
27.000 )*********  ********
26.700 )*****      *********
26.400 )*******    *********11
26.100 )*******    ***
25.800 )********   ***
25.500 )********   ********
25.200 )*********  *******
24.900 )*****      ****
24.600 )****       ***
24.300 )*          ****
24.000 )**
23.700 )*          *
23.400 )
23.100 )
```

Cranial length:

```
22.600 )
22.400 )*
22.200 )
22.000 )            *
21.800 )            *
21.600 )*
21.400 )*           ***
21.200 )****        *******
21.000 )******      ****
20.800 )**          **********
20.600 )******      **********11
20.400 )******      **********
20.200 )*********** *****
20.000 )**********11**********12
19.800 )*******     *********
19.600 )**********  ****
19.400 )*****       ***
19.200 )***         ****
19.000 )**          *
18.800 )**
18.600 )**
18.400 )
```

Maximum width of the skull:

```
20.800 )
20.600 )
20.400 )**          **
20.200 )**          *
20.000 )**********19*********
19.800 )***         **
19.600 )*****       ****
19.400 )**********26**********25
19.200 )****        ***********
19.000 )**********37**********48
18.800 )*********** **********12
18.600 )*********** **********
18.400 )**********17**********16
18.200 )****        ******
18.000 )******      *****
17.800 )******
17.600 )
17.400 )
17.200 )
17.000 )*
16.800 )
16.600 )
```

Bizygomatic width:

```
28.800 )
28.400 ) *
28.000 )            *
27.600 )
27.200 ) *          *
26.800 ) ***        **********
26.400 ) ******     *******
26.000 ) *******    *********18
25.600 ) ***        ***
25.200 ) *********  *********18
24.800 ) *********25*********25
24.400 ) ********   *********21
24.000 ) *********28*********13
23.600 ) *********15**********
23.200 ) *********17*********
22.800 ) ********** ****
22.400 ) *********  **
22.000 ) *          ***
21.600 )
21.200 ) **
20.800 )
20.400 )
```

Biauricular width:

```
18.400 )
18.200 )
18.000 )            *
17.800 )            *
17.600 ) *          **
17.400 ) *          *
17.200 ) **         **
17.000 ) ***        ******
16.800 ) *          **********
16.600 ) *********  *******
16.400 ) *********11******
16.200 ) *******    *********13
16.000 ) *******    *********
15.800 ) *********14*****
15.600 ) *******    ******
15.400 ) ********** ****
15.200 ) ****       ****
15.000 )            ***
14.800 )
14.600 ) *
14.400 )
14.200 )
```

Interorbital width:

```
15.800 )
15.600 )
15.400 )            **
15.200 )            ***
15.000 ) **         ****
14.800 ) ***        *
14.600 )            ******
14.400 ) ******     ******
14.200 ) *****      *****
14.000 ) ********   ******
13.800 ) ********   *********16
13.600 ) *********14*********12
13.400 ) ********   *********
13.200 ) *****      ****
13.000 ) *********12*****
12.800 ) ***        **
12.600 ) **
12.400 ) *
12.200 ) *          *
12.000 )
11.800 )
11.600 )
```

Orbital length:

```
12.000 )
11.850 )
11.700 )
11.550 ) *          *
11.400 ) *          *
11.250 )            *
11.100 ) ***        ****
10.950 ) ****       ******
10.800 ) ********   ***
10.650 ) ******     *******
10.500 ) *********14*********14
10.350 ) *********13*********11
10.200 ) ********** *********20
10.050 ) ***        ***
 9.900 ) ******     *****
 9.750 ) **         ****
 9.600 ) ******     *
 9.450 )
 9.300 ) *          *
 9.150 )
 9.000 )
 8.850 )
```

Orbital width:

```
11.850 )
11.700 )
11.550 )             *
11.400 )
11.250 )
11.100 )
10.950 ) **          *
10.800 ) *
10.650 ) *           *
10.500 ) *****       *******
10.350 ) *******     ******
10.200 ) *********19*********17
10.050 ) ****        *********11
 9.900 ) *********12*********20
 9.750 ) *********11*****
 9.600 ) *********   ******
 9.450 ) ***         ****
 9.300 ) **          ***
 9.150 ) **
 9.000 )
 8.850 )
```

Height of the brain case:

```
17.200 )
17.000 )
16.800 ) *
16.600 )
16.400 )
16.200 )
16.000 ) **
15.800 ) **          *
15.600 ) *           **
15.400 ) **          ***
15.200 ) *****       ****
15.000 ) ***         *****
14.800 ) *******     **********14
14.[illegible]   *********12**********14
14.400     *******12**********
14.200      ******12**********12
14.000       *****   *********
13.800 )             ******
13.600 )             **
13.400 )
13.200 )
```

Distance from ophisthion to opistocranion:

```
13.800 )
13.650 )
13.500 )            **
13.350 )
13.200 )            *
13.050 ) *          *
12.900 )            ****
12.750 ) **         ****
12.600 ) ****       *********14
12.450 ) ******     ********
12.300 ) *********  *********14
12.150 ) ********   **********
12.000 ) *********15*********
11.850 ) ******     ****
11.700 ) *********16*********
11.550 ) *****      **
11.400 ) ***
11.250 ) **
11.100 ) *
10.950 )
```

Molar row length (M^1 - M^3):

```
10.650 )
10.500 )
10.350 )            *
10.200 )
10.050 )
 9.900 )
 9.750 )
 9.600 ) *
 9.450 )            **
 9.300 ) **         ***
 9.150 ) **         *
 9.000 ) *******    *********14
 8.850 ) ******     **********
 8.700 ) *********27*********13
 8.550 ) ********   *********
 8.400 ) *********14*********16
 8.250 ) ***        ***
 8.100 ) ****       *****
 7.950 ) **
 7.800 )
```

Bimolar width:

```
17.550 )
17.400 ) ***        *
17.250 )            **
17.100 )            **
16.950 ) *          *
16.800 ) *****      ********
16.650 ) ******     ****
16.500 ) ******     *********
16.350 ) *******    ********
16.200 ) ****       *********11
16.050 ) ****       *******
15.900 ) *********16*******
15.750 ) *******    ***
15.600 ) *******    ******
15.450 ) ***        ****
15.300 ) *******    **
15.150 )            ****
15.000 ) **         **
14.850 )
14.700 )            *
14.550 )
14.400 )
```

Incisor width:

```
7.125 )
7.050 )            *
6.975 )            **
6.900 )            ****
6.825 )
6.750 ) *          ****
6.675 )            *******
6.600 ) ******     *********13
6.525 )
6.450 ) ***        **********
6.375 ) *****      *********
6.300 ) *******    *********13
6.225 )
6.150 ) *********12******
6.075 ) *********12*****
6.000 ) *********15***
5.925 )
5.850 ) *********12****
5.775 ) ****
5.700 ) *
5.625 )
5.550 )            *
```

Length of the molar tooth row (M_1 - M_3):

```
10.800 )
10.700 )*
10.600 )
10.500 )*
10.400 )            *
10.300 )            *
10.200 )**          ***
10.100 )***
10.000 )**          *****
 9.900 )*****       *****
 9.800 )*********11 ****
 9.700 )*******     *****
 9.600 )*********   *********
 9.500 )********    *********12
 9.400 )**          *********
 9.300 )*****       **********
 9.200 )*********** *****
 9.100 )*****       ******
 9.000 )**          *
 8.900 )***         *
 8.800 )*           *
 8.700 )
```

Jaw length:

```
38.000 )
37.600 )
37.200 )
36.800 )            ***
36.400 )**          **
36.000 )*
35.600 )**          ******
35.200 )**          ***
34.800 )****        *********
34.400 )*******     ******
34.000 )*********** *********11
33.600 )*******     *********11
33.200 )*********11 ********
32.800 )*********12 **********
32.400 )********    *****
32.000 )**          ***
31.600 )**          *
31.200 )**          **
30.800 )***         *
30.400 )
30.000 )
29.600 )
```

Height of the ascending ramus:

```
15.400 )
15.200 )            *
15.000 )            *
14.800 )            **
14.600 ) *          *
14.400 )            *****
14.200 ) *          *****
14.000 ) ***        ********
13.800 ) *******    ****
13.600 ) ****       *********13
13.400 ) *********11********
13.200 ) ********   ********
13.000 ) *********  ********
12.800 ) *********11*******
12.600 ) ********   ****
12.400 ) ***        **
12.200 ) **
12.000 ) **
11.800 ) **         *
11.600 ) *
11.400 ) *
11.200 )
```

Height of the mandibular condyle:

```
10.200 )
10.050 )
 9.900 )            **
 9.750 )            *
 9.600 ) *          *
 9.450 ) *          *
 9.300 ) **         ******
 9.150 ) *          *****
 9.000 ) *******    *******
 8.850 ) **         *****
 8.700 ) ********** *********19
 8.550 ) *****      *****
 8.400 ) *********13*********15
 8.250 ) *******    ***
 8.100 ) ******     ****
 7.950 ) ********   **
 7.800 ) *******    **
 7.650 ) **
 7.500 ) *
 7.350 ) *
 7.200 )
 7.050 )
```

Length of the maxillary tooth row:

```
20.700 )
20.400 )*
20.100 )
19.800 )****           **
19.500 )*********12*********11
19.200 )
18.900 )*********19*********17
18.600 )
18.300 )*********   *********16
18.000 )*********18*********22
17.700 )
17.400 )*********11****
17.100 )*
16.800 )****           **
16.500 )               *
16.200 )
15.900 )*              *
15.600 )
```

Format Note

Tables 2 - 25 follow a standard format:

(1) Each sex and the combined sex columns are arranged as follows:

average S.D.
(minimum - maximum)
N C.V.

(2) The F - ratio is asterixed (*) if significant at α = 0.05. Table 25 indicates a significance at α = 0.01 by double asterices (**).

Table 2 Variation in total length

	FEMALE	MALE	COMBINED	F-RATIO
Bintan, P.				
	345	360	352.50 10.61	
			(345 - 360)	
	1	1	2 3.00	
Batam, P.				
	345.63 10.20	345.43 10.85	345.53 10.12	0.00
	(334 - 360)	(333 - 358)	(333 - 360)	
	8 2.95	7 3.14	15 2.93	
Singapore				
	337.60 11.85	338.20 23.49	337.90 17.54	0.00
	(323 - 325)	(305 - 365)	(305 - 365)	
	5 3.51	5 6.95	10 5.19	
Pelepah, Sungei				
	345	345.00 7.07	345.00 5.00	0.00
		(340 - 350)	(340 - 350)	
	1	2 2.05	3 1.45	
Aor, P.				
			378.50 9.19	
			(372 - 385)	
			2 2.43	
Endau, Sungei				
	338.33 4.73	356.25 13.77	348.57 13.93	4.49
	(333 - 342)	(340 - 370)	(333 - 370)	
	3 1.40	4 3.87	7 4.00	
Tioman, P.				
	324.60 9.84	330.59 0.71	326.29 8.54	0.64
	(316 - 341)	(330 - 331)	(316 - 341)	
	5 3.03	2 0.21	7 2.62	
Ginting Perah Bidai				
	361	342.00 19.80	348.33 17.79	0.61
		(328 - 356)	(328 - 356)	
	1	2 5.79	3 5.11	
Bucki Besi				
	331.50 7.68	347	334.60 9.61	3.26
	(320 - 336)		(320 - 347)	
	4 2.32	1	5 2.87	

	FEMALE	MALE	COMBINED	F-RATIO
Dungun, Tanjong	342.86 7.22 (330 - 349) 7 2.11	338.50 2.12 (337 - 340) 2 0.63	341.89 6.58 (330 - 349) 9 1.93	0.65
Maxwell Bukit			329.0 8.49 (323 - 335) 2 2.58	
Redang, P.			341.50 16.26 (330 - 353) 2 4.76	
Perhentian Kechil, P.			367.00 9.90 (360 - 374) 2 2.70	
Kampong Gunong			336.00 4.24 (333 - 339) 2 1.26	
Langkawi, P.	308.83 17.22 (290 - 330) 6 5.58	324.50 6.26 (314 - 335) 8 1.93	317.79 14.14 (290 - 335) 14 4.45	5.75*
Kaki Bukit	324.50 0.71 (324 - 325) 2 0.22		324.50 0.71 (324 - 325) 2 0.22	
Tarutao, K.	320.17 10.59 (309 - 335) 6 3.31	320.71 6.73 (310 - 330) 7 2.10	320.46 8.33 (309 - 335) 13 2.60	0.01
Trang, Trang	335.83 16.25 (310 - 355) 6 4.84	332.50 11.73 (320 - 350) 6 3.53	334.17 13.62 (310 - 355) 12 4.08	0.17
Mae Nam		341.00 10.15 (330 - 350) 3 2.98	341.00 10.15 (330 - 350) 3 2.98	

	FEMALE	MALE	COMBINED	F-RATIO
Chong, Ko	348.25 12.37 (336 - 365) 4 3.55	342.50 24.75 (325 - 360) 2 7.23	346.33 14.94 (325 - 365) 6 4.31	0.16
Lamae, Klong	351.00 13.23 (341 - 366) 3 3.77	365.00 9.90 (358 - 372) 2 2.71	356.60 13.07 (341 - 372) 5 3.66	1.58
Si Chon		338.00 9.56 (330 - 349) 4 2.83	338.00 9.56 (330 - 349) 4 2.83	
Ban Mong Klang		355.00 21.21 (340 - 370) 2 5.98	355.00 21.2 (340 - 370) 2 5.98	
Zadetkyi Kyun	326.50 13.44 (317 - 336) 2 4.11	330.50 10.21 (320 - 343) 6 3.09	329.50 10.18 (317 - 343) 8 3.09	0.21
Kawthaung	350 1	344.50 17.45 (330 - 365) 4 5.06	345.60 15.31 (330 - 365) 5 4.43	0.08
Letsok-aw Kyun	323.50 9.19 (317 - 330) 2 2.84	315.33 4.62 (310 - 318) 3 1.46	318.60 7.20 (310 - 330) 5 2.26	1.89
Kanmaw Kyun	341.67 2.89 (340 - 345) 3 0.84	355.00 7.07 (330 - 340) 2 2.11	339.00 5.48 (330 - 345) 5 1	2.40
Klong Yai			382.00 14.14 (372 - 392) 2 3.70	
Lak, Ko	337	362.50 10.61 (355 - 370) 2 2.93	354.00 16.52 (337 - 370) 3 4.67	3.85

	FEMALE		MALE		COMBINED		F-RATIO
Tenasserim							
	360		365		362.50	3.54	
					(360 - 365)		
	1		1		2	0.98	
Prachuap Khiri Khan							
	360		342.67	17.79	347.00	16.91	0.71
			(330 - 363)		(330 - 363)		
	1		3	5.19	4	4.87	
Trat							
	376.00	8.49	386		379.33	8.33	0.93
	(370 - 382)				(370 - 386)		
	2	2.26	1		3	2.20	
Chon Buri							
					370.00	14.14	
					(360 - 380)		
					2	3.82	
Pak Tho							
	350.00	0.00	375		358.33	14.43	
	(350)				(350 - 375)		
	2	0.00	1		3	4.03	
Kanchanaburi							
	336.00	17.42	343		337.17	15.84	0.13
	(324 - 366)				(324 - 366)		
	5	5.18	1		6	4.70	
Chai Yo							
			360.00	0.00	360.00	0.00	
			(360)		(360)		
			2	0.00	2	0.00	
Lat Bua Kao							
			365.00	15.00	365.00	15.00	
			(350 - 380)		(350 - 380)		
			3	4.11	3	4.11	
Lop Buri							
	337.50	10.61			337.50	10.61	
	(330 - 345)				(330 - 345)		
	2	3.14			2	3.14	
Ubon Ratchathani							
	386		347.00	25.46	360.00	28.83	1.56
			(329 - 365)		(329 - 386)		
	1		2	7.34	3	8.01	

	FEMALE	MALE	COMBINED	F-RATIO
Nakhon Ratchashima				
	364.33 30.02 (335 - 395) 3 8.24	394 1	371.75 28.65 (335 - 395) 4 7.71	0.73
Nakhon Sawon				
	345.00 15.52 (328 - 366) 5 4.50	356.83 13.59 (340 - 373) 6 3.81	351.45 15.06 (328 - 373) 11 4.29	1.82
Khlong Khlung				
		345.67 4.04 (342 - 350) 3 1.17	345.67 4.04 (342 - 350) 3 1.17	- -
Khon Kaen				
	362.80 7.05 (352 - 370) 5 1.93	361.67 17.10 (338 - 390) 9 4.73	362.07 13.98 (338 - 390) 14 3.86	0.02
Moulmein				
	355.00 0.00 (355) 2 0.00	360.00 10.00 (350 - 370) 3 2.78	358.00 7.58 (350 - 370) 5 2.12	0.45
Dan Sai				
	355.00 10.00 (330 - 350) 4 2.99	356.25 10.61 (340 - 370) 8 2.98	349.17 14.43 (330 - 370) 12 4.13	11.07*
Udonthani				
		370.00 8.66 (365 - 380) 3 2.34	370.00 8.66 (365 - 380) 3 2.34	
Chiang Mai				
	340.00 4.24 (337 - 343) 2 1.25	361.63 9.67 (350 - 375) 8 2.67	357.30 12.56 (337 - 375) 10 3.35	8.91*
Nan				
	354.33 18.64 (335 - 390) 6 5.26	374.00 22.63 (358 - 390) 2 6.05	359.25 20.11 (335 - 390) 8 5.60	1.55
Pai				
	325.50 12.02 (317 - 334) 2 3.69		325.50 12.02 (317 - 334) 2 3.69	

	FEMALE		MALE		COMBINED		F-RATIO
Wet Kyun							
	327.67	8.74	329.00	17.69	328.33	12.50	0.01
	(318 - 335)		(310 - 345)		(310 - 345)		
	3	2.67	3	5.38	6	3.81	
Myitkyina							
	328.00	5.57	362.00	11.31	341.60	19.86	21.90*
	(322 - 333)		(354 - 370)		(322 - 370)		
	3	1.70	2	3.13	5	5.81	

Table 3 Variation in tail length

	FEMALE		MALE		COMBINED		F-RATIO
Bintan, P.							
	147.50	3.54	155.00	6.25	152.00	6.28	2.24
	(145 - 150)		(150 - 162)		(145 - 162)		
	2	2.40	3	4.03	5	4.13	
Batam, P.							
	153.38	5.13	151.86	7.43	152.67	6.11	0.22
	(145 - 160)		(141 - 161)		(141 - 161)		
	8	3.34	7	4.89	15	4.00	
Singapore							
	156.20	2.68	155.60	9.24	155.90	6.42	0.02
	(154 - 160)		(140 - 162)		(140 - 163)		
	5	1.72	5	5.94	10	4.12	
Pelepah, Sungei							
	158		165.00	7.07	162.67	6.43	0.65
			(158 - 170)		(158 - 170))		
	1		2	4.29	3	3.95	
Aor, P.							
					182.50	10.61	
					(175 - 190)		
					2	5.81	
Endau, Sungei							
	150.33	7.02	161.00	9.93	156.43	9.91	2.47
	(143 - 157)		(151 - 173)		(143 - 173)		
	3	4.67	4	6.16	7	6.34	
Tioman, P.							
	146.00	6.00	158.50	9.19	149.57	8.68	4.88
	(140 - 152)		(152 - 165)		(140 - 165)		
	5	4.11	2	5.80	7	5.80	
Ginting Perah Bidai							
	166		165.50	7.78	165.67	5.51	0.00
			(160 - 171)		(160 - 171)		
	1		2	4.70	3	3.32	
Bucki Besi							
	151.50	9.47	152		151.60	8.20	0.00
	(140 - 163)				(140 - 163)		
	4	6.25	1		5	5.41	

	FEMALE	MALE	COMBINED	F-RATIO
Dungun, Tanjong	159.57 9.50 (152 - 178) 7 5.95	162.25 6.60 (155 - 170) 4 4.07	160.55 8.31 (152 - 178) 11 5.18	0.24
Maxwell Bukit			152.50 3.54 (150 - 155) 2 2.32	
Redang, P.			171.00 11.31 (163 - 179) 2 6.62	
Perhentian Kechil, P.			186.50 3.54 (184 - 189) 2 1.90	
Kampong Gunong			162.50 13.44 (153 - 172) 2 1.59	
Langkawi, P.	139.83 8.42 (133 - 154) 6 6.02	148.75 11.18 (129 - 167) 8 7.52	144.93 10.75 (129 - 167) 14 7.42	2.65
Kaki Bukit	157.50 10.61 (150 - 165) 2 6.74		157.50 10.61 (150 - 165) 2 6.74	
Tarutao, Ko	146.86 5.27 (140 - 155) 7 3.59	144.29 5.35 (135 - 150) 7 3.70	145.57 5.27 (135 - 155) 14 3.62	0.82
Trang, Trang	156.83 7.49 (150 - 170) 6 4.78	167.50 8.80 (160 - 180) 6 5.26	162.17 9.58 (150 - 180) 12 5.91	5.11*
Mae Nam	165 1	158.67 6.51 (152 - 165) 3 4.10	160.25 6.18 (152 - 165) 4 3.86	0.71

	FEMALE	MALE	COMBINED	F-RATIO
Chong, Ko	171.50 7.85 (162 - 181) 4 4.58	158.00 19.80 (144 - 172) 2 12.53	167.00 12.81 (144 - 181) 6 7.67	1.68
Lamae, Khlong	162.00 7.21 (156 - 170) 3 4.45	169.00 2.83 (167 - 171) 2 0.17	164.80 6.53 (156 - 171) 5 3.97	1.58
Si Chon		156.50 6.87 (150 - 165) 4 4.38	156.50 6.87 (150 - 165) 4 4.38	
Ban Mong Klang		175.00 35.36 (150 - 200) 2 20.20	175.00 35.36 (150 - 200) 2 20.20	
Zadetkyi Kyun	152.00 0.00 (152) 2 0.00	153.67 4.23 (150 - 159) 6 2.76	153.25 3.65 (150 - 159) 8 2.38	0.28
Kawthaung	157.50 3.54 (155 - 160) 2 2.25	158.75 8.06 (152 - 168) 4 5.08	158.33 6.47 (152 - 168) 6 4.08	0.04
Letsok-aw Kyun	153.50 2.12 (152 - 155) 2 1.38	137.00 1.73 (135 - 138) 3 1.26	143.60 9.18 (135 - 155) 5 6.39	93.34*
Kanmaw Kyun	156.67 5.77 (150 - 160) 3 3.69	151.00 1.41 (150 - 152) 2 0.94	154.40 5.18 (150 - 160) 5 3.35	1.68
Klong Yai			188.50 12.02 (180 - 197) 2 6.38	
Lak Ko	165 1	182.50 0.71 (182 - 183) 2 0.39	176.67 10.12 (165 - 183) 3 5.73	408.33*

	FEMALE	MALE	COMBINED	F-RATIO
Tenasserim				
	175	185	180.00 7.07	
			(175 - 185)	
	1	1	2 3.93	
Prachuap Khiri Khan				
	185	168.33 10.41	172.50 11.90	1.92
		(160 - 180)	(160 - 185)	
	1	3 6.18	4 6.90	
Trat				
	186.00 1.41	194	188.67 4.73	21.33
	(185 - 187)		(185 - 194)	
	2 0.76	1	3 2.50	
Chon Buri				
			187.50 17	
			(175 - 200)	
			2 9.	
Pak Tho				
	182.50 17.68	190	185.00 13.23	0 [illegible]2
	(170 - 195)		(170 - 195)	
	2 9.69	1	3 7.15	
Kanchanaburi				
	168.40 13.24	174	169.33 12.06	0.15
	(156 - 190)		(156 - 190)	
	5 7.86	1	6 7.12	
Chai Yo				
		186.50 2.12	186.50 2.12	
		(185 - 188)	(185 - 188)	
		2 1.14	2 1.14	
Lat Bua Kao				
		176.67 9.07	176.67 9.07	
		(170 - 187)	(170 - 187)	
		3 5.14	3 5.14	
Lop Buri				
	172.50 3.54		172.50 3.54	
	(170 - 175)		(170 - 175)	
	2 2.05		2 2.05	
Nakhon Ratchasima				
	178.67 21.50	198	183.50 20.04	0.61
	(157 - 200)		(157 - 200)	
	3 12.03	1	4 10.92	

	FEMALE	MALE	COMBINED	F-RATIO
Ubon Ratchathani				
	181	176.00 4.24	177.67 4.16	0.93
		(173 - 181)	(173 - 181)	
	1	2 2.41	3 2.34	
Nakhon Sawon				
	176.00 15.88	181.17 12.22	178.82 13.52	0.37
	(155 - 195)	(160 - 195)	(155 - 195)	
	5 9.02	6 6.75	11 7.56	
Khlong Khlung				
		175.00 5.00	175.00 5.00	
		(170 - 180)	(170 - 180)	
		3 2.86	3 2.86	
Khon Kaen				
	183.60 6.43	179.89 11.20	181.21 9.66	0.45
	(173 - 190)	(160 - 195)	(160 - 195)	
	5 3.50	9 6.22	14 5.33	
Moulmein				
	172.50 3.54	175.00 5.00	174.00 4.18	0.36
	(170 - 175)	(170 - 180)	(170 - 180)	
	2 2.05	3 2.86	5 2.40	
Dan Sai				
	162.50 5.00	180.63 10.84	174.58 12.70	9.77*
	(160 - 170)	(165 - 200)	(160 - 200)	
	4 3.08	8 6.00	12 7.27	
Udonthani				
		186.67 11.55	186.67 11.55	
		(180 - 200)	(180 - 200)	
		3 6.19	3 6.19	
Chiang Mai				
	170.00 7.07	181.25 10.42	179.00 10.60	2.00
	(165 - 175)	(165 - 195)	(165 - 195)	
	2 3.95	8 5.75	10 5.75	
Nan				
	179.33 16.42	192.50 10.61	182.63 15.67	1.07
	(150 - 200)	(185 - 200)	(150 - 200)	
	6 9.15	2 5.51	8 8.58	
Pai				
	171.50 3.54		171.50 3.54	
	(169 - 174)		(169 - 174)	
	2 2.06		2 2.06	

	FEMALE		MALE		COMBINED		F-RATIO
Wet Kyun							
	150.00	3.54	147.33	10.79	149.00	6.50	0.28
	(145 - 155)		(135 - 155)		(135 - 155)		
	5	2.36	3	7.32	8	4.36	
Myitkyina							
	169.00	8.19	182.50	6.36	174.40	9.91	3.76
	(162 - 178)		(178 - 187)		(162 - 187)		
	3	4.84	2	3.49	5	5.68	

Table 4 Variation in body length

	FEMALE	MALE	COMBINED	F-RATIO
Bintan, P.	200 1	210 1	205.00 7.07 (200 - 210) 2 3.45	
Batam, P.	192.25 8.57 (180 - 202) 8 4.46	193.57 4.89 (185 - 197) 7 2.53	192.87 6.89 (180 - 202) 15 3.57	0.13
Singapore	181.40 9.40 (169 - 195) 5 5.18	182.60 15.09 (165 - 202) 5 8.27	182.00 11.87 (165 - 202) 10 6.52	0.02
Pelepah, Sungei	187 1	180.00 0.00 (180) 2 0.00	182.33 4.04 (180 - 187) 3 2.22	
Aor, P.			196.00 1.41 (195 - 197) 2 0.72	
Endau, Sungei	188.00 4.36 (183 - 191) 3 2.32	195.25 4.65 (189 - 200) 4 2.38	192.14 5.67 (183 - 200) 7 2.95	4.38
Tioman, P.	178.60 6.31 (172 - 189) 5 3.53	172.00 8.49 (166 - 178) 2 4.93	176.71 6.99 (166 - 189) 7 3.96	1.35
Ginting Perah Bidai	195 1	176.50 12.02 (168 - 185) 2 6.81	182.67 13.65 (168 - 195) 3 7.45	1.58
Bucki Besi	180.00 5.72 (172 - 185) 4 3.18	195 1	183.00 8.34 (172 - 195) 5 4.56	5.51

	FEMALE		MALE		COMBINED		F-RATIO
Dungun Tanjong							
	183.29	9.27	181.50	4.95	182.89	8.25	0.06
	(165 - 191)		(178 - 185)		(165 - 191)		
	7	5.06	2	2.73	9	4.51	
Maxwell Buckit							
					176.50	4.95	
					(173 - 180)		
					2	2.80	
Redang, P.							
					170.50	4.95	
					(167 - 174)		
					2	2.90	
Perhentian Kechil, P.							
					180.50	13.44	
					(171 - 190)		
					2	7.44	
Kampong Gunong							
					173.50	9.19	
					(167 - 180)		
					2	5.30	
Langkawi, P.							
	169.00	11.76	175.75	6.21	172.86	9.27	1.95
	(157 - 190)		(168 - 185)		(157 - 190)		
	6	6.96	8	3.53	14	5.36	
Kaki Bukit							
	167.00	9.90			167.00	9.90	
	(160 - 174)				(160 - 174)		
	2	5.93			2	5.93	
Tarutao, Ko							
	173.00	12.17	176.43	4.76	174.85	8.73	0.48
	(158 - 185)		(170 - 180)		(158 - 185)		
	6	7.03	7	2.70	13	4.99	
Trang, Trang							
	179.00	16.91	165.00	6.33	172.00	14.20	3.61
	(160 - 200)		(160 - 175)		(160 - 200)		
	6	9.45	6	3.83	12	8.26	
Mae Nam							
			182.33	7.51	182.33	7.51	
			(178 - 191)		(178 - 191)		
			3	4.12	3	4.12	

	FEMALE	MALE	COMBINED	F-RATIO
Chong, Ko	176.75 12.15 (166 - 192) 4 6.87	184.50 4.95 (181 - 188) 2 2.68	179.33 10.46 (166 - 192) 6 5.83	0.69
Lamae, Khlong	189.00 6.08 (185 - 196) 3 3.22	196.00 7.07 (191 - 201) 2 .361	191.80 6.76 (185 - 201) 5 3.52	1.42
Si Chon		181.50 5.74 (178 - 190) 4 3.17	181.50 5.74 (178 - 190) 4 3.17	
Ban Mong Klang		180.00 14.14 (170 - 190) 2 0.08	180.00 14.14 (170 - 190) 2 0.08	
Zadetykyi Kyun	174.50 13.44 (165 - 184) 2 7.70	176.83 6.59 (170 - 184) 6 3.72	176.25 7.61 (165 - 184) 8 4.32	0.12
Kawthaung	190 1	185.75 9.39 (178 - 197) 4 5.06	186.60 8.35 (178 - 197) 5 4.48	0.16
Letsok-aw Kyun	170.00 7.07 (165 - 175) 2 4.16	178.33 2.89 (175 - 180) 3 1.62	175.00 6.12 (165 - 180) 5 3.50	3.75
Kanmaw Kyun	185.00 5.00 (180 - 190) 3 2.70	184.00 5.66 (180 - 188) 2 3.07	184.60 4.56 (180 - 190) 5 2.47	0.04
Klong Yai			193.50 2.12 (192 - 195) 2 1.10	
Lak, Ko	172 1	180.00 11.31 (172 - 188) 2 6.29	177.33 9.24 (172 - 188) 3 5.21	0.33

	FEMALE	MALE	COMBINED	F-RATIO
Tenasserim	185 1	180 1	182.50 3.54 (180 - 185) 2 1.94	
Prachuap Khiri Khan	175 1	174.33 9.02 (165 - 183) 3 5.17	174.50 7.37 (165 - 183) 4 4.22	0.00
Trat	190.00 7.07 (185 - 195) 2 3.72	192 1	190.67 5.13 (185 - 195) 3 2.69	0.05
Chon Buri			182.50 3.54 (180 - 185) 2 1.94	
Pak Tho	167.50 17.68 (155 - 180) 2 10.55	185 1	173.33 16.07 (155 - 185) 3 9.27	0.65
Kanchanaburi	167.60 5.86 (160 - 176) 5 3.49	169 1	167.83 5.27 (160 - 176) 6 3.14	0.05
Chai Yo		173.50 2.12 (172 - 175) 2 1.22	173.50 2.12 (172 - 175) 2 1.22	
Lat Bua Kao		183.33 7.23 (180 - 193) 3 3.84	188.33 7.23 (180 - 193) 3 3.84	
Lop Buri	165.00 14.14 (155 - 175) 2 8.57		165.00 14.14 (155 - 175) 2 8.57	
Nakhon Ratchasima	185.67 8.62 (178 - 195) 3 4.65	196 1	188.25 8.73 (178 - 196) 4 4.64	1.08

	FEMALE		MALE		COMBINED		F-RATIO
Ubon Ratchathani							
	205		171.00	29.70	182.33	28.75	0.87
			(150 - 192)		(150 - 205)		
	1		2	17.37	3	15.77	
Nakhon Sawan							
	169.00	5.70	175.67	9.07	172.64	8.14	2.02
	(163 - 177)		(165 - 187)		(163 - 187)		
	5	3.37	6	5.16	11	4.71	
Klong Khlung							
			170.67	1.15	170.67	1.15	
			(170 - 172)		(170 - 172)		
			3	0.68	3	0.68	
Khon Kaen							
	179.20	6.10	181.78	11.28	180.86	9.56	0.22
	(170 - 187)		(166 - 200)		(166 - 200)		
	5	3.40	9	6.20	14	5.29	
Moulmein							
	182.50	3.54	185.00	5.00	184.00	4.18	0.36
	(180 - 185)		(180 - 190)		(180 - 190)		
	2	1.94	3	2.70	5	2.27	
Dan Sai							
	172.50	12.58	175.63	9.80	174.58	10.33	0.23
	(160 - 190)		(160 - 190)		(160 - 190)		
	4	7.29	8	5.58	12	5.91	
Udonthani							
			183.33	2.89	183.33	2.89	
			(180 - 185)		(180 - 185)		
			3	1.57	3	1.57	
Chiang Mai							
	170.00	2.83	180.38	8.30	178.30	8.58	2.81
	(168 - 172)		([illegible] - 190)		(168 - 190)		
	2	1.66	8	4.60	10	4.81	
Nan							
	175.00	10.00	181.50	12.02	176.63	10.06	0.59
	(165 - 190)		(173 - 190)		(165 - 190)		
	6	5.71	2	6.62	8	5.69	
Wet Kyun							
	179.33	9.82	181.67	7.64	180.50	7.97	0.11
	(168 - 185)		(175 - 190)		(168 - 190)		
	3	5.47	3	4.20	6	4.41	

	FEMALE		MALE	COMBINED		F-RATIO
Pai						
	154.00	15.56		154.00	15.56	
	(143 - 165)			(143 - 165)		
	2	0.10		2	0.10	

Table 5 Variation in foot length

	FEMALE	MALE	COMBINED	F-RATIO
Bintan, P.	45.50 0.71 (45 - 46) 2 1.55	46.67 1.16 (46 - 48) 3 2.47	46.20 1.10 (45 - 48) 5 2.37	1.55
Batam, P.	44.50 1.31 (43 - 47) 8 2.94	45.14 1.57 (43 - 47) 7 3.49	44.80 1.42 (43 - 47) 15 3.18	0.75
Singapore	42.78 2.11 (41 - 46) 9 4.93	44.20 0.84 (43 - 45) 5 1.89	43.29 1.86 (41 - 46) 14 4.29	2.03
Pelepah, Sungei	43 1	43.50 2.12 (42 - 45) 2 4.88	43.33 1.53 (42 - 45) 3 3.53	0.04
Melaka	44.50 2.12 (43 - 46) 2 4.77		44.50 2.12 (43 - 46) 2 4.77	
Aor, P.			42.50 0.71 (42 - 43) 2 1.67	
Tioman, P.	40.20 1.30 (39 - 42) 5 3.24	40.00 1.00 (39 - 41) 3 2.50	40.13 1.13 (39 - 42) 8 2.81	0.05
Ginting Perah, Bidai	45 1	45.50 2.12 (44 - 47) 2 4.66	45.33 1.53 (44 - 47) 3 3.37	0.04
Bucki Besi	41.25 0.96 (40 - 42) 4 2.32	43 1	41.60 1.14 (40 - 43) 5 2.74	2.67

	FEMALE	MALE	COMBINED	F-RATIO
Dungun, Tanjong		44.67 1.15 (44 - 46) 3 2.59	44.67 1.15 (44 - 46) 3 2.59	
Maxwell Bukit			42.50 0.71 (42 - 43) 2 1.67	
Pinang, Ko	42.67 0.58 (42 - 43) 3 1.35	43.00 0.00 (43) 2 0.00	42.80 0.45 (42 - 43) 5 1.04	0.60
Redang, P.			41.00 1.41 (40 - 42) 2 3.45	
Perhentian Kechil, P.			45.50 0.71 (45 - 46) 2 1.55	
Kampong Gunong			44.50 0.71 (44 - 45) 2 1.59	
Langkawi, P.	41.83 1.47 (40 - 44) 6 3.53	42.29 1.11 (41 - 44) 7 2.63	42.08 1.26 (40 - 44) 13 2.98	0.40
Kaki Bukit	39.00 1.41 (38 - 40) 2 3.63		39.00 1.41 (38 - 40) 2 3.63	
Tarutau, Ko	42.29 0.49 (42 - 43) 7 1.15	42.29 0.95 (41 - 43) 7 2.25	42.29 0.73 (41 - 43) 14 1.72	0.00
Trang, Trang	41.00 2.00 (40 - 45) 6 4.88	41.33 2.16 (40 - 45) 6 5.23	41.17 1.99 (40 - 45) 12 4.84	0.08

	FEMALE		MALE		COMBINED		F-RATIO
Mae Nam							
	42		42.67	0.58	42.50	0.58	1.00
			(42 - 43)		(42 - 43)		
	1		3	1.35	4	1.36	
Chong, Ko							
	43.00	1.83	43.00	1.41	43.00	1.55	0.00
	(41 - 45)		(42 - 44)		(41 - 45)		
	4	4.25	2	3.29	6	3.60	
Lamae, Khlong							
	43.67	1.16	45.00	0.00	44.20	1.10	2.40
	(43 - 45)		(45)		(43 - 45)		
	3	2.65	2	0.00	5	2.48	
Ban Mong Klang							
			42.50	3.54	42.50	3.54	
			(40 - 45)		(40 - 45)		
			2	8.32	2	8.32	
Zadetkyi Kyun							
	43		43.67	1.16	43.50	1.00	0.25
			(43 - 45)		(43 - 45)		
	1		3	2.65	4	2.30	
Kawthaung							
	42.50	0.71	43.67	0.58	43.20	0.84	4.20
	(42 - 43)		(43 - 44)		(42 - 44)		
	2	1.66	3	1.32	5	1.94	
Letsok-aw Kyun							
	41.50	0.71	44.00	1.41	42.75	1.71	5.00
	(41 - 42)		(43 - 45)		(41 - 45)		
	2	1.70	2	3.21	4	3.99	
Kanmaw Kyun							
	42.33	1.16	43.00	0.00	42.60	0.89	0.60
	(41 - 43)		(43)		(41 - 43)		
	3	2.73	2	0.00	5	2.10	
Klong Yai							
					43.50	2.12	
					(42 - 45)		
					2	4.88	
Lak, Ko							
	40		42.00	0.00	41.33	1.15	0.00
			(42)		(40 - 42)		
	1		2	0.00	3	2.79	

	FEMALE		MALE		COMBINED		F-RATIO
Tenasserim							
	43.00	0.00	43.00	0.00	43.00	0.00	0.00
	(43)		(43)		(43)		
	2	0.00	2	0.00	4	0.00	
Prachuap Khiri Khan							
	44		41.67	1.53	42.25	1.71	1.75
			(40 - 43)		(40 - 43)		
	1		3	3.67	4	4.04	
Trat							
	45.50	0.71	47		46.00	1.00	3.00
	(45 - 56)				(45 - 47)		
	2	1.55	1		3	2.17	
Chon Buri							
					42.50	3.54	
					(40 - 45)		
					2	8.32	
Pak Tho							
	40.50	0.71	43		41.33	1.53	8.33
	(40 - 41)				(40 - 43)		
	2	1.75	1		3	3.70	
Kanchanaburi							
	39.60	4.83	41		39.83	4.36	0.07
	(34 - 45)		—		(34 - 45)		
	5	12.19	1		6	10.93	
Chai Yo							
			42.50	0.71	42.50	0.71	
			(42 - 43)		(42 - 43)		
			2	1.66	2	1.66	
Lat Bua Kao							
			40.33	2.08	40.33	2.08	
			(38 - 42)		(38 - 42)		
			3	5.16	3	5.16	
Nakhon Ratchasima							
	44.67	3.06	47		45.25	2.75	0.44
	(42 - 48)				(42 - 48)		
	3	6.84	1		4	6.09	
Lop Buri							
	42.50	3.54			42.50	3.54	
	(40 - 45)				(40 - 45)		
	2	8.32			2	8.32	

	FEMALE	MALE	COMBINED	F-RATIO
Ubon Ratchathani	43 1	44.00 1.41 (43 - 45) 2 3.21	43.67 1.15 (43 - 45) 3 2.64	0.33
Nakhon Sawon	40.60 0.55 (40 - 41) 5 1.35	42.33 2.66 (39 - 45) 6 6.28	41.55 2.11 (39 - 45) 11 5.09	2.02
Khlong Khlung		45.00 2.00 (43 - 47) 3 4.44	45.00 2.00 (43 - 47) 3 4.44	
Khon Kaen	44.60 1.52 (42 - 46) 5 3.40	44.89 0.78 (45 - 46) 9 1.74	44.79 1.05 (42 - 46) 14 2.35	0.23
Moulmein	45.00 1.41 (44 - 46) 2 3.14	44.40 1.67 (42 - 46) 5 3.77	44.57 1.51 (42 - 46) 7 3.39	0.19
Rangoon			44.00 1.41 (43 - 45) 2 3.21	
Dan Sai	43.75 2.50 (40 - 45) 4 5.71	41.88 2.59 (40 - 45) 8 6.18	42.50 2.61 (40 - 45) 12 6.14	1.43
Udonthani		44.33 2.08 (42 - 46) 3 4.70	44.33 2.08 (42 - 46) 3 4.70	
Chiang Mai	40.00 2.83 (38 - 42) 2 7.07	43.38 2.50 (40 - 47) 8 5.77	42.70 2.79 (38 - 47) 10 6.54	2.81
Nan	42.20 2.17 (40 - 45) 5 5.14	45 1	42.67 2.25 (40 - 45) 6 5.27	1.39

	FEMALE		MALE		COMBINED		F-RATIO
Pai							
	42.00	1.41			42.00	1.41	
	(41 - 43)				(41 - 43)		
	2	3.37			2	3.37	
Wet Kyun							
	42.00	0.71	41.33	0.58	41.75	0.71	1.88
	(41 - 43)		(41 - 42)		(41 - 43)		
	5	1.68	3	1.40	8	1.69	
Myitkyina							
	44.33	2.08	45.00	4.36	44.67	3.08	0.06
	(42 - 46)		(40 - 48)		(40 - 48)		
	3	4.70	3	9.69	6	6.89	

Table 6 Variation in condylobasal length

	FEMALE	MALE	COMBINED	F-RATIO
Bintan, P.	49.50 0.71 (49.0 - 50.0) 2 1.43	49.50 0.50 (49.0 - 50.0) 3 1.01	49.50 0.50 (49.0 - 50.0) 5 1.01	0.00
Batam, P.	49.44 1.40 (47.0 - 51.5) 8 2.83	49.43 0.54 (48.5 - 49.5) 7 1.08	49.43 1.05 (47.0 - 51.5) 15 2.12	0.00
Singapore	47.87 1.88 (44.5 - 50) 10 3.93	48.50 0.99 (47.0 - 49.5) 8 2.04	48.15 1.54 (44.5 - 50.0) 18 3.20	0.73
Pelepah, Sungei	49.5 1	48.50 0.71 (48.0 - 49.0) 2 1.44	48.83 0.76 (48.0 - 49.5) 3 1.56	1.33
Aor, P.			47.75 0.35 (47.5 - 48.0) 2 0.74	
Endau, Sungei	47.37 0.25 (47.1 - 47.6) 3 0.53	48.23 0.93 (47.2 - 49.2) 4 1.93	47.86 0.82 (47.1 - 49.2) 7 1.71	2.31
Tioman, P.	45.90 0.77 (44.8 - 46.5) 5 1.67	46.17 0.58 (45.5 - 46.5) 3 1.25	46.00 0.67 (44.8 - 46.5) 8 1.46	0.27
Rompin, Sungei	48.80 0.57 (48.4 - 49.2) 2 0.86		48.50 0.57 (48.4 - 49.2) 2 0.86	
Ginting Perah, Bukit		48.75 1.06 (48 - 49) 2 2.18	48.75 1.06 (48.0 - 49.5) 2 2.18	

FEMALE		MALE		COMBINED		F-RATIO
Bucki Besi						
46.68	0.45	50.0		47.34	1.54	43.68*
(46.1 - 47.2)				(46.1 - 50.0)		
4	0.96	1		5	3.25	
Dungun, Tanjong						
47.27	0.70	47.70	1.13	47.37	0.75	0.47
(46.2 - 48.5)		(46.9 - 48.5)		(46.2 - 48.5)		
7	1.49	2	2.37	9	1.57	
Maxwell Bukit						
				47.55	1.91	
				(46.2 - 48.9)		
				2	4.02	
Pinang, Ko						
46.67	1.16	47.00	0.71	46.80	0.91	0.13
(46.0 - 48.0)		(46.5 - 47.5)		(46.0 - 48.0)		
3	2.47	2	1.50	5	1.94	
Redang, P.						
				43.50	0.71	
				(43.0 - 44.0)		
				2	1.63	
Perhentian Kechil, P.						
				48.00	0.71	
				(47.5 - 48.5)		
				2	1.47	
Langkawi, P.						
46.65	0.52	46.80	1.39	46.74	1.10	0.06
(46.0 - 47.5)		(43.0 - 48.0)		(43.5 - 48.0)		
6	1.12	9	2.96	15	2.35	
Kaki Bukit						
47.65	0.50			47.65	0.50	
(47.3 - 48.0)				(47.3 - 48.0)		
2	1.04			2	1.04	
Tarutao, Ko						
46.00	0.96	45.60	0.55	45.83	0.81	0.70
(45.0 - 47.5)		(45.0 - 46.0)		(45.0 - 47.5)		
7	2.08	5	1.20	12	1.76	
Mae Nam						
		47.17	2.02	47.17	2.02	
		(45.0 - 49.0)		(45.0 - 49.0)		
		3	4.28	3	4.28	

	FEMALE	MALE	COMBINED	F-RATIO
Chong, Ko				
	47.00 2.16	47.25 0.35	47.08 1.69	0.02
	(44.0 - 49.0)	(47.0 - 47.5)	(44.0 - 49.0)	
	4 4.60	2 0.07	6 3.58	
Lamae, Khlong				
	47.83 0.76	48.00 0.00	47.90 0.55	0.09
	(47.0 - 48.5)	(48.0)	(47.0 - 48.5)	
	3 1.60	2 0.00	5 1.14	
Si Chon				
	45.45 0.07	47.03 1.41	46.50 1.36	2.22
	(45.4 - 45.5)	(45.2 - 48.6)	(45.2 - 48.6)	
	2 0.16	4 3.00	6 2.93	
Tao, Ko				
	45.43 0.15	45.05 0.35	45.28 0.30	3.08
	(45.3 - 45.6)	(44.8 - 45.3)	(44.8 - 45.6)	
	3 0.34	2 0.79	5 0.65	
Zadetkyi Kyun				
	48.00 0.71	48.22 0.78	48.16 0.72	0.12
	(47.5 - 48.5)	(47.1 - 49.0)	(47.1 - 49.0)	
	2 1.47	6 1.62	8 1.50	
Kawthaung				
	48.0	47.82 0.71	47.85 0.63	0.05
		(47.0 - 48.5)	(47.0 - 48.5)	
	1	5 1.47	6 1.33	
Lanbi Kyun				
			47.30 0.28	
			(47.1 - 47.5)	
			2 0.60	
Letsok-aw Kyun				
	46.00 0.71	48.0	46.67 1.26	5.33
	(45.5 - 46.5)		(45.5 - 48.0)	
	2 1.54	1	3 2.30	
Kanmaw Kyun				
	46.70 1.13	46.0	46.47 0.90	0.26
	(45.9 - 47.5)		(45.9 - 47.5)	
	2 2.42	1	3 1.93	
Klong Yai				
			48.65 1.20	
			(47.8 - 49.5)	
			2 2.47	

	FEMALE	MALE	COMBINED	F-RATIO
Prachuap Khiri Khan	45.6 1	46.53 2.08 (45.0 - 48.9) 3 4.47	46.30 1.76 (45.0 - 48.9) 4 3.80	0.15
Chan, Ko			46.20 0.57 (45.8 - 46.6) 2 1.22	
Nong Kho, Khlong	46.0 1	47.20 0.71 (46.7 - 47.7) 2 1.50	46.80 0.85 (46.0 - 47.7) 3 1.83	1.92
Pak Tho	45.10 0.57 (44.2 - 45.5) 2 1.25	46.2 1	45.47 0.75 (44.7 - 46.2) 3 1.65	2.52
Bangkok	47.30 1.38 (46.1 - 48.8) 3 2.91	47.50 0.85 (46.6 - 48.3) 3 1.80	47.40 1.03 (46.1 - 48.8) 6 2.17	0.05
Kanchanaburi	45.56 0.84 (44.8 - 46.6) 5 1.84	44.25 0.78 (43.7 - 44.8) 2 1.76	45.19 0.99 (43.7 - 46.6) 7 2.19	3.59
Lat Bua Kao		44.80 2.40 (43.1 - 46.5) 2 5.37	44.80 2.40 (43.1 - 46.5) 2 5.37	
Lop Buri	46.05 0.07 (46.0 - 46.1) 2 0.15		46.05 0.07 (46.0 - 46.1) 2 0.15	
Nakhon Sawon	45.04 1.11 (43.9 - 46.0) 5 2.46	46.13 1.19 (44.7 - 47.6) 6 2.57	45.64 1.23 (43.9 - 47.6) 11 2.70	2.46
Khlong Khlung		46.63 1.50 (45.1 - 48.2) 3 3.23	46.63 1.50 (45.2 - 48.2) 3 3.23	

	FEMALE		MALE		COMBINED		F RATIO
Khon Kaen							
	45.96	0.76	46.91	1.30	46.55	1.19	2.17
	(45.5 - 47.3)		(45.2 - 48.7)		(45.2 - [illegible].7)		
	5	1.65	8	2.78	13	2.56	
Rangoon							
					47.00	0.00	
					(47.0)		
					2	0.00	
Chiang Mai							
	44.30	0.99	46.17	0.70	45.76	1.08	9.84*
	(43.6 - 45.0)		(43.6 - 47.0)		(43.6 - 47.0)		
	2	2.23	7	1.51	9	2.36	
Nan							
	46.67	0.76	44.6		46.15	1.21	5.49
	(46.0 - 47.5)				(44.6 - 47.5)		
	3	1.64	1		4	2.62	
Pai							
	45.50	0.71			45.50	0.71	
	(45.0 - 46.0)				(45.0 - 46.0)		
	2	1.55			2	1.55	
Wet Kyun							
	46.47	0.45	46.10	0.96	46.28	0.70	0.36
	(46.0 - 46.9)		(45.0 - 46.5)		(45.0 - 46.9)		
	3	0.97	3	2.09	6	1.52	
Myitkyina							
	43.97	1.21	43.45	2.05	43.76	1.36	0.14
	(42.7 - 45.1)		(42.0 - 44.9)		(42.0 - 45.1)		
	3	2.74	2	4.72	5	3.11	

Table 7 Variation in palatal length

	FEMALE	MALE	COMBINED	F-RATIO
Singapore	27.60 0.91 (26.3 - 28.4) 4 3.31	28.47 0.29 (28.3 - 28.8) 3 1.02	27.97 0.81 (26.3 - 28.8) 7 2.9	2.41
Endau, Sungei	27.07 0.38 (26.8 - 27.4) 3 1.40	27.55 0.39 (27.1 - 28.0) 4 1.40	27.34 0.44 (26.8 - 28.0) 7 1.59	2.72
Tioman, P.	26.35 0.44 (25.8 - 26.8) 4 1.68	26.5 1	26.38 0.39 (25.8 - 26.8) 5 1.48	0.09
Rompin, Sungei	27.70 0.71 (27.2 - 28.2) 2 2.55		27.70 0.71 (27.2 - 28.2) 2 2.55	
Bucki Besi	26.90 0.38 (26.4 - 27.2) 4 1.42	28.2 1	27.16 0.67 (26.4 - 28.2) 5 2.46	9.22
Dungun Tanjong	26.76 0.53 (26.1 - 27.2) 7 1.97	27.2 1	26.81 0.51 (26.1 - 27.2) 8 1.88	0.62
Maxwell Buckit			26.75 1.77 (25.5 - 28.0) 2 6.61	
Langkawi, P.	27.8 1	27.22 0.42 (26.8 - 27.9) 5 1.55	27.32 0.44 (26.8 - 27.9) 6 1.63	1.58
Kaki Bukit	27.30 0.85 (26.7 - 27.9) 2 3.11		27.30 0.85 (26.7 - 27.9) 2 3.11	

	FEMALE		MALE		COMBINED		F-RATIO
Si Chon							
	25.90	0.00	26.55	1.05	26.33	0.88	0.68
	(25.9)		(25.0 - 27.2)		(25.0 - 27.2)		
	2	0.00	4	3.95	6	3.34	
Tao, Ko							
	25.10	0.20	25.15	0.21	25.12	0.18	0.07
	(24.9 - 25.1)		(25.0 - 25.3)		(24.9 - 25.3)		
	3	0.80	2	0.84	5	0.71	
Zadetkyi Kyun							
			28.10	0.36	28.10	0.36	
			(27.8 - 28.5)		(27.8 - 28.5)		
			3	1.28	3	1.28	
Kawthaung							
			27.77	0.42	27.77	0.42	
			(27.3 - 28.1)		(27.3 - 28.1)		
			3	1.50	3	1.50	
Lanbi Kyun							
					27.35	0.50	
					(27.0 - 27.7)		
					2	1.81	
Klong Yai							
					26.85	0.35	
					(26.6 - 27.1)		
					2	1.32	
Prachuap Khiri Khan							
	25.0		26.27	1.24	25.95	1.20	0.78
			(25.5 - 27.7)		(25.0 - 27.7)		
	1		3	4.73	4	4.61	
Chan, Ko							
					26.35	0.64	
					(25.9 - 26.8)		
					2	2.42	
Nong Kho, Khlong							
	25.2		26.45	0.64	26.03	0.85	2.57
			(26.0 - 26.9)		(25.2 - 26.9)		
	1		2	2.40	3	3.27	
Pak Tho							
	25.10	0.57	25.6		25.27	0.49	0.52
	(24[illegible] - 25.5)				(24.7 - 25.6)		
	[illegible]	2.25	1		3	1.95	

	FEMALE	MALE	COMBINED	F-RATIO
Bangkok	26.63 1.15 (25.0 - 27.8) 3 4.32	26.87 0.75 (26.1 - 27.6) 3 2.80	26.75 0.88 (25.5 - 27.8) 6 3.28	0.09
Kanchanaburi	25.70 0.74 (24.4 - 26.6) 5 2.87	24.75 0.35 (24.5 - 25.0) 2 1.43	25.43 0.77 (24.5 - 26.6) 7 3.04	2.80
Lat Bua Kao		24.45 1.06 (23.7 - 25.2) 2 4.34	24.45 1.06 (23.7 - 25.2) 2 4.34	
Lop Buri	25.30 0.42 (25.0 - 25.6) 2 1.68		25.30 0.42 (25.0 - 25.6) 2 1.68	
Nakhon Sawan	25.12 0.61 (24.3 - 25.8) 5 2.41	25.48 0.77 (24.3 - 26.4) 6 3.03	25.32 0.69 (24.3 - 26.4) 11 2.74	0.73
Khlong Khlong		25.97 0.85 (25.1 - 26.8) 3 3.29	25.97 0.85 (25.1 - 26.8) 3 3.29	
Khon Kaen	25.54 0.30 (25.4 - 26.0) 5 1.16	26.26 0.86 (25.2 - 27.4) 8 3.27	25.98 0.77 (25.2 - 27.4) 13 2.96	3.21
Chiang Mai	24.0 1	25.53 0.77 (24.7 - 26.5) 4 3.01	25.22 0.95 (24.0 - 26.5) 5 3.78	3.16
Nan	26.5 1	25.4 1	25.95 0.78 (25.4 - 26.5) 2 3.00	
Wet Kyun	26.60 0.57 (26.0 - 27.0) 2 2.13	26.55 0.21 (26.4 - 26.7) 2 0.80	26.58 0.35 (26.2 - 27.0) 4 1.32	0.01

FEMALE		MALE	COMBINED		F-RATIO
Myitkyina					
24.73	0.83	24.4	24.65	0.70	0.12
(23.8 - 25.4)			(23.8 - 25.4)		
3	3.37	1	4	2.84	

Table 8 Variation in cranial length

	FEMALE		MALE		COMBINED		F-RATIO
Singapore							
	20.83	0.51	20.87	0.15	20.84	0.37	0.02
	(20.3 - 21.4)		(21.0 - 26.7)		(20.3 - 21.4)		
	4	2.46	3	0.73	7	1.79	
Endau, Sungei							
	20.37	0.50	20.68	0.70	20.54	0.60	0.41
	(19.9 - 20.9)		(19.8 - 21.5)		(19.8 - 21.5		
	3	2.47	4	3.38	7	2.91	
Tioman, P							
	19.38	0.52	20.0		19.50	0.53	1.16
	(18.6 - 19.7)				(18.6 - 20.0)		
	4	2.68	1		5	2.71	
Rompin, Sungei							
	21.10	0.14			21.10	0.14	
	(21.0 - 21.2)				(21.0 - 21.2)		
	2	0.67			2	0.67	
Bucki Besi							
	19.78	0.61	21.8		20.18	1.05	8.89
	(18.9 - 20.3)				(18.9 - 21.8)		
	4	3.07	1		5	5.19	
Dungun Tanjong							
	20.51	0.50	19.7		20.41	0.54	2.34
	(20.0 - 21.3)				(19.7 - 21.3)		
	7	2.43	1		8	2.66	
Langkawi, P.							
	18.6		20.16	0.31	19.90	0.69	21.81*
			(20.0 - 20.7)		(18.6 - 20.7)		
	1		5	1.51	6	3.48	
Maxwell Buckit							
					20.80	0.14	
					(20.7 - 20.9)		
					2	0.68	
Kaki Bukit							
	20.35	0.35			20.35	0.35	
	(20.1 - 20.6)				(20.1 - 20.6)		
	2	1.74			2	1.74	

	FEMALE	MALE	COMBINED	F-RATIO
Si Chon	19.55 0.07 (19.5 - 19.6) 2 0.36	20.48 0.72 (19.7 - 21.4) 4 3.51	20.17 0.73 (19.5 - 21.4) 6 3.64	2.94
Tao, Ko	20.33 0.06 (20.3 - 20.4) 3 0.29	19.90 0.14 (19.8 - 20.0) 2 0.71	20.16 0.25 (19.8 - 20.4) 5 1.25	25.35*
Zadetkyi Kyun		20.0 0.62 (19.3 - 20.5) 3 3.12	20.0 0.62 (19.3 - 20.5) 3 3.12	
Kawthaung		20.10 0.26 (19.9 - 20.4) 3 1.32	20.10 0.26 (19.9 - 20.4) 3 1.32	
Lanbi Kyun			19.95 0.78 (19.4 - 20.5) 2 3.90	
Klong Yai			21.80 0.85 (21.2 - 22.4) 2 3.89	
Prachuap Khiri Khan	20.6 1	20.27 0.90 (19.4 - 21.2) 3 4.45	20.35 0.76 (19.4 - 21.2) 4 3.71	0.10
Chan, Ko			19.85 0.07 (19.8 - 19.9) 2 0.36	
Nong Kho, Khlong	20.8 1	20.75 0.07 (20.7 - 20.8) 2 0.34	20.77 0.06 (20.7 - 20.8) 3 0.28	0.33
Pak Tho	20.00 0.00 (20.0) 2 0.00	20.6 1	20.20 0.35 (20.0 - 20.6) 3 1.71	0.00

	FEMALE	MALE	COMBINED	F-RATIO
Bangkok	20.67 0.31 (20.4 - 21.0) 3 1.48	20.63 0.12 (20.5 - 20.7) 3 0.56	20.65 0.21 (20.4 - 21.0) 6 1.06	0.03
Kanchanaburi	19.86 0.33 (19.5 - 20.3) 5 1.62	19.50 0.42 (19.2 - 19.8) 2 2.17	19.76 0.36 (19.2 - 20.3) 7 1.84	1.51
Lat Bua Kao		20.35 1.34 (19.4 - 21.3) 2 6.60	20.35 1.34 (19.4 - 21.3) 2 6.60	
Lop Buri	20.25 1.06 (19.5 - 21.0) 2 5.24		20.25 1.06 (19.5 - 21.0) 2 5.24	
Nakhon Sawan	19.92 0.58 (19.2 - 20.6) 5 2.89	20.65 0.46 (19.9 - 21.2) 6 2.22	20.32 0.62 (19.2 - 21.2) 11 3.05	5.49*
Khlong Khlung		20.67 0.67 (20.1 - 21.4) 3 3.22	20.67 0.67 (20.1 - 21.4) 3 3.22	
Khon Kaen	20.42 0.52 (20.0 - 21.3) 5 2.53	20.65 0.57 (19.6 - 21.3) 8 2.77	20.56 0.54 (19.6 - 21.3) 13 2.63	0.53
Chiang Mai	19.6 1	20.28 0.51 (19.7 - 20.8) 4 2.53	20.14 0.54 (19.6 - 20.8) 5 2.66	1.39
Nan	20.0 1	19.2 1	19.60 0.57 (19.2 - 20.0) 2 2.89	
Wet Kyun	20.10 0.28 (19.9 - 20.3) 2 1.12	20.10 0.00 (20.1) 2 0.00	20.10 0.16 (19.9 - 20.3) 4 0.81	0.00

FEMALE		MALE	COMBINED		F-RATIO
Myitkyina					
19.23	0.42	20.5	19.55	0.72	6.94
(18.9 - 19.7)			(18.9 - 20.5)		
3	2.16	1	4	3.68	

Table 9 Variation in maximum width of skull

	FEMALE	MALE	COMBINED	F-RATIO
Bintan, P	20.0 1	19.50 0.71 (19.0 - 20.0) 2 3.63	19.67 0.58 (19.0 - 20.0) 3 2.93	0.33
Batam, P	19.50 0.46 (19.0 - 20.0) 8 2.24	19.29 0.27 (19.0 - 19.5) 7 1.38	19.40 0.39 (19.0 - 20.0) 15 1.99	1.16
Singapore	19.40 0.41 (19.0 - 20.0) 13 2.12	19.18 0.22 (19.0 - 19.5) 8 1.14	19.31 0.36 (19.0 - 20.0) 21 1.88	2.01
Pelepah, Sungei	20.0 1	19.50 0.00 (19.5) 2 0.00	19.67 0.29 (19.5 - 20.0) 3 1.47	0.00
Aor, P.			19.00 0.00 (19.0) 2 0.00	
Endau, Sungei	19.53 0.38 (19.1 - 19.8) 3 1.94	20.00 0.16 (19.8 - 20.2) 4 0.82	19.80 0.35 (19.1 - 20.2) 7 1.77	5.09
Tioman, P.	19.12 0.33 (18.8 - 19.5) 5 1.71	19.07 0.40 (18.7 - 19.5) 3 2.12	19.10 0.33 (18.7 - 19.5) 8 1.73	0.04
Rompin, Sungei	19.60 0.57 (19.2 - 20.0) 2 2.89		19.60 0.57 (19.2 - 20.0) 2 2.89	
Ginting Perah Bukit	20.0 1	19.25 0.35 (19.0 -20.0) 2 1.79	19.50 0.50 (19.0 - 20.0) 3 2.56	3.00

	FEMALE		MALE		COMBINED		F-RATIO
Bucki Besi							
	19.18	0.56	19.5		19.24	0.50	0.27
	(18.5 - 19.8)				(18.5 - 19.8)		
	4	2.90	1		5	2.61	
Dungun Tanjong							
	19.40	0.43	19.25	0.35	19.37	0.40	0.20
	(18.9 - 20.1)		(19.0 - 19.5)		(18.9 - 20.1)		
	7	2.21	2	1.84	9	2.05	
Maxwell Buckit							
					19.75	0.50	
					(19.4 - 20.1)		
					2	2.51	
Pinang, P.							
	19.50	0.50	19.50	0.71	19.50	0.50	0.00
	(19.0 - 20.0)		(19.0 - 20.0)		(19.0 - 20.0)		
	3	2.56	2	3.63	5	2.56	
Redang, P.							
					18.75	0.35	
					(18.5 - 19.0)		
					2	1.89	
Perhentian Kechil, P.							
					19.00	1.41	
					(18.0 - 20.0)		
					2	7.44	
Langkawi, P.							
	18.73	0.52	18.79	0.52	18.77	0.50	0.04
	(18.0 - 19.5)		(18.3 - 20.0)		(18.0 - 20.0)		
	6	2.75	9	2.75	15	2.65	
Kaki Bukit							
	19.05	0.50			19.05	0.50	
	(18.7 - 19.4)				(18.7 - 19.4)		
	2	2.60			2	2.60	
Tarutao, Ko							
	18.50	0.41	19.00	0.00	18.71	0.40	7.29*
	(18.0 - 19.0)		(19.0)		(18.0 - 19.0)		
	7	2.21	5	0.00	12	2.12	
Mae Nam							
			18.67	0.29	18.67	0.29	
			(18.5 - 19.0)		(18.5 - 19.0)		
			3	1.55	3	1.55	

	FEMALE		MALE		COMBINED		F-RATIO
Chong, Ko							
	19.25	0.29	19.50	0.71	19.33	0.41	0.44
	(19.0 - 19.5)		(19.0 - 20.0)		(19.0 - 20.0)		
	4	1.50	2	3.63	6	0.47	
Lamae, Khlong							
	19.50	0.50	19.25	0.35	19.40	0.42	0.36
	(19.0 - 20.0)		(19.0 - 19.5)		(19.0 - 20.0)		
	3	2.56	2	1.84	5	2.16	
Si Chon							
	19.15	0.35	18.95	0.24	19.02	0.26	0.72
	(18.9 - [illegible]		(18.7 - 19.2)		(18.7 - 19.4)		
	2	[illegible]	4	1.26	6	1.39	
Tao, Ko							
	18.1[illegible]	[illegible]	18.60	0.85	18.32	0.54	0.88
	(17[illegible]		(18.0 - 19.2)		(17.8 - 19.2)		
	3	[illegible]9	2	4.56	5	2.92	
Zadetkyi Kyun							
	18.75	0.35	19.00	0.46	18.94	0.43	0.47
	(18.5 - 19.0)		(18.5 - 19.6)		(18.5 - 19.6)		
	2	1.89	6	2 42	8	2.25	
Kawthaung							
	18.5		18.76	0.57	18.72	0.52	0.17
			(18.0 - 19.5)		(18.0 - 19.5)		
	1		5	3.05	6	3.05	
Lanbi Kyun							
					19.10	0.28	
					(18.9 - 19.3)		
					2	1.48	
Letsok-aw Kyun							
	18.50	0.00	19.50		18.83	0.58	0.00
	(18.5)				(18.5 - 19.5)		
	2	0.00	1		3	3.07	
Kanmaw Kyun							
	18.85	0.21	19.0		18.90	0.17	0.33
	(18.7 - 19.0)				(18.7 - 19.0)		
	2	1.12	1		3	0.92	
Klong Yai							
					20.00	0.57	
					(19.6 - 20.4)		
					2	2.83	

FEMALE		MALE		COMBINED		F-RATIO
Prachuap Khiri Khan						
17.9		18.60	0.40	18.43	0.48	2.30
		(18.2 - 19.0)		(17.9 - 19.0)		
1		3	2.15	4	2.60	
Chan, Ko						
				19.10	0.14	
				(19.0 - 19.2)		
				2	0.74	
Nong Kho, Khlong						
20.3		19.10	0.14	19.50	0.70	48.00
		(19.0 - 19.2)		(19.0 - 20.3)		
1		2	0.74	3	3.56	
Pak Tho						
18.00	0.14	18.5		18.17	0.31	8.33
(17.9 - 18.1)				(17.9 - 18.5)		
2	0.78	1		3	1.68	
Bangkok						
19.30	0.87	19.20	0.20	19.25	0.57	0.04
(18.7 - 20.3)		(20.5 - 20.7)		(18.7 - 20.3)		
3	4.52	3	1.04	6	2.95	
Kanchanaburi						
18.96	0.80	18.60	0.42	18.86	0.69	0.34
(18.0 - 19.7)		(18.3 - 18.9)		(18.0 - 19.7)		
5	4.20	2	2.28	7	3.69	
Lat Bua Kao						
		18.65	0.21	18.65	0.21	
		(18.5 - 18.8)		(18.5 - 18.8)		
		2	1.14	2	1.14	
Lop Buri						
18.40	0.85			18.40	0.85	
(17.8 - 19.0)				(17.8 - 19.0)		
2	4.61			2	4.61	
Tenasserim						
20.0		19.25	0.35	19.50	0.50	3.00
		(19.0 - 19.5)		(19.0 - 20.0)		
1		2	2.77	3	2.56	
Nakhon Sawan						
18.20	0.72	18.93	0.43	18.60	0.67	4.44
(17.1 - 18.8)		(18.3 - 19.5)		(17.1 - 19.5)		
5	3.95	6	2.26	11	3.58	

	FEMALE	MALE	COMBINED	F-RATIO
Khlong Khlung				
		19.13 1.12	19.13 1.12	
		(18.3 - 20.4)	(18.3 - 20.4)	
		3 5.83	3 5.83	
Khon Kaen				
	19.16 0.42	19.31 0.59	19.25 0.52	0.25
	(18.4 - 19.7)	(18.5 - 20.4)	(18.5 - 20.4)	
	5 2.20	8 3.05	13 2.69	
Moulmein				
	18.5	18.50 0.71	18.50 0.50	0.00
		(18.0 - 19.0)	(18.0 - 19.0)	
	1	2 3.82	3 2.70	
Rangoon				
			19.50 0.71	
			(19.0 - 20.0)	
			2 3.63	
Chiang Mai				
	18.80 0.28	19.01 0.45	18.97 0.41	0.39
	(18.6 - 19.0)	(18.3 - 19.6)	(18.3 - 19.6)	
	2 1.51	7 2.34	9 2.16	
Nan				
	18.97 1.05	19.0	18.98 0.86	0.00
	(17.9 - 20.0)		(17.9 - 20.0)	
	3 5.53	1	4 4.52	
Pai				
	19.00 0.71		19.00 0.71	
	(18.5 - 19.5)		(18.5 - 19.5)	
	2 3.74		2 3.74	
Wet Kyun				
	18.53 0.06	18.93 0.12	18.73 0.23	28.80*
	(18.5 - 18.6)	(18.8 - 19.0)	(18.5 - 19.0)	
	3 0.31	3 0.61	6 1.25	
Myitkyina				
	18.67 0.06	18.90 0.57	18.76 0.31	0.60
	(18.6 - 18.7)	(18.5 - 19.3)	(18.5 - 19.3)	
	3 0.31	2 2.99	5 1.67	

Table 10 Variation in bizygomatic width

	FEMALE	MALE	COMBINED	F-RATIO
Bintan, P.		26.50 0.71 (26.0 - 27.0) 2 2.67	26.50 0.71 (26.0 - 27.0) 2 2.67	
Batam, P.	26.88 0.84 (26.0 - 28.5) 8 3.11	27.07 0.45 (26.5 - 28.0) 7 1.66	26.97 0.67 (26.0 - 28.5) 15 2.47	0.31
Singapore	25.23 0.89 (23.5 - 26.4) 13 3.51	25.95 0.73 (25.0 - 27.0) 8 2.79	25.50 0.89 (23.5 - 27.0) 21 3.47	3.71
Pelepah	25.0 1	24.00 0.71 (23.5 - 24.5) 2 2.95	24.33 0.76 (23.5 - 25.0) 3 3.14	1.33
Aor, P.			26.00 0.00 (26.0) 2 0.00	
Endau, Sungei	24.00 1.22 (23.2 - 25.4) 3 5.07	25.18 1.41 (23.6 - 26.9) 4 5.60	24.67 1.37 (23.2 - 26.9) 7 5.56	1.33
Tioman, P.	23.84 0.94 (22.5 - 25.0) 5 3.94	25.10 0.36 (24.8 - 25.5) 3 1.44	24.31 0.98 (22.5 - 25.5) 8 4.04	4.71
Rompin, Sungei	24.90 0.85 (24.3 - 25.5) 2 3.41		24.90 0.85 (24.3 - 25.5) 2 3.41	
Ginting Perah, Bukit	26.0 1	26.75 0.35 (26.[illegible] - 27.0) 2 1.29	26.50 0.50 (26.0 - 27.0) 3 1.89	3.00

	FEMALE	MALE	COMBINED	F-RATIO
Bucki Besi	24.68 0.90 (23.7 - 25.7) 4 3.63	27.4 1	25.22 1.44 (23.7 - 27.4) 5 5.73	7.40
Dungun Tanjong	23.54 0.80 (22.5 - 24.5) 7 3.39	24.45 0.07 (24.4 - 24.5) 2 0.29	23.74 0.80 (22.5 - 24.9) 9 3.36	2.34
Maxwell Buckit			24.55 2.33 (22.9 - 26.2) 2 9.50	
Pinang, Ko	25.00 0.50 (24.5 - 25.5) 3 2.00	25.25 0.35 (25.0 - 25.5) 2 1.40	25.10 0.42 (24.5 - 25.5) 5 67	0.36
Redang, P.			24.50 0.71 (24.0 - 25.0) 2 2.89	
Perhentian Kechil, P.			26.00 0.71 (25.5 - 26.5) 2 2.72	
Langkawi, P.	24.18 0.60 (23.4 - 25.0) 5 2.49	24.69 0.91 (23.0 - 26.0) 9 3.67	24.51 0.83 (23.0 - 26.0) 14 3.37	1.25
Kaki Bukit	23.85 1.34 (22.9 - 24.8) 2 5.63		23.85 1.34 (22.9 - 24.8) 2 5.63	
Tarutao, Ko	24.17 0.52 (23.5 - 25.0) 6 2.14	25.00 0.35 (24.5 - 25.5) 5 1.42	24.55 0.61 (23.5 - 25.5) 11 2.49	9.30*
Mae Nam		25.67 0.58 (25.0 - 26.0) 3 2.25	25.67 0.58 (25.0 - 26.0) 3 2.25	

	FEMALE		MALE		COMBINED		F-RATIO
Chong, Ko							
	24.75	0.96	24.50		24.70	0.84	0.05
	(24.0 - 26.0)				(24.0 - 26.0)		
	4	3.87	1		5	3.39	
Lamae, Khlong							
	25.00	0.00	25.0		25.00	0.00	0.00
	(25.0)				(25.0)		
	3	0.00	1		4	0.00	
Si Chon							
	24.25	0.07	25.28	0.82	24.93	0.83	2.76
	(24.2 - 24.3)		(24.2 - 26.2)		(24.2 - 26.2)		
	2	0.29	4	3.25	6	3.32	
Tao, Ko							
	22.87	0.21	24.15	0.21	23.38	0.73	45.03*
	(22.7 - 23.1)		(24.0 - 24.3)		(22.7 - 24.3)		
	3	0.91	2	0.88	5	3.10	
Zadetkyi Kyun							
	25.50	0.00	25.92	0.49	25.81	0.45	1.31
	(25.5)		(25.2 - 26.5)		(25.2 - 26.5)		
	2	0.00	6	1.88	8	1.76	
Kawthaung							
	24.5		24.54	0.70	24.53	0.63	0.00
			(23.4 - 25.2)		(23.4 - 25.2)		
	1		5	2.85	6	2.55	
Lanbi Kyun							
					24.20	0.42	
					(23.9 - 24.5)		
					2	1.75	
Letsok-aw Kyun							
	24.00	0.00	25.75	1.06	24.88	1.18	5.44
	(24.0)		(25.0 - 26.5)		(24.0 - 26.5)		
	2	0.00	2	4.12	4	4.75	
Kanmaw Kyun							
	24.85	0.21	25.5		25.07	0.40	6.26
	(24.7 - 25.0)				(24.7 - 25.5)		
	2	0.85	1		3	1.61	
Klong Yai							
					25.05	0.07	
					(25.0 - 25.1)		
					2	0.28	

Locality	FEMALE	MALE	COMBINED	F-RATIO
Prachuap, Khiri Khan	23.8 1	24.63 1.10 (23.[illegible] - 25.9) 3 4.47	24.43 0.99 (23.8 - 25.9) 4 4.06	0.43
Chan, Ko			23.95 0.78 (23.4 - 24.5) 2 3.25	
Nong Kho, Khlong	23.6 1	24.15 0.35 (23.9 - 24.4) 2 1.47	23.97 0.40 (23.6 - 24.4) 3 1.69	1.61
Pak Tho	23.4 1	25.0 1	24.20 1.13 (23.4 - 25.0) 2 4.68	
Bangkok	23.47 1.60 (22.4 - 25.3) 3 6.80	24.73 0.42 (24.4 - 25.2) 3 1.68	24.10 1.25 (22.4 - 25.3) 6 5.20	1.77
Kanchanaburi	23.48 0.68 (22.5 - 24.2) 5 2.88	23.50 0.14 (23.4 - 23.6) 2 0.60	23.49 0.56 (22.5 - 24.2) 7 2.36	0.00
Lat Bua Kao		23.65 0.92 (23.0 - 24.3) 2 3.89	23.65 0.92 (23.0 - 24.3) 2 3.89	
Lop Buri	23.10 0.28 (22.9 - 23.3) 2 1.22		23.10 0.28 (22.9 - 23.3) 2 1.22	
Tenasserim	27.0 1	25.25 1.06 (24.5 - 26.0) 2 4.20	25.83 1.26 (24.5 - 27.0) 3 4.87	1.81
Nakhon Sawan	22.60 0.89 (21.2 - 23.5) 5 3.92	24.47 0.60 (23.8 - 25.3) 6 2.44	23.62 1.20 (21.2 - 25.3) 11 5.08	17.41*

	FEMALE		MALE		COMBINED		F-RATIO
Khlong Khlung							
			24.70	0.99	24.70	0.99	
			(24.0 - 25.4)		(24.0 - 25.4)		
			2	4.01	2	4.01	
Khon Kaen							
	23.82	0.33	24.23	1.11	24.07	0.89	0.62
	(23.5 - 24.3)		(22.9 - 25.8)		(22.9 - 25.8)		
	5	1.37	8	4.57	13	3.70	
Moulmein							
	25.0		25.00	0.00	25.00	0.00	0.00
			(25.0)		(25.0)		
	1		2	0.00	3	0.00	
Rangoon							
					23.50	2.12	
					(22.0 - 25.0)		
					2	9.03	
Chiang Mai							
	23.55	0.64	24.97	1.25	24.66	1.27	2.27
	(23.1 - 24.0)		(23.4 - 27.0)		(23.1 - 27.0)		
	2	2.70	7	4.99	9	4.58	
Nan							
	23.80	1.06	25.0		24.10	1.05	0.96
	(23.0 - 25.0)				(23.0 - 25.0)		
	3	4.45	1		4	4.37	
Wet Kyun							
	23.57	0.51	23.83	0.29	23.70	0.40	0.62
	(23.0 - 24.0)		(23.5 - 24.0)		(23.0 - 24.0)		
	3	2.18	3	1.21	6	1.69	
Myitkyina							
	22.33	0.91	23.15	0.92	22.66	0.91	0.96
	(21.5 - 23.3)		(22.5 - 23.8)		(21.5 - 23.8)		
	3	4.06	2	3.97	5	4.00	

Table 11 Variation in bi-auricular width

	FEMALE	MALE	COMBINED	F-RATIO
Singapore	16.58 0.17 (16.4 - 16.8) 4 1.03	17.33 0.40 (16.9 - 17.7) 3 2.33	16.90 0.48 (16.4 - 17.7) 7 2.86	11.90*
Endau, Sungei	16.10 0.56 (15.6 - 16.7) 3 3.46	16.58 0.33 (16.2 - 17.0) 4 1.99	16.37 0.47 (15.6 - 17.0) 7 2.88	2.04
Tioman, P.	15.73 0.36 (15.4 - 16.2) 4 2.28	15.2 1	15.62 0.39 (15.2 - 16.2) 5 2.50	1.71
Rompin, Sungei	16.55 0.21 (16.4 - 16.7) 2 1.28		16.55 0.21 (16.4 - 16.7) 2 1.28	
Bucki Besi	16.80 0.35 (16.5 - 17.3) 4 2.06	17.7 1	16.98 0.50 (16.5 - 17.7) 5 2.96	5.40
Dungun Tanjong	15.64 0.29 (15.3 - 16.2) 7 1.84	16.0 1	15.69 0.29 (15.3 - 16.2) 8 1.88	1.35
Maxwell Buckit			17.15 1.06 (16.4 - 17.9) 2 6.18	
Langkawi, P.	16.2 1	16.60 0.29 (16.2 - 16.9) 5 1.76	16.53 0.31 (16.2 - 16.9) 6 1.86	1.57
Kaki Bukit	16.50 0.14 (16.4 - 16.6) 2 0.61		16.50 0.14 (16.4 - 16.6) 2 0.61	

	FEMALE	MALE	COMBINED	F-RATIO
Si Chon	15.75 0.21 (15.6 - 15.9) 2 1.35	16.28 0.25 (16.0 - 16.6) 4 1.54	16.10 0.35 (15.6 - 16.6) 6 2.15	6.32
Tao, Ko	15.70 0.17 (15.5 - 15.8) 3 1.10	15.80 0.71 (15.3 - 16.3) 2 4.47	15.74 0.38 (15.3 - 16.3) 5 2.40	0.06
Zadetkyi Kyun		16.00 0.26 (15.7 - 16.2) 3 1.66	16.00 0.26 (15.7 - 16.2) 3 1.66	
Kawthaung		15.57 0.40 (15.2 - 16.0) 3 2.60	15.57 0.40 (15.2 - 16.0) 3 2.60	
Lanbi Kyun			16.15 0.07 (16.1 - 16.2) 2 0.44	
Letsok-aw Kyun	18.50 0.71 (18.0 - 19.0) 2 3.82	19.00 0.71 (18.5 - 19.2) 2 3.72	18.75 0.65 (18.0 - 19.5) 4 3.44	0.50
Klong Yai			17.00 0.14 (16.9 - 17.1) 2 0.83	
Prachuap Khiri Khan	15.7 1	16.33 0.42 (16.0 - 16.8) 3 2.55	16.18 0.46 (15.7 - 16.8) 4 2.89	1.73
Chan, Ko			15.80 0.57 (15.4 - 16.2) 2 3.58	
Nong Kho, Khlong	17.5 1	16.10 0.57 (15.7 - 16.5) 2 3.52	16.57 0.90 (15.7 - 17.5) 3 5.44	4.08

	FEMALE	MALE	COMBINED	F-RATIO
Pak Tho	15.60 0.57 (15.2 - 16.0) 2 3.63	16.6	15.93 0.70 (15.2 - 16.6) 3 4.41	2.08
Bangkok	16.83 0.75 (16.4 - 17.7) 3 4.46	17.00 0.27 (16.7 - 17.2) 3 1.56	16.92 0.51 (16.4 - 17.7) 6 3.02	0.13
Kanchanaburi	16.10 0.47 (15.4 - 16.7) 5 2.91	15.55 0.78 (15.0 - 16.1) 2 5.00	15.94 0.57 (15.0 - 16.7) 7 3.55	1.46
Lat Bua Kao		16.00 0.57 (15.6 - 16.4) 2 3.54	16.00 0.57 (15.6 - 16.4) 2 3.54	
Lop Buri	16.15 0.78 (15.6 - 16.7) 2 4.82		16.15 0.78 (15.6 - 16.7) 2 4.82	
Nakhon Sawan	15.70 0.69 (14.7 - 16.5) 5 4.39	16.62 0.38 (16.1 - 17.0) 6 2.26	16.20 0.70 (14.7 - 17.0) 11 4.32	7.91*
Khlong Khlung		16.40 1.13 (15.6 - 17.2) 2 6.90	16.40 1.13 (15.6 - 17.2) 2 6.90	
Khon Kaen	16.26 0.65 (15.5 - 17.1) 5 3.93	16.71 0.69 (15.6 - 18.0) 8 4.12	16.54 0.69 (15.5 - 18.0) 13 4.14	1.39
Chiang Mai	15.8 1	16.28 0.62 (15.5 - 17.0) 4 3.81	16.18 0.58 (15.5 - 17.0) 5 3.80	0.47
Nan	15.4 1	15.8 1	15.60 0.28 (15.4 - 15.8) 2 1.81	

	FEMALE		MALE		COMBINED		F-RATIO
Wet Kyun							
	15.40	0.14	15.75	0.64	15.58	0.43	0.58
	(15.3 - 15.5)		(15.3 - 16.2)		(15.3 - 16.2)		
	2	0.92	2	4.04	4	2.74	
Myitkyina							
	15.60	0.35	16.1		15.73	0.38	1.56
	(15.2 - 15.8)				(15.2 - 16.1)		
	3	2.22	1		4	2.40	

Table 12 Variation in interorbital width

FEMALE	MALE	COMBINED	F-RATIO
Singapore 14.58 0.26 (14.3 - 14.8) 4 1.80	14.63 0.12 (14.5 - 14.7) 3 0.79	14.60 0.20 (14.3 - 14.8) 7 1.37	0.12
Endau, Sungei 14.13 0.15 (13.8 - 14.3) 3 1.08	14.20 0.57 (13.6 - 15.0) 4 3.99	14.17 0.41 (13.8 - 15.0) 7 2.90	0.04
Tioman, P. 13.80 0.32 (13.4 - 14.1) 4 2.29	15.3 1	14.10 0.72 (13.4 - 15.3) 5 5.14	18.00*
Rompin, Sungei 14.45 0.07 (14.4 - 14.5) 2 0.49		14.45 0.07 (14.4 - 14.5) 2 0.49	
Bucki Besi 14.30 0.75 (13.6 - 15.0) 4 5.27	15.3 1	14.50 0.7[illegible] (13.6 - 15.3) 5 5.45	1[illegible].41
Dungun Tanjong 13.73 0.44 (13.1 - 14.4) 7 3.20	13.7 1	13.73 0.41 (13.1 - 14.4) 8 2.96	0.00
Maxwell Buckit		14.80 0.85 (14.2 - 15.4) 2 5.73	
Langkawi, P. 13.9 1	14.56 0.42 (14.3 - 15.0) 5 2.86	14.45 0.46 (13.9 - 15.0) 6 3.18	2.10
Kaki Bukit 14.40 0.85 (13.8 - 15.0) 2 5.89		14.40 0.85 (13.8 - 15.0) 2 5.89	

	FEMALE		MALE		COMBINED		F-RATIO
Si Chon							
	13.65	0.07	14.30	0.77	14.08	0.69	1.26
	(13.6 - 13.7)		(13.5 - 15.1)		(13.5 - 15.1)		
	2	0.52	4	5.38	6	4.87	
Tao, Ko							
	13.03	0.25	13.55	0.50	13.24	0.42	2.59
	(12.8 - 13.3)		(13.2 - 13.9)		(12.8 - 13.9)		
	3	1.93	2	3.65	5	3.14	
Zadetkyi Kyun							
			14.33	0.23	14.33	0.23	
			(14.2 - 14.6)		(14.2 - 14.6)		
			3	1.61	3	1.61	
Kawthaung							
			14.07	0.57	14.07	0.57	
			(13.6 - 14.7)		(13.6 - 14.7)		
			3	4.04	3	4.04	
Lanbi Kyun							
					14.20	0.28	
					(14.0 - 14.4)		
					2	1.99	
Klong Yai							
					14.20	0.28	
					(14.0 - 14.4)		
					2	1.99	
Prachuap Khiri Khan.							
	13.5		14.23	0.85	14.05	0.79	0.56
			(13.6 - 15.2)		(13.5 - 15.2)		
	1		3	5.97	4	5.59	
Chan, Ko							
					13.75	0.07	
					(13.7 - 13.8)		
					2	0.51	
Nong Kho, Khlong							
	13.1		14.05	0.50	13.73	0.65	2.46
			(13.7 - 14.4)		(13.1 - 14.4)		
	1		2	3.52	3	4.74	
Pak Tho							
	12.90	0.14	13.9		13.23	0.59	33.33
	(12.8 - 13.0)				(12.8 - 13.9)		
	2	1.09	1	4.43	3	4.43	

	FEMALE		MALE		COMBINED		F-RATIO
Bangkok							
	13.67	0.80	13.90	0.00	13.78	0.52	0.25
	(12.9 - 14.5)		(13.9)		(12.9 - 14.5)		
	3	5.87	3	0.00	6	3.80	
Kanchanaburi							
	12.82	0.30	13.45	0.07	13.00	0.40	7.60*
	(12.4 - 13.1)		(13.4 - 13.5)		(12.4 - 13.5)		
	5	2.36	2	0.53	7	3.04	
Lat Bua Kao							
			13.95	0.07	13.95	0.07	
			(13.9 - 14.0)		(13.9 - 14.0)		
			2	0.51	2	0.51	
Lop Buri							
	13.45	0.64			13.45	0.64	
	(13.0 - 13.9)				(13.0 - 13.9)		
	2	4.73			2	4.73	
Nakhon Sawan							
	13.10	0.57	13.70	0.[illegible]	13.43	0.63	2.99
	(12.2 - 13.7)		(12.8 - 14.[illegible]		(12.2 - 14.[illegible]		
	5	4.32	6	4.[illegible]	11	4.[illegible]	
Khlong Khlung							
			13.87	0.72	13.87	0.72	
			(13.4 - 14.7)		(13.4 - 14.7)		
			3	5.22	3	5.22	
Khon Kaen							
	13.66	0.21	13.73	0.46	13.70	0.37	0.09
	(13.4 - 13.9)		(13.0 - 14.2)		(13.0 - 14.2)		
	5	1.52	8	3.37	13	2.73	
Chiang Mai							
	12.7		13.48	0.29	13.32	0.43	5.82
			(13.1 - 13.8)		(12.7 - 13.8)		
	1		4	2.13	5	3.20	
Wet Kyun							
	13.60	0.14	13.95	0.21	13.78	0.25	3.77
	(13.5 - 13.7)		(13.8 - 14.1)		(13.5 - 14.1)		
	2	1.04	2	1.52	4	1.81	
Nan							
	13.1		13.7		13.40	0.42	
					(13.1 - 13.7)		
	1		1		2	3.17	
Myitkyina							
	13.13	0.15	14.4		13.45	0.65	51.57*
	(13.0 - 13.3)				(13.0 - 14.4)		
	3	1.67	1		4	4.80	

Table 13 Variation in orbital length

	FEMALE	MALE	COMBINED	F-RATIO
Singapore	11.23 0.21 (11.0 - 11.5) 4 1.84	11.17 0.15 (11.0 - 11.3) 3 1.37	11.20 0.17 (11.0 - 11.5) 7 1.55	0.17
Endau, Sungei	10.77 0.25 (10.5 - 11.0) 3 2.34	11.13 0.34 (10.5 - 11.6) 4 3.06	10.97 0.34 (10.5 - 11.6) 7 3.10	2.32
Tioman P.	10.30 0.22 (10.0 - 10.5) 4 2.10	10.7 1	10.38 0.26 (10.0 - 10.7) 5 2.50	2.74
Rompin, Sungei	11.20 0.57 (10.8 - 11.6) 2 5.05		[illegible].20 0.57 [illegible].8 - [illegible] [illegible] 5.05	
Bucki Besi	10.48 0.34 (10.0 - 10.8) 4 3.25	11.0 1	10.58 0.38 (10.0 - 11.0) 5 3.56	1.90
Dungun Tanjong	10.76 0.29 (10.4 - 11.2) 7 2.68	10.6 1	10.74 0.27 (10.4 - 11.2) 8 2.54	0.26
Maxwell Buckit			10.95 0.35 (10.7 - 11.2) 2 3.23	
Langkawi, P.	10.7 1	10.52 0.15 (10.3 - 10.7) 5 1.41	10.55 0.15 (10.3 - 10.7) 6 1.44	1.23
Kaki Bukit	10.60 0.14 (10.5 - 10.7) 2 1.33		10.60 0.14 (10.5 - 10.7) 2 1.33	

	FEMALE		MALE		COMBINED		F-RATIO
Si Chon	10.55	0.21	10.58	0.53	10.57	0.42	0.00
	(10.4 - 10.7)		(9.8 - 11.0)		(9.8 - 11.0)		
	2	2.01	4	5.03	6	4.00	
Tao, Ko	9.73	0.06	9.95	0.07	9.82	0.13	14.49*
	(9.7 - 9.8)		(9.9 - 10.0)		(9.7 - 10.0)		
	3	0.60	2	0.71	5	[illegible].33	
Zadetkyi Kyun			10.67	0.15	10.67	0.15	
			(10.5 - 10.8)		(10.5 - 10.8)		
			3	1.43	3	1.43	
Kawthaung			10.47	0.21	10.47	0.21	
			(10.3 - 10.7)		(10.3 - 10.7)		
			3	1.99	3	1.99	
Lanbi Kyun					10.70	0.14	
					(10.6 - 10.8)		
					2	1.32	
Klong Yai					11.20	0.28	
					(11.0 - 11.4)		
					2	2.53	
Prachuap Khiri Khan	10.2		10.27	0.12	10.25	0.10	0.25
			(10.2 - 10.4)		(10.2 - 10.4)		
	1		3	1.12	4	0.98	
Chan, Ko					10.90	0.14	
					(10.8 - 11.0)		
					2	1.75	
Nong Kho, Khlong	10.2		10.70	0.42	10.53	0.42	0.93
			(10.4 - 11.0)		(10.2 - 11.0)		
	1		2	3.96	3	3.96	
Pak Tho	10.05	0.50	10.0		10.03	0.35	0.01
	(9.7 - 10.4)				(9.7 - 10.4)		
	2	4.93	1		3	3.50	

	FEMALE	MALE	COMBINED	F-RATIO
Bangkok				
	10.40 0.20	10.27 0.06	10.33 0.15	1.23
	(10.2 - 10.7)	(10.2 - 10.3)	(10.2 - 10.6)	
	3 1.92	3 0.56	6 1.46	
Kanchanaburi				
	10.42 0.15	10.30 0.28	10.39 0.18	<1
	(10.2 - 10.6)	(10.1 - 10.5)	(10.1 - 10.6)	
	5 1.42	2 2.75	7 1.71	
Lat Bua Kao				
		10.45 0.35	10.45 0.35	
		(10.2 - 10.7)	(10.2 - 10.7)	
		2 3.38	2 3.38	
Lop Buri				
	10.05 0.21		10.05 0.21	
	(9.9 - 10.2)		(9.9 - 10.2)	
	2 2.11		2 2.11	
Nakhon Sawan				
	9.84 0.42	10.25 0.25	10.06 0.38	4.10
	(9.3 - 10.3)	(9.8 - 10.5)	(9.3 - 10.5)	
	5 4.23	6 2.44	11 3.80	
Khlong Khlung				
		10.30 0.10	10.30 0.10	
		(10.2 - 10.4)	(10.2 - 10.4)	
		3 0.97	3 0.97	
Khon Kaen				
	10.46 0.18	10.41 0.24	10.43 0.21	0.14
	(10.2 - 10.7)	(10.0 - 10.6)	(10.0 - 10.7)	
	5 1.74	8 2.32	[illegible] 2.05	
Chiang Mai				
	9.7	10.00 0.29	9.94 0.29	0.83
		(9.7 - 10.3)	(9.7 - 10.3)	
	1	4 2.94	5 2.90	
Nan				
	10.8	10.4	10.60 0.28	
			(10.4 - 10.8)	
	1	1	2 2.67	
Wet Kyun				
	10.40 0.00	10.40 0.14	10.40 0.08	0.00
	(10.4)	(10.3 - 10.5)	(10.3 - 10.5)	
	2 0.00	2 1.36	4 0.78	

	FEMALE		MALE	COMBINED		F-RATIO
Myitkyina						
	9.90	0.17	9.4	9.78	0.29	0.25
	(9.7 - 10.0)			(9.4 - 10.0)		
	3	1.75	1	4	2.94	

Table 14 Variation in orbital width

	FEMALE	MALE	COMBINED	F-RATIO
Singapore	10.68 0.25 ([illegible] - 11.0) [illegible] 2.34	10.80 0.72 (10.2 - 11.6) 3 6.68	10.73 0.46 (10.2 - 11.6) 7 4.26	0.11
Endau Sungei	10.40 0.40 (10.0 - 10.8) 3 3.85	10.60 0.32 (10.3 - 11.0) 4 2.98	10.51 0.34 (10.0 - 11.0) 7 3.22	0.55
Tioman, P.	10.15 0.34 (9.8 - 10.6) 4 3.37	10.0 1	10.12 0.30 (9.8 - 10.6) 5 3.00	0.15
Rompin, Sungei	10.65 0.50 (10.3 - 11.0) 2 4.65		10.65 0.50 (10.3 - 11.0) 2 4.65	
Bucki, Besi	10.15 0.24 (10.0 - 10.5) 4 2.34	10.4 1	10.20 0.23 (10.0 - 10.5) 5 2.30	0.88
Dungun Tanjong	10.33 0.14 (10.1 - 10.5) 7 1.34	10.4 1	10.34 0.13 (10.1 - 10.5) 8 1.26	0.23
Maxwell Buckit			10.40 0.28 (10.2 - 10.6) 2 2.72	
Langkawi, P.	10.2 1	10.08 0.19 (9.8 - 10.3) 5 1.90	10.10 0.18 (9.8 - 10.3) 6 1.77	0.32
Kaki Bukit	10.20 0.00 (10.2) 2 0.00		10.20 0.00 (10.2) 2 0.00	

	FEMALE	MALE	COMBINED	F-RATIO
Si Chon	10.35 0.07 (10.3 - 10.4) 2 1.69	10.15 0.44 (9.5 - 10.4) 4 4.30	10.22 0.35 (9.5 - 10.4) 6 3.47	0.37
Tao, Ko	9.60 0.20 (9.4 - 9.8) 3 2.08	9.60 0.14 (9.5 - 9.7) 2 1.47	9.60 0.16 (9.4 - 9.8) 5 1.[illegible]5	0.00
Zadetkyi Kyun		10.40 0.10 (10.3 - 10.5) 3 0.96	10.40 0.10 (10.3 - 10.5) 3 0.96	
Kawthaung		10.23 0.23 (10.[illegible] - [illegible]) 3[illegible] 2.26	10.23 0.23 (10.1 - 10.5) 3 2.26	
Lanbi Kyun			10.25 0.07 (10.2 - 10.3) 2 0.69	
Klong Yai			10.25 0.07 (10.2 - 10.3) 2 0.69	
Prachuap Khiri Khan	9.8 1	10.03 0.15 (9.9 - 10.2) 3 1.52	9.98 0.17 (9.8 - 10.2) 4 1.71	1.75
[illegible]n, Ko			10.60 0.00 (10.6) 2 0.00	
Nong Kho, Klong	9.2 1	10.00 0.85 (9.4 - 10.6) 2 8.49	9.73 0.76 (9.2 - 10.6) 3 7.78	0.59
Pak Tho [a]	9.95 0.35 (9.7 - 10.2) 2 3.56	10.2 1	10.03 0.29 (9.7 - 10.2) 3 2.88	0.33

	EMALE	MALE	COMBINED	F-RATIO
Ban kok	[illegible].83 0.25 9.6 - 10.1) 3 2.56	10.00 0.00 (10.0) 3 [illegible].00	9.92 0.18 (9.6 - 10.1) 6 1.85	1.32
nchanaburi	10.12 0.11 (10.0 - 10.2) 5 1.09	10.15 0.07 (10.1 - 10.2) 2 0.70	10.13 0.10 (10.0 - 10.2) 7 0.94	0.12
Lat Bua Kao		9.60 0.28 (9.4 - 9.8) 2 2.95	9.60 0.28 (9.4 - 9.8) 2 2.95	
Lop Buri	9.85 0.07 (9.8 - 9.9) 2 0.72		9.85 0.07 (9.8 - 9.9) 2 0.72	
Nakhon Sawan	9.54 0.26 (9.2 - 9.8) 5 2.74	9.93 0.32 (9.3 - 10.2) 6 3.22	9.75 0.35 (9.2 - 10.2) 11 3.56	4.84
Khlong Khlung		10.00 0.10 (9.9 - 10.1) 3 1.00	10.00 0.10 (9.9 - 10.1) 3 1.00	
Khon Kaen	10.04 0.21 (9.9 - 10.3) 5 2.06	9.91 0.16 (9.7 - 10.1) 8 1.56	9.96 0.18 (9.7 - 10.3) 13 1.81	1.61
Chiang Mai	9.6 1	9.65 0.19 (9.5 - 9.9) 4 1.98	9.64 0.17 (9.5 - 9.9) 5 1.73	0.05
Nan	10.2 1	10.2 1	10.20 0.00 (10.2 2 0.00	
Wet Kyun	10.10 0.14 (10.0 - 10.2) 2 1.40	10.15 0.07 (10.1 - 10.2) 2 0.70	10.13 0.10 (10.0 - 10.2) 4 0.95	0.20

	FEMALE		MALE	COMBINED		F-RATIO
Myitkyina						
	9.63	0.12	9.7	9.65	0.10	0.25
	(9.5 - 9.7)			(9.5 - 9.7)		
	3	1.19	1	4	1.04	

Table 15 Variation in the height of the brain-case

	FEMALE		MALE		COMBINED		F-RATIO
Singapore							
	15.33	0.40	15.20	0.27	15.27	0.33	0.22
	(15.0 - 15.8)		(14.9 - 15.4)		(14.9 - 15.8)		
	4	2.58	3	1.74	7	2.13	
Endau, Sungei							
	15.03	0.42	15.08	0.42	15.05	0.38	0.02
	(14.7 - 15.5)		(14.8 - 15.7)		(14.7 - 15.7)		
	3	2.77	4	2.78	7	2.54	
Tioman, P.							
	14.18	0.21	15.2		14.38	0.49	19.78*
	(14.0 - 14.4)				(14.0 - 15.2)		
	4	1.45	1		5	3.42	
Rompin, Sungei							
	14.75	0.21			14.75	0.21	
	(14.6 - 14.9)				(14.6 - 14.9)		
	2	1.44			2	1.44	
Bucki Besi							
	14.88	0.50	15.6		15.02	0.54	1.69
	(14.5 - 15.6)				(14.5 - 15.6)		
	4	3.35	1		5	3.60	
Dungun Tanjong							
	15.26	0.58	14.9		15.21	0.55	0.33
	(14.5 - 16.1)				(14.5 - 16.1)		
	7	3.80	1		8	3.63	
Maxwell Buckit							
					15.35	0.21	
					(15.2 - 15.5)		
					2	1.38	
Langkawi, P.							
	14.5		14.38	0.43	14.40	0.40	0.06
			(14.0 - 15.1)		(14.0 - 15.1)		
	1		5	3.00	6	2.71	
Kaki Bukit							
	14.65	0.50			14.65	0.50	
	(14.3 - 15.0)				(14.3 - 15.0)		
	2	3.38			2	3.38	

	FEMALE	MALE	COMBINED	F-RATIO
Si Chon	14.15 0.07 (14.1 - 14.2) 2 0.5	14.48 0.44 (14.1 - 15.1) 4 3.01	14.37 0.38 (14.1 - 15.1) 6 2.63	0.98
Tao, Ko	13.93 0.21 (13.7 - 14.1) 3 1.49	13.70 0.14 (13.6 - 13.8) 2 1.03	13.84 0.21 (13.6 - 14.1) 5 1.50	1.84
Zadetkyi Kyun		14.47 0.32 (14.1 - 14.7) 3 2.2	14.47 0.32 (14.1 - 14.7) 3 2.2	
Kawthaung		14.80 0.20 (14.6 - 15.0) 3 1.35	14.80 0.20 (14.6 - 15.0) 3 1.35	
Lanbi Kyun			14.45 0.21 (14.3 - 14.6) 2 1.47	
Klong Yai			15.65 1.63 (14.5 - 16.8) 2 10.39	
Prachuap Khiri Khan	14.0 1	14.23 0.51 (13.8 - 14.8) 3 3.60	14.18 0.43 (13.8 - 14.8) 4 3.07	0.16
Chan, Ko			14.90 0.00 (14.9) 2 0.00	
Nong Kho, Khlong	16.0 1	15.00 1.13 (14.2 - 15.8) 2 7.54	15.33 0.99 (14.2 - 16.0) 3 6.43	0.52
Pak Tho	13.50 0.14 (13.4 - 13.6) 2 1.04	14.0 1	13.67 0.31 (13.4 - 14.0) 3 2.24	8.33

Locality	FEMALE	MALE	COMBINED	F-RATIO
Bangkok	14.23 0.55 (13.6 - 14.6) 3 3.87	14.00 0.27 (13.8 - 14.3) 3 1.89	14.12 0.41 (13.6 - 14.6) 6 2.88	0.44
Kanchanaburi	13.98 0.76 (13.4 - 15.2) 5 5.41	14.30 0.42 (14.0 - 14.[illegible]) 2 2.97	14.07 0.66 (13.4 - 15.2) 7 4.69	0.30
Lat Bua Kao		14.25 0.21 (14.1 - 14.4) 2 1.49	14.25 0.21 (14.1 - 14.4) 2 1.49	
Lop Buri	13.85 0.07 (13.8 - 13.9) 2 0.51		13.85 0.07 (13.8 - 13.9) 2 0.51	
Nakhon Sawan	14.22 0.27 (14.0 - 14.6) 5 1.88	14.40 0.51 (13.9 - 15.3) 6 3.54	14.32 0.41 (13.9 - 15.3) 11 2.86	0.50
Khlong Khlung		14.10 0.70 (13.6 - 14.9) 3 4.96	14.10 0.70 (13.6 - 14.9) 3 4.96	
Khon Kaen	14.44 0.27 (14.2 - 14.9) 5 1.87	14.63 0.42 (14.2 - 15.4) 8 2.87	14.55 0.37 (14.2 - 15.4) 13 2.53	0.76
Chiang Mai	14.4 1	14.70 0.08 (14.6 - 14.8) 4 0.56	14.64 0.15 (14.4 - 14.8) 5 1.04	10.80*
Nan	14.2 1	14.3 1	14.25 0.07 (14.2 - 14.3) 2 1.01	
Wet Kyun	14.45 0.21 (14.3 - 14.6) 2 1.47	14.75 0.07 (14.7 - 14.8) 2 0.48	14.60 0.22 (14.3 - 14.8) 4 1.48	3.60

FEMALE		MALE	COMBINED		F-RATIO
Myitkyina					
14.37	0.49	14.4	14.38	0.40	0.00
(13.8 - 14.7)			(13.8 - 14.7)		
3	3.43	1	4	2.80	

Table 16 Variation in the distance between opisthion and opistocranion

	FEMALE	MALE	COMBINED	F-RATIO
Singapore	12.08 0.28 (11.8 - 12.4) 4 2.28	12.57 0.15 (12.4 - 12.7) 3 1.22	12.29 0.34 (11.8 - 12.7) 7 2.76	7.56*
Endau, Sungei	12.43 0.65 (11.8 - 13.1) 3 5.24	12.60 0.27 (12.2 - 12.8) 4 2.15	12.53 0.43 (11.8 - 13.1) 7 3.44	0.22
Tioman, P.	11.95 0.34 (11.6 - 12.4) 4 2.86	12.8 1	12.12 0.48 (11.6 - 12.8) 5 3.97	4.95
Rompin, Sungei	12.35 0.64 (11.9 - 12.8) 2 5.15		12.35 0.64 (11.9 - 12.8) 2 5.15	
Bucki Besi	12.23 0.25 (11.9 - 12.5) 4 2.04	13.5 1	12.48 0.61 (11.9 - 13.5) 5 4.89	20.81*
Dungun Tanjong	12.27 0.35 (11.8 - 12.6) 7 2.77	12.2 1	12.26 0.32 (11.8 - 12.6) 8 2.61	0.04
Maxwell Buckit			12.40 0.42 (12.1 - 12.7) 2 3.42	
Langkawi, P.	11.6 1	11.94 0.40 (11.6 - 12.6) 5 3.32	11.88 0.38 (11.6 - 12.6) 6 3.21	0.61
Kaki Bukit	12.05 0.64 (11.6 - 12.5) 2 5.28		12.05 0.64 (11.6 - 12.5) 2 5.28	

	FEMALE	MALE	COMBINED	F-RATIO
Si Chon	12.00 0.28 (11.8 - 12.2) 2 2.36	12.30 0.25 (12.0 - 12.5) 4 1.99	12.20 0.28 (11.8 - 12.5) 6 2.26	1.85
Tao, Ko	12.00 0.00 (12.0) 3 0.00	12.35 0.07 (12.3 - 12.4) 2 0.57	12.14 0.19 (12.0 - 12.4) 5 1.61	88.20*
Zadetkyi Kyun	-	12.27 0.12 (12.2 - 12.4) 3 0.94	12.27 0.12 (12.2 - 12.4) 3 0.94	
Kawthaung		12.40 0.10 (12.3 - 12.5) 3 0.81	12.40 0.10 (12.3 - 12.5) 3 0.81	
Lanbi Kyun			12.25 0.35 (12.0 - 12.5) 2 2.[illegible]9	
Klong Yai			12.[illegible]5 0.07 (12.8 - 12.9) 2 0.55	
Prachuap Khiri Khan	12.2 1	12.37 0.55 (12.0 - 13.0) 3 4.46	12.33 0.46 (12.0 - 13.0) 4 3.71	0.07
Chan, Ko			12.40 0.28 (12.2 - 12.6) 2 2.28	
Nong Kho, Khlong	12.4 1	12.45 0.07 (12.4 - 12.5) 2 0.57	12.43 0.06 (12.4 - 12.5) 3 0.46	0.33
Pak Tho	11.20 0.14 (11.1 - 11.3) 2 1.23	12.2 1	11.53 0.59 (11.1 - 12.2) 3 5.08	33.33

	FEMALE	MALE	COMBINED	F-RATIO
Bangkok				
	12.03 0.57	12.20 0.35	12.12 0.43	0.19
	(11.4 - 12.5)	(11.8 - 12.4)	(11.4 - 12.5)	
	3 4.73	3 2.84	6 3.56	
Kanchanaburi				
	11.84 0.18	11.80 0.14	11.83 0.16	0.08
	(11.6 - 12.0)	(11.7 - 11.9)	(11.6 - 12.0)	
	5 1.54	2 1.19	7 1.36	
Lat Bua Kao				
		12.35 0.35	12.35 0.35	
		(12.1 - 12.6)	(12.1 - 12.6)	
		2 2.86	2 2.86	
Lop Buri				
	11.85 0.21		11.85 0.21	
	(11.7 - 12.0)		(11.7 - 12.0)	
	2 1.79		2 1.79	
Nakhon Sawan				
	11.66 0.32	12.03 0.22	11.86 0.32	5.30*
	(11.3 - 12.1)	(11.7 - 12.3)	(11.3 - 12.3)	
	5 2.75	6 1.80	11 2.70	
Khlong Khlung				
		12.40 0.70	12.40 0.70	
		(11.6 - 12.9)	(11.6 - 12.9)	
		3 5.65	3 5.65	
Khon Kaen				
	12.12 0.37	12.75 0.48	12.51 0.53	6.20*
	(11.7 - 12.6)	(12.1 - 13.5)	(11.7 - 13.5)	
	5 3.05	8 3.77	13 4.25	
Chiang Mai				
	12.0	12.48 0.15	12.38 0.25	8.02
		(12.3 - 12.6)	(12.0 - 12.6)	
	1	4 1.20	5 2.01	
Nan				
	11.6	12.4	12.00 0.57	
			(11.6 - 12.4)	
	1	1	2 4.71	
Wet Kyun				
	11.85 0.07	12.10 0.14	11.98 0.17	5.00
	(11.8 - 11.9)	(12.0 - 12.2)	(11.8 - 12.2)	
	2 0.60	2 1.17	4 1.43	

	FEMALE		MALE	COMBINED		F-RATIO
Myitkyina						
	11.67	0.15	11.9	11.73	0.17	1.75
	(11.5 - 11.8)			(11.5 - 11.9)		
	3	1.31	1	4	1.46	

Table 17 Variation in the length of the maxillary molar row (M^1-M^3)

	FEMALE		MALE		COMBINED		F-RATIO
Singapore							
	9.35	0.17	9.30	0.35	9.33	0.24	0.06
	(9.2 - 9.6)		(8.9 - 9.5)		(8.9 - 9.6)		
	4	1.85	3	3.72	7	2.51	
Endau Sungei							
	8.93	0.15	9.13	0.21	9.04	0.20	1.81
	(8.8 - 9.1)		(8.9 - 9.4)		(8.8 - 9.4)		
	3	1.71	4	2.26	7	2.20	
Tioman, P.							
	8.50	0.20	8.4		8.48	0.18	0.20
	(8.4 - 8.8)				(8.4 - 8.8)		
	4	2.35	1		5	2.10	
Rompin, Sungei							
	8.75	0.21			8.75	0.21	
	(8.6 - 8.9)				(8.6 - 8.9)		
	2	2.42			2	2.42	
Bucki Besi							
	8.85	0.17	8.9		8.86	0.15	0.07
	(8.7 - 9.1)				(8.7 - 9.1)		
	4	1.95	1		5	1.71	
Dungun Tanjong							
	8.71	0.20	8.4		8.68	0.21	2.27
	(8.3 - 8.9)				(8.3 - 8.9)		
	7	2.24	1		8	2.44	
Maxwell Buckit							
					8.65	0.21	
					(8.5 - 8.8)		
					2	2.45	
Langkawi, P.							
	8.2		8.98	0.05	8.85	0.32	253.50*
			(8.9 - 9.0)		(8.2 - 9.0)		
	1		5	0.50	6	3.63	
Kaki Bukit							
	8.85	0.21			8.85	0.21	
	(8.7 - 9.0)				(8.7 - 9.0)		
	2	2.40			2	2.40	

	FEMALE	MALE	COMBINED	F-RATIO
Si Chon	8.60 0.28 (8.4 - 8.8) 2 3.29	8.70 0.18 (8.5 - 8.9) 4 2.10	8.67 0.20 (8.4 - 8.9) 6 2.27	0.30
Tao, Ko	8.60 0.10 (8.5 - 8.7) 3 1.16	8.50 0.14 (8.4 - 8.6) 2 1.66	8.56 0.11 (8.4 - 8.7) 5 1.33	0.90
Zadetkyi Kyun		9.30 0.17 (9.1 - 9.4) 3 1.86	9.30 0.17 (9.1 - 9.4) 3 1.86	
Kawthaung		8.77 0.25 (8.5 - 9.0) 3 2.87	8.77 0.25 (8.5 - 9.0) 3 2.87	
Lanbi Kyun			8.60 0.00 (8.6) 2 0.00	
Klong Yai			8.80 0.57 (8.4 - 9.2) 2 6.43	
Prachuap Khiri Khan	8.5 1	8.53 0.42 (8.2 - 9.0) 3 4.88	8.53 0.34 (8.2 - 9.0) 4 3.99	0.00
Chan, Ko			8.90 0.14 (8.8 - 9.0) 2 1.59	
..ong Kho, Khlong	8.7 1	8.9 1	8.80 0.14 (8.7 - 8.9) 2 1.61	
Pak Tho	8.50 0.42 (8.2 - 8.8) 2 4.99	8.7 1	8.57 0.32 (8.2 - 8.8) 3 3.75	0.15

	FEMALE		MALE		COMBINED		F-RATIO
Bangkok							
	8.77	0.40	8.80	0.20	8.78	0.29	0.02
	(8.3 - 9.0)		(8.6 - 9.0)		(8.3 - 9.0)		
	3	4.61	3	2.27	6	3.25	
Kanchanaburi							
	8.74	0.09	8.3		8.67	0.20	20.17*
	(8.6 - 8.8)				(8.3 - 8.8)		
	5	1.02	1		6	2.27	
Lat Bua Kao							
			9.40	1.41	9.40	1.4	
			(8.4 - 10.4)		(8.4 - 10.4		
			2	15.04	2	15	
Lop Buri							
	8.70	0.28			8.70	0.[illegible]	
	(8.5 - 8.9)				(8.5 - 8.9)		
	2	3.25			2	3.25	
Nakhon Sawan							
	8.53	0.10	8.52	0.18	8.52	0.14	0.00
	(8.4 - 8.6)		(8.4 - 8.8)		(8.4 - 8.8)		
	4	1.13	5	2.10	9	1.64	
Khlong Khlung							
			8.73	0.21	8.73	0.21	
			(8.5 - 8.9)		(8.5 - 8.9)		
			3	2.38	3	2.38	
Khon Kaen							
	8.74	0.11	8.73	0.32	8.73	0.25	0.01
	(8.6 - 8.9)		(8.3 - 9.2)		(8.3 - 9.2)		
	5	1.3	8	3.67	13	2.90	
Chiang Mai							
	8.5		8.48	0.28	8.48	0.24	0.01
			(8.2 - 8.8)		(8.2 - 8.8)		
	1		4	3.24	5	2.81	
Wet Kyun							
	8.6		8.8		8.70	0.14	
					(8.6 - 8.8)		
	1		1		2	1.63	
Nan							
	9.0		8.6		8.80	0.28	
					(8.6 - 9.0)		
	1		1		2	3.21	

FEMALE		MALE	COMBINED		F-RATIO
Myitkyina					
8.07	0.12	8.2	8.10	0.12	1.00
(8.0 - 8.2)			(8.0 - 8.2)		
3	1.43	1	4	1.43	

Table 18 Variation in the bimolar width (M^2-M^2)

	FEMALE	MALE	COMBINED	F-RATIO
Singapore	17.25 0.37 (16.7 - 17.5) 4 2.15	17.00 0.38 (16.8 - 17.4) 3 2.04	17.14 0.36 (16.7 - 17.5) 7 2.07	0.82
Endau, Sungei	16.00 0.20 (15.8 - 16.2) 3 1.25	16.58 0.40 (16.1 - 17.0) 4 2.43	16.33 0.43 (15.8 - 17.0) 2.66	4.99
Tioman, P.	15.50 0.20 (15.4 - 15.8) 4 1.29	15.4 1	15.48 0.18 (15.4 - 15.8) 5 [illegible]	0.20
Rompin, Sungei	16.50 0.14 (16.4 - 16.6) 2 0.86		16.50 0.14 (16.4 - 16.6) 2 0.86	
Bucki Besi	16.23 0.44 (15.6 - 16.6) 4 2.68	16.8 1	16.34 0.46 (15.6 - 16.8) 5 2.79	1.40
Dungun Tanjong	15.64 0.24 (15.3 - 15.6) 7 1.56	15.3 1	15.60 0.26 (15.3 - 16.0) 8 1.64	1.73
Maxwell B[illegible]t			15.70 0.99 (15.0 - 16.4) 2 6.31	
Langkawi, P.	16.6 1	16.16 0.42 (15.7 - 16.7) 5 2.57	16.23 0.41 (15.7 - 16.7) 6 2.54	0.93
Kaki Bukit	15.90 0.28 (15.7 - 16.1) 2 1.78		15.90 0.28 (15.7 - 16.1) 2 1.78	

FEMALE	MALE	COMBINED	F-RATIO
S. Chon 15.90 0.71 (15.4 - 16.4) 2 4.44	16.53 0.30 (16.2 - 16.9) 4 1.81	16.32 0.51 (15.4 - 16.9) 6 3.11	2.71
Tao, Ko 16.43 0.31 (16.1 - 16.7) 3 1.86	16.10 0.28 (15.9 - 16.3) 2 1.76	16.30 0.32 (15.9 - 16.7) 5 1.94	1.50
Zadetkyi Kyun	16.57 0.06 (16.5 - 16.6) 3 0.35	16.57 0.06 (16.5 - 16.6) 3 0.35	
Kawthaung	15.37 0.23 (15.1 - 15.5) 3 1.50	15.37 0.23 (15.1 - 15.5) 3 1.50	
Lanbi Kyun		15.80 0.28 (15.6 - 16.0) 2 1.11	
Klong Yai		16.45 0.64 (16.0 - 16.9) 2 3.87	
Prachuap Khiri Khan 16.0 1	16.27 0.31 (16.0 - 16.6) 3 1.88	16.20 0.28 (16.0 - 16.6) 4 1.75	0.57
Chan, Ko		16.05 0.07 (16.0 - 16.1) 2 0.44	
Nong Kho, Khlong 15.9 1	16.55 0.21 (16.4 - 16.7) 2 1.28	16.33 0.40 (15.9 - 16.7) 3 2.47	6.26
Pak Tho 16.15 0.35 (15.9 - 16.4) 2 2.19	17.3 1	16.53 0.71 (15.9 - 17.3) 3 4.29	7.05

	FEMALE		MALE		COMBINED		F-RATIO
Bangkok							
	16.33	0.64	16.53	0.21	16.43	0.44	0.27
	(15.6 - 16.7)		(16.3 - 16.7)		(15.6 - 16.7)		
	3	3.89	3	1.26	6	2.66	
Kanchanaburi							
	16.12	0.41	15.55	1.20	15.96	0.66	1.10
	(15.8 - 16.7)		(14.7 - 16.4)		(14.7 - 16.7)		
	5	2.54	2	7.73	7	4.11	
Lat Bua Kao							
			16.25	0.07	16.25	0.07	
			(16.2 - 16.3)		(16.2 - 16.3)		
			2	0.44	2	0.44	
Lop Buri							
	16.45	0.78			16.45	0.78	
	(15.9 - 17.0)				(15.9 - 17.0)		
	2	4.73			2	4.73	
Nakhon Sawan							
	15.90	0.43	16.17	0.39	16.05	0.41	1.15
	(15.3 - 16.4)		(15.6 - 16.6)		(15.3 - 16.6)		
	5	2.70	6	2.93	11	2.58	
Khlong Khlung							
			16.60	0.26	16.60	0.26	
			(16.3 - 16.8)		(16.3 - 16.8)		
			3	1.59	3	1.59	
Khon Kaen							
	16.30	0.47	16.35	0.63	16.33	0.55	0.02
	(15.8 - 16.8)		(15.5 - 17.2)		(15.5 - 17.2)		
	5	2.88	8	3.83	13	3.37	
Chiang Mai							
	15.8		16.15	0.21	16.08	0.24	2.26
			(15.8 - 16.4)		(15.8 - 16.4)		
	1		4	1.29	5	1.48	
Nan							
	16.0		16.1		16.05	0.07	
					(16.0 - 16.1)		
	1		1		2	0.44	
Wet Kyun							
	16.10	0.57	15.85	0.35	15.98	0.41	0.28
	(15.7 - 16.5)		(15.6 - 16.1)		(15.6 - 16.5)		
	2	3.52	2	2.23	4	2.57	

FEMALE		MALE	COMBINED		F-RATIO
Myitkyina					
15.47	0.35	15.8	15.55	0.33	0.68
(15.1 - 15.8)			(15.1 - 15.8)		
3	2.27	1	4	2.13	

Table 19 Variation in incisor width $(I^2 - I^2)$

	FEMALE		MALE		COMBINED		F-RATIO
Singapore							
	6.48	0.19	6.60	0.10	6.53	0.16	1.05
	(6.2 - 6.6)		(6.5 - 6.7)		(6.2 - 6.7)		
	4	2.92	3	1.52	7	2.54	
Endau, Sungei							
	6.07	0.15	6.73	0.25	6.44	0.40	15.86*
	(5.9 - 6.2)		(6.6 - 7.1)		(5.9 - 7.1)		
	3	2.96	4	3.72	7	6.26	
Tioman, P.							
	6.03	0.13	6.0		6.02	0.11	0.03
	(5.9 - 6.2)				(5.9 - 6.2)		
	4	2.09	1		5	1.82	
Rompin, Sungei							
	6.45	0.21			6.45	0.21	
	(6.3 - 6.6)				(6.3 - 6.6)		
	2	3.29			2	3.29	
Bucki Besi							
	6.18	0.17	7.0		6.34	0.40	18.67*
	(6.0 - 6.4)				(6.0 - 7.0)		
	4	2.77	1		5	6.26	
Dungun Tanjong							
	6.03	0.19	6.2		6.05	0.19	0.72
	(5.8 - 6.4)				(5.8 - 6.4)		
	7	3.13	1		8	3.06	
Maxwell Buckit							
					6.40	0.28	
					(6.2 - 6.6)		
					2	4.42	
Langkawi, P.							
	6.0		6.50	0.24	6.42	0.29	3.79
			(6.3 - 6.8)		(6.0 - 6.8)		
	1		5	3.62	6	4.56	
Kaki Bukit							
	6.10	0.28			6.10	0.28	
	(5.9 - 6.3)				(5.9 - 6.3)		
	2	4.64			2	4.64	

	FEMALE	MALE	COMBINED	F-RATIO
Si Chon	6.00 0.14 (5.9 - 6.1) 2 2.35	6.45 0.19 (6.2 - 6.6) 4 2.96	[illegible] 0.28 ([illegible].9 - 6.6) 6 4.49	8.31*
Tao, Ko	6.27 0.06 (6.2 - 6.3) 3 0.93	6.35 0.07 (6.3 - 6.4) 2 1.12	6.30 0.07 (6.2 - 6.4) 5 1.12	2.14
Zadetkyi Kyun		6.37 0.06 (6.3 - 6.4) 3 0.91	6.37 0.06 (6.3 - 6.4) 3 0.91	
Kawthaung		6.47 0.15 (6.3 - 6.6) 3 2.37	6.47 0.15 (6.3 - 6.6) 3 2.37	
Lanbi Kyun			6.10 0.28 (5.9 - 6.3) 2 4.64	
Klong Yai			6.45 0.07 (6.4 - 6.5) 2 1.10	
Prachuap Khiri Khan	6.1 1	6.43 0.32 (6.2 - 6.8) 3 4.99	6.35 0.31 (6.1 - 6.8) 4 4.90	0.81
Chan, Ko			6.25 0.35 (6.0 - 6.5) 2 5.66	
Nong Kho, Khlong	5.8 1	6.45 0.21 (6.3 - 6.6) 2 3.29	6.23 0.40 (5.8 - 6.6) 3 0.71	6.26
Pak Tho	6.10 0.14 (6.0 - 6.2) 2 2.31	6.7 1	6.30 0.36 (6.0 - 6.7) 3 5.72	12.00

	FEMALE		MALE		COMBINED		F-RATIO
Bangkok							
	6.50	0.30	6.87	0.15	6.68	0.29	3.56
	(6.2 - 6.8)		(6.7 - 7.0)		(6.2 - 7.0)		
	3	4.60	3	2.23	6	4.38	
Kanchanaburi							
	6.02	0.19	5.95	0.50	6.00	0.26	0.09
	(5.8 - 6.3)		(5.6 - 6.3)		(5.6 - 6.3)		
	5	3.19	2	8.32	7	4.30	
Lat Bua Kao							
			6.20	0.42	6.20	0.42	
			(5.9 - 6.5)		(5.9 - 6.5)		
			2	6.84	2	6.84	
Lop Buri							
	6.00	0.14			6.00	0.14	
	(5.9 - 6.1)				(5.9 - 6.1)		
	2	2.36			2	2.36	
Nakhon Sawan							
	6.06	0.22	6.42	0.26	6.25	0.29	6.00*
	(5.8 - 6.4)		(6.1 - 6.7)		(5.8 - 6.7)		
	5	3.61	6	3.99	11	4.71	
Khlong Khlung							
			6.60	0.17	6.60	0.17	
			(6.5 - 6.8)		(6.5 - 6.8)		
			3	2.62	3	2.62	
Khon Kaen							
	6.34	0.17	6.48	0.31	6.42	0.27	0.78
	(6.2 - 6.6)		(6.1 - 6.9)		(6.1 - 6.9)		
	5	2.63	8	4.80	13	4.13	
Chiang Mai							
	6.3		6.58	0.13	6.52	0.16	3.82
			(6.4 - 6.7)		(6.3 - 6.7)		
	1		4	1.92	5	2.52	
Nan							
	6.0		6.4		6.20	0.28	
					(6.0 - 6.4)		
	1		1		2	4.56	
Wet Kyun							
	5.90	0.00	6.05	0.07	5.98	0.10	9.00
	(5.9)		(6.0 - 6.1)		(5.9 - 6.1)		
	2	0.00	2	0.12	4	1.60	

FEMALE		MALE		COMBINED		F-RATIO
Myitkyina						
6.23	0.15	6.3		6.25	0.13	0.14
(6.1 - 6.4)				(6.1 - 6.4)		
3	0.95	1		4	2.06	

Table 20 Variation in length of mandibular molar tooth row (M_1-M_3)

	FEMALE	MALE	COMBINED	F-RATIO
Singapore	10.28 0.40 (9.8 - 10.7) 4 3.92	10.03 0.38 (9.6 - 10.3) 3 3.78	10.17 0.38 (9.6 - 10.7) 7 3.75	0.65
Endau, Sungei	9.73 0.50 (9.2 - 10.2) 3 5.17	9.88 0.57 (9.1 - 10.4) 4 5.81	9.81 0.50 (9.1 - 10.4) 7 5.14	0.12
Tioman, P.	9.53 0.30 (9.2 - 9.9) 4 3.14	9.2 1	9.46 0.30 (9.2 - 9.9) 5 3.14	0.95
Rompin, Sungei	9.85 0.21 (9.7 - 10.0) 2 2.15		9.85 0.21 (9.7 - 10.0) 2 2.15	
Bucki Besi	9.73 0.15 (9.6 - 9.9) 4 1.54	9.4 1	9.66 0.19 (9.4 - 9.9) 5 2.02	3.76
Dungun Tanjong	9.73 0.23 (9.3 - 10.0) 7 2.35	9.4 1	9.69 0.24 (9.3 - 10.0) 8 2.49	1.80
Maxwell Buckit			9.40 0.14 (9.3 - 9.5) 2 1.50	
Langkawi, P.	9.7 1	9.80 0.21 (9.5 - 10.0) 5 2.16	9.78 0.19 (9.5 - 10.0) 6 1.98	0.19
Kaki Bukit	9.85 0.35 (9.6 - 10.1) 2 3.59		9.85 0.35 (9.6 - 10.1) 2 3.59	

	FEMALE	MALE	COMBINED	F-RATIO
[illegible] Chon	9.55 0.35 (9.3 - 9.8) 2 3.71	9.53 0.21 (9.3 - 9.8) 4 2.1[illegible]	9.53 0.2[illegible] (9.3 9.8) 6 2.36	0.01 -
Tao, Ko	9.23 0.06 (9.2 - 9.3) 3 0.63	9.20 0.00 (9.2) 2 0.00	9.22 0.04 (9.2 - 9.3) 5 0.4[illegible]	0.60
Zadetkyi Kyun		10.00 0.17 (9.9 - 10.2) 3 1.73	10.00 0.17 (9.9 - 10.2) 3 1.73	
Kawthaung		9.57 0.12 (9.5 - 9.7) 3 1.20	9.57 0.12 (9.5 - 9.7) 3 1.20	
Lanbi Kyun			9.55 0.21 (9.4 - 9.7) 2 2.22	
Klong Yai			9.65 0.64 (9.2 - 10.1) 2 6.59	
Prachuap Khiri Khan	9.1 1	9.50 0.17 (9.3 - 9.6) 3 1.82	9.40 0.24 (9.1 - 9.6) 4 2.61	4.00
Chan, Ko			9.65 0.21 (9.5 - 9.8) 2 2.20	
Nong Kho, Khlong	9.6 1	9.75 0.35 (9.5 - 10.0) 2 3.63	9.70 0.26 (9.5 - 10.0) 3 2.73	0.12
Pak Tho	9.25 0.35 (9.0 - 9.5) 2 3.83	9.4 1	9.30 0.26 (9.0 - 9.5) 3 2.85	0.12

	FEMALE		MALE		COMBINED		F-RATIO
Bangkok							
	9.60	0.35	9.63	0.31	9.62	0.29	0.02
	(9.2 - 9.9)		(9.3 - 9.8)		(9.2 - 9.9)		
	3	3.60	3	3.18	6	2.73	
Kanchanaburi							
	9.52	0.05	8.9		9.42	0.26	160.17*
	(9.5 - 9.6)				(8.9 - 9.6)		
	5	0.47	1		6	2.72	
Lat Bua Kao							
			9.10	0.00	9.10	0.00	
			(9.1)		(9.1)		
			2	0.00	2	0.00	
Lop Buri							
	9.50	0.42			9.50	0.42	
	(9.2 - 9.8)				(9.2 - 9.8)		
	2	4.47			2	4.47	
Nakhon Sawan							
	9.04	0.09	9.42	0.44	9.23	0.36	3.61
	(8.9 - 9.1)		(8.8 - 10.0)		(8.8 - 10.0)		
	5	0.98	5	4.65	10	3.89	
Khlong Khlung							
			9.57	0.31	9.57	0.31	
			(9.3 - 9.9)		(9.3 - 9.9)		
			3	3.19	3	3.19	
Khon Kaen							
	9.46	0.23	9.66	0.20	9.58	0.23	2.52
	(9.2 - 9.7)		(9.4 - 10.0)		(9.2 - 10.0)		
	5	2.43	7	2.06	12	2.36	
Chiang Mai							
	9.3		9.30	0.10	9.30	0.08	0.00
			(9.2 - 9.4)		(9.2 - 9.4)		
	1		[illegible]	1.08	4	0.87	
Nan							
	9.9		9.		9.50	0.57	
					(9.1 - 9.9)		
	1				2	5.95	
Wet Kyun							
	9.55	0.07	9.50	0.00	9.53	0.05	1.00
	(9.5 - 9.6)		(9.5)		(9.5 - 9.6)		
	2	0.74	2	0.00	4	0.52	

FEMALE		MALE	COMBINED		F-RATIO
Myitkyina					
9.10	0.17	9.1	9.10	0.14	0.00
(8.9 - 9.2)			(8.9 - 9.2)		
3	1.90	1	4	1.55	

Table 21 Variation in jaw length

	FEMALE	MALE	COMBINED	F-RATIO
Singapore	35.65 0.55 (35.0 - 36.3) 4 1.53	36.67 0.23 (36.4 - 36.8) 3 0.63	36.09 0.68 (35.0 - 36.8) 7 1.88	8.89*
Endau, Sungei	34.07 0.71 (33.3 - 34.7) 3 2.08	35.23 0.41 (34.7 - 35.6) 4 1.17	34.73 0.80 (33.3 - 35.6) 7 2.30	7.60*
Tioman, P.	33.45 0.83 (32.8 - 34.6) 4 2.47	34.2 1	33.60 0.79 (32.8 - 34.6) 5 2.35	0.66
Rompin, Sungei	35.15 0.50 (34.8 - 35.5) 2 1.41		35.15 0.50 (34.8 - 35.5) 2 1.41	
Bucki Besi	34.18 1.03 (33.4 - 35.7) 4 3.03	37.0 1	34.74 1.55 (33.4 - 37.0) 5 4.46	5.97
Dungun Tanjong	34.09 0.65 (33.2 - 34.9) 7 1.90	33.8 1	34.05 0.61 (33.2 - 34.9) 8 1.78	0.17
Maxwell Buckit			33.85 1.48 (32.8 - 34.9) 2 4.39	
Langkawi, P.	33.6 1	34.36 0.33 (34.0 - 34.7) 5 0.96	34.23 0.43 (33.6 - 34.7) 6 1.25	4.46
Kaki Bukit	34.55 0.21 (34.4 - 34.7) 2 0.61		34.55 0.21 (34.4 - 34.7) 2 0.61	

	FEMALE	MALE	COMBINED	F-RATIO
Si Chon	32.70 0.00 (32.7) 2 0.00	34.25 0.90 (33.1 - 35.1) 4 2.62	33.73 1.06 (32.7 - 35.1) 6 3.14	5.32
Tao, Ko	32.70 0.20 (32.5 - 32.9) 3 0.61	32.80 0.42 (32.5 - 33.1) 2 1.29	32.74 0.26 (32.5 - 33.1) 5 0.80	0.14
Zadetkyi Kyun		35.77 0.85 (34.9 - 36.6) 3 2.38	35.77 0.85 (34.9 - 36.6) 3 2.38	
Kawthaung		34.43 0.91 (33.4 - 35.1) 3 2.63	34.43 0.91 (33.4 - 35.1) 3 2.63	
Lanbi Kyun			34.05 0.07 (34.0 - 34.1) 2 0.21	
Klong Yai			36.00 0.99 (35.3 - 36.7) 2 2.75	
Prachuap Khiri Khan	32.5 1	34.17 1.46 (33.0 - 35.8) 3 4.26	33.75 1.45 (32.5 - 35.8) 4 4.30	0.98
Chan, Ko			33.10 0.57 (32.7 - 33.5) 2 1.71	
Nong Kho, Khlong	34.3 1	34.15 0.50 (33.8 - 34.5) 2 1.45	34.20 0.36 (33.8 - 34.5) 3 1.05	0.06
Pak Tho	32.40 0.14 (32.3 - 32.5) 2 0.44	33.9 1	32.90 0.87 (32.3 - 33.9) 3 2.65	75.00

	FEMALE		MALE		COMBINED		F-RATIO
Bangkok							
	33.67	1.16	34.33	0.35	34.00	0.85	0.92
	(33.0 - 35.0)		(34.0 - 34.7)		(33.0 - 35.0)		
	3	3.43	3	1.02	6	2.49	
Kanchanaburi							
	32.64	1.02	31.15	0.07	32.21	1.11	3.80
	(31.9 - 34.0)		(31.1 - 31.2)		(31.1 - 34.0)		
	5	3.13	2	0.23	7	3.44	
Lat Bua Kao							
			32.60	1.13	32.60	1.13	
			(31.8 - 33.4)		(31.8 - 33.4)		
			2	3.47	2	3.47	
Lop Buri							
	33.15	0.50			33.15	0.50	
	(32.8 - 33.5)				(32.8 - 33.5)		
	2	1.49			2	1.49	
Nakhon Sawan							
	32.48	1.13	33.57	0.98	33.07	1.14	2.94
	(30.8 - 33.6)		(32.3 - 35.2)		(30.8 - 35.2)		
	5	3.48	6	2.90	11	3.46	
Khlong Khlung							
			33.83	1.81	33.83	1.81	
			(32.5 - 35.9)		(32.5 - 35.9)		
			3	5.36	3	5.36	
Khon Kaen							
	33.40	0.42	33.70	0.77	33.60	0.67	0.51
	(33.0 - 34.0)		(32.6 - 35.0)		(32.6 - 35.0)		
	4	1.27	8	2.28	12	1.99	
Chiang Mai							
	31.4		33.10	0.50	32.68	0.94	8.67
			(32.6 - 33.6)		(31.4 - 33.6)		
	1		3	1.51	4	2.89	
Nan							
	33.8		32.6		33.20	0.85	
					(32.6 - 33.8)		
	1		1		2	2.51	
Wet Kyun							
	33.50	0.14	33.40	0.42	33.45	0.26	0.10
	(33.4 - 33.6)		(33.1 - 33.7)		(33.1 - 33.7)		
	2	0.42	2	1.27	4	0.79	

	FEMALE		MALE	COMBINED		F-RATIO
Myitkyina						
	31.70	0.90	32.1	31.80	0.76	0.15
	(30.8 - 32.6)			(30.8 - 32.6)		
	3	2.84	1	4	2.39	

Table 22 Variation in the height of the ascending ramus

	FEMALE		MALE		COMBINED		F-RATIO
Singapore							
	13.83	0.31	14.90	0.36	14.29	0.65	18.09*
	(13.4 - 14.1)		(14.5 - 15.2)		(13.4 - 15.2)		
	4	2.24	3	2.42	7	4.54	
Endau, Sungei							
	13.37	1.08	13.33	0.38	13.34	0.68	0.01
	(12.6 - 14.6)		(12.9 - 13.8)		(12.6 - 14.6)		
	3	8.07	4	2.83	7	5.08	
Tioman, P.							
	13.25	0.89	14.0		13.40	0.84	0.57
	(12.4 - 14.2)				(12.4 - 14.2)		
	4	6.68	1		5	6.24	
Rompin, Sungei							
	13.40	0.14			13.40	0.14	
	(13.3 - 13.5)				(13.3 - 13.5)		
	2	1.06			2	1.06	
Bucki Besi							
	12.90	0.65	14.0		13.12	0.75	2.30
	(12.3 - 13.6)				(12.3 - 14.0)		
	4	5.02	1		5	5.69	
Dungan Tanjong							
	12.97	0.63	13.8		13.08	0.66	1.49
	(12.2 - 13.9)				(12.2 - 13.9)		
	7	4.89	1		8	4.72	
Maxwell Buckit							
					13.05	1.91	
					(11.7 - 14.4)		
					2	14.62	
Langkawi,							
	13.0		13.78	0.45	13.65	0.51	2.51
			(13.2 - 14.4)		(13.0 - 14.4)		
	1		5	3.26	6	3.76	
Kaki Bukit							
	13.65	0.2[illegible]			13.65	0.21	
	(13.5 - 1[illegible])				(13.5 - 13.8)		
	2	[illegible]55			2	1.55	

	FEMALE	MALE	COMBINED	F-RATIO
Si Chong	12.65 0.07 (12.6 - 12.7) 2 0.56	13.88 0.41 (13.5 - 14.4) 4 2.96	13.47 0.71 (12.6 - 14.4) 6 5.26	15.62*
Tao, Ko	12.87 0.12 (12.8 - 13.0) 3 0.89	13.50 0.42 (13.2 - 13.8) 2 3.14	13.12 0.41 (12.8 - 13.8) 5 3.16	6.99
Zadetkyi Kyun		13.37 0.49 (12.8 - 13.7) 3 3.69	13.37 0.49 (12.8 - 13.7) 3 3.69	
Kawthaung		13.30 0.46 (12.8 - 13.7) 3 3.45	13.30 0.46 (12.8 - 13.7) 3 3.45	
Lanbi Kyun			13.20 0.42 (12.9 - 13.5) 2 2.28	
Klong Yai			14.15 0.07 (14.1 - 14.2) 2 0.50	
Prachuap Khiri Khan	13.2 1	13.80 0.53 (13.2 - 14.2) 3 3.83	13.65 0.53 (13.2 - 14.2) 4 3.85	0.96
Chan, Ko			12.70 0.85 (12.1 - 13.3) 2 6.68	
Nong Kho, Khlong		13.95 0.50 (13.6 - 14.3) 2 3.55	13.95 0.50 (13.6 - 14.3) 2 3.55	
Pak Tho	12.90 0.14 (12.8 - 13.0) 2 1.09	13.4 1	13.07 0.31 (12.8 - 13.4) 3 2.37	8.33

FEMALE	MALE	COMBINED	F-RATIO
Bangkok 13.53 0.35 (13.2 - 13.9) 3 2.59	14.37 0.59 (13.7 - 14.8) 3 4.08	13.95 0.63 (13.2 - 14.8) 6 4.51	4.46
Kanchanaburi 12.56 0.92 (11.4 - 13.4) 5 7.33	12.20 0.57 (11.8 - 12.6) 2 4.64	12.46 0.81 (11.4 - 13.4) 7 6.47	0.25
Lat Bua Kao	13.60 0.85 (13.0 - 14.2) 2 6.24	13.60 0.85 (13.0 - 14.2) 2 6.24	
Lop Buri 13.25 0.35 (13.0 - 13.5) 2 2.67		13.25 0.35 (13.0 - 13.5) 2 2.67	
Nakhon Sawan 13.00 0.60 (12.1 - 13.6) 5 4.62	13.45 0.40 (12.9 - 14.0) 6 2.97	13.25 0.53 (12.1 - 14.0) 11 4.00	2.18
Khlong Khlung	13.47 1.17 (12.6 - 14.8) 3 8.70	13.47 1.17 (12.6 - 14.8) 3 8.70	
Khon Kaen 13.40 0.42 (13.0 - 13.9) 4 3.16	13.71 0.48 (13.1 - 14.3) 7 3.50	13.60 0.47 (13.0 - 14.3) 11 3.43	1.17
Chiang Mai	13.85 0.78 (13.3 - 14.4) 2 5.62	13.85 0.78 (13.3 - 14.4) 2 5.62	
Nan 13.7 1	12.7 1	13.20 0.71 (12.7 - 13.7) 2 5.36	
Wet Kyun 13.25 0.07 (13.2 - 13.3) 2 0.54	13.00 0.71 (12.5 - 13.5) 2 5.44	13.13 0.43 (12.5 - 13.5) 4 3.31	0.25

	FEMALE		MALE	COMBINED		F-RATIO
Myitkyina						
	12.47	0.59	13.0	12.60	0.55	0.62
	(11.8 - 12.9)			(11.8 - 13.0)		
	3	4.70	1	4	4.35	

Table 23 Variation in the height of the mandibular condyle

	FEMALE	MALE	COMBINED	F-RATIO
Singapore	9.18 0.29 (9.0 - 9.6) 4 3.13	9.53 0.42 (9.2 - 10.0) 3 4.36	9.33 0.37 (9.0 - 10.0) 7 3.95	1.85
Endau, Sungei	8.30 0.72 (7.7 - 9.1) 3 8.69	8.48 0.13 (8.3 - 8.6) 4 1.45	8.40 0.44 (7.7 - 9.1) 7 5.19	0.24
Tioman, P.	8.10 0.86 (7.0 - 9.0) 4 10.6	9.1 1	8.30 0.87 (7.0 - 9.1) 5 9.55	1.08
Rompin, Sungei	8.45 0.21 (8.3 - 8.6) 2 2.51		8.45 0.21 (8.3 - 8.6) 2 2.51	
Bucki Besi	8.55 0.53 (7.8 - 9.0) 4 6.15	9.0 1	8.64 0.50 (7.8 - 9.0) 5 5.76	0.59
Dungun Tanjong	8.37 0.28 (8.0 - 8.7) 7 3.36	8.7 1	8.41 0.29 (8.0 - 8.7) 8 3.39	1.20
Maxwell Buckit			8.65 1.20 (7.8 - 9.5) 2 13.90	
Langkawi, P.	8.0 1	9.02 0.33 (8.6 - 9.4) 5 3.63	8.85 0.51 (8.0 - 9.4) 6 5.75	8.10*
Kaki Bukit	9.1 0.42 (8.8 - 9.4) 2 4.66		9.1 0.42 (8.8 - 9.4) 2 4.66	

	FEMALE	MALE	COMBINED	F-RATIO
Si Chon	8.15 0.21 (8.0 - 8.3) 2 2.60	8.80 0.36 (8.5 - 9.2) 4 4.05	8.58 0.44 (8.0 - 9.2) 6 5.18	5.30
Tao, Ko	8.53 0.15 (8.4) 3 1.79	8.75 0.07 (8.7 - 8.8) 2 0.81	8.62 0.16 (8.4 - 8.8) 5 1.91	3.27
Zadetkyi Kyun		8.63 0.12 (8.5 - 8.7) 3 1.33	8.63 0.12 (8.5 - 8.7) 3 1.33	
Kawthaung		8.77 0.45 (8.3 - 9.2) 3 5.14	8.77 0.45 (8.3 - 9.2) 3 5.14	
Lanbi Kyun			8.35 0.50 (8.0 - 8.7) 2 5.93	
Klong Yai			9.55 0.07 (9.5 - 9.6) 2 0.74	
Prachuap Khiri Khan	9.2 1	8.83 0.60 (8.2 - 9.4) 3 6.83	8.93 0.53 (8.2 - 9.4) 4 5.88	0.28
Chan, Ko			8.40 0.28 (8.2 - 8.6) 2 3.37	
Nong Kho, Khlong		9.00 0.42 (8.7 - 9.3) 2 4.71	9.00 0.42 (8.7 - 9.3) 2 4.71	
Pak Tho	8.25 0.07 (8.2 - 8.3) 2 0.86	8.4 1	8.30 0.10 (8.2 - 8.4) 3 1.20	3.00

	FEMALE		MALE		COMBINED		F-RATIO
Bangkok							
	8.67	0.21	9.50	0.61	9.08	0.61	5.04
	(8.5 - 8.9)		(8.8 - 9.9)		(8.5 - 9.9)		
	3	2.40	3	6.40	6	6.73	
Kanchanaburi							
	8.06	0.61	8.25	0.64	8.11	0.57	0.14
	(7.4 - 8.8)		(7.8 - 8.7)		(7.4 - 8.8)		
	5	7.53	2	7.71	7	6.99	
Lat Bua Kao							
			8.90	0.42	8.90	0.42	
			(8.6 - 9.2)		(8.6 - 9.2)		
			2	4.77	2	4.77	
Lop Buri							
	8.65	0.35			8.65	0.35	
	(8.4 - 8.9)				(8.4 - 8.9)		
	2	4.09			2	4.09	
Nakhon Sawan							
	8.18	0.35	8.70	0.19	8.46	0.37	9.94*
	(7.8 - 8.6)		(8.5 - 9.0)		(7.8 - 9.0)		
	5	4.27	6	2.18	11	4.43	
Khlong Khlung							
			8.57	0.60	8.57	0.60	
			(8.0 - 9.2)		(8.0 - 9.2)		
			3	7.04	3	7.04	
Khon Kaen							
	8.73	0.44	8.81	0.24	8.78	0.31	0.20
	(8.3 - 9.3)		(8.5 - 9.0)		(8.3 - 9.3)		
	4	4.99	7	2.73	11	3.48	
Chiang Mai							
			9.15	0.35	[illegible]	0.35	
			(8.9 - 9.4)		(8.9 - 9.4)		
			2	3.87		3.86	
Nan							
	8.7		8.4		8.55	0.21	
					(8.4 - 8.7)		
	1		1		2	2.48	
Wet Kyun							
	8.65	0.21	8.40	0.42	8.53	0.31	0.56
	(8.5 - 8.8)		(8.1 - 8.7)		(8.1 - 8.8)		
	2	2.45	2	5.05	4	3.63	

	FEMALE		MALE	COMBINED		F-RATIO
Myitkyina						
	7.93	0.40	8.6	8.10	0.47	2.04
	(7.5 - 8.3)			(7.5 - 8.6)		
	3	5.09	1	4	5.79	

Table 24 Variation in the length of the maxillary tooth row

Locality	FEMALE	MALE	COMBINED	F-RATIO
Bintan, P.	19.5	19.50 0.71	19.50 0.50	0.00
		(19.0 - 20.0)	(19.0 - 20.0)	
	1	2 3.63	3 2.56	
Batam, P.	19.63 0.52	19.43 0.35	19.53 0.44	0.72
	(19.0 - 20.5)	(19.0 - 20.0)	(19.0 - 20.5)	
	8 2.64	7 1.78	15 2.26	
Singapore	18.94 0.53	19.10 0.42	19.00 0.48	0.32
	(18.0 - 19.5)	(18.5 - 19.5)	(18.0 - 19.5)	
	9 2.78	5 2.19	14 2.53	
Pelepah, Sungei	20.0	19.25 0.35	19.50 0.50	3.00
		(19.0 - 19.5)	(19.0 - 20.0)	
	1	2 1.84	3 2.56	
Aor, P.			18.85 0.92	
			(18.2 - 19.5)	
			2 4.88	
Tioman, P.	17.80 0.45	18.17 0.29	17.94 0.42	1.56
	(17.5 - 18.5)	(18.0 - 18.5)	(17.5 - 18.5)	
	5 2.51	3 1.59	8 2.33	
Ginting Perah, Bukit	19.5	19.25 0.35	19.33 0.29	0.33
		(19.0 - 19.5)	(19.0 - 19.5)	
	1	2 1.79	3 1.49	
Pinang, Ko	18.50 0.87	18.25 0.35	18.40 0.65	0.14
	(17.0 - 19.0)	(18.0 - 18.5)	(17.5 - 19.0)	
	3 4.68	2 1.94	5 3.53	
Redang, P.			18.00 0.71	
			(17.5 - 18.5)	
			2 3.93	

	FEMALE	MALE	COMBINED	F-RATIO
Perhentian Kechil, P.			18.75 0.35 (18.5 - 19.0) 2 1.89	
Langkawi, P.	18.40 0.42 (18.0 - 19.0) 5 2.27	18.25 0.50 (18.0 - 19.0) 4 2.74	18.33 0.43 (18.0 - 19.0) 9 2.36	0.24
Tarutao, P.	18.00 0.50 (17.5 - 19.0) 7 2.78	18.17 0.26 (18.0 - 18.5) 6 1.42	18.08 0.40 (17.5 - 19.0) 13 2.21	0.54
Mae Nam		17.67 1.04 (16.5 - 18.5) 3 5.89	17.67 1.04 (16.5 - 18.5) 3 5.89	
Chong, Ko	18.63 1.11 (17.0 - 19.5) 4 5.95	18.75 0.35 (18.5 - 19.0) 2 1.89	18.67 0.88 (17.0 - 19.5) 6 4.69	0.02
Lamae Khlong	19.00 0.50 (18.5 - 19.5) 3 2.63	18.50 0.71 (18.0 - 19.0) 2 3.82	18.80 0.57 (18.0 - 19.5) 5 3.03	0.90
Zadetkyi Kyun	19.25 0.35 (19.0 - 19.5) 2 1.84	19.17 0.29 (19.0 - 19.5) 3 1.51	19.20 0.27 (19.0 - 19.5) 5 1.43	0.09
Kawthaung	19.0 (19.0) 1	18.50 0.00 (18.5) 4 0.00	18.60 0.22 (18.5 - 19.0) 5 1.20	0.00
Kanmaw Kyun	18.25 0.35 (18.0 - 18.5) 2 1.94	17.25 0.35 (17.0 - 17.5) 2 2.05	17.75 0.65 (17.0 - 18.5) 4 3.64	
Tenasserim	17.5 1	17.50 0.71 (17.0 - 18.0) 2 4.04	17.50 0.50 (17.0 - 18.0) 3 4.04	0.00

	FEMALE		MALE		COMBINED		F-RATIO
Moulmein							
	18.00	0.00	17.75	0.35	17.83	0.29	0.33
	(18.0)		(17.5 - 18.0)		(17.5 - 18.0)		
	1	0.00	2	1.99	3	1.62	
Rangoon							
					18.25	0.35	
					(18.0 - 18.5)		
					2	1.94	
Chiang Mai							
	17.5		18.33	0.29	18.13	0.48	6.25
			(18.0 - 18.5)		(17.5 - 18.5)		
	1		3	1.58	4	2.64	
Nan							
	18.00	0.00			18.00	0.00	
	(18.0)				(18.0)		
	2	0.00			2	0.00	
Pai							
	17.25	0.35			17.25	0.35	
	(17.0 - 17.5)				(17.0 - 17.5)		
	2	2.05			2	2.05	
Wet Kyun							
	18.0		18.00	0.00	18.00	0.00	0.00
			(18.0)		(18.0)		
	1		3	0.00	4	0.00	

Table 25 Variation in each character over the entire sample

	FEMALE		MALE		COMBINED		F-RATIO
Total length							
	341.66	18.99	345.88	19.90	343.92	19.56	3.58
	(290 - 395)		(290 - 394)		(290 - 395)		
	142	5.56	164	5.75	306	5.69	
Tail length							
	162.79	14.90	166.52	16.35	164.78	15.77	4.45*
	(133 - 200)		(129 - 200)		(129 - 200)		
	148	9.15	168	9.82	316	9.57	
Head and body length							
	178.47	12.20	179.26	11.64	178.89	11.89	0.34
	(143 - 205)		(120 - 210)		(120 - 210)		
	142	6.83	164	6.49	306	6.65	
Foot length							
	42.62	2.17	43.24	2.11	42.94	2.16	6.71*
	(34 - 48)		(38 - 48)		(34 - 48)		
	155	5.10	160	4.87	315	5.03	
Condylobasal length							
	46.74	1.62	47.08	1.65	46.91	1.64	3.06
	(42.7 - 51.5)		(42.0 - 50.0)		(42.0 - 51.5)		
	142	3.47	142	3.51	284	3.50	
Palatal length							
	26.18	1.11	26.46	1.16	26.32	1.14	2.52
	(23.8 - 29.2)		(23.7 - 28.8)		(23.7 - 29.2)		
	78	4.24	82	4.38	160	4.34	
Cranial length							
	20.16	0.72	20.40	0.64	20.28	0.69	5.16*
	(18.6 - 22.4)		(19.1 - 22.1)		(18.6 - 22.4)		
	78	3.56	82	3.17	160	3.40	
Maximum width of skull							
	19.09	0.64	19.06	0.50	19.07	0.57	0.17
	(17.1 - 20.5)		(18.0 - 20.4)		(17.1 - 20.5)		
	152	3.33	148	2.60	300	2.98	
Bizygomatic width							
	24.35	1.23	24.96	1.19	24.65	1.25	18.48**
	(21.2 - 28.5)		(22.0 - 28.0)		(21.2 - 28.5)		
	145	5.06	145	4.77	290	5.06	

	FEMALE	MALE	COMBINED	F-RATIO
Biauricular width	16.09 0.59 (14.7 - 17.7) 78 3.67	16.32 0.67 (15.0 - 18.0) 80 3.93	16.21 0.64 (14.7 - 18.0) 158 3.96	4.88*
Interorbital width	13.66 0.61 (12.2 - 15.0) 78 4.45	13.96 0.66 (12.3 - 15.5) 82 4.70	13.81 0.65 (12.2 - 15.5) 160 4.69	8.44**
Orbital length	10.43 0.44 (9.3 - 11.6) 78 4.23	10.46 0.41 (9.4 - 11.6) 82 3.90	10.45 0.42 (9.3 - 11.6) 160 4.05	0.25
Orbital width	10.05 0.38 (9.2 - 11.0) 78 3.79	10.09 0.36 (9.3 - 11.6) 82 3.59	10.07 0.37 (9.2 - 11.6) 160 3.68	0.56
Brain case height	14.55 0.64 (13.4 - 16.8) 78 4.42	14.57 0.49 (13.6 - 15.8) 82 3.36	14.56 0.57 (13.4 - 16.8) 160 3.90	0.04
Ophisthion to Opistocranion	12.04 0.39 (11.1 - 13.1) 78 3.23	12.36 0.41 (11.6 - 13.5) 82 3.33	12.20 0.43 (11.1 - 13.5) 160 3.53	25.27**
Molar row length (M^1 - M^3)	8.69 0.30 (8.0 - 9.6) 76 3.43	8.76 0.38 (8.2 - 10.4) 77 4.28	8.72 0.34 (8.0 - 10.4) 153 3.89	1.30
Bimolar width (M^2 - M^2)	16.12 0.54 (15.0 - 17.5) 78 3.38	16.19 0.58 (14.7 - 17.4) 82 3.57	16.15 0.56 (14.7 - 17.5) 160 3.47	0.66
Incisor width (I^2 - I^2)	6.15 0.24 (5.7 - 6.8) 78 3.86	6.44 0.29 (5.6 - 7.1) 82 4.53	6.30 0.30 (5.6 - 7.1) 160 4.83	48.67**
Molar Tooth Row (M_1 - M_3)	9.56 0.38 (8.8 - 10.7) 77 3.99	9.54 0.33 (8.8 - 10.4) 78 3.49	9.55 0.36 (8.8 - 10.7) 155 3.72	0.12

	FEMALE		MALE		COMBINED		F-RATIO
Jaw length							
	33.54	1.25	34.01	1.29	33.78	1.29	5.45*
	(30.8 - 36.7)		(31.1 - 37.0)		(30.8 - 37.0)		
	76	3.74	81	3.79	157	3.82	
Height of ascending ramus							
	13.09	0.63	13.56	0.65	13.33	0.68	20.56**
	(11.4 - 14.6)		(11.8 - 15.2)		(11.4 - 15.2)		
	74	4.78	78	4.80	152	5.09	
Height of mandibular condyle							
	8.44	0.48	8.77	0.45	8.61	0.49	18.49**
	(7.4 - 9.6)		(7.8 - 10.0)		(7.4 - 10.0)		
	74	5.66	78	5.12	152	5.10	
Length of maxillary tooth row							
	18.50	0.87	18.50	0.77	18.50	0.83	0.00
	(16.0 - 20.5)		(16.0 - 20.0)		(16.0 - 20.5)		
	80	4.79	76	4.14	156	4.47	

Table 26 Average coefficients of variation of sites where the sample was greater than five

CHARACTER	FEMALE	MALE	COMBINED
Total length	3.84	3.58	3.65
Tail length	5.12	5.48	5.35
Body length	5.24	4.61	4.57
Foot length	4.04	3.92	3.82
Condylobasal length	2.12	1.91	2.09
Palatal length	2.93	2.62	2.33
Cranial length	2.37	2.17	2.66
Maximum width of the skull	2.62	2.04	2.25
Bizygomatic width	2.97	2.69	3.46
Bi-auricular width	3.27	2.71	2.95
Interorbital width	2.85	3.49	3.57
Orbital length	2.52	2.06	2.40
Orbital width	1.80	2.23	2.37
Height of the brain case	3.24	3.14	2.78
Opisthion to opistocranion	2.53	2.96	2.97
Maxillary molar row length	1.52	2.09	2.39
Maxillary bimolar width	2.42	3.11	2.47
Maxillary incisor width	3.14	4.14	3.86
Mandibular molar tooth row	1.61	2.96	2.76
Jaw length	2.84	2.05	2.45
Height of the ascending ramus	5.61	3.24	4.74
Height of the mandibular condyle	5.05	2.85	5.19
Length of maxillary tooth row	2.52	1.80	2.56

Table 27 Results of the F - test for sexual dimorphism

Dashes (-) indicate a non-significant test result; "x" indicates a significant test result; "x̲" indicates a significant test result with no qualifications (refer to discussion in the text for information on the nature of qualifications which are attached to specific test results).

Site	Character* 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Bintan, Pulau		-		-	-			-															-
Batam, P.	-	-	-	-	-			-	-														-
Singapore	-	-	-	-	-	-	-	-	-	x	-	-	-	-	x	-	-	-	-	x	x	-	-
Pelepah, Sungei	-	-		-	-			-	-														-
Endau, Sungei	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	
Tioman, P.	-	-		-	-	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-
Ginting Perah	-	-	-	-				-	-														-
Bucki Besi	-	-	-	-	x	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	-	
Dungun, Tanjong	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Pinang, P.				-	-			-	-														-
Langkawi, P.	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	x	-
Tarutao, Ko	-	-	-	-	-	-	-	x̲	x̲														-
Trang	-	x̲	-	-																			
Mae Nam		-		-																			
Si Chon					-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-
Chong, Ko	-	-	-	-	-			-	-														-
Lamae, Khlong	-	-	-	-	-			-	-														-
Zadetkyi Kyun	-	-	-	-	-			-	-														-
Kawthaung	-	-		-	-			-	-														-
Tao, Ko					-	-	x	-	x	-	-	x	-	-	x	-	-	-	-	-	-	-	
Wet Kyun	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-		-	-	-	-	-	-	-
Kanmaw Kyun	-	-	-	-	-			-	-														-
Lak, Ko	-	x	-	-																			
Tenasserim				-				-	-														-
Prachuap Khiri Khan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Trat	-	-	-	-																			
Nong Kho, Khlong					-	-	-	-	-	-	-	-	-	-	-		-	-	-	-			
Pak Tho		-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	
Bangkok					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Kanchanaburi	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	x	-	-	x	-	-	-	
Nakhon Ratchisma	-	-	-	-																			
Ubon Ratchathani	-	-	-	-																			
Nakhon Sawan	-	-	-	-	-	-	x̲	-	x̲	x̲	-	-	-	-	x̲	-	-	x̲	-	-	-	x̲	
Khon Kaen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x̲	-	-	-	-	-	-	-	
Moulmein	-	-	-	-				-	-														-
Dan Sai	x̲	x̲	-	-																			
Chiang Mai	x	-	-	-	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-			-
Nan	-	-	-	-				-	-														
Myitkyina	x	-		-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	
Entire sample	-	x	-	x	-	-	x	-	x̲	x	x̲	-	-	-	x̲	-	-	x̲	-	x	x̲	x̲	-

*Number corresponds to list on page of the text.