CHAPTER III

Distribution and Habitat Characteristics of Butterfly Lizards, Genus *Leiolepis* (Reptilia: Agamidae)

Abstract

The distribution and habitat characteristics of butterfly lizards, genus *Leiolepis* were studied in Thailand from May 2000 to May 2002. Three species comprising *L. belliana* (with two subspecies, *L. belliana belliana, L. belliana ocellata*), *L. reevesii rubritaeniata*, and *L. boehmei* were found. *L. triploida* which was reported by Chan-ard et al. (1999) was not evident during the field surveys. *L. b. belliana* distributed widely from lower northern to eastern and southern Thailand, whereas *L. b. ocellata* was limited in upper northern Thailand. *L. r. rubritaeniata* distributed throughout the northeast, while *L. boehmei* was found only in Nakhon Si Thammarat and Songkhla Provinces, southern Thailand. The sympatric area where two species occurred together was not present.

The habitat characteristics of butterfly lizards, Genus *Leiolepis* were examined in fifteen localities. The climatic condition, the habitat type, the burrow location, and the burrow environment were recorded. In general, all *Leiolepis* species were found in the open area. The mean distance from the burrow to the other nearest burrow of *L. b. ocellata* was longest, whereas the mean of distance from the burrow to the nearest tree was shortest. The soil texture where the burrows of *L. boehmei* located comprised highest percentages of sand when compared with other species.

3.1 Introduction

All butterfly lizards belong to Family Agamidae, Genus *Leiolepis*. Darevsky and Kupriyanova (1993) reported that seven species occurred over Southeast Asia including *L. belliana* (Hardwick and Gray, 1827), *L. guttata* Cuvier, 1829, *L. reevesii* (Gray, 1831), *L. peguensis* Peters, 1971, *L. triploida* Peters, 1971, *L. guentherpetersi* Darevsky & Kupriyanova, 1993, and *L. boehmei* Darevsky & Kupriyanova, 1993. The distribution of the butterfly lizards is ranging from Myanmar, China, Vietnam, Laos, Cambodia, Thailand and Peninsular Malaysia to Singapore (Peters, 1971; Darevsky and Kupriyanova, 1993). Four species (Chan-ard et al., 1999) have been reported to occur in Thailand, consisting of *L. belliana*, *L. reevesii*, *L. boehmei*, and *L. triploida*.

The objectives were to study the distribution of butterfly lizards in Thailand and to investigate their habitat characteristics in order to provide basic ecological data that could help the conservation of butterfly lizards, and a basis for designing more specific applied ecological research.

3.2 Methodology

During May 2000 to May 2002, field surveys were conducted in thirty-eight provinces of Thailand (Fig. 3.1) including Phayao, Nan, Lampang, Tak, Phitsanulok, Uthai Thani, Kanchanaburi, Ratchaburi, Phetchaburi, Nakhon Ratchasima, Chon Buri, Rayong, Chachoengsao, Chumphon, Surat Thani, Ranong, Phangnga, Phuket, Nakhon Si Thammarat, Satun, Pattani, Narathiwat, Yala, Loei,

Nongkhai, Maha Sarakham, Sakon Nakhon, Mukdahan, Kalasin, Roi Et, Yasothon, Amnat Charoen, Ubon Ratchathani, Si Sa Ket, Surin, Buri Ram, Sa Kaeo, and Songkha. Butterfly lizards were captured by digging and trapping. Each sample was identified using the key to species of Peters (1971). Its habitat type was recorded and its locality was plotted in a map.

Habitat characteristics of *L. belliana belliana, L. belliana ocellata, L. reevesii rubritaeniata* and *L. boehmei*, were surveyed during January 2001 to December 2002. The study sites of each species shown in Figure 3.1 were selected based on the abundance of its local population in which the area with more than 3 burrows per 20 x 20 m^2 were selected. Three parameters were investigated in the habitat of each species, consisting of the climatic condition, the burrow location, and the burrow environment. The climatic condition of each study site consisted of means of monthly rainfall, temperature and relative humidity where the Meteorological Department provided the data. The burrow location and the elevation above mean sea level were identified by the coordination which recorded using the GPS and the slope of the ground where the burrow existed was estimated. In a 4 x 4 m^2 area where the butterfly lizard burrow was at the center, the burrow environment was focused on the distance from the burrow to the nearest tree that can provide the shade during the day, the proportion of vegetation cover and bare ground around the burrow, the distance from the burrow to the other nearest burrow, and the texture of soil where the burrow was found. Then, variations in habitat characteristics among species were compared using descriptive statistics.

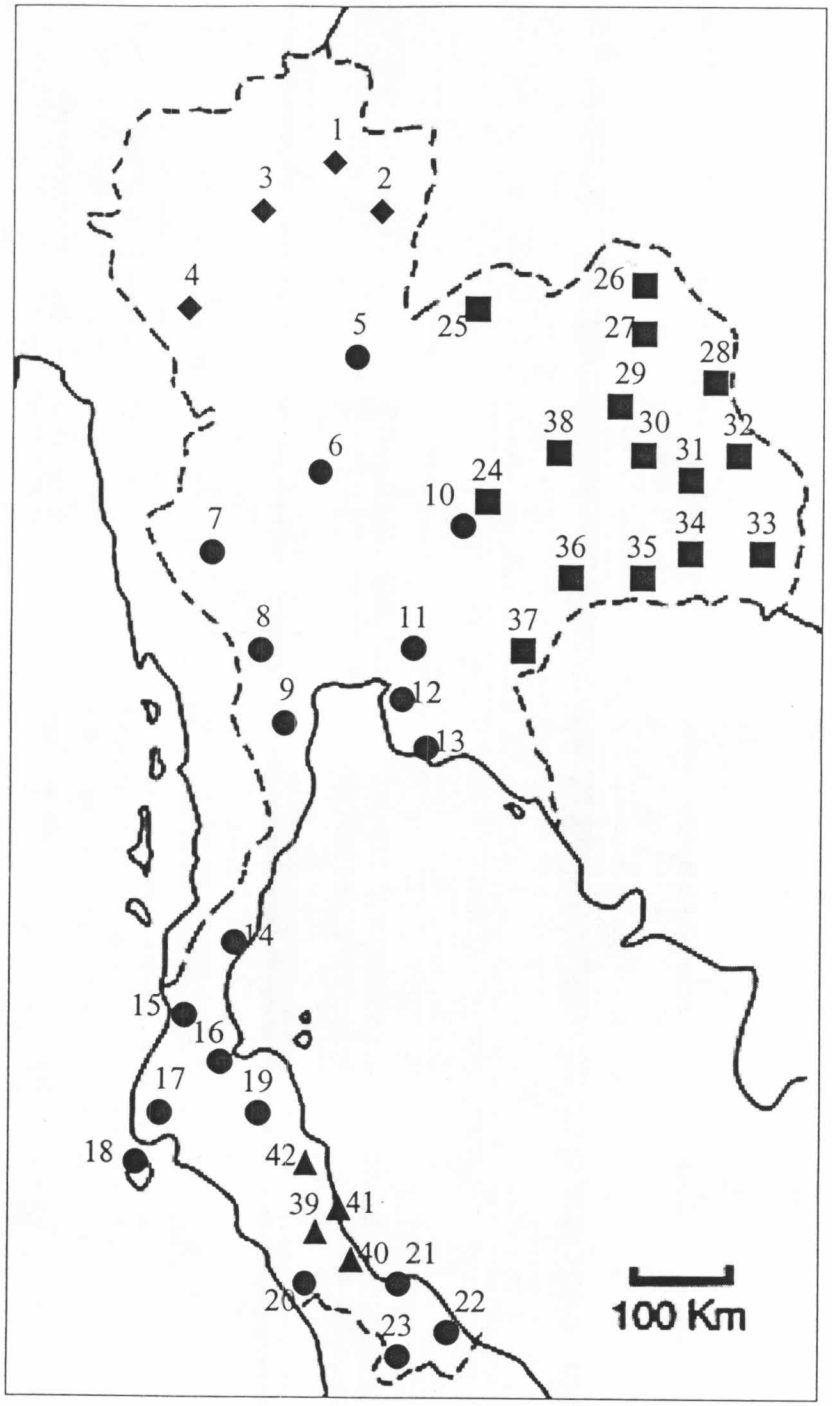

Figure 3.1 Distribution map of *Leiolepis* species in Thailand. ●, *L. belliana belliana*; ◆, *L. belliana ocellata*; ■, *L. reevesii rubritaeniata*; ▲, *L. boehmei*. Localities 1, 7, 10, 13, 14, 15, 17, 18, 19, 20, 21, 22, 24, 39, 42 were selected to study habitat characteristics of butterfly lizards.

3.3 Results and Discussion

Three species of butterfly lizards including *L. belliana* (with two subspecies, *L. b. belliana* and *L. b. ocellata*), *L. reevesii*, and *L. boehmei* were found during the survey (Figure 3.2). Localities and habitat types of them were shown in Figure 3.1 and Table 3.1. *L. belliana* was the most common and widespread in northern, western, eastern, and southern Thailand, while *L. boehmei* was relatively rare and found only in a few areas in Nakhon Si Thammarat and Songkhla Province of southern Thailand. *L. b. belliana* seemed to be a habitat generalist since it was found in many types of habitat which were the abandoned areas, dipterocarp forests, secondary forests, Chinese graveyards, grasslands, farmlands, orchard plantations, and coconut plantations. *L. b. ocellata* was found at higher elevation, mostly in the deciduous forest of northern Thailand. *L. boehmei* was habitat specialist species, which occurred in the limited areas in the coastal habitat above the intertidal zone and in coconut plantation. Conservation is an important requirement for the protection of this species from human disturbances. *L. r. rubritaeniata* which mainly inhabited in northeastern Thailand was also often threatened by human hunting. It was found mostly in the secondary forest, open abandoned area, farmland, orchard plantation and eucalyptus plantation. The sympatric area where two species occur together was not found. The butterfly lizards were not found in the lowland of central Thailand.

Results of the climatic condition were displayed in Table 3.2. In the study, *L. b. belliana* was found in areas with relative humidity ranging from 58 up to 90 %, temperature ranging from 10 up to 41.9 $^{\circ}$C, and daily rainfall ranging from 0 up

Table 3.1 Localities and habitat types of butterfly lizards.

Species	No.	Locality (District, Province)	Habitat Type
L. b ocellata	1	Chiang Muan, Phayao	orchard plantation
L. b ocellata	2	Wiang Sa, Nan	deciduous forest
L. b ocellata	3	Mae Phrik, Lampang	deciduous forest
L. b ocellata	4	Ban Tak, Tak	deciduous forest
L. b belliana	5	Wang Thong, Phitsanulok	open abandoned area
L. b belliana	6	Lan Sak, Uthai Thani	dipterocarp forest
L. b belliana	7	Bo Phloi, Kanchanaburi	secondary forest
L. b belliana	8	Suan Phung, Ratchaburi	orchard plantation
L. b belliana	9	Ban Lat, Phetchaburi	orchard plantation
L. b belliana	10	Sikhiu, Nakhon Ratchasima	open abandoned area
L. b belliana	11	Sanam Chai Khet, Chachoengsao	orchard plantation
L. b belliana	12	Si Racha, Chon Buri	orchard plantation
L. b belliana	13	Ban Khai, Rayong	orchard plantation
L. b belliana	14	Lang Suan, Chumphon	coconut plantation
L. b belliana	15	Kapoe, Ranong	grassland
L. b belliana	16	Ban Na San, Surat Thani	coconut plantation
L. b belliana	17	Thai Muang, Phangnga	coconut plantation
L. b belliana	18	Thalang, Phuket	open abandoned area
L. b belliana	19	Tha Sala, Nakhon Si Thammarat	coconut plantation
L. b belliana	20	La-Ngu, Satun	farmland
L. b belliana	21	Muang, Pattani	chinese graveyard
L. b belliana	22	Tak Bai, Narathiwat	grassland
L. b belliana	23	Muang, Yala	farmland
L. r. rubritaeniata	24	Non Sung, Nakhon Ratchasima	eucalyptus plantation
L. r. rubritaeniata	25	Muang, Loei	open abandoned area
L. r. rubritaeniata	26	Phon Phisai, Nongkhai	farmland
L. r. rubritaeniata	27	Sawang Daen Din, Sakon Nakhon	orchard plantation
L. r. rubritaeniata	28	Nong Sung, Mukdahan	open abandoned area
L. r. rubritaeniata	29	Sahatsakhan, Kalasin	farmland
L. r. rubritaeniata	30	Changhan, Roi Et	open abandoned area
L. r. rubritaeniata	31	Pa Tiu, Yasothon	open abandoned area
L. r. rubritaeniata	32	Muanh, Amnat Charoen	farmland
L. r. rubritaeniata	33	Nam Yun, Ubon Ratchathani	open abandoned area
L. r. rubritaeniata	34	Khukhan, Si Sa Ket	orchard plantation
L. r. rubritaeniata	35	Sangkha, Surin	farmland
L. r. rubritaeniata	36	Krasang, Buri Ram	farmland
L. r. rubritaeniata	37	Aranyaprathet, Sa Kaeo	secondary forest
L. r. rubritaeniata	38	Kantharawichai, Maha Sarakham	secondary forest
L. boehmei	39	Chana, Songkhla	coconut plantation
L. boehmei	40	Thepha, Songkhla	coastal habitat (above intertidal zone)
L. boehmei	41	Muang, Songkhla	open abandoned area
L. boehmei	42	Hua Sai, Nakhon Si Thammarat	coastal habitat (above intertidal zone)

to 285.7 mm. These results indicated that *L. b. belliana* could be able to live in the area just above sea level up to the area medium high whereas *L. b. ocellata* were more likely to be found in sites with colder temperature, lower relative humidity (54 up to 84 %), and lower daily rainfall (0 up to 135.4 mm). *L. r. rubritaeniata* presented itself in the area with relative humidity ranging from 59 up to 80 %, temperature ranging from 12.9 up to 41.2 °C, and daily rainfall ranging from 0 up to 121.3 mm. *L. boehmei* was found in the sites with high relative humidity ranging from 73 up to 88 %, moderate temperature ranging from 16.4 up to 37.8 °C, and high daily rainfall ranging from 0 up to 252.4 mm. In addition, the daily sunshine duration in the study sites of *L. b. ocellata* was longer than other species.

Ranges of elevation, means distance from the burrow to the other nearest burrow and mean distance from the burrow to the nearest tree of each species were shown in Table 3.3. *L. b. ocellata* showed the mean elevation of their burrows higher than other species. The mean distance from its burrow to the other nearest burrow of *L. b. ocellata* was longest, while the mean of distance from its burrow to the nearest tree was shortest. The mean distance from its burrow to the other nearest burrow of *L. b. belliana*, *L. r. rubritaeniata* and *L. boehmei* was 3.5, 3.0 and 3.3 m, respectively. The mean of distance from its burrow to the nearest tree of *L. b. belliana*, *L. r. rubritaeniata* and *L. boehmei* was 5.5, 8.0 and 6.0 m, respectively. The slope of the ground where the burrow existed of all *Leiolepis* species was flat terrain in all study sites.

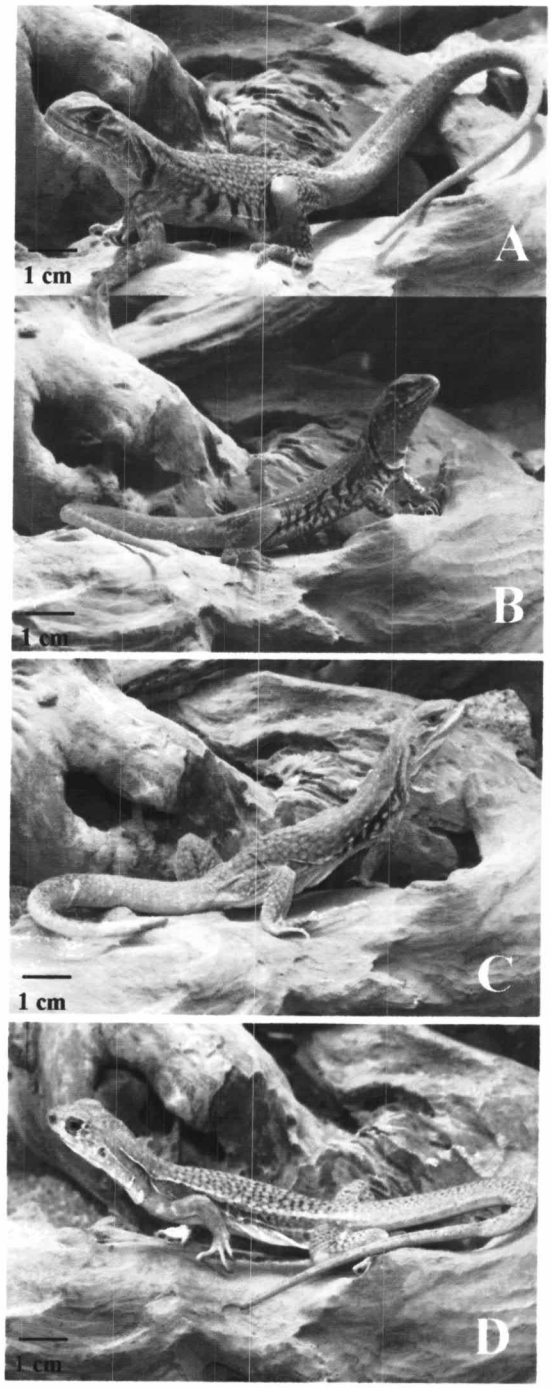

Figure 3.2 Butterfly lizards in Thailand. (A) *Leiolepis belliana ocellata*; (B) *Leiolepis belliana belliana*; (C) *Leiolepis reevesii rubritaeniata*; (D) *Leiolepis boehmei*.

Table 3.2 Means and ranges (in parentheses) of relative humidity, temperature, daily rainfall and daily sunshine duration at the study sites of butterfly lizards during January 2000 to December 2002.

Species (Study site)	Relative humidity (%)	Temperature (°C)	Daily rainfall (mm)	Daily sunshine duration (hr)
L. b. ocellata (Lampang)	72.68 **(54.00 - 84.00)**	26.49 **(9.40 - 41.90)**	6.80 **(0 - 135.40)**	6.90 **(2.80 - 9.90)**
L. b. belliana (Kanchanaburi)	69.90 **(58.00 - 84.00)**	28.26 **(10.00 - 41.90)**	6.40 **(0 - 107.80)**	6.40 **(3.70 - 8.70)**
L. b. belliana (Rayong)	77.26 **(69.00 - 85.00)**	28.05 **(16.80 - 40.00)**	9.46 **(0 - 140.00)**	6.00 **(3.30 - 7.90)**
L. b. belliana (Chumphon)	81.84 **(77.00 - 87.00)**	26.95 **(14.40 – 36.70)**	13.39 **(0 - 178.10)**	NA
L. b. belliana (Ranong)	79.94 **(66.00 - 87.00)**	27.23 **(17.50 - 38.20)**	21.21 **(0 - 162.40)**	NA
L. b. belliana (Phangnga)	83.48 **(74.00 - 90.00)**	27.45 **(18.00 - 37.50)**	16.17 **(0 - 141.60)**	NA
L. b. belliana (Phuket)	76.03 **(64.00 - 83.00)**	28.38 **(19.20 - 36.30)**	22.43 **(0 – 207.80)**	5.70 **(3.20 - 9.20)**
L. b. belliana (Pattani)	80.90 **(77.00 - 88.00)**	27.28 **(18.60 - 36.20)**	12.70 **(0 - 226.90)**	NA
L. b. belliana (Satun)	78.90 **(64.00 - 85.00)**	27.59 **(19.20 - 38.40)**	11.41 **(0 - 110.90)**	NA
L. b. belliana Narathiwat	81.63 **(76.00 - 87.00)**	27.03 **(19.50 - 36.60)**	15.64 **(0 - 285.70)**	NA
L. b. belliana *L. r. rubritaeniata* (Nakhon Ratchasima)	69.97 **(59.00 - 80.00)**	27.58 **(12.90 - 41.20)**	6.67 **(0 - 121.30)**	6.60 **(3.40 - 9.10)**
L. b. belliana *L. boehmei* (Nakhon Si Thammarat)	81.45 **(74.00 - 88.00)**	27.20 **(18.80 - 36.70)**	13.75 **(0 –252.40)**	NA
L. boehmei Songkhla	78.30 **(73.00 - 86.00)**	27.90 **(16.40 - 37.80)**	29.19 **(0 – 161.20)**	6.50 **(3.60 - 9.00)**

Note: Values were analysed from records of Meteorological Department.

"NA" = not available

Table 3.3 Ranges of the elevation, slopes of the ground at the burrows exit, means of the distance from the burrow to the other nearest burrow (DB) and means of the distance from the burrow to the nearest tree (DT) of each *Leiolepis* species.

Species	Elevation (m)	Slope (degree)	DB (m)	DT (m)	No. of Study Locations	Total No. of Burrows Examined (n)
L. b. belliana	4 - 310	Flat	3.5	5.5	11	112
L. b. ocellata	388 - 416	Flat	9.8	1.8	1	13
L. r. rubritaeniata	293 - 302	Flat	3.0	8.0	1	15
L. boehmei	14 - 61	Flat	3.3	6.0	2	23

The mean percentages of shrub cover, herb cover, grass cover and bare ground around the burrows in each species were shown in Table 3.4. The results indicated that the burrow of all *Leiolepis* species presented in the areas with less vegetation cover or the open area which they encounter spend their time basking or easily moving into their burrows when they found the predators. They did not prefer to live very close together or under the shade of the tree. The evident of group living was not found. The soil texture of the burrow in each species was presented in mean percentages of sand, silt and clay (Table 3.4). Each species presented their burrows in the different soil type that were sandy clay loam in *L. b. ocellata*, loamy sand in *L. r. rubritaeniata*, and sand in *L. boehmei*. *L. b. belliana* distributed in various soil types including loam, loamy sand and sand. These results indicated that the burrow of *Leiolepis* species occur in the area which mostly consisted of sand.

Table 3.4 Vegetation cover, soil texture and soil type around the butterfly lizard burrows.

District, Province (Region)	Sample Sizes (n)	Species	Vegetation Cover			Bare Ground (%)	Soil Texture			Soil Type
			Shrub (%)	Herb (%)	Grass (%)		Sand (%)	Silt (%)	Clay (%)	
Bo Phloi, Kanchanaburi (W)	11	*L. b. belliana*	1	3	38	58	55.25	26.30	18.45	Loam
Ban Khai, Rayong (E)	11	*L. b. belliana*	2	2	26	70	79.70	14.96	5.34	Loamy sand
Sikhiu, Nakhon Ratchasima (NE)	12	*L. b. belliana*	1	2	28	69	79.30	11.74	8.96	Loamy sand
Lang Suan, Chumphon (S)	7	*L. b. belliana*	0	0	30	70	96.94	2.97	0.09	Sand
Kapoe, Ranong (S)	8	*L. b. belliana*	0	2	34	66	99.60	0.16	0.19	Sand
Tha Sala, Nakhon Si Thammarat (S)	7	*L. b. belliana*	0	0	19	81	97.80	2.00	0.19	Sand
Thai Muang, Phangnga (S)	7	*L. b. belliana*	0	7	29	64	99.46	0.18	0.25	Sand
Thalang, Phuket (S)	6	*L. b. belliana*	0	11	10	79	92.47	3.07	4.47	Sand
Muang, Pattani (S)	14	*L. b. belliana*	2	6	18	74	96.30	0.31	3.39	Sand
La-Ngu, Satun (S)	4	*L. b. belliana*	1	1	24	74	89.80	4.46	5.74	Sand
Tak Bai, Narathiwat (S)	27	*L. b. belliana*	0	2	51	57	97.03	2.51	0.42	Sand
Mae Phrik, Lampang (N)	11	*L. b. ocellata*	3	1	1	95	51.67	20.84	27.49	Sandy clay loam
Non Sung, Nakhon Ratchasima (NE)	15	*L. r. rubritaeniata*	2	1	10	87	78.84	14.53	6.62	Loamy sand
Hua Sai, Nakhon Si Thammarat (S)	6	*L. boehmei*	10	1	17	72	98.13	1.61	0.26	Sand
Chana, Songkhla (S)	17	*L. boehmei*	1	7	25	65	97.58	1.53	0.89	Sand

Appendix

Species	No.	District, Province	Coordination		Elevation (m)
L. b. ocellata	3	Mae Phrik, Lampang	N 18°25'55.3"	E 099°43'42.3"	392
	3	Mae Phrik, Lampang	N 18°25'55.8"	E 099°43'42.7"	394
	3	Mae Phrik, Lampang	N 18°25'55.5"	E 099°43'43.4"	396
	3	Mae Phrik, Lampang	N 18°25'55.3"	E 099°43'44.4"	397
	3	Mae Phrik, Lampang	N 18°25'56.2"	E 099°43'41.5"	405
	3	Mae Phrik, Lampang	N 18°25'58.4"	E 099°43'38.3"	415
	3	Mae Phrik, Lampang	N 18°25'39.6"	E 099°42'32.8"	388
	3	Mae Phrik, Lampang	N 18°25'39.7"	E 099°42'31.6"	394
	3	Mae Phrik, Lampang	N 18°25'39.7"	E 099°42'30.5"	408
	3	Mae Phrik, Lampang	N 18°25'39.5"	E 099°42'30.1"	416
	3	Mae Phrik, Lampang	N 18°25'39.4"	E 099°42'29.6"	413
L. b. belliana	7	Bo Phloi, Kanchanaburi	N 14°42'30.9"	E 099°26'13.9"	170
	7	Bo Phloi, Kanchanaburi	N 14°42'31.2"	E 099°26'13.8"	170
	7	Bo Phloi, Kanchanaburi	N 14°42'31.0"	E 099°26'13.9"	170
	7	Bo Phloi, Kanchanaburi	N 14°42'31.1"	E 099°26'14.1"	169
	7	Bo Phloi, Kanchanaburi	N 14°42'31.6"	E 099°26'14.2"	168
	7	Bo Phloi, Kanchanaburi	N 14°42'31.8"	E 099°26'14.5"	169
	7	Bo Phloi, Kanchanaburi	N 14°42'31.8"	E 099°26'14.1"	169
	7	Bo Phloi, Kanchanaburi	N 14°42'31.8"	E 099°26'14.1"	169
	7	Bo Phloi, Kanchanaburi	N 14°42'31.8"	E 099°26'14.2"	169
	7	Bo Phloi, Kanchanaburi	N 14°42'32.0"	E 099°26'12.0"	171
	7	Bo Phloi, Kanchanaburi	N 14°42'31.7"	E 099°28'11.3"	171
	10	Sikhiu, Nakhon Ratchasima	N 14°51'24.3"	E 101°35'45.9"	310
	10	Sikhiu, Nakhon Ratchasima	N 14°51'25.0"	E 101°35'45.4"	308
	10	Sikhiu, Nakhon Ratchasima	N 14°51'25.2"	E 101°35'45.6"	308
	10	Sikhiu, Nakhon Ratchasima	N 14°51'25.1"	E 101°35'45.5"	308
	10	Sikhiu, Nakhon Ratchasima	N 14°51'24.0"	E 101°35'45.1"	302
	10	Sikhiu, Nakhon Ratchasima	N 14°51'24.0"	E 101°35'45.0"	302
	10	Sikhiu, Nakhon Ratchasima	N 14°51'24.1"	E 101°35'45.1"	301
	10	Sikhiu, Nakhon Ratchasima	N 14°51'24.3"	E 101°35'45.6"	303
	10	Sikhiu, Nakhon Ratchasima	N 14°51'24.3"	E 101°35'45.2"	303
	10	Sikhiu, Nakhon Ratchasima	N 14°51'24.3"	E 101°35'45.8"	303

Appendix (Cont.)

Species	No.	District, Province	Coordination		Elevation (m)
L. b. belliana	10	Sikhiu, Nakhon Ratchasima	N 14°51'24.3"	E 101°35'45.7"	303
	10	Sikhiu, Nakhon Ratchasima	N 14°51'24.1"	E 101°35'45.3"	296
	13	Ban Khai, Rayong	N 12°47'39.8"	E 101°21'33.1"	36
	13	Ban Khai, Rayong	N 12°47'39.8"	E 101°21'34.0"	34
	13	Ban Khai, Rayong	N 12°47'39.3"	E 101°21'34.6"	34
	13	Ban Khai, Rayong	N 12°47'40.0"	E 101°21'34.8"	35
	13	Ban Khai, Rayong	N 12°47'40.0"	E 101°21'34.5"	36
	13	Ban Khai, Rayong	N 12°47'40.4"	E 101°21'34.4"	36
	13	Ban Khai, Rayong	N 12°47'40.0"	E 101°21'34.4"	38
	13	Ban Khai, Rayong	N 12°47'31.9"	E 101°21'16.9"	40
	13	Ban Khai, Rayong	N 12°47'32.6"	E 101°21'17.2"	40
	13	Ban Khai, Rayong	N 12°47'32.4"	E 101°21'17.6"	41
	13	Ban Khai, Rayong	N 12°47'32.4"	E 101°21'17.8"	40
	14	Lang Suan, Chumphon	N 09°58'07.7"	E 099°08'39.8"	41
	14	Lang Suan, Chumphon	N 09°58'08.2"	E 099°08'38.5"	35
	14	Lang Suan, Chumphon	N 09°58'08.1"	E 099°08'38.6"	30
	14	Lang Suan, Chumphon	N 09°58'07.9"	E 099°08'37.8"	29
	14	Lang Suan, Chumphon	N 09°58'07.3"	E 099°08'39.4"	25
	14	Lang Suan, Chumphon	N 09°58'07.5"	E 099°08'39.7"	24
	14	Lang Suan, Chumphon	N 09°58'08.1"	E 099°08'42.6"	25
	15	Kapoe, Ranong	N 09°36'03.6"	E 098°28'55.0"	59
	15	Kapoe, Ranong	N 09°36'02.3"	E 098°28'54.8"	57
	15	Kapoe, Ranong	N 09°36'02.2"	E 098°28'54.4"	56
	15	Kapoe, Ranong	N 09°36'01.6"	E 098°28'53.6"	59
	15	Kapoe, Ranong	N 09°36'48.5"	E 098°28'06.1"	54
	15	Kapoe, Ranong	N 09°36'47.9"	E 098°28'05.7"	55
	15	Kapoe, Ranong	N 09°36'48.0"	E 098°28'05.9"	54
	15	Kapoe, Ranong	N 09°36'46.4"	E 098°28'05.6"	53
	17	Thai Muang, Phangnga	N 08°18'55.7"	E 098°16'25.3"	12
	17	Thai Muang, Phangnga	N 08°18'56.6"	E 098°16'24.5"	9
	17	Thai Muang, Phangnga	N 08°19'01.4"	E 098°16'25.4"	10
	17	Thai Muang, Phangnga	N 08°19'01.6"	E 098°16'27.2"	10

Appendix (Cont.)

Species	No.	District, Province	Coordination		Elevation (m)
L. b. belliana	10	Sikhiu, Nakhon Ratchasima	N 14°51'24.3"	E 101°35'45.8"	303
	17	Thai Muang, Phangnga	N 08°19'02.0"	E 098°16'26.6"	10
	17	Thai Muang, Phangnga	N 08°19'01.9"	E 098°16'26.7"	9
	17	Thai Muang, Phangnga	N 08°19'01.5"	E 098°16'26.8"	10
	18	Thalang, Phuket	N 08°06'46.4"	E 098°19'57.7"	34
	18	Thalang, Phuket	N 08°06'49.2"	E 098°20'01.8"	35
	18	Thalang, Phuket	N 08°06'47.8"	E 098°19'54.0"	29
	18	Thalang, Phuket	N 08°06'47.7"	E 098°19'51.6"	25
	18	Thalang, Phuket	N 08°06'47.5"	E 098°19'51.5"	30
	18	Thalang, Phuket	N 08°06'47.7"	E 098°19'52.0"	32
	19	Tha Sala, Nakhon Si Thammarat	N 08°36'10.1"	E 099°57'14.8"	16
	19	Tha Sala, Nakhon Si Thammarat	N 08°36'13.0"	E 099°57'14.8"	16
	19	Tha Sala, Nakhon Si Thammarat	N 08°36'12.7"	E 099°57'14.4"	15
	19	Tha Sala, Nakhon Si Thammarat	N 08°36'12.0"	E 099°57'15.2"	16
	19	Tha Sala, Nakhon Si Thammarat	N 08°36'11.8"	E 099°57'14.7"	15
	19	Tha Sala, Nakhon Si Thammarat	N 08°36'12.0"	E 099°57'14.6"	14
	19	Tha Sala, Nakhon Si Thammarat	N 08°06'10.3"	E 099°57'14.0"	15
	21	Muang, Pattani	N 06°52'16.8"	E 101°14'39.1"	18
	21	Muang, Pattani	N 06°52'16.9"	E 101°14'38.6"	7
	21	Muang, Pattani	N 06°52'16.8"	E 101°14'38.5"	4
	21	Muang, Pattani	N 06°51'08.6"	E 101°15'53.0"	26
	21	Muang, Pattani	N 06°51'08.4"	E 101°15'53.1"	26
	21	Muang, Pattani	N 06°51'08.8"	E 101°15'52.9"	24
	21	Muang, Pattani	N 06°51'08.8"	E 101°15'52.3"	22
	21	Muang, Pattani	N 06°51'08.4"	E 101°15'52.3"	22
	21	Muang, Pattani	N 06°51'08.9"	E 101°15'51.8"	24
	21	Muang, Pattani	N 06°51'08.9"	E 101°15'51.6"	24
	21	Muang, Pattani	N 06°51'08.7"	E 101°15'51.6"	24
	21	Muang, Pattani	N 06°51'08.7"	E 101°15'50.9"	24
	21	Muang, Pattani	N 06°51'08.8"	E 101°15'50.9"	24
	21	Muang, Pattani	N 06°51'09.5"	E 101°15'51.3"	24
	22	Tak Bai, Narathiwat	N 06°32'05.1"	E 101°44'07.4"	32

Appendix (Cont.)

Species	No.	District, Province	Coordination		Elevation (m)
L. b. belliana	22	Tak Bai, Narathiwat	N 06°32'05.2"	E 101°44'07.3"	20
	22	Tak Bai, Narathiwat	N 06°32'05.2"	E 101°44'07.5"	19
	22	Tak Bai, Narathiwat	N 06°32'05.2"	E 101°44'07.2"	21
	22	Tak Bai, Narathiwat	N 06°32'07.2"	E 101°44'07.2"	22
	22	Tak Bai, Narathiwat	N 06°32'06.1"	E 101°44'08.0"	21
	22	Tak Bai, Narathiwat	N 06°32'03.9"	E 101°44'08.5"	21
	22	Tak Bai, Narathiwat	N 06°32'04.0"	E 101°44'08.4"	21
	22	Tak Bai, Narathiwat	N 06°32'04.5"	E 101°44'08.6"	22
	22	Tak Bai, Narathiwat	N 06°32'03.9"	E 101°44'08.3"	22
	22	Tak Bai, Narathiwat	N 06°32'05.1"	E 101°44'07.4"	32
	22	Tak Bai, Narathiwat	N 06°15'06.2"	E 102°04'34.9"	25
	22	Tak Bai, Narathiwat	N 06°15'06.8"	E 102°04'34.4"	25
	22	Tak Bai, Narathiwat	N 06°15'06.5"	E 102°04'34.6"	23
	22	Tak Bai, Narathiwat	N 06°15'06.8"	E 102°04'34.8"	23
	22	Tak Bai, Narathiwat	N 06°15'06.8"	E 102°04'34.8"	20
	22	Tak Bai, Narathiwat	N 06°15'07.0"	E 102°04'34.4"	21
	22	Tak Bai, Narathiwat	N 06°15'07.0"	E 102°04'34.5"	11
	22	Tak Bai, Narathiwat	N 06°14'55.6"	E 102°04'51.3"	10
	22	Tak Bai, Narathiwat	N 06°14'55.6"	E 102°04'51.2"	10
	22	Tak Bai, Narathiwat	N 06°14'55.5"	E 102°04'51.1"	10
	22	Tak Bai, Narathiwat	N 06°14'57.5"	E 102°04'47.3"	10
	22	Tak Bai, Narathiwat	N 06°14'57.5"	E 102°04'57.8"	18
	22	Tak Bai, Narathiwat	N 06°14'57.5"	E 102°04'35.5"	18
	22	Tak Bai, Narathiwat	N 06°15'06.6"	E 102°04'05.4"	22
	22	Tak Bai, Narathiwat	N 06°32'04.0"	E 101°44'04.2"	21
	22	Tak Bai, Narathiwat	N 06°32'01.6"	E 101°44'02.7"	21
	20	La-Ngu, Satun	N 06°51'21.5"	E 099°43'49.7"	8
	20	La-Ngu, Satun	N 06°49'27.3"	E 099°47'43.7"	11
	20	La-Ngu, Satun	N 06°51'28.3"	E 099°46'44.6"	17
	20	La-Ngu, Satun	N 06°51'28.0"	E 099°46'44.6"	18
L. r. rubritaeniata	24	Non Sung, Nakhon Ratchasima	N 14°48'25.7"	E 101°37'57.6"	294
	24	Non Sung, Nakhon Ratchasima	N 14°48'11.4"	E 101°37'51.0"	293

Appendix (Cont.)

Species	No.	District, Province	Coordination		Elevation (m)
L. r. rubritaeniata	22	Tak Bai, Narathiwat	N 06°32'05.1"	E 101°44'07.4"	32
	24	Non Sung, Nakhon Ratchasima	N 14°18'11.7"	E 101°38'01.8"	295
	24	Non Sung, Nakhon Ratchasima	N 14°48'11.2"	E 101°38'03.2"	297
	24	Non Sung, Nakhon Ratchasima	N 14°43'17.6"	E 101°38'03.0"	299
	24	Non Sung, Nakhon Ratchasima	N 14°48'12.8"	E 101°38'02.4"	301
	24	Non Sung, Nakhon Ratchasima	N 14°48'13.9"	E 101°38'00.5"	296
	24	Non Sung, Nakhon Ratchasima	N 14°48'31.6"	E 101°37'57.4"	299
	24	Non Sung, Nakhon Ratchasima	N 14°48'32.8"	E 101°37'58.2"	300
	24	Non Sung, Nakhon Ratchasima	N 14°48'32.8"	E 101°37'58.4"	300
	24	Non Sung, Nakhon Ratchasima	N 14°48'32.2"	E 101°37'58.7"	299
	24	Non Sung, Nakhon Ratchasima	N 14°48'33.2"	E 101°37'56.0"	297
	24	Non Sung, Nakhon Ratchasima	N 14°48'33.3"	E 101°37'55.6"	298
	24	Non Sung, Nakhon Ratchasima	N 14°48'34.3"	E 101°37'54.2"	302
	24	Non Sung, Nakhon Ratchasima	N 14°48'34.4"	E 101°37'54.4"	301
L. boehmei	39	Chana, Songkha	N 07°02'10.5"	E 100°42'45.7"	61
	39	Chana, Songkha	N 07°02'09.5"	E 100°42'46.0"	50
	39	Chana, Songkha	N 07°02'09.5"	E 100°42'46.1"	47
	39	Chana, Songkha	N 07°02'09.1"	E 100°42'45.9"	59
	39	Chana, Songkha	N 07°02'09.3"	E 100°42'46.4"	51
	39	Chana, Songkha	N 07°02'08.6"	E 100°42'45.8"	45
	39	Chana, Songkha	N 07°02'08.7"	E 100°42'46.0"	45
	39	Chana, Songkha	N 07°02'10.9"	E 100°42'46.8"	41
	39	Chana, Songkha	N 07°02'10.8"	E 100°42'46.7"	37
	39	Chana, Songkha	N 07°02'10.7"	E 100°42'46.9"	34
	39	Chana, Songkha	N 07°02'11.2"	E 100°42'47.7"	33
	39	Chana, Songkha	N 07°02'10.7"	E 100°42'45.3"	14
	39	Chana, Songkha	N 07°02'04.1"	E 100°42'46.1"	20
	39	Chana, Songkha	N 07°02'04.3"	E 100°42'45.8"	19
	39	Chana, Songkha	N 07°02'04.2"	E 100°42'45.8"	19
	39	Chana, Songkha	N 07°02'04.5"	E 100°42'45.8"	18
	39	Chana, Songkha	N 07°02'04.4"	E 100°42'45.9"	18
	42	Hua Sai, Nakhon Si Thammarat	N 08°02'29.6"	E 100°19'10.4"	29

Appendix (Cont.)

Species	No.	District, Province	Coordination		Elevation (m)
L. boehmei	42	Hua Sai, Nakhon Si Thammarat	N 08°02'27.9"	E 100°19'10.0"	28
	42	Hua Sai, Nakhon Si Thammarat	N 08°02'27.9"	E 100°19'10.3"	25
	42	Hua Sai, Nakhon Si Thammarat	N 08°02'28.0"	E 100°19'10.2"	24
	42	Hua Sai, Nakhon Si Thammarat	N 08°02'27.7"	E 100°19'10.2"	21
	42	Hua Sai, Nakhon Si Thammarat	N 08°02'28.8"	E 100°19'11.1"	18