ความแปรผันทางสัณฐานของกิ้งก่ารั้ว *Calotes versicolor* (Daudin, 1802) ในประเทศไทย

นางสาว อาภาพรรณ ประกอบการ

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MORPHOLOGICAL VARIATION OF GARDEN FENCE LIZARD *Calotes versicolor* (Daudin, 1802) IN THAILAND

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A Thesis Submitted in Partial Fulfillment of the Requirements
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กิ้งก่ารั้ว เป็นกิ้งก่าที่พบมากและมีขอบเขตการแพร่กระจายกว้าง ตั้งแต่ตะวันออกกลาง จนถึงตะวันออกไกล และเอเชียตะวันออกเฉียงใต้ แม้ว่าในหลายประเทศรวมทั้งประเทศไทยกิ้งก่าชนิดนี้จะมีความผันแปรทางสัณฐานอย่างชัดเจน แต่ยังไม่มีผู้ใดทำการศึกษา การศึกษาครั้งนี้ได้ทำการศึกษาโดยเก็บตัวอย่างกิ้งก่ารั้วตัวเต็มวัยในภาคเหนือและภาคใต้ของประเทศไทยซึ่งอยู่ต่างเขตสัตวศาสตร์ย่อย (zoological subregion) โดยเก็บตัวอย่างจาก 3 พื้นที่ในแต่ละภาค พื้นที่ละ 20 ตัว เป็นเพศผู้และเพศเมียอย่างละ 10 ตัว ทำการศึกษาความแตกต่างทางสัณฐานระหว่างเพศและระหว่างภาค โดยตรวจสอบความแตกต่างของลักษณะขนาด (mensural character) ด้วย analysis of covariance (ANCOVA) และ จัดกลุ่มแต่ละตัวจากความแตกต่างของลักษณะขนาด ด้วย principle component analysis (PCA) วิเคราะห์ความแตกต่างของจำนวนเกล็ด (meristic character) ด้วย Mann-Whitney *U*-test แ ละจัดกลุ่มแต่ละตัวจากความแตกต่างของจำนวนเกล็ด ด้วย PCA และเปรียบเทียบความถี่การปรากฏของลายโดย chi-squared test ผลการศึกษาพบว่าความแตกต่างระหว่างเพศพบได้ในตัวอย่างกิ้งก่ารั้วทั้งภาคเหนือและภาคใต้ โดยตัวผู้จะมีขนาดหัวและรยางค์ใหญ่กว่าตัวเมียแต่ตัวเมียมีขนาดลำตัวใหญ่กว่า ส่วนจำนวนเกล็ดในตัวผู้พบมากกว่าตัวเมีย นอกจากนี้พบความถี่การปรากฏของลายในตัวเมียมากกว่าในตัวผู้ ซึ่งพบที่ลายข้างลำตัว (DorsSt) ลายบนขาหน้า (ForearSt) และจุดดำกลางหัว (NucSpot) ส่วนความแตกต่างทางสัณฐานระหว่างภาคจะพบในลักษณะของขนาดและลายชัดเจนกว่าจำนวนเกล็ดระหว่างประชากรในภาคเหนือและภาคใต้ โดยพบว่าตัวผู้ทางใต้จะมีขนาดหัวและรยางค์ใหญ่กว่า และยังพบว่าลายบนลำตัว (TrnkBand) และคอ (ThroatPa) ถี่กว่าทางเหนือ ส่วนความแตกต่างที่พบในตัวเมียจะไม่ชัดเจนเหมือนในตัวผู้

ภาควิชา.................ชีววิทยา........... ลายมือชื่อนิสิต.........อาภาพรรณ ประกอบการ.........

สาขาวิชา...............สัตววิทยา........ ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก.........

ปีการศึกษา............2553.............. ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์ร่วม.........

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KEYWORDS : *Calotes versicolor* / garden fence lizard / mensural character / meristic character / morphological difference

ARPAPAN PRAKOBKARN: MORPHOLOGICAL VARIATION OF GARDEN FENCE LIZARD *Calotes versicolor* (Daudin, 1802) IN THAILAND. THESIS ADVISOR: ASSOC. PROF. KUMTHORN THIRAKHUPT, Ph.D., THESIS CO-ADVISOR: THONGCHAI NGAMPRASERTWONG, Ph.D., 138 pp.

The garden fence lizard, *Calotes versicolor*, is a common and widely distributed lizard throughout the Middle East, Far-East and Southeast Asia. Although this species displays variations in its morphology throughout its range, these variations have not been examined in many countries including Thailand. Thus, we examined 20 adult lizards, ten males and ten females from each of three sampling localities in each of northern and southern Thailand to document sexual and regional variations. Differentiation in characters between sexes and populations were tested by analysis of covariance (ANCOVA) and principle component analysis (PCA) for the mensural characters, Mann-Whitney *U*-test for meristic characters and chi-squared test for stripe patterns. Sexual dimorphism was found in both northern and southern populations. Males have a larger relative head size and longer relative limb lengths, whilst females exhibit a longer relative trunk length. The number of scale in males was also more prominent than in females. Females in both southern and northern Thailand populations have brighter patterns in paired dorsolateral stripe (DorsSt), forearm stripe (ForearSt) and paired nuchal spots (NucSpot) than the corresponding males. Geographic difference in mensural characters and stripe patterns was more prominent in males, but meristic characters were not clearly different. Males in the southern populations have a larger relative head size and longer relative limb lengths than those from the northern populations, but these differences were not found in females. No difference in stripe pattern was found between females from the northern and southern populations, whereas males in the southern populations have brighter patterns in dark bands on trunk (TrnkBand) and colored throat patch (ThroatPa) than those in the northern populations.

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CHAPTER I
INTRODUCTION

1.1 Rationale

Lizards are the most successful group of the reptiles because of their majority in species number (Hedges and Vidal, 2009; Mattison, 2009). They also exceed other reptiles in anatomical, behavioral, and reproductive diversity and in the extant of their geographical distribution (Halliday and Adler, 2002).

One of the most common lizards is the garden fence lizard, *Calotes versicolor,* which is widespread over a large area, ranging from southern Iran, Afghanistan, Nepal, Sri Lanka, India, southern China, Myanmar, Thailand, Laos, Vietnam, Peninsular Malaysia and Sumatra (Erdelen, 1984, 1986; Auffenberg and Rehman, 1993; Ji *et al*., 2002; Radder, 2006).

The taxonomic status of this species has been classified into only one species, but it is proposed that this species represents a complex of several species because morphological variations among populations of *C. versicolor* were found in Pakistan, India and Myanmar (Tiwara and Schiavina, 1990; Auffenberg and Rehman, 1993; Zug *et al*., 2006). Geographic differences among populations have been reported in this species, with specimens from the Himalayan mountain complex in Afghanistan, Pakistan and India being distinctly different from those in other parts of the countries (Auffenberg and Rehman, 1993). Thus, *C. versicolor* in this area was divided into two subspecies, *C. v. versicolor* and *C. v. nigrigularis*, which are found at elevations below 300 m and at between 300–1800 m amsl, respectively.

Moreover, sexual dimorphism has been widely studied in lizards (Ji *et al*., 2002; Kuo *et al*., 2009), and in *C. versicolor*, as in many other animals, sexual differences occur in morphology, shape, size and color (Auffenberg and Rehman, 1993; Radder *et al*., 2001; Ji *et al*., 2002). The occurrence of morphological differences between males and females could arise from natural selection processes, where the different evolutionary trends are explained as the results of three major forces that differentially act on males and females of a population: fecundity, sexual and natural selection (Olsson *et al*., 2002).

In Thailand, there are three species in genus *Calotes*, i.e. *C. versicolor*, *C. mystaceus* and *C. emma* which was divided into two subspecies, *C. e. emma* and *C. e. alticristatus* (Cox *et al*., 1998). Both *C. versicolor* and *C. mystaceous* have adapted to man and so are commonly found among the undergrowth in human-made habitats. However, *C. versicolor* probably occurs in all the provinces and many reports from other countries were showed it had more morphological variation than *C. mystaceous*.

Although Radder *et al.* (2001) and Ji *et al.* (2002) reported sexual differences in this species in some regions, it is still unclear whether sexual dimorphism occurs in other parts of its range or not. Indeed, sexual dimorphism in this species has not been studied in Thailand. In order to address geographic variation and sexual dimorphism of *C. versicolor* in Thailand, in this study the mensural and meristic (scalation) characters plus the stripe patterns of *C. versicolor* from northern and southern region of Thailand were examined. These two regions represent the Indochinese subregion and Sundaic subregion for northern and southern Thailand, respectively. The morphological differences between the northern and southern populations in both sexes were also investigated separately.

1.2 Objectives

1.2.1. To study the morphological variation in mensural characters, meristic characters and stripe patterns of *C. versicolor* between northern and southern Thailand.

1.2.2. To study sexual dimorphism between adult males and females of *C. versicolor*.

1.3 Anticipated benefit

The information obtained from this study could be used for providing basic knowledge on taxonomic status of *C. versicolor* in Thailand. The results also point out the difference between sexes in non-breeding season.

CHAPTER II
LITERATURE REVIEW

2.1 Classification and general description

Most of reptiles are squamates (~8,200 species) which consists of ~4,900 species of lizards, ~3,070 species of snakes, and ~200 species of amphisbaenians (Hedges and Vidal, 2009). Much greater diversity is found in lizards because of their small body size and lower demand for food, likewise each species can adapt to their available microhabitats (Cogger and Zweifel, 2004).

Lizards are classified into 26 families (Fig. 2–1) (Hedges and Vidal, 2009). One of these families is Agamidae, which consists of 54 genera and more than 400 species (Vitt and Caldwell, 2009).

Agamids consist of small to large lizards (45-350 cm SVL in adult). They are diurnal and terrestrial or arboreal lizards. The body is covered dorsally and ventrally by overlapping scales or granular, juxtaposed scales. The scales are often modified to form extensive crests, frills, or spines. In many agamids these features are sexually dimorphic and are used in intraspecific interactions (Pough *et al*., 2004; Vitt and Cladwell, 2009). Limbs are well developed. The pectoral girdle has T-shaped or cruciform interclavicles, and curved rod-shaped clavicles. The tail is long, less than SVL, to 1.4 times SVL, and lacks feature planes in caudal vertebrae (except in some *Uromastax*). The tongue is thick and covered dorsally with reticular papillae. The foretongue is nonretractable (Vitt and Cladwell, 2009). The skull is diapsid type.

Agamids are largely confined to Africa, southern and central Asia, and the Indoaustralian Archipelago to Australia (Fig 2–2) (Taylor, 1963; Cox *et al*., 1998; Pough, 2004; Vitt and Cladwell, 2009).

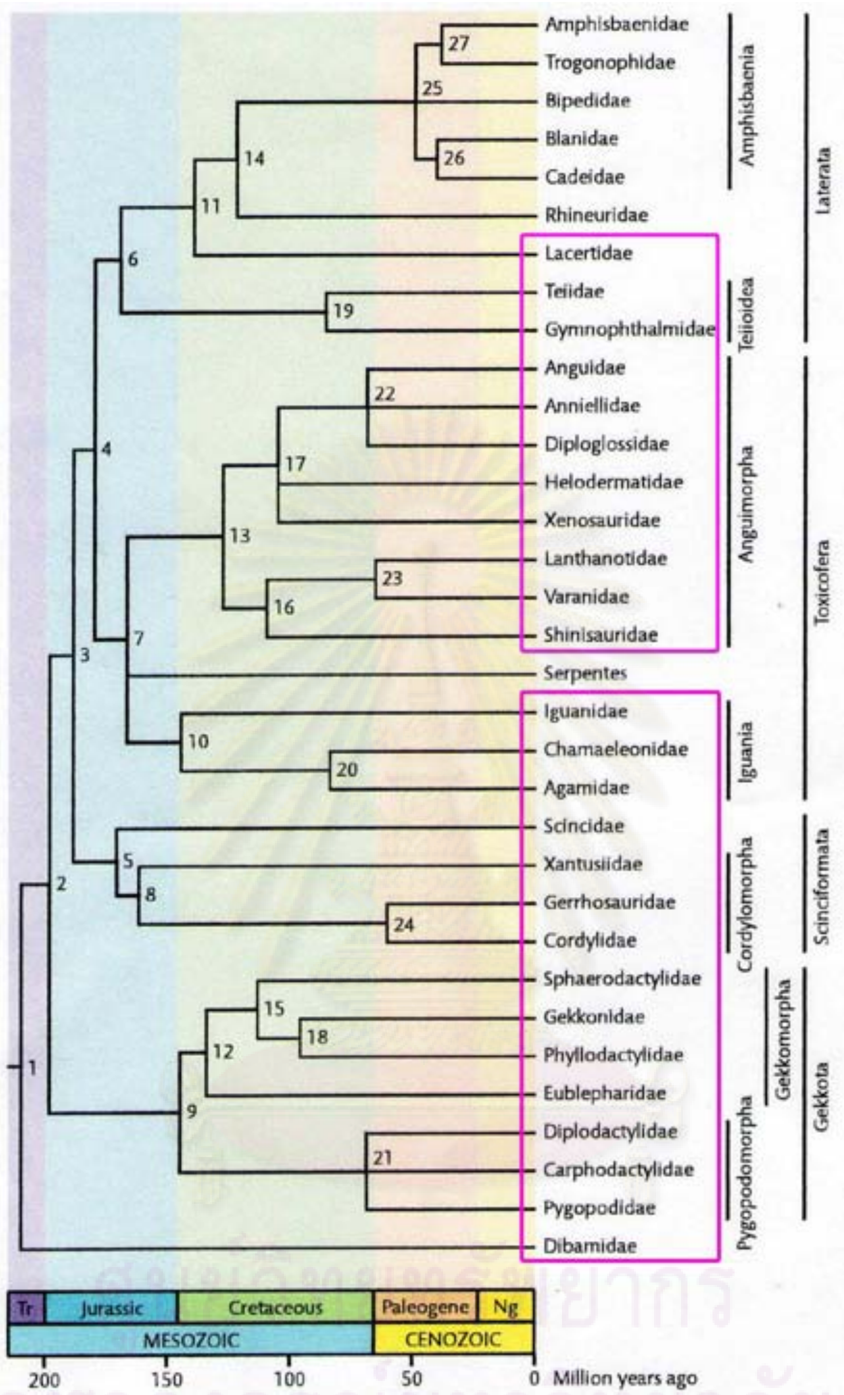

Figure 2–1 A time tree of squamate reptiles (Squamata). *Abbreviations*: Ng (Neogene) and Tr (Triassic) (Hedges and Kumar, 2009). Twenty-six lizard families are shown in pink boxes.

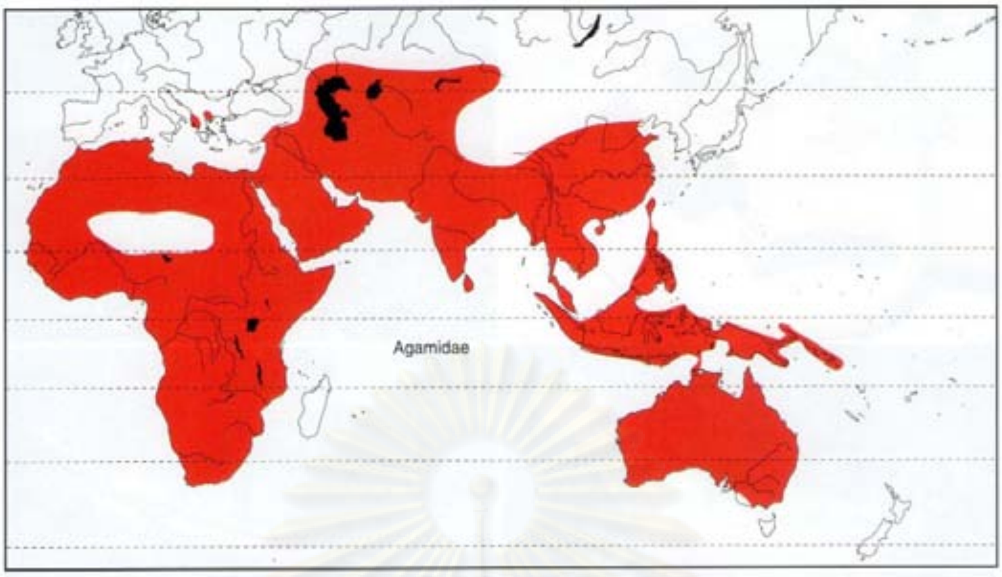

Figure 2–2 Distribution of Family Agamidae (Vitt and Cladwell, 2009)

In Thailand, family Agamidae consists of 9 genera and 24 species (Cox *et al*., 1998; Honda *et al*., 2000). One of these genera, *Calotes*, is commomly found throughout Thailand. Three species in genus *Calotes*, *C. versicolor*, *C. mystaceus*, and *C. emma*, have been reported in Thailand.

Calotes versicolor in Thailand was reported in **North**: Chiang Mai, Mae Hong Son, and Phrae; **Northeast**: Loei, Nong Khai, and Kalasin; **East**: Ubon Ratchathani, Nakhon Ratchasima, Roi Et, and Chaiyaphum; **Southeast**: Chanthaburi, Chachoengsao, and Rayong; **Central**: Bangkok; **Southwest**: Kanchanaburi, Phetchaburi, and Ratchaburi; **South**: Ranong, Trang, Surat Thani, Nakhon Si Thammarat, Songkla, Pattani, Phattalung, and Narathiwat (Taylor, 1963 and Nabhitabhata *et al*, 2000).

C. mystaceous was reported in **North**: Nakhon Sawan, Chiang Mai, Mae Hong Son, and Phrae; **Northeast**: Udon Thani, Khon Khaen, Loei, and Nong Khai; **East**: Nakhon Ratchasima, Ubon Ratchathani, and Chaiyaphum; **Central**: Bangkok, Saraburi, and Nakhon Pathom; **Southeast**: Sa Kaeo; **Southwest**: Uthai Thani, Ratchaburi, Kanchanaburi, Prachuap Khiri Khan, and Phetchaburi (Taylor, 1963 and Nabhitabhata *et al*, 2000).

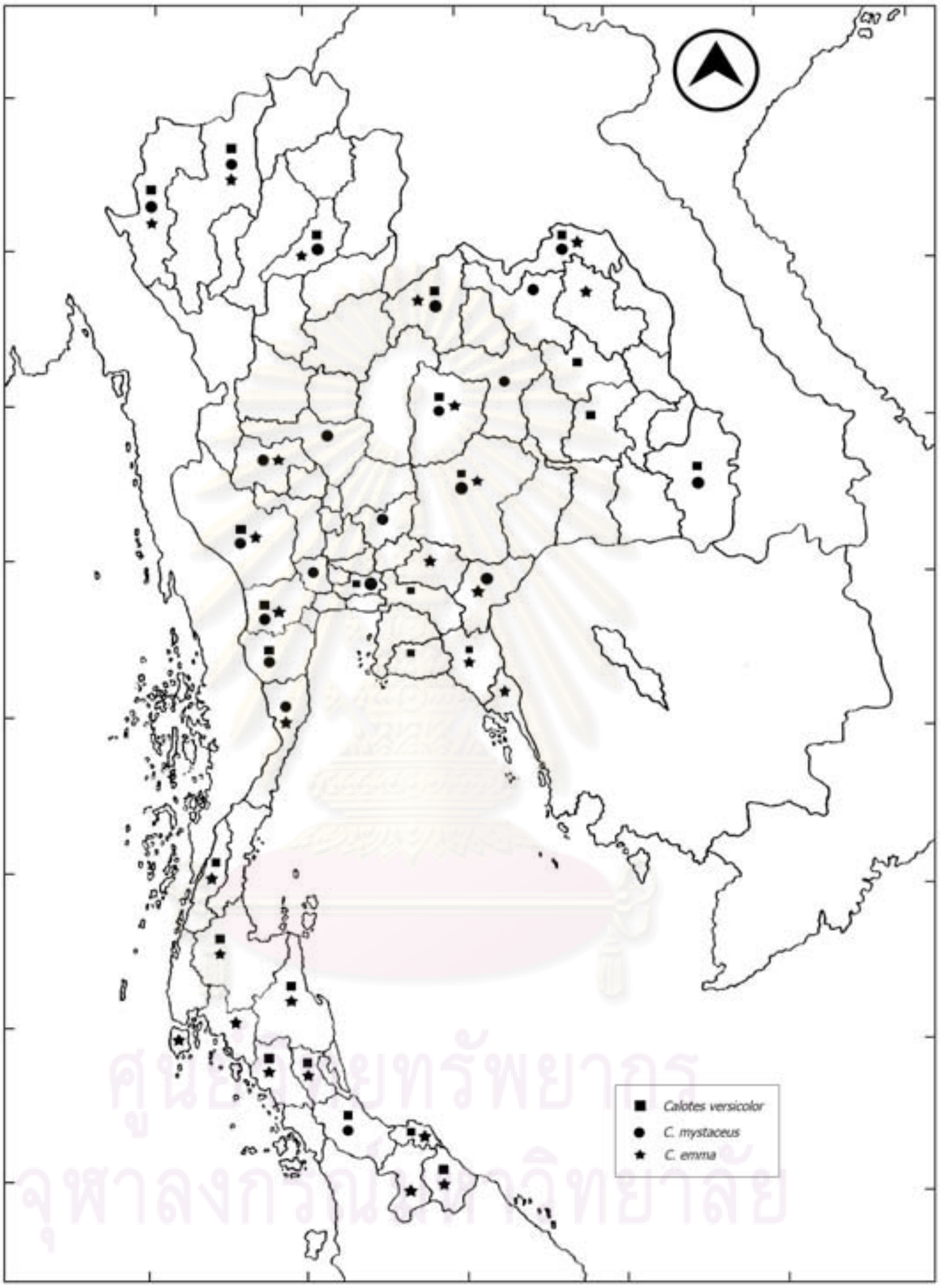

Figure 2–3 Distribution of *Calotes* in Thailand.

C. emma was reported in **North**: Tak, Kamphaeng Phet, Chiang Mai, Phrae, and Mae Hong Son; **Northeast**: Loei, Nong Khai, and Sakon Nakhon; **East:** Nakhan Ratchasima, and Chaiyaphum; **Southeast**: Sa Kaeo, Prachin Buri, Chanthaburi, and Trat;

Southwest: Uthai Thani, Kanchanaburi, Ratchaburi, and Prachuap Khiri Khan; **South**: Trang, Nakhon Si Thammarat, Phattalung, Pattani, Surat Thani, Narathiwat, Yala, Ranong, Phuket, and Krabi (Taylor, 1963 and Nabhitabhata *et al*, 2000).

C. versicolor and *C. mystaceous* have adapted to human and so are commonly found among the undergrowth in human-man habitats. Both species can be found in urban and agricultural areas.

Genus *Calotes* mostly has acrodont teeth. The tail is often two to three times length of head and body. The dorsal crest usually presents higher in males, likewise femoral and preanal pores are absent. Each species of this genus has variation in the number of scales around the middle of the body, and also in color and markings (Taylor, 1963).

Calotes versicolor (Fig 2-3) was first described by Francois M. Daudin, who was French naturalist, in 1802. The type specimens were collected from Pondicherry, Chenai [Madras], and Kolkata [Calcutta], in India.

This lizard is distributed widely in southeastern Iran, Afghanistan, Nepal, Sri Lanka, India, southern China, Myanmar, Thailand, Laos, Vietnam, Peninsular Malaysia and Sumatra in Indonesia (Erdelen, 1984; Cox *et al*., 1998; Radder, 2006). Within Thailand, *C. versicolor* probably occurs in all the provinces (Taylor, 1963).

C. versicolor has several common names in different geographic locations; Blood-sucker Lizard (India), Crested Tree Lizard (Florida, US), Garden Fence Lizard (Thailand) and Garden lizard (China, Sri Lang Ka) (Cox *et al*., 1998; Enge and Krysko, 2004; Matyot, 2004; Radder, 2006).

Zug *et al*. (2006) noted that this species classified in genus *Calotes* by sharing traits: 1.) pre-axillary scales is uniform-sized, i.e., absence of a crescent-shaped patch of granular scales in front of the shoulder; 2.) trunk scales are smaller than or equal to size of ventral scales; 3.) a continuous row of dorsal crest scales is above the shoulders; 4.) supratympanic area with a pair of spine patches or patches fused as a single longitudinal series; and 5.) multiple (2–4) distinctly linear rows of elongate loreal and suboccular scales are above the supralabial scales.

Figure 2–4 *Calotes versicolor*

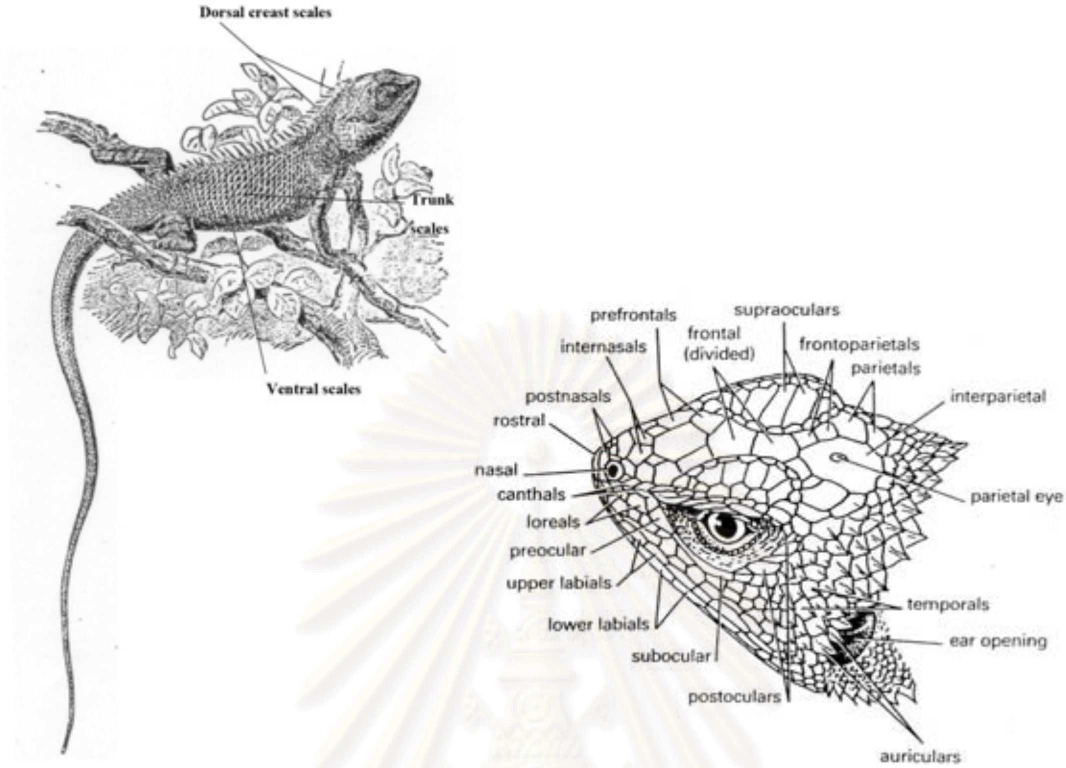

Figure 2–5 Picture of *Calotes versicolor* (Smith, 1935) (left). Head scale of lizard group (Dennis and Adler, 2003) (right).

Furthermore, their scales on the sides of body point backwards and upwards and no fold in front of shoulder, likewise two spine locate above tympanum. The body color is light brown, fawn or grayish with darker marking. Throat and chin with longitudinal darker marks that are continuous with radiating lines from eye. A dim median dark line is found on venter. The moderate nuchal and dorsal crests are continuous raw on dorsum. Base of tail in males thickened and their scales are larger and thicker than females (Taylor, 1963).

Halliday and Adler (2002) noted that the bright red head of the male was a conspicuous social cue used to signal other members of its species.

The diets of *C. versicolor* are small various insects. This lizard laid 4–12 eggs and then hatchlings emerge after five to seven weeks and they mature in about one year (Cox *et al*., 1998).

2.2 Geographic variation

This species has widely distribution, and morphological difference has been found among population.

Auffenberg and Rehman (1993) reported that they found the variation in the scalation and color of this species at difference of gradient level of Himalayan mountain complex in Afghanistan, Pakistan and India. Two subspecies, *C. v. nigrigularis* and *C. v. versicolor* were found in the mountain complex area at elevations below 300 m and at between 300–1800 m amsl, respectively. The difference in a number of midbody scale rows, the subdigital lamellae under 4th toe, a number of gular scales, angle of dorsal scale rows and head and body length (SVL) supported the subspecies difference in their groups.

Zug *et al*. (2006) examined *Calotes "versicolor"* group, which were collected from among and within in Myanmar and they found new species in its group. These new species, *C. htunwini* and *C. irawadi*, showed the morphological difference on a number and shape of head scale.

Radder (2006) noted that *C. versicolor* groups had difference in the life history traits between China and India populations because these differences were provided for the ecological adaptation. China populations are smaller than India populations because *C. versicolor* from cooler climate (China) matures at a smaller size than at the same age compared to the warmer (India) population.

However, Taylor (1963) noted that the Thailand form cannot be ascertained at this time. The Indian form reaches a size nearly a half larger than the typical-sized adults of Thailand.

2.3 Sexual dimorphism

Sexual dimorphism is the differences in shape, size, morphology, color, etc., between male and female of a species.

In *C. versicolor*, sexual differences occur in morphology, shape, size and color (Auffenberg and Rehman 1993; Radder *et al*. 2001; Ji *et al*. 2002). The occurrence of morphological differences between males and females could arise from natural selection processes, where the different evolutionary trends are explained as the results of three major forces that differentially act on males and females of a population: fecundity, sexual and natural selection (Olsson *et al*. 2002).

Sexual size dimorphism may appear at any stage during the life history of *C. versicolor* (Ji *et al*., 2001; Radder *et al*; 2002), while differences in color and stripe patterns among adult males, adult females and juveniles are reported (Auffenberg and Rehman 1993).

Auffenberg and Rehman (1993) reported that the difference in mean SVL of mature males are greater than females within all samples in Pakistan. In addition, the number of midbody scale rows, with females having a higher number than males. Females usually have a series of circumorbital radiating darker bars which are usually lacking in males. Females also lack a dark ventral partial collar at the base of the neck, which is characteristic of the adult males of some population.

CHAPTER III

METHODOLOGY

3.1 Study area

In this study, a total of 120 individuals of *C. versicolor*, 60 adult males and 60 adult females, was captured from three sampling sites in northern Thailand and three sites in southern Thailand from June 2008 to September 2009. Ten males and 10 females were collected from each sampling site. Sixty samples in total from northern region were collected at [1] Mae Hong Son (zone 47 384049mE 2079323mN), [2] Chiang Mai (zone 47 509105mE 2084247mN) and [3] Nan (zone 47 681552mE 2078573mN) where the elevation is between 130-150 m amsl. The other 60 samples were collected at [4] Songkla (zone 47 656230mE 759923mN), [5] Krabi (zone 47 513357mE 885169mN) and [6] Ranong (zone 47 459585mE 1097063mN) in southern Thailand where elevation is between 4-50 m amsl (Fig 3-1).

The three sampling localities in northern region were divided by three major mountain ranges; Thanon Thongchai mountain range, western Phi Pan Nam mountain range and eastern Phi Pan Nam mountain range. Sampling localities in southern region were also divided by two major mountain ranges; Phuket mountain range and Nakornsri-Thammarat mountain range.

These northern and southern *C. versicolor* populations are inhabited in the Indochinese and Sundaic subregions, respectively, which were divided by Isthmus of Kra (Fig 3-1).

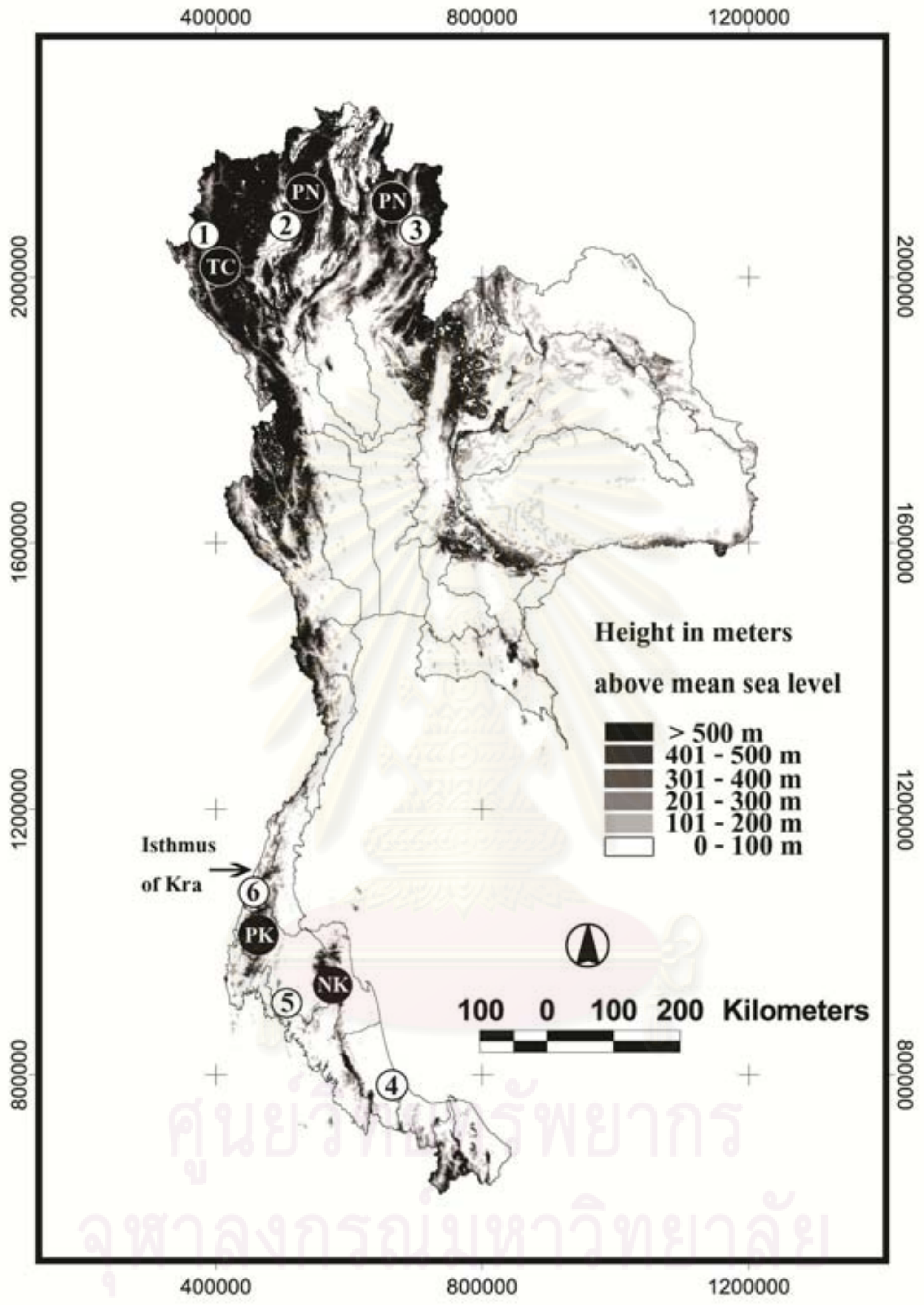

Figure 3–1. Map of Thailand, showing 6 sampling localities in northern and southern regions. Northern sampling sites are [1] Mea Hong Son, [2] Chiang Mai and [3] Nan. Southern sampling sites are [4] Songkla, [5] Krabi and [6] Ranong. The map also shows mountain ranges: PK, Phuket mountain range; NK, Nakornsri-Thammarat mountain range; TC, Thannon Thongchai mountain range; PN, Phi Pan Nam mountain range.

3.2 Methods

Lizards were caught by noosing and hand catching (Fig 3-5). Then, their habitat types and co-ordinates were recorded. Each specimen was photographed and weighed before it was anaesthetized using thiopental (Close *et al*., 1997). Tissue samples were collected from the liver of each individual and stored in 95% (v/v) ethanol for future molecular studies, and then the rest of each individual was preserved in 70% (v/v) alcohol for routine storage. All samples were cataloged (see in Appendix A) and deposited at Chulalongkorn University Museum of Natural History.

3.2.1 Morphological study

In this study, 54 morphological characters, consisted of mensural characters, meristic characters and stripe patterns, were recorded. Mensural characters were taken to the closest 0.01 mm using dial caliper. Meristic characters were counted under a stereomicroscope and stripe patterns were observed by eyes. All characters were measured on the right side of the body. The sex and maturity of each specimen were determined by abdominal dissection (Zug *et al.,* 2006). In mature females, the diameter of vitellogenic follicles was more than 1.5 mm, or they possessed oviductal eggs or stretched oviducts. Epididymides were enlarged in mature males (Fig 3-6). Each character and its abbreviation followed Auffenberg and Rehman (1993), Angsirijinda (1999) and Zug *et al*. (2006).

Morphological characters measured in this study were as follows:

<u>Mensural characters</u> (Fig 3–2)

1). Eye-ear length (EyeEar): Distance from anterior edge of tympanum to posterior of orbit.

2). Head height (HeadH): Dorsoventral distance from top of head to underside of jaw at transverse plane intersecting angle of jaws.

3). Head length (HeadL): Distance from anterior edge of tympanum to tip of snout.

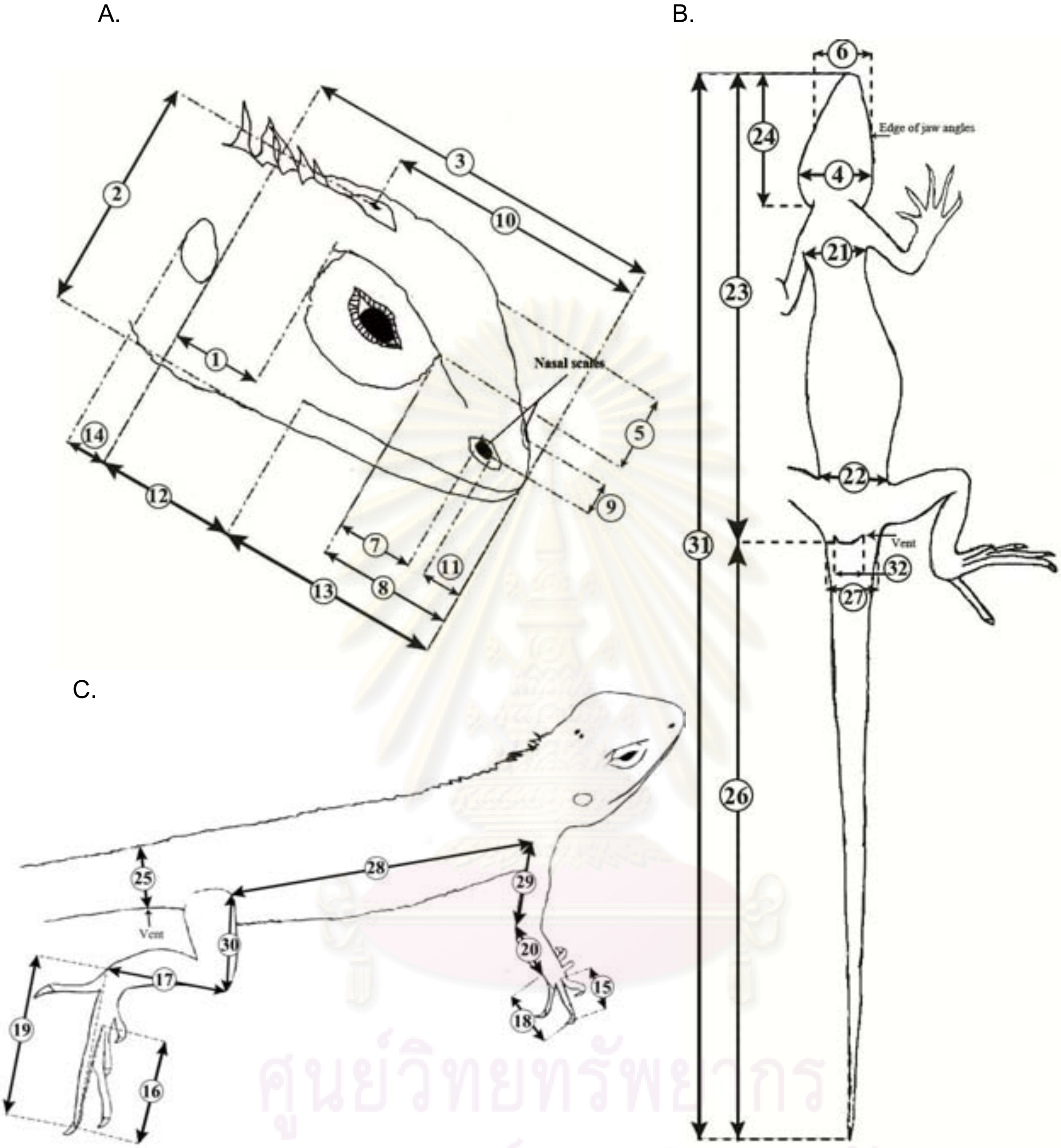

Figure 3–2. Mensural characters of *Calotes versicolor* were used for this study.

4). Head width (HeadW): Distance from left to right outer edge of temporal or jaw muscles at their widest point without compression of soft tissue.

5). Interorbital width (Interorb): Transverse distance between anterodosal corners of left and right orbits.

6). Jaw width (JawW): Distance from left to right outer edge of jaw angles; this measurement excludes jaw musculature broadening of head.

7). Naris-eye length (NarEye): Distance from anterior edge of orbit to posterior edge of naris.

8). Snout-eye length (SnEye): Distance from anterior edge of orbit to tip of snout (rostral scale).

9). Snout-eye width (SnW): Transverse distance between left and right nares (Internasal distannce).

10). Snout to pineal (SP): Distance from tip of snout to parietal eye.

11). Snout to nostril (SN): Distance from tip of snout to anterior edge of naris.

12). Labial to ear length (LE): Distance from angle of jaw to anterior edge of tympanum.

13). Labial length (LL): Distance from tip of snout to angle of jaw.

14). Tympanum diameter (ED): Transverse distance between anterior edge of left and right tympanum.

15). The fourth finger length (4FingLng): Distance from juncture of 3rd and 4th digits to distalmost extant (Outer/distalmost surface of claw) of 4th finger.

16). The fourth toe length (4ToeLng): Distance from juncture of 3rd and 4th digits to distal end of 4th digit on hindfoot.

17). Crus length (CrusL): Length of crus (tibia) from knee to heel.

18). Forefoot length (ForefL): Distance from wrist of forefoot to tip of fourth digit.

19). Hindfoot length (HindfL): Distance from heel of hindfoot to tip of fourth toe.

20). Lower arm length (LoArmL): Distance from elbow to distal end of wrist.

21). Pectoral width (PectW): Distance between left and right axilla (posterior to forelimb insersions) measured on ventral side.

22). Pelvic width (PelvW): Distance between left and right inguen (posterior to hindlimb insertions).

23). Snout-vent length (SVL): Distance between tip of snout to anterior edge of vent.

24). Snout-forelimb length (SnForel): Distance from anterior of anterior of forelimb to tip of snout.

25). Tail Thickness (TailTh): Distance from dorsal to ventral surface of tail base measured just posterior to vent.

26). Tail length (TailL): Distance from posterior edge of vent to distal end of tail.

27). Tail width (TailW): Distance from left to right side of tail base just posterior to vent.

28). Trunk length (TrunkL): Distance between posterior edge of forelimb insertion to anterior edge of hindlimb insertion.

29). Upper arm length (UpArmL): Distance from anterior insertion of forelimb to elbow.

30). Upper leg length (UpLegL): Distance from anterior edge of hindlimb insertion to knee.

31). Total length (TL): Distance from tip of snout to distal end of tail.

32). Vent width (VentW): Transverse distance between (inner) angle of left and right vent.

<u>Meristic characters</u> (Fig 3–2)

33). Canthus rostralis (CanthR): Number of scales from above posterodorsal corner of nasal scale to and including posteriormost supraciliary scale.

34). Dorsal eyelid scales (Eyelid): Number of scales found along dorsal edge of eyelid.

35). Dorsal head scales (HeadSLn): Number of scales longitudinally on midline between interparietal and rostal scale.

36). Head scales (HeadSTr): Number of scales in transverse line between posterior left and right supraciliary scales.

37). Infralabials (Inflab): Number of scales between postmental scales to enlarged scale at corner of mouth.

38). Snout scales (SnS): Number of scales on line transversally between left and right nasal scales.

39). Supralabials (Suplab): Number of scales between rostal scales to enlarged scale at corner of mouth.

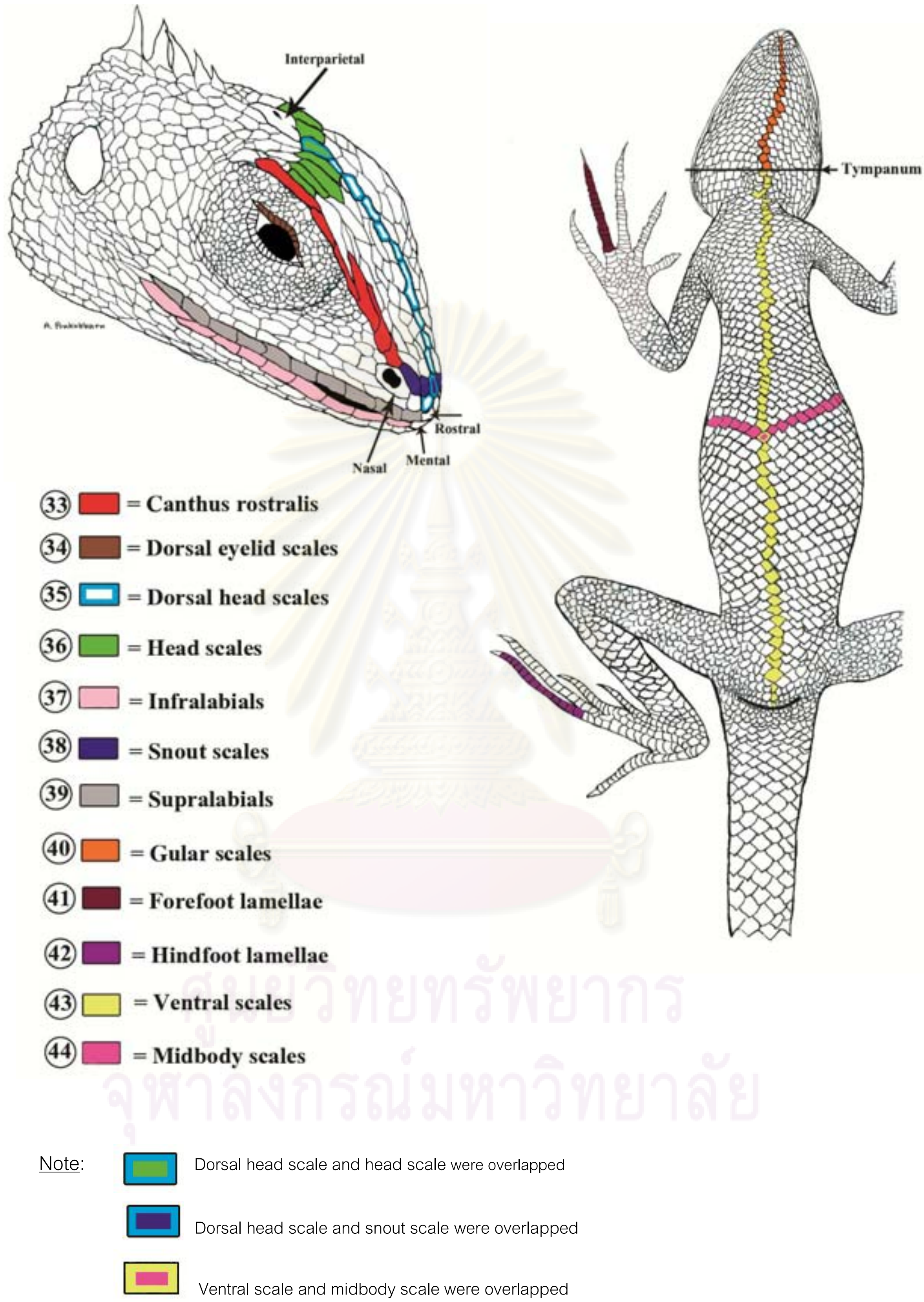

Figure 3–3. Meristic characters of *Calotes versicolor* were used for this study.

40). Gular scales (GuS): Number of scales between mental scale longitudinally on transverse scales between tympanums on ventral side.

41). Forefoot lamellae (4FingLm): Number of 4^{th} digit lamellae; from 1^{st} lamellae at digits' cleft that is wider than deep and touches dorsal digital scale to most distal lamella.

42). Hindfoot lamellae (4ToeLm): Number of 4^{th} toe lamellae; as for 4FingLm.

43). Ventral scale (VentS): Number of midventral scale, beginning on nape to anterior vent.

44). Midbody scales (Midbody): Number of scale rows around trunk at midbody.

Stripe patterns (Fig 3–4)

45). Cheek Color (CheekCol): Presence (1) or absence (0) of dark patches on jowl muscles.

46). Cheek Stripe (CheekSt): Presence (1) or absence (0) of dark stripe on jowl muscles.

47). Paired Dorsolateral Stripes (DorsSt): Presence (1) or absence (0) of pair of dorsolateral light stripes, one on each side of trunk.

48). Forearm Stripe (ForearSt): Presence (1) or absence (0) of longitudinal light stripe on outer surface of forearm.

49). Paired Nuchal Spots (NucSpot): Presence (1) or absence (0) of pair of dark spots on interpariatal scale.

50). Dark Bands on Trunk (TrnkBand): Presence (1) or absence (0) of dark bands on dorsum of trunk between axilla and inguen.

51). Mid-ventral Dark Line (MidvLine): Presence (1) or absence (0) of dark line on venter midline from throat to pelvis.

52). Throat Stripes (ThroatSt): Presence (1) or absence (0) of striping on throat.

53). Throat Patch (ThroatPa): Presence (1) or absence (0) of dark patch on throat.

54). Ventral Trunk Striping (TrunkSt): Presence (1) or absence (0) of ventral trunk stripe.

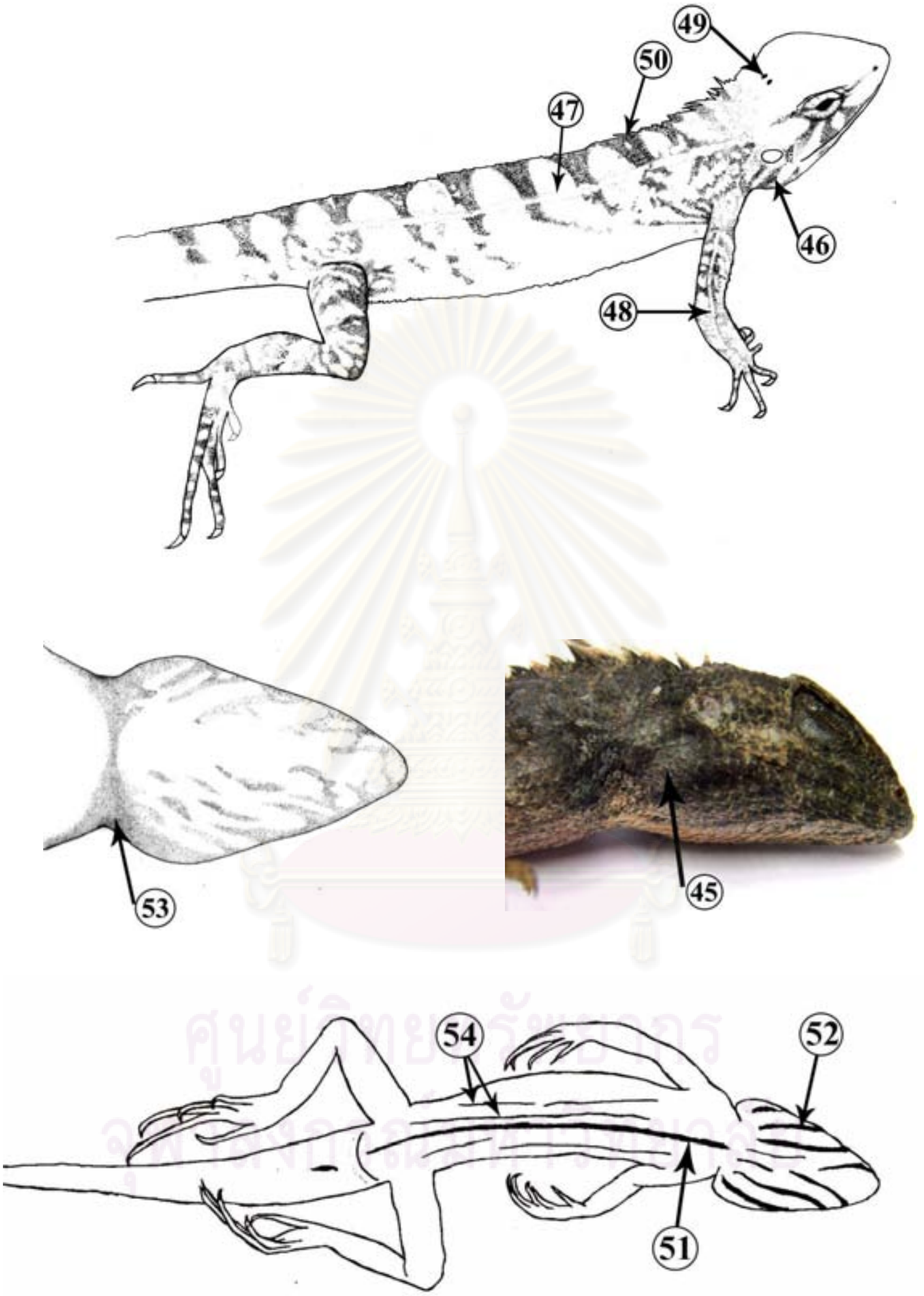

Figure 3–4. Stripe patterns of *Calotes versicolor* were used for this study.

3.2.2 Data analysis

The data of mensural and meristic characters in adult females and adult males from each region were calculated and shown in mean ± SE. Variations within-region were analyzed using principal component analysis (PCA). PCA identified which characters vary most between individuals and then the score of these analyzes was grouped which was shown in scattered graph (in results). All mensural characters of each sex were analyzed for the relationship between SVL and other morphological parameters using linear regression analysis and then these data were log_e-transformed for parametric tests (Sokal and Rohlf, 1998).

Intersexual differences and geographic differences of mensural characters of adult lizards from northern and southern populations were compared using analysis of covariance (ANCOVA) due to the parametric results. This analysis examined morphological differences based on the same linear relationship data and used snout-vent length (SVL) as covariate. SVL of these samples were also parametric data, therefore these results were compared by independent samples *t*-test. Moreover, the PCA was used to analyze mensural characters between sexes and between regions. Scattered graphs of the scores from PCA were shown and can be used for grouping individuals.

The differences in meristic characters, which were non-parametric data, were compared using Mann-Whitney *U*-test. Sexual dimorphism and geographic variation were also described using PCA.

Additionally, stripe patterns, which were quality data, were analyzed by chi-square test (χ^2) and presented in occurrence percentage. All statistical analyses were carried out using SPSS for Window version 17.

Figure 3–5. Captured technique, using of noose for *Calotes versicolor*.

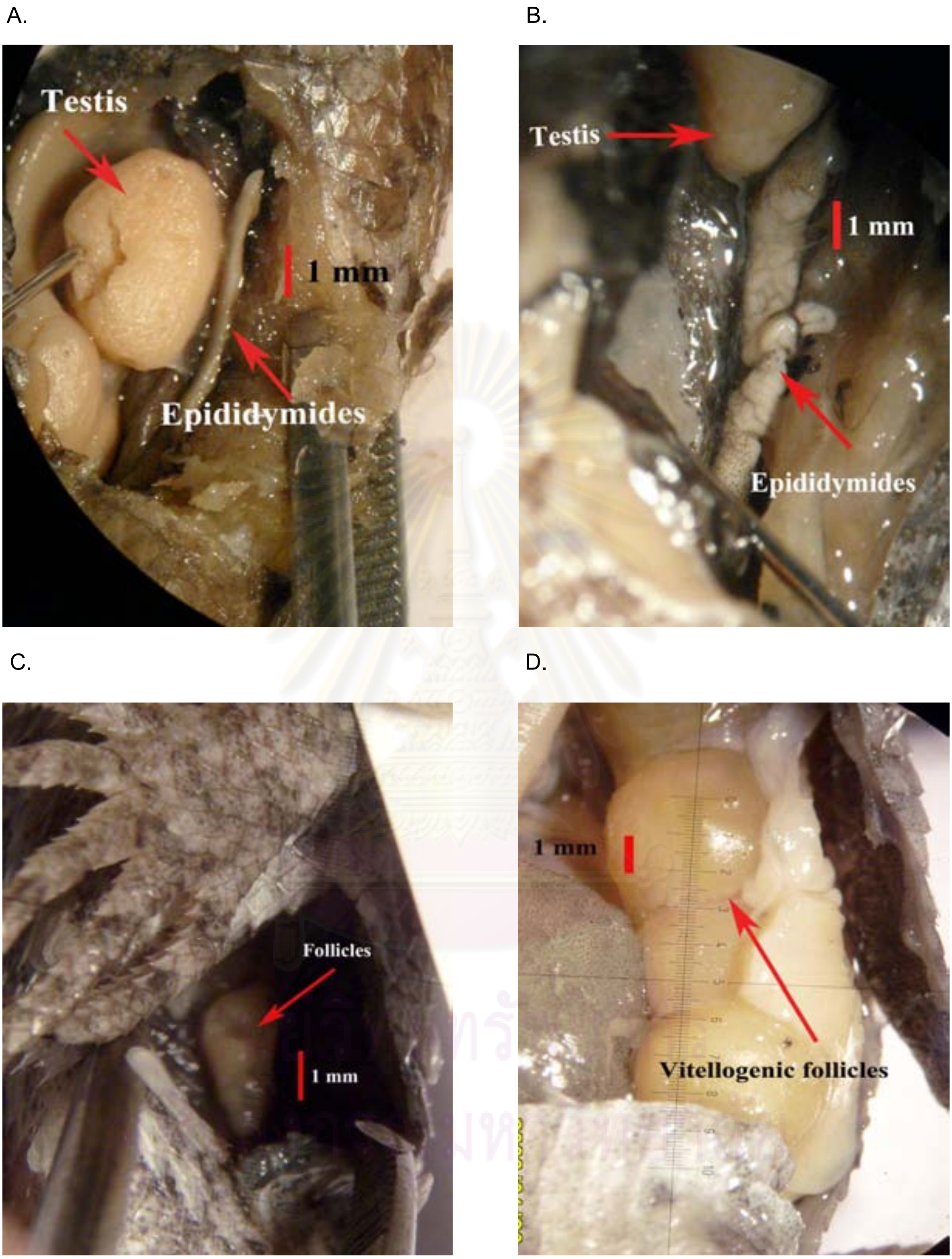

Figure 3–6. Reproductive organs of *Calotes versicolor*; immature male (A), mature male (B), immature female (C) and mature female (D).

CHAPTER IV

RESULTS

4.1 General information from field study

From June 2008 to September 2009, 120 individuals of *Calotes versicolor* were collected from six localities; Mae Hong Son, Chiang Mai, Nan, Songkla, Krabi and Ranong. These lizards were usually found in suburban area, such as the village and its surrounding area, and agricultural area, such as rubber plantation. At all six localities, female lizards were mostly found on the ground, while male lizards were usually found on the trees or shrubs. All specimens were mature and being in reproductive stage, indicated by large vitellogenic follicles (>1.5 mm diameter) in females and large epididymides in males. A few males which were collected in December 2008 and January 2009 had small epididymides, but their body sizes were larger than the smallest mature male collected in breeding season.

Specimens from Mae Hong Son were collected in May 2009. Large vitellogenic follicles were found in all adult females from this locality and epididymides were also enlarged in all adult males, indicating that all specimens were in reproductive stage during this time of the year.

Specimens from Chiang Mai were collected in December 2008 and May 2009. In December 2008, all adult females were in non-reproductive stage, as well as adult males. However, all female and male specimens collected in May 2009 were in reproductive stage.

Specimens from Nan were collected in July 2008, October 2008, June 2009 and August 2009. All female and male specimens were in reproductive stage during these times of the year.

Specimens from Songkla were collected in June 2008, March 2009 and September 2009. All female and male specimens were in reproductive stage during these times of the year.

Specimens from Krabi were collected in January 2009 and April 2009. All female and male specimens were in reproductive stage during January 2009 and April 2009.

Specimens from Ranong were collected in January 2009 and March 2009. All female and male specimens collected in March 2009 were in reproductive stage, but some specimens collected in January 2009 were in non-reproductive stage.

All reproductive status of this species in June 2008 to September 2009 were shown in Table 4-1.

4.2 Morphological difference within-region

Results of the principal component analysis (PCA) showed that the three locality-based populations sampled in northern Thailand could be combined into one group (Fig. 4–1, 4–2), and the same result also occurred for the three populations within southern Thailand (Fig. 4–3, 4–4). These results showed only principal component (PC) 1 and PC2 and not PC3, PC4, PC5 and PC6. The percentage of the variation was shown in appendix B. However, these results do not show PCA results in northern females and southern males because the program SPSS cannot analyze these data.

Thus, samples from the three localities in each region were grouped into one population, composing of 60 lizards, 30 males and 30 females

Table 4-1. Summary of reproductive status of *Calotes versicolor* in Thailand during July 2008 to September 2009

Year	2008							2009								
	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MHS												Ma (F & M)				
CM							Im (F &M)					Ma (F&M)				
NN		Ma (F&M)			Ma (F)								Ma (F)		Ma (F&M)	
RN								Im (F)		Ma (F&M)						
KB								Ma (F&M)			Ma (F)					
SK	Ma (F&M)									Ma (F&M)						Ma (M)

<u>Note</u>: Ma = Maturity, Im = Imaturity, F = Females and M = Males

MHS = Mae Hong Son, CM = Chiang Mai, NN = Nan, RN = Ranong, KB = Krabi and SK = Songkla

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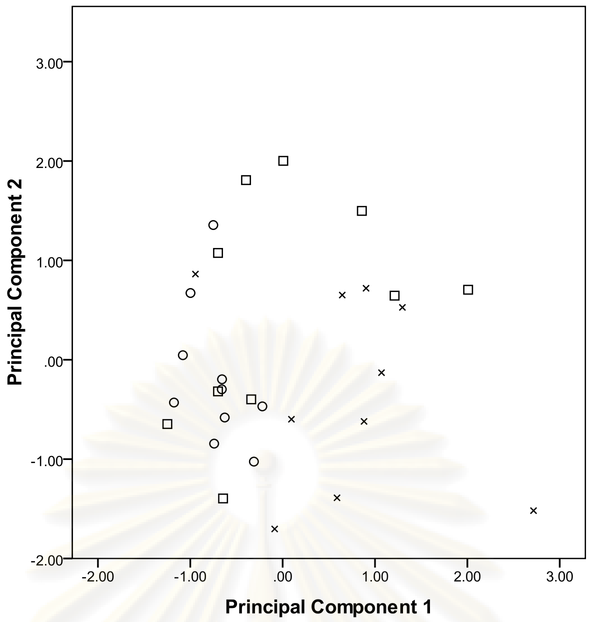


Figure 4–1 PCA for the mensural characters of *C. versicolor* males in northern region. Abbreviations: ○, Mae Hong Son; □, Chiang Mai; ×, Nan.

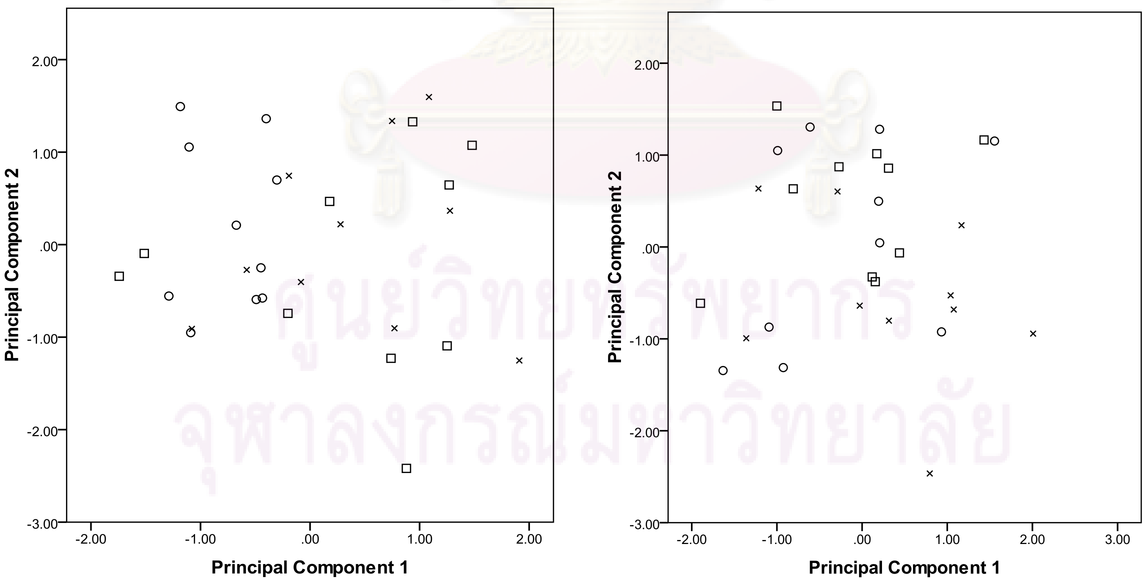


Figure 4–2 PCA for the meristic characters of male (left) and female (right) *C. versicolor* in northern region. Abbreviations: ○, Mae Hong Son; □, Chiang Mai; ×, Nan.

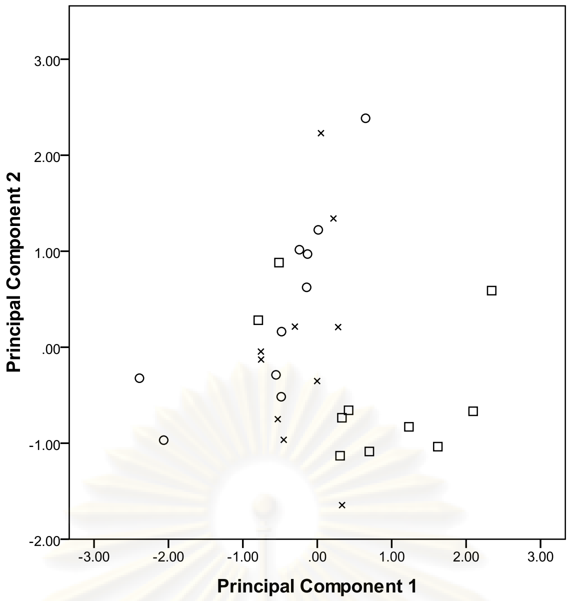


Figure 4–3 PCA for the mensural characters of *C. versicolor* females in southern region. Abbreviations: ○, Songkla; □, Krabi; ×, Ranong.

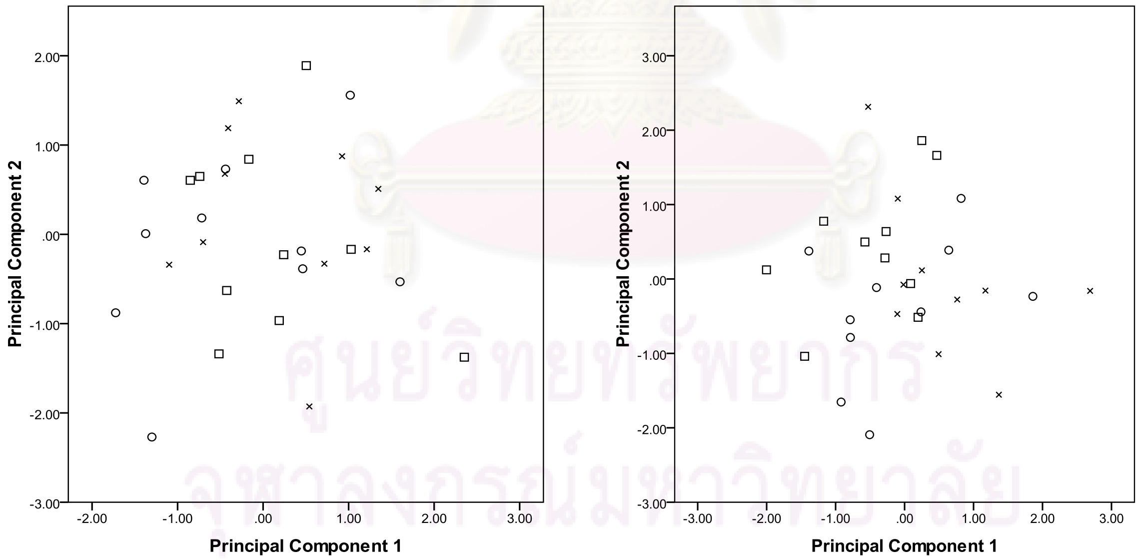


Figure 4–4 PCA for the meristic characters of male (left) female (rigth) *C. versicolor* in southern region. Abbreviations: ○, Songkla; □, Krabi; ×, Ranong.

4.3 Sexual dimorphism of *C. versicolor*

The mean ± SE (standard error) of each morphological trait, such as mensural character and meristic character, in both northern and southern populations are presented in Table 4–2, 4–3 and 4–4. The percentage occurrences of stripe pattern are also shown in Table 4–5.

Mensural characters. — The average snout-vent lengths (SVLs) of males were significantly larger than those of females in both northern (84.11±0.96 mm vs. 78.67±0.99 mm, respectively, t=3.942, p<0.001) and southern populations (87.08±0.86 mm vs. 75.74±0.89 mm, respectively, t=9.161, p<0.001).

Table 4-2. Summary of the head measurements of *C. versicolor* in northern and southern populations in Thailand. Data are mean±SE with the range in parentheses, and are derived from 30 samples each. All measurements are in mm. The *F*- and *p*-values from ANCOVA are also shown.

Characters	Northern population				Southern population			
	Males	Females	*F*	*p*-value	Males	Females	*F*	*p*- value
EyeEar	5.64±0.10	4.54±0.06	77.483	<0.001	6.33±0.10	4.55±0.06	73.092	<0.001
	(4.70–6.62)	(4.06–5.25)			(5.24–7.28)	(3.98–5.53)		
HeadH	12.49±0.18	11.54±0.22	1.870	0.177	14.05±0.23	10.87±0.15	27.272	<0.001
	(11.10–14.92)	(9.37–14.06)			(11.70–16.40)	(9.67–12.77)		
HeadL	19.63±0.21	17.41±0.25	26.252	<0.001	21.15±0.23	17.28±0.21	33.982	<0.001
	(17.86–22.10)	(14.42–19.62)			(18.56–23.52)	(15.37–19.87)		
HeadW	16.55±0.30	13.82±0.23	28.078	<0.001	19.67±0.35	13.21±0.20	87.132	<0.001
	(13.14–19.86)	(11.70–16.10)			(16.10–23.48)	(11.45–15.52)		
Interorb	8.19±0.10	7.42±0.11	7.296	0.009	8.78±0.09	7.44±0.13	–	–
	(7.14–9.44)	(6.38–8.38)			(7.81–9.70)	(6.30–9.16)		
JawW	13.43±0.20	12.06±0.16	10.556	0.002	14.26±0.21	11.78±0.18	5.085	0.028
	(11.54–15.64)	(10.60–13.45)			(12.40–16.82)	(10.20–14.20)		
NarEye	4.50±0.05	4.13±0.06	5.967	0.018	4.77±0.06	4.02±0.07	8.550	0.005
	(4.05–5.18)	(3.45–4.72)			(4.21–5.37)	(3.52–5.28)		
SnEye	8.22±0.10	7.66±0.10	2.189	0.145	8.77±0.08	7.55±0.10	11.342	0.001
	(7.38–9.67)	(6.43–8.72)			(7.98–9.48)	(6.73–8.71)		
SnW	4.91±0.07	4.69±0.06	0.295	0.589	5.40±0.06	4.76±0.08	1.162	0.286
	(4.12–5.74)	(3.91–5.25)			(4.74–6.15)	(4.04–5.70)		
SP	15.95±0.16	14.94±0.19	2.102	0.153	16.70±0.15	14.49±0.16	8.937	0.004
	(14.55–18.14)	(12.90–17.44)			(15.16–18.64)	(13.12–16.34)		
SN	3.67±0.07	3.47±0.05	–	–	3.93±0.04	3.41±0.05	9.051	0.004
	(3.00–4.40)	(3.04–3.97)			(3.58–4.54)	(2.92–4.09)		
LE	5.51±0.10	4.65±0.07	26.105	<0.001	6.33±0.10	4.65±0.08	36.272	<0.001
	(4.65–6.75)	(3.94–5.86)			(5.25–7.35)	(3.76–5.68)		
LL	14.64±0.16	13.45±0.17	8.042	0.006	15.39±0.17	12.99±0.18	4.409	0.040
	(13.33–16.44)	(11.28–14.63)			(13.03–17.52)	(11.37–15.00)		
ED	3.15±0.08	2.67±0.05	9.786	0.003	3.44±0.07	2.69±0.05	5.206	0.026
	(2.55–4.30)	(2.20–3.24)			(2.71–4.18)	(2.22–3.36)		

Table 4-3. Summary of the limb, body and tail measurements of *C. versicolor* in northern and southern populations in Thailand. Data are mean±SE, with the range in parentheses, and are derived from 30 samples each unless indicated otherwise (N). All measurements are in mm. The *F*- and *p*-values from ANCOVA are shown.

Characters	Northern population				Southern population			
	Males	Females	*F*	*p*-value	Males	Females	*F*	*p*-value
4FingLng	9.76±0.15[b]	8.48±0.12	26.566	<0.001	10.33±0.16	8.37±0.06	37.447	<0.001
	(8.50–11.88)	(7.32–9.50)			(7.14–11.36)	(7.50–8.92)		
4ToeLng	14.88±0.17	13.00±0.14	46.039	<0.001	16.11±0.15	13.40±0.10[a]	60.222	<0.001
	(13.33–16.81)	(11.56–14.35)			(14.24–18.00)	(12.54–14.20)		
CrusL	18.15±0.15	16.27±0.20	35.952	<0.001	18.91±0.16	15.89±0.15	44.394	<0.001
	(16.72–19.96)	(14.33–19.00)			(17.33–20.85)	(14.16–17.70)		
ForefL	13.69±0.19[b]	11.98±0.14	32.638	<0.001	14.72±0.22	11.95±0.13	31.908	<0.001
	(12.02–15.48)	(10.24–13.52)			(11.19–16.75)	(10.04–13.50)		
HindfL	24.24±0.28	21.44±0.28[a]	26.629	<0.001	25.95±0.25	21.68±0.19[a]	44.952	<0.001
	(21.02–27.38)	(18.80–24.36)			(22.80–28.80)	(19.76–23.64)		
LoArmL	14.20±0.14	12.85±0.13	27.747	<0.001	14.92±0.13	12.43±0.17	19.672	<0.001
	(12.03–15.72)	(11.41–14.40)			(13.62–16.80)	(10.30–15.00)		
PectW	14.34±0.24	12.90±0.20	5.279	0.025	15.17±0.27	11.92-0.18	11.729	0.001
	(12.44–16.88)	(10.94–14.66)			(12.20–19.76)	(10.12–13.93)		
PelvW	12.20±0.22	11.91±0.14	–	–	13.05±0.18	11.42±0.19	0.015	0.902
	(10.46–14.70)	(10.20–13.37)			(10.98–15.07)	(9.51–13.44)		
SnForel	26.12±0.31	22.32±0.28	97.060	<0.001	28.94±0.34	21.99±0.28	91.564	<0.001
	(23.10–29.59)	(19.40–25.20)			(25.54–32.40)	(19.46–25.08)		
UpArmL	14.10±0.13	12.88±0.17	13.140	0.001	15.01±0.18	12.28±0.13	35.044	<0.001
	(12.49–15.47)	(10.90–14.36)			(13.50–17.42)	(11.00–13.88)		
UpLegL	19.99±0.21	18.10±0.20	21.058	<0.001	21.08±0.22	17.89±0.18	21.155	<0.001
	(16.84–22.50)	(16.07–20.80)			(18.54–24.44)	(15.98–20.00)		
TrunkL	39.88±0.62	38.11±0.68	4.556	0.037	40.97±0.53	36.55±0.55	9.243	0.004
	(34.24–45.42)	(31.14–43.88)			(37.27–49.10)	(30.16–43.48)		
TailTh	10.01±0.14	6.68±0.11	346.21	<0.001	10.65±0.15	6.29±0.13	210.36	<0.001
	(8.12–11.22)	(5.37–7.84)			(8.98–12.64)	(5.34–8.32)		
TailL	233.63±3.57[e]	208.55±5.94[d]	–	–	254.90±2.38[d]	213.14±3.81[c]	6.665	0.014
	(210.00–260.00)	(170.00–280.00)			(236.00–278.00)	(174.00–250.00)		
TailW	10.61±0.15	9.22±0.14	21.795	<0.001	10.69±0.15	8.87±0.19	2.417	0.126
	(9.14–12.11)	(7.78–10.92)			(9.26–12.92)	(7.02–11.28)		
TL	318.32±4.82[e]	282.90±5.77[d]	–	–	343.00±3.04[d]	286.52±4.29[c]	11.414	0.002
	(286–357)	(236.00–324.00)			(322.00–377.00)	(239.00–322.00)		
VentW	9.10±0.15	7.38±0.12	51.700	<0.001	9.02±0.14	6.84±0.18	16.037	<0.001
	(7.25–10.58)	(6.26–8.87)			(7.50–10.00)	(5.20–9.12)		

[a]N=29; [b]N=28; [c]N=21; [d]N=20; [e]N=19.

Table 4-4. Summary of the scalation characters of *C. versicolor* in northern and southern populations in Thailand. Data are mean±SE, with the range in parentheses and are derived from 30 samples unless indicated otherwise (N). The *Z*- and *p*-values from Mann-Whitney *U*-test are also shown.

Characters	Northern population				Southern population			
	Males	Females	*Z*	*p*- value	Males	Females	*Z*	*p*- value
CanthR	7.90±0.14	8.00±0.08	-0.932	0.352	7.87±0.09	7.57±0.09	-2.165	0.030
	(7–10)	(7–9)			(7–9)	(7–8)		
Eyelid	9.87±0.20	9.37±0.17	-1.949	0.051	10.03±0.20	9.53±0.19	-1.642	0.101
	(7–12)	(8–11)			(8–13)	(8–13)		
HeadSLn	13.17±0.21	13.43±0.26	-0.709	0.479	13.83±0.19	13.23±0.26	-2.344	0.019
	(11–15)	(11–16)			(11–16)	(11–17)		
HeadSTr	13.43±0.21	12.47±0.27	-3.633	<0.001	13.40±0.25	13.03±0.22	-1.220	0.223
	(11–16)	(10–19)			(11–16)	(11–16)		
Inflab	9.50±0.12	9.30±0.16	-0.853	0.394	9.27±0.11	9.33±0.12	-0.104	0.917
	(8–11)	(8–11)			(8–10)	(8–11)		
SnS	6.13±0.08	6.00±0.08	-1.146	0.252	6.47±0.11	6.40±0.10	-0.457	0.647
	(5–7)	(5–7)			(5–8)	(6–7)		
Suplab	9.87±0.12[a]	9.62±0.12	-1.253	0.210	9.47±0.11	9.17±0.11	-1.797	0.072
	(9–11)	(8–11)			(8–11)	(8–10)		
GuS	12.20±0.32	11.03±0.23	-2.496	0.013	11.27±0.22	10.83±0.19	-1.427	0.154
	(9–15)	(9–14)			(9–14)	(9–13)		
4FingLm	19.68±0.25	18.57±0.20[b]	-3.366	0.001	20.27±0.24	19.37±0.18	-2.741	0.006
	(16–22)	(17–21)			(18–23)	(17–21)		
4ToeLm	23.90±0.21[a]	23.21±0.23	-1.806	0.071	25.07±0.27[a]	24.79±0.23	-0.789	0.430
	(22–26)	(21–25)			(22–28)	(23–28)		
VentS	58.93±0.74	56.37±0.72	-2.497	0.013	58.70±0.55	58.13±0.62	-0.721	0.417
	(52–70)	(51–66)			(53–64)	(52–66)		
Midbody	43.53±0.34	44.10±0.44	-1.058	0.290	43.67±0.56	44.50±0.54	-0.813	0.416
	(41–48)	(38–50)			(35–49)	(39–51)		

[a]N=29; [b]N=28; [c]N=21; [d]N=20; [e]N=19.

Table 4-5. The percentages of occurrence of stripe patterns in *C. versicolor* in northern and southern populations of Thailand.

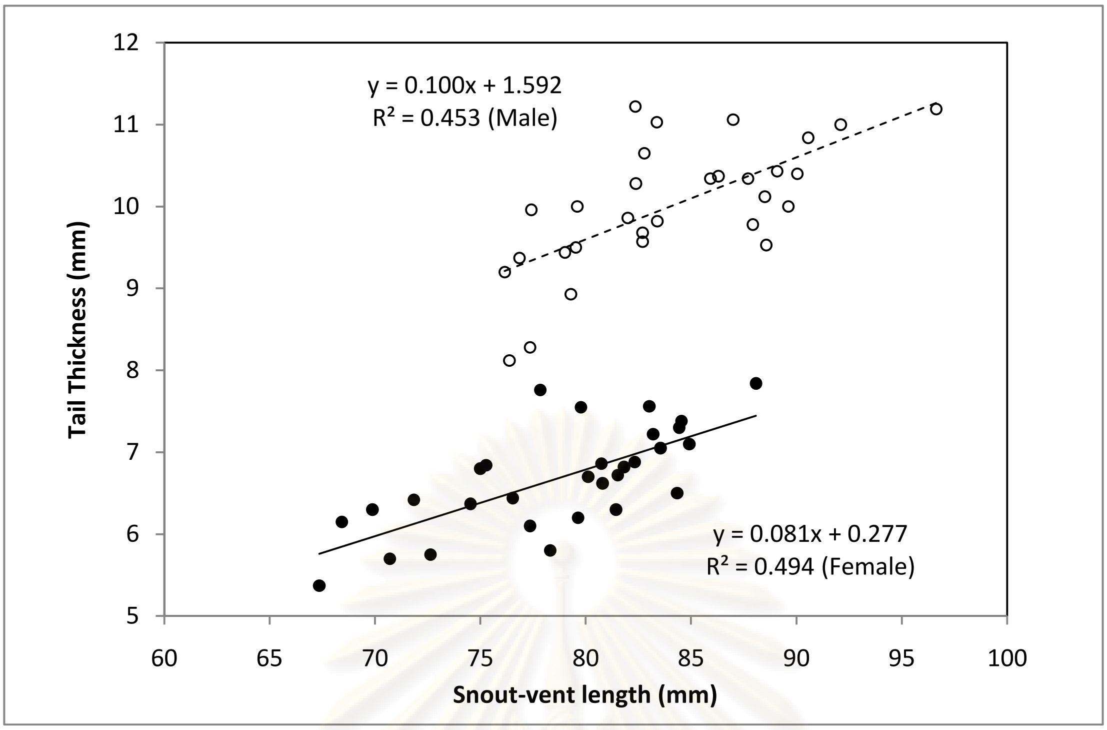
Characters	Northern population				Southern population			
	Males	Females	χ^2	*p*-value	Males	Females	χ^2	*p*-value
CheekCol	47	7	12.273	<0.001	33	13	3.354	0.067
CheekSt	100	97	1.017	0.313	100	100	–	–
DorsSt	10	63	18.373	<0.001	3	73	28.708	<0.001
ForearSt	53	83	6.239	0.012	50	87	9.320	0.002
NucSpot	53	83	6.239	0.012	50	87	9.320	0.002
TrnkBand	73	93	12.273	<0.001	97	100	1.017	0.313
MidvLine	97	100	1.017	0.313	100	100	–	–
ThroatSt	97	97	1.017	0.313	100	100	–	–
ThroatPa	13	3	1.964	0.161	63	6	21.172	<0.001
TrunkSt	40	53	3.330	0.189	53	63	0.617	0.432

Of the 14 head measurements, nine characters showed significant difference ($p < 0.05$) between the sexes in northern population, while 12 characters showed significant difference between the sexes in southern population. Head size of both populations was significantly greater in males than in females (Table 4–2). In addition, linear regression analysis showed the positive relationship between SVL and head size, except HeadW in northern males and SN in southern males (Table 4–6 and Table 4–7).

Differences between the sexes in limb, tail and body sizes were also found to be significant. The eight characters associated with limb lengths (4FingLng, 4ToeLng, CrusL, ForefL, HindfL, LoArmL, UpArmL and UpLegL) were all statistically longer in males than in females (Table 4–3). Moreover, the TailTh and VentW were significantly larger in males than in females in both populations (Table 4–3 and Fig 4–5). TailL and TL were significantly longer in males than in females only in the southern population, likewise tail width was significantly larger in males than in females only in the northern population. Note here that *C. versicolor* does not shed its tail (no autotomy), which could otherwise potentially compound any tail length analyses. With respect to the trunk length (TrunkL), this was significantly larger in females than in males in both northern and southern populations (Table 4–3).

The linear regression analysis revealed the relationship between SVL and each of the other morphological parameters (Table 4–6 and 4–7). The results showed that most of the mensural characters were related to SVL except HeadW and VentW of northern males, SN of southern males, VentW of southern females and 4FingLng and ForefL of both sexes. Each morphological character of each sex was also plotted against SVL (Appendix C). Tail thickness (Fig 4–6) was also showed obvious difference character.

Figure 4–5 Picture of male (upper) and female (lower) *Calotes versicolor* in northern Thailand. Male have thicker tail (TailTh) and larger vent (VentW) than female.



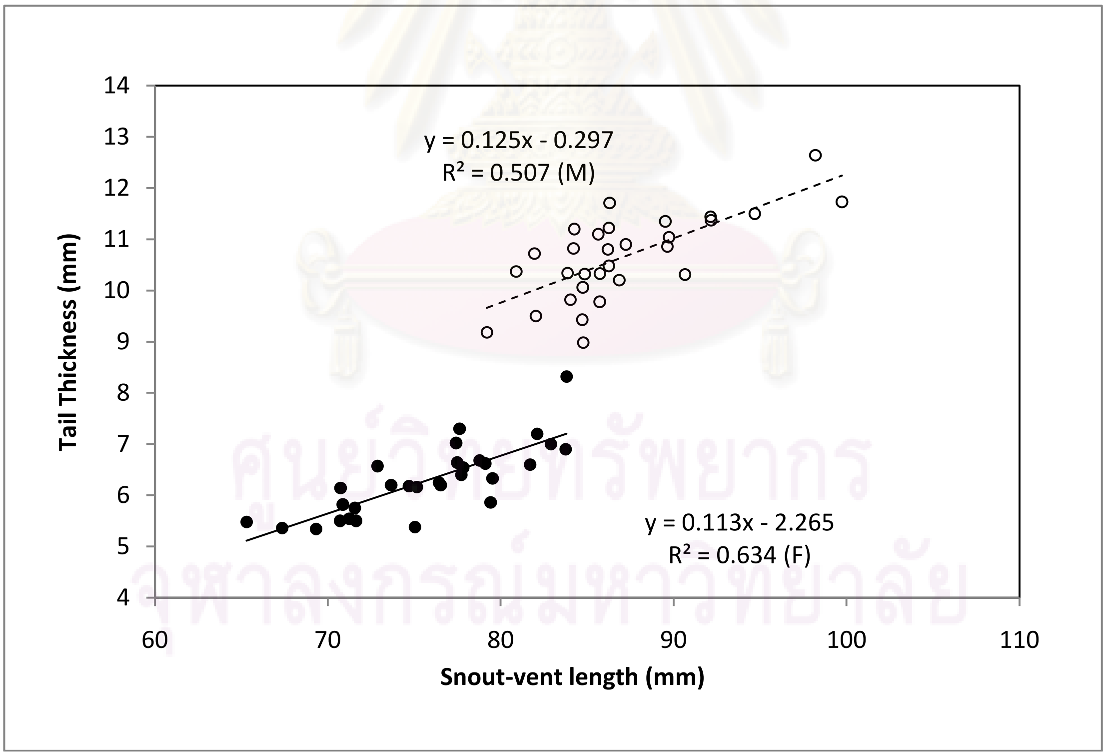


Figure 4–6 Linear regression line between Snout-vent length with Tailthickness both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.

Table 4–6 Regression analysis of *Calotes versicolor* morphological characters in both sexes of northern population.

Sex	Linear regression equation	F	*p*-value
Male	EyeEar = 0.067SVL - 0.054	23.319	<0.001
Female	EyeEar = 0.039SVL + 1.446	23.447	<0.001
Male	HeadH = 0.138SVL + 0.825	37.036	<0.001
Female	HeadH = 0.085SVL + 4.804	4.859	0.036
Male	HeadL = 0.194SVL + 3.256	96.668	<0.001
Female	HeadL = 0.195SVL + 2.072	41.101	<0.001
Male	HeadW = 0.094SVL + 8.586	2.777	0.107
Female	HeadW = 0.165SVL + 0.783	28.368	<0.001
Male	Interorb = 0.079SVL + 1.522	33.990	<0.001
Female	Interorb = 0.094SVL + 0.003	54.642	<0.001
Male	JawW = 0.176SVL - 1.418	74.614	<0.001
Female	JawW = 0.135SVL + 1.368	56.821	<0.001
Male	NarEye = 0.024SVL + 2.423	6.843	0.014
Female	NarEye = 0.044SVL + 0.607	31.574	<0.001
Male	SnEye = 0.065SVL + 2.689	22.199	<0.001
Female	SnEye = 0.080SVL + 1.334	37.944	<0.001
Male	SnW = 0.058SVL - 0.005	48.989	<0.001
Female	SnW = 0.038SVL + 1.622	20.813	<0.001
Male	SP = 0.129SVL + 5.044	48.731	<0.001
Female	SP = 0.152SVL + 2.937	53.726	<0.001
Male	SN = 0.052SVL - 0.706	32.744	<0.001
Female	SN = 0.027SVL + 1.295	10.631	0.003
Male	LE = 0.073SVL - 0.651	25.874	<0.001
Female	LE = 0.048SVL + 0.822	19.736	<0.001
Male	LL = 0.131SVL + 3.599	47.461	<0.001
Female	LL = 0.141SVL + 2.321	63.672	<0.001
Male	ED = 0.057SVL - 1.664	26.095	<0.001
Female	ED = 0.033SVL + 0.059	25.518	<0.001
Male	4FingLng = 0.070SVL + 3.830	8.707	0.006
Female	4FingLng = 0.059SVL + 3.762	9.249	0.005
Male	4ToeLng = 0.105SVL + 5.978	16.407	<0.001
Female	4ToeLng = 0.090SVL + 5.927	17.803	<0.001
Male	ForefL = 0.112SVL + 4.224	17.038	<0.001
Female	ForefL = 0.090SVL + 4.872	18.328	<0.001
Male	HindfL = 0.203SVL + 7.154	27.108	<0.001
Female	HindfL = 0.183SVL + 7.052	19.959	<0.001

Table 4–6 (Cont.) Regression analysis of *Calotes versicolor* morphological characters in both sexes of northern population.

Sex	Linear regression equation	F	*p*-value
Male	LoArmL = 0.103SVL + 5.456	31.038	<0.001
Female	LoArmL = 0.093SVL + 5.515	25.877	<0.001
Male	CrusL = 0.101SVL + 9.651	19.560	<0.001
Female	CrusL = 0.151SVL + 4.348	38.798	<0.001
Male	PectW = 0.187SVL - 1.389	38.731	<0.001
Female	PectW = 0.135SVL + 2.224	23.039	<0.001
Male	PelvW = 0.153SVL - 0.732	23.938	<0.001
Female	PelvW = 0.073SVL + 6.14	10.141	0.004
Male	SnForel = 0.281SVL + 2.473	101.137	<0.001
Female	SnForel = 0.233SVL + 3.944	60.563	<0.001
Male	TailTh = 0.100SVL + 1.592	23.256	<0.001
Female	TailTh = 0.081SVL + 0.277	27.387	<0.001
Male	TailL = 0.213SVL + 5.309	27.228	<0.001
Female	TailL = 0.413SVL - 11.50	22.473	<0.001
Male	TailW = 0.094SVL + 2.690	14.423	0.001
Female	TailW = 0.069SVL + 3.719	8.363	0.007
Male	TrunkL = 0.550SVL - 6.412	79.081	<0.001
Female	TrunkL = 0.566SVL - 6.436	56.704	<0.001
Male	UpArmL = 0.076SVL + 7.698	12.216	0.002
Female	UpArmL = 0.132SVL + 2.479	43.077	<0.001
Male	UpLegL = 0.122SVL + 9.695	12.685	0.001
Female	UpLegL = 0.131SVL + 7.721	21.537	<0.001
Male	TL = 0.319SVL + 4.892	42.621	<0.001
Female	TL = 0.434SVL - 5.791	30.820	<0.001
Male	VentW = 0.047SVL + 5.108	3.030	0.093
Female	VentW = 0.051SVL + 3.324	6.059	0.020

Table 4–7 Regression analysis of *Calotes versicolor* morphological characters in both sexes of southern population.

Sex	Linear regression equation	*F*	*p*-value
Male	EyeEar = 0.094SVL - 1.925	53.432	<0.001
Female	EyeEar = 0.056SVL + 0.305	45.444	<0.001
Male	HeadH = 0.184SVL - 1.969	26.791	<0.001
Female	HeadH = 0.116SVL + 2.024	29.276	<0.001
Male	HeadL = 0.224SVL + 1.599	68.990	<0.001
Female	HeadL = 0.216SVL + 0.916	128.555	<0.001
Male	HeadW = 0.247SVL - 1.900	16.456	<0.001
Female	HeadW = 0.178SVL - 0.334	50.582	<0.001
Male	Interorb = 0.059SVL + 3.564	13.115	0.001
Female	Interorb = 0.118SVL - 1.554	58.020	<0.001
Male	JawW = 0.162SVL + 0.081	23.079	<0.001
Female	JawW = 0.165SVL - 0.767	56.250	<0.001
Male	NarEye = 0.028SVL + 2.294	5.888	0.022
Female	NarEye = 0.041SVL + 0.862	11.161	0.002
Male	SnEye = 0.047SVL + 4.648	11.535	0.002
Female	SnEye = 0.074SVL + 1.901	26.349	<0.001
Male	SnW = 0.033SVL + 2.512	7.632	0.010
Female	SnW = 0.051SVL + 0.830	15.672	<0.001
Male	SP = 0.124SVL + 5.877	32.711	<0.001
Female	SP = 0.160SVL + 2.327	113.894	<0.001
Male	SN = 0.014SVL + 2.699	2.202	0.149
Female	SN = 0.025SVL + 1.485	7.615	0.010
Male	LE = 0.067SVL + 0.447	12.389	0.001
Female	LE = 0.054SVL + 0.496	19.292	<0.001
Male	LL = 0.171SVL + 0.499	67.564	<0.001
Female	LL = 0.171SVL + 0.019	68.691	<0.001
Male	ED = 0.046SVL - 0.604	13.228	0.001
Female	ED = 0.044SVL - 0.682	39.085	<0.001
Male	4FingLng = 0.060SVL + 5.026	3.525	0.071
Female	4FingLng = 0.006SVL + 7.869	0.250	0.621
Male	4ToeLng = 0.084SVL + 8.719	8.757	0.006
Female	4ToeLng = 0.049SVL + 9.637	6.565	0.016
Male	ForefL = 0.080SVL + 7.731	2.954	0.097
Female	ForefL = 0.017SVL + 10.63	0.379	0.543
Male	HindfL = 0.145SVL + 13.24	9.457	0.005
Female	HindfL = 0.089SVL + 14.91	5.848	0.022

Table 4–7 (Cont.) Regression analysis of *Calotes versicolor* morphological characters in both sexes of southern population.

Sex	Linear regression equation	*F*	*p*-value
Male	LoArmL = 0.094SVL + 6.730	17.471	<0.001
Female	LoArmL = 0.137SVL + 2.012	28.831	<0.001
Male	CrusL = 0.112SVL + 9.136	17.186	<0.001
Female	CrusL = 0.130SVL + 5.975	42.405	<0.001
Male	PectW = 0.230SVL - 4.917	35.119	<0.001
Female	PectW = 0.156SVL + 0.059	41.360	<0.001
Male	PelvW = 0.121SVL + 2.442	14.946	0.001
Female	PelvW = 0.157SVL - 0.502	30.609	<0.001
Male	SnForel = 0.278SVL + 4.717	28.839	<0.001
Female	SnForel = 0.290SVL + 0.015	157.954	<0.001
Male	TailTh = 0.125SVL - 0.297	28.861	<0.001
Female	TailTh = 0.113SVL - 2.265	48.565	<0.001
Male	TailL = 0.169SVL + 10.77	7.309	0.012
Female	TailL = 0.237SVL + 3.499	9.849	0.004
Male	TailW = 0.076SVL + 3.992	6.383	0.017
Female	TailW = 0.150SVL - 2.503	29.169	<0.001
Male	TrunkL = 0.569SVL - 8.613	172.176	<0.001
Female	TrunkL = 0.535SVL - 3.975	79.517	<0.001
Male	UpArmL = 0.092SVL + 6.947	6.366	0.018
Female	UpArmL = 0.082SVL + 6.045	14.082	0.001
Male	UpLegL = 0.118SVL + 10.78	7.714	0.010
Female	UpLegL = 0.157SVL + 5.951	44.663	<0.001
Male	TL = 0.258SVL + 11.83	11.818	0.002
Female	TL = 0.374SVL + 0.496	29.386	<0.001
Male	VentW = 0.052SVL + 4.431	3.458	0.074
Female	VentW = 0.074SVL + 1.178	4.229	0.049

The results of the multivariate analyses of the mensural characters between sexes also revealed clear sexual differences. The PCA of adult lizards showed a clustering of each sex in both populations (Fig. 4–7). PCA revealed VentW, TailTh, TailW, HeadW, UpLegL, EyeEar, CrusL, SnForel, HindfL, 4ToeLng, 4FingLng, UpArmL, LoArmL, HeadL, LE, JawW, HeadH and Interorb being the major loadings on the first component (PC1), whilst the EyeEar, CrusL, SnForel, TL, TailL, ForefL, HindfL, 4ToeLng, 4FingLng, NarEye, UpArmL, LoArmL, HeadL, SnEye, LE and SVL were the main loading for the second component (PC2) and the SnEye, SnW, PelvW, TrunkL, SN, SVL, JawW, PectW, LL, HeadH, ED, Interorb and SP were the major loading for the third component (PC3) in the northern populations. PC1, PC2 and PC3, at 26.63%, 26.49%, and 24.28% of the total variation, respectively, accounted for 77.40% of the total variance.

In addition, for the southern population the PCA revealed two components, the LL, Interorb, SnW, SP, SVL, HeadL, JawW, SnEye, TrunkL, ED, PelvW, SnForel, SN, EyeEar, TailW, PectW, NaeEye, UpArmL, TailTh, UpLegL, CrusL, HeadW, LoArmL, LE, HeadH, VentW, TL and TailL were the major loading for the PC1, and SP, SVL, HeadL, SnEye, SnForel, EyeEar, TailW, PectW, NarEye, ForefL, 4FingLng, HindfL, 4ToeLng, UpArmL, TailTh, UpLegL, CrusL, HeadW, LoArmL, LE, HeadH, VentW, TL, TailL were the main loading in PC2. PC1 and PC2, at 44.32% and 39.31% of the total variation, respectively, accounted for 83.63% of the total variance.

Meristic characters.—The meristic characters of the mature males and females were found to exhibit a much lower degree of sexual dimorphism than the mensural characters, but significant differences between the genders within populations still existed (Table 4–4). Across both the northern and southern populations, from the twelve characters evaluated, only one (4FingLm) was significantly different, being more numerous in males than in females in both populations. However, within either regional population, the numbers of HeadSTr, GuS and VentS in males were statistically more than in females from the northern population, whilst conversely the numbers of CanthR and HeadSLn in males were statistically more than in females in the southern population (Table 4–4).

The PCA of the meristic characters in the northern population revealed 15.98%, 15.34%, 12.91%, 12.39% and 11.45% of the total variation was compartmented into PC1, PC2, PC3, PC4 and PC5, respectively, accounting for 68.07% of the total variance. 4FingLm and 4ToeLm were the major loading on PC1, Suplab and GuS on PC2, Midbody and VentS on PC3, HeadSLn, SnS and Inflab on PC4 and Eyelid, HeadSTr and CanthR on PC5. However, PCA of northern populations showed overlapping between sexes (Fig. 4–7C). In southern populations, PCA revealed 14.94%, 14.21%, 14.11%, 14.00% and 11.99% of the total variation in PC1, PC2, PC3, PC4 and PC5, respectively, although this accounted for 69.25% of the total variation. Within these groupings, 4FingLm, HeadSTr and 4ToeLm were the major loading traits on PC1, GuS, Inflab and Suplab on PC2, VentS, CanthR and Midbody on PC3, SnS on PC4, and Suplab on PC5. The PCA of the southern population could not be separately discerned (Fig. 4-7D). However, note that figure 4–7 only shows PC1 and PC2 and not PC3, PC4, and PC5 for the southern and northern populations.

Stripe patterns.—Females from the northern populations displayed statistically brighter patterns in DorsSt, ForearSt, NucSpot and TrnkBand than males, whereas CheekCol was more frequently found in males (Table 4–5). In the southern populations, DorsSt, ForearSt and NucSpot were more often found in females, whereas ThroatPa was more frequently found in males (Table 4–5).

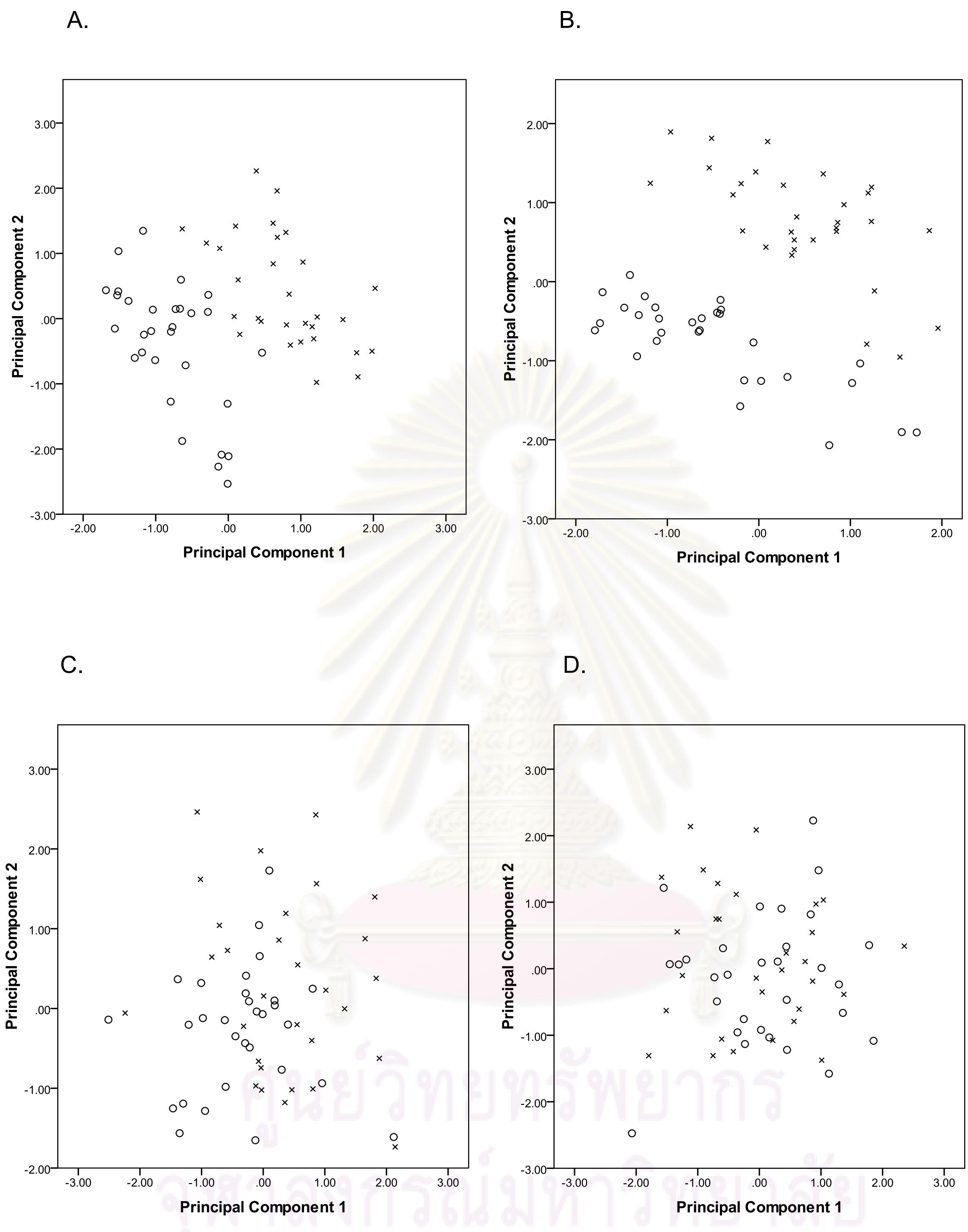


Figure 4–7. PCA for (A, B) the mensural characters and (C, D) the meristic characters of *C. versicolor* in (A, C) northern and (B, D) southern Thailand populations. Abbreviations: ○, females; ×, males.

4.4 Geographic variation of *C. versicolor*

Mensural characters.—The mean SVLs in males from the northern populations were significantly smaller than the SVLs in males from the southern populations (84.11±0.96 mm vs. 87.08±0.86 mm, respectively, t=2.296, p=0.025), but in it was the other way round with females from the northern populations having a larger SVL than those from the southern populations (78.67±0.99 mm vs. 75.74±0.89 mm, respectively, t=-2.200, p=0.032).

Ten characters;EyeEar, HeadH, HeadL, HeadW, Interorb, NarEye, SnEye, SnW, SP and LE, of the fourteen head measurements were significantly different between populations of males, whereas females showed significant differences between populations in five characters, being EyeEar, HeadL, Interorb, SnW and ED (Table 4–8).

With respect to the limb lengths, only two (4ToeLng and HindfL) of the eight limb lengths showed significant differences between populations in both sexes. Seven (4ToeLng, CrusL, ForefL, HindfL, LoArmL, UpArmL and UpLegL) of the eight limb lengths evaluated were significantly different between populations of males, whereas only two (4ToeLng and HindfL) were significantly different between populations of females (Table 4–8).

With regards to the trunk and tail, the trunk length was not significantly different between males or between females in all populations, but of the two tail measurements, TailL and TL were significantly different between populations in both sexes (Table 4–8). TailTh and TailW were not significantly different between populations in both sexes.

PCA revealed no clustering of each population in females and males (Fig. 4–8A and 4–8B). The PCA of all females showed 26.44%, 18.89%, 13.08%, 9.30% and 7.89% of the total variation expressed in PC1, PC2, PC3, PC4 and PC5, respectively, which together accounted for 75.60% of the total variation. Within these five components, SnForel, SnEye, SN, LL, HeadL, EyeEar, Interorb, SnW, NarEye, SP, LE, SVL, HeadW, JawW and TailTh were the major loading on PC1, SVL, HeadH, VentW, PectW, TailW, HeadW, JawW, PelvW, TailTh and TrunkL on PC2, 4ToeLng, HindfL, ForefL, 4FingLng on PC3, TaiL and TL on PC4, LoArmL and UpArmL on PC5.

For males, the PCA revealed 26.43%, 17.38%, 16.23%, 9.19% and 8.25% of the total variation expressed in PC1, PC2, PC3, PC4 and PC5, respectively, which together accounted for 77.48% of the total variation. Within these five components, LL, SVL, ED, TrunkL, SnW, HeadL, SP, JawW, SnForel, PectW, HeadH, SN, TailTh, Interorb, PelvW and EyeEar were the major loading on PC1, HindfL, 4ToeLng, UpLegL, CrusL, ForefL, 4FingLng and UpArmL were the major loading on PC2, HeadL, SnForel, Interorb, NarEye, SnEye, HeadW, EyeEar, LE were the major loading on PC3, VentW and TailW were the major loading on PC4, and TailL and TL were the major loading on PC5. Figure 4–8A and 4–8B show only PC1 and PC2 not PC3, PC4 and PC5 for both sexes.

Meristic characters.—The meristic characters of both populations were found to be slightly different in both sexes (Table 4–9), with the numbers of HeadSLn, SnS, Suplab, GuS and 4ToeLm between populations in males, and the numbers of CanthR, HeadSTr, SnS, Suplab, 4FingLm, 4ToeLm and VentS in females, being significantly different between the northern and southern populations (Table 4–9). These are split as having significantly more CanthR, Suplab and GuS in the northern populations compared to the southern ones, but more HeadSLn, HeadSTr, SnS, 4FingLm and 4ToeLm in the southern populations.

PCA revealed no clustering of each population for either female or male populations (Fig. 4–8C and 4–8D). With respect to females, PCA revealed 16.56%, 14.59%, 13.61%, 11.68% and 10.93% of the total variation in females being found in PC1, PC2, PC3, PC4 and PC5, respectively, although this only accounts for 67.37% of the total variation. Nevertheless, 4ToeLm and 4FingLm were the major loading on PC1, Suplab, Inflab and GuS on PC2, Midbody and VentS on PC3, HeadSLn and SnS on PC4 and HeadSTr and Eyelid on PC5.

With respect to males, PCA revealed 16.83%, 15.78%, 15.10%, 11.91% and 9.85% of the total variation being found in PC1, PC2, PC3, PC4 and PC5, respectively, together accounting for 69.47% of the total variation. Within these components the major loadings were; GuS, Suplab and Inflab on PC1, 4ToeLm and 4FingLm on PC2, VentS, Midbody and Eyelid on PC3, HeadSLn and SnS on PC4 and CanthR on PC5. Figure 4–8C and 4–8D show only PC1 and PC2 not PC3, PC4 and PC5 for both sexes.

Stripe patterns.—Females showed no significant differences between populations, whilst in males only the TrnkBand (χ^2=6.405, p=0.011) and ThroatPa (χ^2=15.864, p<0.001) were found more often in southern populations.

Table 4–8. The *F*- and *p*-values from ANCOVA of the mensural characters of *C. versicolor* in males and females between populations in northern and southern Thailand.

Characters	Males		Females	
	F	*p*-value	*F*	*p*-value
Head				
EyeEar	19.803	<0.001	6.433	0.014
HeadH	27.322	<0.001	2.298	0.135
HeadL	27.895	<0.001	5.807	0.019
HeadW	35.663	<0.001	0.246	0.622
Interorb	12.561	0.001	10.196	0.002
JawW	2.550	0.116	0.996	0.323
NarEye	6.168	0.016	<0.001	0.996
SnEye	13.272	0.001	1.380	0.245
SnW	21.272	<0.001	6.536	0.013
SP	6.775	0.012	0.004	0.947
SN	–	–	0.032	0.858
LE	26.008	<0.001	2.466	0.122
LL	3.929	0.052	0.010	0.919
ED	2.611	0.112	5.791	0.019
Body				
TrunkL	1.828	0.182	0.027	0.871
SnForel	46.370	<0.001	4.160	0.046
PectW	0.725	0.398	8.241	0.006
PelvW	3.924	0.052	–	–
VentW	1.252	0.268	3.406	0.070
Limb				
4FingLng	2.604	0.112	–	–
4ToeLng	22.617	<0.001	16.779	<0.001
CrusL	6.324	0.015	0.081	0.777
ForefL	5.998	0.018	–	–
HindfL	13.837	<0.001	5.459	0.023
LoArmL	7.851	0.007	0.459	0.501
UpArmL	9.442	0.003	2.852	0.097
UpLegL	6.954	0.011	1.175	0.283
Tail				
TailTh	3.337	0.073	1.081	0.303
TailL	29.507	<0.001	11.995	0.001
TailW	0.829	0.366	–	–
TL	29.888	<0.001	25.884	<0.001

Table 4–9. The *Z*- and *p*-values from Mann-Whitney *U*-tests of the meristic characters of *C. versicolor* in males and females between populations in northern and southern Thailand.

Characters	Males		Females	
	Z	*p*-value	Z	*p*-value
CanthR	-0.087	0.931	-3.189	0.001
Eyelid	-0.447	0.655	-0.704	0.481
HeadSLn	-2.188	0.029	-0.842	0.400
HeadSTr	-0.030	0.976	-2.521	0.012
Inflab	-1.269	0.205	-0.024	0.981
SnS	-2.353	0.019	-2.991	0.003
Suplab	-2.185	0.029	-2.763	0.006
GuS	-1.970	0.049	-0.640	0.522
4FingLm	-1.361	0.174	-2.724	0.006
4ToeLm	-3.029	0.002	-4.022	<0.001
VentS	-0.022	0.982	-2.071	0.038
Midbody	-0.567	0.576	-0.224	0.823

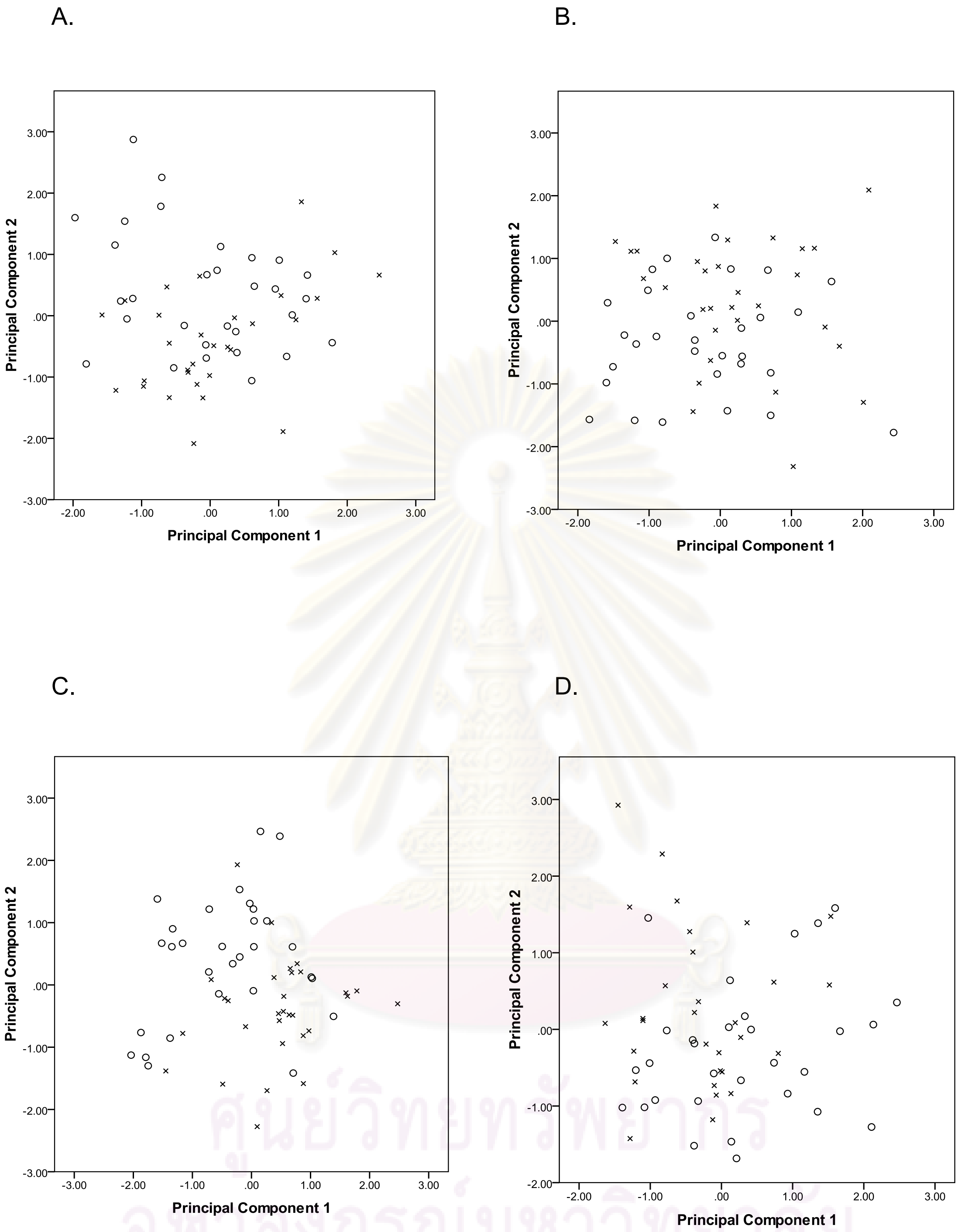


Figure 4-8. PCA for (A, B) the mensural characters and (C, D) the meristic characters of *C. versicolor* in (A, C) female and (B, D) male populations. Abbreviations: ○, northern populations; ×, southern populations.

CHAPTER V
DISCUSSION

This study supported many previous researches (Taylor, 1963; Cox *et al*., 1998; Radder, 2006) in that *C. versicolor* was usually found in man-made habitats such as rubber plantation, orchards, gardens and along garden fences both northern and southern regions. Although habitat type of the northern region was similar to the southern region, the climate and microhabitat were different. Averages of the rainfall and air temperature for ten years from January 2000 to December 2009 at six localities were shown in appendix D.

According to the results, reproductive stage of this species in Thailand might be found all the year, corresponded to the the study by Erdelen (1986), who reported that *C. versicolor* in Sri-Lanka had no breeding season. In India, however, *C. vers*icolor in reproductive stage was found only during May to October (Shanbhag, 2003).

5.1 Morphological difference of *Calotes versicolor* within-region

5.1.1 Morphological difference within northern Thailand

The principal component analysis (PCA) on northern Thailand samples showed that *C. versicolor* captured from the three sampling sites i.e. Mae Hong Son, Chiang Mai and Nan can be combined into one group. These sampling sites are located on nearly the same Latitude (Mae Hong Son at 2079323mN, Chiang Mai at 2084247mN and Nan at 2078573mN) with similar climate. Thai Meteorological Department data showed that the mean temperatures from 2000 to 2009 were 26.18°C at Mae Hong Son, 26.21 °C at Chiang Mai and 26.45 °C at Nan. Therefore, the temperature should not be the cause for morphological difference and growth rate of this species. Differences in temperature could influence to morphology and growth rate of this lizard as suggested by Radder (2006). The average adult size of *C. versicolor* in India where the mean temperature is 23°C is larger than in China where the mean temperature is 29°C.

5.1.2 Morphological difference of within southern Thailand

The PCA of within southern Thailand samples also showed only one group for the three sampling sites i.e. Songkhla, Ranong and Krabi. Even though each site is located in different latitude, the average temperatures in those areas were similar. Thai Meteorological Department data showed that the annual mean temperatures since 2000 to 2009 were 27.62°C at Songkla, 26.92°C at Krabi and 27.66°C at Ranong indicating the similarity of environmental factors in the southern region.

5.2 Sexual dimorphism of *C. versicolor*

5.2.1 Mensural character

In Thailand, the mean SVL, head size, limb length and tail size of males were significantly larger than those of females in both northern and southern populations.

Sexual dimorphism in head size were reported in adult *C. versicolor* in China, India and Myanmar (Ji *et al*., 2002; Radder *et al*., 2001; Radder, 2006; Zug *et al*., 2006). In China, the sexual dimorphism in head size of this lizard was found in hatchings, but not in juveniles and subadults (Ji *et al.,* 2002). A larger head size in adult males could perhaps indicate a greater resource holding power, and has been shown to be an advantage in intrasexual competition for territory defense and mate choice, and in intersexual dietary difference in prey size in many lizard species including *C. versicolor* (Cooper and Vitt, 1989; Hews, 1996; Radder *et al*., 2001; Vitt and Cooper, 1985).

Additionally, this study found that all characters related to limb lengths such as 4FingLng, 4ToeLng, CrusL, ForefL, HindfL, LoArmL, UpArmL and UpLegL in males were longer than in females, which may enhance the ability to compete in territorial defense, as suggested by Olsson *et al*. (2002). Moreover, a robust leg structure and snout-forelimb length in males could be the result of male-male competition.

Similar to studies in China, India and Myanmar (Ji *et al*., 2002; Radder *et al*., 2001; Radder, 2006; Zug *et al*., 2006), sexual dimorphism in body size was also found in *C. versicolor* in northern and southern populations. PectW, SnForeal and VentW were larger in males than in females. However, females have greater trunk length than males in both northern and southern populations. The strong sexual dimorphism in relative trunk length of lizards has been suggested to be the result of fecundity selection because the increase in the relative trunk length in females will result in an increased abdominal volume to carry the developing offspring (Olsson *et al*., 2002). Correspondingly, a reduction in this character is favored in males (Vitt and Congdon, 1978; Arak, 1988; Shine, 1992; Olsson *et al*., 2002). Greater PectW and SnForel demonstrate that the skeleton of front body part in male is larger and may be helpful in male-male competition.

Even though Radder *et al*. (2001) did not demonstrate any sexual dimorphism in the tail length of this species in India, this study in contrast found that males of southern populations have significantly longer tails than females. This is, however, in accord with the report of sexual dimorphism in tail length of this species from Hainan population in southern China (Ji *et al.* 2002). Adult male lizards possess a longer tail than females at the same SVL throughout their size range which likely reflects the fact that the lizard uses its long tail as a balancing organ on arboreal activities (Ji *et al*. 2002).

Male has greater tail thickness than female because of its hemipenes at the base of the tail. This result agrees with the study of Radder *et al.* (2001). Larger VentW in males may relate to TailTh size because VentW located on base of tail and available to hemipenis of males.

5.2.2 Meristic character

The meristic characters of the males and females exhibited a much lower degree of sexual dimorphism than the mensural characters, but significant differences between the genders within populations still existed.

The significant difference of the number of scale on the head was found only in four characters i.e. HeadSTr and GuS on northern population, and CanthR and HeadSLn on southern population. Numbers of scale in those characters were found in males more than in females. This may be because males have larger size than females and should have more number of those scales.

Moreover, the difference of the number of scale on limb was found only in 4FingLm. This character may relate to the perching capacities between males and females. More 4FingLm in males would allow them to perch higher than females. In accordance, this difference had been found in lizards from the Anoles family from the Greater Antilles island groups in the Caribbean Sea (Glossip and Losos, 1997).

5.2.3 Stripe pattern

The sexual dimorphism in stripe pattern of *C. versicolor* during breeding season displayed on the bright red head of the male, this is a conspicuous social cue used to signal other members of its species (Halliday and Adler, 2000)

Moreover, the differences of DorsSt, ForearSt and NucSpot in both northern and southern populations were found. The difference of stripe pattern in lizard might be caused from the differences in habitat types, reproductive strategies or the genetic variation of each individual (Vercken *et al*., 2007; Stuart-fox and Ord, 2004; LeBas and Marshall, 2000). Vercken *et al*. (2007) reported that *Lacerta vivipara* have color variation for the benefit of reproduction in females, whereas coloration in *Ctenophorus ornatus* has the role for signaling and male choice (LeBas and Marshall, 2000).

5.3 Geographic variation of *C. versicolor*

5.3.1 Mensural character

Geographic differences in the mensural characters between northern and southern populations of *C. versicolor* in Thailand were observed in males. All the different characters in males were found in the head size, limb lengths, only one character in body size and tail length which were larger in the southern population than in the northern population. Greater head size and body size in southern Thailand had also been found in the common skink, *Sphenomorphus maculatus* (Yamasaki *et al*., 2001). Yamasaki *et al.* (2001) reported that the common skink had head size larger in southern Myanmar and southern Thailand than in eastern India, southern China and northern Thailand, and was able to separate into 2 subspecies, *Sphenomorpus maculates maculates* (Blyth, 1854) and *Sphenomorpus maculates mitanensis* (Annandale, 1905), according to mensural and meristic characters. In Thailand, although *C. versicolor* of southern populations was larger than of northern populations, it was not able to divide into new species or subspecies because the meristic characters were not clearly different.

Morphological difference could occur from many reasons. Radder (2006) mentioned that the difference of *C. versicolor* specimens in India and China was influenced by environmental factors. China populations, living in cooler temperature, were smaller than India populations. This can be explained that the lizard in cooler temperature has lower growth rate but it can increase fecundity fitness by faster maturity. However, this result did not agree with Adolph and Porter's model (1996) who reported that lizards might mature at smaller size in warmer habitat.

Although differences in the prey availability could influence the body size (Karn *et al*., 2005), this effect should then influence not only males but also females. However, a larger head and longer limbs are potentially more advantageous in male-male competition (Olsson *et al*. 2002), and so it is possible that males in the southern populations may be involved in stronger male-male competition for resources or mating success than in those northern populations.

5.3.2 Meristic character

The geographic variation of meristic characters was rarely found as well as the sexual dimorphism of those characters. Thus, there was no clearly separated from using PCA test.

The causes of the difference of meristic character in lizards were reported by many herpetologists. Thorpe and Baez (1993) mentions that the lizard, *Gallotia stehlini,* on the Grand Canaria Island has geographic variation in meristic character due to altitude difference and habitat types. Additionally, climate is also thought to influence the size of scales (Soule and Kerfoot, 1972). They found that large scale has higher rate of cutaneous evaporation than smaller scale in sceloporine lizard. Therefore, large scale of this species was found more in rainfall area than in drought area.

In some cases, the meristic character difference could be divided into new species or subspecies. Example of the common skink, *Sphenomorphus maculates*, (Yamasaki *et al*., 2009) become to 2 subspecies. Zug et al. (2006) suggested that the scalation on head area of *C. "versicolor"* in Myanmar could be used to separate them into 2 species, *C. htunwini* and *C. irawadi*. According to the study by Auffenberg and Rehman (1993), Midbody scale was one of key characteristics used to distinguishable between *C. versicolor versicolor* in Sumatra, Malay Peninsula and China, and *C. v. nigrigularis* in Afghanistan. Data on midbody scale from this study indicated that *C. versicolor* from northern and southern Thailand is classified into *C. v. versicolor.*

From this study, the meristic character difference of *C. versicolor* between northern and southern regions could not be separated into new species or subspecies because of the lower degree of geographic difference in those characters.

5.3.3 Stripe pattern

The geographic difference in stripe pattern of *C. versicolor* was found only in male. ThroatPa and TrnkBand were only two characters found in this study.

Many reasons can explain this result such as habitat type difference, predators and climate difference. Stuart-Fox and Ord (2004) referred to the difference of coloration and ornamentation in that it may be influenced from sexual selection and natural selection. In this case, habitat type could be one of the causes for the difference. In close habitat, male lizard always shows outstanding body color in order to have highly efficient communications. Moreover, in open habitat, color in the body may not be clearly seen and this can protect it from predators. The climate may influence the balance between selection for signaling coloration for sexual/territorial purposes and natural selection for crypsis (Thorpe and Brown, 1989a and 1989b).

CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

1. *C. versicolor* in Thailand can be found in man-made habitat similar to those in other distribution range. The reproductive stage was seasonal and was found during May to October.

2. Distinct from this study morphological difference of *C. versicolor* within northern and southern regions was not found.

3. Sexual dimorphism of *C. versicolor* in each region was examined and significant differences were found. Adult males have larger head and thicker tail, while adult females have greater trunk length in both northern and southern populations. A larger head size in adult males could indicate a greater power to protect the resource and the intersexual dietary difference in prey size in this and other lizard species, and has been shown to be an advantage in intrasexual competition for territory defense and mate choice,. Greater trunk length of lizards has been suggested to be the result of fecundity selection. Although meristic characters did not show much difference between sexes, they demonstrated a greater number of scales in males than in females. For the stripe pattern, only 3 characters, i.e. DorSt, ForearSt and NucSpot, showed significant differences and were more distinguishable in females than in males.

4. Geographic differences in the mensural characters between the northern and southern populations of *C. versicolor* in Thailand were obvious in males. All different characters in males were found in the head size and limb lengths, and were larger in the southern populations than in the northern populations. With respect to the meristic characters, there was no obvious geographic variation. The geographic difference in stripe pattern was found only in two characters in male. The climate may influence the balance between selection for signaling coloration for sexual/territorial purposes and selection for crypsis.

6.2 Recommendations

Although, the populations within a region are not strongly different, there are some differences between populations of the two (northern and southern) regions in Thailand. However, this research should be supported by ecological data such as behavior for accurate discussion. Detailed studies on population genetics of *C. versicolor* in Thailand and nearby countries should be conducted in the future.

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APPENDICES

APPENDIX A

Specimen and Morphological data

Specimen and Morphological data of garden fence lizard

Number	Locality	Date of collection	Sex	Maturity	EyeEar	HeadH	HeadL	HeadW	InterOrb	JawW	NarEye	SnEye	SnW	SP
CUMZ-R-2010.07.14,1	Songkla	29 Jun 08	Male	Mature	6.43	14.38	21.20	19.10	8.57	13.32	4.55	8.66	5.40	17.05
CUMZ-R-2010.07.14,2	Songkla	29 Jun 08	Female	Mature	5.04	11.90	17.68	12.96	7.58	11.13	4.57	7.88	4.55	14.64
CUMZ-R-2010.07.14,4	Songkla	30 Jun 08	Male	Mature	6.26	14.90	21.36	19.76	8.48	12.90	4.81	8.84	5.30	17.20
CUMZ-R-2010.07.14,6	Nan	19 Jul 08	Male	Mature	4.90	11.18	18.47	15.16	7.84	12.34	4.40	7.70	4.84	16.06
CUMZ-R-2010.07.14,7	Nan	19 Jul 08	Female	Mature	4.54	11.54	18.20	13.01	8.16	12.17	4.57	7.85	4.97	16.64
CUMZ-R-2010.07.14,19	Nan	29 Oct 08	Female	Mature	5.11	11.87	19.62	14.76	8.38	12.82	4.72	8.72	5.25	15.86
CUMZ-R-2010.07.14,56	Chiang Mai	15 Dec 08	Female	Imature	4.60	11.24	18.60	14.54	8.30	13.14	4.63	8.46	4.88	15.26
CUMZ-R-2010.07.14,58	Chiang Mai	15 Dec 08	Male	Imature	6.38	13.17	20.55	19.10	8.64	14.98	4.46	8.58	5.34	15.48
CUMZ-R-2010.07.14,59	Chiang Mai	15 Dec 08	Female	Imature	4.96	11.88	18.70	15.54	7.92	13.10	4.53	8.05	5.06	15.22
CUMZ-R-2010.07.14,61	Chiang Mai	15 Dec 08	Female	Imature	4.37	10.84	17.52	12.87	7.37	11.73	4.07	7.36	4.71	15.14
CUMZ-R-2010.07.14,67	Chiang Mai	15 Dec 08	Male	Imature	5.63	12.66	19.59	18.00	7.97	13.29	4.84	8.46	5.20	15.35
CUMZ-R-2010.07.14,69	Chiang Mai	15 Dec 08	Male	Imature	6.34	13.06	20.48	19.22	8.88	14.12	5.18	8.98	4.98	16.30
CUMZ-R-2010.07.14,70	Chiang Mai	15 Dec 08	Female	Imature	5.10	12.92	19.00	14.67	7.53	12.74	4.38	7.65	5.14	15.02
CUMZ-R-2010.07.14,71	Chiang Mai	15 Dec 08	Female	Imature	5.25	11.63	18.60	14.53	8.05	12.94	4.51	8.38	4.88	15.30
CUMZ-R-2010.07.14,72	Chiang Mai	15 Dec 08	Male	Imature	6.16	12.66	20.55	18.38	8.61	14.62	4.90	8.58	5.04	16.38
CUMZ-R-2010.07.14,73	Chiang Mai	15 Dec 08	Male	Imature	6.06	13.39	21.72	17.10	9.23	14.50	5.14	9.67	5.24	16.64
CUMZ-R-2010.07.14,80	Krabi	25 Jan 09	Male	Mature	6.53	14.18	21.39	19.23	9.13	13.04	4.50	9.26	5.78	16.70
CUMZ-R-2010.07.14,82	Krabi	25 Jan 09	Male	Mature	6.90	13.70	22.10	20.20	9.10	15.66	4.79	9.04	5.86	17.63
CUMZ-R-2010.07.14,83	Krabi	25 Jan 09	Male	Mature	5.90	12.48	20.06	16.62	8.30	12.40	4.28	8.20	5.56	16.30
CUMZ-R-2010.07.14,88	Krabi	25 Jan 09	Male	Mature	6.06	12.82	21.30	17.43	8.96	14.10	4.82	8.95	5.60	17.22
CUMZ-R-2010.07.14,90	Krabi	25 Jan 09	Female	Mature	4.71	10.46	17.10	13.27	7.19	11.94	4.02	7.00	4.94	14.37
CUMZ-R-2010.07.14,91	Krabi	25 Jan 09	Male	Mature	6.36	13.60	21.00	19.70	8.74	14.78	4.84	8.72	5.52	16.37
CUMZ-R-2010.07.14,93	Krabi	25 Jan 09	Male	Mature	6.85	15.92	23.20	18.80	8.82	14.18	4.64	9.45	6.00	18.64
CUMZ-R-2010.07.14,94	Krabi	25 Jan 09	Female	Mature	4.71	11.04	17.89	14.15	8.37	12.34	3.77	7.86	5.46	14.97
CUMZ-R-2010.07.14,95	Krabi	25 Jan 09	Male	Mature	6.90	14.38	21.86	20.66	9.60	15.54	4.80	9.48	6.15	16.94

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	SN	LE	LL	ED	4FingLng	4ToeLng	CrusL	ForefL	HindfL	LoArmL	PectW	Pelvw	SVL	SnForel	Tailthick	TailL
CUMZ-R-2010.07.14,1	3.75	6.54	15.02	3.69	10.82	16.12	19.30	13.64	25.67	13.62	15.36	14.09	84.26	28.36	11.20	26.30
CUMZ-R-2010.07.14,2	3.52	4.90	13.12	2.88	8.70	14.20	16.50	13.02	21.94	12.96	12.31	12.62	79.11	22.45	6.62	22.30
CUMZ-R-2010.07.14,4	4.10	6.62	15.75	3.75	11.17	17.13	18.58	16.16	26.56	14.64	12.90	12.58	86.25	30.00	11.22	-
CUMZ-R-2010.07.14,6	3.25	5.40	13.33	2.91	9.81	14.98	17.80	14.40	24.50	13.70	13.56	11.36	82.70	24.60	9.68	24.80
CUMZ-R-2010.07.14,7	3.16	4.66	13.75	2.58	8.20	13.86	17.08	12.70	23.50	12.76	12.22	11.58	81.82	22.71	6.82	21.80
CUMZ-R-2010.07.14,19	3.80	5.86	14.63	2.96	9.07	13.90	17.84	12.88	23.44	13.08	12.90	11.05	88.08	25.20	7.84	23.70
CUMZ-R-2010.07.14,56	3.55	4.43	14.43	2.96	8.28	12.75	16.94	12.16	21.67	12.59	13.28	12.02	83.20	24.17	7.22	-
CUMZ-R-2010.07.14,58	4.40	6.13	14.62	3.55	10.05	15.70	17.87	15.44	25.08	14.28	16.71	14.70	88.57	27.77	9.53	25.10
CUMZ-R-2010.07.14,59	3.97	5.19	14.59	2.98	8.34	-	16.55	11.87	-	13.02	14.23	12.72	84.92	23.72	7.10	-
CUMZ-R-2010.07.14,61	3.86	4.54	13.84	2.62	8.34	12.54	15.35	11.20	19.58	12.82	10.94	11.20	78.32	21.85	5.80	21.30
CUMZ-R-2010.07.14,67	4.20	5.81	14.23	2.71	10.10	15.58	17.95	14.53	25.40	13.60	16.00	12.25	82.70	26.48	9.57	22.90
CUMZ-R-2010.07.14,69	4.03	6.04	14.93	3.08	11.88	16.81	18.68	15.48	27.21	15.11	16.05	14.51	90.04	27.87	10.40	25.50
CUMZ-R-2010.07.14,70	3.44	5.12	14.24	2.40	8.82	13.02	17.20	12.12	22.00	12.98	13.54	12.96	84.44	23.59	7.30	23.20
CUMZ-R-2010.07.14,71	3.74	5.42	14.02	2.42	8.00	13.16	17.05	11.68	22.18	13.64	13.04	13.37	77.85	23.73	7.76	-
CUMZ-R-2010.07.14,72	3.60	6.50	15.38	2.92	11.00	16.56	18.90	14.38	27.38	14.38	14.85	12.92	87.93	27.40	9.78	23.00
CUMZ-R-2010.07.14,73	3.78	6.75	15.57	3.41	11.19	15.69	19.96	14.86	25.46	15.72	14.80	12.86	89.09	27.86	10.43	25.00
CUMZ-R-2010.07.14,80	4.11	6.40	15.62	4.08	10.48	16.77	20.14	14.46	27.74	15.53	15.43	13.26	89.74	30.50	11.04	-
CUMZ-R-2010.07.14,82	4.11	6.10	17.19	3.86	10.10	15.14	18.15	14.10	24.60	14.36	14.62	13.40	90.66	29.83	10.31	26.20
CUMZ-R-2010.07.14,83	3.76	5.58	14.88	2.96	10.38	16.37	17.46	14.93	24.94	14.53	14.00	11.62	84.77	26.58	8.98	25.40
CUMZ-R-2010.07.14,88	4.13	6.67	15.50	3.58	9.30	14.24	17.33	12.24	22.80	14.05	14.33	12.07	84.72	28.40	9.43	-
CUMZ-R-2010.07.14,90	2.96	4.61	13.44	3.20	7.77	13.30	16.05	11.57	23.18	13.00	11.57	10.82	77.48	22.45	6.64	23.70
CUMZ-R-2010.07.14,91	4.53	5.96	15.70	3.64	9.65	15.71	18.56	13.30	25.34	14.60	15.60	13.40	86.26	28.44	10.48	24.20
CUMZ-R-2010.07.14,93	4.54	7.35	16.33	3.25	10.55	17.15	19.40	15.86	28.00	15.85	15.76	14.03	92.17	31.76	11.37	-
CUMZ-R-2010.07.14,94	3.53	4.55	13.80	2.74	7.50	12.91	15.42	11.34	20.25	11.90	11.78	11.00	76.43	22.55	6.25	21.50
CUMZ-R-2010.07.14,95	4.00	7.04	15.64	3.57	11.15	18.00	18.52	16.12	28.80	15.80	16.27	14.23	89.52	30.00	11.35	-

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	TailW	TrunkL	UpArmL	UpLegL	TL	VentW	CanthR	Eyelid	HeadSLn	HeadSTr	Inflab	SnS	Suplab	GuS	4FingLm
CUMZ-R-2010.07.14,1	10.55	39.82	14.20	21.76	35.00	9.10	7	11	14	13	10	7	10	10	19
CUMZ-R-2010.07.14,2	9.38	40.50	12.30	20.00	30.40	6.35	8	8	13	13	8	6	8	9	19
CUMZ-R-2010.07.14,4	10.96	40.16	14.36	21.47	-	9.54	8	10	15	15	9	8	10	12	20
CUMZ-R-2010.07.14,6	9.88	40.67	13.52	20.38	33.30	9.12	8	10	13	13	9	6	9	10	20
CUMZ-R-2010.07.14,7	8.37	32.24	14.10	20.31	29.90	7.47	8	9	14	12	9	6	9	9	17
CUMZ-R-2010.07.14,19	8.48	41.82	14.02	19.04	32.40	8.04	8	9	13	12	9	6	9	12	20
CUMZ-R-2010.07.14,56	9.36	40.14	12.53	18.94	-	8.18	8	10	12	12	9	5	10	10	17
CUMZ-R-2010.07.14,58	11.27	40.50	14.87	19.90	34.00	8.38	8	10	15	16	9	7	10	11	16
CUMZ-R-2010.07.14,59	9.93	43.88	13.37	18.61	-	7.28	8	10	14	13	10	6	10	12	19
CUMZ-R-2010.07.14,61	9.43	36.67	13.03	18.10	29.20	6.38	8	10	16	13	10	6	9	11	18
CUMZ-R-2010.07.14,67	10.32	38.58	13.02	19.63	31.00	7.25	8	9	13	12	9	5	9	9	19
CUMZ-R-2010.07.14,69	11.97	41.17	15.43	19.92	34.60	9.09	7	10	15	14	10	6	10	12	20
CUMZ-R-2010.07.14,70	10.46	43.10	13.82	17.50	31.70	7.78	8	9	12	13	8	5	-	11	18
CUMZ-R-2010.07.14,71	10.92	35.10	14.30	18.80	-	7.45	7	9	13	11	9	6	9	9	17
CUMZ-R-2010.07.14,72	10.55	43.70	14.58	20.56	31.90	8.14	7	11	12	15	10	6	10	15	22
CUMZ-R-2010.07.14,73	10.92	43.58	15.47	21.78	34.00	9.30	7	9	15	13	9	6	10	12	18
CUMZ-R-2010.07.14,80	10.23	41.62	14.43	21.13	-	9.56	7	13	14	14	10	6	9	12	21
CUMZ-R-2010.07.14,82	10.04	44.00	14.14	20.43	35.30	7.64	7	9	13	13	9	6	10	12	19
CUMZ-R-2010.07.14,83	9.44	39.92	13.50	19.26	33.90	8.17	8	10	14	12	9	7	11	11	21
CUMZ-R-2010.07.14,88	9.95	38.37	14.18	19.36	-	8.64	8	10	13	14	9	6	9	9	20
CUMZ-R-2010.07.14,90	7.74	35.15	12.25	18.02	31.70	5.73	8	11	12	14	9	6	9	12	21
CUMZ-R-2010.07.14,91	10.59	39.94	14.94	19.92	33.00	9.93	8	12	16	14	10	7	9	11	22
CUMZ-R-2010.07.14,93	11.58	42.06	14.89	22.34	-	9.89	8	10	13	14	9	7	9	11	22
CUMZ-R-2010.07.14,94	8.78	37.20	11.31	17.05	29.30	7.28	8	10	11	11	9	7	9	10	19
CUMZ-R-2010.07.14,95	11.16	43.07	14.72	21.62	-	8.88	8	11	13	14	9	6	8	12	20

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	ToeLm	ventS	Midbody	CheekCol	CheekSt	DorsSt	ForearSt	NucSpot	TrnkBand	MidvLine	ThroatSt	ThroatPa	TrunkSt
CUMZ-R-2010.07.14,1	24	59	41	0	1	0	0	0	1	1	1	1	0
CUMZ-R-2010.07.14,2	24	52	41	1	1	0	0	0	1	1	1	1	1
CUMZ-R-2010.07.14,4	27	56	43	1	1	0	0	0	1	1	1	1	0
CUMZ-R-2010.07.14,6	22	60	42	0	1	0	0	0	1	1	1	0	0
CUMZ-R-2010.07.14,7	22	52	42	0	1	0	1	0	1	1	1	0	0
CUMZ-R-2010.07.14,19	25	56	47	0	1	0	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,56	23	56	45	0	1	0	1	1	0	1	1	0	0
CUMZ-R-2010.07.14,58	22	55	46	0	1	1	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,59	-	59	46	0	1	1	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,61	24	53	43	0	1	0	0	1	0	1	1	0	0
CUMZ-R-2010.07.14,67	24	60	42	0	1	1	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,69	24	60	42	0	1	1	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,70	23	55	44	0	1	0	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,71	22	56	41	0	0	1	0	1	1	1	0	0	0
CUMZ-R-2010.07.14,72	25	59	47	0	1	0	0	0	1	1	1	0	0
CUMZ-R-2010.07.14,73	23	56	41	0	1	0	0	1	1	0	1	0	0
CUMZ-R-2010.07.14,80	25	62	49	1	1	0	0	1	1	1	1	1	1
CUMZ-R-2010.07.14,82	24	62	46	0	1	0	1	0	1	1	1	0	1
CUMZ-R-2010.07.14,83	26	64	46	0	1	0	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,88	24	62	48	1	1	0	0	1	1	1	1	1	1
CUMZ-R-2010.07.14,90	26	58	46	0	1	1	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,91	26	61	49	1	1	0	1	1	1	1	1	1	1
CUMZ-R-2010.07.14,93	27	63	46	0	1	0	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,94	26	58	43	0	1	0	1	0	1	1	1	0	1
CUMZ-R-2010.07.14,95	24	60	46	0	1	1	1	1	1	1	1	1	1

Note: 0 = Absence, 1 = Present

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	Locality	Date of collection	Sex	Maturity	EyeEar	HeadH	HeadL	HeadW	InterOrb	JawW	NarEye	SnEye	SnW	SP
CUMZ-R-2010.07.14,97	Krabi	25 Jan 09	Male	Mature	7.04	15.72	22.87	23.48	9.70	15.25	4.76	8.66	5.78	17.47
CUMZ-R-2010.07.14,98	Krabi	25 Jan 09	Male	Mature	5.92	13.03	20.48	17.38	8.23	13.78	4.32	8.07	5.75	15.70
CUMZ-R-2010.07.14,100	Krabi	25 Jan 09	Male	Mature	6.91	14.80	21.65	21.52	9.47	15.95	5.14	9.08	5.71	16.66
CUMZ-R-2010.07.14,111	Ranong	26 Jan 09	Female	Imature	4.84	12.77	19.16	15.08	9.16	14.20	5.28	8.66	4.88	16.16
CUMZ-R-2010.07.14,114	Ranong	26 Jan 09	Female	Imature	4.57	11.77	18.65	15.52	8.86	13.94	4.65	8.71	5.02	15.69
CUMZ-R-2010.07.14,118	Songkla	27 Mar 09	Male	Mature	6.25	15.25	20.95	20.44	8.60	14.21	4.48	8.70	5.27	16.36
CUMZ-R-2010.07.14,119	Songkla	27 Mar 09	Male	Mature	7.10	16.40	22.93	21.74	9.21	15.05	5.37	9.03	5.60	17.00
CUMZ-R-2010.07.14,120	Songkla	27 Mar 09	Female	Mature	4.27	10.55	15.90	12.25	6.92	11.10	3.86	7.18	4.04	13.40
CUMZ-R-2010.07.14,121	Songkla	27 Mar 09	Female	Mature	4.33	9.86	16.12	12.43	6.80	11.17	3.56	6.97	4.75	13.70
CUMZ-R-2010.07.14,122	Songkla	27 Mar 09	Female	Mature	4.12	10.03	15.61	11.45	6.54	10.20	3.60	6.95	4.38	13.42
CUMZ-R-2010.07.14,123	Songkla	27 Mar 09	Male	Mature	5.87	13.70	19.73	19.98	8.06	14.18	4.63	8.55	4.98	15.62
CUMZ-R-2010.07.14,124	Ranong	28 Mar 09	Male	Mature	5.55	12.90	19.44	18.38	8.93	13.08	4.44	8.12	5.06	15.71
CUMZ-R-2010.07.14,125	Ranong	28 Mar 09	Male	Mature	5.37	12.25	18.56	16.55	7.96	12.45	4.21	7.98	5.21	15.16
CUMZ-R-2010.07.14,126	Ranong	28 Mar 09	Male	Mature	5.24	11.70	19.70	16.84	8.56	13.17	4.90	8.78	5.30	15.90
CUMZ-R-2010.07.14,127	Ranong	28 Mar 09	Male	Mature	5.84	12.60	19.50	19.04	7.81	13.90	4.78	8.49	5.05	15.98
CUMZ-R-2010.07.14,128	Ranong	28 Mar 09	Male	Mature	6.45	13.00	21.56	21.83	8.22	14.36	5.34	9.06	4.90	16.70
CUMZ-R-2010.07.14,131	Ranong	28 Mar 09	Female	Mature	4.26	11.26	16.66	11.94	6.86	11.42	4.20	7.46	4.76	14.08
CUMZ-R-2010.07.14,132	Ranong	28 Mar 09	Female	Mature	4.68	11.66	17.53	13.16	7.53	12.09	4.04	7.26	4.53	14.36
CUMZ-R-2010.07.14,133	Ranong	28 Mar 09	Male	Mature	6.88	14.12	21.70	20.70	8.77	14.68	5.09	8.94	5.38	16.76
CUMZ-R-2010.07.14,134	Ranong	28 Mar 09	Female	Mature	4.06	10.03	15.37	12.38	6.30	10.66	3.64	6.73	4.18	13.12
CUMZ-R-2010.07.14,135	Ranong	28 Mar 09	Female	Mature	3.98	10.00	15.48	11.79	6.82	11.04	3.78	7.05	4.24	13.16
CUMZ-R-2010.07.14,136	Ranong	28 Mar 09	Male	Mature	6.19	14.02	20.77	20.38	9.02	15.69	4.86	8.77	5.06	15.86
CUMZ-R-2010.07.14,137	Ranong	28 Mar 09	Female	Mature	4.54	11.33	17.96	13.45	7.69	12.13	4.18	7.73	4.82	15.29
CUMZ-R-2010.07.14,138	Ranong	29 Mar 09	Female	Mature	4.24	10.04	16.21	12.24	7.02	10.40	4.24	7.17	4.38	13.76
CUMZ-R-2010.07.14,140	Ranong	29 Mar 09	Male	Mature	6.12	13.18	20.64	19.04	8.34	14.40	4.48	8.36	5.36	16.55

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	SN	LE	LL	ED	4FingLng	4ToeLng	CrusL	ForefL	HindfL	LoArmL	PectW	Pelvw	SVL	SnForel	Tailthick	TailL
CUMZ-R-2010.07.14,97	3.86	6.72	16.62	4.06	11.00	16.55	19.85	15.66	27.58	14.87	16.87	14.60	94.70	32.40	11.50	26.70
CUMZ-R-2010.07.14,98	3.58	5.40	16.02	3.23	7.14	16.10	18.78	11.19	25.43	14.02	13.89	12.20	85.73	26.87	9.78	24.50
CUMZ-R-2010.07.14,100	4.06	7.10	15.72	3.40	10.84	16.46	19.31	15.09	26.21	14.32	15.58	12.20	89.64	30.50	10.86	-
CUMZ-R-2010.07.14,111	3.48	4.82	14.70	3.36	8.70	14.02	17.25	11.69	23.60	13.90	13.53	13.44	83.81	24.50	8.32	-
CUMZ-R-2010.07.14,114	3.56	5.68	13.96	2.88	8.16	13.27	17.70	12.16	21.86	13.43	11.87	12.96	83.76	24.20	6.90	-
CUMZ-R-2010.07.14,118	3.65	6.68	15.39	3.37	10.16	16.40	19.18	14.92	25.92	15.66	14.74	14.26	87.24	30.38	10.90	25.30
CUMZ-R-2010.07.14,119	3.90	7.05	15.64	3.60	11.00	16.20	20.30	14.86	26.26	15.80	16.72	13.61	86.30	30.65	11.71	25.40
CUMZ-R-2010.07.14,120	2.92	4.56	11.78	2.51	8.51	12.60	16.00	11.44	21.60	12.14	10.84	11.96	70.71	20.26	5.50	20.70
CUMZ-R-2010.07.14,121	3.05	4.42	11.83	2.94	8.14	13.66	15.27	12.51	20.78	11.50	12.89	10.38	71.64	20.75	5.50	-
CUMZ-R-2010.07.14,122	3.25	4.02	11.58	2.38	8.25	12.54	15.00	11.37	19.76	10.30	10.12	11.14	69.32	20.12	5.34	19.30
CUMZ-R-2010.07.14,123	3.61	6.56	13.74	3.34	9.48	15.82	18.66	15.27	25.72	14.37	15.92	13.53	84.86	28.10	10.32	25.70
CUMZ-R-2010.07.14,124	3.84	5.92	14.54	3.27	10.74	15.48	18.81	16.23	25.37	15.03	14.79	12.27	84.03	27.17	9.82	25.80
CUMZ-R-2010.07.14,125	3.63	5.71	13.03	2.85	10.33	15.06	18.74	14.73	26.33	14.42	12.20	10.98	79.20	25.54	9.18	-
CUMZ-R-2010.07.14,126	4.09	5.35	14.90	3.26	10.12	15.36	18.86	13.96	24.42	15.06	13.07	12.24	82.04	27.17	9.50	-
CUMZ-R-2010.07.14,127	3.75	6.07	14.57	3.34	11.36	16.96	18.02	15.62	26.75	14.41	13.04	13.05	80.90	26.54	10.37	25.60
CUMZ-R-2010.07.14,128	3.79	5.95	15.36	2.71	11.16	16.85	19.01	15.98	26.98	14.24	15.04	12.40	86.86	29.91	10.20	25.50
CUMZ-R-2010.07.14,131	3.61	4.27	12.88	2.64	8.88	14.02	15.28	12.96	22.52	12.12	11.12	10.55	70.74	21.21	6.14	-
CUMZ-R-2010.07.14,132	3.24	4.83	12.00	2.38	8.54	14.18	16.55	12.48	23.64	12.43	11.61	10.40	75.04	22.03	5.38	21.00
CUMZ-R-2010.07.14,133	4.10	6.92	15.40	3.19	10.95	16.84	20.20	16.75	27.75	15.28	16.00	13.92	92.14	28.72	11.44	27.00
CUMZ-R-2010.07.14,134	3.25	3.76	11.76	2.25	8.45	12.64	14.89	11.20	20.52	12.32	10.76	10.38	67.36	19.46	5.36	20.10
CUMZ-R-2010.07.14,135	3.26	4.08	11.88	2.26	8.26	12.82	14.53	11.38	21.06	11.42	10.20	9.51	65.30	19.70	5.48	17.40
CUMZ-R-2010.07.14,136	3.75	6.10	14.96	3.93	10.10	14.90	18.28	14.97	24.80	14.80	15.50	12.06	81.95	28.88	10.72	-
CUMZ-R-2010.07.14,137	3.37	4.99	13.71	2.65	8.92	13.98	16.31	13.05	22.14	12.20	12.48	12.60	77.62	22.94	7.30	-
CUMZ-R-2010.07.14,138	3.43	4.68	12.37	2.36	8.10	13.07	15.39	11.56	20.98	11.86	10.24	11.10	71.56	20.64	5.75	20.30
CUMZ-R-2010.07.14,140	4.04	6.15	14.87	3.04	9.82	15.64	18.53	14.48	23.82	14.97	14.54	12.54	84.75	28.68	10.06	23.60

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	TailW	TrunkL	UpArmL	UpLegL	TL	VentW	CanthR	Eyelid	HeadSLn	HeadSTr	Inflab	SnS	Suplab	GuS	4FingLm
CUMZ-R-2010.07.14,97	11.29	44.85	16.02	24.44	36.10	9.74	8	11	12	16	8	6	9	10	23
CUMZ-R-2010.07.14,98	10.54	41.05	14.50	20.90	33.10	7.50	8	10	13	13	10	7	10	10	20
CUMZ-R-2010.07.14,100	10.10	41.57	14.79	20.82	-	8.55	7	9	15	12	10	7	9	11	21
CUMZ-R-2010.07.14,111	11.28	39.34	13.14	19.36	-	7.94	8	9	13	14	11	6	10	13	18
CUMZ-R-2010.07.14,114	9.50	43.48	13.80	19.22	-	7.39	8	9	16	13	9	7	10	11	20
CUMZ-R-2010.07.14,118	11.61	42.93	17.26	21.86	34.40	8.55	8	11	14	14	9	7	9	10	20
CUMZ-R-2010.07.14,119	12.32	40.50	16.63	22.78	34.30	9.72	8	9	14	12	9	6	9	10	21
CUMZ-R-2010.07.14,120	8.68	30.16	11.58	17.84	27.80	7.77	8	8	14	12	10	6	9	11	19
CUMZ-R-2010.07.14,121	8.03	34.33	12.10	17.23	-	5.43	7	9	13	13	9	6	9	9	17
CUMZ-R-2010.07.14,122	8.75	34.53	12.24	16.80	26.40	5.40	7	9	13	12	9	6	9	10	18
CUMZ-R-2010.07.14,123	11.30	41.45	14.57	22.06	34.60	9.82	8	8	13	12	9	6	9	9	18
CUMZ-R-2010.07.14,124	10.69	39.62	15.55	20.32	34.10	9.74	9	10	14	13	9	7	10	11	20
CUMZ-R-2010.07.14,125	9.47	37.35	13.88	20.14	-	7.75	8	10	15	15	9	6	9	11	21
CUMZ-R-2010.07.14,126	9.38	38.26	15.28	20.83	-	8.35	9	10	13	14	9	7	9	11	22
CUMZ-R-2010.07.14,127	10.71	37.27	15.40	21.02	34.10	8.64	7	10	14	13	8	7	9	11	23
CUMZ-R-2010.07.14,128	10.21	40.10	14.58	21.18	34.20	9.06	8	11	14	11	9	6	9	10	20
CUMZ-R-2010.07.14,131	7.83	33.10	11.00	17.29	-	6.78	8	10	15	14	10	6	10	12	19
CUMZ-R-2010.07.14,132	8.10	33.67	12.52	18.18	28.60	6.60	7	9	13	15	9	7	10	12	21
CUMZ-R-2010.07.14,133	10.16	42.25	15.35	22.51	36.30	8.81	8	9	14	11	9	6	10	12	19
CUMZ-R-2010.07.14,134	7.93	34.48	11.76	16.72	26.90	5.68	8	8	13	13	9	7	9	12	19
CUMZ-R-2010.07.14,135	7.38	31.10	11.98	15.98	23.90	6.30	8	8	15	13	9	7	9	10	20
CUMZ-R-2010.07.14,136	10.98	37.37	14.18	20.30	-	9.54	8	11	14	13	9	7	10	12	20
CUMZ-R-2010.07.14,137	8.54	37.18	12.66	18.30	-	6.87	8	10	17	16	10	7	9	11	20
CUMZ-R-2010.07.14,138	8.07	34.47	11.53	16.72	27.60	6.87	8	10	12	13	10	7	9	13	19
CUMZ-R-2010.07.14,140	10.37	39.96	14.60	20.56	32.20	8.62	8	11	15	14	10	7	10	13	20

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	ToeLm	ventS	Midbody	CheekCol	CheekSt	DorsSt	ForearSt	NucSpot	TrnkBand	MidvLine	ThroatSt	ThroatPa	TrunkSt
CUMZ-R-2010.07.14,97	28	57	47	1	1	0	0	0	1	1	1	1	0
CUMZ-R-2010.07.14,98	24	61	46	1	1	0	0	0	1	1	1	1	0
CUMZ-R-2010.07.14,100	25	58	45	0	1	0	1	1	1	1	1	1	1
CUMZ-R-2010.07.14,111	24	60	49	0	1	1	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,114	26	53	44	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,118	24	56	43	0	1	0	0	1	1	1	1	1	1
CUMZ-R-2010.07.14,119	22	54	39	0	1	0	0	0	1	1	1	1	0
CUMZ-R-2010.07.14,120	25	55	43	0	1	1	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,121	23	57	42	0	1	0	0	1	1	1	1	0	1
CUMZ-R-2010.07.14,122	23	54	48	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,123	23	58	43	0	1	0	0	0	1	1	1	1	1
CUMZ-R-2010.07.14,124	24	58	41	0	1	0	0	1	1	1	1	1	1
CUMZ-R-2010.07.14,125	27	60	44	0	1	0	0	0	1	1	1	1	1
CUMZ-R-2010.07.14,126	27	53	44	0	1	0	0	0	1	1	1	0	1
CUMZ-R-2010.07.14,127	27	62	43	0	1	0	0	0	1	1	1	1	1
CUMZ-R-2010.07.14,128	26	56	43	0	1	0	0	1	1	1	1	1	0
CUMZ-R-2010.07.14,131	25	54	39	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,132	28	62	45	0	1	0	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,133	24	60	41	0	1	0	0	0	1	1	1	1	0
CUMZ-R-2010.07.14,134	24	55	41	0	1	1	0	1	1	1	1	0	1
CUMZ-R-2010.07.14,135	24	60	44	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,136	24	64	44	0	1	0	0	0	1	1	1	0	1
CUMZ-R-2010.07.14,137	24	66	44	0	1	1	0	1	1	1	1	0	1
CUMZ-R-2010.07.14,138	24	59	43	0	1	1	0	1	1	1	1	0	1
CUMZ-R-2010.07.14,140	23	56	43	0	1	0	1	0	1	1	1	0	1

Note: 0 = Absence, 1 = Present

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	Locality	Date of collection	Sex	Maturity	EyeEar	HeadH	HeadL	HeadW	InterOrb	JawW	NarEye	SnEye	SnW	SP
CUMZ-R-2010.07.14,141	Ranong	29 Mar 09	Male	Mature	6.35	13.13	21.07	20.89	9.05	13.86	5.01	9.05	5.08	16.36
CUMZ-R-2010.07.14,142	Ranong	29 Mar 09	Male	Mature	5.93	13.70	20.26	19.33	8.48	13.70	5.26	9.24	5.36	16.12
CUMZ-R-2010.07.14,143	Ranong	29 Mar 09	Female	Mature	4.20	10.21	16.88	12.62	7.06	11.04	4.03	7.42	4.38	14.00
CUMZ-R-2010.07.14,144	Ranong	29 Mar 09	Female	Mature	4.58	11.21	17.44	13.55	7.23	11.76	4.22	7.70	4.48	14.87
CUMZ-R-2010.07.14,147	Songkla	30 Mar 09	Female	Mature	4.30	10.77	16.10	13.20	7.14	11.30	3.70	7.93	4.60	13.62
CUMZ-R-2010.07.14,148	Songkla	30 Mar 09	Female	Mature	4.54	11.00	17.20	13.82	7.28	11.52	4.16	7.14	4.54	14.11
CUMZ-R-2010.07.14,149	Songkla	30 Mar 09	Male	Mature	6.84	14.91	22.18	22.22	9.35	14.75	4.71	9.04	5.51	17.10
CUMZ-R-2010.07.14,150	Krabi	15 Apr 09	Female	Mature	4.73	10.50	17.06	13.42	7.20	11.70	4.20	7.73	4.74	13.96
CUMZ-R-2010.07.14,151	Krabi	15 Apr 09	Female	Mature	4.32	9.67	16.43	11.70	7.04	10.54	3.52	7.06	5.25	13.86
CUMZ-R-2010.07.14,152	Krabi	15 Apr 09	Female	Mature	4.80	11.25	17.93	15.04	7.72	12.20	4.20	8.07	5.40	14.84
CUMZ-R-2010.07.14,153	Krabi	15 Apr 09	Female	Mature	5.03	12.24	19.74	13.59	8.70	13.46	3.70	8.05	5.70	16.34
CUMZ-R-2010.07.14,154	Krabi	15 Apr 09	Female	Mature	5.53	11.78	19.87	15.22	8.73	13.37	4.46	8.50	5.54	16.20
CUMZ-R-2010.07.14,155	Krabi	15 Apr 09	Female	Mature	4.86	10.87	17.40	13.69	7.40	12.00	3.68	7.12	5.10	14.45
CUMZ-R-2010.07.14,156	Krabi	15 Apr 09	Female	Mature	5.04	11.69	18.16	12.80	7.29	11.30	3.90	7.86	5.10	14.70
CUMZ-R-2010.07.14,157	Krabi	15 Apr 09	Female	Mature	4.48	9.76	16.85	11.69	7.70	10.93	3.94	7.64	4.95	14.00
CUMZ-R-2010.07.14,158	Chiang Mai	7 May 09	Female	Mature	4.90	11.60	19.20	15.88	7.94	12.48	4.42	8.37	4.76	15.40
CUMZ-R-2010.07.14,161	Chiang Mai	7 May 09	Female	Mature	4.46	10.20	17.22	12.66	6.88	10.92	3.86	7.33	4.22	14.16
CUMZ-R-2010.07.14,163	Chiang Mai	7 May 09	Female	Mature	4.42	10.80	17.86	12.87	7.86	11.57	4.21	7.34	4.87	13.86
CUMZ-R-2010.07.14,164	Chiang Mai	7 May 09	Male	Mature	6.20	13.78	20.46	13.14	8.25	13.86	4.43	8.14	5.74	15.85
CUMZ-R-2010.07.14,166	Chiang Mai	7 May 09	Female	Mature	4.55	10.50	18.54	12.83	7.40	12.26	4.12	7.96	4.87	15.80
CUMZ-R-2010.07.14,167	Chiang Mai	7 May 09	Female	Mature	4.80	10.96	18.18	14.37	7.46	12.04	4.20	8.04	4.83	15.36
CUMZ-R-2010.07.14,225	Chiang Mai	7 May 09	Male	Mature	5.04	11.74	17.86	14.20	7.25	11.70	4.10	7.52	4.20	15.00
CUMZ-R-2010.07.14,226	Chiang Mai	7 May 09	Male	Mature	5.84	11.68	20.56	15.40	8.00	11.84	4.57	8.70	5.00	15.80
CUMZ-R-2010.07.14,227	Chiang Mai	7 May 09	Male	Mature	6.32	13.14	20.38	16.62	8.10	13.64	4.75	8.44	4.74	17.32
CUMZ-R-2010.07.14,228	Chiang Mai	7 May 09	Male	Mature	5.78	12.77	19.06	16.72	8.30	13.84	4.38	8.04	4.93	16.54

Specimen and Morphological data of garden fence lizard (Cont.)

Number	SN	LE	LL	ED	4FingLng	4ToeLng	CrusL	ForefL	HindfL	LoArmL	PectW	Pelvw	SVL	SnForel	Tailthick	TailL
CUMZ-R-2010.07.14,141	4.20	6.10	15.44	3.40	10.21	15.28	18.13	14.48	25.50	15.26	14.80	12.62	85.65	29.50	11.10	26.20
CUMZ-R-2010.07.14,142	3.93	5.76	14.36	3.20	10.26	15.20	17.52	14.80	23.97	14.37	14.68	12.12	85.74	26.54	10.33	23.70
CUMZ-R-2010.07.14,143	3.56	4.42	12.91	2.47	8.48	13.61	16.10	11.87	22.48	12.53	12.16	11.27	72.88	21.45	6.57	20.90
CUMZ-R-2010.07.14,144	3.22	4.46	13.37	2.80	8.54	13.33	15.70	12.74	21.02	12.27	10.98	11.37	76.53	21.58	6.20	-
CUMZ-R-2010.07.14,147	3.23	5.20	11.37	2.61	7.97	12.72	15.10	12.04	21.09	11.36	11.94	10.90	70.87	20.44	5.82	25.00
CUMZ-R-2010.07.14,148	3.52	4.71	12.70	2.69	8.50	13.57	16.30	11.37	21.84	13.56	12.50	10.15	77.72	21.61	6.40	21.50
CUMZ-R-2010.07.14,149	4.00	7.02	15.20	3.06	10.08	16.36	19.13	14.07	26.65	14.91	16.00	14.09	86.20	31.20	10.80	25.40
CUMZ-R-2010.07.14,150	3.73	4.69	13.03	2.72	7.94	13.27	15.82	11.40	21.47	11.54	11.38	11.76	73.66	21.77	6.20	19.70
CUMZ-R-2010.07.14,151	3.21	4.55	12.00	2.22	8.46	13.78	15.40	13.00	21.95	11.17	11.37	10.23	71.24	20.77	5.54	-
CUMZ-R-2010.07.14,152	3.54	4.76	13.60	2.70	8.50	13.80	15.44	12.00	21.66	12.33	12.40	12.12	77.42	22.58	7.02	-
CUMZ-R-2010.07.14,153	3.88	4.86	14.85	3.00	8.05	13.40	17.35	11.78	21.31	13.06	13.39	12.91	82.11	25.08	7.20	-
CUMZ-R-2010.07.14,154	4.09	5.25	15.00	3.06	8.10	13.88	16.42	11.43	22.20	12.63	13.93	13.44	82.91	24.84	7.00	23.80
CUMZ-R-2010.07.14,155	3.08	5.00	12.90	2.86	8.46	-	16.40	11.62	-	12.78	13.20	11.85	81.70	24.04	6.60	23.00
CUMZ-R-2010.07.14,156	3.60	4.69	14.03	2.95	8.88	14.16	15.70	13.50	23.62	13.50	13.04	11.03	78.78	23.20	6.68	22.20
CUMZ-R-2010.07.14,157	3.37	4.24	12.72	2.41	8.17	12.84	14.16	10.04	20.26	11.93	11.86	10.05	75.15	21.20	6.16	20.40
CUMZ-R-2010.07.14,158	3.52	5.13	14.16	2.84	9.40	13.14	17.37	12.90	22.37	14.40	13.32	11.82	82.33	24.70	6.88	-
CUMZ-R-2010.07.14,161	3.28	4.50	13.34	2.88	8.73	12.85	15.80	11.72	21.06	13.00	13.06	11.83	74.54	21.70	6.37	18.90
CUMZ-R-2010.07.14,163	3.44	5.02	13.26	2.88	8.18	13.06	16.30	12.76	21.96	12.90	13.60	11.34	81.44	22.36	6.30	22.10
CUMZ-R-2010.07.14,164	4.04	5.86	14.96	3.50	10.49	15.73	17.94	14.58	24.78	13.96	14.69	12.50	89.62	28.38	10.00	25.20
CUMZ-R-2010.07.14,166	3.76	4.86	14.05	2.78	8.06	13.00	16.30	12.18	21.90	13.46	12.90	12.04	80.75	23.74	6.86	-
CUMZ-R-2010.07.14,167	3.86	4.78	13.70	2.55	9.25	14.28	17.00	13.52	23.44	13.44	13.86	12.95	81.52	23.04	6.72	22.50
CUMZ-R-2010.07.14,225	3.33	5.10	13.54	3.14	9.06	13.63	17.02	12.02	21.96	13.20	12.78	10.47	79.30	23.12	8.93	-
CUMZ-R-2010.07.14,226	4.10	5.52	15.14	3.32	8.92	14.44	19.00	13.34	24.70	14.91	13.57	10.52	83.40	27.04	9.82	-
CUMZ-R-2010.07.14,227	3.34	6.53	14.74	2.95	-	14.93	17.92	-	23.88	14.17	13.60	11.38	86.30	27.50	10.37	-
CUMZ-R-2010.07.14,228	3.49	5.65	13.58	2.88	9.50	14.50	18.52	13.58	23.40	13.96	13.70	11.30	82.38	24.96	10.28	-

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	TailW	TrunkL	UpArmL	UpLegL	TL	VentW	CanthR	Eyelid	HeadSLn	HeadSTr	Inflab	SnS	Suplab	GuS	4FingLm
CUMZ-R-2010.07.14,141	10.81	38.00	13.85	18.54	34.70	9.60	8	9	13	14	9	5	10	12	18
CUMZ-R-2010.07.14,142	9.26	41.11	13.56	19.75	32.30	8.08	8	9	15	15	10	7	10	14	20
CUMZ-R-2010.07.14,143	8.03	35.46	12.38	18.70	28.30	6.56	7	10	15	13	10	6	9	11	19
CUMZ-R-2010.07.14,144	7.72	37.92	11.94	16.60	-	7.20	7	8	15	12	10	7	9	11	20
CUMZ-R-2010.07.14,147	9.23	33.26	12.40	17.36	27.90	8.33	8	10	13	15	11	6	9	11	19
CUMZ-R-2010.07.14,148	9.12	38.58	12.52	18.62	29.20	6.11	7	10	13	13	9	7	10	11	18
CUMZ-R-2010.07.14,149	11.70	39.17	15.39	20.78	34.40	9.86	8	11	14	14	9	6	9	11	20
CUMZ-R-2010.07.14,150	9.84	36.21	12.00	17.10	27.00	7.63	7	8	12	11	9	6	10	11	19
CUMZ-R-2010.07.14,151	7.02	32.92	12.23	16.52	-	5.30	8	11	14	13	9	6	9	11	21
CUMZ-R-2010.07.14,152	9.05	38.38	11.40	17.86	-	7.38	8	10	13	13	9	6	9	9	20
CUMZ-R-2010.07.14,153	9.70	40.51	12.90	19.02	-	8.03	7	10	14	13	9	7	8	11	19
CUMZ-R-2010.07.14,154	10.55	37.60	12.00	18.27	32.20	8.18	7	10	12	11	9	6	10	10	19
CUMZ-R-2010.07.14,155	9.72	39.48	13.10	18.40	31.10	7.48	7	10	11	13	9	6	8	11	20
CUMZ-R-2010.07.14,156	10.87	37.34	12.95	18.47	30.10	9.12	8	12	12	12	9	6	9	10	19
CUMZ-R-2010.07.14,157	8.70	35.55	11.45	17.37	27.70	7.56	7	10	13	14	9	7	10	11	20
CUMZ-R-2010.07.14,158	10.02	40.37	13.80	18.70	-	8.20	9	11	15	13	11	6	10	13	19
CUMZ-R-2010.07.14,161	8.64	33.20	11.63	17.53	26.30	7.12	8	11	14	13	10	7	10	12	19
CUMZ-R-2010.07.14,163	8.72	39.37	13.40	17.08	30.30	7.02	8	9	14	12	9	6	10	11	19
CUMZ-R-2010.07.14,164	9.42	42.95	14.23	20.28	34.20	8.12	8	9	13	12	9	6	9	10	19
CUMZ-R-2010.07.14,166	9.14	37.65	12.83	18.74	-	6.79	7	10	13	13	10	6	10	12	17
CUMZ-R-2010.07.14,167	8.58	38.58	13.49	18.88	30.70	7.42	7	9	14	12	10	6	10	11	19
CUMZ-R-2010.07.14,225	9.14	39.12	13.50	16.84	-	8.18	7	10	14	15	9	6	10	14	19
CUMZ-R-2010.07.14,226	10.00	35.82	13.55	19.90	-	9.53	7	10	12	15	10	7	10	13	21
CUMZ-R-2010.07.14,227	10.72	43.88	14.47	19.43	-	9.73	7	9	12	14	8	6	10	14	-
CUMZ-R-2010.07.14,228	9.23	39.22	12.49	20.18	-	9.08	7	11	12	14	10	6	11	14	21

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	ToeLm	ventS	Midbody	CheekCol	CheekSt	DorsSt	ForearSt	NucSpot	TrnkBand	MidvLine	ThroatSt	ThroatPa	TrunkSt
CUMZ-R-2010.07.14,141	26	58	43	0	1	0	0	0	1	1	1	1	1
CUMZ-R-2010.07.14,142	25	58	46	0	1	0	0	0	1	1	1	0	0
CUMZ-R-2010.07.14,143	24	53	43	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,144	24	59	43	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,147	26	60	44	0	1	1	1	1	1	1	1	1	0
CUMZ-R-2010.07.14,148	24	58	44	1	1	0	0	1	1	1	1	0	1
CUMZ-R-2010.07.14,149	26	59	44	0	1	0	0	1	1	1	1	1	1
CUMZ-R-2010.07.14,150	26	61	47	0	1	1	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,151	27	58	48	0	1	1	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,152	24	60	51	0	1	1	0	1	1	1	1	0	1
CUMZ-R-2010.07.14,153	24	64	48	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,154	23	61	47	0	1	0	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,155	-	63	45	0	1	1	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,156	26	57	44	0	1	1	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,157	25	61	50	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,158	24	59	44	0	1	1	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,161	24	59	45	0	1	1	1	0	1	1	1	0	1
CUMZ-R-2010.07.14,163	24	61	45	0	1	1	0	1	1	1	1	0	1
CUMZ-R-2010.07.14,164	24	55	41	0	1	0	0	0	1	1	1	0	0
CUMZ-R-2010.07.14,166	23	56	46	0	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,167	24	52	44	0	1	1	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,225	23	62	45	0	1	0	0	1	1	1	1	0	1
CUMZ-R-2010.07.14,226	25	57	42	0	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,227	22	59	42	0	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,228	24	65	45	0	1	0	0	0	0	1	1	0	0

Note: 0 = Absence, 1 = Present

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	Locality	Date of collection	Sex	Maturity	EyeEar	HeadH	HeadL	HeadW	InterOrb	JawW	NarEye	SnEye	SnW	SP
CUMZ-R-2010.07.14,169	Mae Hong Son	9 May 09	Male	Mature	5.80	12.90	19.18	19.86	8.40	12.58	4.66	8.06	4.92	15.22
CUMZ-R-2010.07.14,170	Mae Hong Son	9 May 09	Male	Mature	5.90	11.50	19.65	16.04	7.74	12.48	4.28	7.97	4.71	15.98
CUMZ-R-2010.07.14,171	Mae Hong Son	9 May 09	Male	Mature	5.46	12.25	19.55	17.03	8.26	13.71	4.52	8.45	4.80	16.04
CUMZ-R-2010.07.14,172	Mae Hong Son	9 May 09	Male	Mature	4.70	11.12	17.88	14.38	7.14	12.43	4.05	7.56	4.50	14.66
CUMZ-R-2010.07.14,173	Mae Hong Son	9 May 09	Female	Mature	4.20	10.42	15.46	12.30	6.38	10.68	3.58	6.43	4.36	13.14
CUMZ-R-2010.07.14,174	Mae Hong Son	9 May 09	Male	Mature	4.80	11.66	17.87	16.60	7.42	12.24	4.34	7.55	4.12	14.78
CUMZ-R-2010.07.14,175	Mae Hong Son	9 May 09	Male	Mature	5.38	11.10	18.52	16.13	7.70	12.90	4.31	7.42	4.54	14.94
CUMZ-R-2010.07.14,176	Mae Hong Son	9 May 09	Male	Mature	5.50	11.70	19.02	16.75	7.92	12.97	4.51	8.21	4.42	15.46
CUMZ-R-2010.07.14,177	Mae Hong Son	9 May 09	Male	Mature	5.54	11.62	19.36	15.82	7.90	12.40	4.86	8.50	4.70	15.36
CUMZ-R-2010.07.14,178	Mae Hong Son	9 May 09	Female	Mature	4.55	10.58	14.42	13.68	7.90	12.30	4.08	8.05	4.70	15.37
CUMZ-R-2010.07.14,179	Mae Hong Son	9 May 09	Male	Mature	4.88	11.59	17.87	14.87	7.42	11.54	4.10	7.66	4.52	14.55
CUMZ-R-2010.07.14,180	Mae Hong Son	9 May 09	Female	Mature	4.27	10.40	16.95	14.86	6.86	11.10	4.00	7.71	4.70	14.75
CUMZ-R-2010.07.14,181	Mae Hong Son	9 May 09	Male	Mature	5.22	11.58	17.94	17.26	8.06	12.31	4.25	7.38	4.36	14.83
CUMZ-R-2010.07.14,182	Mae Hong Son	9 May 09	Female	Mature	4.20	13.20	14.42	11.70	6.56	11.10	4.04	6.66	4.36	13.36
CUMZ-R-2010.07.14,183	Mae Hong Son	9 May 09	Female	Mature	4.28	9.37	15.21	11.86	6.49	10.72	3.68	6.77	3.91	12.90
CUMZ-R-2010.07.14,184	Mae Hong Son	9 May 09	Female	Mature	4.19	9.87	16.46	12.35	6.60	10.70	3.96	7.26	4.37	13.87
CUMZ-R-2010.07.14,185	Mae Hong Son	9 May 09	Female	Mature	4.42	11.08	16.38	12.55	6.56	10.73	4.03	7.27	4.71	13.96
CUMZ-R-2010.07.14,186	Mae Hong Son	9 May 09	Female	Mature	4.53	10.88	17.70	12.87	6.70	11.83	3.92	7.84	4.95	14.46
CUMZ-R-2010.07.14,187	Mae Hong Son	9 May 09	Female	Mature	4.14	10.38	16.04	12.36	6.60	10.60	3.70	7.12	4.06	13.58
CUMZ-R-2010.07.14,188	Mae Hong Son	9 May 09	Female	Mature	4.74	11.04	18.44	14.46	8.22	12.80	4.70	8.20	4.54	16.05
CUMZ-R-2010.07.14,195	Songkla	15 Jun 09	Female	Mature	4.80	10.74	18.46	13.90	7.66	12.22	4.06	7.88	4.68	15.27
CUMZ-R-2010.07.14,196	Songkla	15 Jun 09	Female	Mature	4.48	11.12	16.92	13.66	7.37	12.14	3.87	7.54	4.66	14.94
CUMZ-R-2010.07.14,197	Songkla	15 Jun 09	Female	Mature	4.20	10.12	17.58	13.60	7.68	12.38	3.77	7.35	4.65	14.74
CUMZ-R-2010.07.14,199	Songkla	15 Jun 09	Female	Mature	4.52	10.48	17.14	12.76	6.62	11.82	3.68	7.00	4.20	14.70
CUMZ-R-2010.07.14,200	Nan	18 Jun 09	Female	Mature	4.42	11.95	17.21	14.20	7.30	11.88	4.12	7.24	4.36	15.60

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	SN	LE	LL	ED	4FingLng	4ToeLng	CrusL	ForefL	HindfL	LoArmL	PectW	Pelvw	SVL	SnForel	Tailthick	TailL
CUMZ-R-2010.07.14,169	3.56	5.64	13.73	2.97	9.90	13.33	17.36	13.25	21.48	14.24	14.24	12.95	79.60	25.56	10.00	-
CUMZ-R-2010.07.14,170	3.20	5.58	14.54	3.00	9.65	15.48	19.53	13.22	25.20	14.38	15.33	11.33	82.36	26.70	11.22	22.50
CUMZ-R-2010.07.14,171	3.57	5.27	14.86	3.08	9.38	14.50	18.50	13.12	24.17	14.36	13.69	11.86	83.38	26.21	11.03	23.20
CUMZ-R-2010.07.14,172	3.23	4.65	13.38	2.76	9.15	13.77	17.70	12.25	22.42	13.70	12.54	10.46	76.86	23.10	9.37	21.10
CUMZ-R-2010.07.14,173	3.04	4.32	11.82	2.38	8.28	11.96	14.33	11.03	19.50	11.41	11.07	10.74	67.36	20.04	5.37	17.00
CUMZ-R-2010.07.14,174	3.00	4.79	13.42	2.71	8.80	13.80	16.72	13.15	21.02	12.03	13.38	11.33	76.16	23.72	9.20	21.00
CUMZ-R-2010.07.14,175	3.37	5.54	13.94	2.55	9.00	14.00	17.70	12.46	23.30	14.20	12.44	11.21	77.42	24.18	9.96	21.20
CUMZ-R-2010.07.14,176	3.30	4.73	14.86	3.05	9.86	14.82	18.21	13.80	24.11	14.36	13.22	11.26	79.02	24.43	9.44	23.30
CUMZ-R-2010.07.14,177	3.60	4.85	14.85	2.55	10.46	15.89	17.53	14.70	25.12	14.26	14.38	11.23	79.53	25.87	9.50	-
CUMZ-R-2010.07.14,178	3.55	4.37	14.13	2.72	8.76	12.84	16.20	11.76	20.80	13.00	12.67	12.45	80.12	22.40	6.70	-
CUMZ-R-2010.07.14,179	3.36	4.70	13.56	2.57	9.33	14.14	17.13	12.24	23.36	13.75	13.56	10.74	76.38	24.90	8.12	23.00
CUMZ-R-2010.07.14,180	3.68	4.52	13.04	2.50	7.32	11.84	15.84	11.40	20.04	12.63	14.40	11.82	75.27	22.20	6.84	19.70
CUMZ-R-2010.07.14,181	3.48	5.03	13.37	2.70	9.26	13.66	16.74	12.96	22.43	13.21	12.45	11.40	77.36	23.96	8.28	-
CUMZ-R-2010.07.14,182	3.11	4.75	11.53	2.28	7.72	11.96	14.86	10.24	18.80	11.50	11.72	10.20	70.71	20.03	5.70	17.50
CUMZ-R-2010.07.14,183	3.04	4.18	11.28	2.20	7.84	12.38	14.78	11.34	20.30	11.92	11.53	10.68	68.43	19.40	6.15	-
CUMZ-R-2010.07.14,184	3.10	3.94	13.05	2.28	8.13	12.25	15.30	11.46	20.46	12.20	12.04	11.14	72.64	20.40	5.75	18.30
CUMZ-R-2010.07.14,185	3.50	4.36	12.50	2.35	8.52	13.60	15.47	11.89	21.85	12.72	11.10	11.45	71.85	20.78	6.42	18.40
CUMZ-R-2010.07.14,186	3.92	4.54	13.70	2.78	9.42	14.11	17.07	12.74	23.18	12.91	11.80	12.88	76.54	22.60	6.44	21.20
CUMZ-R-2010.07.14,187	3.14	4.21	12.06	2.58	7.44	11.56	14.80	11.18	18.86	12.10	11.34	11.44	69.88	20.08	6.30	-
CUMZ-R-2010.07.14,188	3.56	4.80	14.24	2.70	8.50	12.88	16.30	11.70	20.62	13.16	12.86	12.40	80.80	24.06	6.62	-
CUMZ-R-2010.07.14,195	3.78	5.04	13.92	2.60	8.68	13.06	16.46	12.22	21.58	15.00	11.75	10.84	79.53	23.60	6.33	21.90
CUMZ-R-2010.07.14,196	3.37	3.80	13.03	2.65	8.87	14.00	16.90	12.22	22.36	13.30	12.14	12.13	77.84	21.00	6.54	21.70
CUMZ-R-2010.07.14,197	3.44	4.68	13.23	2.90	8.34	12.82	15.88	11.60	21.26	12.61	12.56	12.54	79.42	22.04	5.86	21.90
CUMZ-R-2010.07.14,199	3.15	4.84	12.34	2.54	8.32	13.02	15.46	11.83	20.88	11.80	11.53	11.02	74.70	21.12	6.18	19.30
CUMZ-R-2010.07.14,200	3.21	4.78	12.70	2.88	8.26	13.80	17.12	11.70	23.12	12.70	13.50	12.24	84.34	21.21	6.50	28.00

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	TailW	TrunkL	UpArmL	UpLegL	TL	VentW	CanthR	Eyelid	HeadSLn	HeadSTr	Inflab	SnS	Suplab	GuS	4FingLm
CUMZ-R-2010.07.14,169	10.36	37.67	13.85	19.84	-	9.00	8	10	14	13	9	6	10	12	20
CUMZ-R-2010.07.14,170	11.40	37.20	14.76	20.94	30.70	10.11	8	9	14	12	9	6	9	11	19
CUMZ-R-2010.07.14,171	10.54	41.42	14.08	19.27	31.50	9.06	9	11	14	11	10	7	9	12	18
CUMZ-R-2010.07.14,172	9.30	35.48	13.46	19.04	28.70	7.74	9	10	13	13	9	7	9	11	21
CUMZ-R-2010.07.14,173	8.50	34.14	10.90	17.13	23.60	7.70	8	10	16	11	10	6	10	11	20
CUMZ-R-2010.07.14,174	9.37	34.54	13.47	19.20	28.60	8.26	7	12	11	14	9	6	9	11	19
CUMZ-R-2010.07.14,175	10.30	36.22	14.16	19.53	29.00	9.20	8	12	15	14	9	6	10	11	20
CUMZ-R-2010.07.14,176	10.45	36.36	14.74	19.08	31.20	9.54	8	8	13	13	10	6	10	11	19
CUMZ-R-2010.07.14,177	11.02	38.78	14.16	19.70	-	9.09	8	11	14	13	10	7	10	11	21
CUMZ-R-2010.07.14,178	9.63	39.73	12.72	17.54	-	7.72	8	9	14	12	8	6	9	10	18
CUMZ-R-2010.07.14,179	9.76	34.24	13.78	18.23	30.70	8.50	7	11	14	12	9	6	11	10	21
CUMZ-R-2010.07.14,180	9.38	39.68	11.70	17.23	27.20	7.88	8	11	14	13	10	6	10	12	18
CUMZ-R-2010.07.14,181	10.68	35.70	13.29	19.17	-	8.94	8	10	13	13	9	6	10	11	20
CUMZ-R-2010.07.14,182	8.55	33.26	12.03	17.18	24.50	6.40	8	8	11	12	8	6	9	9	17
CUMZ-R-2010.07.14,183	8.57	31.54	12.38	16.70	-	6.82	8	9	12	13	8	6	10	12	18
CUMZ-R-2010.07.14,184	7.78	34.64	12.55	16.07	25.60	6.26	8	11	14	12	10	6	10	12	19
CUMZ-R-2010.07.14,185	8.59	34.77	11.72	16.79	25.60	6.46	8	9	13	11	9	7	9	11	21
CUMZ-R-2010.07.14,186	8.24	38.53	12.28	18.73	28.90	6.92	8	8	15	12	10	6	11	13	20
CUMZ-R-2010.07.14,187	8.58	31.14	11.18	16.66	-	7.56	8	10	14	19	9	6	9	10	17
CUMZ-R-2010.07.14,188	9.40	38.45	12.88	18.45	-	7.38	8	10	11	13	10	6	10	10	18
CUMZ-R-2010.07.14,195	9.81	40.20	13.88	19.00	29.80	5.20	7	9	12	11	9	6	9	11	20
CUMZ-R-2010.07.14,196	9.08	38.92	13.05	18.76	29.40	6.11	8	9	13	14	10	6	9	11	21
CUMZ-R-2010.07.14,197	9.44	38.04	12.26	18.22	29.70	6.00	8	11	12	14	9	6	9	11	20
CUMZ-R-2010.07.14,199	8.37	37.46	11.86	17.69	26.70	6.76	7	10	13	13	9	7	9	9	18
CUMZ-R-2010.07.14,200	10.28	43.56	13.54	18.55	29.20	8.26	9	9	14	12	9	6	10	9	19

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	ToeLm	ventS	Midbody	CheekCol	CheekSt	DorsSt	ForearSt	NucSpot	TrnkBand	MidvLine	ThroatSt	ThroatPa	TrunkSt
CUMZ-R-2010.07.14,169	23	55	43	1	1	0	0	0	1	1	1	1	1
CUMZ-R-2010.07.14,170	23	54	41	0	1	0	0	0	0	1	1	0	1
CUMZ-R-2010.07.14,171	23	61	44	1	1	0	0	0	0	1	1	0	0
CUMZ-R-2010.07.14,172	26	52	45	0	1	0	0	0	0	1	1	0	1
CUMZ-R-2010.07.14,173	22	52	41	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,174	23	58	42	0	1	0	0	0	0	1	1	0	0
CUMZ-R-2010.07.14,175	23	61	45	1	1	0	0	0	1	1	1	1	1
CUMZ-R-2010.07.14,176	25	55	42	1	1	0	0	0	0	1	1	0	1
CUMZ-R-2010.07.14,177	26	61	46	0	1	0	0	0	1	1	1	1	1
CUMZ-R-2010.07.14,178	21	55	43	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,179	25	56	42	1	1	0	0	0	0	1	1	1	1
CUMZ-R-2010.07.14,180	21	52	43	0	1	1	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,181	24	56	43	0	1	0	0	0	0	1	1	0	1
CUMZ-R-2010.07.14,182	21	52	42	0	1	1	1	0	1	1	1	0	1
CUMZ-R-2010.07.14,183	23	55	44	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,184	24	59	48	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,185	25	53	42	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,186	24	56	44	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,187	21	51	43	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,188	23	52	45	1	1	0	1	1	1	1	1	1	0
CUMZ-R-2010.07.14,195	25	56	40	1	1	0	0	0	1	1	1	0	1
CUMZ-R-2010.07.14,196	26	57	43	0	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,197	24	56	41	0	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,199	25	57	45	1	1	1	1	0	1	1	1	0	1
CUMZ-R-2010.07.14,200	24	63	45	0	1	0	0	0	1	1	1	0	1

Note: 0 = Absence, 1 = Present

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	Locality	Date of collection	Sex	Maturity	EyeEar	HeadH	HeadL	HeadW	InterOrb	JawW	NarEye	SnEye	SnW	SP
CUMZ-R-2010.07.14,201	Nan	18 Jun 09	Female	Mature	4.06	12.72	16.40	14.08	7.29	11.98	3.45	7.04	4.70	14.96
CUMZ-R-2010.07.14,202	Nan	18 Jun 09	Female	Mature	4.38	13.83	17.82	15.20	7.90	13.22	4.02	7.58	4.73	15.28
CUMZ-R-2010.07.14,203	Nan	18 Jun 09	Female	Mature	4.45	13.00	17.90	16.10	8.32	13.45	4.20	7.79	5.19	15.44
CUMZ-R-2010.07.14,204	Nan	18 Jun 09	Female	Mature	4.96	12.20	19.04	15.32	7.72	12.87	4.38	8.61	4.62	17.44
CUMZ-R-2010.07.14,205	Nan	18 Jun 09	Female	Mature	4.53	11.70	17.50	14.06	7.20	12.74	4.00	7.56	4.50	15.54
CUMZ-R-2010.07.14,206	Nan	29 Aug 09	Female	Mature	4.17	14.06	16.75	12.88	7.22	11.96	3.69	7.34	4.88	14.62
CUMZ-R-2010.07.14,207	Nan	29 Aug 09	Female	Mature	4.62	13.50	17.08	15.20	7.58	13.08	4.22	7.87	4.47	14.88
CUMZ-R-2010.07.14,208	Nan	29 Aug 09	Male	Mature	6.20	13.66	22.10	17.65	8.80	15.64	4.70	8.36	5.36	18.14
CUMZ-R-2010.07.14,209	Nan	30 Aug 09	Male	Mature	5.34	13.58	21.12	16.12	8.30	14.74	4.52	8.68	5.15	16.08
CUMZ-R-2010.07.14,210	Nan	30 Aug 09	Male	Mature	5.34	13.05	19.24	18.37	8.88	14.70	4.28	7.98	5.38	16.93
CUMZ-R-2010.07.14,213	Nan	30 Aug 09	Male	Mature	6.09	14.92	20.55	18.50	9.44	13.91	4.62	8.70	4.98	16.42
CUMZ-R-2010.07.14,214	Nan	30 Aug 09	Male	Mature	4.90	11.80	18.98	13.81	7.84	13.36	4.30	7.90	4.82	16.98
CUMZ-R-2010.07.14,215	Nan	30 Aug 09	Male	Mature	6.62	12.04	20.20	15.42	8.16	13.42	4.11	8.47	5.03	16.73
CUMZ-R-2010.07.14,216	Nan	30 Aug 09	Male	Mature	5.64	13.13	20.86	16.16	8.12	14.68	4.44	8.57	5.37	16.46
CUMZ-R-2010.07.14,217	Nan	31 Aug 09	Male	Mature	5.92	13.88	20.00	17.42	9.03	14.70	4.80	8.70	5.37	16.56
CUMZ-R-2010.07.14,218	Nan	31 Aug 09	Male	Mature	5.34	12.28	19.28	15.12	8.08	13.54	4.31	7.96	5.17	15.53
CUMZ-R-2010.07.14,220	Songkla	2 Sep 09	Male	Mature	5.63	14.48	19.70	16.10	8.96	12.74	4.42	8.08	4.74	16.64
CUMZ-R-2010.07.14,221	Songkla	2 Sep 09	Male	Mature	5.98	14.28	20.46	18.78	8.67	13.80	4.58	8.40	5.04	17.38
CUMZ-R-2010.07.14,223	Songkla	2 Sep 09	Male	Mature	7.03	15.98	23.52	20.71	8.76	16.82	5.36	9.12	5.32	18.40
CUMZ-R-2010.07.14,224	Songkla	2 Sep 09	Male	Mature	7.28	16.20	23.24	23.20	9.68	16.12	4.96	9.00	5.50	17.52

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	SN	LE	LL	ED	4FingLng	4ToeLng	CrusL	ForefL	HindfL	LoArmL	PectW	Pelvw	SVL	SnForel	Tailthick	TailL
CUMZ-R-2010.07.14,201	3.16	4.29	12.60	2.61	8.28	12.22	14.44	11.60	20.02	11.74	11.94	11.46	75.00	20.84	6.80	19.30
CUMZ-R-2010.07.14,202	3.48	4.55	13.65	2.55	9.37	13.78	16.36	11.46	22.92	13.02	14.04	12.50	83.02	22.14	7.56	20.80
CUMZ-R-2010.07.14,203	3.37	4.46	14.22	3.00	9.38	14.35	19.00	13.14	24.36	13.05	14.66	12.86	79.78	22.48	7.55	22.90
CUMZ-R-2010.07.14,204	3.54	4.74	14.60	3.24	9.46	13.30	16.34	13.08	21.80	14.23	14.08	11.86	84.55	24.45	7.38	-
CUMZ-R-2010.07.14,205	3.35	4.68	13.53	3.04	9.50	13.51	17.11	13.20	21.50	14.20	13.74	11.86	83.55	22.21	7.05	23.00
CUMZ-R-2010.07.14,206	3.22	4.08	13.60	2.56	8.10	12.40	15.40	11.30	20.54	12.20	13.50	11.70	77.36	21.90	6.10	18.40
CUMZ-R-2010.07.14,207	3.84	4.55	13.34	2.74	7.35	12.83	16.50	11.54	20.12	12.76	14.20	12.64	79.64	21.98	6.20	19.10
CUMZ-R-2010.07.14,208	4.18	6.04	16.38	3.74	10.88	16.22	19.54	14.90	26.24	15.48	16.54	13.23	96.64	29.59	11.19	26.00
CUMZ-R-2010.07.14,209	4.12	5.45	16.44	4.30	8.50	14.28	18.12	13.35	24.38	15.26	16.88	13.00	92.10	28.02	11.00	24.00
CUMZ-R-2010.07.14,210	3.89	5.66	14.54	3.28	9.88	14.64	19.40	14.88	25.71	15.33	15.88	12.54	90.56	26.08	10.84	-
CUMZ-R-2010.07.14,213	3.69	5.74	15.36	3.48	9.68	15.15	17.82	12.59	24.89	14.54	13.86	12.30	87.70	27.38	10.34	23.10
CUMZ-R-2010.07.14,214	3.59	4.90	14.70	3.31	9.12	14.32	17.60	13.18	22.72	13.58	12.60	12.02	82.00	25.16	9.86	22.30
CUMZ-R-2010.07.14,215	4.18	5.49	15.32	3.10	9.45	13.88	17.65	12.86	23.34	14.34	14.62	12.98	88.50	27.22	10.12	-
CUMZ-R-2010.07.14,216	4.15	5.63	15.44	3.23	9.23	15.67	18.84	14.15	25.38	14.22	14.50	14.12	87.00	27.55	11.06	-
CUMZ-R-2010.07.14,217	3.79	5.38	15.28	4.14	9.85	15.27	18.71	13.85	24.35	14.21	14.76	13.30	85.92	25.70	10.34	-
CUMZ-R-2010.07.14,218	3.38	4.90	15.33	3.61	-	14.98	18.03	-	23.92	13.54	15.02	13.84	82.78	25.33	10.65	21.70
CUMZ-R-2010.07.14,220	3.62	5.25	14.78	3.16	10.08	15.68	18.56	14.04	25.52	15.16	16.00	12.58	83.87	25.74	10.34	25.00
CUMZ-R-2010.07.14,221	3.70	6.42	14.87	3.06	9.00	16.00	19.44	12.93	25.19	14.54	15.12	13.54	84.21	28.12	10.82	24.50
CUMZ-R-2010.07.14,223	3.78	7.06	17.52	4.05	11.16	16.92	20.85	15.38	27.66	16.80	19.76	13.00	99.74	30.63	11.73	-
CUMZ-R-2010.07.14,224	3.94	6.45	17.12	4.18	11.16	16.52	19.88	15.26	26.20	16.18	16.72	15.07	98.20	31.00	12.64	27.80

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	TailW	TrunkL	UpArmL	UpLegL	TL	VentW	CanthR	Eyelid	HeadSLn	HeadSTr	Inflab	SnS	Suplab	GuS	4FingLm
CUMZ-R-2010.07.14,201	9.27	37.04	13.00	17.06	26.80	7.48	8	10	12	10	9	6	10	10	18
CUMZ-R-2010.07.14,202	9.38	42.64	13.06	18.43	29.00	7.87	8	9	16	13	8	6	8	11	19
CUMZ-R-2010.07.14,203	10.54	40.44	13.62	20.80	31.00	8.87	9	8	14	12	9	6	10	11	20
CUMZ-R-2010.07.14,204	9.28	41.45	13.48	18.66	-	7.00	8	8	13	12	11	7	10	11	19
CUMZ-R-2010.07.14,205	10.51	42.64	14.36	19.20	31.30	8.08	8	9	13	12	10	6	9	10	20
CUMZ-R-2010.07.14,206	8.90	37.30	12.18	17.67	25.80	7.35	8	9	12	13	9	6	10	12	19
CUMZ-R-2010.07.14,207	9.16	40.31	12.39	17.98	26.80	6.27	8	8	11	13	8	5	9	14	18
CUMZ-R-2010.07.14,208	11.12	45.42	15.00	21.80	35.70	9.95	10	10	14	14	11	6	11	14	21
CUMZ-R-2010.07.14,209	11.16	45.38	13.64	18.60	33.40	8.67	8	11	12	13	9	6	9	12	20
CUMZ-R-2010.07.14,210	11.86	45.18	14.34	22.50	-	9.65	8	9	12	13	10	6	10	11	20
CUMZ-R-2010.07.14,213	11.45	39.30	14.50	19.68	31.80	10.58	9	10	12	13	10	6	11	12	20
CUMZ-R-2010.07.14,214	10.08	38.30	13.59	20.37	30.50	8.95	9	9	11	12	10	6	9	13	20
CUMZ-R-2010.07.14,215	11.36	42.48	14.53	20.17	-	10.42	8	9	14	15	9	6	11	15	19
CUMZ-R-2010.07.14,216	12.11	38.36	15.19	21.52	-	9.30	8	10	12	15	10	6	10	15	21
CUMZ-R-2010.07.14,217	11.76	43.70	14.26	21.44	-	10.20	8	7	13	13	10	6	10	14	17
CUMZ-R-2010.07.14,218	10.70	41.37	13.26	20.76	30.00	10.00	8	9	14	14	11	6	10	15	-
CUMZ-R-2010.07.14,220	10.62	40.79	15.94	22.04	33.40	9.48	8	9	15	12	9	6	10	12	19
CUMZ-R-2010.07.14,221	10.74	38.75	16.06	21.00	32.90	8.40	7	9	11	11	10	6	9	13	18
CUMZ-R-2010.07.14,223	10.94	49.10	17.42	22.33	-	9.52	8	8	14	16	10	6	10	13	21
CUMZ-R-2010.07.14,224	12.92	48.80	16.00	21.02	37.70	10.00	8	10	14	14	10	6	10	12	20

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Specimen and Morphological data of garden fence lizard (Cont.)

Number	ToeLm	ventS	Midbody	CheekCol	CheekSt	DorsSt	ForearSt	NucSpot	TrnkBand	MidvLine	ThroatSt	ThroatPa	TrunkSt
CUMZ-R-2010.07.14,201	22	56	45	0	1	1	1	0	1	1	1	0	1
CUMZ-R-2010.07.14,202	25	65	48	0	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,203	23	58	45	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,204	24	66	50	0	1	1	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,205	23	60	44	0	1	1	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,206	25	54	41	1	1	0	1	1	1	1	1	0	1
CUMZ-R-2010.07.14,207	24	58	38	0	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,208	25	65	43	1	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,209	24	59	45	1	1	0	0	1	1	1	1	0	1
CUMZ-R-2010.07.14,210	25	60	44	1	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,213	24	66	45	1	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,214	24	61	48	1	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,215	23	70	45	1	1	0	0	1	1	1	1	0	1
CUMZ-R-2010.07.14,216	26	58	42	1	1	0	0	1	1	1	1	0	1
CUMZ-R-2010.07.14,217	23	53	42	1	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,218	24	59	44	1	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,220	24	55	42	1	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,221	24	54	35	1	1	0	1	1	1	1	1	0	0
CUMZ-R-2010.07.14,223	26	57	41	1	1	0	0	1	1	1	1	0	0
CUMZ-R-2010.07.14,224	26	58	39	1	1	0	0	1	0	1	1	0	0

Note: 0 = Absence, 1 = Present

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APPENDIX B

Principal component analysis

1. Morphological difference within-region

1.1 PCA for mensural characters of female in northern Thailand.

Total Variance Explained

Component	Initial Eigenvalues Total	Initial Eigenvalues % of Variance	Initial Eigenvalues Cumulative %	Extraction Sums of Squared Loadings Total	Extraction Sums of Squared Loadings % of Variance	Extraction Sums of Squared Loadings Cumulative %
1	18.253	57.040	57.040	18.253	57.040	57.040
2	2.279	7.121	64.161	2.279	7.121	64.161
3	2.167	6.773	70.933	2.167	6.773	70.933
4	1.343	4.197	75.131	1.343	4.197	75.131
5	1.194	3.731	78.861	1.194	3.731	78.861
6	1.064	3.324	82.185	1.064	3.324	82.185

Rotated Component Matrix[a]

	Component 1	Component 2		Component 1	Component 2
Zscore(LL)	.850	.453	Zscore(NarEye)	.599	.582
Zscore(InterOrb)	.846	.413	Zscore(ForefL)	.288	.890
Zscore(SnW)	.802	.265	Zscore(FingLng)	.331	.873
Zscore(SP)	.802	.522	Zscore(HindfL)	.453	.838
Zscore(SVL)	.801	.531	Zscore(ToeLng)	.478	.818
Zscore(HeadL)	.795	.583	Zscore(UpArmL)	.513	.747
Zscore(JawW)	.784	.495	Zscore(Tailthick)	.637	.743
Zscore(SnEye)	.769	.519	Zscore(UpLegL)	.554	.743
Zscore(TrunkL)	.758	.388	Zscore(CrusL)	.602	.739
Zscore(ED)	.733	.488	Zscore(HeadW)	.642	.714
Zscore(Pelvw)	.729	.448	Zscore(LoArmL)	.601	.693
Zscore(SnForel)	.719	.665	Zscore(LEE)	.627	.692
Zscore(SN)	.718	.380	Zscore(HeadH)	.667	.683
Zscore(EyeEar)	.704	.666	Zscore(VentW)	.576	.617
Zscore(TailW)	.695	.516	Zscore(TL)	.572	.575
Zscore(PectW)	.684	.620	Zscore(TailL)	.516	.574

1.2 PCA for mensural characters of male in northern Thailand.

Total Variance Explained									
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	18.080	56.501	56.501	18.080	56.501	56.501	6.284	19.638	19.638
2	2.622	8.195	64.695	2.622	8.195	64.695	4.874	15.230	34.868
3	1.939	6.061	70.756	1.939	6.061	70.756	4.659	14.559	49.427
4	1.456	4.549	75.305	1.456	4.549	75.305	4.584	14.325	63.752
5	1.324	4.138	79.443	1.324	4.138	79.443	3.423	10.696	74.448
6	1.064	3.326	82.769	1.064	3.326	82.769	2.663	8.321	82.769

Rotated Component Matrix[a]

	Component								Component					
	1	2	3	4	5	6			1	2	3	4	5	6
Zscore(SN)	.759	.222		.299	.281			Zscore(Tailthick)	.379	.114	.743		.269	
Zscore(ED)	.734	-.197	.361	.259	.151			Zscore(UpLegL)	.246	.451	.739			.193
Zscore(PectW)	.718	.433	.121	.144	.175	.186		Zscore(SP)	.245	.138	.738	.444	.155	
Zscore(SnW)	.712	.341	.372	.278				Zscore(VentW)		-.267	.664		.474	.201
Zscore(Pelvw)	.711	.300	.147		.144	.459		Zscore(CrusL)	.158	.477	.660	.169	.336	
Zscore(JawW)	.635	.268	.469	.260		.307		Zscore(TrunkL)	.501	.181	.505	.497		
Zscore(SVL)	.625	.252	.431	.497	.231			Zscore(TL)	.402	.333		.740	.157	
Zscore(LL)	.573	.113	.389	.237	.571			Zscore(TailL)	.336	.363		.731	.140	
Zscore(HeadH)	.561		.267	.486	.115	.439		Zscore(LEE)	.156	.381	.271	.610	.157	.329
Zscore(SnForel)	.532	.328	.253	.479	.446			Zscore(EyeEar)	.250	.225	.184	.510	.444	.345
Zscore(HeadL)	.506	.272	.347	.479	.494	.102		Zscore(UpArmL)	.104	.379	.216	.183	.649	.232
Zscore(ToeLng)	.242	.795	.168	.232	.275	.104		Zscore(TailW)	.402	.209	.347	-.122	.561	.445
Zscore(ForefL)	.365	.785	.137	.254		.218		Zscore(SnEye)	.332	.313	.169	.420	.554	.247
Zscore(FingLng)		.751		.409	.130	.316		Zscore(LoArmL)	.258	.260	.413	.382	.537	
Zscore(HindfL)	.285	.727	.259	.221	.376			Zscore(HeadW)	.103	.227			.129	.872
Zscore(NarEye)		.529		.417	.304	.434		Zscore(InterOrb)	.356	.179	.404	.427	.226	.587

1.3 PCA for meristic characters of female in northern Thailand.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.207	26.726	26.726	3.207	26.726	26.726	2.038	16.986	16.986
2	1.850	15.419	42.145	1.850	15.419	42.145	1.813	15.107	32.093
3	1.377	11.473	53.618	1.377	11.473	53.618	1.776	14.797	46.890
4	1.238	10.318	63.936	1.238	10.318	63.936	1.698	14.152	61.043
5	1.094	9.116	73.052	1.094	9.116	73.052	1.441	12.009	73.052

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
Zscore(GuS)	.751	.422	-.131	-.120	.162
Zscore(ToeLm)	.733			.299	-.228
Zscore(FingLm)	.704		.475		-.363
Zscore(CanthR)	.454	-.160		.257	.236
Zscore(Suplab)	.155	.831	-.123		-.156
Zscore(Inflab)		.729	.505	.151	
Zscore(Eyelid)	-.179	.548	.287		.526
Zscore(SnS)		.105	.755	.186	-.264
Zscore(HeadSLn)	.228		.743		.307
Zscore(Midbody)		.240	.189	.872	
Zscore(VentS)	.350			.835	
Zscore(HeadSTr)					.837

1.4 PCA for meristic characters of male in northern Thailand.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.978	24.814	24.814	2.978	24.814	24.814	2.312	19.266	19.266
2	1.931	16.088	40.902	1.931	16.088	40.902	1.966	16.379	35.645
3	1.536	12.802	53.704	1.536	12.802	53.704	1.657	13.809	49.454
4	1.464	12.197	65.901	1.464	12.197	65.901	1.646	13.715	63.169
5	1.194	9.948	75.849	1.194	9.948	75.849	1.344	11.199	74.368
6	1.045	8.708	84.557	1.045	8.708	84.557	1.223	10.189	84.557

Rotated Component Matrix[a]

	Component					
	1	2	3	4	5	6
Zscore(GuS)	.886		.112			-.150
Zscore(HeadSTr)	.806		-.316	.166	.188	
Zscore(Suplab)	.607	.279			-.295	.520
Zscore(ToeLm)		.918	.145		.163	
Zscore(FingLm)		.810		.387	-.168	-.188
Zscore(CanthR)	-.203		.889			
Zscore(Inflab)	.366	.531	.561	-.182		
Zscore(Eyelid)		.182	-.193	.879	.134	
Zscore(Midbody)	.351		.461	.585	.227	-.235
Zscore(SnS)			.139	.202	.883	.127
Zscore(VentS)	.431		.377	.512	-.532	
Zscore(HeadSLn)		-.240			.159	.891

1.5 PCA for mensural characters of female in southern Thailand.

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	17.721	55.377	55.377	17.721	55.377	55.377	6.563	20.509	20.509
2	2.979	9.308	64.685	2.979	9.308	64.685	6.303	19.698	40.207
3	1.930	6.031	70.716	1.930	6.031	70.716	5.447	17.022	57.228
4	1.717	5.367	76.083	1.717	5.367	76.083	3.899	12.183	69.411
5	1.193	3.727	79.810	1.193	3.727	79.810	3.327	10.398	79.810

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
Zscore(SnW)	.789		.104	.485	
Zscore(SN)	.770	.129	.247	-.101	
Zscore(LL)	.763	.372	.371	.195	.121
Zscore(HeadL)	.712	.430	.406	.286	.125
Zscore(SP)	.680	.491	.387	.215	.114
Zscore(SnForel)	.626	.482	.380	.385	
Zscore(InterOrb)	.615	.395	.542	.198	
Zscore(EyeEar)	.600	.213	.348	.487	.180
Zscore(UpArmL)		.828		.132	.153
Zscore(CrusL)	.222	.753	.326	.194	.255
Zscore(LoArmL)	.252	.747	.126	.153	.292
Zscore(UpLegL)	.195	.734	.277	.262	.317
Zscore(TrunkL)	.516	.714	.158	.130	
Zscore(SVL)	.512	.623	.342	.409	
Zscore(JawW)	.485	.533	.520	.187	
Zscore(HeadW)	.422	.516	.495	.282	

	Component				
	1	2	3	4	5
Zscore(VentW)	.202	-.205	.792	.219	
Zscore(SnEye)	.526	.269	.698	.104	
Zscore(NarEye)	.203	.329	.684	-.123	.293
Zscore(HeadH)	.390	.352	.624	.154	.397
Zscore(Pelvw)	.333	.436	.582	.169	
Zscore(TailW)	.339	.418	.553	.232	
Zscore(Tailthick)	.515	.415	.521	.165	.231
Zscore(LEE)	.151	.361	.490	.441	
Zscore(TailL)		.158	.157	.878	.116
Zscore(TL)	.304	.305		.793	.240
Zscore(PectW)	.473	.321	.258	.558	.188
Zscore(ED)	.318	.363	.426	.535	
Zscore(ToeLng)	.341		.123	.217	.843
Zscore(FingLng)		.246		-.253	.805
Zscore(ForefL)				.172	.789
Zscore(HindfL)		.234	.292	.277	.738

1.6 PCA for mensural characters of male in southern Thailand.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	15.489	48.402	48.402	15.489	48.402	48.402
2	3.020	9.437	57.839	3.020	9.437	57.839
3	2.273	7.103	64.941	2.273	7.103	64.941
4	1.796	5.614	70.555	1.796	5.614	70.555
5	1.654	5.168	75.724	1.654	5.168	75.724
6	1.406	4.392	80.116	1.406	4.392	80.116
7	1.082	3.381	83.497	1.082	3.381	83.497

1.7 PCA for meristic characters of female in southern Thailand.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.570	21.418	21.418	2.570	21.418	21.418	1.978	16.487	16.487
2	1.809	15.079	36.497	1.809	15.079	36.497	1.786	14.886	31.372
3	1.670	13.918	50.415	1.670	13.918	50.415	1.761	14.677	46.049
4	1.306	10.886	61.301	1.306	10.886	61.301	1.541	12.841	58.890
5	1.213	10.109	71.410	1.213	10.109	71.410	1.502	12.520	71.410

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
Zscore(HeadSTr)	.785	.200	.211		.150
Zscore(Inflab)	.675	-.255		.536	-.104
Zscore(CanthR)	.591	.309	-.386		-.200
Zscore(FingLm)	.185	.849			
Zscore(ToeLm)		.847		.261	
Zscore(VentS)	.162		.855		.142
Zscore(Midbody)	-.116		.789		-.114
Zscore(Suplab)	-.140			.820	.121
Zscore(GuS)	.398	.225		.689	
Zscore(SnS)		.135	.226		.791
Zscore(HeadSLn)	.513		-.114		.641
Zscore(Eyelid)	.204	.244	.366	-.143	-.574

1.8 PCA for meristic characters of male in southern Thailand.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.011	25.090	25.090	3.011	25.090	25.090	2.181	18.176	18.176
2	1.974	16.451	41.542	1.974	16.451	41.542	1.745	14.543	32.719
3	1.565	13.038	54.580	1.565	13.038	54.580	1.743	14.527	47.245
4	1.190	9.919	64.499	1.190	9.919	64.499	1.627	13.562	60.808
5	1.090	9.085	73.584	1.090	9.085	73.584	1.533	12.776	73.584

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
Zscore(ToeLm)	.835		.111	-.140	
Zscore(HeadSTr)	.833			.144	
Zscore(FingLm)	.643	.288	.171	-.261	-.355
Zscore(SnS)		.801			
Zscore(HeadSLn)		.768		.216	
Zscore(VentS)			.939		.105
Zscore(Midbody)	.360	.220	.672	-.126	-.282
Zscore(Inflab)	-.232	.272		.793	
Zscore(GuS)	.263		-.133	.738	.393
Zscore(CanthR)	.267	.313	-.442	-.498	.214
Zscore(Suplab)		.302	.133	.154	.848
Zscore(Eyelid)	.183	.329	.354		-.624

2. Morphological difference between regions (populations)

2.1 PCA for mensural characters of female between populations.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	17.462	54.569	54.569	17.462	54.569	54.569	8.460	26.439	26.439
2	2.693	8.416	62.986	2.693	8.416	62.986	6.045	18.891	45.330
3	1.649	5.152	68.138	1.649	5.152	68.138	4.186	13.080	58.410
4	1.319	4.121	72.259	1.319	4.121	72.259	2.975	9.298	67.708
5	1.067	3.335	75.595	1.067	3.335	75.595	2.524	7.886	75.595

Rotated Component Matrix[a]

	Component						Component				
	1	2	3	4	5		1	2	3	4	5
Zscore(SnForel)	.806	.350	.195	.251	.213	Zscore(TailW)	.294	.680		.275	.276
Zscore(SnEye)	.799	.342	.200		.142	Zscore(HeadW)	.500	.640	.109	.150	.296
Zscore(SN)	.778				.116	Zscore(JawW)	.601	.613	.154	.122	.233
Zscore(LL)	.775	.431	.212		.207	Zscore(Pelvw)	.444	.605	.128		.186
Zscore(HeadL)	.763	.293	.274	.271	.172	Zscore(Tailthick)	.524	.603	.259	.144	.209
Zscore(EyeEar)	.724	.218	.177	.372		Zscore(TrunkL)	.404	.529	.139	.194	.435
Zscore(InterOrb)	.719	.452	.121	.240		Zscore(ToeLng)	.286		.854	.232	
Zscore(SnW)	.657	.268	.202	.290	-.351	Zscore(HindfL)	.235	.175	.817	.300	
Zscore(NarEye)	.641	.238	.204		.285	Zscore(ForefL)	.165		.797	.195	.144
Zscore(SP)	.630	.465	.246	.137	.304	Zscore(FingLng)		.167	.789		.291
Zscore(LEE)	.574	.143		.475	.181	Zscore(CrusL)	.409	.428	.488	.282	.377
Zscore(SVL)	.567	.506	.222	.351	.390	Zscore(UpLegL)	.363	.407	.468	.250	.363
Zscore(ED)	.416	.413	.220	.359	.130	Zscore(TailL)		.180	.275	.868	.112
Zscore(HeadH)	.183	.752	.152	-.129		Zscore(TL)	.311	.128	.375	.753	.160
Zscore(VentW)	.126	.743		.210	-.199	Zscore(LoArmL)	.429	.251	.298	.142	.665
Zscore(PectW)	.297	.696	.128	.197	.250	Zscore(UpArmL)	.239	.320	.297	.311	.632

2.2 PCA for mensural characters of male between populations.

.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	18.740	58.564	58.564	18.740	58.564	58.564	8.460	26.437	26.437
2	2.028	6.337	64.901	2.028	6.337	64.901	5.561	17.377	43.814
3	1.735	5.422	70.322	1.735	5.422	70.322	5.194	16.232	60.046
4	1.199	3.748	74.070	1.199	3.748	74.070	2.939	9.185	69.231
5	1.091	3.410	77.480	1.091	3.410	77.480	2.640	8.249	77.480

Rotated Component Matrix[a]

	Component						Component				
	1	2	3	4	5		1	2	3	4	5
Zscore(LL)	.813	.189	.303	.192		Zscore(ToeLng)	.306	.752	.394		.173
Zscore(SVL)	.795	.355	.185	.182	.256	Zscore(UpLegL)	.375	.701		.295	
Zscore(ED)	.751		.136	.264	.206	Zscore(CrusL)	.457	.681	.168	.293	
Zscore(TrunkL)	.734	.339		.182	.243	Zscore(ForefL)		.679	.365		.400
Zscore(SnW)	.725	.280	.343	-.185	.213	Zscore(FingLng)		.622	.460		.346
Zscore(HeadL)	.701	.330	.530	.195	.151	Zscore(UpArmL)	.280	.569	.204	.435	
Zscore(SP)	.676	.340	.266	.217	.106	Zscore(LoArmL)	.483	.485	.280	.309	.144
Zscore(JawW)	.669	.239	.401	.230		Zscore(NarEye)	.187	.297	.768		
Zscore(SnForel)	.594	.369	.564	.163	.214	Zscore(SnEye)	.482	.261	.721		.125
Zscore(PectW)	.576	.366	.258	.314	.112	Zscore(HeadW)	.225	.300	.698	.282	.261
Zscore(HeadH)	.570	.350	.441	.320	.175	Zscore(EyeEar)	.526	.312	.599	.204	.257
Zscore(SN)	.568		.451	-.121	.322	Zscore(LEE)	.420	.457	.594		.171
Zscore(Tailthick)	.561	.404	.275	.484		Zscore(VentW)	.101			.839	
Zscore(InterOrb)	.534	.191	.522	.299	.284	Zscore(TailW)	.296	.215	.147	.757	.144
Zscore(Pelvw)	.512	.316	.291	.329	.328	Zscore(TailL)	.279	.250	.228	.120	.850
Zscore(HindfL)	.336	.763	.337		.183	Zscore(TL)	.361	.240	.224	.139	.829

2.3 PCA for meristic characters of female between populations.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.646	22.050	22.050	2.646	22.050	22.050	1.988	16.565	16.565
2	1.780	14.831	36.882	1.780	14.831	36.882	1.751	14.592	31.156
3	1.297	10.809	47.691	1.297	10.809	47.691	1.633	13.608	44.764
4	1.235	10.292	57.983	1.235	10.292	57.983	1.402	11.681	56.446
5	1.127	9.390	67.373	1.127	9.390	67.373	1.311	10.928	67.373

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
Zscore(ToeLm)	.862		.176		
Zscore(FingLm)	.848			.191	
Zscore(Suplab)	-.143	.825	.113		-.190
Zscore(Inflab)		.628	.189	.405	.234
Zscore(GuS)	.459	.617	-.171		.169
Zscore(Midbody)		.143	.845		
Zscore(VentS)	.416		.656	.116	
Zscore(CanthR)		.408	-.421		
Zscore(HeadSLn)		.188	-.106	.841	
Zscore(SnS)	.315	-.184	.333	.617	
Zscore(HeadSTr)	.103	-.105	-.149	.262	.766
Zscore(Eyelid)		.158	.233	-.160	.750

2.4 PCA for meristic characters of male between populations.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.589	21.578	21.578	2.589	21.578	21.578	2.019	16.829	16.829
2	2.072	17.267	38.845	2.072	17.267	38.845	1.893	15.779	32.608
3	1.341	11.177	50.022	1.341	11.177	50.022	1.812	15.097	47.704
4	1.195	9.961	59.983	1.195	9.961	59.983	1.429	11.908	59.612
5	1.138	9.483	69.466	1.138	9.483	69.466	1.182	9.854	69.466

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
Zscore(GuS)	.842			-.169	-.148
Zscore(Suplab)	.750	-.175		.116	
Zscore(Inflab)	.648				.372
Zscore(ToeLm)		.872			.118
Zscore(FingLm)		.806	.298		
Zscore(HeadSTr)	.406	.466	.191	.106	-.422
Zscore(VentS)	.313		.803	-.136	
Zscore(Midbody)		.254	.785		
Zscore(Eyelid)	-.233	.230	.642	.222	-.208
Zscore(HeadSLn)		-.122		.856	
Zscore(SnS)		.287		.746	.101
Zscore(CanthR)					.874

3. Morphological difference between sexes.

3.1 PCA for mensural characters of northern population.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	21.674	67.732	67.732	21.674	67.732	67.732	8.522	26.631	26.631
2	1.859	5.808	73.540	1.859	5.808	73.540	8.477	26.491	53.121
3	1.236	3.861	77.401	1.236	3.861	77.401	7.770	24.280	77.401

Rotated Component Matrix[a]

	Component				Component		
	1	2	3		1	2	3
Zscore(VentW)	.860	.264	.125	Zscore(LoArmL)	.564	.600	.364
Zscore(Tailthick)	.810	.429	.220	Zscore(HeadL)	.518	.595	.497
Zscore(TailW)	.718	.287	.393	Zscore(SnEye)	.338	.591	.549
Zscore(HeadW)	.686	.368	.329	Zscore(LEE)	.517	.586	.355
Zscore(UpLegL)	.662	.445	.353	Zscore(SnW)	.233	.322	.755
Zscore(EyeEar)	.646	.543	.327	Zscore(Pelvw)	.118	.202	.753
Zscore(CrusL)	.635	.593	.328	Zscore(TrunkL)	.237	.247	.746
Zscore(SnForel)	.587	.584	.465	Zscore(SN)		.397	.731
Zscore(TL)	.205	.796	.378	Zscore(SVL)	.358	.509	.719
Zscore(TailL)	.152	.760	.296	Zscore(JawW)	.547	.351	.689
Zscore(ForefL)	.458	.714	.300	Zscore(PectW)	.445	.353	.630
Zscore(HindfL)	.534	.677	.320	Zscore(LL)	.462	.463	.623
Zscore(ToeLng)	.560	.670	.279	Zscore(HeadH)	.545		.623
Zscore(FingLng)	.507	.664	.184	Zscore(ED)	.471	.259	.598
Zscore(NarEye)	.369	.657	.352	Zscore(InterOrb)	.543	.446	.558
Zscore(UpArmL)	.540	.617	.291	Zscore(SP)	.480	.423	.522

3.2 PCA for mensural characters of southern population.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	25.554	79.855	79.855	25.554	79.855	79.855	14.183	44.322	44.322
2	1.209	3.778	83.633	1.209	3.778	83.633	12.580	39.311	83.633

Rotated Component Matrix[a]

	Component				Component	
	1	2			1	2
Zscore(LL)	.850	.453		Zscore(NarEye)	.599	.582
Zscore(InterOrb)	.846	.413		Zscore(ForefL)	.288	.890
Zscore(SnW)	.802	.265		Zscore(FingLng)	.331	.873
Zscore(SP)	.802	.522		Zscore(HindfL)	.453	.838
Zscore(SVL)	.801	.531		Zscore(ToeLng)	.478	.818
Zscore(HeadL)	.795	.583		Zscore(UpArmL)	.513	.747
Zscore(JawW)	.784	.495		Zscore(Tailthick)	.637	.743
Zscore(SnEye)	.769	.519		Zscore(UpLegL)	.554	.743
Zscore(TrunkL)	.758	.388		Zscore(CrusL)	.602	.739
Zscore(ED)	.733	.488		Zscore(HeadW)	.642	.714
Zscore(Pelvw)	.729	.448		Zscore(LoArmL)	.601	.693
Zscore(SnForel)	.719	.665		Zscore(LEE)	.627	.692
Zscore(SN)	.718	.380		Zscore(HeadH)	.667	.683
Zscore(EyeEar)	.704	.666		Zscore(VentW)	.576	.617
Zscore(TailW)	.695	.516		Zscore(TL)	.572	.575
Zscore(PectW)	.684	.620		Zscore(TailL)	.516	.574

3.3 PCA for meristic characters of northern population.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.089	25.743	25.743	3.089	25.743	25.743	1.917	15.979	15.979
2	1.563	13.025	38.768	1.563	13.025	38.768	1.840	15.336	31.315
3	1.360	11.337	50.105	1.360	11.337	50.105	1.550	12.913	44.228
4	1.143	9.527	59.632	1.143	9.527	59.632	1.487	12.389	56.618
5	1.012	8.437	68.069	1.012	8.437	68.069	1.374	11.451	68.069

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
Zscore(FingLm)	.865	.183	.108		
Zscore(ToeLm)	.860	.160	.110		
Zscore(Suplab)		.775		.144	
Zscore(GuS)	.252	.772		-.118	.192
Zscore(Midbody)			.848	.197	
Zscore(VentS)	.201	.359	.737	-.124	
Zscore(HeadSLn)	-.231			.741	
Zscore(SnS)	.326	-.168	.146	.642	.196
Zscore(Inflab)	.309	.480	.140	.554	-.104
Zscore(Eyelid)	.194		.234	.304	.668
Zscore(HeadSTr)	-.140	.428			.654
Zscore(CanthR)			.384	.184	-.625

3.4 PCA for meristic characters of southern population.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.643	22.023	22.023	2.643	22.023	22.023	1.793	14.939	14.939
2	1.971	16.429	38.451	1.971	16.429	38.451	1.705	14.207	29.146
3	1.528	12.733	51.184	1.528	12.733	51.184	1.693	14.111	43.256
4	1.146	9.553	60.738	1.146	9.553	60.738	1.681	14.005	57.261
5	1.021	8.508	69.246	1.021	8.508	69.246	1.438	11.985	69.246

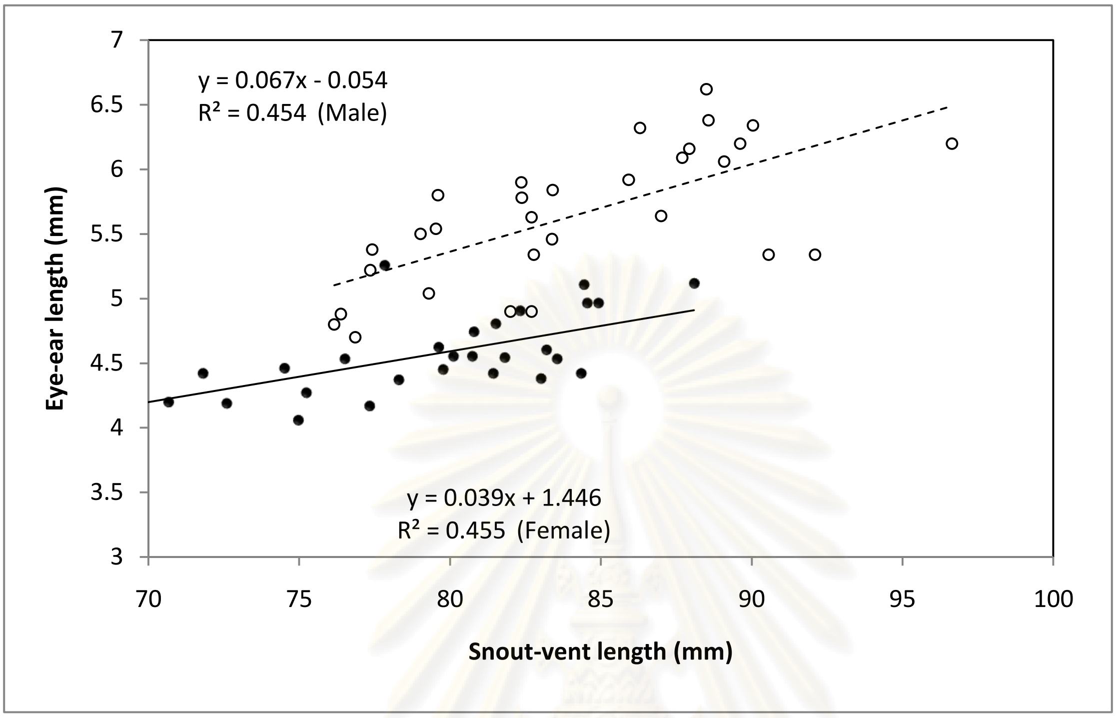
Rotated Component Matrix[a]

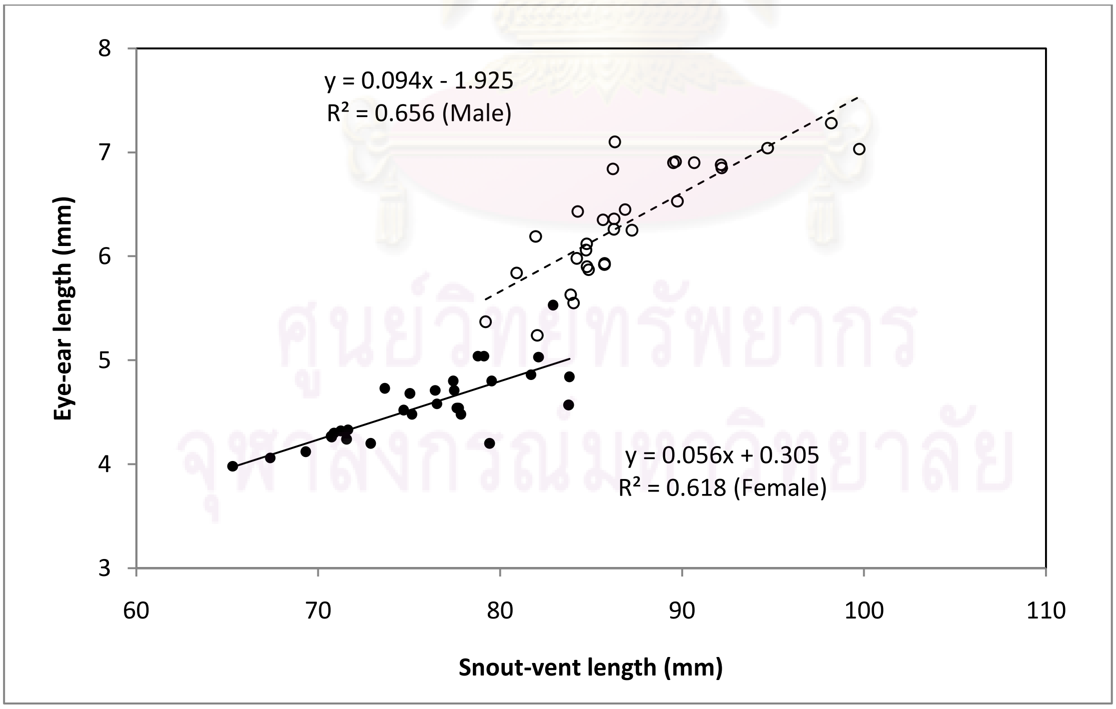
	Component				
	1	2	3	4	5
Zscore(VentS)	.826	.130			.127
Zscore(Midbody)	.796	-.150	.130		
Zscore(GuS)		.848	.184		
Zscore(Suplab)		.684	-.273	.119	.317
Zscore(Inflab)		.589	.345	-.557	
Zscore(HeadSTr)	.144	.232	.711	.222	.119
Zscore(CanthR)	-.443		.560	.221	.145
Zscore(Eyelid)	.434	-.148	.510	.140	
Zscore(ToeLm)		.180	.228	.831	
Zscore(FingLm)	.163		.422	.693	.230
Zscore(SnS)	.154			.158	.810
Zscore(HeadSLn)		.132	.366	-.168	.751

APPENDIX C

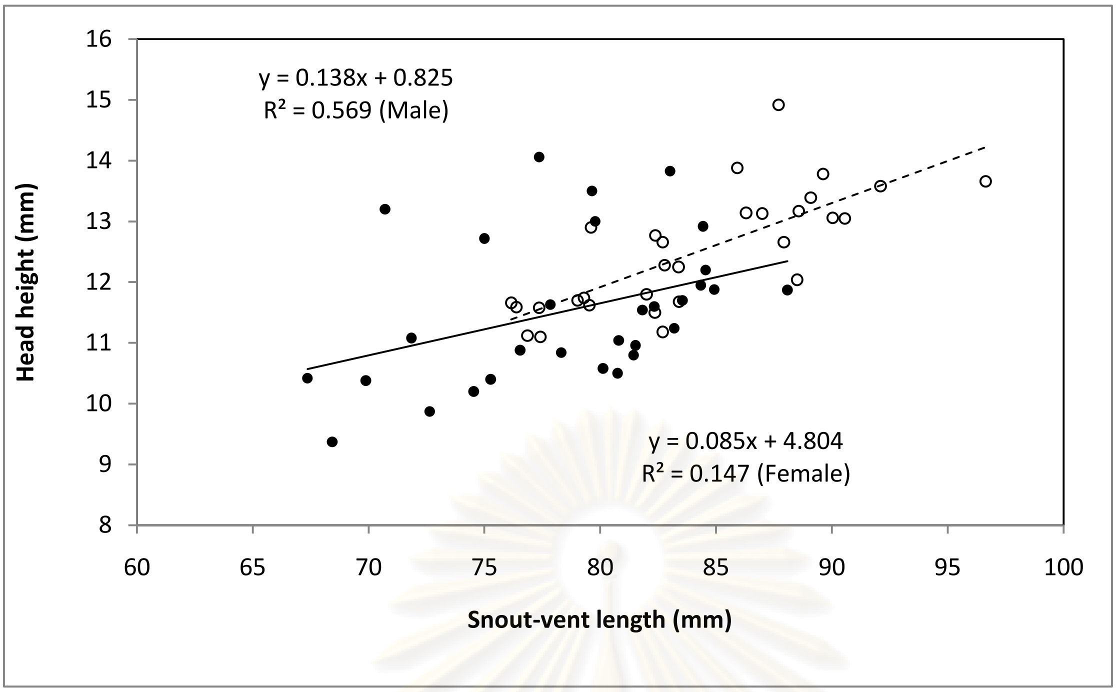
Linear regression analysis

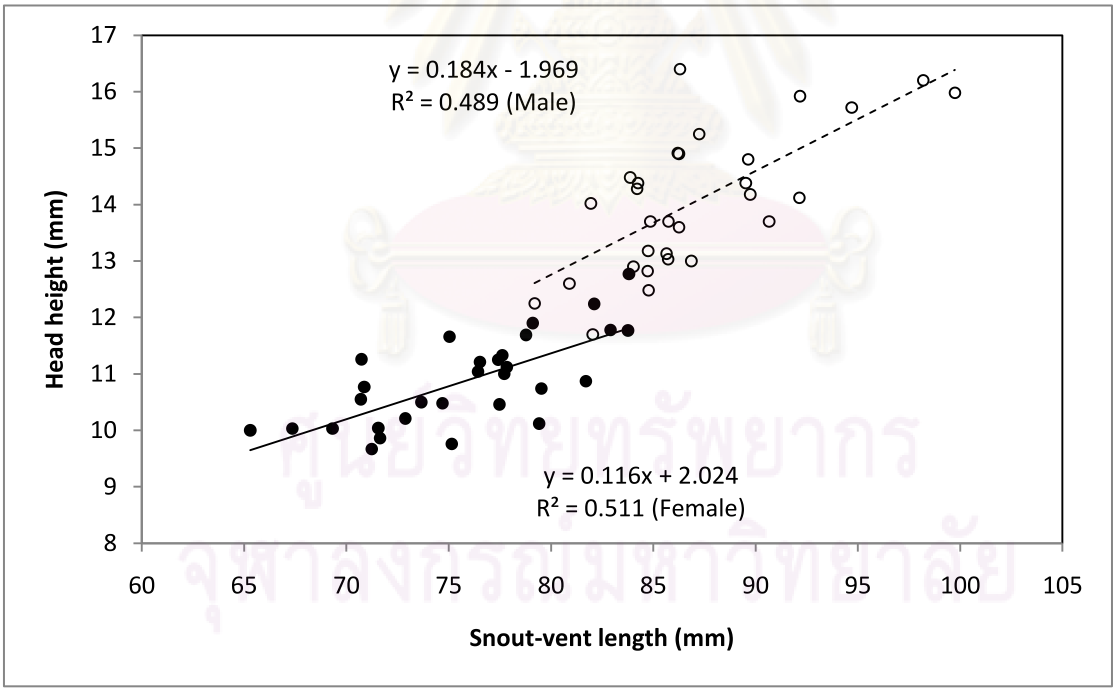
Linear regression line of *Calotes versicolor* morphological characters in both sexes of northern and southern population.



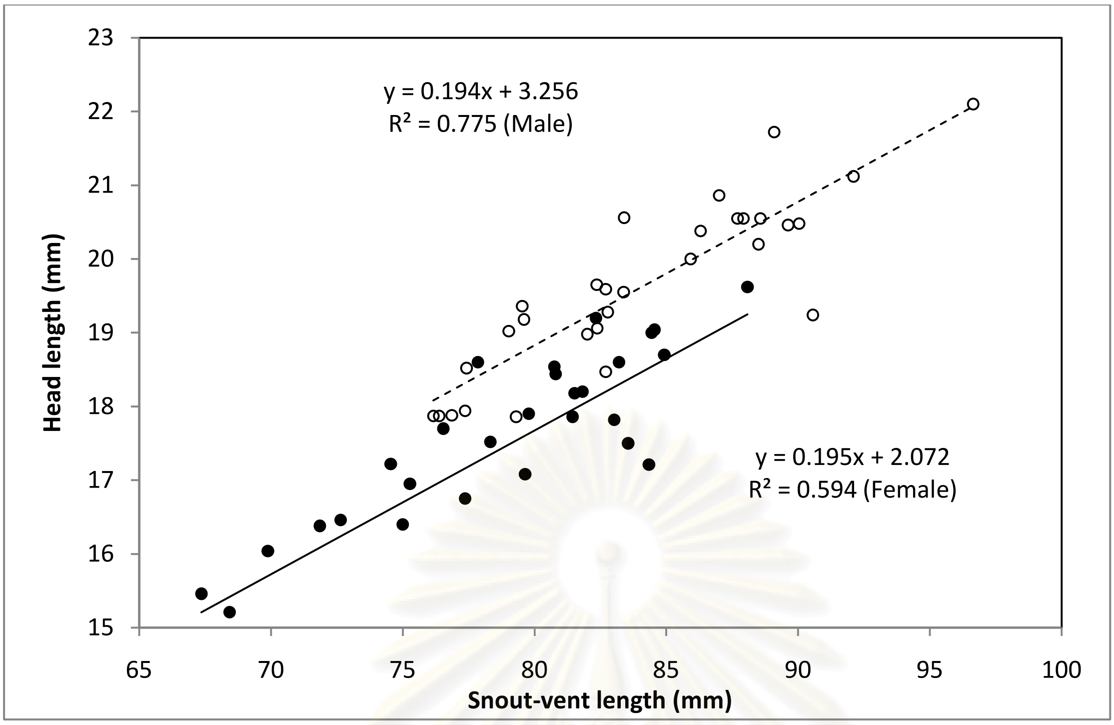


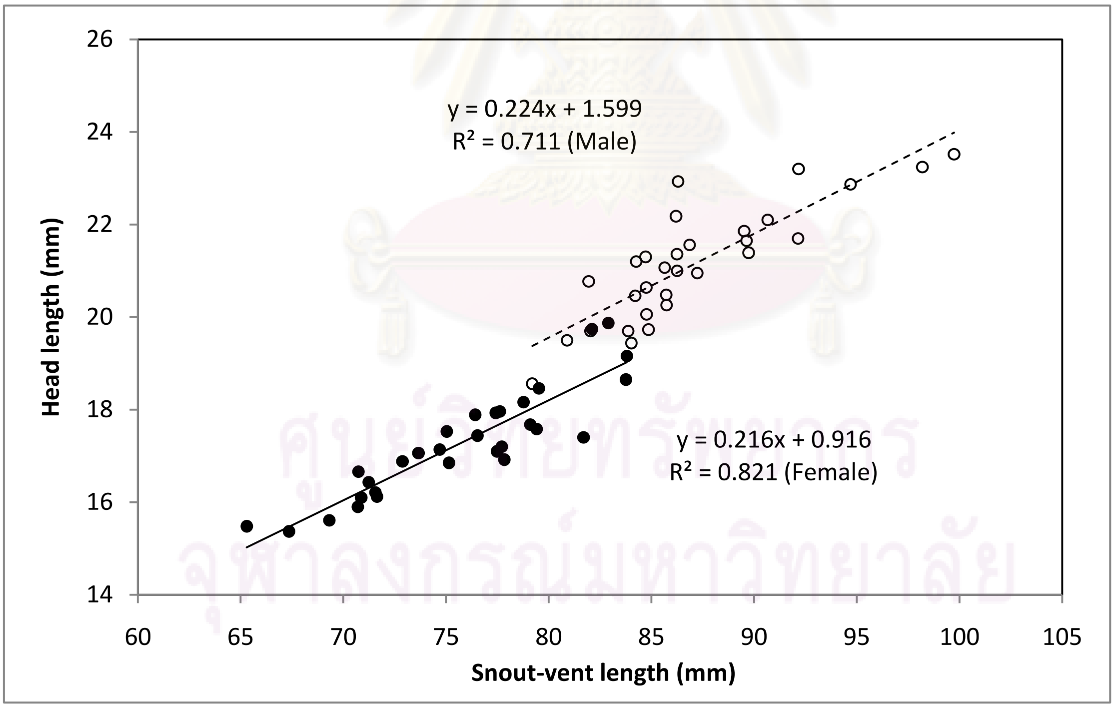
1. Linear regression line between Snout-vent length with Eye-ear length of both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



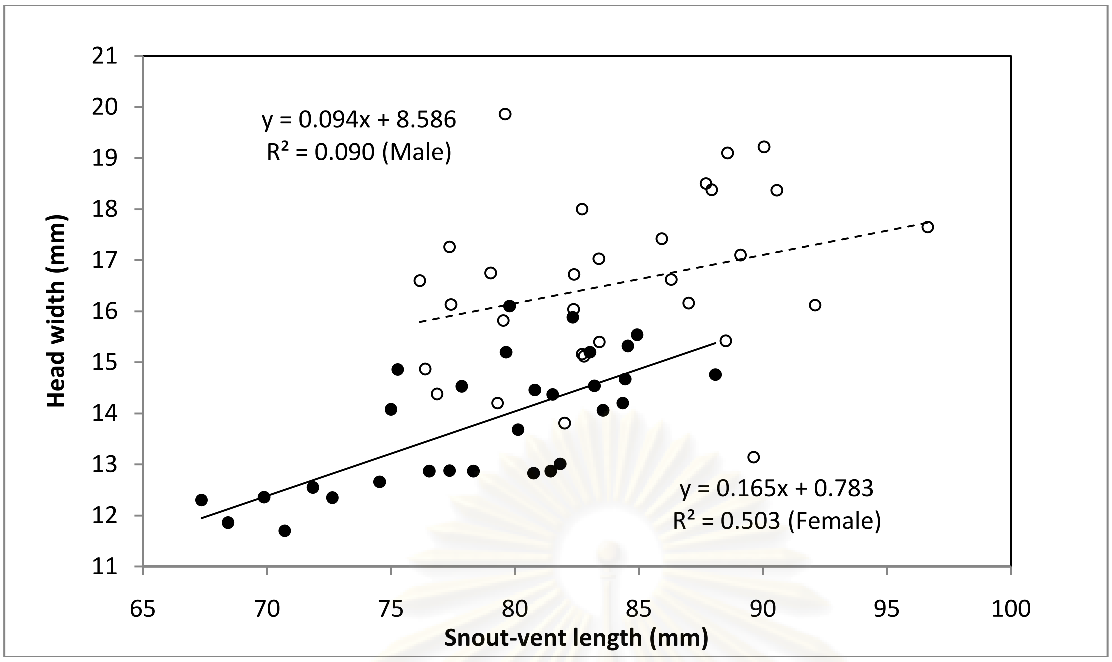


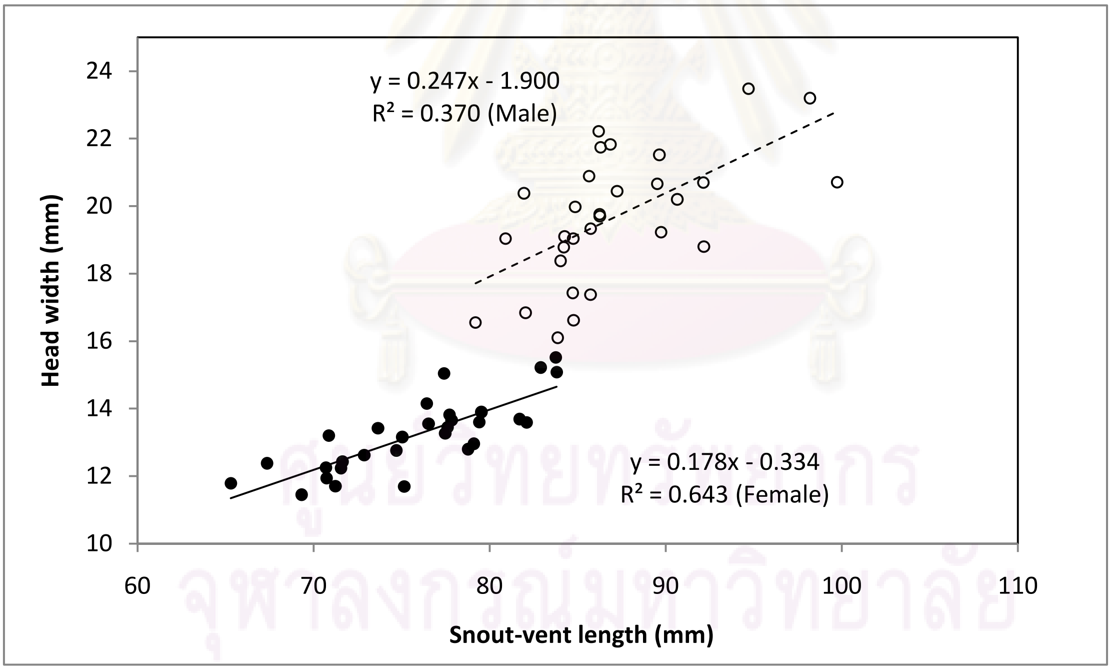
2. Linear regression line between Snout-vent length with Head height of both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



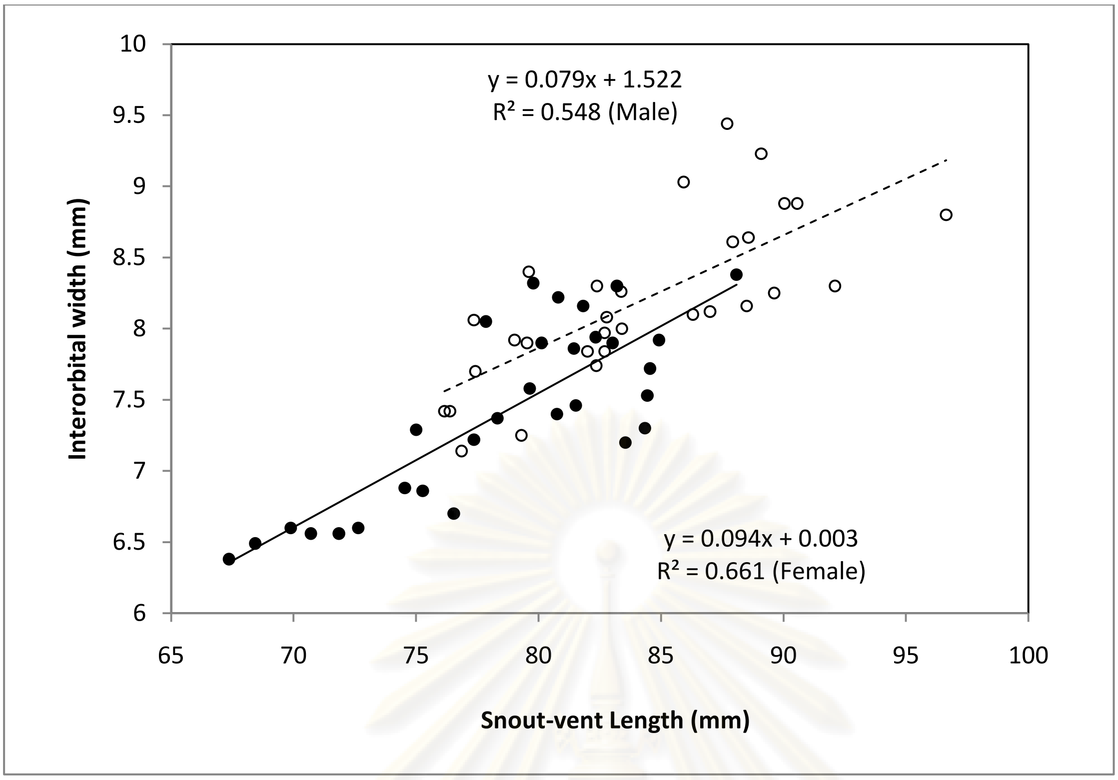


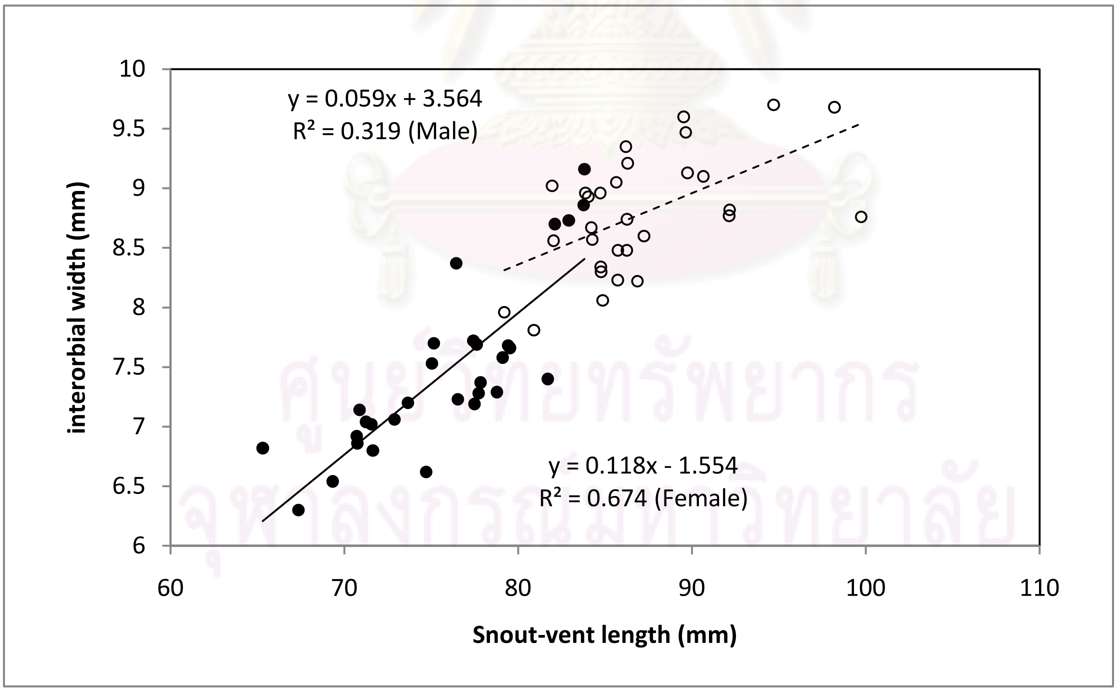
3. Linear regression line between Snout-vent length with Head length of both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



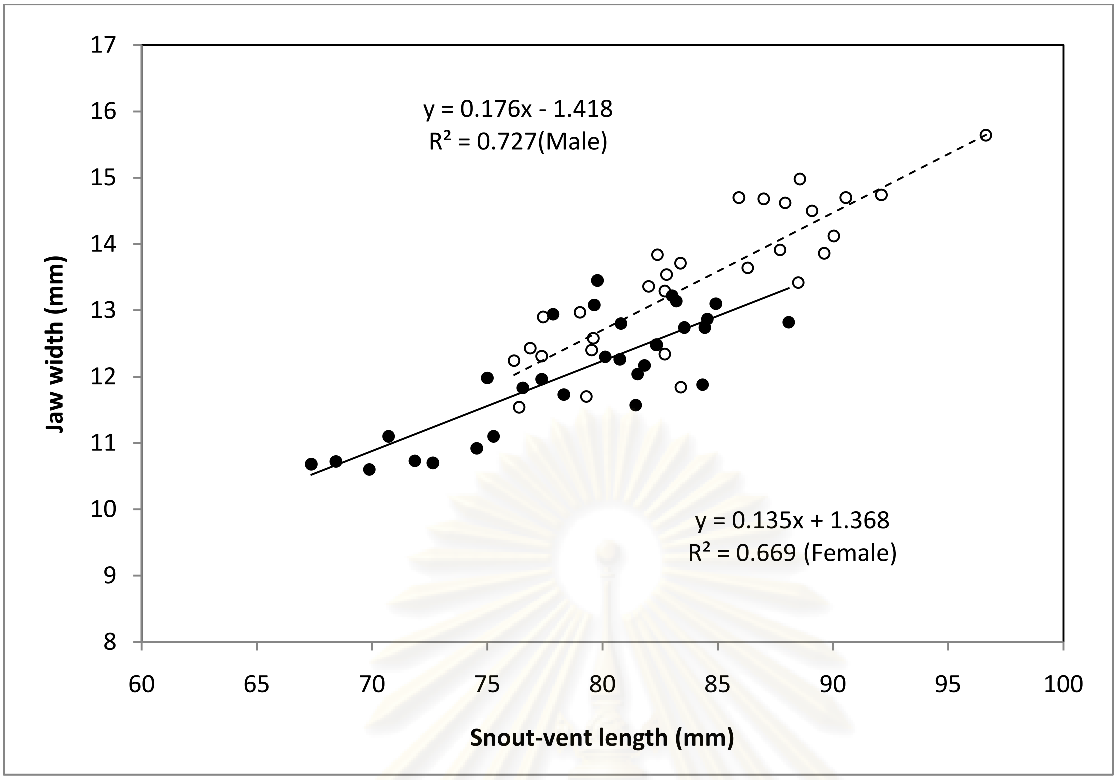


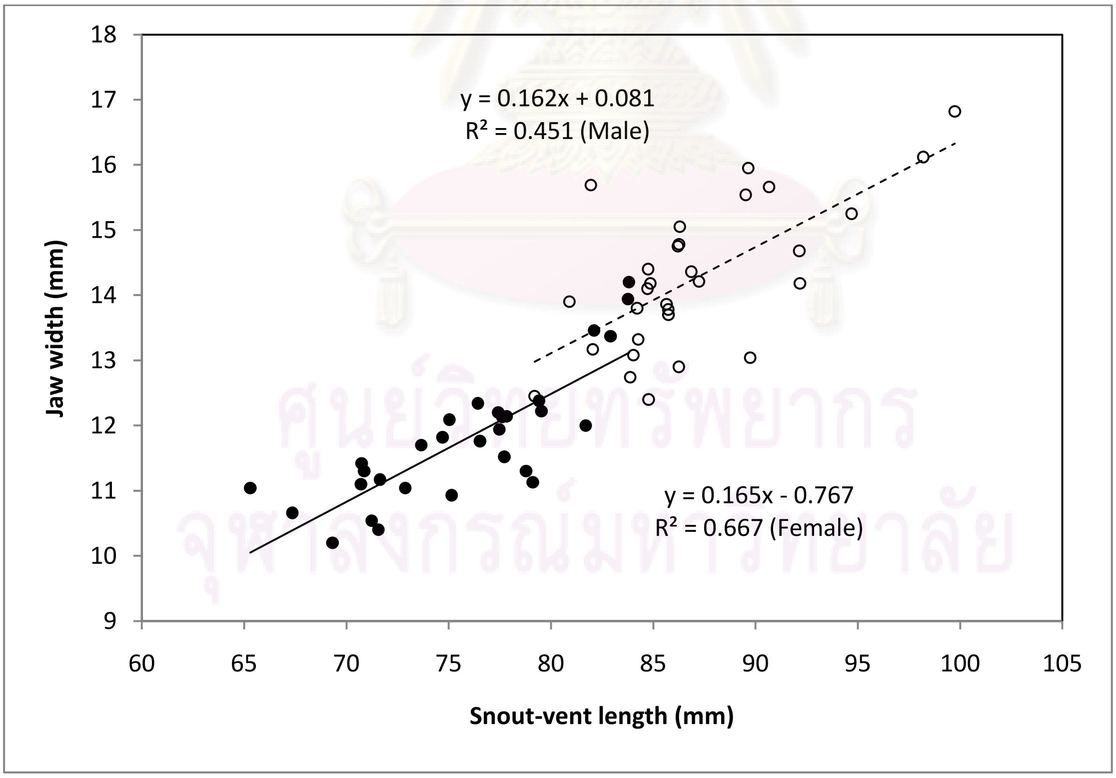
4. Linear regression line between Snout-vent length with Head width of both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



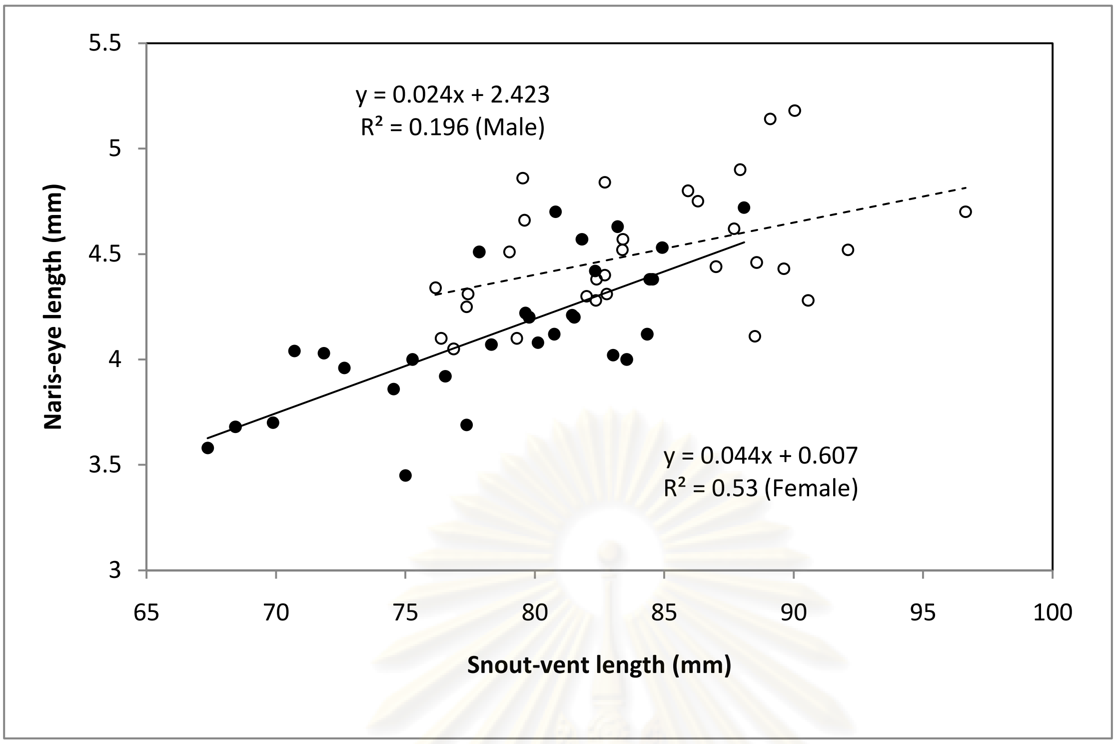


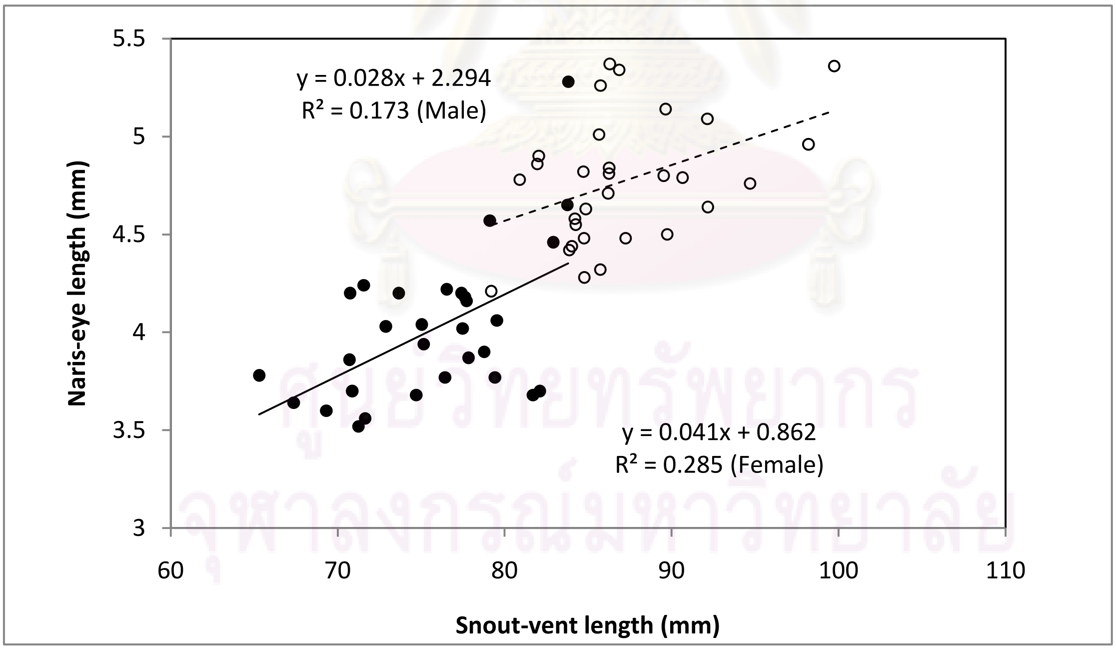
5. Linear regression line between Snout-vent length with Interorbital width of both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



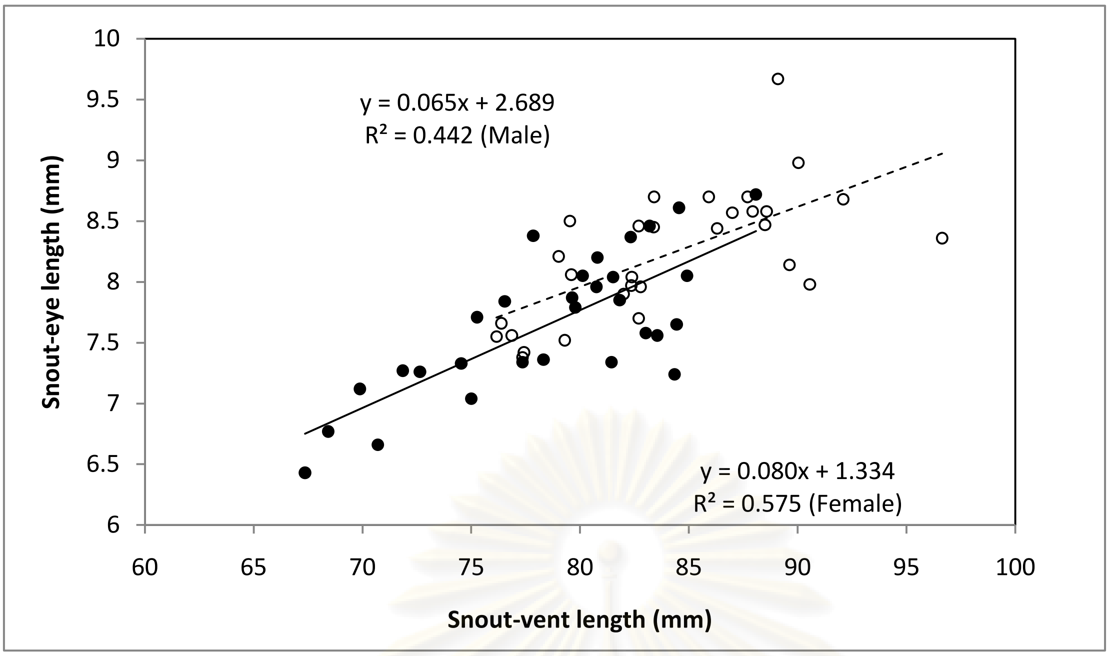


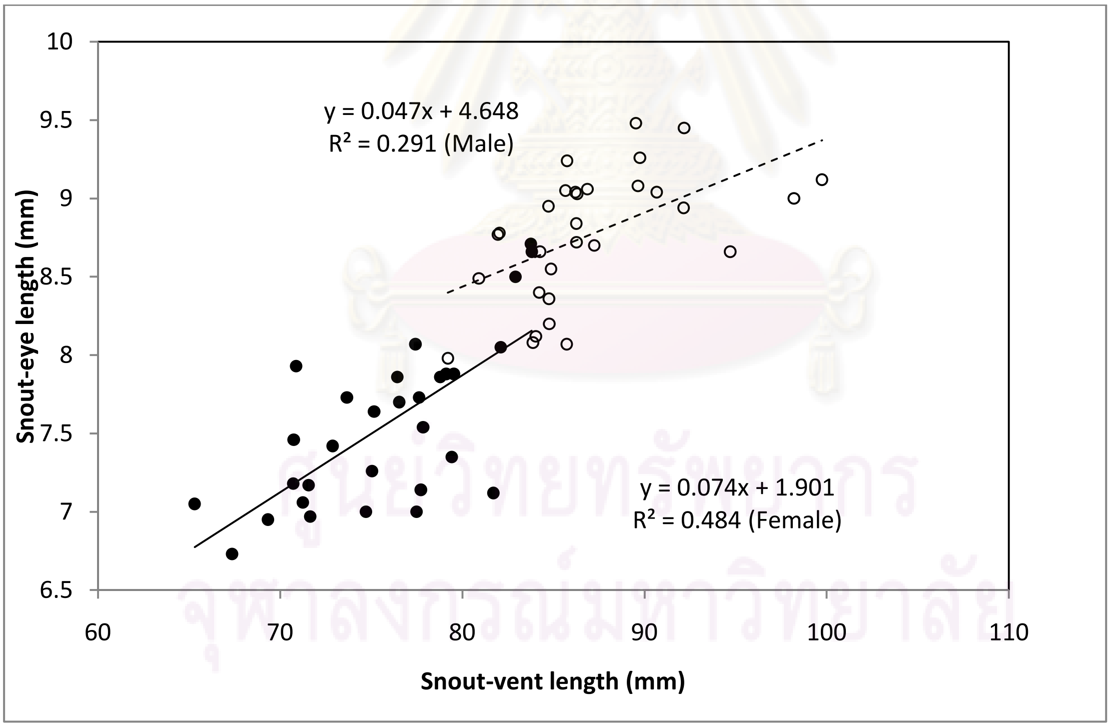
6. Linear regression line between Snout-vent length with Jaw width of both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



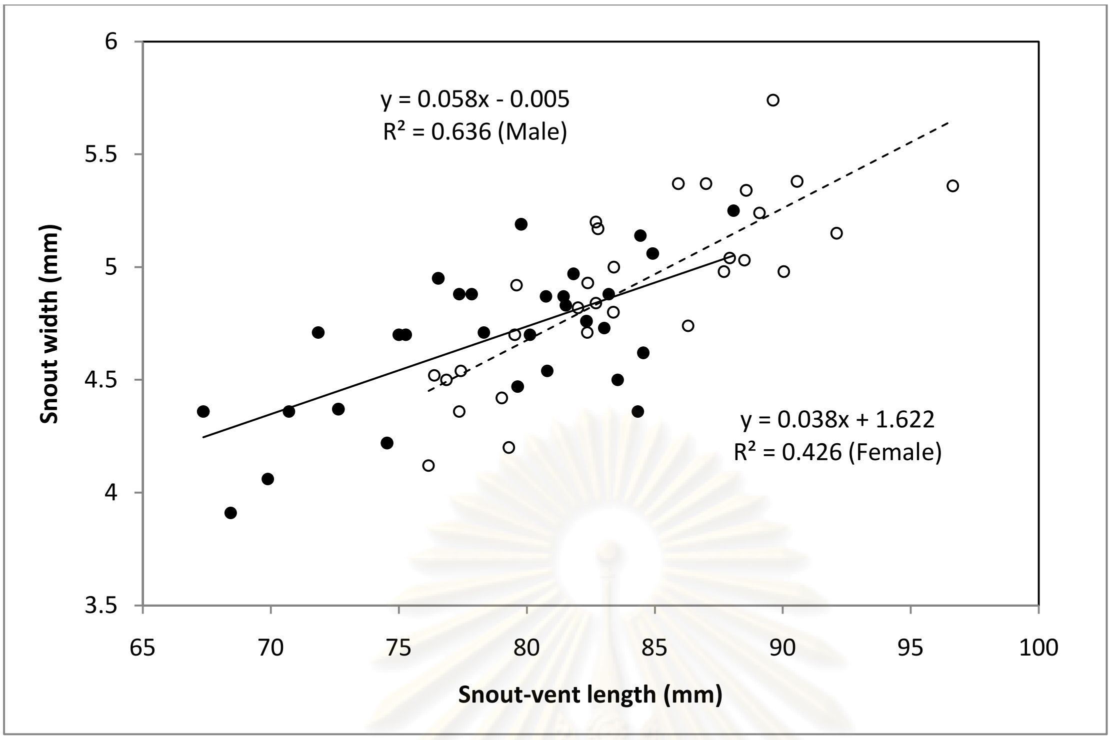


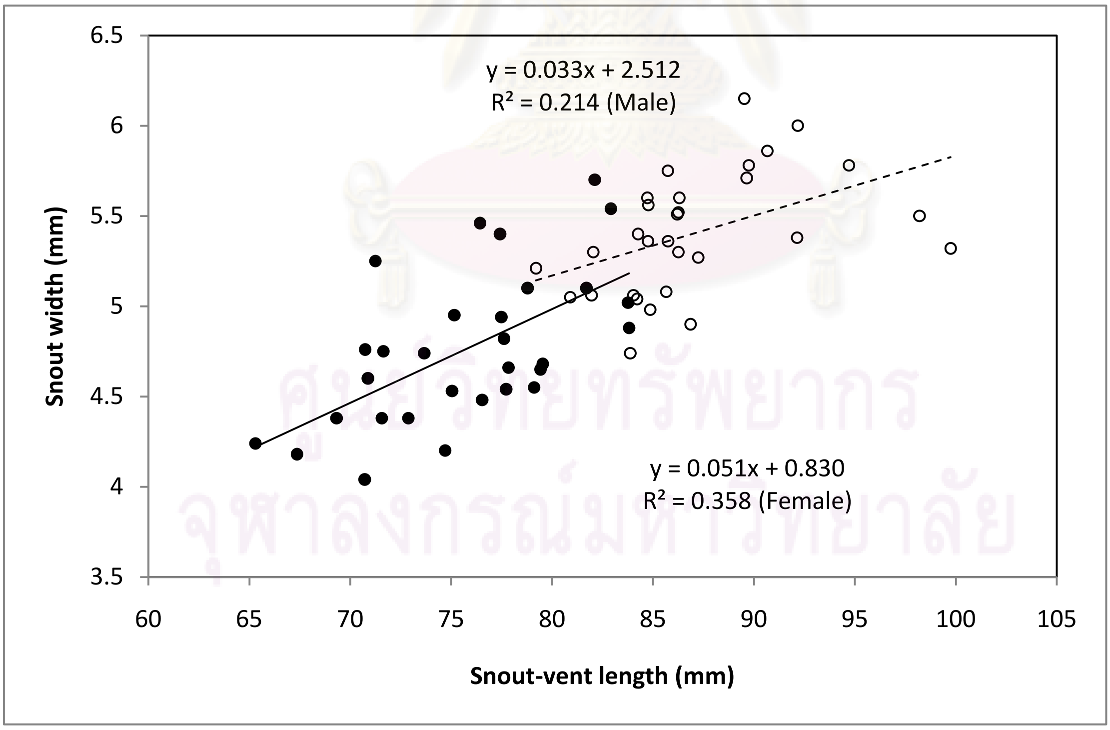
7. Linear regression line between Snout-vent length with Naris-eye length of both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



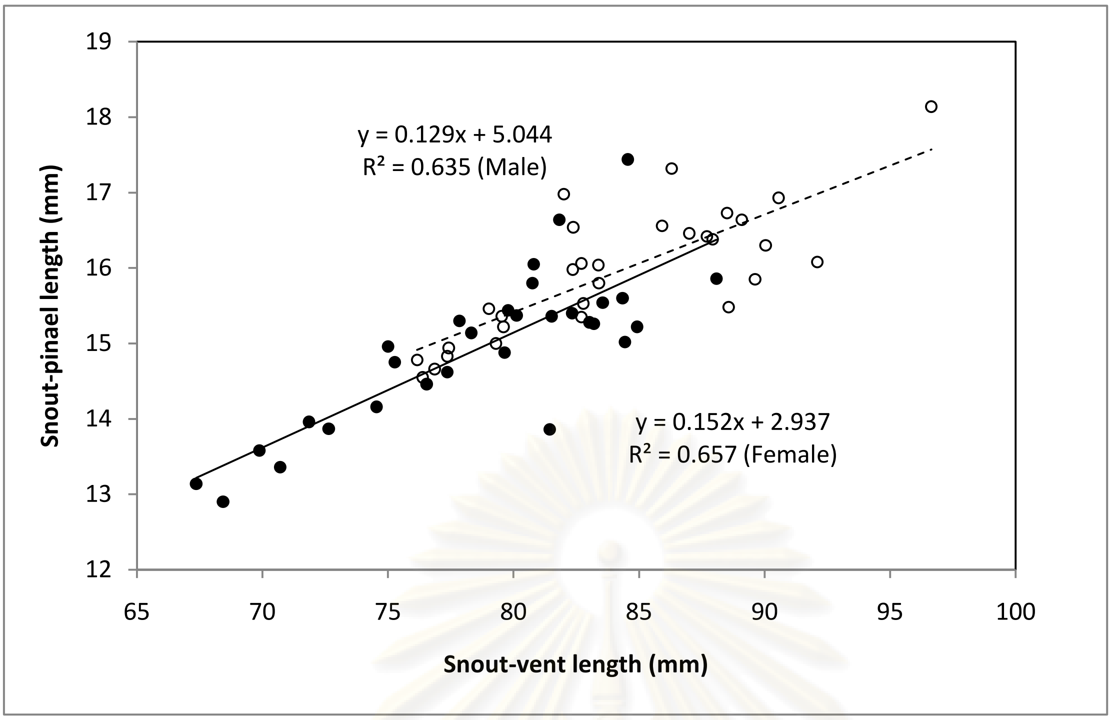


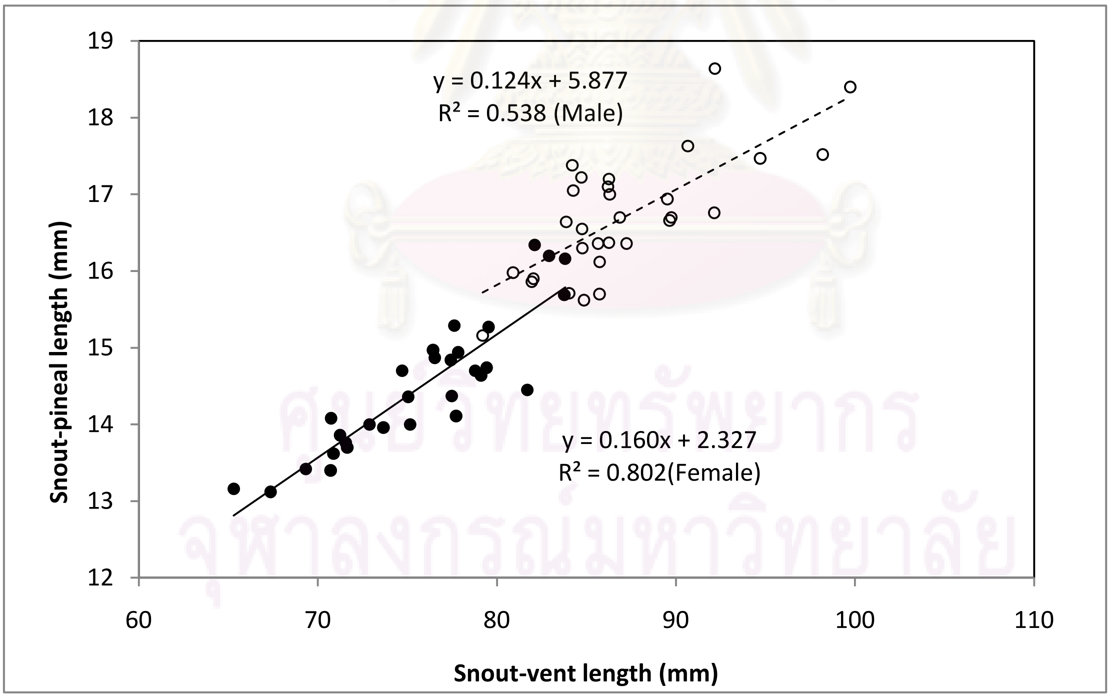
8. Linear regression line between Snout-vent length with Snout-eye length of both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



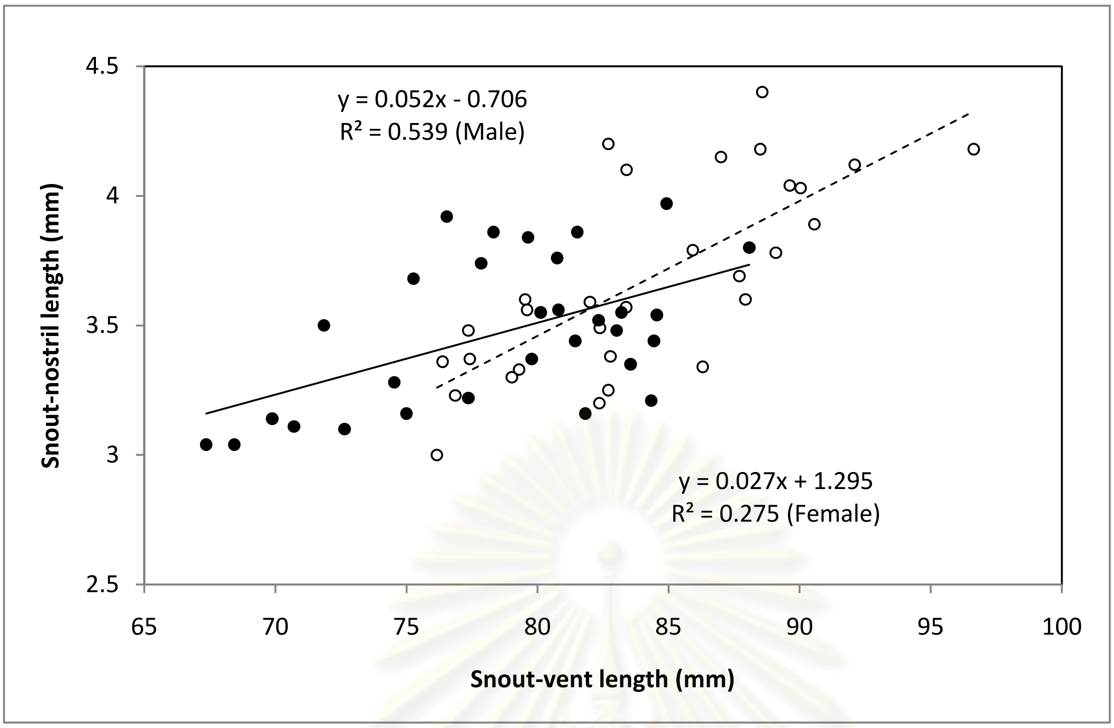


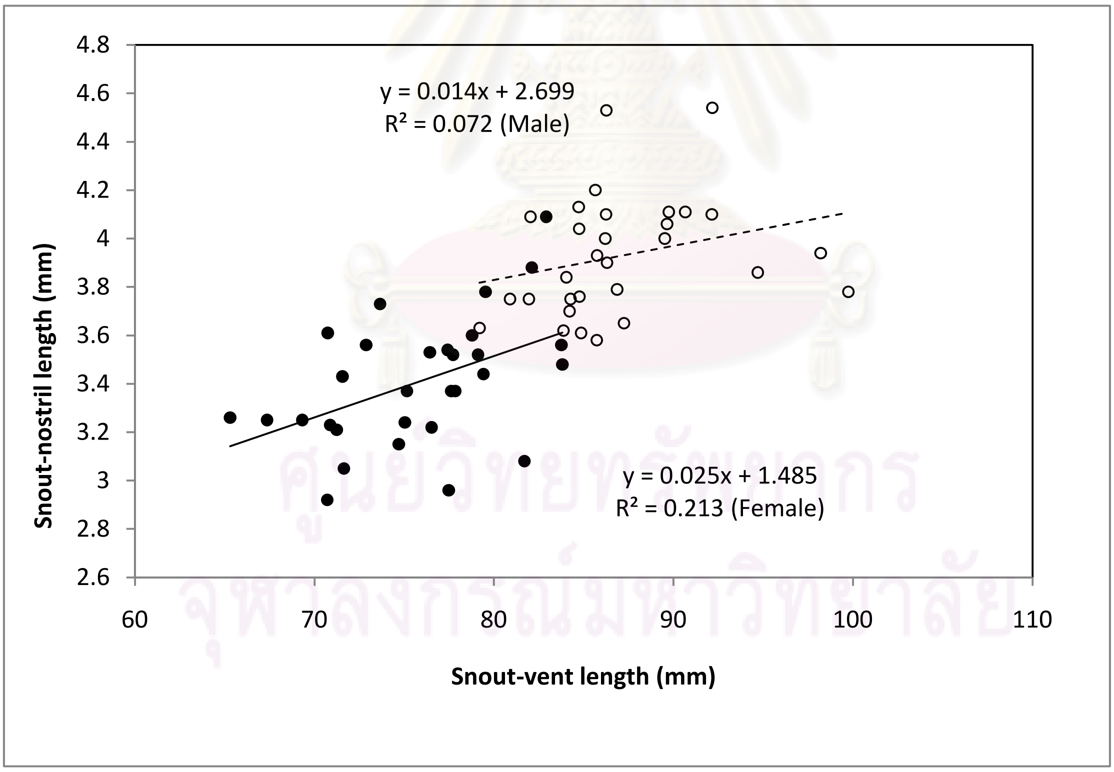
9. Linear regression line between Snout-vent length with Snout width of both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



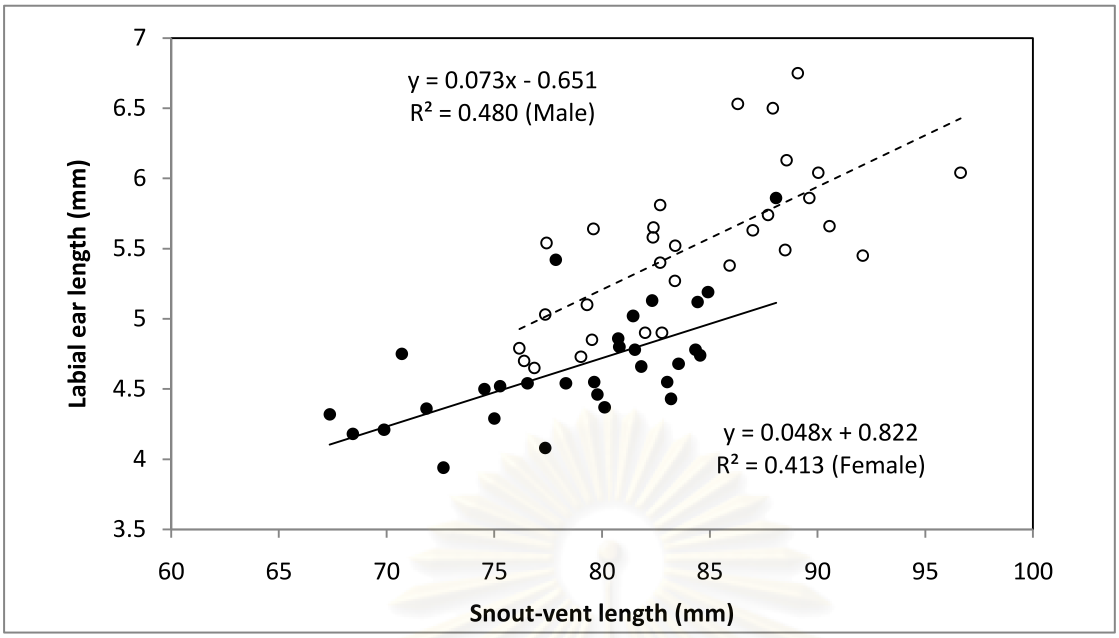


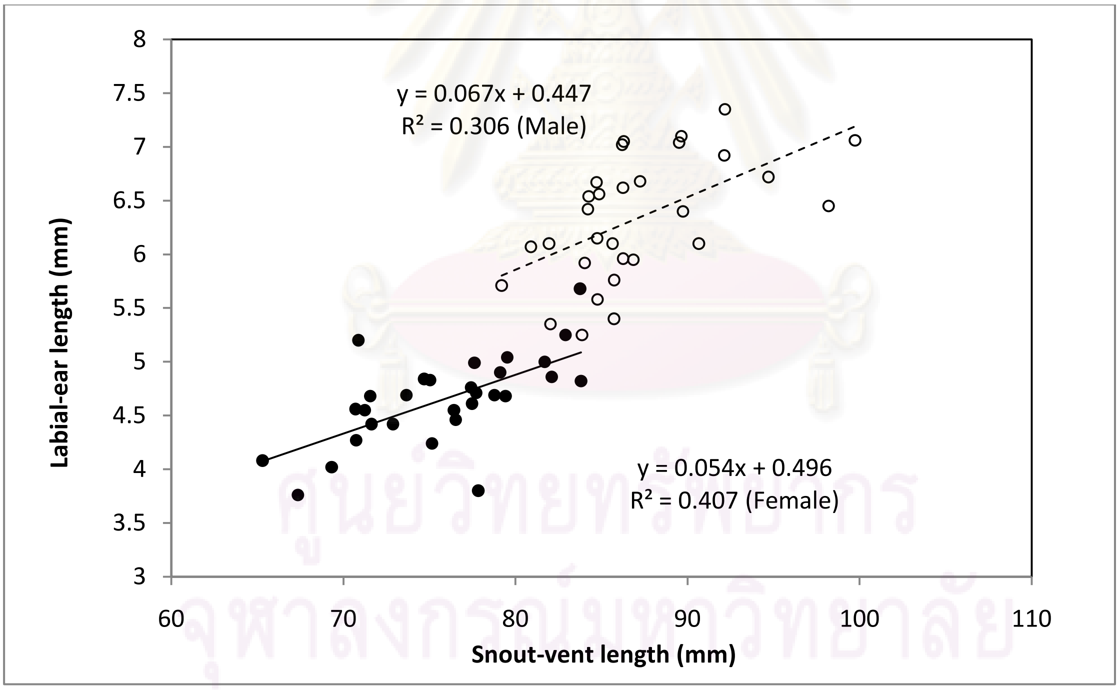
10. Linear regression line between Snout-vent length with Snout-pineal length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



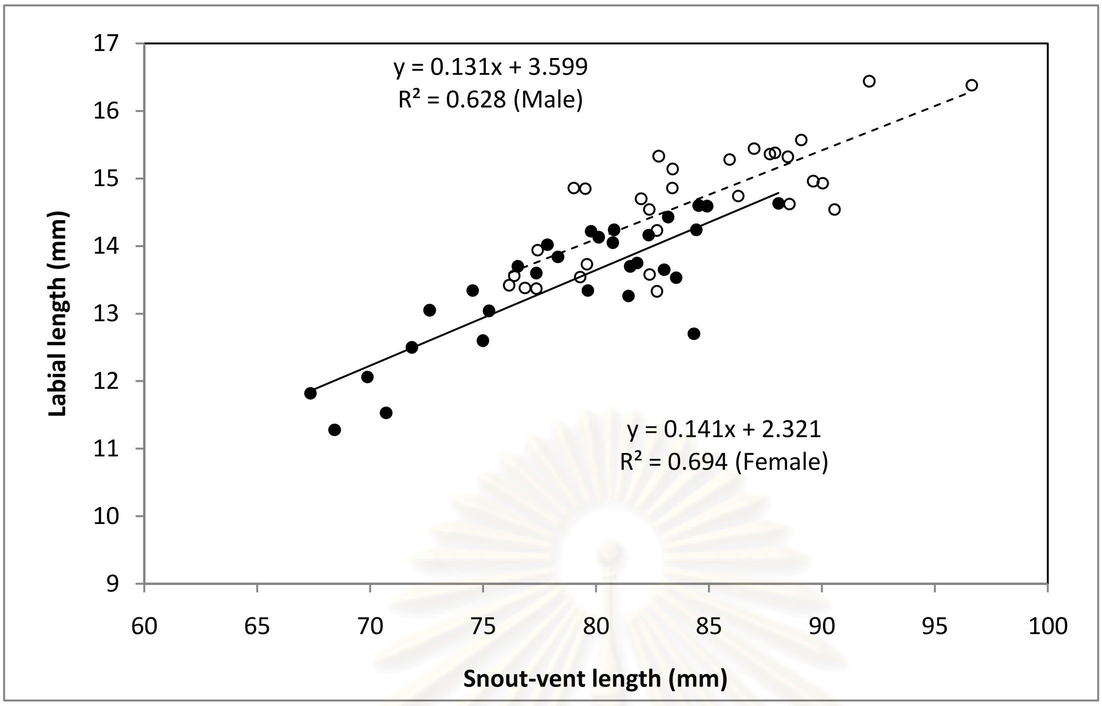


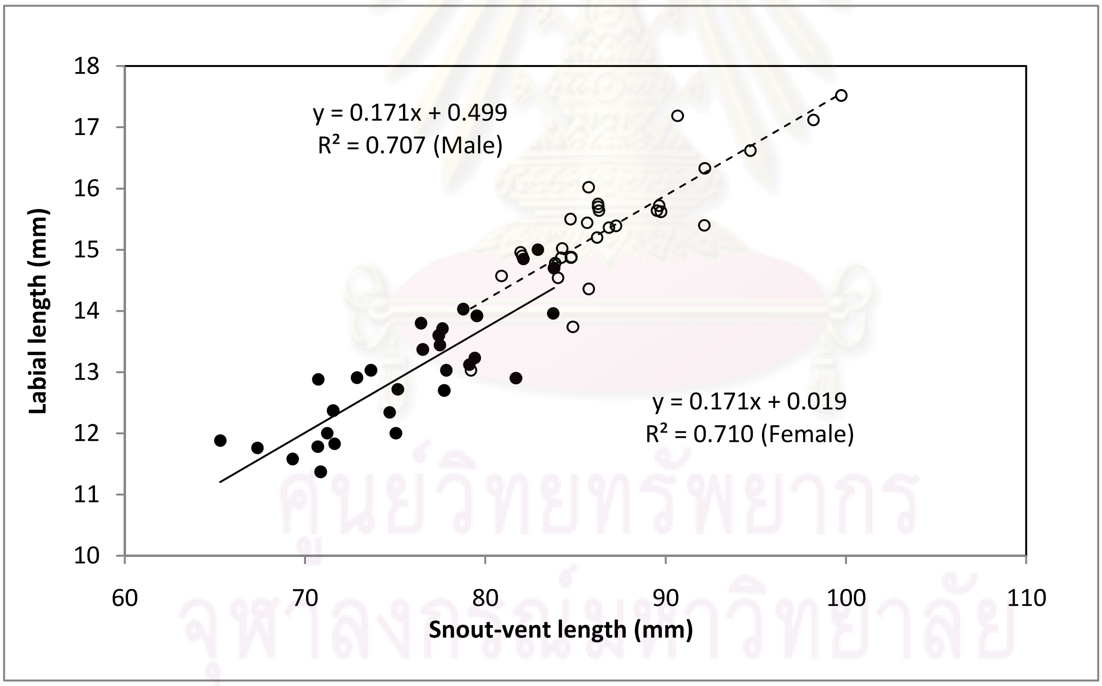
11. Linear regression line between Snout-vent length with Snout-nostril length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



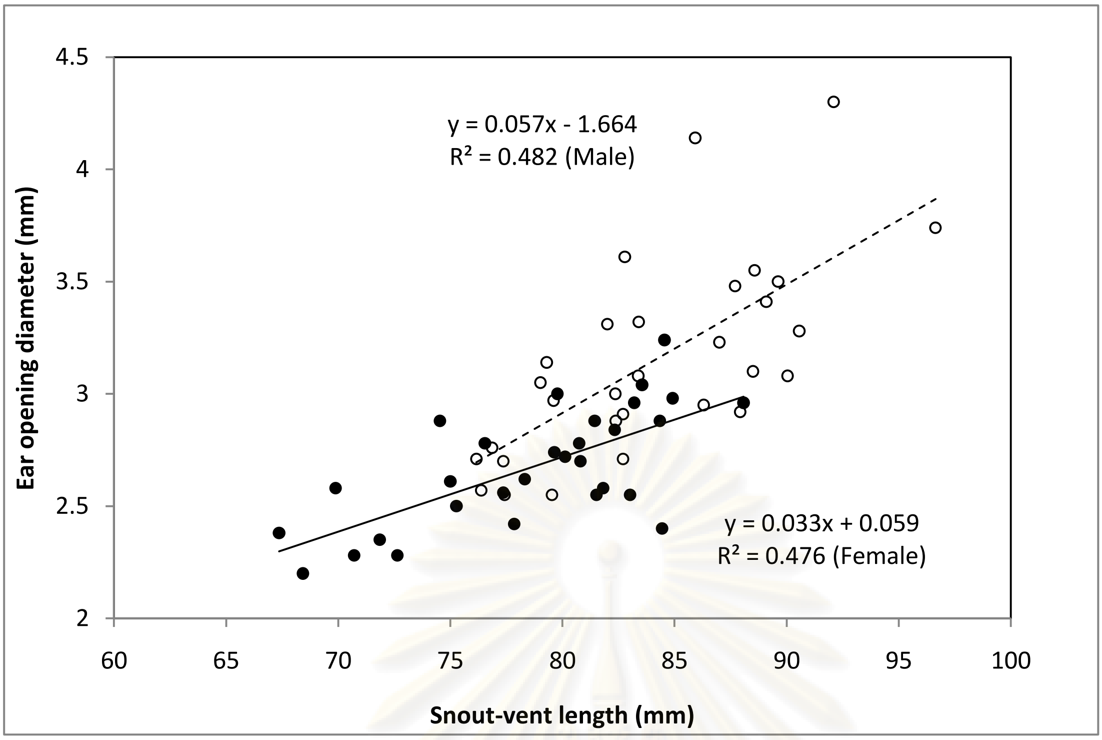


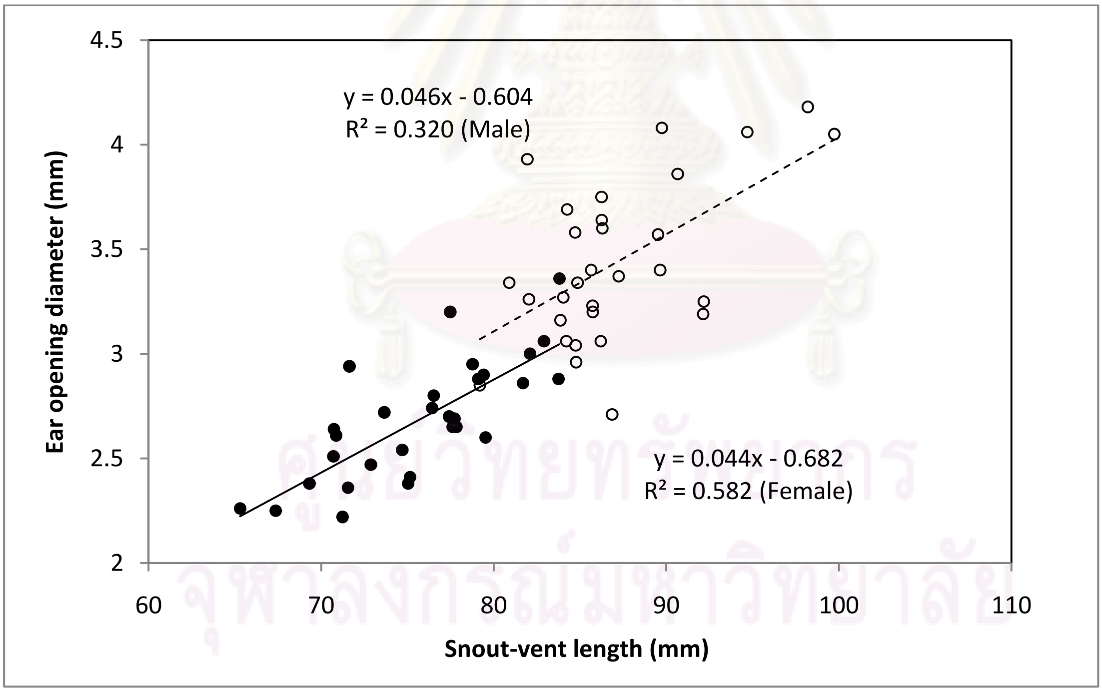
12. Linear regression line between Snout-vent length with Labial-ear length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



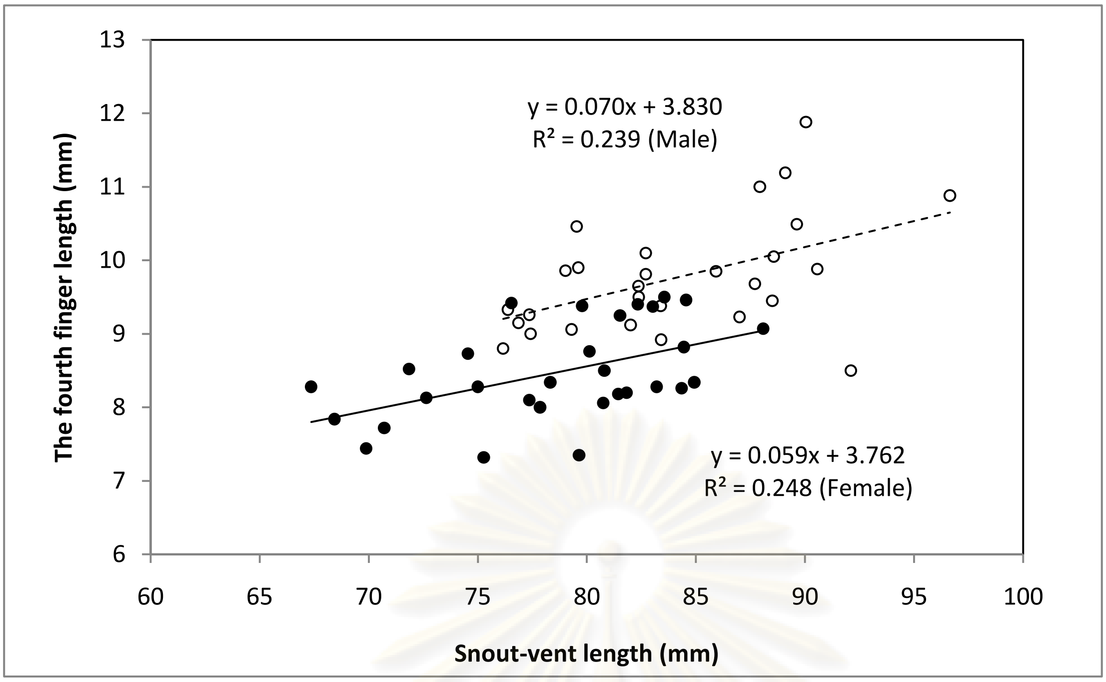


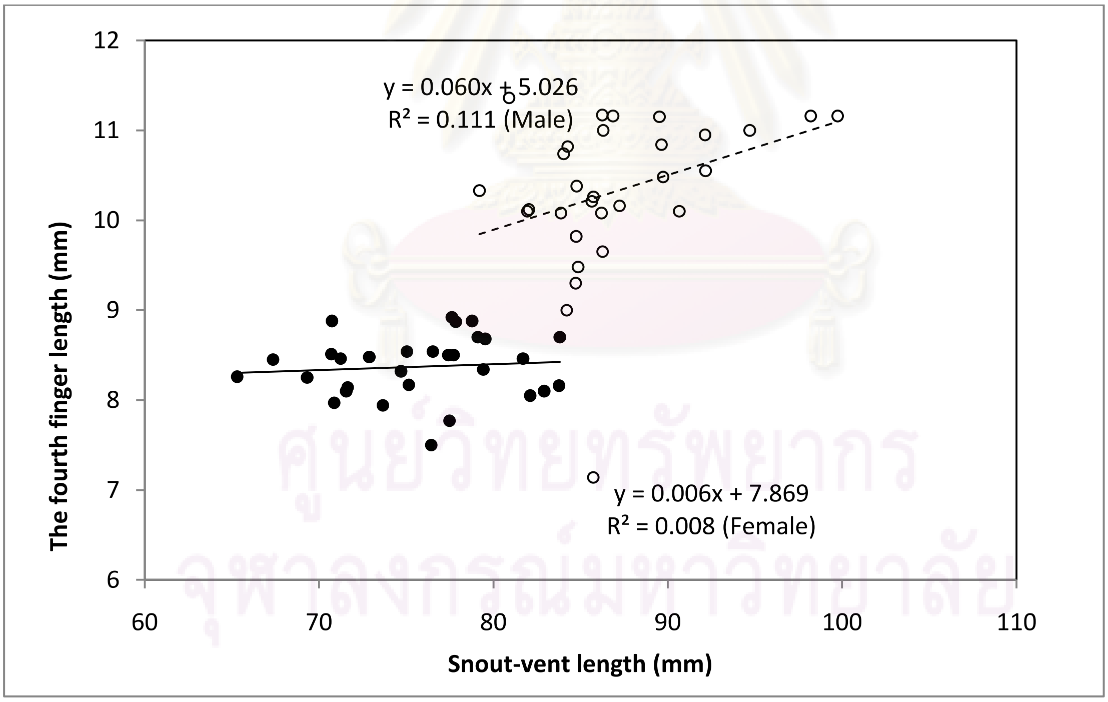
13. Linear regression line between Snout-vent length with Labial length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



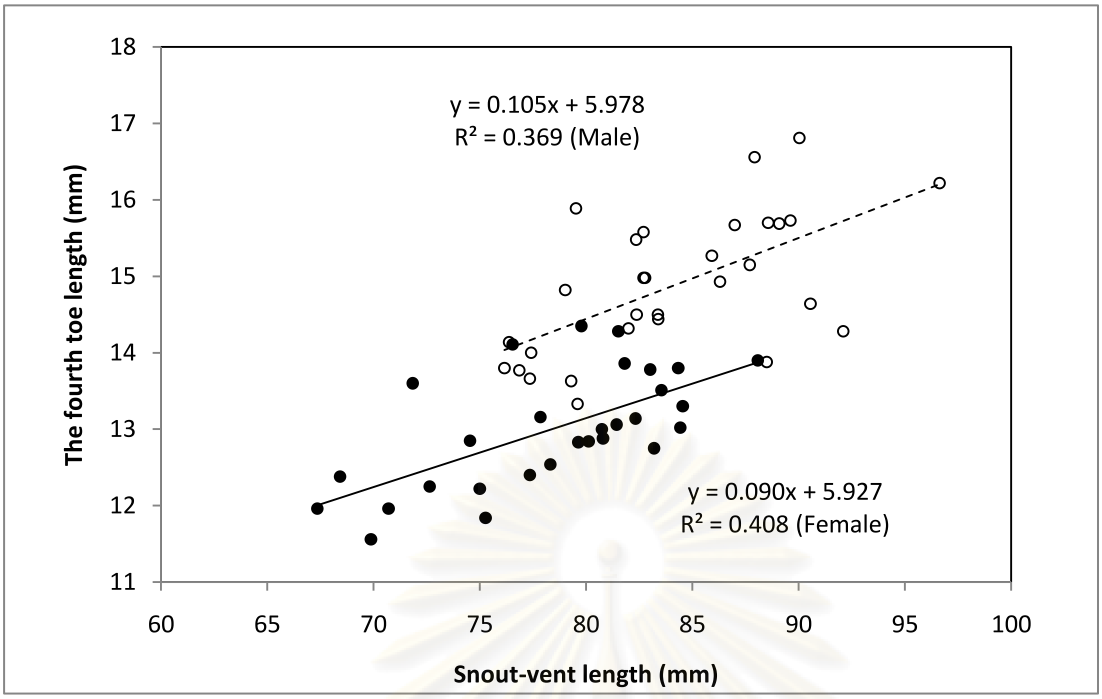


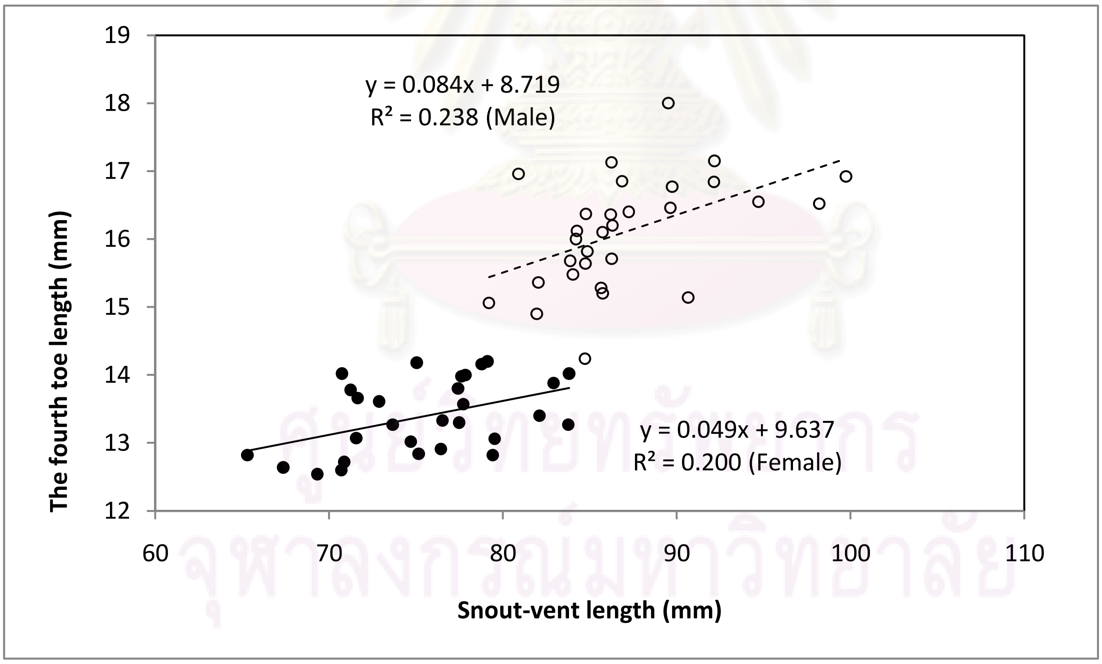
14. Linear regression line between Snout-vent length with Ear opening diameter both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



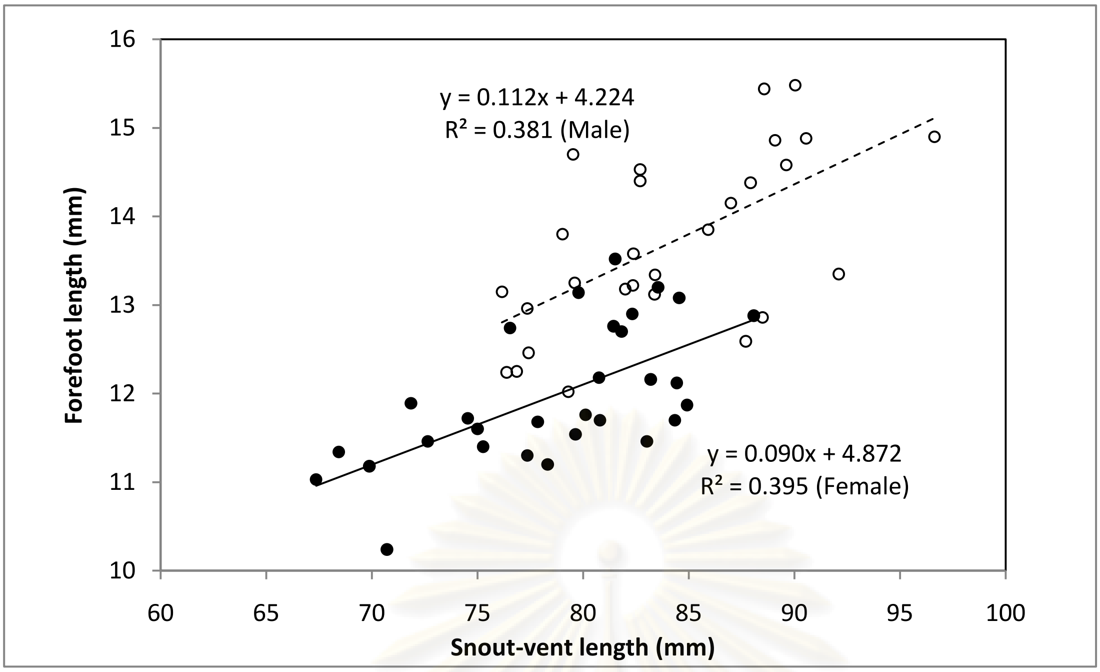


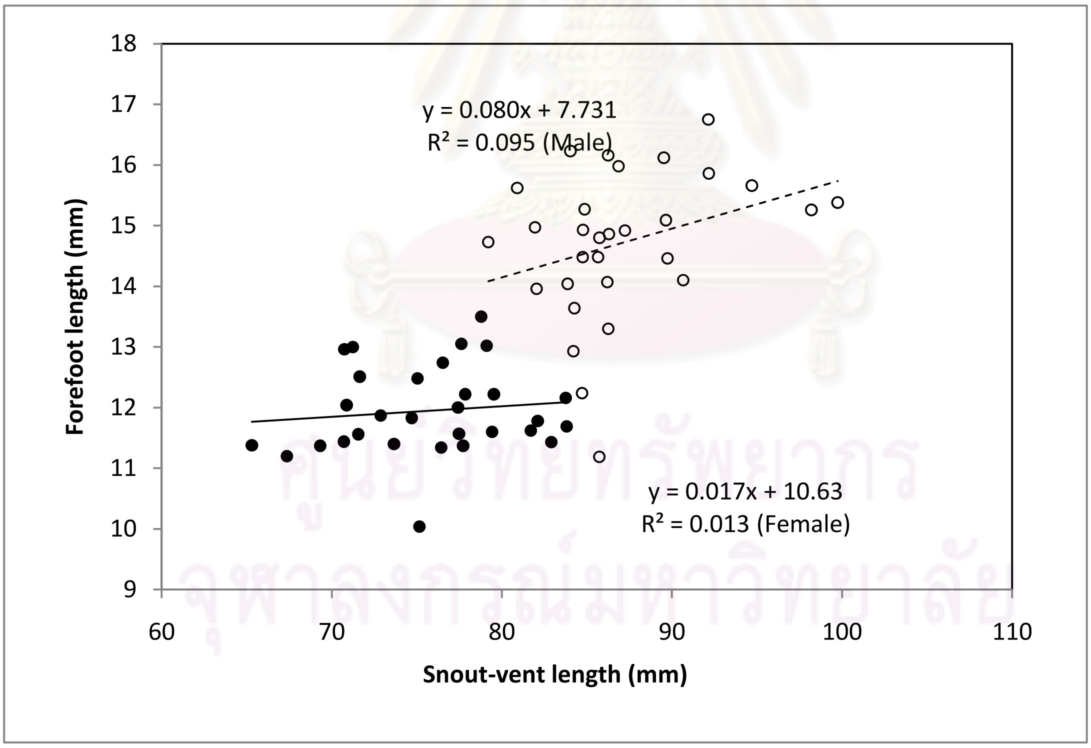
15. Linear regression line between Snout-vent length with The fourth finger length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



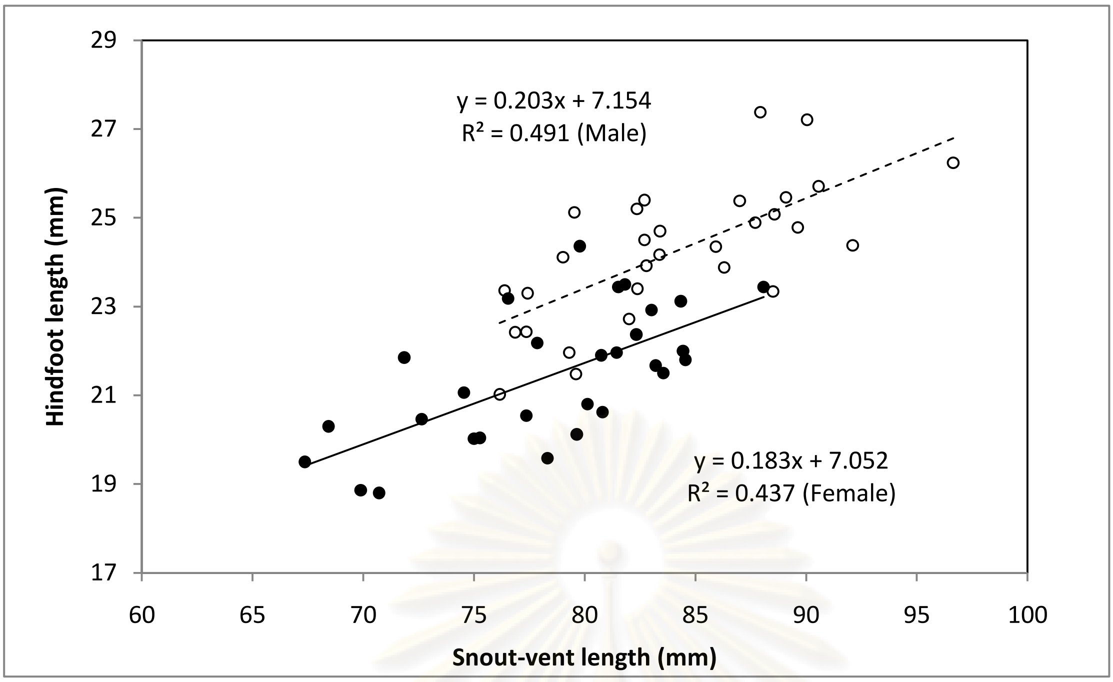


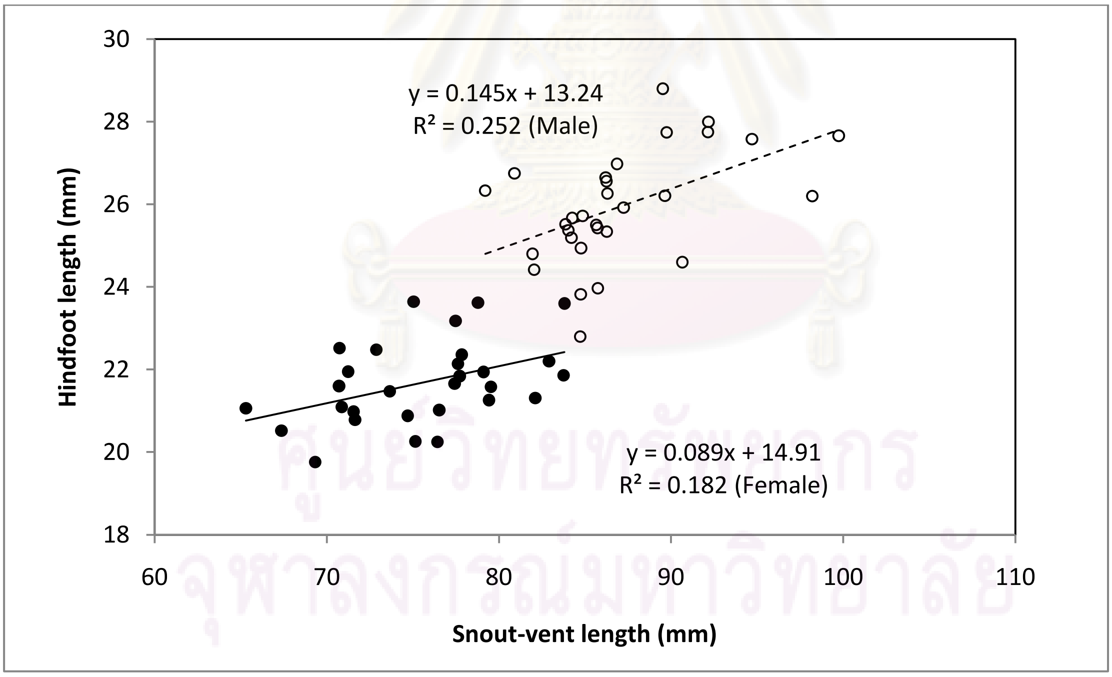
16. Linear regression line between Snout-vent length with The fourth toe length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



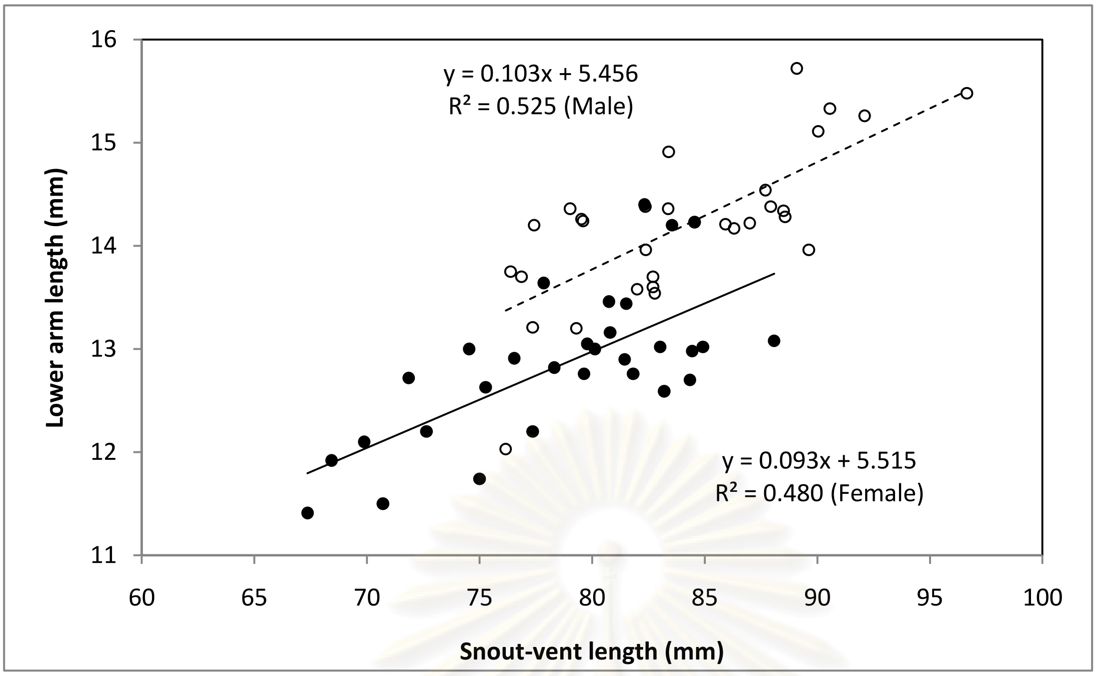


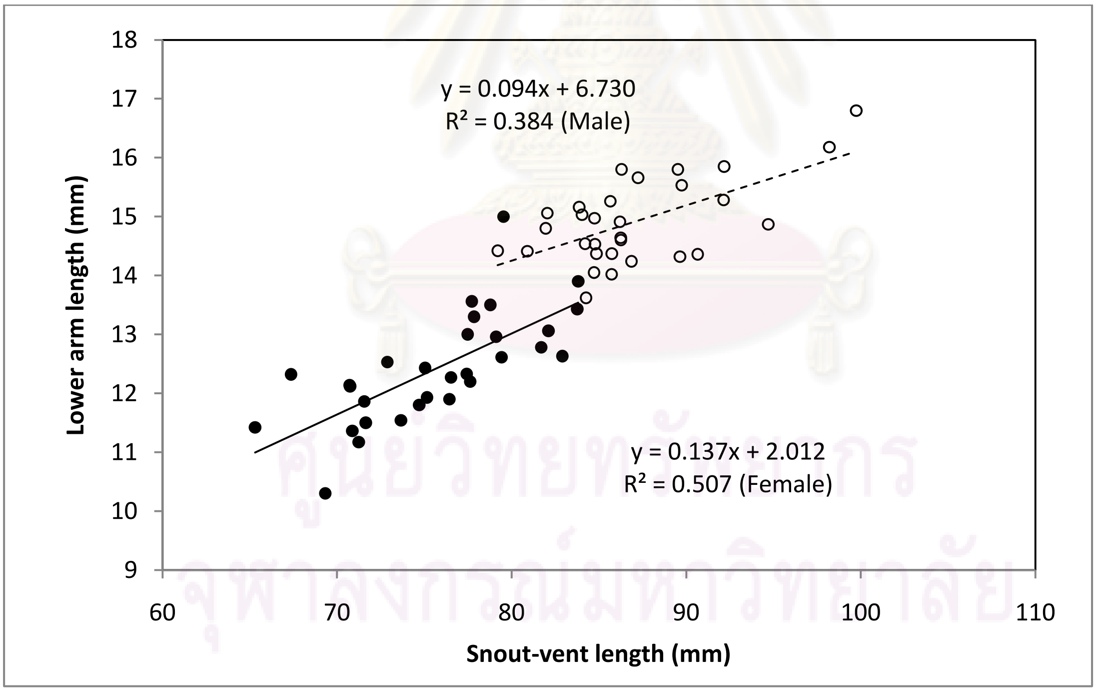
17. Linear regression line between Snout-vent length with Forefoot length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



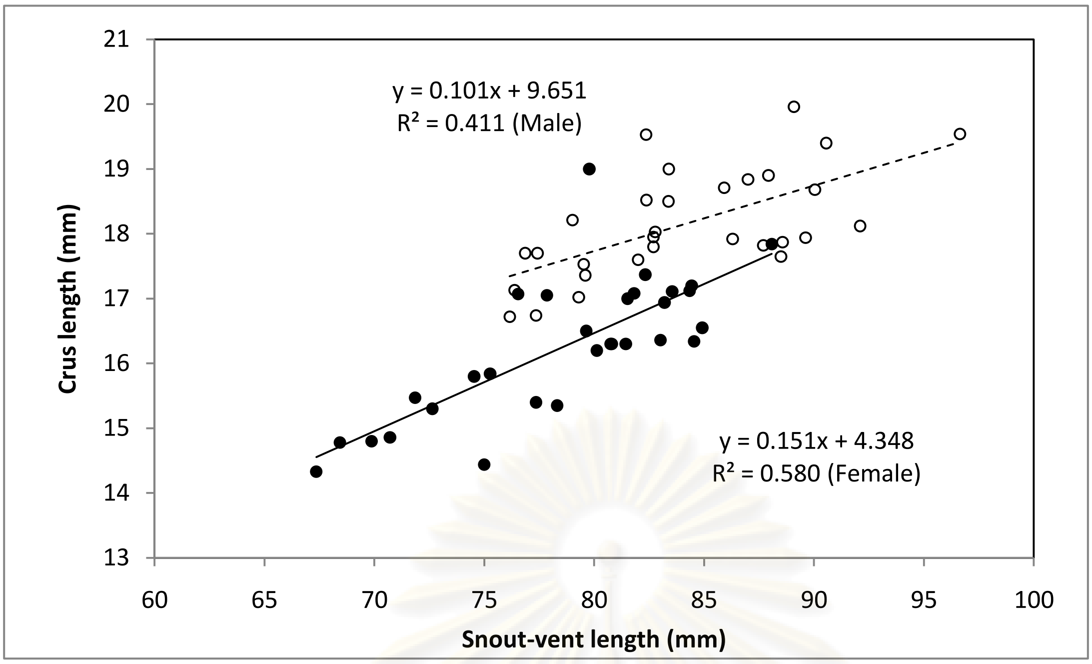


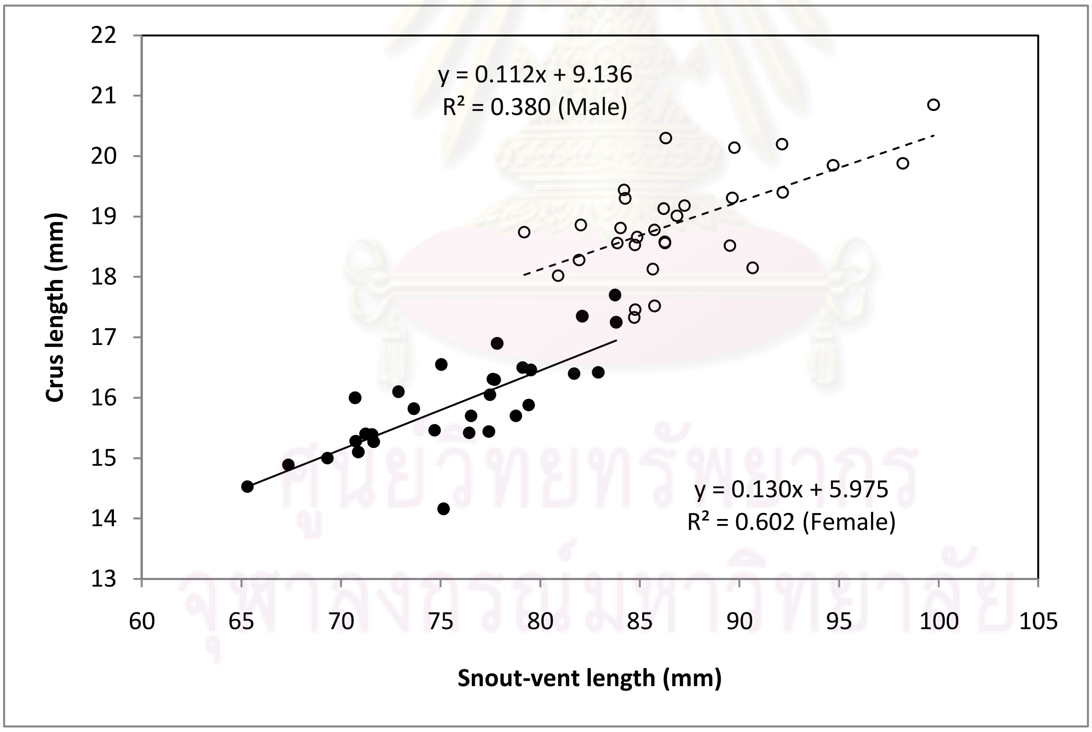
18. Linear regression line between Snout-vent length with Hindfoot length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



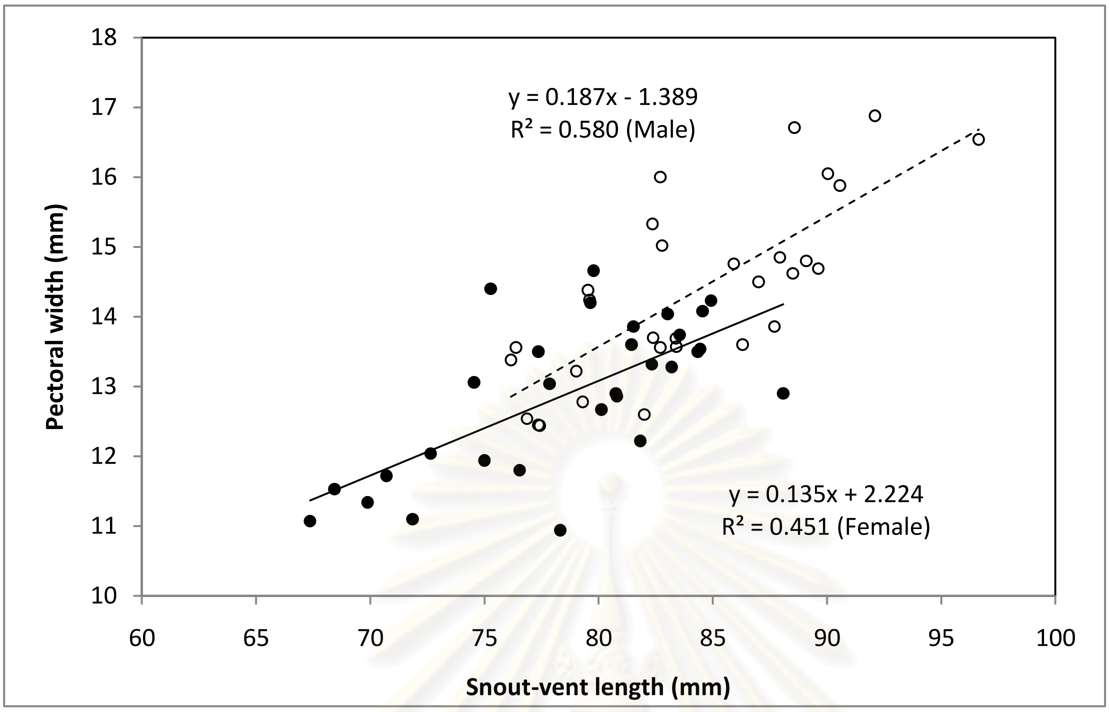


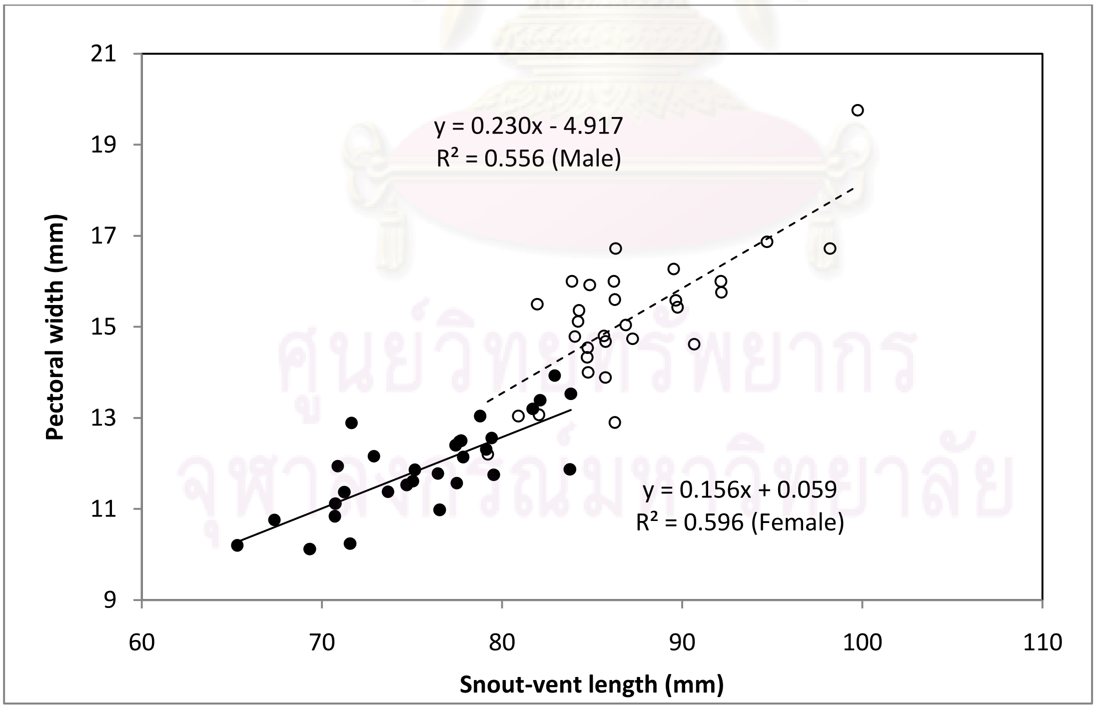
19. Linear regression line between Snout-vent length with Lower arm length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



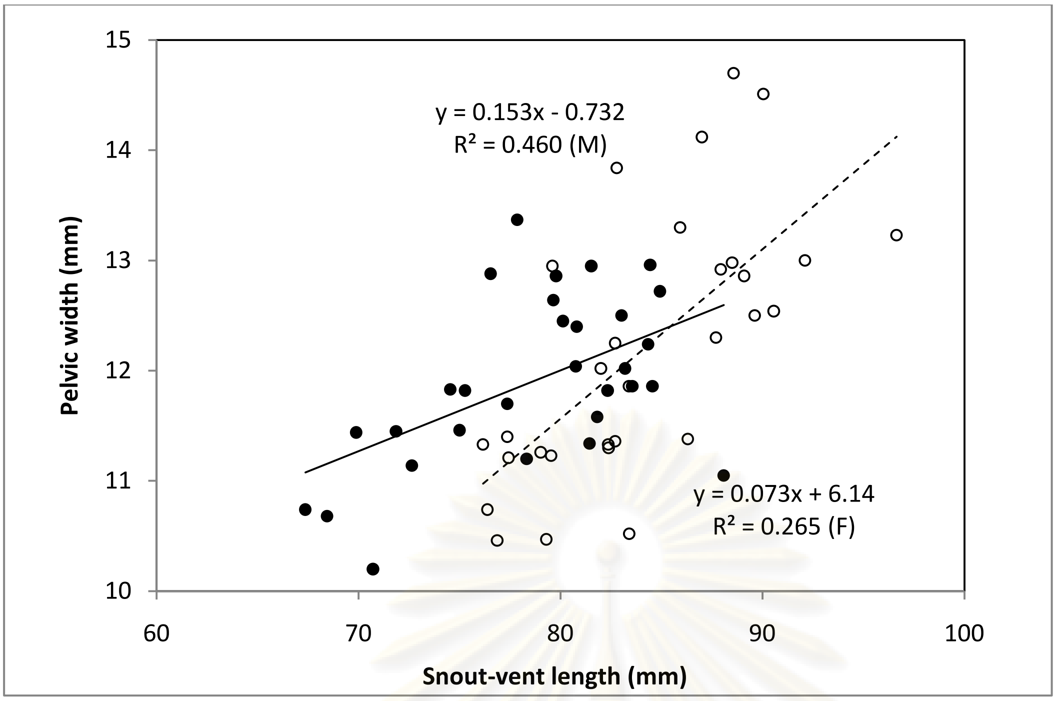


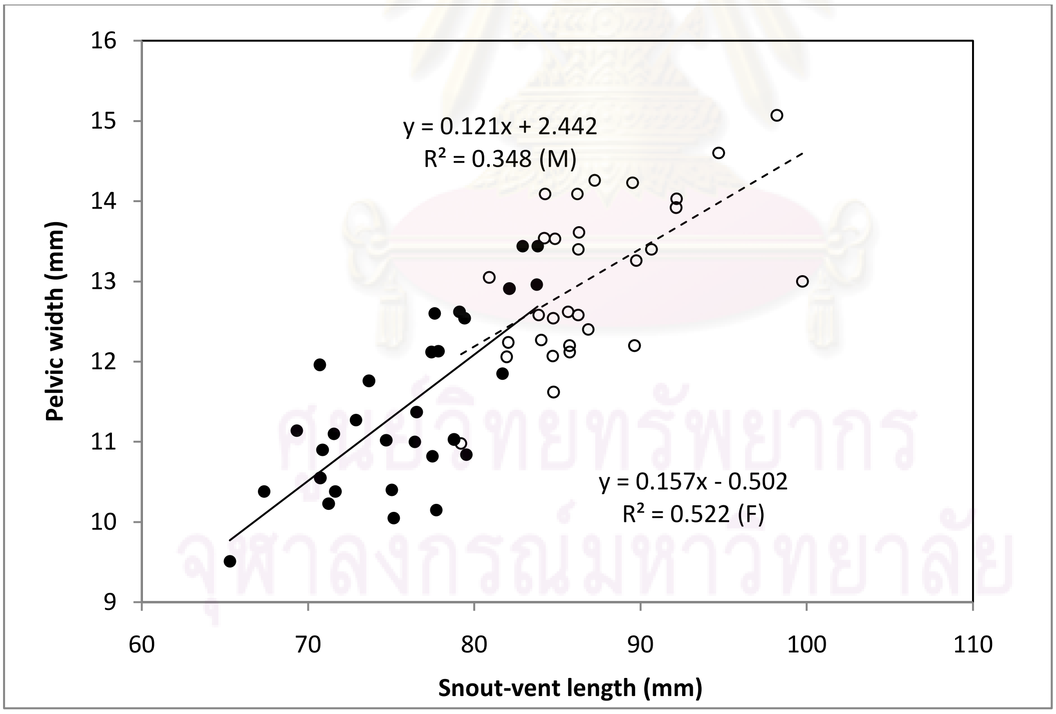
20. Linear regression line between Snout-vent length with Crus length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.





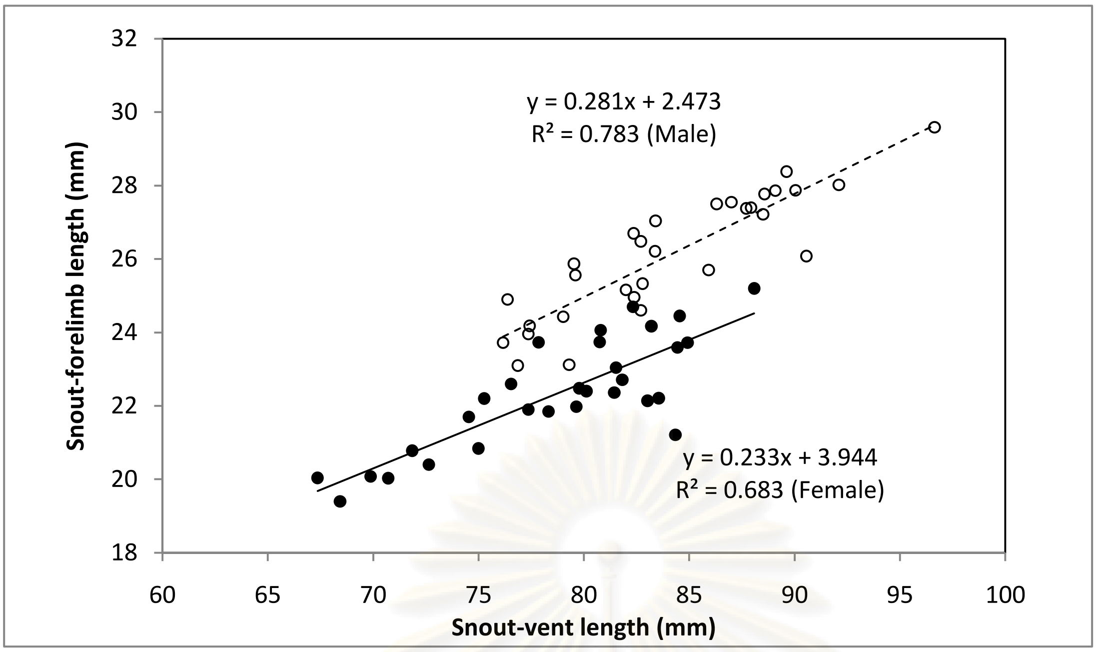
21. Linear regression line between Snout-vent length with Pectoral width both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.

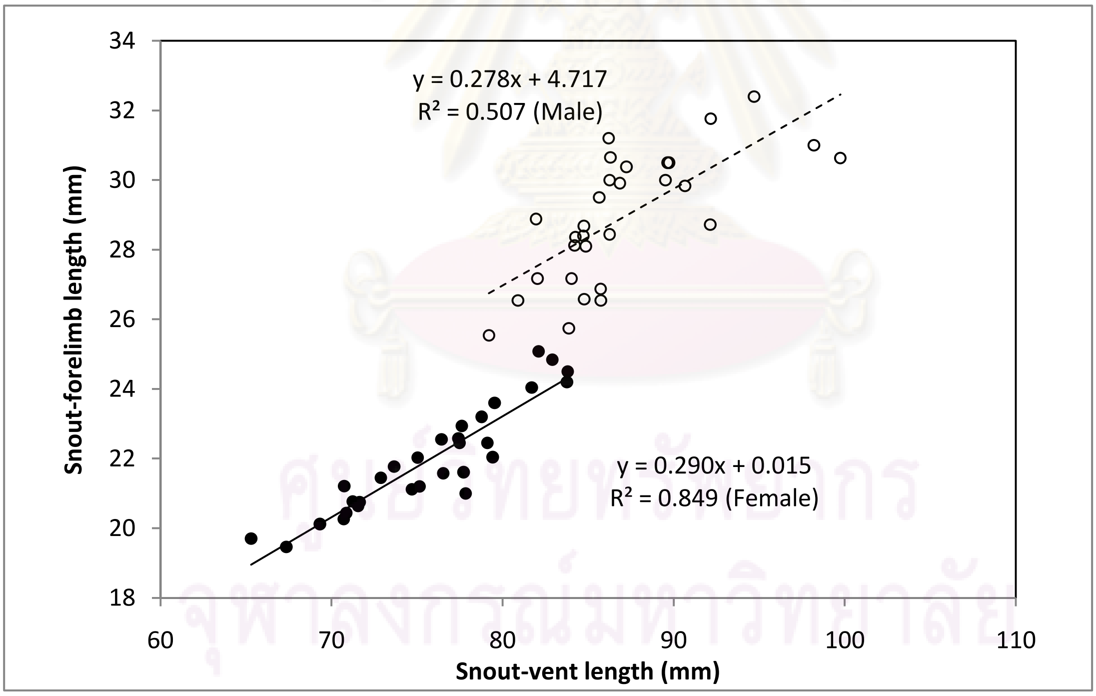




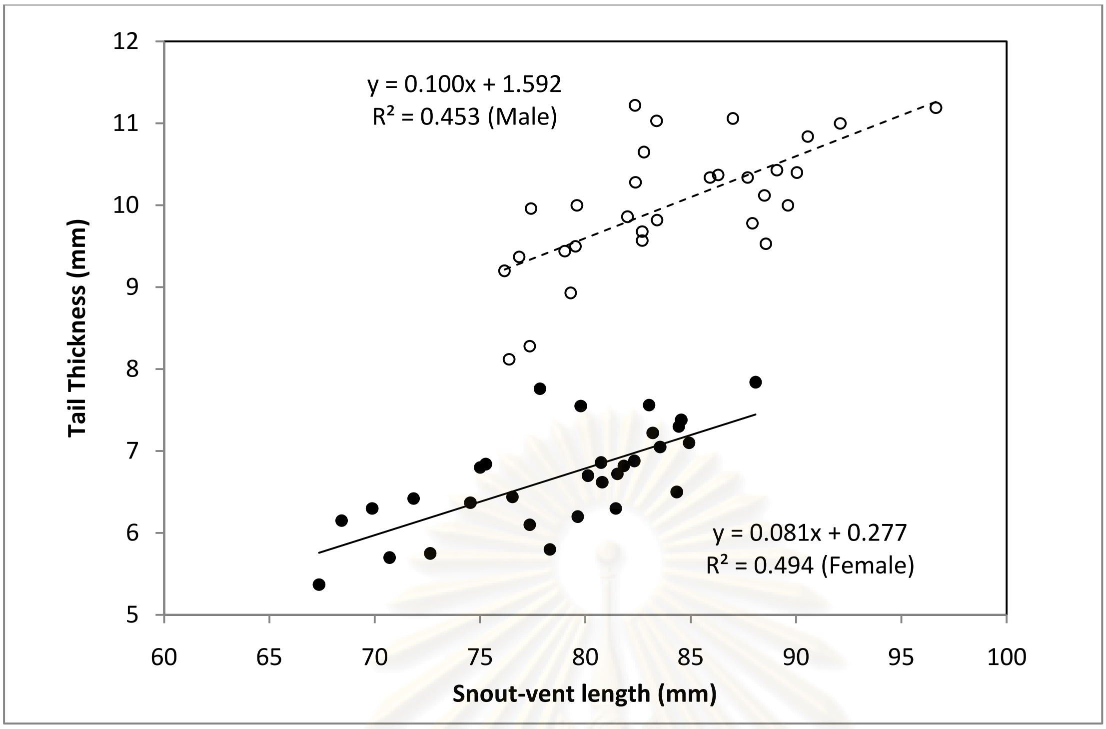
22. Linear regression line between Snout-vent length with Pelvic width both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.

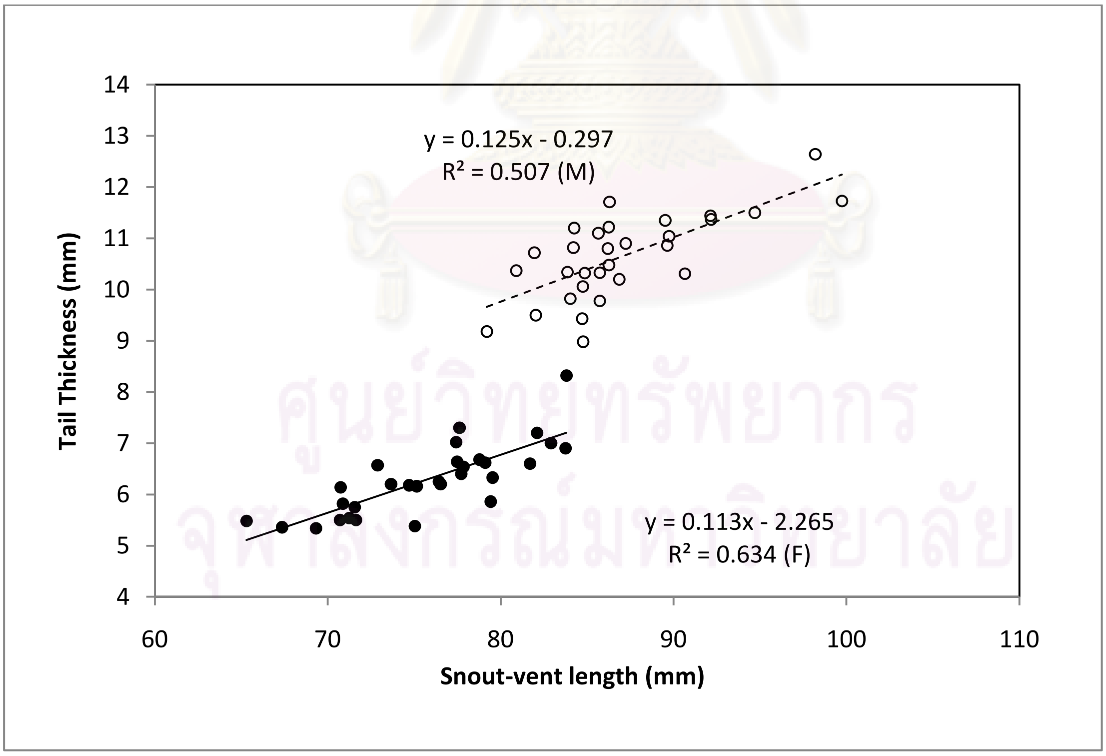
.



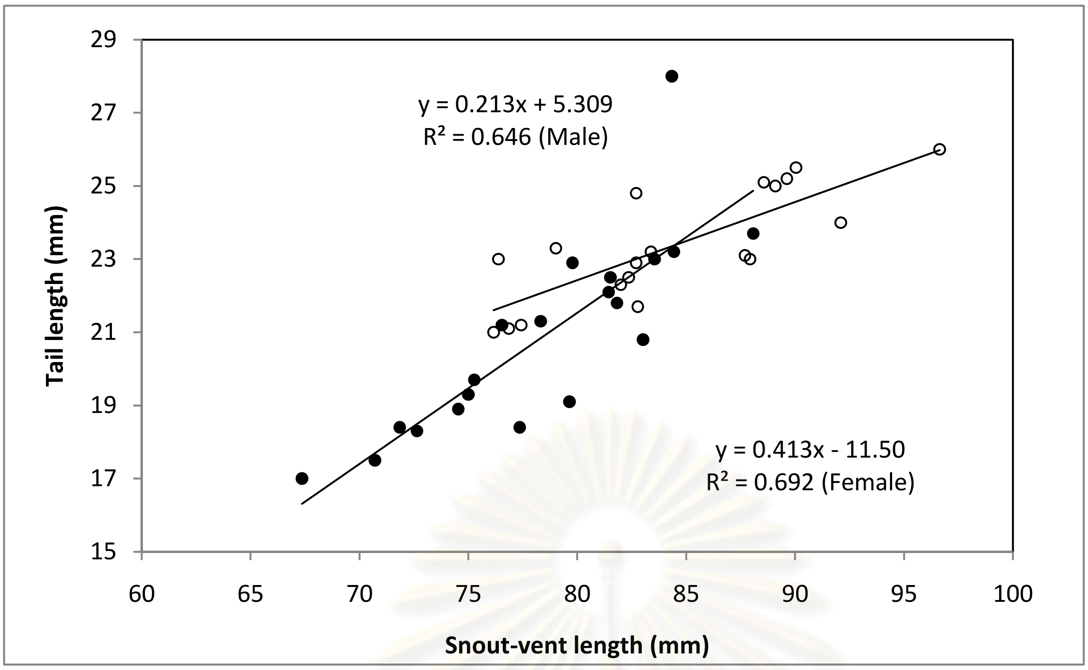


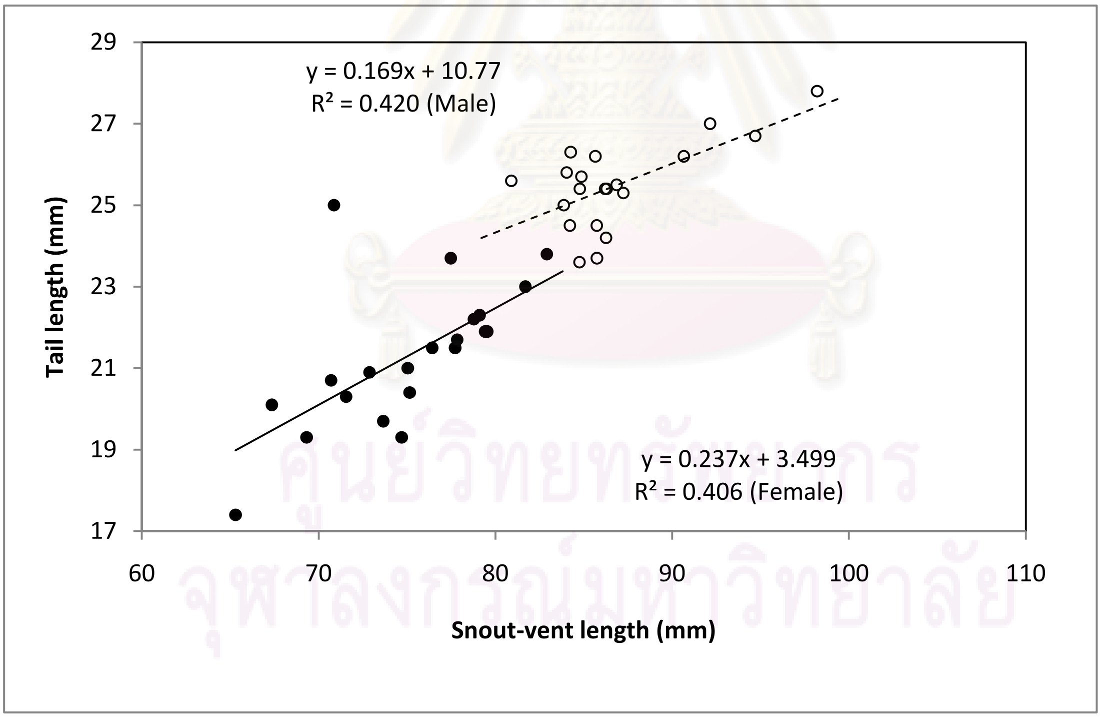
23. Linear regression line between Snout-vent length with Snout-forelimb length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



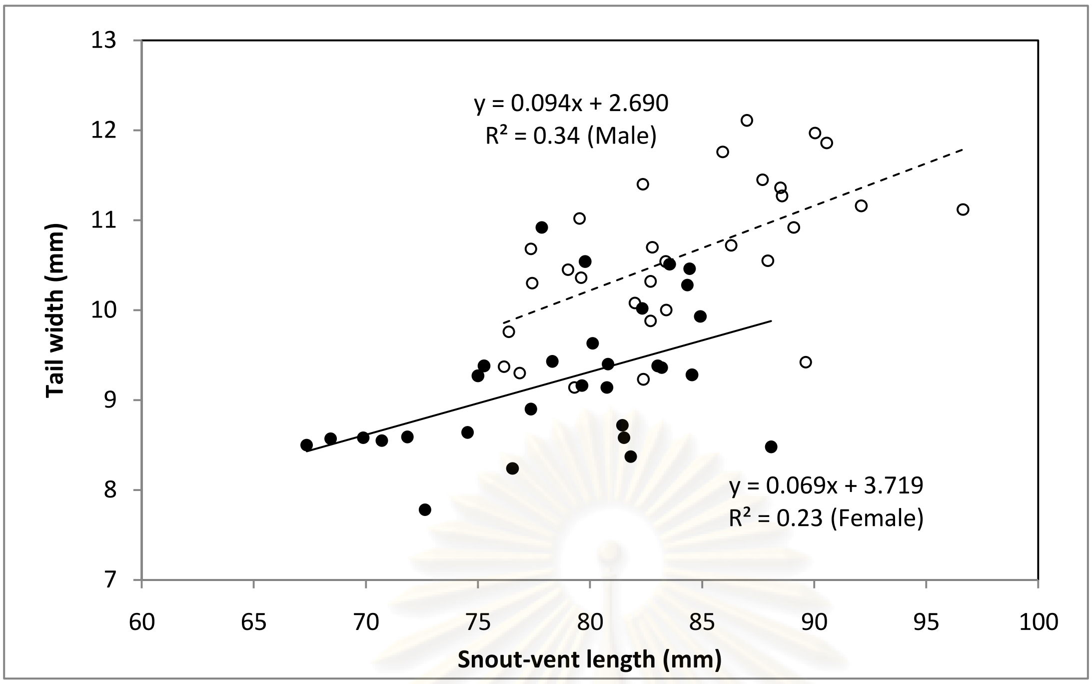


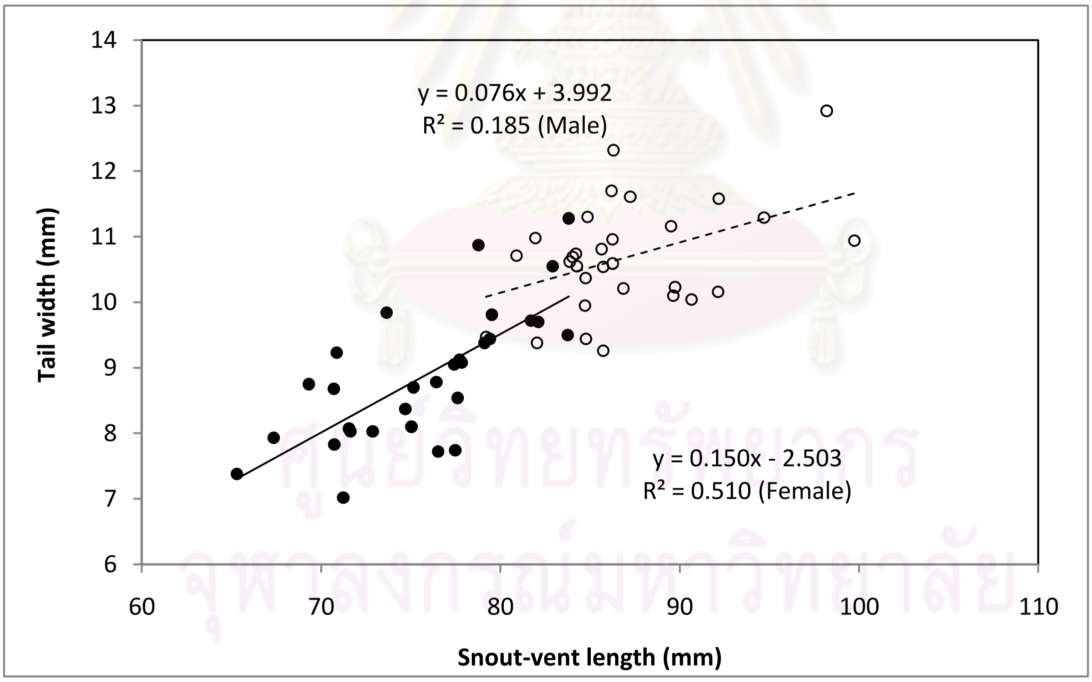
24. Linear regression line between Snout-vent length with Tailthickness both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



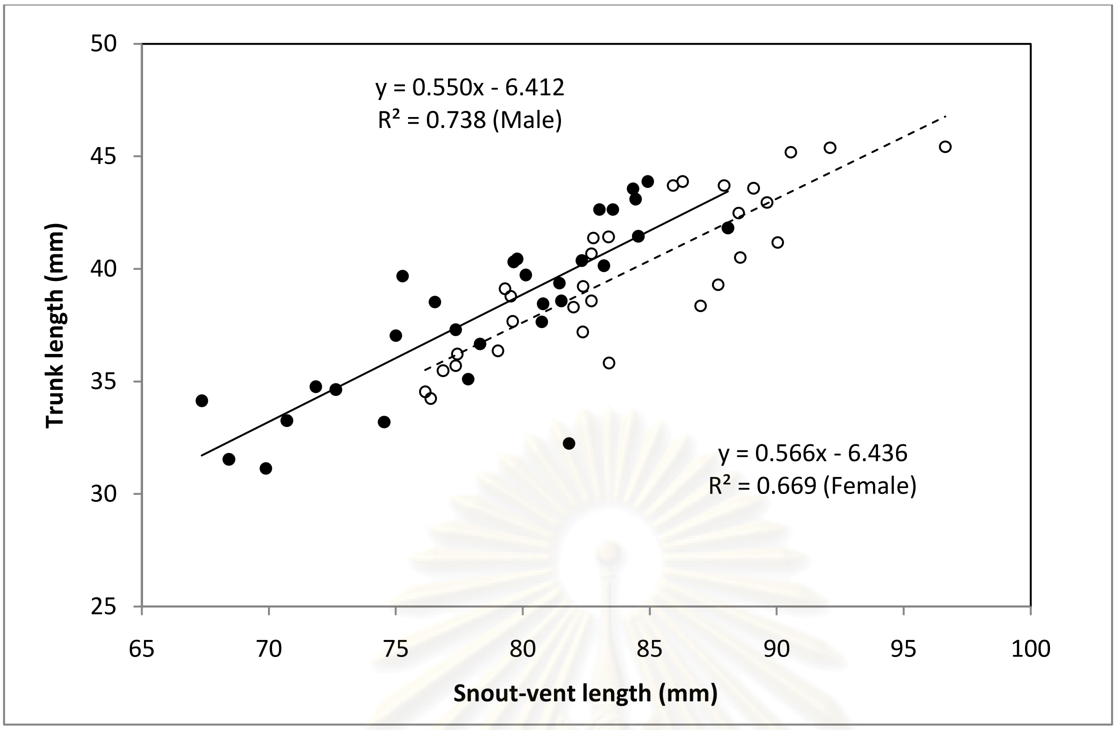


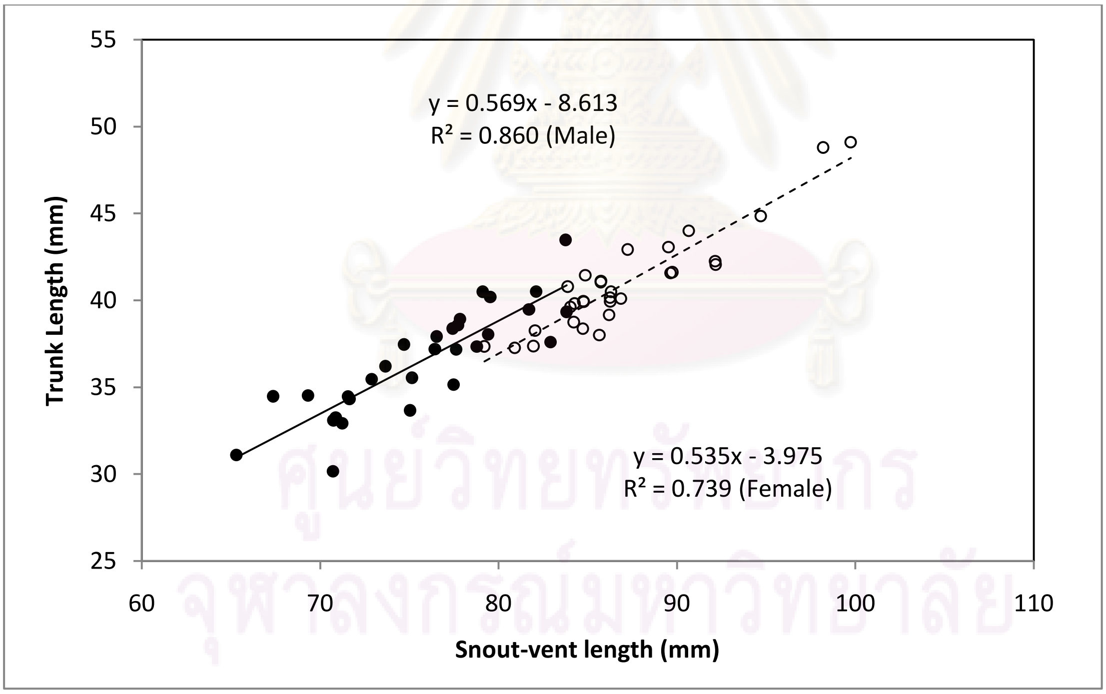
25. Linear regression line between Snout-vent length with Tail length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



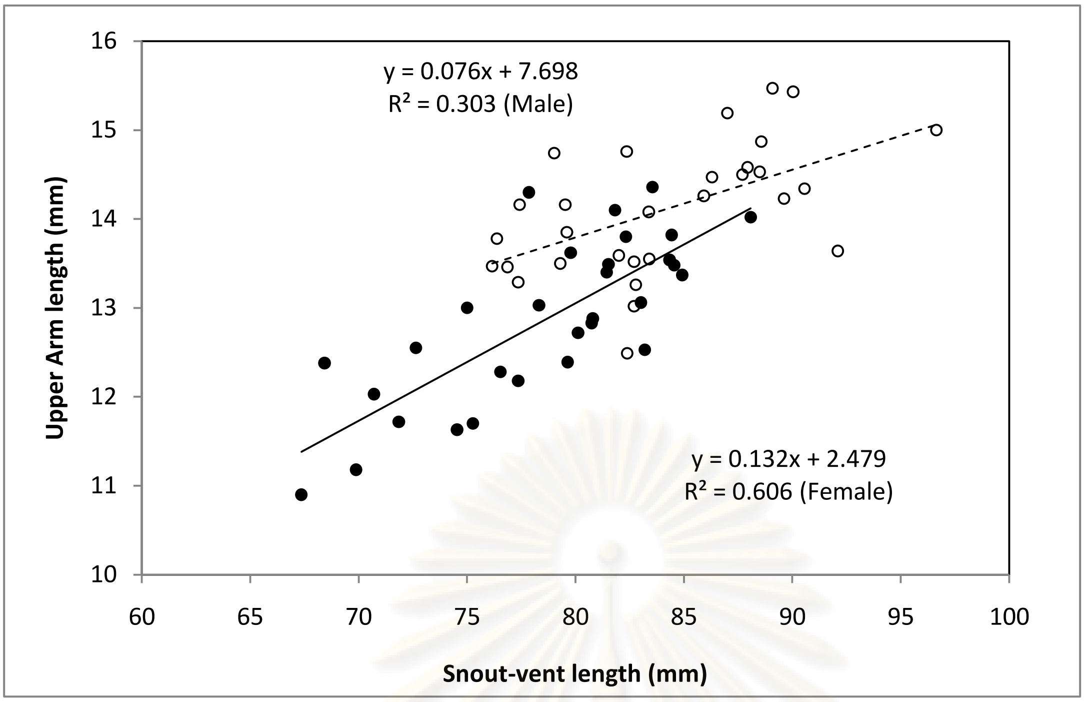


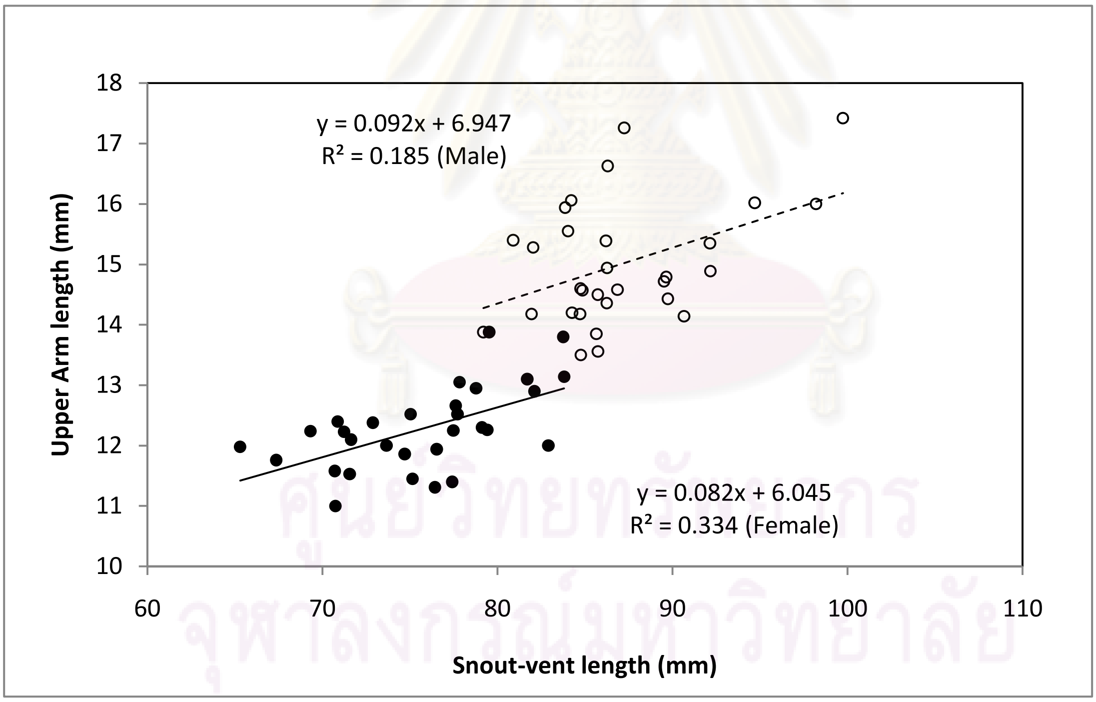
26. Linear regression line between Snout-vent length with Tail width both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



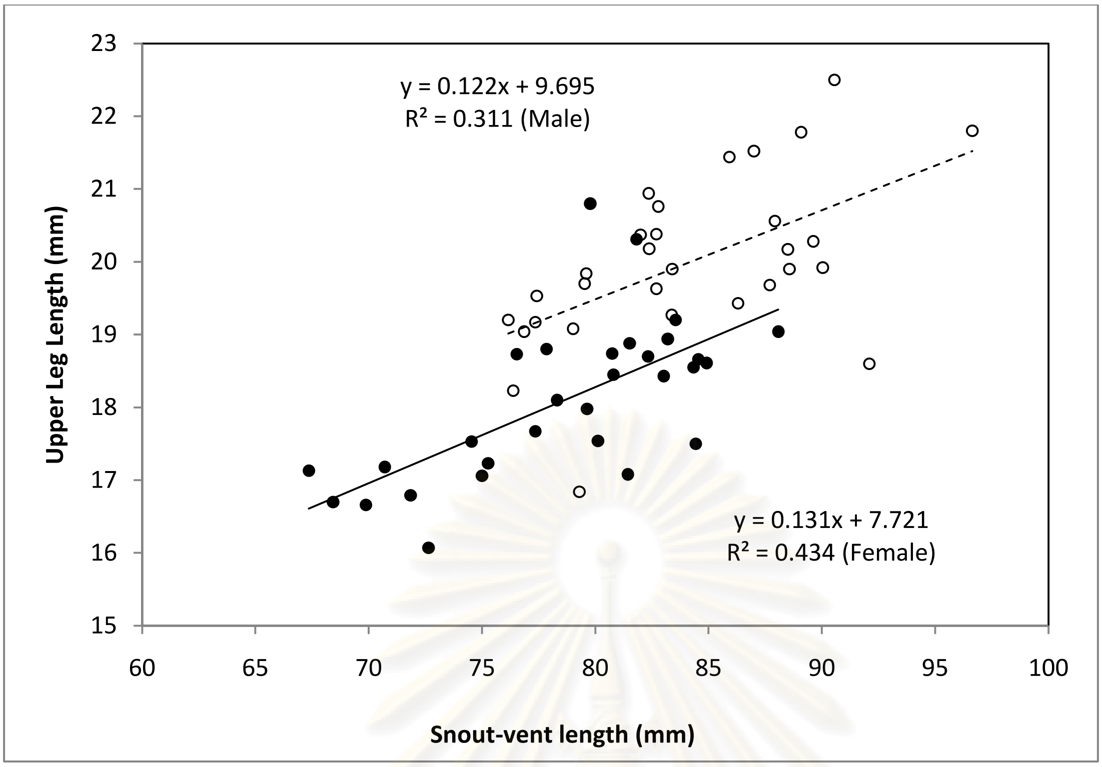


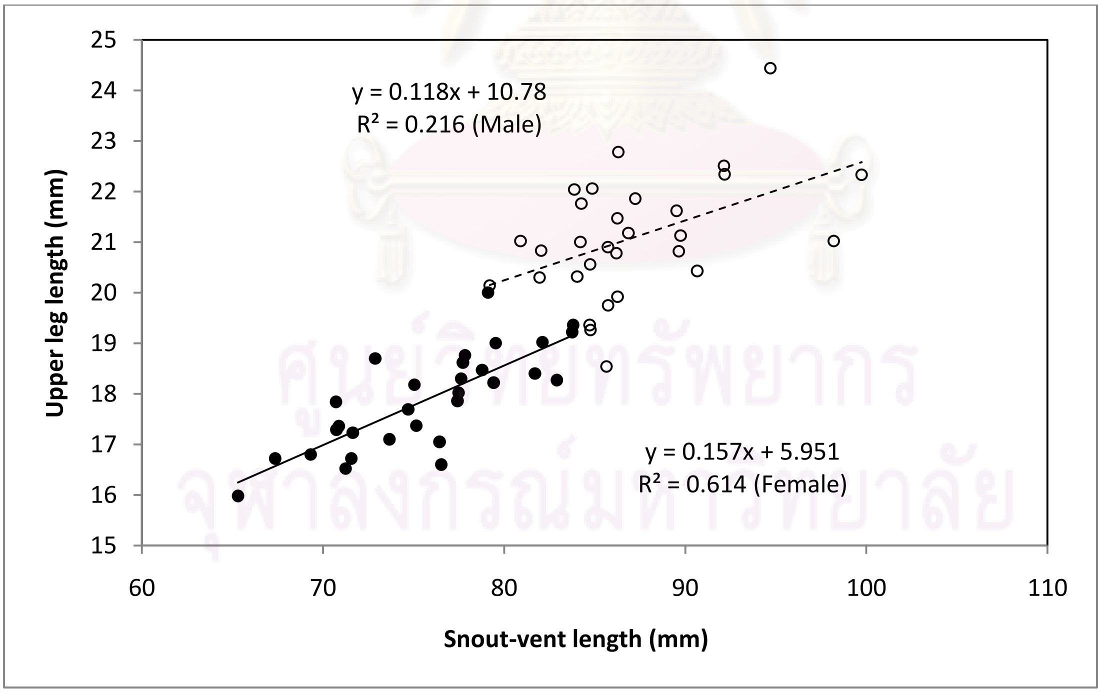
27. Linear regression line between Snout-vent length with Trunk length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



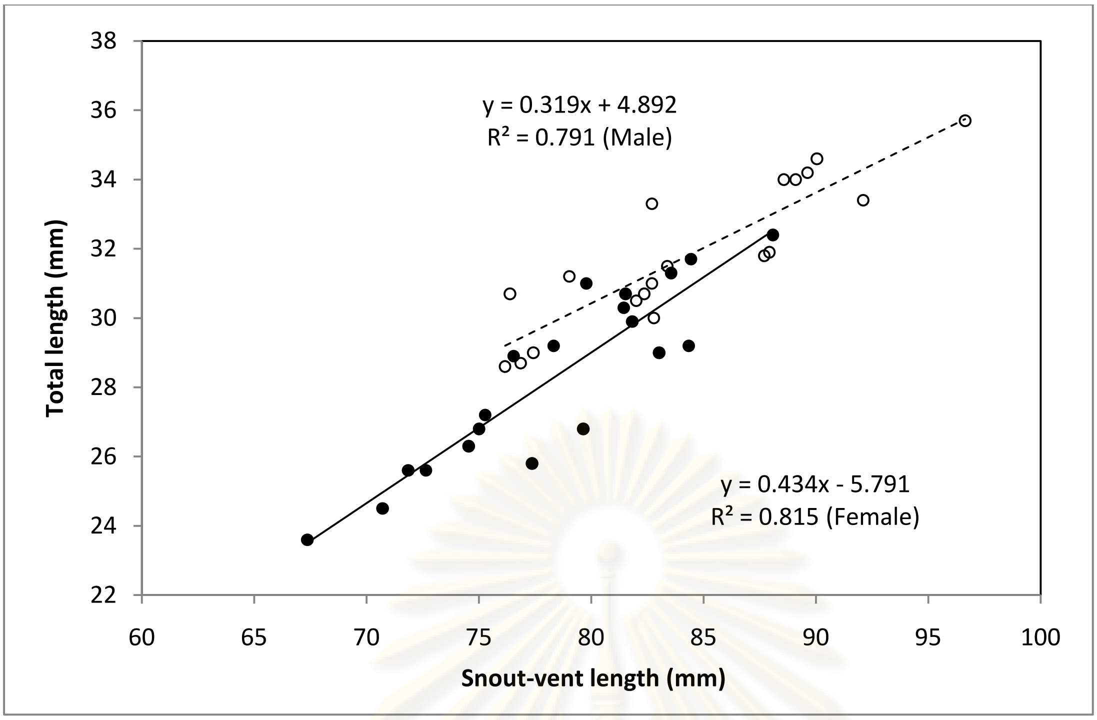


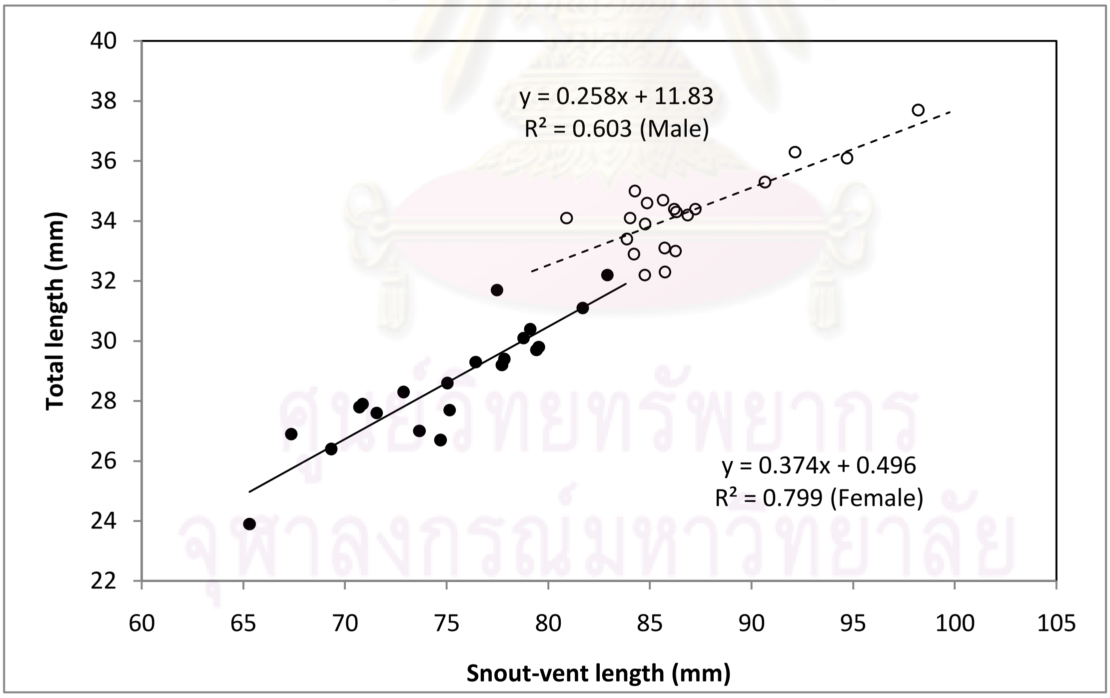
28. Linear regression line between Snout-vent length with Upper Arm length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



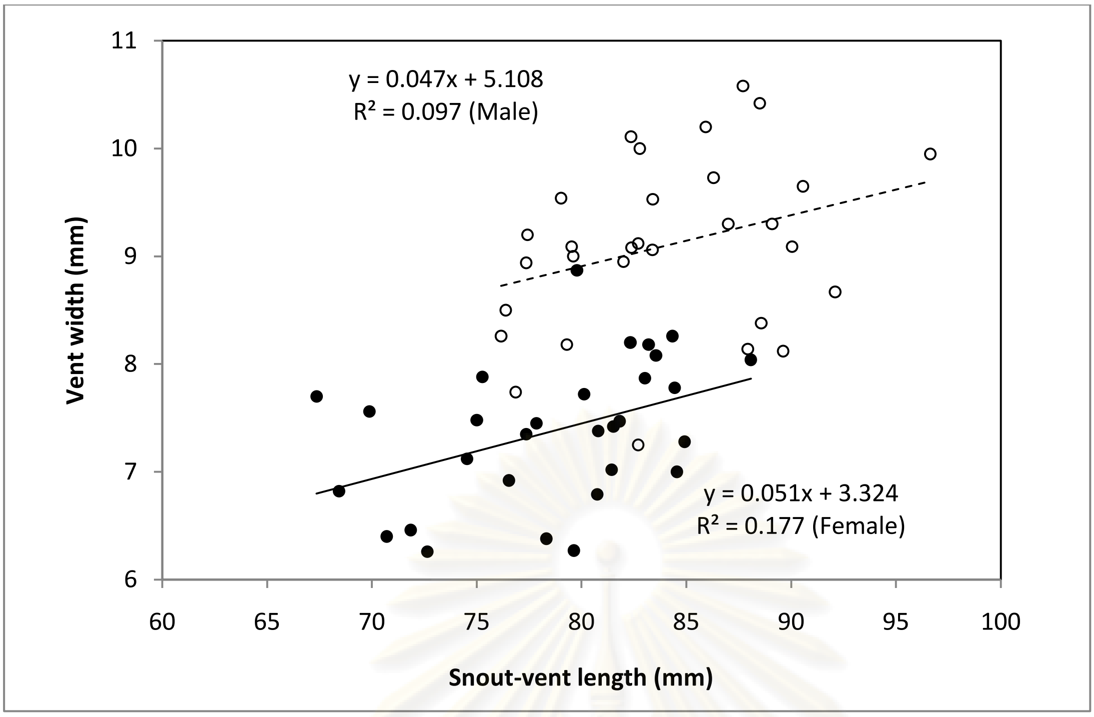


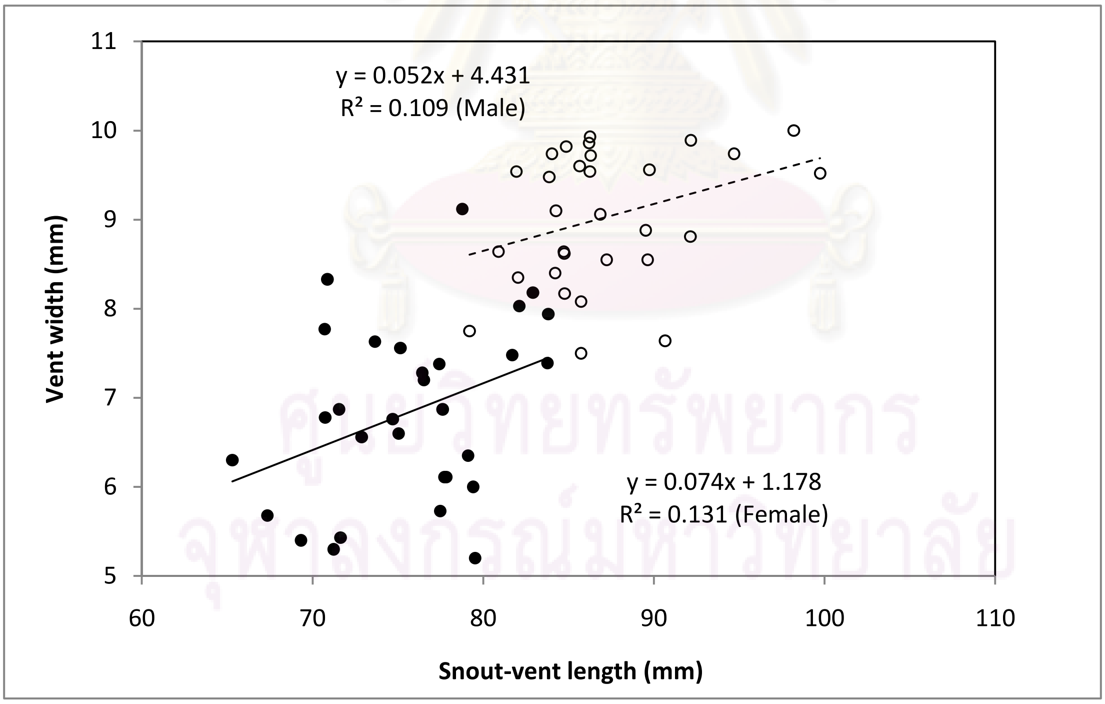
29. Linear regression line between Snout-vent length with Upper Leg length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.





30. Linear regression line between Snout-vent length with Total length both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.



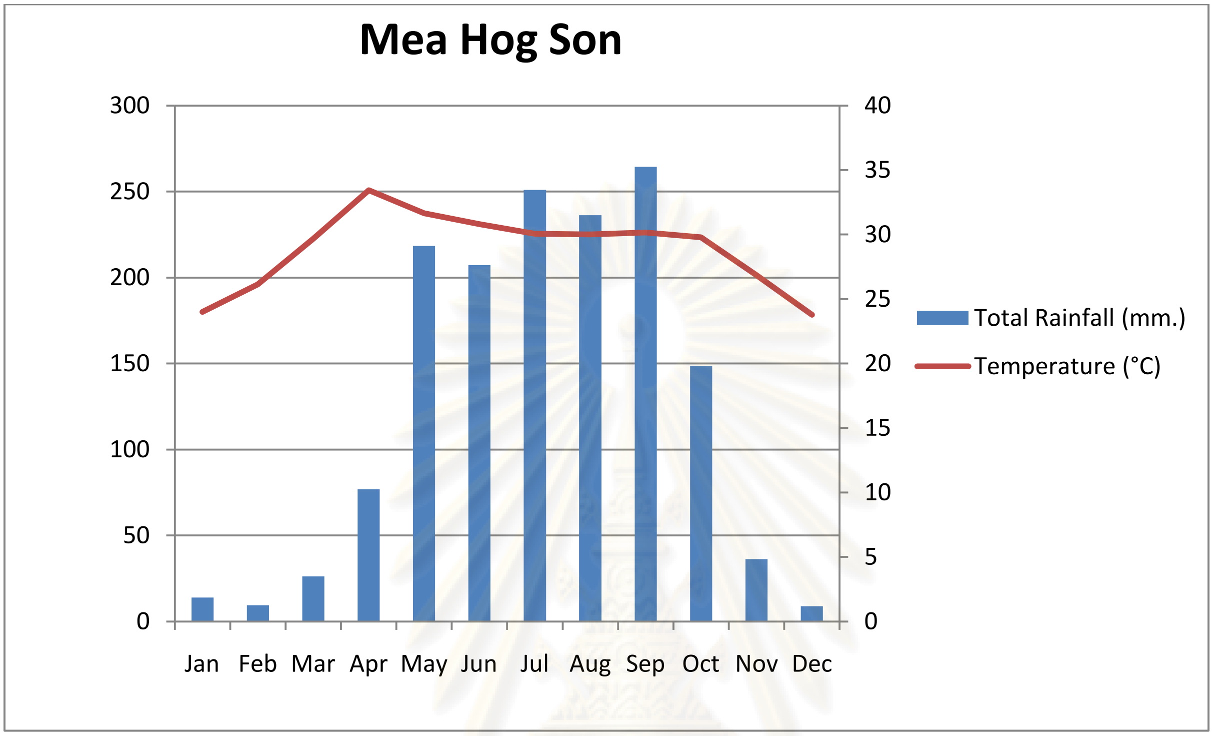


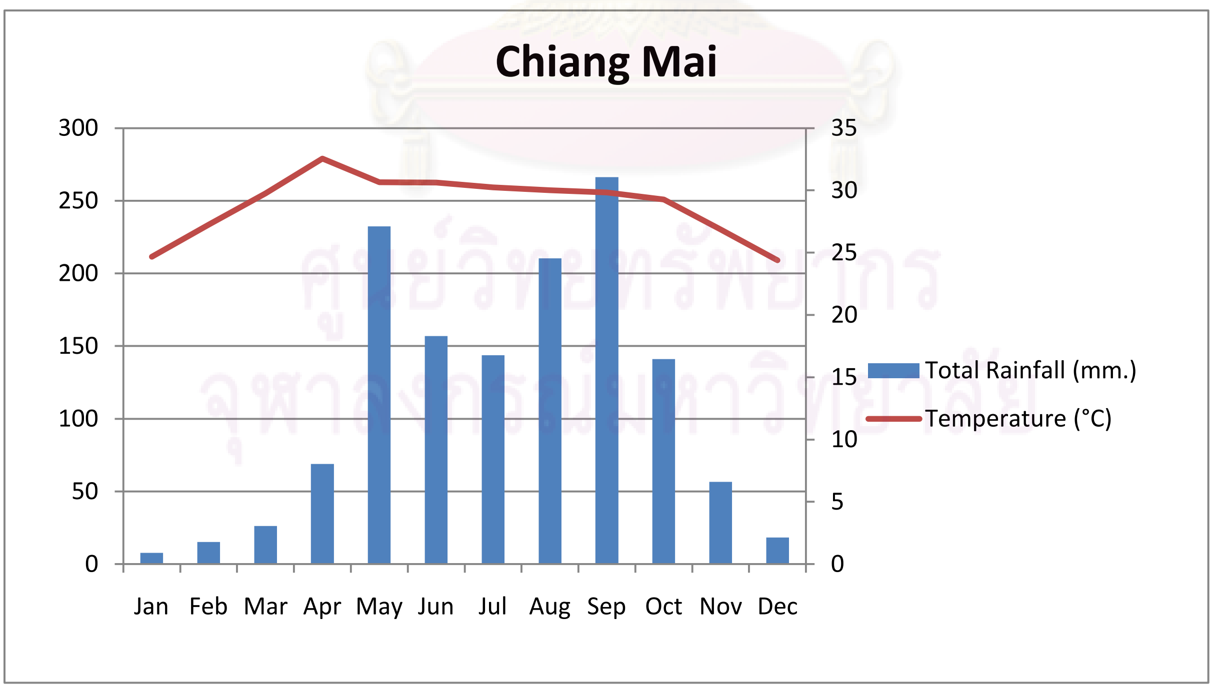
31. Linear regression line between Snout-vent length with Vent width both sexes in northern (upper) and southern (lower) population. Abbreviations: ●, females; ○, males.

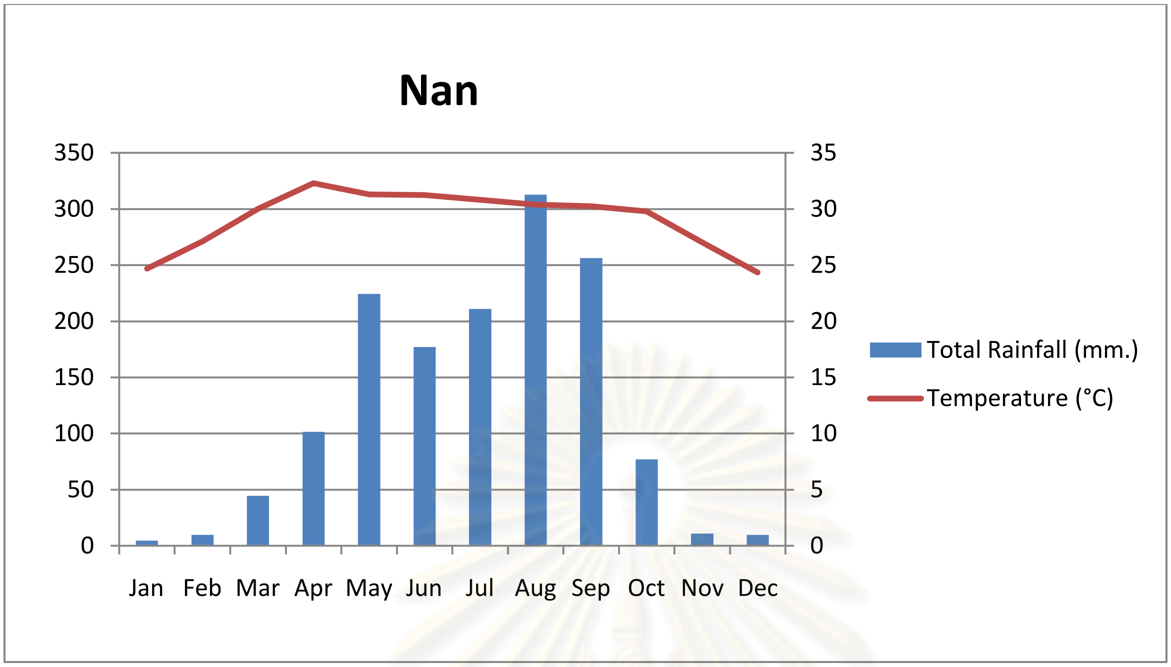
Appendix D

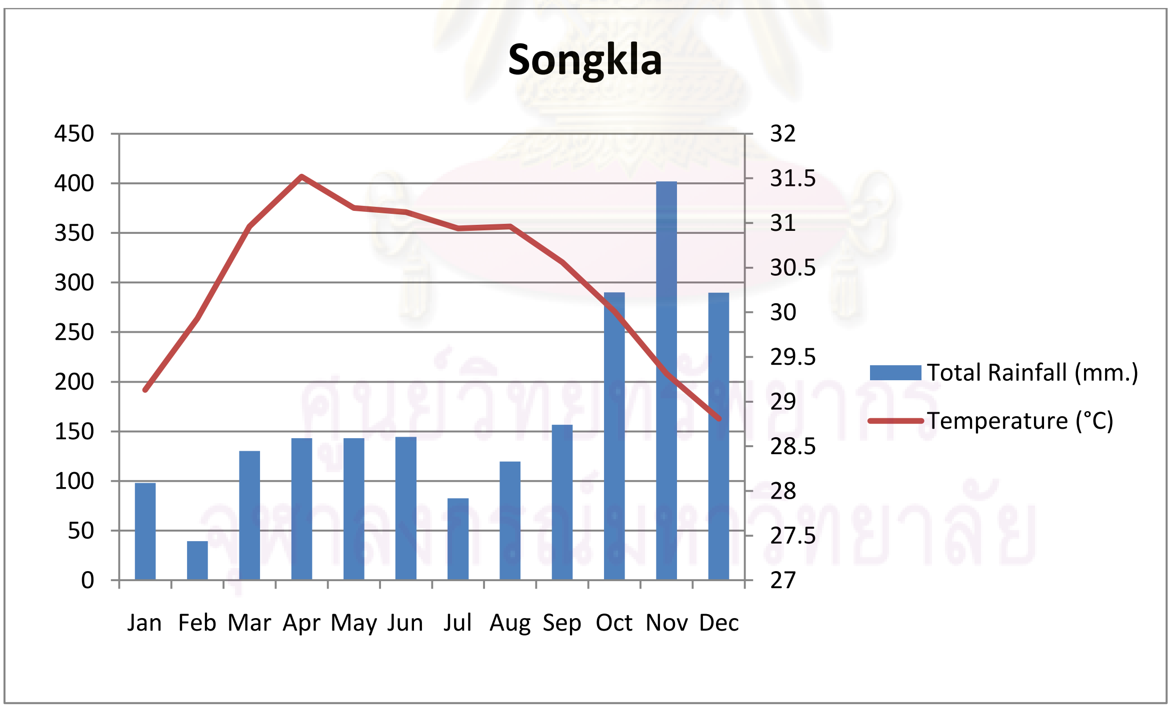
Means of rainfall and air temperature

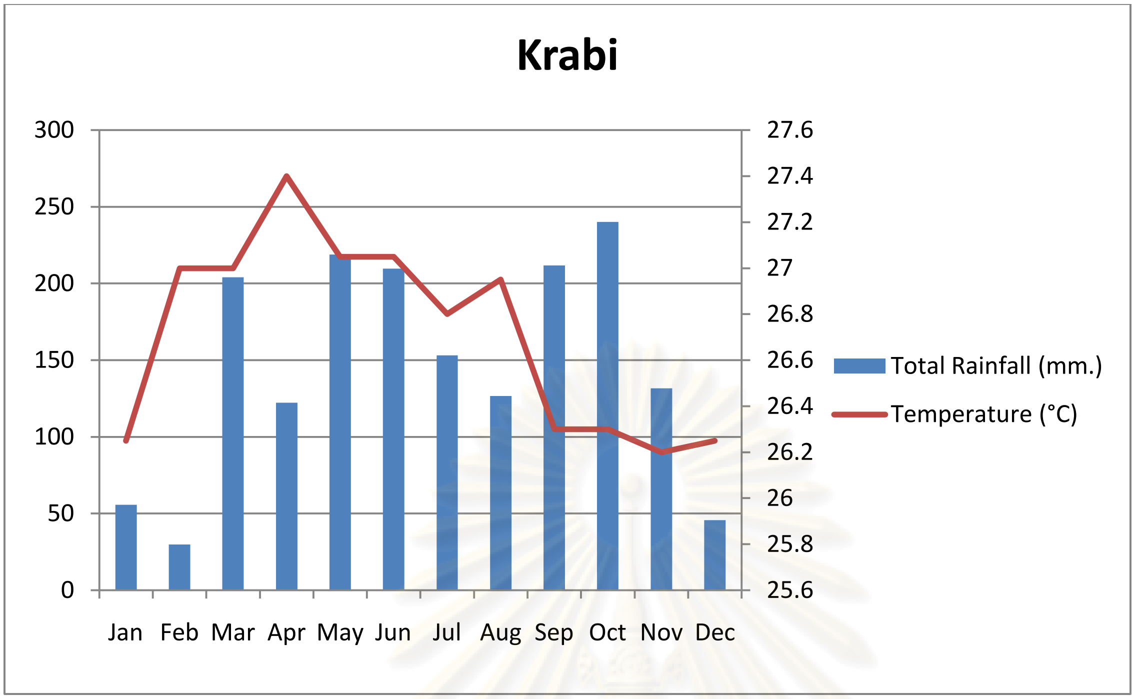
The rainfall and air temperature averages ten years from January 2000 to December 2009 at six localities.

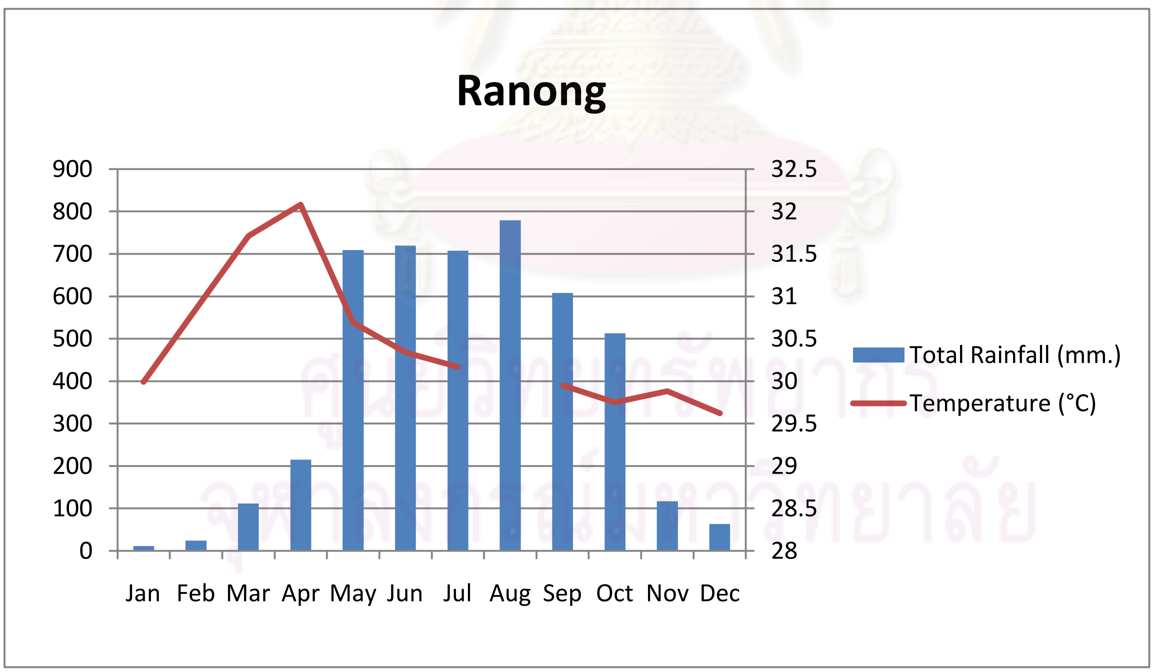





Nan
350
300
250
200
150
100
50
0
35
30
25
20
15
10
5
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Total Rainfall (mm.)
Temperature (°C)


Songkla
450
400
350
300
250
200
150
100
50
0
32
31.5
31
30.5
30
29.5
29
28.5
28
27.5
27
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Total Rainfall (mm.)
Temperature (°C)


Krabi
300
250
200
150
100
50
0
27.6
27.4
27.2
27
26.8
26.6
26.4
26.2
26
25.8
25.6
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Total Rainfall (mm.)
Temperature (°C)


Ranong
900
800
700
600
500
400
300
200
100
0
32.5
32
31.5
31
30.5
30
29.5
29
28.5
28
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Total Rainfall (mm.)
Temperature (°C)

BIOGRAPHY

Miss Arpapan Prakobkarn was born on January 1, 1985 in Songkla Province. She graduated with a Bachelor degree of Science in Biology from the Faculty of Science, Prince of Songkla University in 2007. She furthered her graduate study for master's degree of science in Zoology at Chulalongkorn University in 2007.

Research publications:

Prakobkarn, A., Ngamprasertwong, T. and Thirakhupt, K. 2009. Morphological Variation of Garden fence lizard *Calotes versicolor* (Daudin, 1802) between Northern and Southern Thailand. Abstract. *The 14th Biological Science Graduate Congress*, Chulalongkorn University, Bangkok, Thailand.