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ผศ. ดร. ศิริวิไล ธีระโรจนารัตน์

Using GIS for exploring Karen settlements: A case of Western and Northern Thailand in the vicinity of the Thai-Burmese border

USING GIS FOR EXPLORING KAREN SETTLEMENTS: A CASE STUDY OF WESTERN AND NORTHERN THAILAND IN THE VICINITY OF THE THAI-BURMESE BORDER[1]

Sirivilai Teerarojanarat[2]

Abstract

The Karen are one of the largest ethnic minority groups living in Thailand today, residing mostly in the mountainous ranges along the Thai-Burmese border. In most previous Karen studies, map presentation of Karen settlements has been disregarded. This paper explores the Karen from the spatial aspect. The study area covered 15 provinces in western and northern Thailand along the Thai-Burmese border. The scope of the study focused on the village locations of 6 Karen subgroups, namely the Sgaw, the Pwo, the Taungthu or Pa'O, the Kayah, the Kayan, and the Kayaw. A survey of these Karen subgroups settlements was performed via a questionnaire that was collected between 2011 and 2012. A spatial-based technique, the Geographic Information System (GIS), was used as a tool to develop a geographical database of Karen settlements. Further analysis was performed to explore the population numbers of Karen subgroups and their population change, settlement distribution, village size and the relationship of village locations to topography. The findings show that the Sgaw Karen are still the largest Karen-speaking group living in Thailand today. The population size of Karen villages varies largely but their average size is almost the same. According to the settlement pattern, Karen villages of the same subgroup tend to stay close together. A mixture of Karen subgroups in a village are found in small numbers. All subgroups are located on mountain peaks or at high elevations along the Thai-Burmese border or along the provincial boundaries. However, the Sgaw and the Pwo Karen tend to settle at a higher elevation than the Kayah and the Taungthu (Pa'O) Karen. The findings also suggest that the role of GIS is obvious, showing its great potential for advancing our understanding of Karen studies from the spatial aspect.

1. Introduction

Among non-Thai speaking peoples living in today's Thailand, the Karen are the largest tribal group and they reside mostly in mountainous areas along the Thai-Burmese border. According to the recent demographic figures reported by Delang (2003), there are between four and six million Karen residing in Myanmar with a large number in the Shan States and there are over 400,000 Karen in Thailand. It has been estimated that there will be more than one million Karen in Thailand in 2011 if the Karen in refugee camps and the Karen from Myanmar who have come to work as alien labour are taken into account (Booranaprasertsook 2012). The Karen

[1] Please visit http://www.manusya.journals.chula.ac.th/html/search. for a colored version

[2] Assistant Professor,
Department of Geography, Faculty of Arts,
Chulalongkorn University

are believed to be one of the earliest ethnic groups to have migrated to Southeast Asia from the northeast before 1000 AD ("The Karen Tribal Group of Thailand" 1969). According to Renard (1980) and Schliesinger (2000), the Karen living in Thailand came across the eastern border of Myanmar and first settled down in the vicinity of present-day Chiangmai during the eighth century. The migration of the Karen from Myanmar to Thailand occurred many times. However, a huge migration took place in the middle of the eighteenth century around the late Ayuthaya and early Ratanakosin period because of conflict and fighting with Myanmar. The Sgaw and the Pwo Karen formerly arrived to Thailand a long time ago. Both subgroups are known as people without a history because their movements cannot be traced back to their origins. Other subgroups that have recently migrated are the Taungthu (Pa'O), the Kayah, the Kayan and the Kayaw Karen. The Taungthu (Pa'O) emigrants escaped to Thailand from Myanmar after 1975 and later from the State Law and Order Restoration Council (SLORC) armies. It was reported that there were 4 principal Taungthu villages in Mae Hong Son province in 1996. The Kayah Karen illegally fled from the Kayah state of Myanmar to Thailand in small numbers in the 1940 and settled down in Mae Hong Son province. The Kayan fled from their homes in the Kayah state of Myanmar in 1988 and settled down in 3 border villages in Mae Hong Son province of Thailand. Finally, in 1994 the Kayaw Karen migrated from their homes in the Kayah state of Myanmar to Thailand as a result of the increase in the tourist attraction of Ban Nai Soi in Mae Hong Son province.

According to a report of the Center for Research in Social Systems (1970), the word Karen was first used by missionaries and British administrators in Myanmar in the early nineteenth century. Each Karen subgroup, however, refers itself in its own way, e.g., the so- called 'Pga K'Nyaw' by the Sgaw Karen and the so-called 'Phloung' by the Pwo Karen. All of these terms probably came from a Chinese origin and mean "men" or "human beings" (Schliesinger 2000; Laungaramsri 2003). The Karen tribe has its own way of life, speaks its own language and adheres to its own particular customs, traditions, rituals and rites. Up to now a number of pieces of research in Karen studies have been carried out, covering a wide variety of aspects including language, culture, beliefs, costumes and woven fabrics. Most of these pieces of research work, however, paid little attention to giving information about the precise location of Karen settlements. In these previous studies, maps, if provided, were usually drawn on paper by hand and the locations of data collection were roughly marked or ignored. The derived map information thus lacked reliability and could not be used further by other agencies.

In 2009, the Karen Linguistics Project was launched under the sponsorship of the Thailand Research Fund (TRF). The research project director is Professor Theraphan Luangthongkum, Ph.D. from the Department of Linguistics, Faculty of Arts, Chulalongkorn University. The key objective of the project is to analyze the diversity of languages spoken by 6 subgroups; namely the Sgaw, the Pwo, the Taungthu (Pa'O), the Kayah, the Kayan and the Kayaw. According to the linguistic study, the Karen are classified as a tribe that

speaks in the Karenic division of the Tibeto-Burman speakers, a subgroup of the Sino- Tibetan language grouping (Schliesinger, 2000). Each subgroup distinguishes itself from other groups on the basis of its communicating language, style of costume and personal decoration and hair style (The Karen Tribal Group of Thailand, 1969). The study area of the project focuses on Karen settlements covering 15 provinces in western and northern Thailand in the vicinity of the Thai-Burmese border.

In the project, linguistics, in terms of vowel system and acoustics, was mainly applied to study the Karen languages. Field surveys—interviewing and asking questions of a number of Karen people in upland Karen villages—were primarily conducted for Karen data collection. In doing the field surveys, however, the linguistic staff were hampered by the unavailability or inaccuracy of Karen location maps. This work was established, therefore, to facilitate the preparation of maps for this purpose. This paper differs from most previous Karen studies because observing the Karen from the spatial aspect is the key focus. A spatial-based technique using GIS has been integrated with the aim of developing a geographical database of Karen settlements to map the locations of Karen settlements classified by the 6 Karenic groups at village level and to investigate the spatial pattern of the settlements as well as their relationship with topography.

In the next section, the background concepts of GIS and its application to Karen studies are briefly explained. The study area and its scope, the data source and methodology, results and discussion as well as conclusions are then given in turn.

2. GIS and its related application to Karen studies

The Karen study inevitably involves spatially-related work including field surveys, data collection and the recording, mapping, analyzing and displaying of location data. To present data on a map, two types of data—spatial and attribute—are mainly involved. Spatial data refers to the geographical location whilst attributes data constitute related descriptions of the location data e.g. collected Karenic language data and names of Karen villages. Spatial features are symbolized on a map in three forms; point, line and polygon. Their locations are defined by x and y coordinates in units of a geographical reference system such as degrees of longitude and latitude. Prior to today's computerized maps, map making and cartographic display was always done manually. Drawing locations of data collection was roughly defined by hand. In addition, integrating maps using the overlay technique was traditionally performed by simply superimposing multiple paper maps by hand. Overlaying maps of different scales cannot be done.

The development of computer technology led to a big improvement in geographical technology in the 1960s. Geographical tools and technology for spatial data measurement, data collection and analysis was developed to be more powerful, especially in the handling of voluminous data and for performing complex spatial analysis. Among these technologies, the Geographic Information System (GIS) was mainly designed to manage digital geographic data. GIS comes with powerful functions for capturing, storing, querying, analyzing and displaying

data that are linked to locations on the Earth's surface. Differing from MIS (Management Information Systems) such as the tabular data of Microsoft Access, GIS provides a geographical database linking geographical features to their attributes. To manage many themes of maps in a study location, GIS uses the concept of "layer" to organize these themes. Each "layer" or theme is stored separately in a GIS database, for example, a layer of Karen settlement, a topography layer and a road layer. Displaying or retrieving these layers separately or in combination can be easily performed to serve different user requirements. GIS also provides a wide variety of basic and complex spatial analysis functions, including the extension module of geostatistics, 3-D surface and network analyses. Details of GIS principles, functions and capabilities are described extensively elsewhere, e.g., the textbooks of Tomlin (1990), Heywood et al. (2002), Longley et al. (2005) and Demers (2009). The derived spatially-related information of a GIS, as a result, has been primarily used for policy decision making and planning purposes. Because of its beneficial uses, GIS is nowadays widely applied in spatially-related work in the area of science, social science as well as humanity studies such as disaster management, agriculture, urban planning, and linguistic geography.

For less than a decade, GIS has been applied to the study of the settlements of minority groups in Thailand and its neighbouring countries. Masron et al., (2005) employed GPS (global positioning System) and GIS technologies to capture the coordinates of the locations of respondents, to develop a geographical database and to map the spatial patterns of dialectal variation spoken by Melanau speakers in Sarawak, Malaysia. A series of research works published by Luo et al. (2000), Wang et al. (2006), Luo et al. (2007), and Luo et al., (2010) integrated GIS mapping techniques and spatial analysis functions with linguistic and geophysical information to reconstruct the historical past settlement pattern of Tai minority groups in southern China and Southeast Asia. According to Luo et al., (2000), the spatial variation for the pronunciation of the word "rice" in the Tai Languages was mapped with topography to locate and reconstruct the settlement pattern. Their extension work used place names (Wang et al. 2006), kinship terms (Luo et al. 2007), and three Tai toponyms (Muang, Chiang and Viang) (Luo et al. 2010) to further explore the settlement patterns in the study location.

In the case of Thailand, Premsrirat et al., (2004) reported that over 60 ethnolinguistic groups had been found in this country. However, up to now, a handful of research works have paid attention to creating a map showing settlements of these ethnic groups. The oldest one, produced by "The Karen Tribal Group of Thailand" in 1969, is a map showing undetailed locations of 4 Karen tribes - the Sgaw, the Pwo, the Kayah (the so-called B'ghwe in the report paper) and the Pa'O (the so-called Taungthu in the report paper). Later, the research work of Premsrirat et al., (2004) produced maps at village level showing the language variation spoken by these ethnic groups found in the whole of Thailand. Their work was also the first to integrate GIS as a tool for storing and mapping the language distribution of all ethnic groups in Thailand. Another work was conducted by Cheewinsiriwat (2010)

to apply GIS for exploring the settlement patterns of ethnic groups residing in Nan province, Thailand. In her study, some terrain analysis functions were incorporated to examine the relationship between the settlement patterns and the physical environment. The work, conducted by Puginier (2000), applied a participatory land use planning approach using GIS as a tool to produce land use maps based on data collection at two Karen villages in Mae Hong Son Province, Thailand. The most recent research work was conducted by Burusphat et. al. (2011). The main aim of their work was to explore the language use and language attitudes of the ethnic groups in the western region of Thailand. Ethnolinguistic maps and a GIS database were constructed to help explain the locations of ethnic groups residing in the study location.

None of these previous works, however, recorded and gave details of the locations of Karen settlements classified by subgroup. In this paper, the main objective is to produce a map of Karen settlements of these subgroups at village level and explore the settlement patterns, population size and their relationship with topography. The result of the study, to some extent, will be a reference point for the settlement maps of Karen subgroups surveyed in 2011-2012.

3. Study area and scope of study

In this paper northern and western parts of Thailand in the vicinity of the Thai-Burmese border covering 15 provinces, including Chiang Rai, Mae Hong Son, Chiang Mai, Lamphun, Lampang, Phrae, Tak, Sukhothai, Kamphaeng Phet, Uthai Thani, Kanchanaburi, Suphan Buri, Ratchaburi, Phetchaburi and Prachuap Khirikhan, were chosen as the study area (see Figure1).

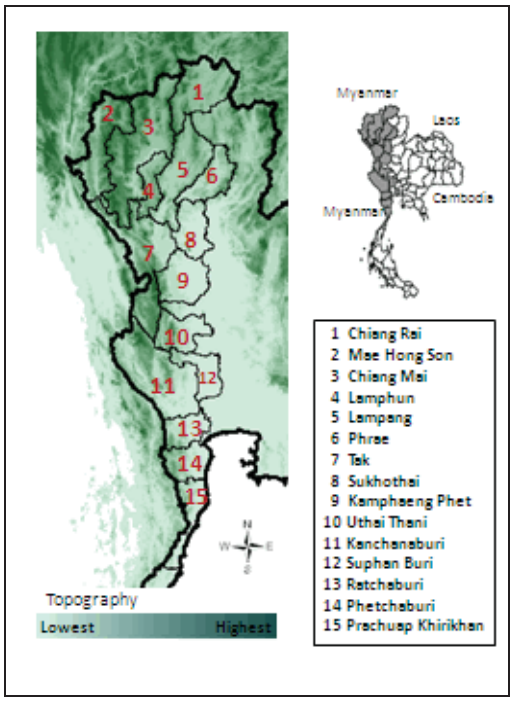


Figure 1 Study area

Geographically, the northern region of Thailand is characterized by north-south mountain ranges lying in north-south direction, natural forests and narrow, fertile valleys. There are different types of agriculture, including wet-rice farming in the valleys, swidden cultivation, temperate vegetables and fruit such as strawberries and lychees in the uplands. Similar to the North, the western region of Thailand is dominated by high mountain ranges and steep river valleys. Western Thailand, close to the Myanmar border, contains protected forest areas, including the world heritage Thung Yai Naresuan-Huai Kha Khaeng Wildlife Sanctuary. This region also contains major dams such as the Bhumibhol dam in Tak

province, the Srinakharin dam and the Wachiralongkorn dam in Kanchanaburi, the Kaengkrajarn dam in Phetchaburi and the Pranburi dam in Prachuap Khirikhan. Mining is an important industry in the area. In the study area, mountain ranges with an average height of approximately 1,600 meters above mean sea level border the northern and western part of the country and mostly high mountain ranges are close to the border of Myanmar. These mountain ranges lie in a north-south direction extending from the Daen Lao Range and the Thanon Thong Chai Range in the North to the Tanaosri Range in the western part of Thailand. For some villages, no roads but walking trails are the only way to visit. Water sources for the villages are creeks or small streams in high mountains.

The scope of the study focused on the village locations of 6 Karen subgroups, namely the Sgaw, the Pwo, the Taungthu or Pa'O, the Kayah, the Kayan, and the Kayaw. The photographs in Figure 2 show the 6 Karen subgroups wearing their traditional dress and personal adornments. The photos were obtained courtesy of the Karen Linguistics Project.

The Sgaw Karen

The Pwo Karen

The Taungthu or Pa'O Karen

The Kayah Karen

The Kayan Karen

The Kayaw Karen

Figure 2 Photographs of 6 Karen subgroups in their traditional costumes

4. Data source and methodology

4.1. Data source

The data used in this study came from different sources. The first data source was Karen village data. A total of 1,896 pieces of Karen village data, obtained in 2002 courtesy of the Department of Social Development and Welfare, the Ministry of Social Development and Human Security. Thailand, was made available in a Microsoft excel spreadsheet containing information about village location and estimated Karen population. Village locations were recorded in the Universal Transverse Mercator (UTM) geographic coordinate system in the form of X and Y coordinates. The village names and information about the subdistrict (so-called *Tambon* in Thai), the district (the so-called *Amphoe* in Thai) and the province (the so-called *Changwat* in Thai) names where the villages are located also were included in the file. It should be noted that the X and Y coordinates of the village locations as well as information such as village names were originally read from the topographical paper maps of the Royal Thai Survey Department (RTSD). To do this task, an approximately 240 map sheets based on the available L7018 map sheets on a scale of

1:50,000 were used. The estimated Karen population of each village had been surveyed and collected many times in the past (during the period 1985-1988, in 1995 and in 1997) and finally updated to produce the 2002 data.

Unfortunately, the document had no record of the population numbers of Karen subgroups. A questionnaire was thus constructed and sent by post for this study in April 2011 to all of the subdistricts in the study area. The respondents were selected from the informants or the officers of the Subdistrict Administrative Organization (SAO). The results of the questionnaire collection were then used as the second data source of the study. Data collection was completed within 10 months. The data used in this study was obtained from 68.1% of all the observed Karen villages in the study area from 14 provinces with the exception of Ratchaburi province. As a result, the map and the analysis will cover 14 provinces only.

The third data source was the administrative boundary maps. Thailand's administrative boundary maps at subdistrict, district and provincial level, obtained courtesy of the Ministry of Transportation (MOT), were available in vector format in the form of a polygon shaped file in the latest version of 2011. These administrative boundary maps were mainly used for map display and error checking.

The final and last data source was topographical maps. Topographical maps of Thailand are available from the Royal Thai Survey Department (RTSD) at a scale of 1:50,000. However, for national security reasons, some sheets of topographical maps covering the areas bordering Thailand and its neighbouring countries, including the Thai-Burmese border, are not available to public and can not be sold by the Department. Therefore, other sources for topographical maps were sought. Finally, the topographical map of Thailand used in this study was obtained courtesy of the USGS (the U.S. Geological Survey), namely the SRTM (the NASA Shuttle Radar Topographic Mission) digital elevation data. The SRTM topographical map is considered to be a uniform representation of the Earth's topography that is all-purpose to users and applications. It is stored in the raster form of a digital elevation model (DEM), covering a land area between 56 degrees South and 60 degrees North latitudes and constituting about 80 percent of the Earth's landmass (Slater et al., 2006). The extraction of ground heights from the SRTM data was processed by the interpretation of Radar satellite data through the digital image processing technique of interferometry (Slater et al., 2006). In this study, the SRTM topographical map, specifically called DTED® Level 1, was available for use at a spatial resolution of 30x30 m. For more information about the SRTM data, visit the CGIAR-CSI website http://srtm.csi.cgiar.org/.

4.2. Preparation of a GIS database and cartographic presentation for a spatial analysis of Karen settlements

Based on the available data illustrated in the previous section, a geographical database of Karen settlements was created under a GIS environment. A spreadsheet file containing the village locations in the form of X and Y coordinates was converted and added as

a vector map layer, represented as point features. The village map produced contained information about village names including subdistrict, district, and province names. The administrative boundary maps, having more up-to-date information about administrative boundaries in 2011, were also overlaid with village locations to recheck and make corrections to subdistrict, district, and province names. Then, a file containing the number of population in each Karen subgroup village, derived from the questionnaire collection, was recorded and joined to the village map. The final map, as a result, had village locations and village information including the population of Karen subgroups. Figure 3 shows a map of all Karen villages in the study area. From the Figure, a total of 1,291 villages from the returned questionnaires, or about 68% of all Karen villages in the study area, were used for the analysis in this study.

Map presentation of Karen settlements was done in two ways. Firstly, the technique was to produce a map of the settlement of Karen classified by subgroups. In this technique, the Karen villages were symbolized in circles with different colours based on the Karen's subgroups. The second technique was to produce a map of the settlement of Karen subgroups classified by population size. In this technique, the population size of Karen villages for each subgroup was classified and symbolized. For both techniques, a district map, in the form of polygon features, was superimposed on the village map to make the resultant map more complete and easily readable. However, due to unrest in the area along the Thai-Burmese border, map production with a reference coordinate system was omitted for security reasons. Map results are shown and discussed in the next section.

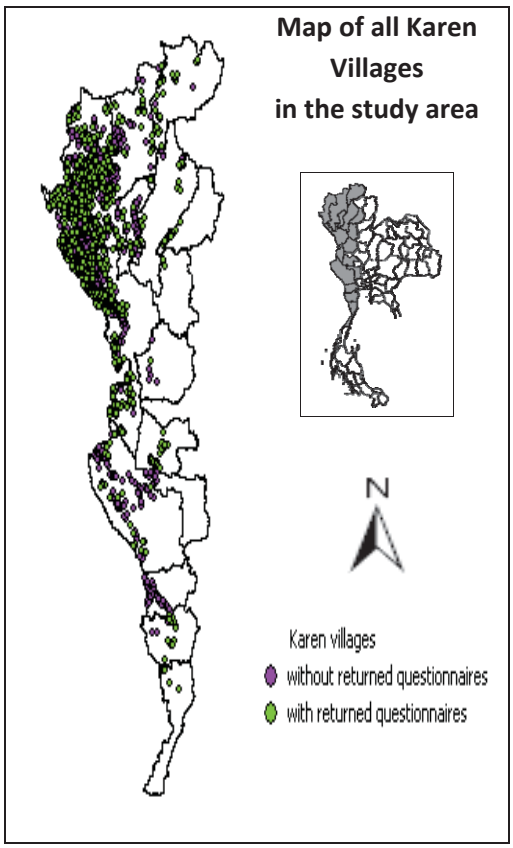


Figure 3 Map of all Karen villages covering 15 provinces in the study area

It should be noted that although a village database provides useful information about Karen settlements, there are some defects. Careless mistakes such as map reading errors or wrong entries with data input into the GIS database possibly occurred during the map input process. One inevitable error that should be highlighted was due to mismatch as well as misplacement between administrative boundaries and Karen village locations. As previously mentioned, Karen village data was obtained from the Department of

Social Development and Welfare, the Ministry of Social Development and Human Security. Thailand—a government organization that takes full responsibility for collecting Karen data. The Department mainly read the Karen village locations from 1:50,000 RTSD topographical maps. The RTSD maps have details of administrative boundaries at provincial and district level, but no details about subdistrict boundaries. Therefore, subdistrict data for all Karen villages was read from text-based information obtained from the Department of Provincial Administration (DOPA)[3]. In some areas, the subdistrict boundaries of some Karen villages had been changed and some newly established villages had been split administratively from old villages as a result of population increase. With the long reporting delay to other relevant government agencies, information about villages was not up-to-date. As a result, there were many cases where a village name labelled in one *Tambon* was located in a different *Tambon* or even a different *Amphoe*. Also, some newly established villages could not be found on the RTSD map. According to the study, errors involving mismatching and misplacing villages accounted for almost 2% of the study area.

4.3. Exploring the relationship between village locations and topography

To explore the relationship between Karen village locations and topography, the village location layer was overlaid with the village elevation layer. Spatial overlay analysis is commonly used among GIS applications. Basically when two map layers are overlaid, information can be extracted between these two layers using 'union' or 'intersection' operations. The 'union' operation can be considered to be the Boolean logic 'OR' while the 'intersection' operation can be considered to be the Boolean logic 'AND'. In this study, the intersection overlay function was applied to extract the elevation of Karen village locations classified by Karen subgroup. Summarizing and interpreting the relationship between Karen villages and elevation was conducted using statistical functions within GIS software such as boxplot and histogram as shown in Figure 4 and Figure 5. The results of the investigation are given and interpreted in terms of tables and graphs in the next section.

3 The Department of Provincial Administration (DOPA) is a government agency responsible for assigning and demarcating *Tambon* (subdistrict), *Amphoe* (district) and *Changwat* (province) boundaries in Thailand.

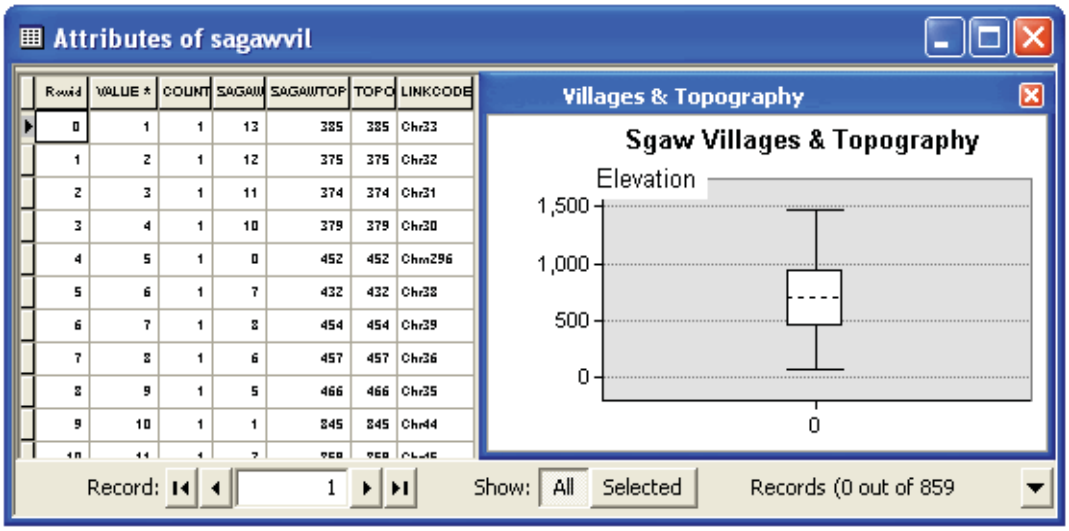


Figure 4 An example of a boxplot showing the relationship between the Sgaw Karen's villages and elevations

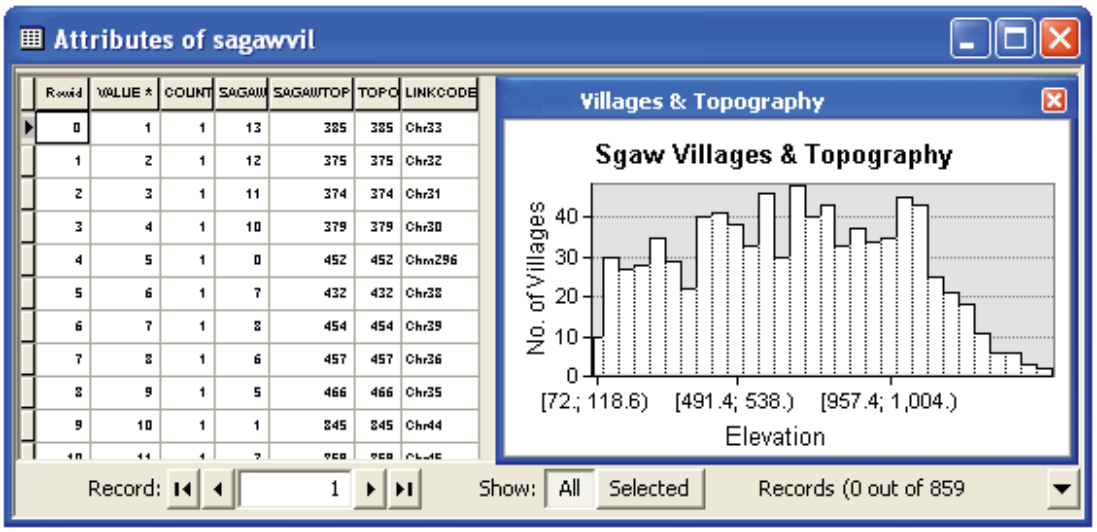


Figure 5 An example of histogram showing the relationship between the Sgaw Karen's villages and elevations

5. Results and discussion

In this section, results based on data collection and maps produced are reported and discussed. Firstly, the population numbers of Karen subgroups in the study as well as the population change are investigated. Secondly, the distribution of Karen settlements classified by subgroup is examined. Villages of Karen subgroups classified by population size are also investigated. Finally, the relationship between Karen villages and topography is explored.

5.1 Exploring the population numbers of Karen subgroup and population change

5.1.1 Numbers of subgroup population by province

Table 1 lists the population numbers of Karen subgroups conducted in this study. The survey was performed based on the 15 provinces in 2011-2012. Ratchaburi was excluded from the observation because no questionnaire was returned from this province. Moreover, some questionnaires gave total numbers of Karen but without the numbers classified by Karen subgroup. As a result, for example, the total numbers of Karen in Sukhothai accounts for 989 people but no value who filled in all Karen subgroup columns in the Table.

Overall, a total of 332,754 Karen from 1,291 villages were identified. Of all Karen subgroups, Sgaw accounts for 76.0%, Pwo 22.8%, Kayah 1.1% and Taungthu (Pa'O) 0.1%. No Kayan and Kayaw were found in the study area. Obviously, the majority of the Karen population in the vicinity of the Thai-Burmese border are Sgaw. The number of the Pwo population places them in the second place. The Kayah population accounts for third place and the Taungthu (Pa'O)'s population are found in small numbers. As previously mentioned in the data source section, the numbers here came back from the collection of about 68% of all observed Karen villages in the study area. Thus, the correct population numbers should be more than those indicated in the Table.

5.1.2 Exploring population change

Two available Karen population sources were used to compare the population numbers surveyed by the project. The first source was the survey work in 1995 compiled by Schliesinger (2000) and the second source was the survey data in 2002 obtained from the Department of Social Development and Welfare, the Ministry of Social Development and Human Security, Thailand.

The survey work compiled by Schliesinger (2000) estimated the population numbers of Karen subgroups in 1995. According to Schliesinger (2000)[4], there were an estimated 245,000 Sgaw, 105,000 Pwo, 2,500 Kayah, 900 Taungthu (Pa'O), 500 Kayan (Padong), and 30 Kayaw in the whole of Thailand.

[4] Remark: the population numbers of the Kayan Karen was reported by Tribal Research Institute, Service and Publicity Section, Chiang Mai, in 1995 while the other subgroups were estimated figures.

Table1 The population numbers of Karen subgroups in Northern and Western Thailand in the vicinity of the Thai- Burmese Border

No.	Province	Population numbers of Karen subgroups (2012) [1]						
		Total	Sgaw	Pwo	Taungthu (Pa'o)	Kayah	Kayan	Kayaw
1	Chiang Rai	7,108	6,460	594	0	4	0	0
2	Mae Hong Son	92,160	63,648	18,701	260	2,001	0	0
3	Chiang Mai	98,155	65,615	30,161	0	0	0	0
4	Lamphun	16,276	13,812	2,454	0	10	0	0
5	Lampang	3,313	2,036	220	0	0	0	0
6	Phrae	8,158	519	6,276	0	1,363	0	0
7	Tak	85,472	81,684	2,754	66	0	0	0
8	Sukhothai	989	989	0	0	0	0	0
9	Kamphaeng Phet	495	275	0	0	0	0	0
10	Uthai Thani	3,284	0	3,284	0	0	0	0
11	Kanchanaburi	8,531	4,357	3,797	42	225	0	0
12	Suphan Buri	1,504	0	1,504	0	0	0	0
13	Ratchaburi	-	-	-	-	-	-	-
14	Petchaburi	4,788	495	2,882	0	0	0	0
15	Prachuap Khirikhan	2,521	2,521	0	0	0	0	0
	Total	**332,754**	**242,411**	**72,627**	**368**	**3,603**	**0**	**0**

Remark:

1. Data source: questionnaire collection conducted by the project. The respondents were the informants or the officers of the Subdistrict Administrative Organization (SAO), Thailand in 2011-2012.

However, these population numbers did not truly compare to those surveyed by the project. This is due to the fact that Schliesinger did not give the population numbers of Karen subgroups classified by province. Also, details about the survey method such as how the data has been surveyed and collected were not given. More importantly, the survey conducted by the project was accomplished based on a collection of 68.1% of all Karen villages. For these reasons, population change could not be calculated. Nevertheless, the overall percentage of population for each subgroup between these two sources was compared to investigate the proportion of population among these subgroups. The result of the comparison is shown in Table 2. According to the Table, the proportion of population of these subgroups in the two data sources was relatively the same. The Sgaw Karen are the largest group. The smaller groups are the Pwo, the Kayah and the Taungthu Karen in that order. Th

population numbers of the Kayan and Kayaw Karen surveyed in 1995 were in small numbers and appeared as 0.0% in the Table while the survey in 2012 had no return from these two subgroups.

Table 2 The percentage of Karen population for each subgroup between the year 1995 and 2012 compared

Karen subgroups	Population numbers of Karen subgroups in comparison (unit: percent)	
	1995 data[1]	2012 data[2]
Sgaw	69.3	76.0
Pwo	29.7	22.8
Kayah	0.7	1.1
Taungthu	0.3	0.1
Kayan	0.0[3]	0.0
Kayaw	0.0[4]	0.0
Total	100.0	100.0

Remark: 1. Data source: the population numbers of Karen surveyed in 1995 compiled by Schliesinger (2000).

2. Data source: the population numbers of Karen obtained from the questionnaire collection conducted by the project. The respondents were the informants or officers of the Subdistrict Administrative Organization (SAO), Thailand in 2011-2012.

3. Kayan population accounts for 0.0014%.

4. Kayaw population accounts for 0.0008%.

Although a comparison between subgroups could not be provided, overall population change could be observed by using the second source—the survey data obtained from the Department of Social Development and Welfare. As shown in Table 3, the population numbers of Karen previously surveyed in 2002 by the Department of Social Development and Welfare was comparable to the data surveyed by the project in 2012. From the table, it is quite clear that the numbers of Karen population increased in most provinces, except in Phrae and Uthai Thani. The degree of percent increase varied from 5.5% to 44.4%. Classified by 3 classes—below 20% increase, 20-30% increase and higher than 30% increase, conclusions can be made. The number of the Karen population in Chiang Mai, Tak, Lampang, and Lamphun increased at a low rate. The number of the Karen population in Mae Hong Son, Chiang Rai, Sukhothai and Kanchanaburi increased at a medium rate while Petchaburi, Suphan Buri and especially Prachuap Khirikhan increased at a high rate. Overall, it can be concluded that in the last 10 years the number of the Karen population in the study area increased by 10%. In the case of Phrae and Uthai Thani, the percentage decrease could possibly have occurred due to the fact that an observed village had been divided into two or more villages as a result of population increase and some newly established villages were not included in the survey.

5.2. A map of the spatial distribution of Karen settlements

This research studied the spatial distribution of Karen subgroup settlements in 3 aspects—settlement distribution, village size, and the relationship between village location and topography.

Table 3 Population numbers of Karen between the year of 2002 and 2012 compared

		Population numbers of Karen in comparison		
No.	Province	Year 2002[1]	Year 2012[2]	Difference (in percent)
1	Chiang Rai	5,630	7,108	20.8
2	Mae Hong Son	73,650	92,160	20.1
3	Chiang Mai	92,766	98,155	5.5
4	Lamphun	13,099	16,276	19.5
5	Lampang	2,694	3,313	18.7
6	Phrae	8,298	8,158	-1.7
7	Tak	73,734	85,472	13.7
8	Sukhothai	741	989	25.1
9	Kamphaeng Phet	275	495	44.4
10	Uthai Thani	3,382	3,284	-3.0
11	Kanchanaburi	6,146	8,531	28.0
12	Suphan Buri	953	1,504	36.6
13	Ratchaburi	13,577	-	-
14	Petchaburi	3,338	4,788	30.3
15	Prachuap Khirikhan	1,278	2,521	49.3
	Total	**299,561**	**332,754**	10.0

Remark:

1. Data source: the population numbers of Karen surveyed in 2002 obtained from the Department of Social Development and Welfare, the Ministry of Social Development and Human Security, Thailand.

2. Data source: the population numbers of Karen obtained from the questionnaire collection conducted by the project. The respondents were the informants or officers of the Subdistrict Administrative Organization (SAO), Thailand in 2011-2012.

5.2.1 Exploring settlement distribution

A map of Karen settlements was produced as shown in Figure 6 to investigate settlement distribution. The Karen villages were symbolized in circles with different colors based on Karen subgroups, namely the Sgaw, the Pwo, the Taungthu or Pa'O, the Kayah, the Kayan and the Kayaw. It is obvious that a mixture of subgroups in the same village is hardly ever seen (see the magnified area 'A' in the Figure), except in Kanchanaburi (see the magnified area 'B' in the Figure). Overall, villages that contain only one subgroup account for about 89% of all observed Karen villages in the study area. That is, the mixture of subgroups in a village is found to be at about 11%. By considering them separately, villages containing only Sgaw people account for 93% of all villages where the Sgaw Karen reside. Villages containing only Pwo people account for 75% of all villages where the Pwo Karen reside, villages containing only Kayah people account for 73% of all villages where the Kayah Karen reside, and villages containing Taungthu people[5] only account for 20% of all villages where the Taungthu Karen reside. In other words, the Taungthu people are found mostly mingling with other subgroups in a village. The finding thus confirms the Karen's social structure, as stated in the "The Karen Tribal Group of Thailand" (1969), in that there is much interaction among the same group and each tends to live independently from other groups. One suggestion, however, would be the case of Kanchanaburi province where a mixture of Karen subgroups in some villages such as Saphan Lao village, Dinso village, and Rai Pa village are found in almost the same proportion. This would be an interesting case for linguists and anthropologists to study as to whether the social and cultural change in the area has occurred or not.

5.2.2 Exploring village sizes

Village size reflects how many people live in a village. Table 4 gives a summary of village size observed for all Karen subgroups. According to the Table, the village size where the Sgaw Karen and the Pwo Karen reside varies largely. For example, villages containing the Sgaw Karen range from 1 to 1,840 people. The village size where the Kayah and Taungthu Karen reside has a smaller range compared to that of the Sgaw and the Pwo Karen. In spite of their range-size variations, however, one finding is that the average village size for all subgroups except Taungthu is almost the same. Approximately, the average size of a Karen village is 240 people in the study area.

Table 4 The village sizes of Karen subgroups found in the study area

	Population numbers of subgroups in a village	Mean average village size (S.D.)
Sgaw	1 – 1,840	247 people (238)
Pwo	1 – 1,249	298 people (236)
Kayah	4 - 572	240 people (240)
Taungthu	5 - 260	70 people (106)

[5] Only 5 villages where the Taungthu Karen reside were found in the study area.

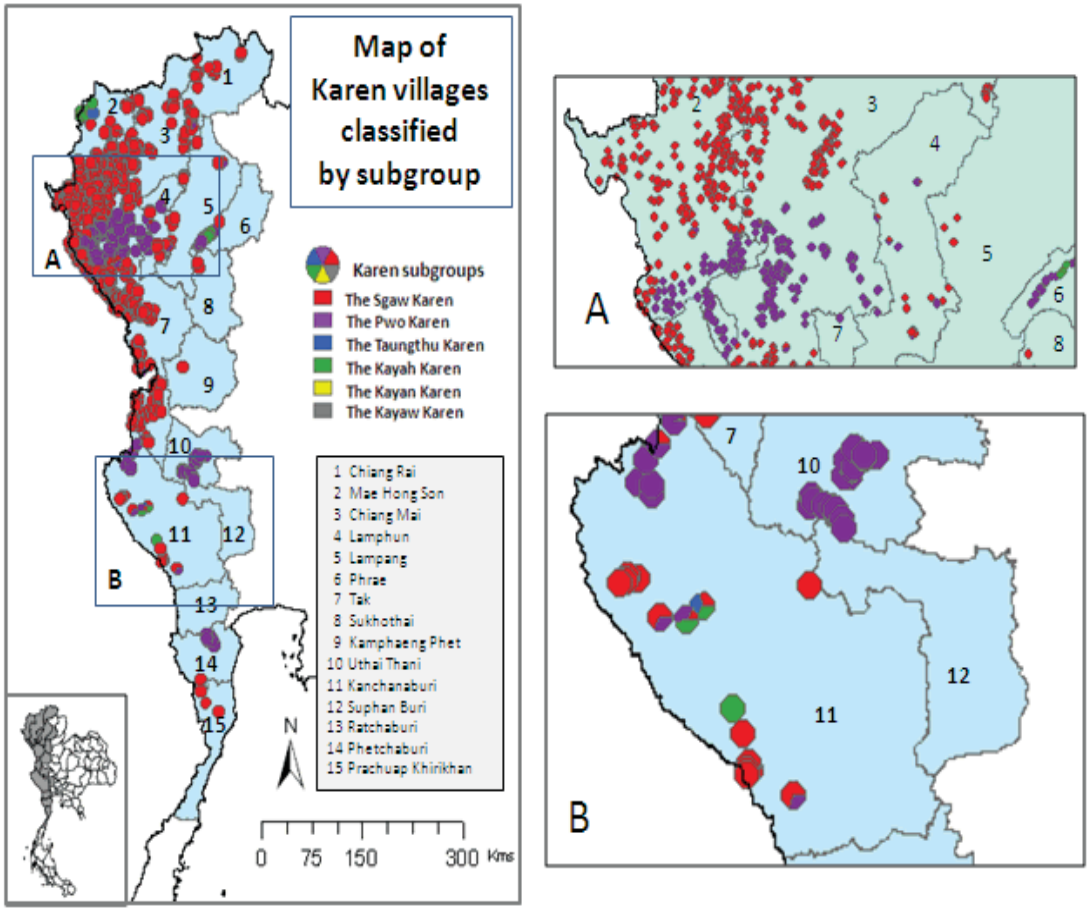


Figure 6 A map of the Karen settlement classified by subgroups

To explore the pattern of village size, the numbers of population in a village was classified. In the case of Thailand, up to now classification of village size has not been informally set. The National Village and Urban Community Fund Office, Thailand, has recently set criteria for village size using S-M-L classification to help allocate financial aid to rural villages and communities (The National Village and Urban Community Fund Office, 2012). A Small village is considered to have 500 people in a village, a Medium village having 501-1,000 people, and a Large village to have more than 1,000 people. Some researches such as a survey conducted by Yoshikatsu et al. (1996) have concluded that the average size of a rural village in Northeastern Thailand is about 500 – 1000 people. Based on the visual observation and statistics means applied in this study, the numbers of Karen in a village have been classified as 4 groups; a village of 1-250 people, 251-500 people, 501-1000 people, and a village of more than 1,000 people.

Table 5 gives a summary of classified village sizes by subgroup. Of all villages where the Sgaw Karen reside, for

example, villages containing Sgaw people of between 1-250 account for 66%, Sgaw people of between 251-500 account for 23%, Sgaw people of between 501-1,000 account for 9%. Villages containing more than 1,000 Sgaw people account for 2%. According to the Table, it can be summarized that the majority of the village sizes for all subgroups is a village of 1-250 people, the smallest one. This size of village occupies approximately 65% of all observed Karen villages. A larger village size of 251-500 people is found in the second place. A village size of 501-1,000 people accounts for the third place while a village size of more than 1,000 people is hardly ever found.

Table 5 The classified village size of Karen subgroups

	Percent of classified village size by subgroup			
Classification of the numbers of Karen in a village	Sgaw	Pwo	Kayah	Taungthu
1-250 people	66	63	53	80
251-500 people	23	23	40	20
501-1000 people	9	12	7	0
> 1000 people	2	1	0	0
Total	100	100	100	100

The distribution of settlement patterns based on population size of the 4 Karen subgroups was plotted on a map and symbolized with different dot sizes as shown in Figure 7. Overall, Karen villages of the same subgroup tend to stay close together.

As shown in Figure 7(a), villages where the Sgaw Karen reside are generally distributed over the study locations but one big group is mainly in the northern and western part of the study area. Their settlements are clearly in a linear pattern lying in a north-south direction of the study area. A clearer view of the classified Sgaw village sizes is shown in Figure 8. In spite of different village sizes, a similar pattern can be noticed. Villages cluster densely close to the Thai-Burmese border. This area mainly covers the southern part of Mae Hong Son, the western part of Chiang Mai, and the northern and western part of Tak. In Figure 8(c) in which a village size between 501-1,000 was plotted, village locations lie mainly along the provincial borders between Mae Hong Son and Chang Mai whereas villages in Tak lie along the border between the two countries.

Different from the Sgaw villages, villages where the Pwo Karen reside are found as a few clusters in the study area. A big cluster is located in the southern part of Chiangmai, Mae Hong Son, Lamphun and Lampang. Another cluster is located in the southern part of Tak and the northern part of Kanchanaburi. A smaller cluster can be found in Uthai Thani, the northern part of Kanchanaburi and is connected to Suphan Buri. When different village sizes were plotted separately as shown in figure 9, the settlement appears to be in a linear pattern lying in the east-west direction. Interestingly, larger villages (see Figure 9(d)) tend to be located farther from the country border than smaller villages (see Figure 9(a)).

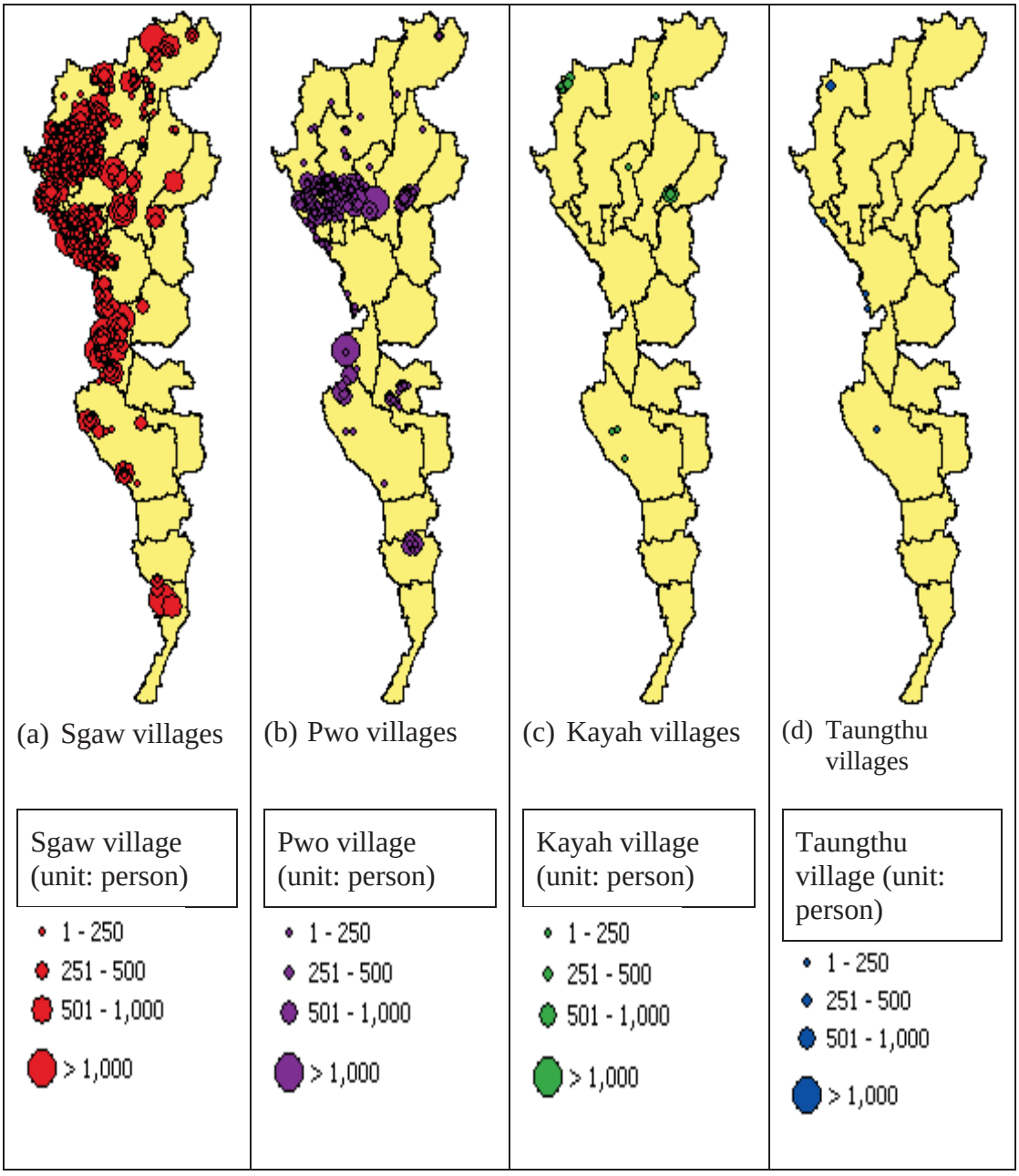
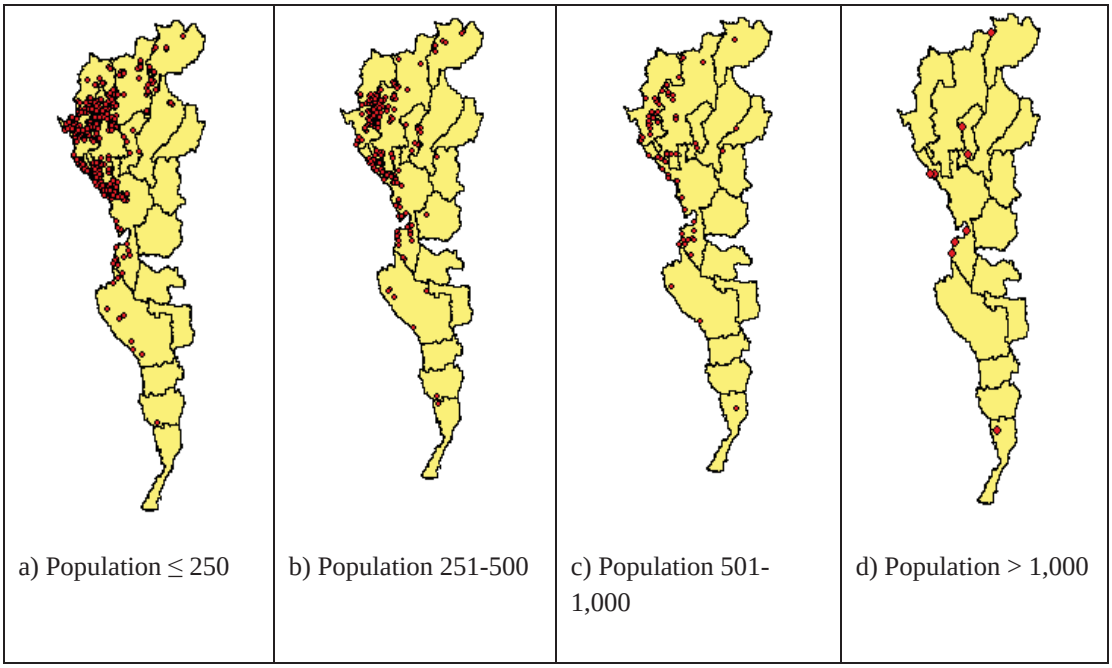
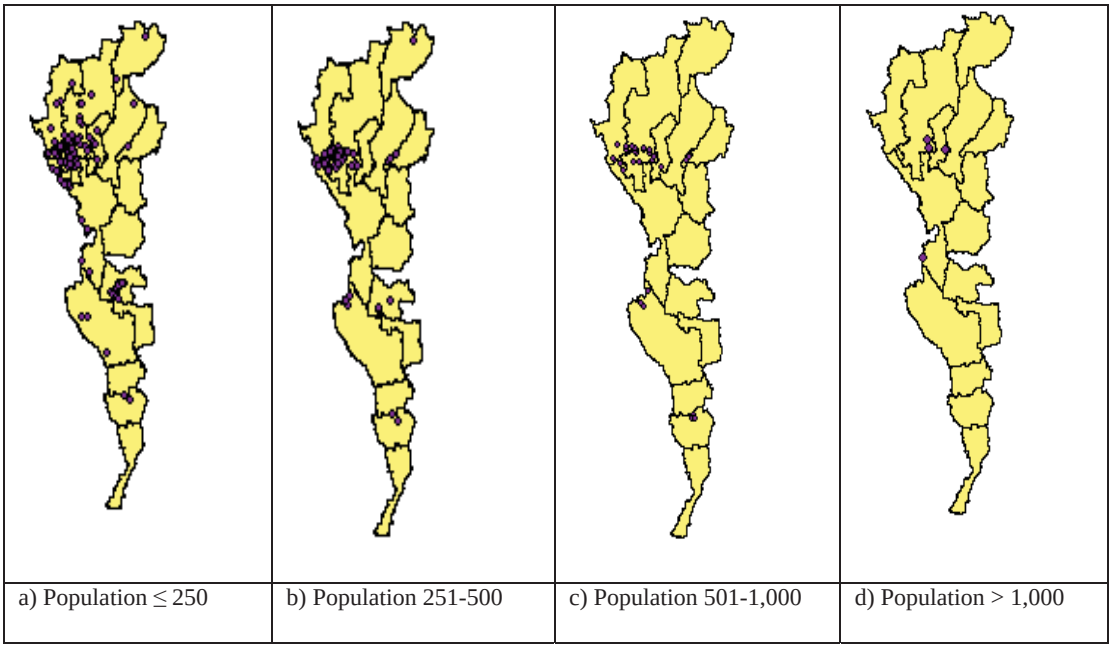


Figure 7 Map showing the population size of Karen villages classified by subgroup



a) Population ≤ 250 | b) Population 251-500 | c) Population 501-1,000 | d) Population > 1,000

Figure 8 Sgaw villages with different population size



a) Population ≤ 250 | b) Population 251-500 | c) Population 501-1,000 | d) Population > 1,000

Figure 9 Pwo villages with different population size

A total of 15 Kayah villages were found in the study area. Villages where the Kayah Karen reside are shown in Figure 7(c), small groups can be detected in the northwestern part of Mae Hong Son and in the southern part of Phrae. A few villages are also found in the western part of Kanchanaburi.

Only 5 Taungthu villages were found in the study area. Their village distribution, as shown in Figure 7(d), locates with no-pattern. However, they have all settled along the Thai-Burmese border. Among all Taungthu villages, the biggest village size, containing 260 Taungthu people, is located in the northern part of Mae Hong Son at Huai Cha Rob village. Of the 5 villages, this is only village that contains only Taungthu people.

When superimposing the Karen settlements with a topographical map in a 3-D view as shown in Figure 10, one noticeable point is that the clusters of settlements in all Karen subgroups are often on mountain peaks or at high elevations. The villages mainly lie linearly along the Thai-Burmese border or the provincial boundaries. Further investigation of the relationship between Karen village locations and topography will be examined in the next section.

5.2.3. Relationship between village locations and topography

In their physical setting, the Karen in Thailand commonly live in small villages in mountainous areas at elevations of between 600 and 1,500 meters above mean sea level (Delang 2003). The settlements, as reported by "The Karen Tribal Group of Thailand" (1969), have some variations ranging from small upland settlements placed around the activity of swidden agriculture (slash-and-burn technique) to larger permanent valley where villages are placed around wet rice cultivation. In this section, the relationship between village locations and topography for each Karen subgroup is examined.

Determining by the government agency of Thailand (Buddee 1985:19) in Delang 2003)), elevations below 200 meters above MSL are defined as 'lowlands', up to 500 meters above MSL are defined as 'uplands' and elevation exceeding 500 meters are referred to as 'highlands'.

Based on the definition above, a topographical map was classified according to 3 classes. These classes were 'lowland', 'upland', and 'highland' areas. As shown in Figure 11, the classified map (see Figure 11(a) was superimposed with Karen villages (see Figure 11(b)) to observe the preference height of the Karen settlements. Overall, most Karen settlements are at an elevation exceeding 200 meters above MSL. The high elevation area (exceeding 500 meters above MSL) in the northern and western part of the study area comprises the thick pack of settlements as shown in the magnified area '1' (see Figure 11(c)). The lower elevation in the southern part of the study area, as shown in the magnified area '2' (see Figure 11(d)), has a lower concentration of settlements.

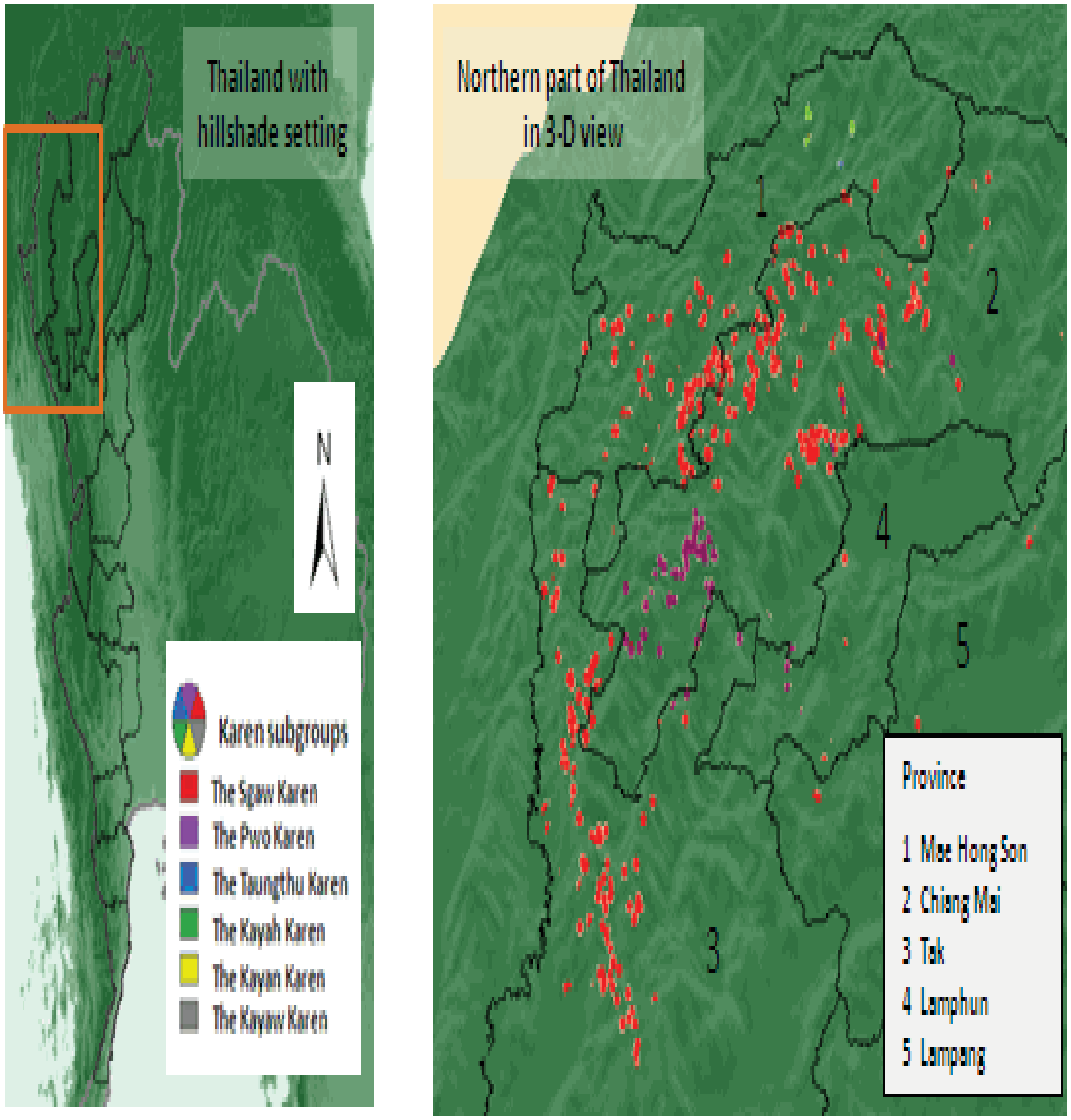
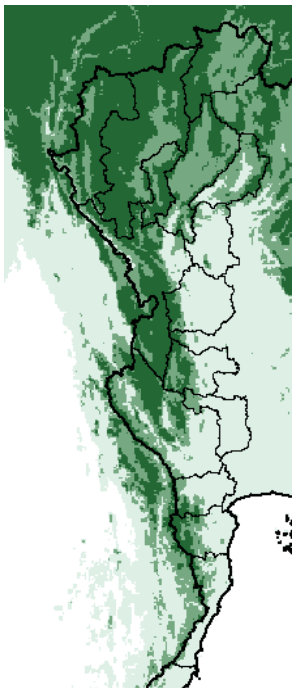
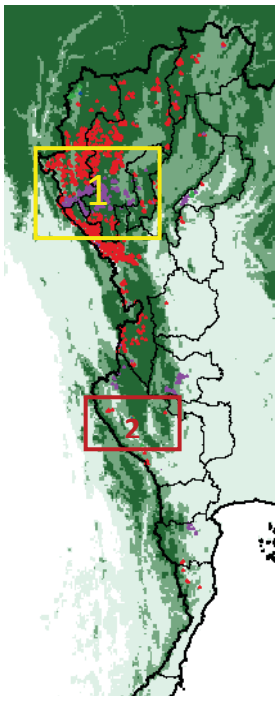


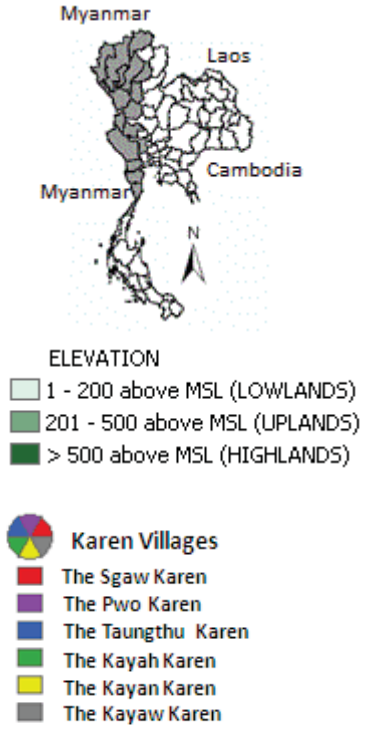
Figure 10 A topographical map superimposed with Karen villages

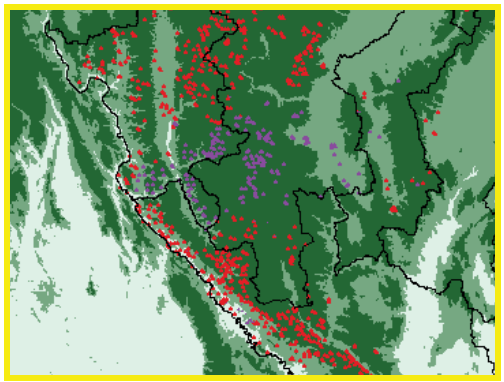


(a) A classified topographical map, assigned as 'lowland', 'uplands', and 'highlands' area

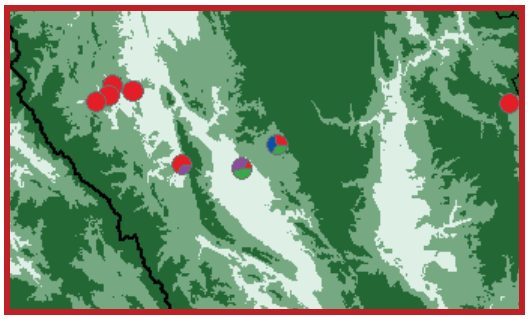


(b) A classified topographical map draped with Karen villages





(c) Magnified area '1'



(d) Magnified area '2'

Figure 11 A classified topographical map superimposed with Karen villages

Statistical calculation was also performed to observe the relationship between Karen's village locations and topography. The elevation ranges of settlements are illustrated as graphs in Figure 12 and Figure 13. Villages where the Sgaw Karen reside are located at elevations ranging from 72.0 – 1470.0 meters above mean sea level (MSL) with an average elevation of 692.2 meters above MSL. Villages where the Pwo Karen reside are located at elevations ranging from 47.0 and 1470.0 meters above MSL with an average elevation of 661.9 meters above MSL. The village locations of both the Sgaw and Pwo Karen can thus classify them as a 'highland' tribe.

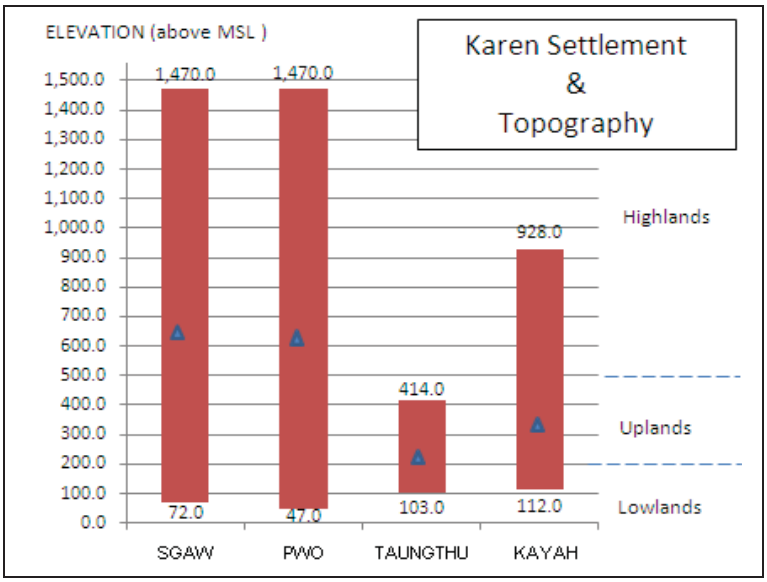


Figure 12 Graphs showing ranges of elevation occupied by Karen subgroup

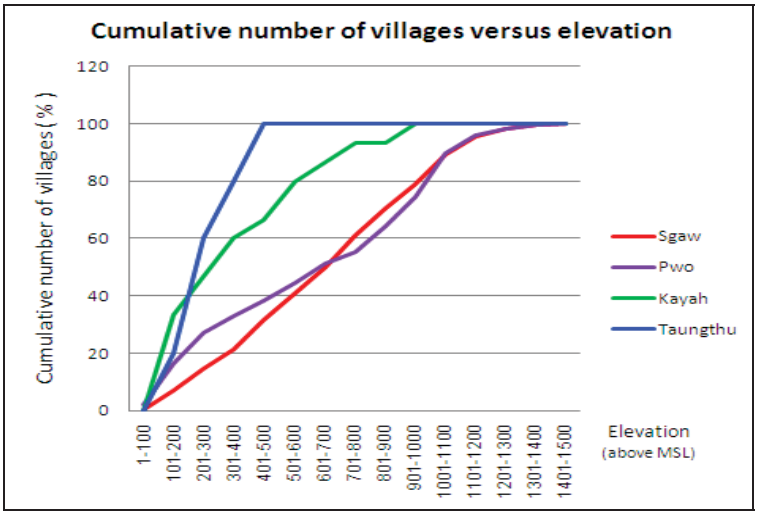


Figure 13 Graph showing cumulative numbers of village against elevation

Villages where the Kayah Karen reside locate at a lower elevation between 112.0 and 908.0 meters above MSL with an average elevation of 384.2 meters above MSL. Village locations of the Kayah Karen can thus be define them as an 'upland' tribe.

Compared to the other observed subgroups, villages where the Taungthu Karen reside are located at the lowest elevation between 103.0 and 414.0 meters above MSL. Their average elevation is 275.5 meters above MSL. Based on the examination, the village locations of the Taungthu Karen can also define them as an 'upland' tribe.

To sum up, the preferential topographical heights for these subgroups are different. The Sgaw and Pwo Karen mostly settle at high elevations in 'highland' areas while the Kayah and Taungthu (Pa'O) Karen locate at lower elevations in 'upland' areas. Since higher elevation implies less accessibility and more isolation of the villages, the Sgaw and the Pwo Karen who live at higher altitudes may better preserve the originality of their languages than the Kayah and Taungthu Karen. Such a finding may help linguists to further investigate the variation of languages in these subgroups more clearly.

6. Conclusion

In this study, a village database of Karen settlements of 6 Karen subgroups was produced with the main aim of facilitating linguists' work. Locations of 6 Karen subgroups in western and northern Thailand in the vicinity of the Thai-Burmese border are the main scope. The Geographic Information System (GIS), a spatially-based technique, was used as a tool to map the Karen village locations. Further analysis was conducted to explore the population numbers of Karen subgroup and their population change, settlement distribution, village sizes and the relationship of village locations and topography. Overall the key findings of the study can be summarized as follows.

Firstly, among all of the 6 Karen subgroups, the Sgaw Karen are still the largest Karen population residing in Thailand today. The second largest subgroup is the Pwo Karen. This finding is in agreement with most previous Karen surveys such as the study compiled by Schliesinger (2000).

Secondly, in the last 10 years the total number of the Karen population in the study area has increased by 10%. The numbers of Karen population in some provinces such as Kamphaeng Phet and Suphan Buri have increased at an alarming rate while the population numbers in two provinces—Uthai Thani and Phrae—have decreased slightly.

Thirdly, the findings show that the size of village of all subgroups varies greatly ranging from small to large ones. However, their average size is relatively similar— approximately 250 people per village. In addition, village size below this number ($\leq$ 250 people) applies to over 60% of all Karen villages.

Fourthly, the distribution of Karen villages is unique and totally different from Thai settlements. Each subgroup tends to live independently from other subgroups. The pattern of their settlement linearly lies along the Thai-Burmese border or provincial boundaries due to their being confined by mountain ranges, hills, and valleys. For the Sgaw Karen, their settlements are found clustered mostly

close to the Thai-Burmese border. The Pwo Karen have settled closer to the mainland of the Thai Kingdom. The settlements of the Kayah and Taungthu Karen are distributed with no-pattern.

And finally, the elevation ranges of settlements occupied by Karen subgroups are approximately between 100 and 1,500 meters above MSL. The preferred topographical height for these subgroups is different. The Sgaw and Pwo Karen tend to settle at higher elevations in 'highland' areas whereas the Kayah and Taungthu (Pa'O) Karen locate at lower elevations in 'upland' areas.

The main result of the study, a GIS village database, provides very useful information in the spatial dimension and will be used as a reference map for the settlement of Karen subgroups surveyed in 2011-2012. Maps of Karen settlements can help linguists and relevant researchers to interpret and get a better knowledge of Karen studies from the spatial aspect. Also, this information will be useful for government agencies in performing rural planning and policy making as well as setting up action plans to mitigate problems in upland and highland areas.

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ภาคผนวก 2

Abstracts และ PowerPoints ของบทความที่เสนอในการประชุมวิชาการนานาชาติ

ศ.ดร. ธีระพันธ์ เหลืองทองคำ

- **Proto-Karen worldview as reflected in the use of noun classifiers in six modern Karenic languages, Sgaw, Pwo, Pa-O, Kayah, Kayan and Kayaw**
- **A comparison between the speech of brass-coiled necked and non-brass-coiled necked Kayan speakers: An acoustic study**
- **Numeral and classifiers in modern Karenic languages and Proto-Karen**
- **Proto-Karen (*k-rjaŋ^{A}) fauna**
- **Language change in progress: A case study of Pwo Karen fauna**

ABSTRACT

Proto-Karen Worldview as Reflected in the Use of Noun Classifiers in Six Modern Karenic Languages, Sgaw, Pwo, Pa-o, Kayah, Kayan, and Kayaw*

Theraphan L-Thongkum
Department of Linguistics, Chulalongkorn University,
Bangkok, Thailand
E-mail: <Theraphan.L@chula.ac.th>

In the modern Karenic languages, Sgaw, Pwo, Pa-o, Kayah, Kayan and Kayaw, there are two major types of noun classifier, i.e. the general or basic type and the specific one. The former occurs more frequently since its use is less restricted or, in other words, general noun classifiers are used to classify many more things than specific classifiers.

Karen speaking people make a distinction between 'human beings' and 'non-human beings'. There is only one classifier for nouns belonging to the human category, e.g. /ɣa^{33}/, /ɣa^{55}/ and /pra^{33}/ in N. Sgaw, N. Pwo and Kayan, respectively. The non-human category comprises animals (animate) and things (inanimate). Animal species (except mammals) and inanimate objects are classified with the same set of classifiers depending primarily upon their shape; for example, in Kayan, the classifier /bɔ^{453}/ which has the semantic feature [+long] is used to classify snakes, pangolins, crocodiles, eels, millipedes, earthworms, chameleons, as well as needles, candles, cigarettes, incense sticks, pestles, bangles, roads and so forth.

To reconstruct Proto-Karen noun classifiers with a focus on the general type and Proto-Karen worldview as reflected in the use of classifiers, a three-step data collecting method was devised: a general interview, an in-depth interview after preparing working hypotheses and a final interview based on the devised thematic word list. The data used for the analysis is fresh and solely collected by the author. To compare and conclude the research findings, the comparative method was applied.

Six basic noun classifiers were reconstructed: *bra^{A}, *ʔdə^{A}, *ʔbɔN^{A}, *ʔba^{B}, *hma^{A} and *phloŋ^{B}. To comprehend the worldview of the Karen, the cognitive or conceptual system of noun classification was analysed using binary and descriptive semantic features, i.e. [±human], [±animate], [±mammal], [±big], [+long], [+flat] and [+round].

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Proto-Karen Worldview as Reflected in the Use of Noun Classifiers in Six Modern Karenic Languages, Sgaw, Pwo, Pa-O, Kayah, Kayan and Kayaw

Theraphan L-Thongkum

Department of Linguistics, Chulalongkorn University,

Bangkok, Thailand

E-mail: <Theraphan.L@chula.ac.th>

International Conference on South-East Asian Languages

at University Paris Diderot, Paris, December 19, 2009

Background (1)

- Six groups of Karenic speaking people can be found in Thailand.

- Estimated number of population is about 500,000 (Sgaw Karen> 50%).

- They are scattered in 13 northern and western provinces: Chiangrai, Chiangmai, Lamphun, Lampang, Phrae, Maehongsorn, Tak, Kanchanaburi, Uthaithani, Suphanburi, Ratchaburi, Petchaburi and Prachuapkhirikhan.

- The Karen can also be found in big cities, e.g. Bangkok, as private college students, construction labourers, housekeepers, etc.

Background (2)

- Distribution of the Karen in Myanmar and Thailand

Background (3)

- Six groups of Karen speaking people in Thailand

Sgaw
(White Karen)

Kayah
(Red Karen)

Pwo
(Phlong, Phlou)

Kayan
(Long-necked Karen)

Pa-o
(Black Karen, Tongsu)

Kayaw
(Big-eared Karen)

Background (4)

- Earlier descriptive studies of Karen classifiers

Hsa Eh Ywar and Ken Manson. 2009. Classifiers in Kayan. Paper presented at 42nd ICSTLL, organized by Phayap University, Chiangmai, November 2-4, 2009.

Limpichati, Chirapasr. 1991. Worldviews of the six hilltribes in Thailand as reflected in noun classifiers for households items. Unpublished M.A. thesis, Department of Linguistics, Chulalongkorn University, Bangkok.

Ratanakul, Suriya. 2004. Numeral classifiers in Sgaw Karen. In *Selected Topic I: Karen*, pp. 107-120. Bangkok: Faculty of Liberal Arts, Mahidol University.

Yingsawadi, Piyawalee. 1990. Worldviews of the six hilltribes in Thailand as reflected in classifiers for animate nouns. Unpublished M.A. thesis, Department of Linguistics, Chulalongkorn University, Bangkok.

Objectives

- To analyse basic noun classifiers in the six Karenic languages spoken in Thailand using the componential analysis method
- To compare the results of the above analyses and to interpret the cognitive system of noun classification and the worldview of the Karen
- To reconstruct the forms and meanings of basic noun classifiers in Proto-Karen
- To evaluate the earlier results of Karenic language classification based on the lexicostatistic method and phonological development

Hypotheses

- Karen speakers primarily classify nouns into “human beings” and non-human beings”.

- Non-human beings, i.e. “animals” (except mammals with four legs) and “things” belong to the same category in Karen perception.

- The use of noun classifiers can be traced back to Proto-Karen times and it can reflect Proto-Karen worldview.

- A conceptual or cognitive system of noun classification can be additional evidence for language classification.

Research Sites

Kayan (May, 2009)

- Huay Suea Thaw, Maehongson: Kayaw (November, 2009)
  Kayah (November, 2009)
- Huay Khan, Maehongson: Pa-O (November, 2009)
- Huay Khom, Chiangrai: Sgaw (September, 2009)
- Suan Phueng, Ratchaburi: Pwo (July, 2009)

Scope

- “Basic noun classifiers” used in this paper are “noun classifiers commonly known and widely used in everyday conversation among the Karen”. Those referring to “collective units” are not included.

- Two types of semantic features used are:

  (1) BINARY FEATURES: [±human], [±mammal], [±animate], [±big];

  (2) DESCRIPTIVE FEATURES: [+long], [+flat], [+round]

- Based on the above definition, only 7 basic noun classifiers were analysed.

Data Collecting Method

- Three steps of data collecting

  (1) General interview

  (2) In-depth interview after preparing working hypotheses

  (3) Final interview with a devised thematic word list.

Classifier for Human Beings

- [+human]

Kayan: pra^{33}; **Kayaw**: ra^{33}; **Kayah**: phre^{11};

Sgaw: ɣa^{33}; **Pwo**: ɣa$^{31¨}$; **Pa-O**: phra^{33}

Non-Human Beings

- [-human], [±animate]

Mammals with Four Legs

- [-human], [+animate], [+mammal]

Kayan: dəi^{53}; **Kayaw:** də^{55}; **Kayah**: do^{33};

Sgaw: di^{33}; **Pwo**: di$^{31¨}$; **Pa-O**: ba^{55}

Animals and Things (1)

- [-human], [-mammal], [±animate], [+long]

Kayan: bɔ^{53}; **Kayaw**: bo^{55}; **Kayah**: bo^{33};

Sgaw: bo^{33}; **Pwo**: bõ$^{31¨}$; **Pa-O**: ba^{55}/li^{53}

Animals and Things (2)

- [-human], [-mammal], [±animate], [+flat]

Kayan: ba^{11}; **Kayaw**: ba^{11}; **Kayah**: be^{11};

Sgaw: be$^{31˜}$; **Pwo**: bai^{55}; **Pa-O**: ba^{55}

Animals and Things (3)

- [-human], [-mammal], [±animate], [+round]

Kayan: ma^{53}; **Kayaw**: ma^{55}

Kayah: me^{33}

Sgaw: - ; **Pwo**: - ; **Pa-O**: -

Animals and Things (4)

- [-human], [-mammal], [±animate], [+round], [-big]

Kayan: phləu^{11}; **Kayaw**: phlə^{11}; **Kayah**: plɔ^{11}

Sgaw: phlə$^{31˜}$; **Pwo**: phlõu^{55}

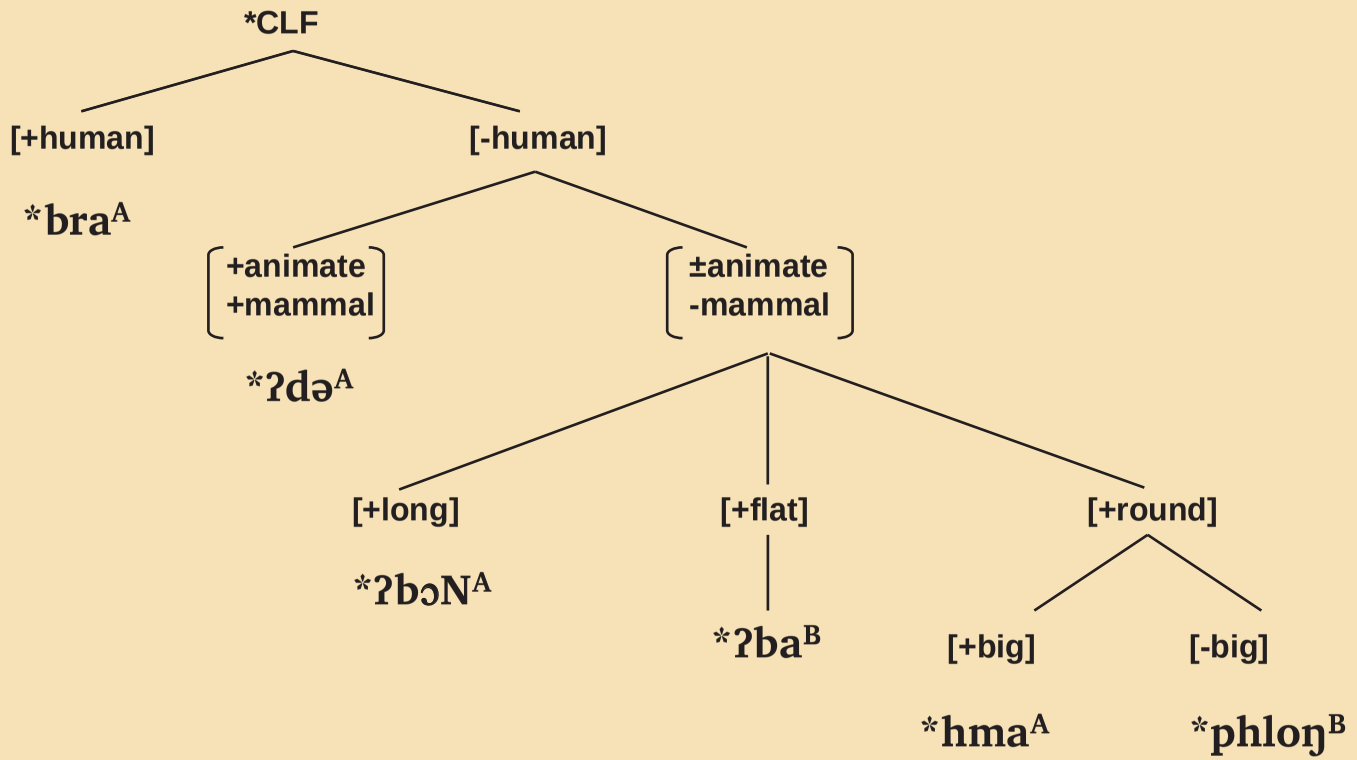
Pa-O: phloŋ^{55}

Cognate Sets of Basic Noun Classifiers

Kayan	Kayaw	Kayah	Sgaw	Pwo	Pa-O
pra^{33}	ra^{33}	phre^{11}	ɣa^{33}	ɣa$^{31¨}$	phra^{33}
dəi^{53}	də^{55}	do^{33}	di^{33}	di$^{31¨}$	–
bɔ^{53}	bo^{55}	bo^{33}	bo^{33}	bõ$^{31¨}$	–
ba^{11}	ba^{11}	be^{11}	be$^{31˜}$	bi^{55}	bai^{55}
phləu^{11}	phlə^{11}	phlɔ^{11}	phlə$^{31˜}$	phlõu^{55}	phloŋ^{55}
ma^{53}	ma^{55}	me^{33}	–	–	–

Research Findings (1)

- Proto-Karen Cognitive System of Noun Classification
- Reconstructed forms of basic noun classifiers



(tentative reconstruction)

Research Findings (2)

- Conceptual system as revealed by the use of basic noun classifiers shows how the Karen construe their world of experience.
- Karen speakers primarily make a distinction between [+human] and [-human].
- The [-human] category can be [+animate] or [±animate]
- [+animate] must be [+mammal] / [+4-legged].
- [±animate] must be [-mammal].
- [±animate] can be [+long], [+flat] or [+round].
- [+round] can be [+big] or [-big] (only in Kayan, Kayaw and Kayah)

Research Findings (3)

- NP structure = N NUM CLF, e.g. **di^{33} khi^{33} phlə$^{31˜}$** ‘two drums’ (Sgaw)

- 3-6 basic noun classifiers were found in the six modern Karenic languages studied.

- “Shape” is more important than “size” in the Karen worldview (less clear in Pa-O).

- Based on the use of noun classifiers, the six Karenic languages investigated can be classified into 3 groups: (1) Kayan, Kayaw, Kayah; (2) Sgaw, Pwo; and (3) Pa-O.

Research Findings (4)

- *hma^{A} [+round, +big] has been lost in Sgaw, Pwo and Pa-O.

- The Christian Sgaw use dɨ^{33} [-human, +animate, +mammal] for classifying ‘back baskets’, ‘spirits, ghosts’, and ‘Buddha statues’, which is innovated by religious preaching.

- The Pa-O seem to have a different conceptual system of, noun classification, for example, the classifier ba^{55} [+flat] is used for most animals, except for snails and tortoises, when phloŋ^{55} [+round] is used instead.

Research Findings (5)

- Tai or Shan words have been borrowed into Pa-O and used as classifiers, e.g. law^{33} ‘clf. for flutes’, li^{53} ‘clf. for long objects’, phɨ^{33} ‘clf. for mats, blankets’, phoŋ^{55} ‘flock, herd’, etc.

- The above finding suggests that the Pa-O may have been in contact with Tai speaking peoples for a long time, long enough to have their cognitive system changed.

Research Findings (6)

• 6 basic noun classifiers can be tentatively reconstructed, i.e. *bra^{A}, *ʔdə^{A}, *ʔbɔN^{A}, *ʔɓa^{B}, *hma^{A} and *phloŋ^{B}

• Kayan, Kayaw and Kayah have retained all of them, while Sgaw and Pwo have kept only five: *bra^{A}, *ʔdə^{A}, *ʔbɔN^{A}, *ʔba^{B}, *phloŋ^{B}.

• The distinction between [+big] and [-big] for [+flat] and [+round] shapes has been lost in Sgaw, Pwo and Pa-O.

• Pa-O has kept only 3: *bra^{A}, *ʔba^{B} and *phloŋ^{B}, resulting from the loss of *ʔdə^{A}, *ʔbɔN^{A} and *hma^{A}.

Conclusions

- A cognitive or conceptual system of noun classification can be used as additional evidence for language classification.

- The different conceptual system of noun classification suggests that the Pa-O separated from the other Karenic speaking groups quite earlier in time depth.

- This finding seems to confirm the results of the Karenic language classification based on lexical and phonological development proposed by, e.g. Shintani (2002).

Acknowledgements

- I would like to express my sincere gratitude to the Thailand Research Fund (TRF) for funding the “Karen Linguistics Project” and our trip to Paris. Many thanks go to my research assistants, Narinthorn Sombutnon Behr and Charttreeya Churat, and also to my Karen friends for their kind cooperation and hospitality.

THANK YOU

ABSTRACT

A Comparison between the Speech of Brass-coiled Necked and Non-brass-coiled Necked Kayan Speakers: An Acoustic Study

Theraphan Luangthongkum

Department of Linguistics, Faculty of Arts
Chulalongkorn University
Bangkok, Thailand
E-mail: Theraphan.L@chula.ac.th

The Kayan (Padaung, Long-necked Karen) can be found in the province of Mae Hong Son, northern Thailand. The estimated size of the population is 500-2,800. Kayan phonology was analysed by Sirinya Khammuang (1998) and Manson (2007). However, an acoustic study of Kayan speech has never been done before.

The objectives of our research are to analyse the acoustic characteristics of the Kayan plosives (VOT / laryngeal timing), vowel quality and length (F1, F2 and duration), tones and their length (F0 and the duration of voiced segments bearing F0); and to compare the acoustic findings from three groups of speakers to see whether there has been any effect of the brass coils on the speech production of the female speakers who have worn brass coils around their necks for many years.

In sum, normal F0 and VOT values indicate that female speakers with brass coils can control their intrinsic laryngeal muscles well. The F1 values of the high vowels suggest that they have some difficulty in moving their tongues vertically. Tongue movements are controlled by the extrinsic muscles of the tongue connected to the palate and the hyoid bone. The results of wearing heavy brass coils are: the mandible is constantly pushed up; the shoulders and the upper areas of the rib cage are pressed down; there has been atrophy of the shoulder muscles; the extrinsic muscles that are involved in larynx, neck and tongue movements have been affected. The decreased space of the upper thoracic cavity can affect breathing when speaking is modified breathing. However, compensation for the deformity is possible due to a synchronisation of the speech organs and muscles. To obtain solid answers, detailed physiological studies are needed, especially a longitudinal study.

A Comparison between the Speech of Brass-coiled Necked and Non-brass-coiled Necked Kayan Speakers: An Acoustic Study

Theraphan Luangthongkum

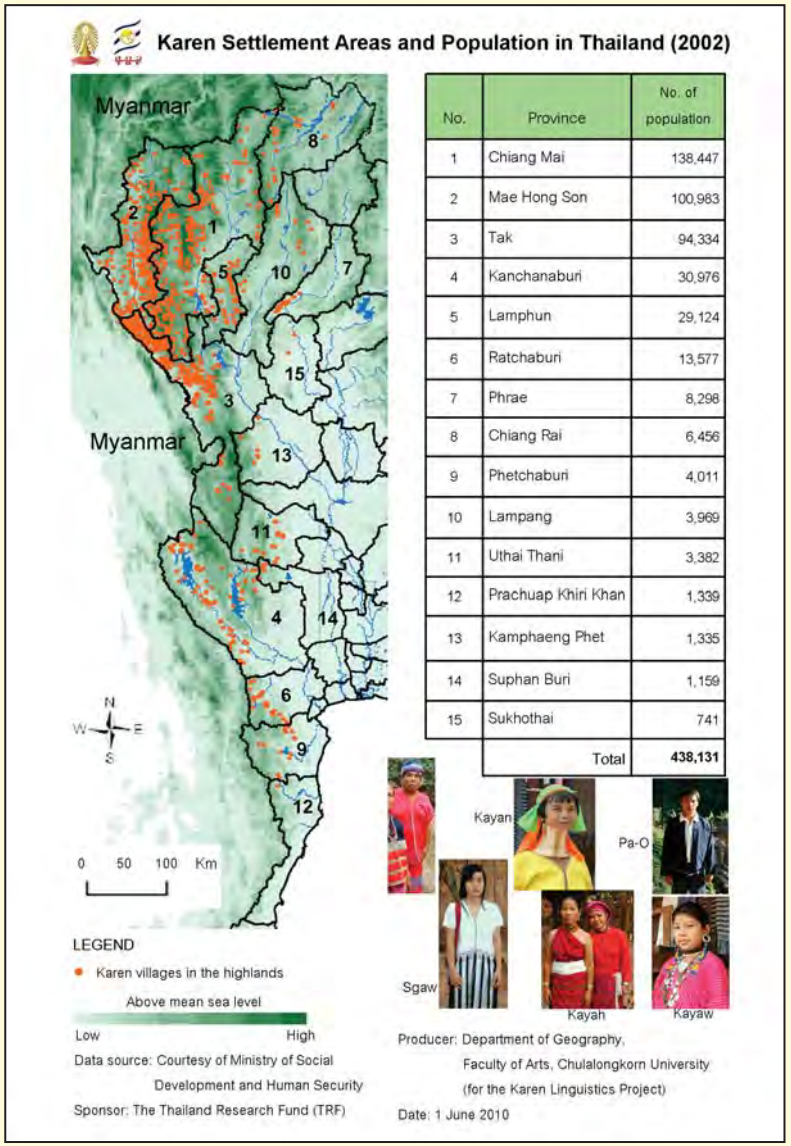
Department of Linguistics, Faculty of Arts
Chulalongkorn University
Bangkok, Thailand
E-mail: theraphan.l@chula.ac.th

Paper presented at SEALS XX, organized by the Linguistics Department, University of Zurich, Switzerland, June 10-11, 2010

Background (1)

- Sub-project of the “Karen Linguistics Project”
- Three-year project (1 July 2009 – 30 June 2012)
- Supported by the Thailand Research Fund (TRF)

Background (2)



No.	Province	No. of population
1	Chiang Mai	138,447
2	Mae Hong Son	100,983
3	Tak	94,334
4	Kanchanaburi	30,976
5	Lamphun	29,124
6	Ratchaburi	13,577
7	Phrae	8,298
8	Chiang Rai	6,456
9	Phetchaburi	4,011
10	Lampang	3,969
11	Uthai Thani	3,382
12	Prachuap Khiri Khan	1,339
13	Kamphaeng Phet	1,335
14	Suphan Buri	1,159
15	Sukhothai	741
	Total	**438,131**

- *Karen population in Thailand:*
  438,131 (Ministry of Social Development and Human Security, 2002)

- *Kayan population in Thailand:*
  500 (Schiesinger,2000)
  2,800 (http://www.joshuaprojectnet/peoples.php?peo3=14250,15-Apr-2010)

- *Total Kayan population (Myanmar & Thailand):*
  60,000 (http://www.joshuaprojectnet/peoples.php?peo3=14250,15-April-2010)
  150,000 (Manson, 2007)
  85,000 (Bradley, 1997)
  41,080 (http://www.ethnologue.com/showlanguage.asp?code=pdu,30-April-2010)

Figure 1 Karen settlements in Thailand (6 sub-groups)

Background (3)

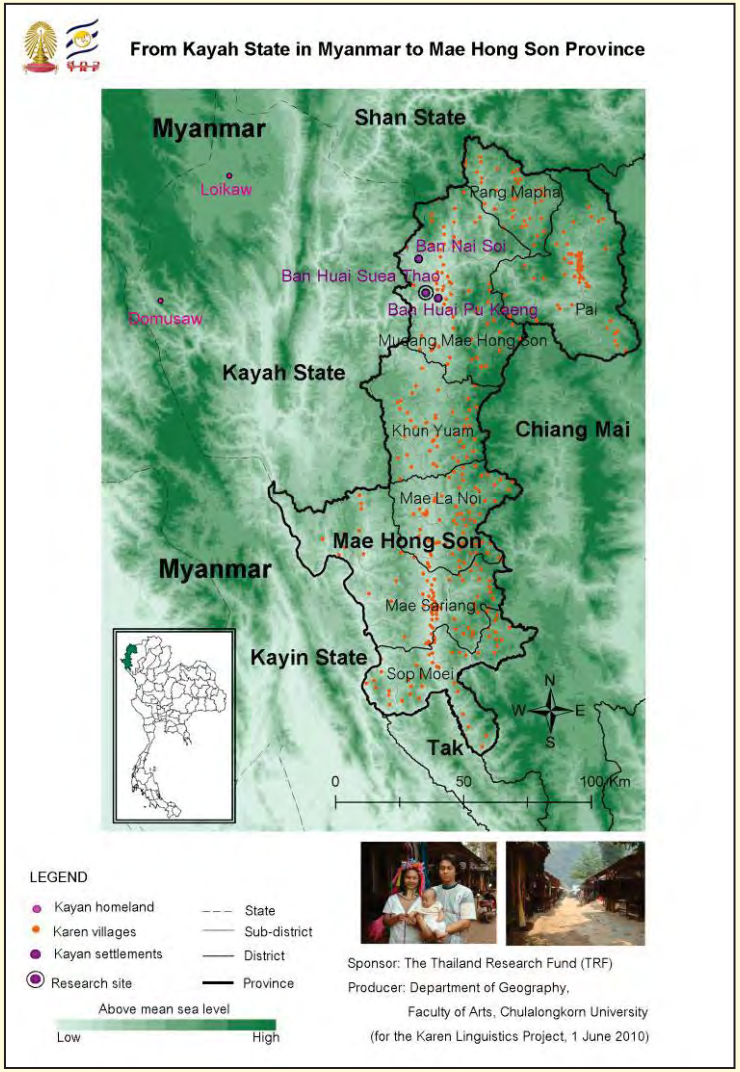


Figure 2 Migration from the Kayah (Karenni) State of Myanmar to the province of Mae Hong Son,Thailand

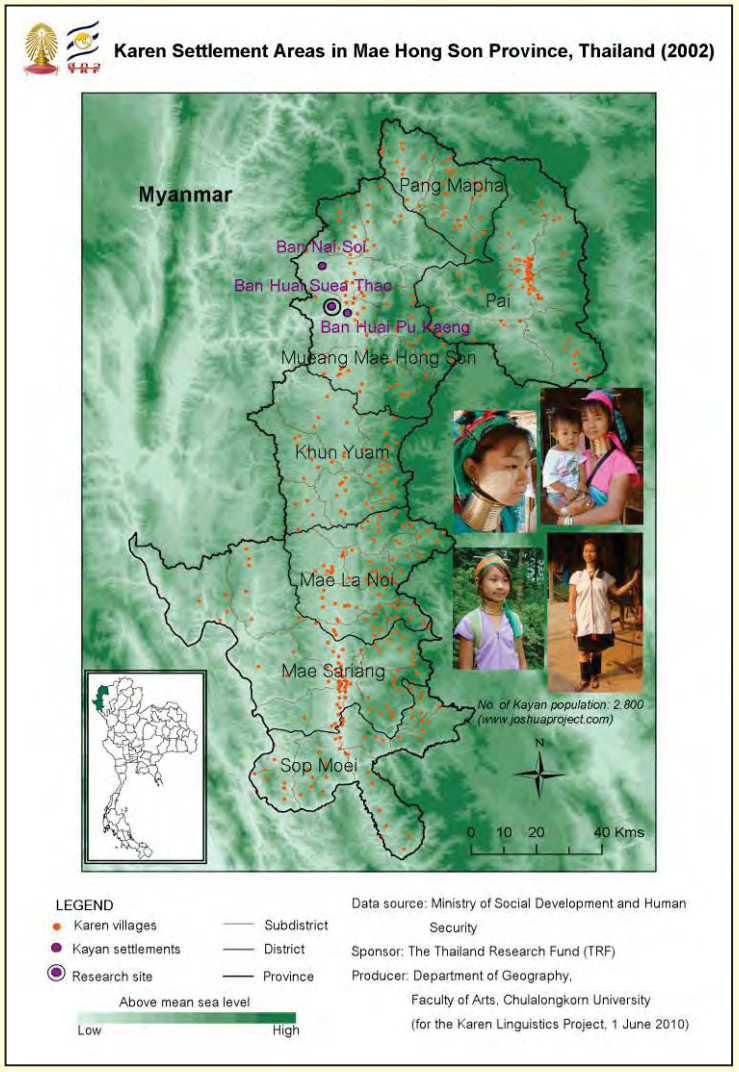


Figure 3 Area of habitation of the Kakhoun Kayan in Mae Hong Son province

Background (4)

- *Alternate names:* Kayang, Padaung (Padong), Kakaung (Kakhoun, Kakhon), Lae Kur (Lae Khoe), Long-neck people, Long-necked Karen

- *Linguistic classification:* Sino-Tibetan, Tibeto-Burman, Karenic

- *Kayan sub-groups in Myanmar:* Latha, Kakhoun (Kakhon), Kakhau (Geker), KaNgan (Yinbaw)

- *Kayan ethnic group in Thailand:* Padaung (Kayang, Kakaung)

Background (5)

More information on their history, clothings, crafts, houses and villages, agriculture and economy, society, myths, beliefs and rituals can be found in Schliesinger (2000), the Illustrated Encyclopedia of mankind (1978), Somsonge Burusphat & Sarinya Khammuang (1998, in Thai) and Somsonge Burusphat (1989, in Thai)

Objectives

- To analyse the acoustic characteristics of Kayan plosives (VOT/ laryngeal timing), vowel quality and length (F1, F2 and duration), tones and their length (F0 and duration of voiced segments)

- To compare the results of the above acoustic studies to help interpret the effects of the brass coils on speech production

Literature review (1)

- Ban Nai Soi Padaung (Long-necked Karen) phonology is studied and described in detail by Sarinya Khammuang (unpublished M.A. thesis, Mahidol University, 1998)

- Pekon Kayan (a variety of standard Kayan) phonology is analysed by Manson (unpublished research reports submitted to Payap University, 2003 and 2007).

Literature review (2)

- Kayan-English word lists used for their phonological analysis is provided in the appendix of the research reports (Khammuang, 1998; Manson, 2007).
- Kayan-English-Burmese dictionary (KAYAN-ENGLE-KATAN NGO, 136 pp.) is available (Matthias U Shwe, Taunggyi-Myanmar, 1998).

Literature review (3)

- None of the previous research works discusses or mentions about the abnormality or distortion of the speech sounds produced by female Kayan speakers wearing many brass coils around their necks.

Research questions

- Are there any differences between the generalized acoustic characteristics of plosives, vowels and tones produced by brass-coiled necked and non-brass-coiled necked female speakers?
- Does the deformity of the anatomical areas from the mandible to the shoulders of the brass-coiled female speakers cause an abnormal sound production?

Methods (1)

- An English-Thai word list of 1,700 items was devised for data collecting at Huai Suea Thao village.
- Three field trips were conducted in March, May and November altogether about a month in the year 2009.
- Phonological analysis was done to be used as a base for acoustic studies and comparative purposes.

Methods (2)

- After rechecking all data, the other three word lists were devised for analysing tones (16 sets), vowels (22 sets), and plosives (12 sets).
- Six speakers (2 females with brass coils, 2 females without brass coils, and 2 males, 25-32 years old) were trained to perform properly before and during the recordings.

Methods (3)

- Each set of tones, vowels, and plosives were recorded 3 times to be used as the test tokens for acoustical measurements.
- The citation forms of 343 words produced with moderate speed were directly recorded onto a portable computer using a high-quality microphone and Adobe Audition version 3 with the sample rate: 16,000 Hz (mono 16-bit)

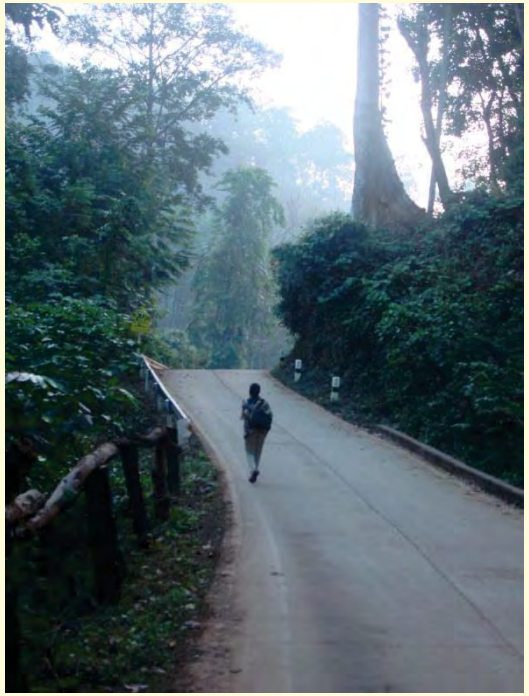
Methods (4)

- The 6,174 test tokens (343 words x 3 times x 6 speakers) were acoustically analysed using PRAAT version 4.5.06 and in some cases statistically tested (ANOVA, $F < .05$; t-Test, $p < .05$).
- Microsoft Excel 2007 and extra programmes, i.e. extractFeatures, Vowel plot and Polygon were used for calculating and plotting.

Methods (5)

- When plotting the acoustic characteristics of the 6 tones, the average F0 values were converted to semitone values:

$$\text{Semitone} = 3.32 \times 12 \times \text{LOG}\left(\frac{\text{Hz to be translated}}{\text{Hz reference level}}\right)$$



Methods (6)

- The results of the acoustical measurements (F0, F1-F2, duration, VOT) of each speaker were shown in tables and graphs.
- An interpretation of the acoustical findings and a physiological explanation of sound production was attempted to provide some suggestions for future research.

Results (1)

- The Kayan dialect spoken at Huai Suea Thao is different from the ones studied by Manson (2003, 2007) and compiled in the Kayan-English-Burmese Dictionary (1998).

Results (2)

A sketch of Huai Suea Thao Kayan phonology:

- *64 initial consonants:*

  p t c k ʔ ph th ch kh b d ɟ g m n ŋ θ h r l j

  pr kr phr khr pl kl phl khl bl

  pw phw bw tw thw dw cw chw ɟw kw khw gw ʔw mw nw ŋw θw hw rw lw

  pj phj bj tj thj dj cj chj kj khj ʔj mj ŋj lj

Results (3)

- 2 final consonants: ʔ ŋ
- 13 vowels: i e ɛ ɨ ə a u o ɔ əɨ ai au
- 4 tones in CVø and CVŋ syllable-types:
  T1 (mid) T2 (low)
  T3 (high-falling) T4 (mid-falling with glottal constriction in CVø)
- 2 tones in CVʔ syllable-type:

  T5 (high) / allotone of T3 T6 (low) / allotone of T2

Results (4)

- VOT / Laryngeal timing (1)

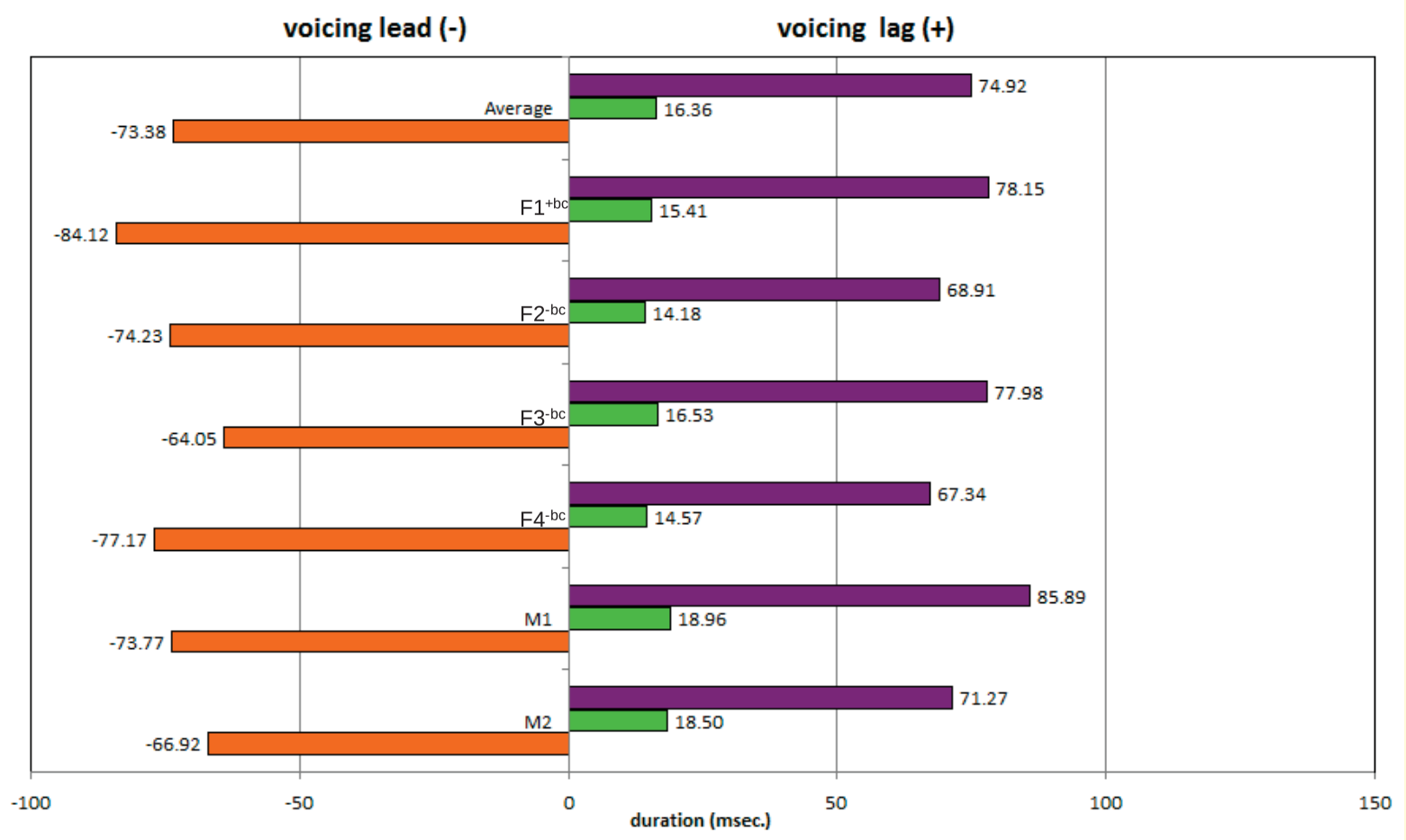


Figure 4 Average VOT values of the plosives of each speaker

b d g p t k ph th kh

Results (5)

- VOT / Laryngeal timing (2)

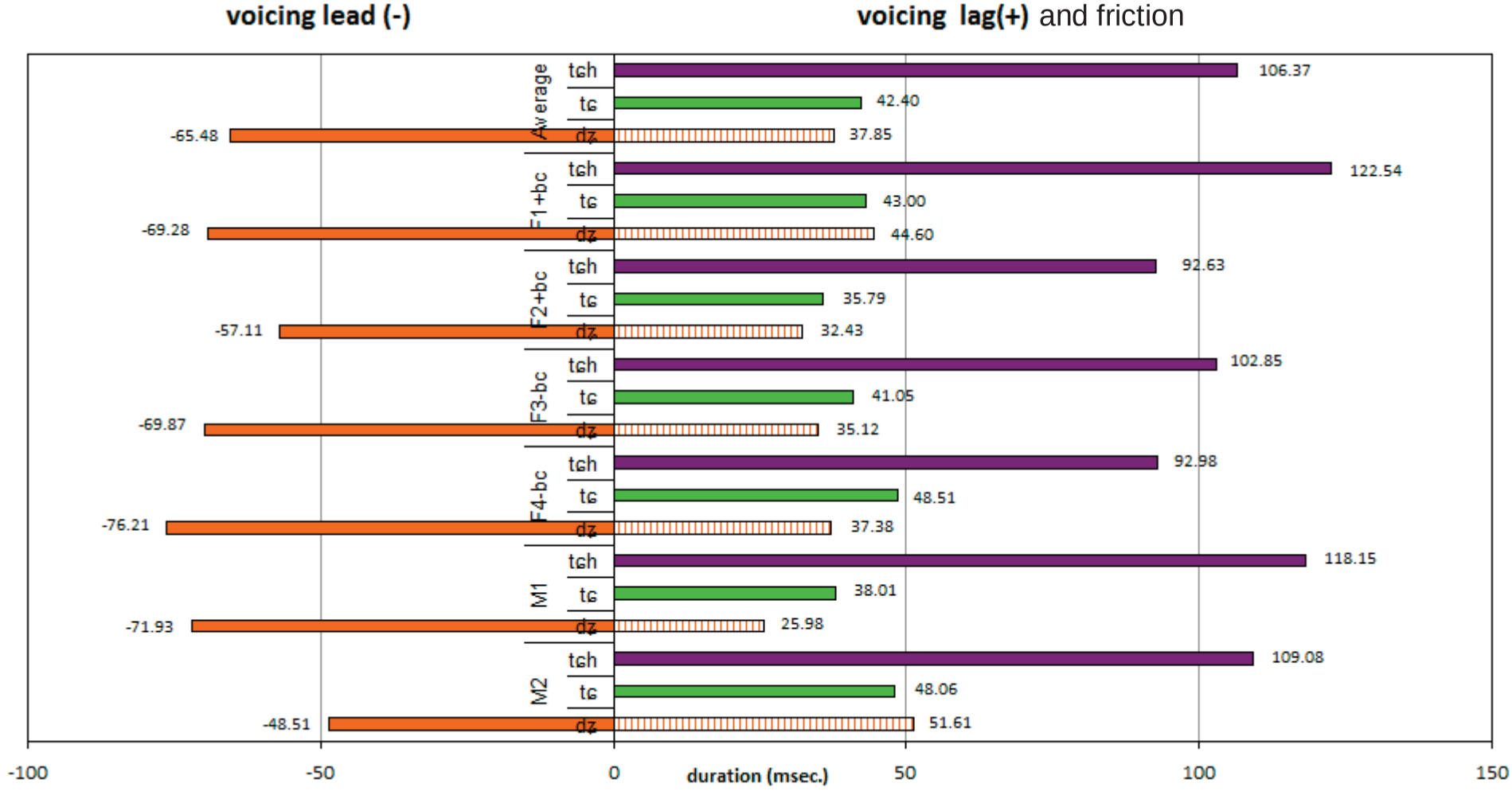


Figure 5 Average VOT values of the affricates of each speaker

ɟ [dʑ] c [tɕ] ch [tɕh]

Results (6)

- VOT / Laryngeal timing (3)

Table 1 Level of difference of the average VOT values of the plosives produced by the three groups of speakers

Speaker / Plosive	A-B	A-C	B-C	A-B&C	A&B-C
Voiced	.009*	.007*	.936	.001*	.099
Voiceless unaspirated	.644	.000*	.001*	.013*	.000*
Voiceless aspirated	.671	.014*	.004*	.226	.001*

* = significant difference (ANOVA, F < .05)

A = $F1^{+bc}$ $F2^{+bc}$ B = $F3^{-bc}$ $F4^{-bc}$ C = M1 M2

Results (7)

- VOT / Laryngeal timing (4)

Table 2 Level of difference of the average voicing-lag values of the voiceless plosives having different places of articulation (six speakers)

Voiceless unaspirated			Voiceless aspirated		
p-t	p-k	t-k	ph-th	ph-kh	th-kh
.770	.000*	.000*	.805	.000*	.000*

* = significant difference (ANOVA, F < .05)

Results (8)

- Tone / Fundamental frequency (F0)

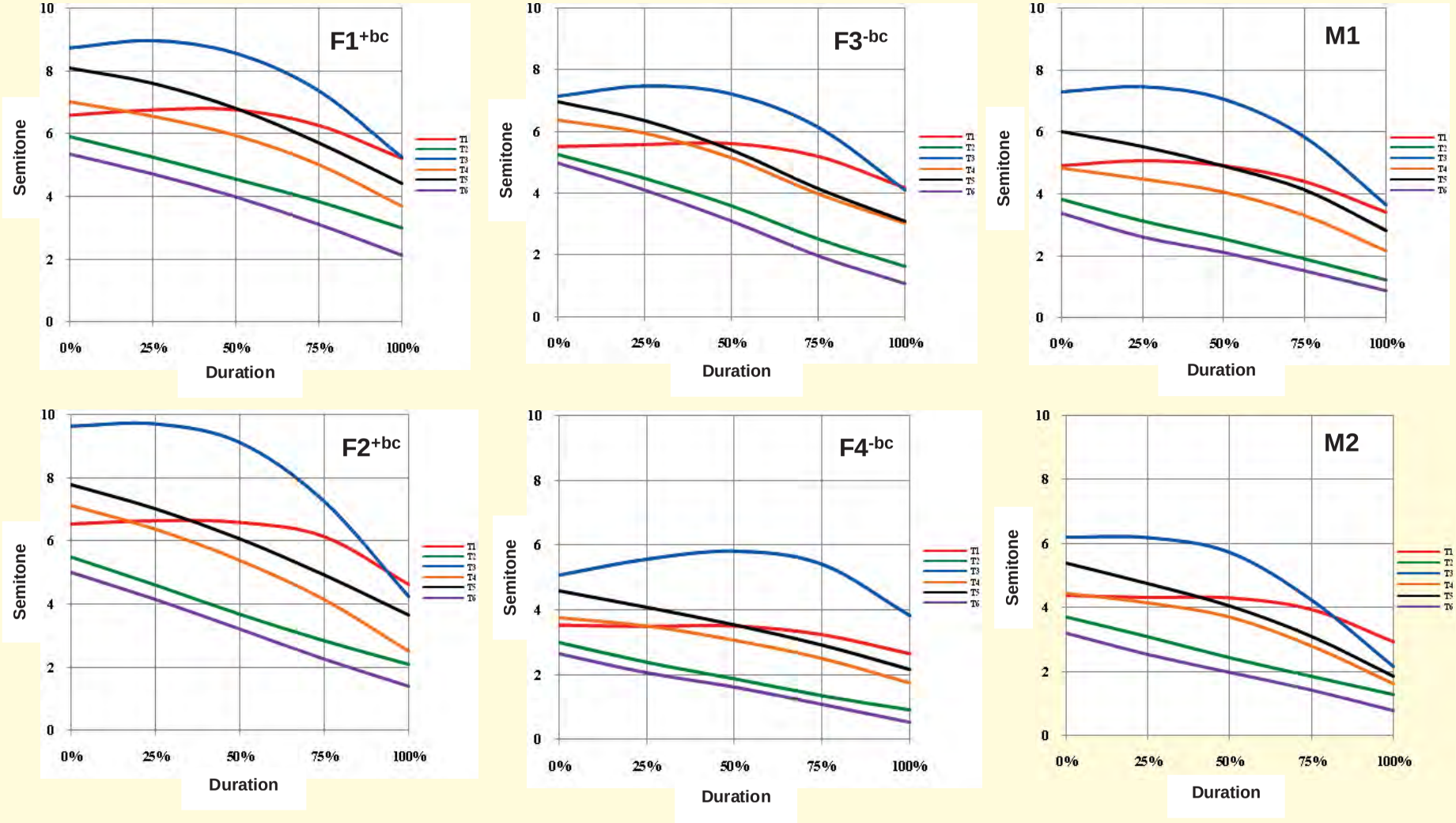


Figure 6 Acoustic characteristics of the tones of each speaker

F = female speaker M = male speaker $^{+bc}$ = with brass coils $^{-bc}$ = without brass coils

Results (9)

- Tone / F0 duration

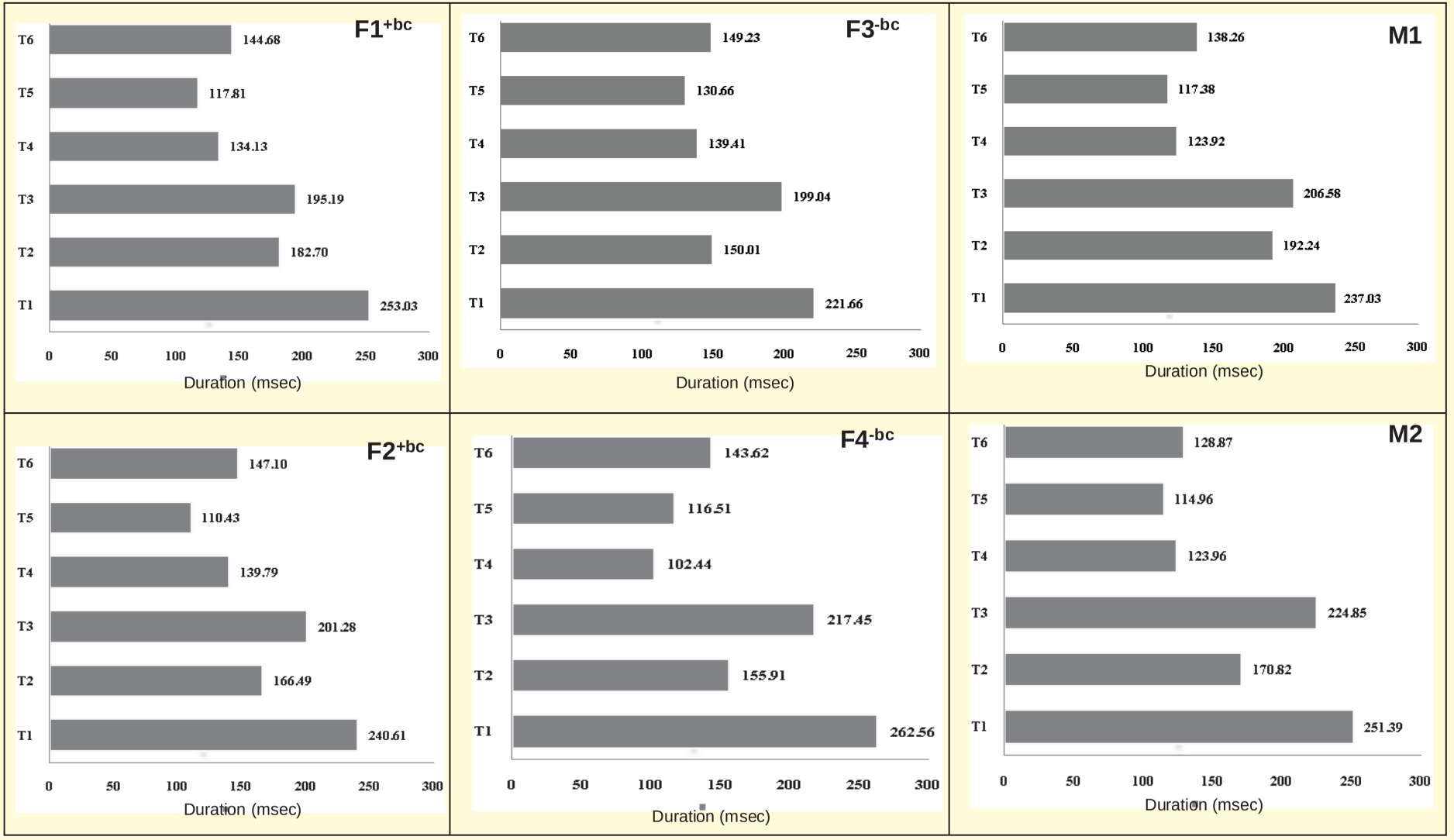
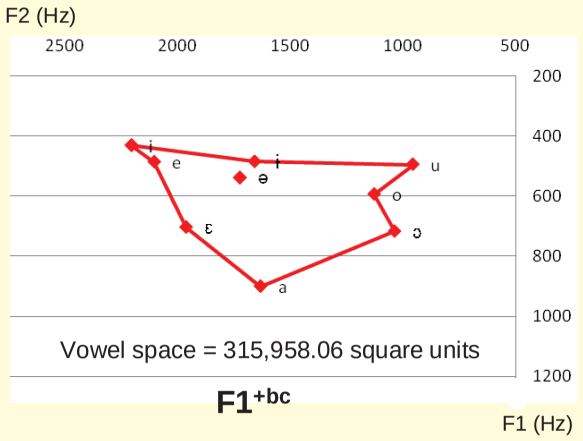
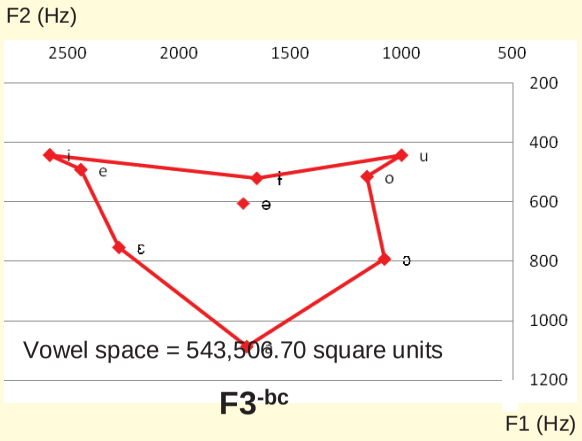
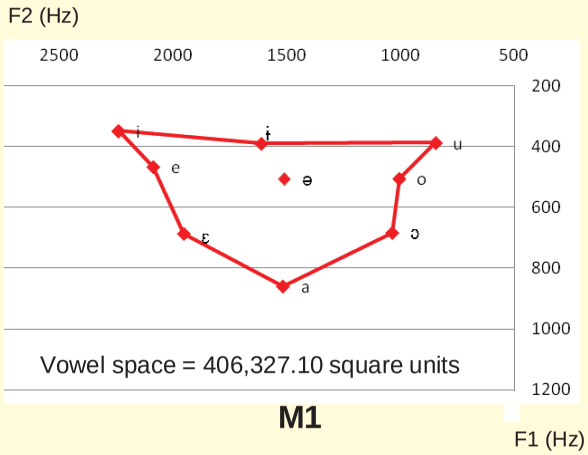


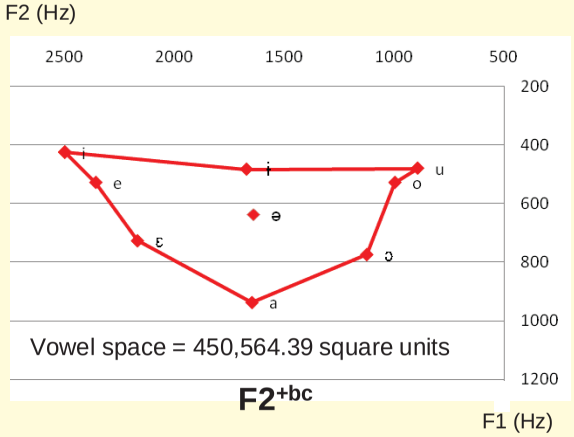
Figure 7 Durations of the tones of each speaker (F = female speaker M = male speaker +bc = with brass coils -bc = without brass coils; T1-T4 in CVø and CVŋ; T5-T6 in CVʔ)

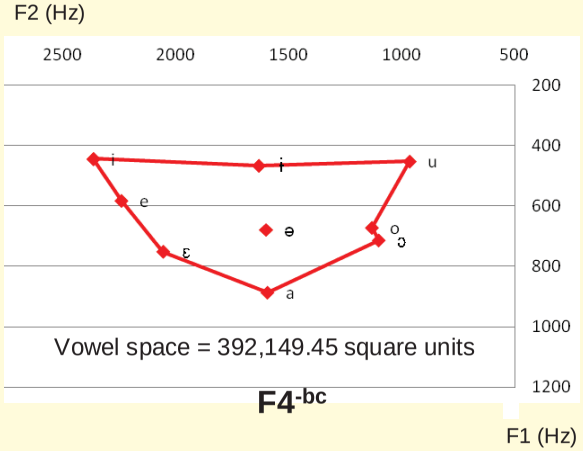
Results (10)











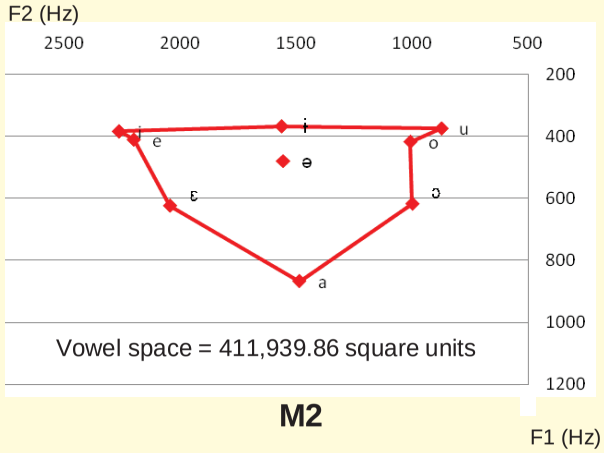


Figure 8 Overall vowel space of each speaker (CVø)

F = female speaker M = male speaker

+bc = with brass coils -bc = without brass coils

Results (11)

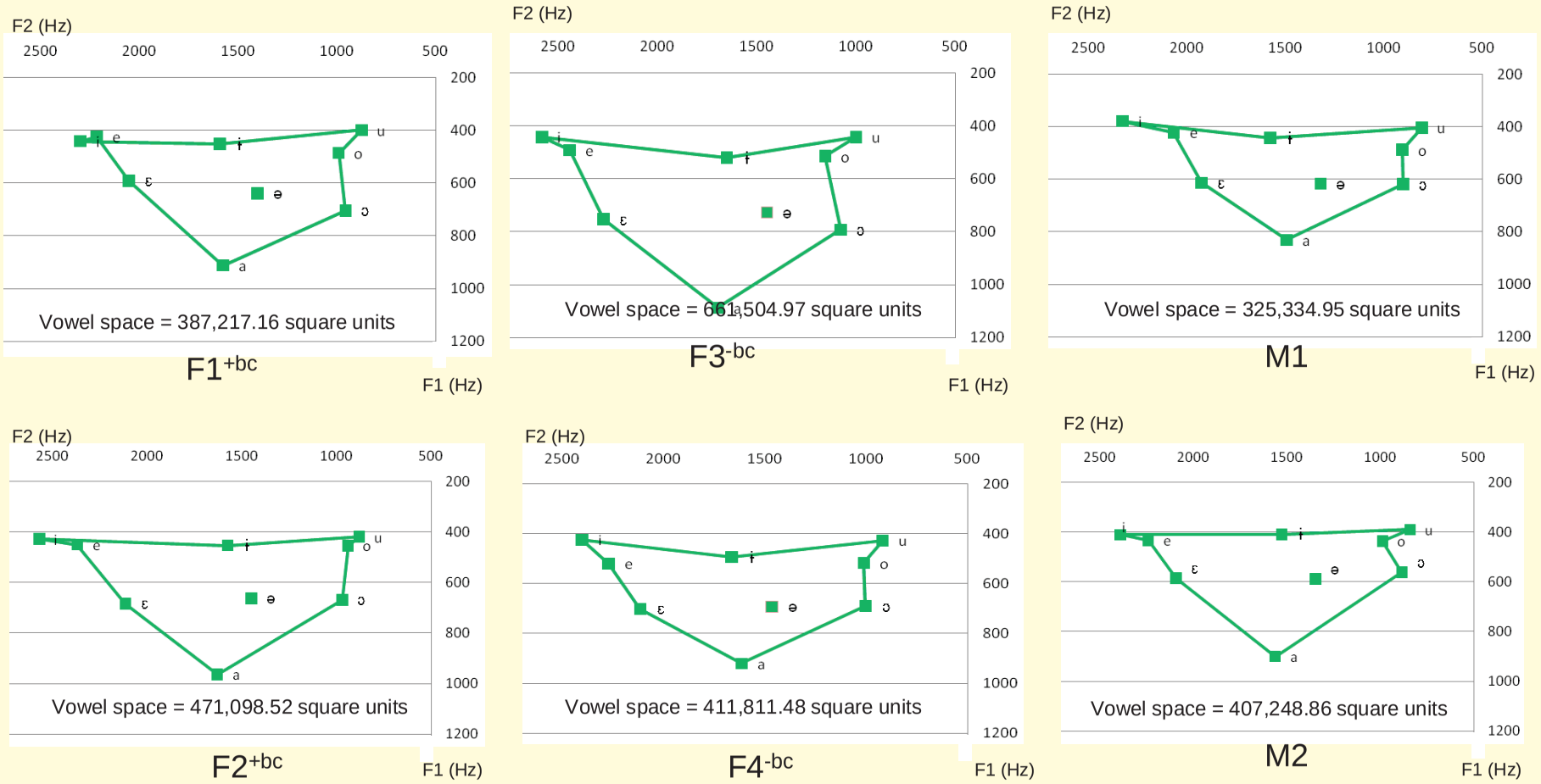
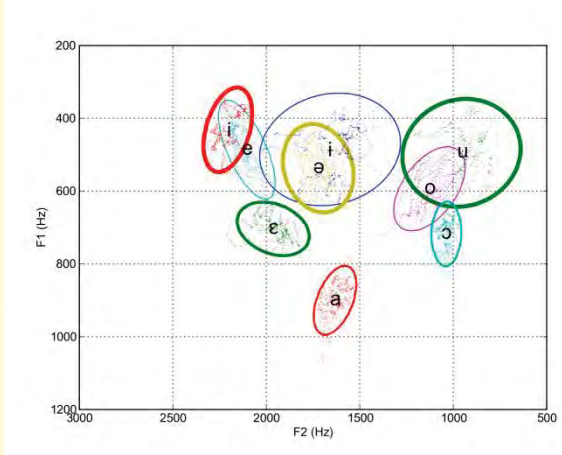


Figure 9 Overall vowel space of each speaker (CV?)

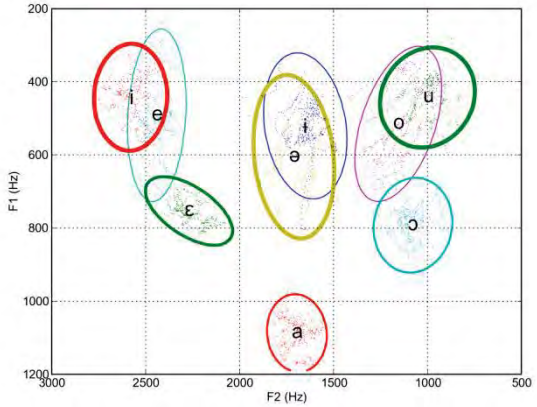
F = female speaker M = male speaker

+bc = with brass coils -bc = without brass coils

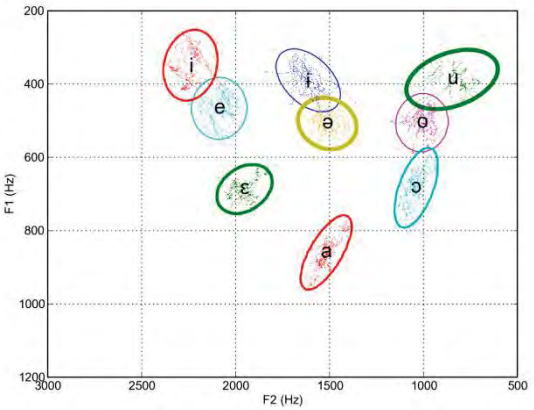
Results (12)



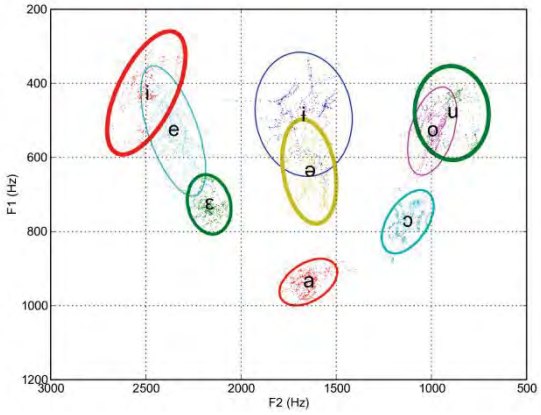
F1^{+bc}



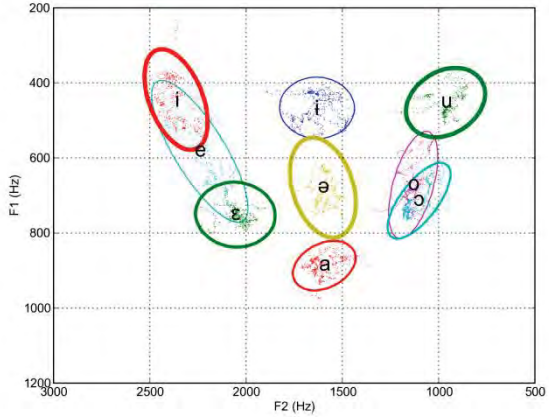
F3^{-bc}



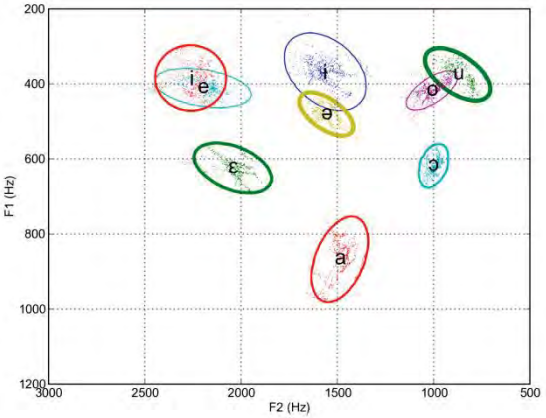
M1



F2^{+bc}



F4^{-bc}



M2

Figure 10 Vowel space of each vowel of each speaker (CVø)

F = female speaker M = male speaker

+bc = with brass coils -bc = without brass coils

Results (13)

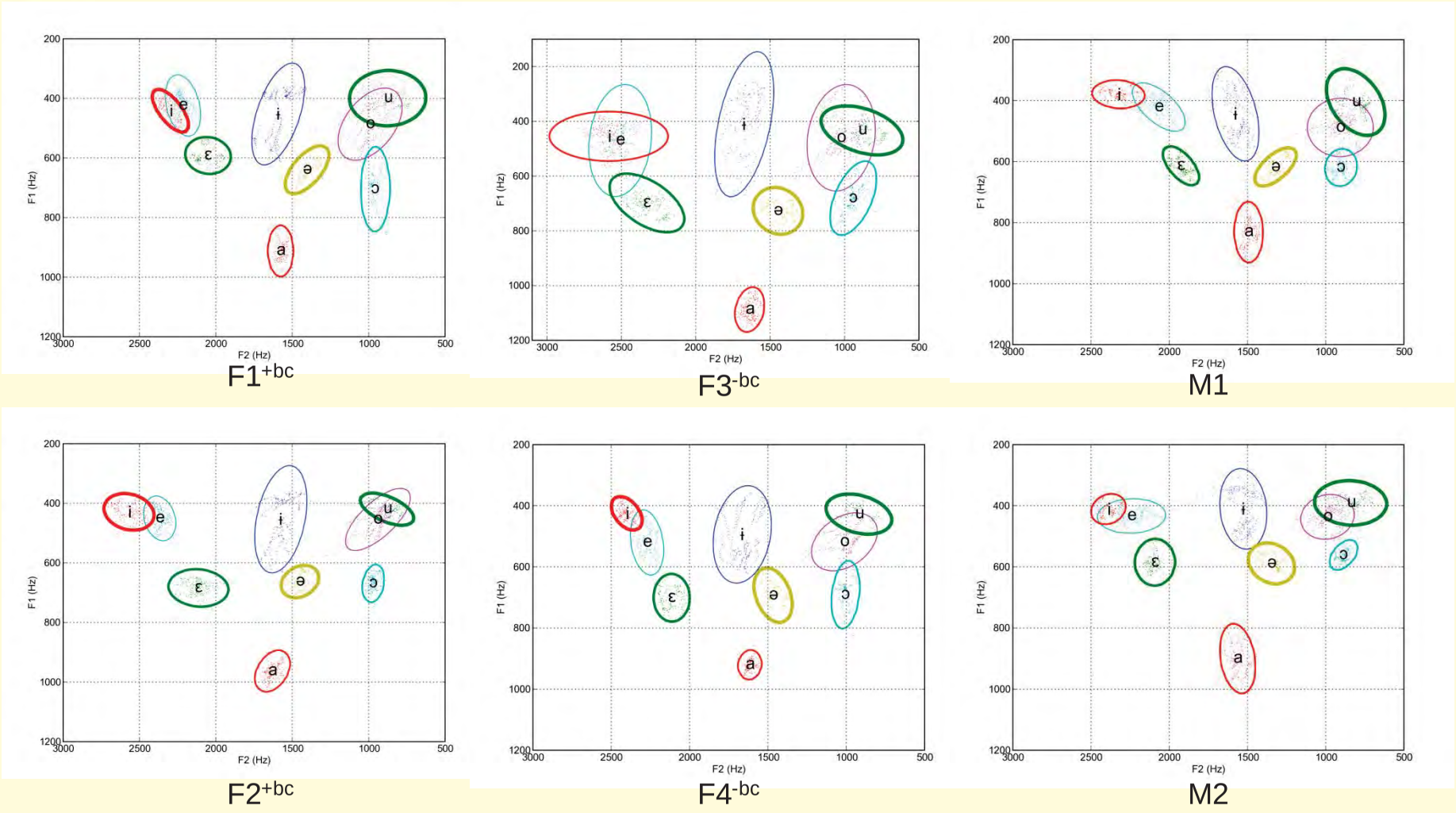


Figure 11 Vowel space of each vowel of each speaker (CV?)

F = female speaker M = male speaker

+bc = with brass coils -bc = without brass coils

Results (14)

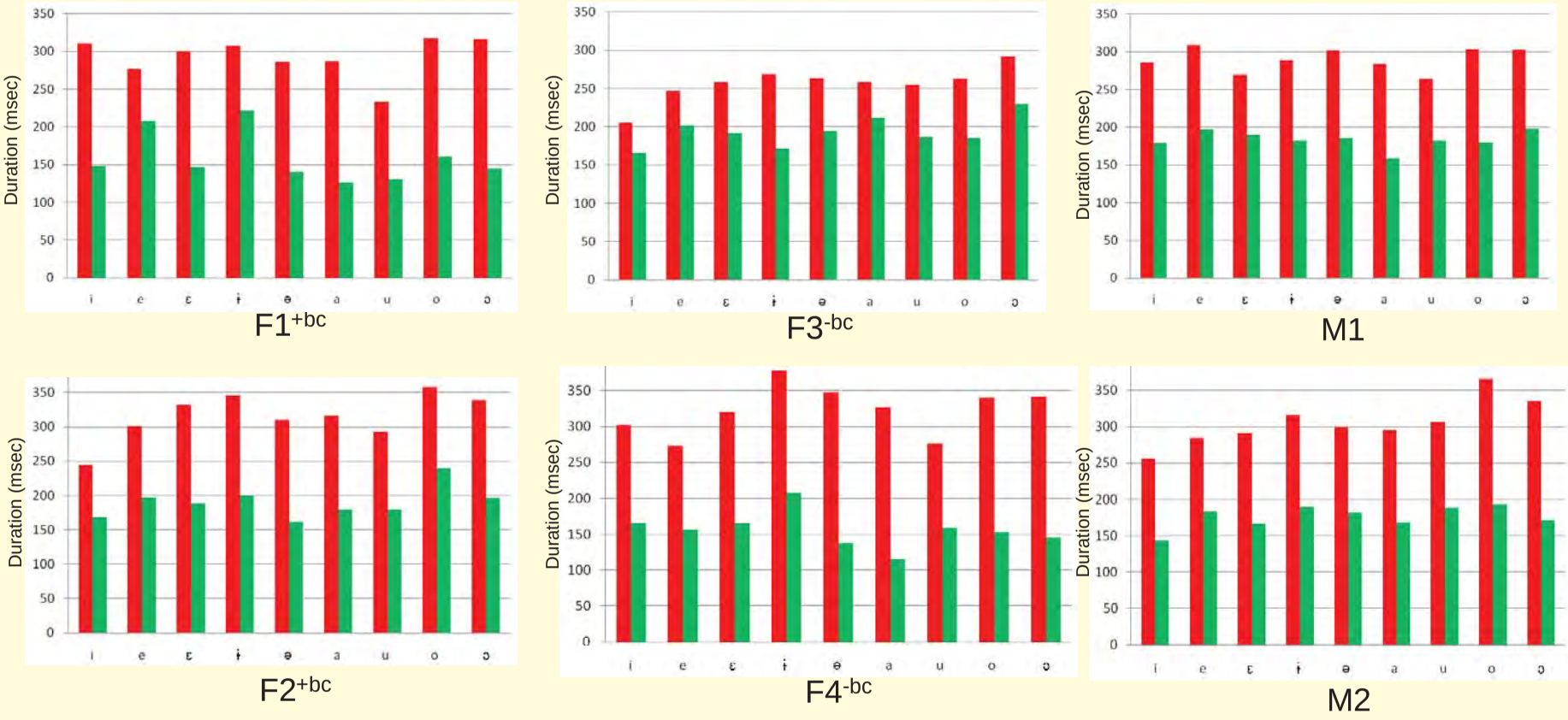


Figure 12 Average vowel durations of each speaker (■ CVø ■ CVʔ)

F = female speaker M = male speaker

+bc = with brass coils -bc = without brass coils

Conclusions (1)

- **Tone/Fundamental frequency (F0)**

(1) The six tones produced by the three groups of speakers, i.e. two females wearing brass coils, two females no longer wearing brass coils and two males, seem to have similar F0 characteristics and durations.

(2) It is noticeable that when C- in all syllable types (CVø, CVŋ, CVʔ) voiceless aspirated plosive followed by high –V-, the F0 values are higher in the speech of all speakers.

Conclusions (2)

(3) T1, T2 and T3 in CVø and CVŋ syllable-types have longer durations than T4 (glottalized tone in CVø syllable-type), T5 and T6 in CVʔ syllable-type, the same behaviors in all speakers.

Conclusions (3)

- **VOT/Laryngeal timing in plosives**

(1) The laryngeal timing in plosives with three types of phonation, i.e. voice, voiceless and aspiration, seems to behave the same way in the three groups of speaker.

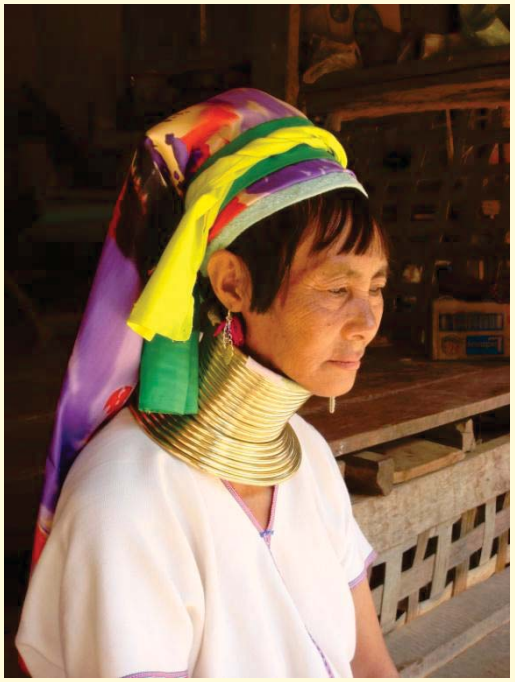
(2) With regard to the articulation places, the velar plosives have longer voicing lags than the labial and alveolar plosives, and the difference is statistically significant.

Conclusions (4)

(3) The phenomenon in (2) can be explained: “with a velar occlusion, there is a very small cavity behind it with a small volume of air enclosed; thus, it takes longer for the transglottal pressure to drop enough for phonation to happen” Abramson, e-mail communication) and Weismer (1980).

Conclusions (5)

- Normal F0 and VOT behaviors seem to indicate that female speakers both with and without brass coils have no problem in controlling their intrinsic laryngeal muscles.



Conclusions (6)

- **Vowel quality and length/ Formant frequency (F1, F2) and duration**

(1) The high vowels /i ɨ u/ and the lowest vowel /a/ of the male group have lower F1 values than those of the two female groups, brass-coiled neck and non-brass-coiled neck. The F2 values show nothing interesting.

(2) The above findings indicate that the vowels produced by the two male speakers are generally higher than those produced by all female speakers.

Conclusions (7)

(3) The behaviors of F1 and F2 of the vowels in the two female groups show no different patterns. There is an explanation for this, i.e. the two female speakers, $F3^{-bc}$ and $F4^{-bc}$, have recently taken off the brass coils for some benefits, so both female groups have more or less the same anatomy.

(4) The sizes of the overall vowel space of the female speakers seem to vary in comparison with those of the male speakers.

Conclusions (8)

(5) The results of acoustic studies suggest that the female speakers cannot raise their tongues as high as the male speakers during the high vowel production, or in other words, the female speakers, to a certain extent, have difficulty in moving their tongues vertically.
Some movements of the tongue are controlled by the extrinsic muscles of the tongue connected to the palate and to the hyoid bone.