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From Proto-Southwestern Tai to Modern Lanna Tai: Implications From the 16th-Century Phonology

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Abstract

This study established the relative chronology of sound changes in the Lanna Tai language from Proto-Southwestern Tai to Modern Lanna Tai dialects. The 16th-Century Lanna Tai phonology, as documented in the *Sino-Lanna Tai Manual of Translation*, was compared to Proto-Southwestern Tai and Modern Lanna Tai dialects to differentiate pre-16th century and post-16th century changes. Based on this chronology, Lanna Tai can be divided into three stages: Old Lanna Tai featuring the loss of uvulars and changes in consonants; Early Modern Lanna Tai exhibiting tone split, loss of voicing contrast and vowel acquisitions; and Modern Lanna Tai dialects showing changes in consonants, acquisition of additional vowels and diphthong monophthongization in some dialects. The study focused on several sound changes, providing valuable insights into the evolution of the Lanna Tai language.

Keywords

historical Tai linguistics – historical phonology – Northern Thai dialects – philology – sound change

1 Introduction

Due to its conservative orthography, existing Lanna Tai manuscripts have not been studied historically. In detail, the orthography retains a three-way tone

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contrast and two classes of consonant graphemes reflecting original phonation types, suggesting that the writing system was adopted when there were three tones and a voicing contrast instead of the modern six tones and a lack of voicing contrast. However, the unchanged orthography makes it impossible to determine both when the three original tones split into two as well as when the voicing contrast disappeared. Furthermore, the tentative periodization of Lanna Tai by Rungreuangsri (1991) is based on writing media types rather than sound system development. Thus, our knowledge is limited to Proto-Southwestern Tai and Modern Lanna Tai, with little information about the intermediate stages. To establish a clearer developmental path, projecting an intermediate stage and identifying transitional changes will be beneficial.

Continuing from Tangsiriwattanakul (2021), this study aims to establish a more precise trajectory from Proto-Southwestern Tai to Modern Lanna Tai. I will utilize evidence from the 16th-Century Lanna Tai period to demonstrate changes between Proto-Southwestern Tai and the 16th century, as well as between the 16th century and Modern Lanna Tai. Initially, I will describe the sound systems of the two known stages: Proto-Southwestern Tai and Modern Lanna Tai. By comparing these stages, I will demonstrate a detailed list of changes. This list will be compared with 16th century data to identify the pre- and post-16th century changes. Such an analysis will enable us to establish a relative chronology of the sound changes that shaped Modern Lanna Tai dialects over the centuries. Based on this relative chronology, I will also propose a tentative periodization of the Lanna Tai language, categorized into Old Lanna Tai (pre-16th century), Early Modern Lanna Tai (around the 16th century) and Modern Lanna Tai dialects.

2 Background

To comprehend the gradual sound changes from Proto-Southwestern Tai to Modern Lanna Tai, it is valuable to summarize the sound systems of both reference points: Proto-Southwestern Tai (starting point) and Modern Lanna Tai (end point). By comparing these two known stages, we can derive a list of sound changes, which will serve as the foundation for the subsequent section.

2.1 *Proto-Southwestern Tai*

Li (1977), Jonsson (1991) and Pittayaporn (2009) reconstructed the consonant inventory of Proto-Southwestern Tai with voicing distinctions in all consonant manners of articulation. Stops exhibited a maximum four-way distinction (aspirated voiceless, plain voiceless, pre-glottalized and voiced), while

non-stop consonants had a two-way voicing distinction (voiceless and voiced). Consonant phonemes contrasted in six places of articulation: labial, alveolar, palatal, velar, uvular and glottal. Final stops and nasals were reconstructed in three places: labial, alveolar and velar. Pittayaporn (2009) proposed that voiced uvular stops *ɢ were absent from Proto-Southwestern Tai, potentially merging with their velar counterparts at that stage. Additionally, Proto-Southwestern Tai included consonant clusters, particularly stops combined with a liquid or rounded glide *-w-.

Proto-Southwestern Tai exhibited a relatively symmetrical dimension of contrast in vowels and finals. Vowels contrasted at three heights (high, mid, low) and three degrees of backness (front, central, back), with only back vowels being rounded. Length contrast was reconstructed in high vowels and low central vowels, as mid vowels were exclusively short in complementary distribution with long low non-central vowels. Furthermore, short vowels did not occur in open syllables. Both diphthongs consisting of a high vowel and/a/ were reconstructed, though the classification of *-a- followed by a glide as a true diphthong is not relevant here.

TABLE 1 Proto-Southwestern Tai consonant phonemes

Place / **Manner & Voicing**		**Labial**	**Alveolar**	**Palatal**	**Velar**	**Uvular**	**Glottal**
Stops	aspirated	*pʰ	*tʰ	*cʰ	*kʰ		
	voiceless	*p	*t	*c	*k	*q	
	voiced	*b	*d	*ɟ	*g	(*ɢ)	
	glottalized	*ʔb	*ʔd	*ʔj			*ʔ
Fricative	voiceless	*f	*s		*x	*χ	*h
	voiced	*v	*z		*ɣ		
Nasal	voiceless	*ʰm	*ʰn	*ʰɲ	*ʰŋ		
	voiced	*m	*n	*ɲ	*ŋ		
Approximant	voiceless	*ʰw	*ʰl				
	voiced	*w	*l	*j			
Trill	voiceless		*ʰr				
	voiced		*r				

TABLE 2 Proto-Southwestern Tai consonant clusters

	Labial				Velar					Uvular
	*p	*ʔb	*b	*m	*k	*kʰ	*g	*ɣ	*ŋ	*q
*-w-					*kw	*kʰw	*gw	*ɣw	*ŋw	*qw
*-l-	*pl	*ʔbl	*bl	*ml	*kl		*gl			
*-r-			*br			*kʰr	*gr			

TABLE 3 Proto-Southwestern Tai vowel phonemes

	Front	Central	Back
High	*i, iː	*ɯ, ɯː	*u, uː
Mid	*e	*ɤ	*o
Low	*ɛː	*a, aː	*ɔː
Falling Diphthong	*ia	*ɯa	*ua
Rising Diphthong	*aj	*auɻ	*aw

The modern 4–9 tones in Tai dialects can be reconstructed back to only three original contrastive tones in Proto-Southwestern Tai and Proto-Tai (Li 1977; Gedney 1972; Pittayaporn 2009). These three tones, Tone *A, *B, and *C, are typically found in open syllables or closed syllables ending in sonorants, referred to as "live syllables" (Gedney 1972). In contrast, closed syllables ending in obstruents, known as "dead syllables" (Gedney 1972), lack tonal contrast and are usually labeled as Tone *D.

2.2 *Modern Lanna Tai Phonology*

Unlike Proto-Southwestern Tai, Modern Lanna Tai has a reduced inventory of twenty consonant phonemes (Katsura 1969; Rungreuangsri 1991; Thianthaworn 1998, 21, 23–31; Burutphakdee 2004, 32; Wimonkasem 2006, 9; Akharawatthanakun 2012, 173, 180, 183, 665). Notably, there have been reports that /kʰ/ can be phonetically realized as fricative [x] in certain northern provinces (Katsura 1969; Akharawatthanakun 2012, 665, 678–683). Additionally,

TABLE 4 Proto-Southwestern Tai vocabulary and the Modern Lanna Tai reflexes

Gloss	Proto-Southwestern Tai	Modern Lanna Tai
'gold'	*ɣam^{A}	/k^{h}am^{0}/
'wharf; quay'	*da:^{B}	/ta:^{3}/
'hot'	*χaw^{C}	/k^{h}aw^{4}/
'separate'	*bra:k^{D}	/p^{h}a:k^{3}/

Siamese /r/ and /c^{h}/ consistently correspond to /h/ and /s/ in Modern Lanna Tai, respectively (Burutphakdee 2004, 16). Table 5 provides a summary of the consonantal inventory of Modern Lanna Tai based on Thianthaworn (1998, 38, 100), Burutphakdee (2004, 32–34) and Wimonkasem (2006). The number of final consonants corresponds to the italicized phonemes in the table.

In contrast to Proto-Southwestern Tai, Modern Lanna Tai exhibits nine pairs of short and long vowel phonemes (Pankhuenkhat 1982; Rungreuangsri 1991; Thianthaworn 1998, 21, 23–31; Burutphakdee 2004, 16, 18, 34–35; Wimonkasem 2006, 41–42; Akharawatthanakun 2012, 174–175, 181–182, 186, 666). Falling diphthongs do not display contrastive vowel length but have short allophones before a final glottal stop (Burutphakdee 2004, 19, 34, 36). Some dialects underwent monophthongization of diphthongs to long mid vowels due to Lue and Khuen influences (Akharawatthanakun 2012, 689–697). The merger of *auɥ to *aj has resulted in the Modern Lanna Tai vowel inventory being identical to Siamese (Burutphakdee 2004, 16). In Table 6, newly acquired vowel phonemes are given in underlined bold characters.

Unlike Proto-Southwestern Tai with only three reconstructed tones (Tone *A, *B, and *C), Modern Lanna Tai exhibits six tones in live syllables (Chaengphrai 1977, 43; Pankhuenkhat 1982, Rungreuangsri 1991; Thianthaworn 1998, 21, 23–31; Burutphakdee 2004, 16, 18, 38; Kantong 2007, 7; Akharawatthanakun 2012, 176, 181–182, 187, 190), precisely twice the number of tones of Proto-Southwestern Tai. These six tones are denoted as Tone 0 to Tone 5, following Rungreuangsri's (1991) notation. Variation in the phonetic realization of these tones across different dialects will not be discussed here.

TABLE 5 Lanna Tai consonant phonemes

Place Manner & Voicing		Labial	Alveolar	Palatal	Velar	Glottal
Stops	voiceless	p	*t*	c	k	*ʔ*
	Aspirated	pʰ	tʰ		kʰ [kʰ~x]	
	Voiced	b	d			
Fricative	Voiceless	f	s			h
Nasal	Voiced	m	n	ɲ	ŋ	
Approximant	Voiced	w	l	j		

TABLE 6 Lanna Tai vowel phonemes (Thianthaworn 1998, 49, 102–103; Burutphakdee 2004, 36–37), with additional historical insights

	Front	Central	Back
High	i, iː	ɯ, ɯː	u, uː
Mid	e, e̲ː	ɤ, ɤ̲ː	o, o̲ː
Low	ɛ̲, ɛː	a, aː	ɔ̲, ɔː
Falling Diphthong	ia	ɯa	ua
Rising Diphthong	aj	< *aɯ	aw

3 Methodology

Toward the objective of this study, the following procedures were undertaken. Firstly, the transformations that occurred from Proto-Southwestern Tai to Modern Lanna Tai were investigated by comparing their respective sound systems, as discussed earlier. This comparison yielded a comprehensive list of changes from Proto-Southwestern Tai to Modern Lanna Tai. Secondly, following the approach of Tangsiriwattanakul (2021), the vocabulary recorded in the manuscript was compared to its Proto-Southwestern Tai etyma to identify the changes from Proto-Southwestern Tai to 16th-Century Lanna Tai. This analysis differentiates the changes predating the 16th century from the changes after the 16th century. Pre-16th century changes were those present in

TABLE 7 16th-Century Lanna Tai vocabulary, their etyma and modern reflexes

Gloss	Proto-Southwestern Tai	16th-Century Lanna Tai	Chinese transcription	Modern Lanna Tai
five	*ha:^{C}	หา^{1} *hā*	哈hā	/ha:^{4}/
six	*^{h}rok^{D}	หฺรก^{1} *hrok*	路lù	/hok^{1}/
virtuous	*^{ʔ}di:^{A}	ดี^{1} *tī*	李lǐ	/di:^{0}/
bladder	*^{ʔ}bli:^{A}			

the manuscript, while post-16th century changes were those absent from the manuscript. Refer to Table 7 for examples.

Comparing Proto-Southwestern Tai and Modern Lanna Tai reveals that *^{h}r and *h in Proto-Southwestern Tai became/h/ in Modern Lanna Tai. Similarly, *^{ʔ}bl and *^{ʔ}d in Proto-Southwestern Tai both became/d/ in Modern Lanna Tai. If these changes were already completed before the 16th century, their Chinese transcriptions would be expected to be the same. However, the transcription of *^{h}r differs from that of *h, while *^{ʔ}bl has the same transcription as *^{ʔ}d, as shown in Table 7. This indicates that the change *^{ʔ}bl > *^{ʔ}d predated the 16th century, whereas the change *^{h}r >/h/ post-dated the 16th century. This approach allows for deriving the relative chronology of most changes. With such relative chronology established, I propose a tentative periodization of the Lanna Tai language into Old Lanna Tai (pre-16th century), Early Modern Lanna Tai (16th century) and Modern Lanna Tai dialects (present), based solely on phonological development.

1 As in Tangsiriwattanakul (2021), Lanna Tai lexical items in the manuscript are represented using the fakKHAM1954 font. Their romanization follows Varasarin(2010)'s Indic-based etymological transliteration of the Thai writing system. Modified graphemes for exclusive Thai phonemes are shown as base grapheme plus an underline, such as <ฃ> k̲h from <ข > *kh* and <ฅ> g̲ from <ค> *g*. Throughout this article, unconventional notation may be encountered, such as the use of *p* & *t* for <บ>/b/ & <ด>/d/, and p̲ & t̲ for <ป>/p/ and <ต>/t/. Vowel graphemes <เ า>, <เิ>, and <เิอ> are transliterated as *eā, ei,* and *eia,* respectively. However, the fakKHAM1954 font does not distinguish the graphemes for/i/,/i:/,/ɯ/, and/ɯ:/.

4 Changes From Proto-Southwestern Tai to Modern Lanna Tai

The consonant inventory of Proto-Southwestern Tai decreased from 41 to 20 in Modern Lanna Tai. This reduction resulted from various consonant changes that have occurred over the past few centuries, as shown in Table 8, and were identified by comparing phonemes with their modern reflexes. For instance, Proto-Southwestern Tai words starting with *ʔbl- and *ʔd- both transformed into/d/ in Modern Lanna Tai, such as in *ʔ<u>bl</u>ɯən^{A} >/<u>d</u>ɯən^{0}/ and *ʔ<u>d</u>in^{A} >/<u>d</u>in^{0}. This suggests that *ʔbl- fused with *ʔd-, which eventually became/d/. Table 8 provides additional examples of these changes.

While Proto-Southwestern Tai only had short mid vowels *e, *ɤ, *o, and long low vowels *ɛː and *ɔː, Modern Lanna Tai boasts a fully symmetrical vowel inventory with nine pairs of short and long vowel phonemes. This development involved the acquisition of additional long mid vowels /eː/,/ɤː/,/oː/ and short low vowels /ɛ/ and /ɔ/ over the centuries. Partially replicating Table 6, Table 9 highlights the newly acquired vowels in this vowel expansion from Proto-Southwestern Tai in underlined bold print.

As mentioned previously, the six tones in Modern Lanna Tai emerged through the division of the original three tones in Proto-Southwestern Tai. The doubling of the tones was based on the laryngeal characteristics of the Proto-Southwestern Tai onset, a process comparable to the tonal development found in Sinitic, Hmong-Mien and Viet-Muong, beyond the Kra-Dai languages (Haudricourt 1954, 1961). Gedney (1972) identified four distinct types of laryngeal settings for Proto-Southwestern Tai.[2]

In Modern Lanna Tai, the original Proto-Southwestern Tai *A, *B and *C tones split into Tone 0 & Tone 1, Tone 2 & Tone 3, and Tone 4 & Tone 5, respectively. The split of Tone *A occurred between voiceless phonemes (Gedney's class 1 & 2 consonants) and other consonants (class 3 & 4 consonants), while the split of the other tones happened between voiced phonemes (class 4 consonants) and other consonants (class 1-2-3 consonants). Dead syllable tones also split based on vowel length. Under Gedney's terminology, the Modern Lanna Tai tones are: Tone 0 = A34, Tone 1 = A12, Tone 2 = B123, Tone 3 = B4, Tone 4 = C123, and Tone 5 = C4. In Lanna dialects, the tones in long dead syllables (*DL tones) are usually the same as their respective *B tones: DL123 = Tone 2, DL4 = Tone 3.

2 Gedney's (1972) tone box is a model for representing modern tone phonemes of particular Tai dialects that resulted from the split and merger of the original Proto-Southwestern Tai tones through combinatorics of the original/reconstructed tones (Tone *A, *B, *C, or *D) and the original laryngeal setting of the onset (1 – voiceless "friction", 2- voiceless unaspirated stops, 3 – glottalized, and 4 – voiced).

TABLE 8 Examples of changes from Proto-Southwestern Tai to Modern Lanna Tai

Changes	PSWT	Modern Lanna Tai	Examples
deglottalization	*ʔd	d	*ʔ**d**in^{A} >/**d**in^{0}/ 'soil, earth'
fusion & deglottalization	*ʔbl		*ʔ**b**lɔ:k^{D} >/**d**ɔ:k^{2}/ 'flower'
deglottalization	*ʔj	j	*ʔ**j**en^{A} >/**j**en^{0}/ 'cool'
nasalisation	*j	ɲ	*j**a**:^{B} >/ ɲ**a**:^{3}/ 'gran mother'
voicing	*^{h}m	m	*^{h}**m**i:^{A} >/**m**i:^{1}/ 'bear'
devoicing	*b	p	***b**i:^{A} >/**p**i:^{3}/ 'elder sibling'
aspiration	*^{h}r	h	*^{h}**r**u:^{A} >/**h**u:^{1}/ 'ear'
	*r	h	*r**u**:^{A} >/**h**u:^{0}/ 'hole'
devoicing + aspiration	*br	p^{h}	*b**r**a:k^{D} >/**p**^{h}a:k^{3}/ 'separate'
fronting	*q	k^{h}	*q**e**m^{A} >/**k**^{h}em^{1}/ 'needle'
fronting + plosivisation	*χ		*χ**a**w^{C} >/**k**^{h}aw^{4}/ 'enter'
fronting + devoicing + aspiration	*ɢ		*ɢ**o**n^{A} >/**k**^{h}on^{0}/ 'human'
plosivisation	*x		*x**a**:w^{A} >/**k**^{h}a:w^{1}/ 'white'
devoicing + plosivisation + aspiration	*ɣ		*ɣ**a**m^{A} >/**k**^{h}am^{0}/ 'gold'

TABLE 9 Modern Lanna Tai vowel inventory as symmetricized from Proto-Southwestern Tai

	Front	Central	Back
High	i, iː	ɯ, ɯː	u, uː
Mid	e, **e̲ː**	ɤ, **ɤ̲ː**	o, **o̲ː**
Low	**ɛ̲**, ɛː	a, aː	**ɔ̲**, ɔː

Figure 1 illustrates the splits and mergers of Proto-Southwestern Tai tones into Modern Lanna Tai tones using Rungreuangsri's notation, while Table 10 provides examples of the modern reflexes of the Proto-Southwestern Tai tones in Modern Lanna Tai.

Thus, the sound changes in (1) are defining features of Modern Lanna Tai compared to other Southwestern Tai dialects:

(1) Sound changes from Proto-Southwestern to Modern Lanna Tai:
- a. Merger of *ʔbl & *ʔd >/d/
- b. Merger of dorsals: *q,*χ, *x, *kʰ, *kʰr >/kʰ/
- c. Merger of *ʰr & *r >/h/
- d. Merger of *j & *ɲ >/ɲ/
- e. Merger of final *-ɯ̨ &* -j >/-j/

f. Tone split conditioned by laryngeal features of the syllable onset
- a. Split of Tone A between group 1, 2 and 3, 4
- b. Spilts of Tone B, C, and D between 1, 2, 3 and 4
- c. Splits of Tone D according to vowel lengths into DL & DS
  - i. Retention of B = D in DL tones
  - ii. Coalescences of DS tones to non-checked tones
- g. Voicing of voiceless sonorant
  - a. Nasal: *ʰm >/m/, *ʰn >/n/, *ʰɲ >/ɲ/, *ʰŋ >/ŋ/
  - b. Approximant: *ʰw >/w/, *ʰl >/l/
- h. Devoicing of voiced obstruents
  - a. Fricatives: *v >/f/, *z >/s/, *ɣ > (/x/ >)/kʰ/
  - b. Plosives: *b >/p/, *d >/t/, *ǰ >/c/, *g >/k/

i. De-glottalization of glottalized consonants: *ʔb >/b/, *ʔd >/d/, *ʔj >/j/

j. Acquisition of long mid vowels/eː/,/ɤː/, and/oː/

k. Acquisition of short low front and back vowels/ɛ/ and/ɔ/

	Proto-Southwestern Tai tones				
	A	B	C	DL	DS
(1)	*A	*B	*C	*D	
(2)					
(3)					
(4)					

>

	Modern Lanna Tai tones				
	A	B	C	DL	DS
(1)	1	2	4	2	o[3]
(2)					
(3)	o				
(4)		3	5	3	4, 5

FIGURE 1 Tonal changes from Proto-Southwestern Tai to Modern Lanna Tai[3]

These changes now guide the analysis of the 16th-Century Lanna Tai data. Changes found in the manuscript indicate their completion before the 16th century, while changes absent from the manuscript suggest their occurrence after the 16th century. This approach offers insights into the timeline and relative chronology of the significant sound changes.

3.2 *Lanna Tai Phonology in the 16th Century*

In Tangsiriwattanakul (2021), the 16th-Century Lanna Tai sound system was reconstructed by examining the Chinese transcription[4] of Lanna Tai vocabulary in the manuscript *Sino-Lanna Manual of Translation* (Chinese: 八百舘譯語 *Bābǎiguǎn Yìyǔ*).[5] This manuscript serves as a glossary between Chinese and Lanna Tai, providing Lanna Tai words in Fakkham script,

3 Whereas Akharawatthanakun(2012, 178) reports DS123 = A34 for the Lampang and Chiang Rai dialects, DS123 = C123 for the Phrae and Nan dialects, Wimonkasem(2006) reports DS123 = A12 for the Chiang Mai dialect, so as Thianthaworn(1998, 59, 82, 103–105) for the Saraburi and Nakorn Pathom dialects. Also, Thianthaworn(1998, 59, 82, 103–105) reports DS123 = C4 for the Lopburi dialect.

4 The pronunciation of the Chinese characters Tangsiriwattanakul's (2021) analysis was that of Míng-Qīng/Middle Mandarin Chinese, which was based on Jiang-Huai/Southern Mandarin dialects. During the Ming and Qing Dynasties, even after the capital was moved to Beijing, the Jiang-Huai dialect remained the official standard dialect and was known as the Nanjing dialect in Western accounts until the mid-19th century (Coblin, 2000; 2002). The distinctive feature of the Jiang-Huai dialect is the fifth tone, which continued the Middle Chinese *entering* tone as a special tone with a final glottal stop (Norman, 2013). This feature is also found in the native rime book from the early Ming dynasty called *Hongwu's Standard Rime Book* (Chinese: 洪武正韻 *Hóngwǔ Zhèngyùn*) (Coblin, 2000; 2001) and European manuals for "Mandarin Chinese" like Francisco Varo's *Arte de la Lengua Mandarina* (1703). For the purpose of this study, the Romanized transcription of the Chinese characters is provided in Modern Standard Mandarin Pinyin.

5 The version examined in Tangsiriwattanakul (2021) is the one preserved at the National Library of China, available online at https://archive.org/details/02076757.cn. This version is identical to the digitized Berlin version found at the Staatsbibliothek zu Berlin, accessible at https://digital.staatsbibliothek-berlin.de/werkansicht? PPN = PPN334615730 X&PHYSID = PHYS_1509&D MDID = DMDLOG_0008&view = overview-toc (listed as 8.Pa-pai, Suppl Vol. 15; Texte Vol. 21). Both versions match the Toyo Bunko version mentioned in Izui (1953), although the latter was never officially published.

TABLE 10 Modern Lanna Tai reflexes of Proto-Southwestern Tai tones

Proto-Southwestern Tai	**Laryngeal setting**	**Tonal category**	**Modern Lanna Tai**
*p^{h}iː^{A} 'spirit'	voiceless aspirated (1)	*A	/p^{h}iː^{1}/
*biː^{A} 'chubby'	voiced (4)		/piː^{0}/
*paː^{B} 'forest'	voiceless unaspirated (2)	*B	/paː^{2}/
*biː^{B} 'older sibling'	voiced (4)		/piː^{3}/
*^{ʔ}baː^{C} 'lunatic'	(pre)glottalized (3)	*C	/baː^{4}/
*maː^{C} 'hourse'	voiced (4)		/maː^{5}/
*^{h}rok^{D} 'six'	voiceless (1)	*D	/hok^{1}/
*nok^{D} 'bird'	voiced (4)		/nok^{5}/

TABLE 11 16th-Century Lanna Tai consonant inventory

Place Manner & Voicing		**Labial**	**Alveolar**	**Palatal**	**Velar**	**Glottal**
Stops	Voiceless	ᨸ & ᨻ *p	ᨲ & ᨴ *t	ᨧ & ᨩ *c	ᨠ & ᨣ *k	ᩋ *ʔ
	Aspirated	ᨹ & ᨻᩕ *p^{h}	ᨳ *t^{h}	ᨨ *c^{h}	ᨡ & ᨣᩕ *k^{h}	
	Voiced	ᨷ *b [ˀb~b]	ᨯ *d [ˀd~d]			
Fricative (Voiceless)		ᨺ & ᨼ *f	ᩈ & ᨪ *s		ᨢ & ᨤ *x	ᩉ *h
Nasal (Voiced)		ᩉ᩠ᨾ & ᨾ *m	ᩉ᩠ᨶ & ᨶ *n	ᩉ᩠ᨿ, ᨬ, ᨿ *ɲ	ᩉᨦ & ᨦ *ŋ	
Approximant (Voiced)		ᩉᩅ & ᩅ *w	ᩉᩃ & ᩃ *l	ᩋ᩠ᨿ *j [ˀj~j]		
Trill (Voiced)			ᩉ᩠ᩁ & ᩁ *r			

along with Chinese translations and phonetic transcriptions using Chinese characters. The examination revealed that while Modern Lanna Tai dialects have 20 consonant phonemes, 16th-Century Lanna Tai had 23 consonant phonemes. These additional phonemes included a velar fricative *x, aspirated

palatal stops *cʰ, and a trill *r. The presence of medial *-r- in consonant clusters beginning with a stop had already changed to simple aspiration *-ʰ-. The completion or occurrence of deglottalization in preglottalized phonemes *ˀb, *ˀd, and *ˀj during that period cannot be guaranteed due to inconclusive evidence, suggesting non-contrastive realization.

The manuscript also suggests that 16th-Century Lanna Tai inherited the Proto-Southwestern Tai vowel inventory, except for the change of *auɥ to *aj. Additionally, two new vowel phonemes, *oː and *ɤː, were acquired through borrowing. However, there is no evidence for the acquisition of the vowels/eː/,/ɛ/ and/ɔ/ found in Modern Lanna Tai.

In Tangsiriwattanakul (2021), it was demonstrated based on the correspondence between the hypothetical tones in the manuscript and the Middle Mandarin Chinese tones that the tonal inventory of 16th-Century Lanna Tai resembled that of Modern Lanna Tai. However, there is no evidence for the split of tones in dead syllables of non-voiced initials (tone D123) based on vowel length, as observed in modern dialects. This is summarized in Table 13.

TABLE 12 16th-Century Lanna Tai vowel inventory

	Front	**Central**	**Back**
High	i, iː	ɯ, ɯː	u, uː
Mid	e	ɤ, ɤː	o, **oː**
Low	ɛː	a, aː	ɔː
Falling diphthongs	ia	ɯa	ua
Rising diphthongs	aj	aj < auɥ	aw

TABLE 13 The 16th-Century Lanna Tai tonal inventory

	A	**B**	**C**	**DL**	**DS**
1	A12	B123	C123	D123	
2					
3	A34	C4	C4	DL4	DS4
4					

3.3 *Implications From Tangsiriwattanakul (2021) for 16th-Century Lanna Tai*

This section examines 16th-Century Lanna Tai in light of the sound changes that occurred during the transition from Proto-Southwestern Tai to Modern Lanna Tai, discussing the sound changes observed in both the pre-16th century and post-16th century periods based on the manuscript data.

3.3.1 Sound Changes Before the 16th Century

In this section, the changes listed in (2) are discussed:

(2) Sound changes before the 16th century:
- a. Loss of the original voicing contrast
- b. Merger of *j > *ɲ
- c. Merger of *ʔbl > *ʔd
- d. Development of PSWT dorsal consonants
- e. Merger of *auɥ > *aj
- f. Split of D4 > DL4 vs DS4 according to vowel length

16th-Century Lanna Tai most certainly underwent the devoicing of voiced obstruents, as syllables starting with voiced obstruents in Proto-Southwestern Tai were not differentiated from their voiceless counterparts in the 16th-century manuscript. This suggests the complete collapse of voicing contrast and implies the preceding tone split. Following the pattern observed in most other Southwestern Tai dialects, voiced stops simply became voiceless plain stops. Table 14 provides examples of the 16th-century reflexes of syllables with voiced initials.

The attestation of lexica in Table 15 provides further evidence for the devoicing of voiced obstruents and the voicing of voiceless sonorants. In these lexica, graphemes representing original voiced initials are used, even though they are reconstructed with original voiceless initials. For instance, the word *pa:^{C} 'aunt' is attested as <ᩋᩣ> *bā* instead of the expected <ᨷᩣ> *pā*, and the word *^{h}lajA 'flow' is attested as <ᩖᩢ> *lai* instead of <ᩉᩖᩢ> *hlai*. These instances suggest the completion of the loss of the original voicing contrast among consonants, resulting in the graphemes <ᨷ᩠> *p̲* and *b* <ᩋ>, as well as <ᩉᩢ> *hl* and <ᩢ> *l*, being consonantally identical.

Aside from the tone split and devoicing of voiced obstruents, 16th-Century Lanna Tai also exhibited the merger of *ʔbl and *ʔd. The Fakkham graphemes <ᨻ> *p* and <ᨯ> *t* represented two voiced stops that can be traced back to earlier *ʔb and *ʔd, respectively. For example, <ᨻᩣᨶ> *pān* and <ᨯᩣᩅ> *tāv* cold be traced back to *ʔba:n^{C} 'village' and *ʔda:w^{A} 'star', respectively. Interestingly, words with etyma of *ʔbl were also expressed by <ᨯ> *t*, for example, <ᨴᩮᩬᨶ> *te̲ian*

TABLE 14 Reflex of original voiced stops in the 16th century

Gloss	Manuscript	Proto-Southwestern Tai	Modern Lanna Tai	Chinese transcription
事 shì 'word'	ຄາ ***gặ***	gam^{A}	kam^{0}	敢 gǎn
象 xiàng 'elephant'	ຊາງ ***jāṅ***	ɟaːŋ^{C}	caːŋ^{5}	章 zhāng
路 lù 'road'	ທາງ ***dāṅ***	daːŋ^{A}	taːŋ^{0}	党 dǎng
宵 xiāo 'night'	ຄືນ ***gīn***	ɣɯːn^{A}	kʰɯːn^{0}	痕 hén
買 mǎi 'buy'	ຊື ***jī***	zɯː^{C}	sɯː^{5}	塞 sè
天 tiān 'sky'	ຟ້າ ***vặ***	vaː^{C}	faː^{5}	法 fǎ

TABLE 15 Additional orthographic evidence for the loss of voicing contrast

Gloss	Manuscript	Proto-Southwestern Tai	Modern Lanna Tai	Chinese transcription
姑 gū 'aunt'	ພາ ***bā***	paː^{C}	paː^{4}	巴 bā
流 liú 'flow'	ໄລ *lai*	ʰlaj^{A}	laj^{1}	賴 lài

for *ˀblɯanA 'moon' and <ດອກ> *tak* for *ˀblɔːkD 'flower', suggesting that the change from *ˀbl to *ˀd predated the 16th century.

Akin to Modern Lanna Tai, 16th-Century Lanna Tai also had two distinct palatal continuants: *j and *ɲ. While the 16th-century *j directly continued the Proto-Southwestern Tai *ˀj, the 16th-century *ɲ continued not only the nasal pair *ʰɲ and *ɲ but also to the original *j. This distribution suggests that the merger between *j and *ɲ into 16th century *ɲ likely predated the change from *ˀj to 16th-century *j (referred to as "bleeding order" in linguistics). If *ˀj changed to *j first (referred to as "feeding order" in linguistics), then *j and *ɲ, regardless of their origin, would both be reflected as/ɲ/ in the modern period, which is not the case. The manuscript and Modern Lanna Tai data show that *j < *ˀj remains distinct from *ɲ < *j. This also suggests that *j > *ɲ predated the voicing of voiceless sonorants. The two competing orders of operation

TABLE 16 Order of operations for the palatal mergers

Feeding order	**Bleeding order**
1. *^{ʔ}j & *j > *j	1. *j > *ɲ
2. *j > *ɲ	2. *^{ʔ}j > *j
3. *^{ʔ}j & *j =/ɲ/	3. /j/ ≠/ɲ/

are compared in Table 16, while Figure 2 illustrates the chain of phonological changes in Proto-Southwestern Tai palatal continuants.

16th-Century Lanna Tai distinguishes between the graphemes <ᨡ> *kh* and <ᨢ> *k̲h*, as evidenced by their different transcriptions: <ᨡ> *kh* is transcribed as Mandarin/k^h/ while <ᨢ> *k̲h* is transcribed as Mandarin/x/. However, when comparing the attested forms with the Proto-Southwestern Tai etyma, syllables with <ᨢ> *k̲h* actually corresponded to three different dorsal initials in Proto-Southwestern Tai: *q, *χ, and *x. On the other hand, syllables with <ᨡ> *kh* corresponded to two relatively similar initials in Proto-Southwestern Tai: *k^h and *k^hr. This reveals that Proto-Southwestern Tai *q, *χ, and *x merged into 16th-Century Lanna Tai/x/, while Proto-Southwestern Tai *k^h and *k^hr merged into 16th-Century Lanna Tai/kh/.

Likewise, the grapheme <ᨤ> *g̲* is transcribed as/x/, indicating that it is a devoiced form of Proto-Southwestern Tai *ɣ, whereas the grapheme <ᨣ> *g* is consistently transcribed as/k/, reflecting the devoiced outcome of *g >/k/. However, the manuscript shows that words with the etyma of *ɢ are also written with <ᨤ> *g̲* and transcribed as/x/. This suggests that *ɢ > *ɣ in Lanna Tai predated *ɣ >/x/. This challenges Pittayaporn's (2009) proposal that Proto-Tai *ɢ > *g in Proto-Southwestern Tai, as the reflex of *ɢ is consistently represented by *g across many Southwestern Tai dialects. Based on the Lanna evidence, it is proposed that *ɢ was also present in the Proto-Southwestern Tai phonemic inventory. The merger of *ɢ with *g or *ɣ occurred after the divergence of separate Southwestern Tai varieties. This distinction may serve as a criterion for sub-branching within Southwestern Tai dialects. Additionally, the presence of the word *ɢɛːp 'narrow' (etymologically related to Chinese <狹> xiá) in the manuscript as <ᩮᩮᨣᨸ> *geep* transcribed as <歙> xiē confirms Pittayaporn's (2009) reconstruction.

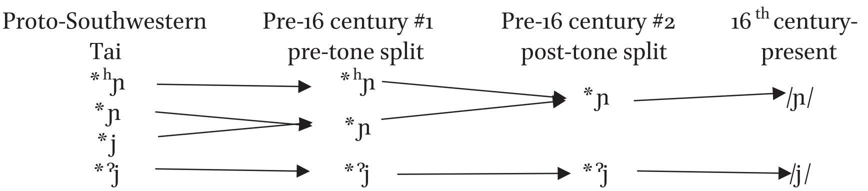

FIGURE 2 Development of palatal continuants

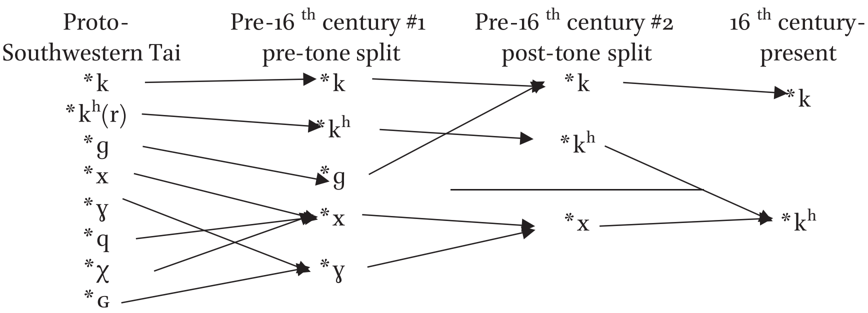

FIGURE 3 Developments of dorsal obstruents

In Modern Lanna Tai, the vowels and final consonants have undergone minimal changes compared to the initial consonants in the Proto-Southwestern Tai phonemic inventory. Similar to Siamese, Modern Lanna Tai exhibits a merger between *aj and *aɰ, resulting in/aj/. This merger was completed by the 16th century, as evidenced by the consistent representation of syllables with *aɰ etyma as if they were *aj. For example, *ˀbaɰA 'leaf' is attested as <ໃປ> *pai*. As a result, the Proto-Southwestern Tai finals reduced from 9 to 8, eliminating the contrast between/j/ and/ɰ/.

Although Modern Lanna Tai has acquired long mid-vowels/eː/,/ɤː/, and/oː/, as well as short low vowels/ɛ/ and/ɔ/, possibly due to contact with Siamese, the acquisition of long mid-vowels was not complete in the 16th-Century Lanna Tai. Only the long vowels/oː/ and/ɤː/ are attested in 16th-Century Lanna Tai, as seen in words like <ເຣົງ> *roṅ*/roːŋ^{A4}/ 'hall', <ເຈົນ> *con*/coːn^{A2}/ 'robber', <ເມືອງເກືອ> *meiaṅ.kveia*/mɯəŋ^{A4}.kwɤːˀ/ 'country', and <ເມືອງເຂີນ> *meiaṅ.khein*/mɯəŋ^{A4}.kʰɤːn^{A1}/ 'Kengtung'. This indicates that the acquisition of long mid-vowels, despite existing before the 16th century, did not include/eː/ during that period.

Unlike Siamese, but similar to Lao, Modern Lanna Tai did not undergo a merger of/ɤ/ to/ɯ/ before a velar consonant. This is evidenced by the retention of Proto-Southwestern Tai *tʰɤŋ^{A} 'arrive' and *pʰɤŋ^{C} 'bee' as/tʰɤŋ^{1}/ and/pʰɤŋ^{4}/ respectively in Modern Lanna Tai. The 16th-Century Lanna Tai manuscript

TABLE 17 Velar fricatives in the 16th-Century and their Proto-Southwestern Tai origin

Chinese translation	Manuscript	Proto-Southwestern Tai	Modern Lanna Tai	Chinese transcription
蛟 jiāo 'horn'	ᩁᩮᩣ *kheā*	qaw^{A}	kʰaw^{1}	毫 háo
入 rù 'to enter'	ᩁᩮᩣ *kheā*	χaw^{C}	kʰaw^{4}	毫 háo
白 bái 'white'	ᩉᩣᩅ *khāv*	xaːw^{A}	kʰaːw^{1}	浩 hào
宵 xiāo 'night'	ᨣᩤᨶ *gīn*	ɣɯːn^{A}	kʰɯːn^{0}	痕 hén
回 huí 'return'	ᨣᩤᨶ *gīn*	**ɢɯːn**^{A}	kʰɯːn^{0}	痕 hén
'human'	ᨘᨶ *gan*	**ɢon**^{A}	kʰon^{0}	混 hùn
狹 xiá 'narrow'	ᨡᨮᨻ *geep*	**ɢɛːp**^{D}	kʰɛːp^{3}	歇 xiē

also confirms this pattern. In summary, the vowel inventory changes from 14 in Proto-Southwestern Tai to 15 in 16th-Century Lanna Tai, as shown in Table 18, with the newly acquired vowel phonemes highlighted in bold and underlined.

As was already mentioned, the 16th-Century Lanna Tai exhibits a tone split and merger pattern that closely resembles Modern Lanna Tai. This indicates that the tone split occurred prior to the 16th century. Additionally, the 16th-Century Lanna Tai only shows tonal contrast in dead syllables with long and short vowels, as they are transcribed differently. This suggests that the split of tones on dead syllables with initial voiced consonants (D4 > DL4 vs DS4) predated the 16th-century. Figure 4 illustrates the change in tonal inventory from Proto-Southwestern Tai to 16th-Century Lanna Tai.

4.3.2 Sound Changes After the 16th Century

This section discusses the changes listed in (3):

(3) Sound changes after the 16th century:
- a. Merger of/x/ >/kh/
- b. Merger of *cʰ > *s
- c. Development of PSWT trills
- d. Deglottalization of pre-glottalized phonemes *ˀj, *ˀb, *ˀd
- e. Symmetricisation of vowel length contrast
- f. Split of D123 > DL123 vs DS123 according to vowel length

TABLE 18 Simple vowel inventory of the 16th-Century Lanna Tai

	Front	**Central**	**Back**
Final glide	-j	-j < -ɯ	-w
High	i, iː	ɯ, ɯː	u, uː
Mid	e	ɤ, ɤ̱ː	o, o̱ː
Low	ɛː	a, aː	ɔː

	Proto-Southwestern Tai tones				
	A	B	C	DL	DS
(1)	*A	*B	*C	*D	
(2)					
(3)					
(4)					

>

	16 th-Century Lanna Tai tones				
	A	B	C	DL	DS
(1)	T1	T3	T5	DL123	
(2)					
(3)	T2				
(4)		T4	T6	DL4	DS4

FIGURE 4 Tonal Changes from Proto-Southwestern Tai the 16th-Century Lanna Tai

As previously mentioned, Proto-Southwestern Tai *q, *χ, and *x merged into the 16th-Century Lanna Tai *x as represented by the grapheme <ฆ> *kh̲*, whereas the Proto-Southwestern Tai *kʰ and *kʰr coalesced into the 16th-Century Lanna Tai *kʰ, as represented by the grapheme <ข> *kh*. In addition, the phoneme *x as represented by the grapheme <ฅ> *g̲* can be traced back to Proto-Southwestern Tai *ɣ & *ʁ as well. The contrast between *kʰ vs *x in the 16th century suggests that the change form *x > *kʰ actually post-dated the 16th century. At this point, it became possible to schematize the path of change of the Proto-Southwestern Tai dorsal consonants as shown in Table 19.

In the manuscript, the grapheme <ฉ> *ch* appears five times, and each instance is transcribed as Mandarin/ʈʂʰ/. This indicates the presence of the *cʰ in the 16th-Century Lanna Tai. Although Modern Lanna Tai no longer has initial/cʰ/, and words in Siamese with initial/cʰ/ are now pronounced with initial/s/ in Modern Lanna Tai, there was a clear distinction between the two sounds in the 16th century, since the 16th-Century *s transcribed as Mandarin/s/, never overlapped with the *cʰ as represented by <ฉ> *ch*. While *cʰ was not originally present in Proto-Tai or Proto-Southwestern Tai, it was likely acquired through contact with Chinese and Austro-Asiatic languages. The five instances of lexica with initial <ฉ> *ch* cannot be traced back to a Tai etymon. However, the presence of this phoneme was likely marginal and short-lived, as it merged with/s/ in most Modern Southwestern Tai varieties. Only Siamese and Southern Thai, which have had prolonged contact with Austro-Asiatic languages, have

TABLE 19 Proposed timeline of changes in dorsal obstruents

Proto-Southestern Tai	Lanna Tai		
	Pre-16th century	16th century	Modern
*k	*k	<ᨡ> *k	/k/
*kʰ	*kʰ	<ᨠ> *kʰ	/kʰ/
*x			
*q	*x	<ᨣ> *x	
*χ			
*ɡ	*ɡ	<ᨤ> *k	/k/
*ɣ			
*ɢ	*ɣ	<ᨥ> *x	/kʰ/

retained this phoneme in their systems. The merger of the newly acquired *cʰ with the existing *s must be relatively recent in Lanna Tai, as *cʰ still existed as a distinct phoneme in the 16th century.

In Modern Lanna Tai, the reflex of Proto-Southwestern Tai voiceless *ʰr is identical to Siamese, represented as/h/. However, the manuscript reveals an intriguing and unexpected development. The consistent transcription of <ᩉᩬᩰ > *hr* and <ᩁ> *r* as Mandarin/l/ indicates the presence of *r. Unlike Siamese, where *ʰr changed to/h/ as early as the late 13th century, *ʰr likely remained as *ʰr until it merged with the original *r, hence its transcription as/l/. This data suggests that while the voicing of voiceless sonorants and devoicing of voiced obstruents predated the 16th century, the merger of *r to *h actually post-dated the 16th century, when the manuscript was composed.

The phonetic nature of the 16th-Century *j, which evolved from Proto-Southwestern Tai *ʔj, as either a plain approximant [j] or a pre-glottalized [ʔj], remains unknown. Similarly, it is unclear if *d and *b in the 16th century were still pre-glottalized or had de-glottalized to simple voiced sounds. The de-glottalization of *ʔj > *j does not necessarily coincide with the de-glottalization of pre-glottalized stops *ʔb > *b and *ʔd > *d, as some Modern Tai dialects retain the pre-glottalization of *ʔb and *ʔd, while virtually none preserve the pre-glottalization of *ʔj. Relatively though, the de-glottalization of *ʔb and *ʔd must have post-dated the devoicing of voiced obstruents for they evaded merging with the original voiced stops. If the de-glottalization

TABLE 20 Contrast between 16th century/c^h/ and/s/

Chinese translation	**Manuscript**	**Chinese transcription**
麥 mài 'wheat'	ເຂາຊາ *kheā.chā*	栲察kǎo**ch**á
揖 yī 'to salute'	ຊາງແຍ ***chāṅ.yee***	唱也**chàng**yě
朝 cháo 'imperial court'	ເຊາ ***cheā***	朝**cháo**
梨lí 'pear'	ສາລີ ***sā.lī***	撒李**s**ālǐ
向化 xiànghuà 'educate'	ສັງສອນ ***săṅ.san***	喪筭**s**à**ng**suàn
棟dòng 'house beam'	ເສາເຣີນ ***seā.rein***	掃冷**s**à**o**lěng

TABLE 21 16th century alveolar trill

Chinese translation	**Manuscript**	**Proto-Southwestern Tai**	**Modern Lanna Tai**	**Chinese transcription**
頭 tóu 'head'	ᩉᩕ᩠ᩅᩢ *hrvă*	^{h}rua^A	hua^1	路lù
耳 ěr 'ear'	ᩉᩕᩪ *hrū*	^{h}ruː^A	huː^1	路lù
'hole'	ᩁᩪ *rū*	ruː^A	huː^0	魯lǔ
知 zhī 'to know'	ᩁᩪ *rū*	ruː^C	huː^5	蘆lú

predated the devoicing, they would have become devoiced like the original voiced stops and would now be indistinguishable from one another, as shown in Table 22. Similarly, the merger of *ˀbl with *ˀd must have preceded the de-glottalization of *ˀb and *ˀd, as it yielded the same result as *ˀd. Figure 5 illustrates the sequence of phonological changes involving pre-glottalized and plain voiced stops in Proto-Southwestern Tai.

The 16th-Century Lanna Tai had only acquired long *oː and *ɤː, whereas the Modern Lanna Tai has a more complete and symmetrical vowel inventory. This suggests that the acquisition of long/eː/, short/ɛ/, and short/ɔ/ post-dated the 16th century. Table 24 provides an overview of the vowel system in Modern Lanna Tai, highlighting the vowels that were acquired after the 16th century with underlined bold print.

TABLE 22 Order of operations for the change of *ʔb & *ʔd

Feeding order	**Bleeding order**
1. *ʔb >/b/, *ʔd >/d/	1. *b >/p/, *d >/t/
2. *b >/p/, *d >/t/	2. *ʔb > b, *ʔd >/d/
3. *ʔb, *b and *ʔd, *d >/p/ &/t/	3./p/ &/t/ ≠/b/ &/d/

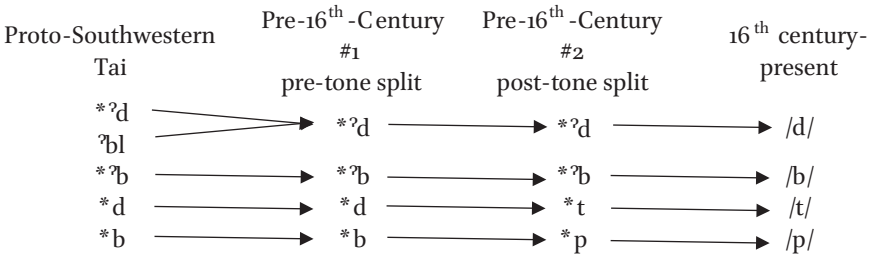

FIGURE 5 Development of Proto-Southwestern Tai pre-glottalized and plain voiced stops

Dialectologically, Modern Lanna Tai dialects exhibit the merger of *B tones and tones in long-dead syllables (DL tones) but they differ in how the tones in short dead syllables (DS tones) merged with tones in non-checked syllables. The split of tones on dead syllables based on the laryngeal settings of the initial consonant (i.e., tone *D > D123 & D4) occurred before the loss of the original voicing contrast. While Modern Lanna Tai dialects show the split based on vowel length for both originally voiced (D4 > DL4 vs DS4) and non-voiced consonants (D123 > DL123 vs DS123), the 16th-Century Lanna Tai shows such a split for originally voiced consonants only. This suggests that the split based on vowel length for originally non-voiced consonants postdared the 16th century. Figure 6 illustrates the tonal changes from the 16th century to Modern Lanna Tai.

Furthermore, while modern Lanna Tai dialects exhibit a shared tone split and merger pattern, the pitch height and contour of the 16th-Century Lanna Tai tones evolved into distinct outcomes in each Modern Lanna Tai dialect. However, this study does not delve into the specific changes in the phonetic realization of each tone from Proto-Southwestern Tai to Modern Lanna Tai dialects.

TABLE 23 From Proto-Southwestern Tai consonants to Modern Lanna Tai consonants

Place / **Manner & Voicing**		**Labial**	**Alveolar**	**Palatal**	**Velar**	**Uvular**	**Glottal**
Stops	aspirated	*pʰ >/pʰ/	*tʰ >/tʰ/	*cʰ >/cʰ/>/s/	*kʰ >/kʰ/		
	voiceless	*p > /p/	*t >/t/	*c >/c/	*k >/k/	*q >*χ >/x/ > *ɢ > *ɣ kʰ/	
	voiced	*b	*d	*ɟ	*g		
	glottalized	*ʔb > /b/	*ʔd >/d/	*ʔj >/j/			*ʔ >/ʔ/
Fricative	voiceless	*f >/f/	*s >/s/		*x >/x/	*χ >/x/ >/kʰ/	*h >/h/
	voiced	*v	*z		*ɣ		
Nasal	voiceless	*ʰm >/m/	*ʰn >/n/	*ʰɲ >/ɲ/	*ʰŋ >/ŋ/		
	voiced	*m	*n	*ɲ	*ŋ		
Approximant	voiceless	*ʰw >/w/	*ʰl >/l/				
	voiced	*w	*l	*j >/ɲ/			
Trill	voiceless		*ʰr >/r/				
	voiced		*r >/h/				

TABLE 24 Simple vowel inventory of Modern Lanna Tai

	Front	Central	Back
High	i, iː	ɯ, ɯː	u, uː
Mid	e, e̲ː	ɤ, ɤː	o, oː
Low	ɛ̲, ɛː	a, aː	ɔ̲, ɔː

	16 th-Century Lanna Tai tones						Modern Lanna Tai tones					
	A	B	C	DL	DS		A	B	C	DL	DS	
(1)	A12	B123	C123	DL123		>	1 (A12)	2 (B123)	4 (C123)	2 (DL123)	ɔ 6, 1 7, 4 8, 5 9 (DS123)	
(2)												
(3)	A34						ɔ (A34)					
(4)		B4	C4	DL4	DS4		3 (B4)	5 (C4)	3 (DL4)	4, 5 (DS4)		

FIGURE 6 Tonal changes from the 16th-Century Lanna Tai to Modern Lanna Tai[6, 7, 8, 9]

5 Tentative Periodization of Lanna Tai

This section summarizes the phonological changes that occurred from the oldest stage of Lanna Tai to the modern stage. Inventories are provided when relevant to significant systemic or structural shifts. The findings of this study contribute to establishing a relative chronology for each change. Accordingly, the Lanna Tai language can be tentatively divided into three periods: Old Lanna Tai, Early Modern Lanna Tai, and Modern Lanna Tai. This three-fold periodization is necessary because the writing system itself suggests its adoption during a time when there were still three phonemic tones and a voicing contrast. The exact timing of the tone split and loss of voicing contrast cannot be determined solely based on the orthography, but it certainly post-dated the adoption of the writing system.

6 Akharawatthanakun (2012: 178) reports DS123 = A34 for the Lampang and Chiang Rai dialects

7 Wimonkasem (2006) reports DS123 = A12 for the Chiang Mai dialect, as does Thianthaworn (1998: 59, 82, 103–105) for the Saraburi and Nakorn Pathom dialects

8 Akharawatthanakun (2012: 178) reports DS123 = C123 for the Phrae and Nan dialects.

9 Thianthaworn (1998: 59, 82, 103–105) reports DS123 = C4 for the Lopburi dialect.

5.1 *Old Lanna Tai*

I propose the period of Old Lanna Tai as the oldest stage of Lanna Tai diverging from Proto-Southwestern Tai. Though its existence predates the 16th century, the exact time of divergence from Proto-Southwestern Tai is still unknown. The distinguishing features separating Old Lanna Tai from its proto-language include those in (4):

(4) Sound changes from Proto-Southwestern Tai to Old Lanna Tai:
   a. Merger of *ʔbl > *ʔd (change in place & number of segment, unchanged manner)
   b. Nasalization of *j > *ɲ (change in manner, unchanged place)
   c. Spirantisation of uvular stops: *q > *χ, *ɢ > *(ʁ) (unchanged place, change in manner)
   d. Fronting of uvulars: *χ > *x, *(ʁ) > *ɣ (change in place, unchanged manner)
   e. Simplification of *kʰr > *kʰ (change in number of segment, unchanged place & manner)

Thereby, the simple consonant phonemes of Proto-Southwestern Tai were reduced from 41 to 38 in Old Lanna Tai, as presented in Table 25, while the vowels and tones remained stable.

5.2 *Early Modern Lanna Tai*

I propose that Early Modern Lanna Tai can be conceived as a transitional phase between the Old Lanna Tai and the Modern Lanna Tai dialects. During this period, significant changes occurred, including the split in tones and the loss of the original voicing contrast. The voiced-voiceless minimal pairs merged, while the existing tones split based on the variation in voicing of the initial consonants. The number of tone phonemes doubled from 3 to 6, while the number of consonant phonemes decreased from 38 to 23. The timing of the de-glottalization of pre-glottalized phonemes *ʔb, *ʔd, and *ʔj is still unknown. In terms of vowels, Early Modern Lanna Tai acquired the long mid non-front vowels *oː and *ɤː and the distinction between *aj and *auɻ was lost in favor of a single/aj/. The split of Tone D4 according to vowel length can be confirmed based on the different tonal transcriptions in the manuscript. Taking these changes into account, the inventories presented in Table 25 transformed into the ones shown in Table 26. Additionally, Table 27 illustrates the tone inventory and demonstrates the patterns of tone split and merger.

TABLE 25 Old Lanna Tai phonology

Consonant inventory

Manner	Phonation	Labial	Alveolar	Palatal	Velar	Glottal
Stops	aspirated	*pʰ	*tʰ	*cʰ	*kʰ	
	voiceless	*p	*t	*c	*k	
	voiced	*b	*d	*ǰ	*ɡ	
	glottalized	*ʔb	*ʔd	*ʔj		*ʔ
Fricative	voiceless	*f	*s		*x	*h
	voiced	*v	*z		*ɣ	
Nasal	voiceless	*ʰm	*ʰn	*ʰɲ	*ʰŋ	
	voiced	*m	*n	*ɲ	*ŋ	
Approximant	voiceless	*ʰw	*ʰr *ʰl			
	voiced	*w	*r *l			

Vowel inventory

	Front	Central	Back
High	i, iː	ɯ, ɯː	u, uː
Mid	e	ɤ	o
Low	ɛː	a, aː	ɔː
Falling	ia	ɯa	ua
Rising	aj	aɰ	aw

5.3 *Modern Lanna Tai*

Finally, I propose Modern Lanna Tai as a continuation of Early Modern Lanna Tai with the changes given in (5):

(5) Sound changes from Early Modern Lanna Tai to Modern Lanna Tai:
   a. Plosivisation of the velar fricative/x/ >/k^h/
   b. Spirantisation of aspirated palatal stop/c^h/ >/s/
   c. Aspiration of the alveolar trill, including in clusters,/r/ >/h/
   d. Acquisition of/e:/,/ɛ/ and/ɔ/ which symmetrized the vowel system
   e. Split of Tone D123 > DL123 & DS123 according to vowel length
   f. Phonetic changes of the tones
   g. Monophthongisation of diphthongs in some dialects (Akharawatthanakun, 2012: 689–697)

The consonant phoneme count decreased from 23 to 20, while the vowel phoneme count increased to 21 in dialects with diphthongs or remained the same with different structures in dialects without diphthongs. The six tones of Early Modern Lanna Tai underwent no systemic changes. Changes in tones from Early Modern Lanna Tai included the split of D123 into DL123 and DS123 based on vowel length (a structural change), as well as variations in the phonetic realization of each tone across different dialects. Thus, the following inventories represent the phonology of Modern Lanna Tai.

Thus, the Old Lanna Tai period corresponds to the stage prior to and shortly after the adoption of the writing system, whereas the Early Modern Lanna Tai corresponds to the period roughly before and after the compilation of the *Sino-Lanna Tai Manual of Translation* manuscript. Phonologically, in Old Lanna tone split and the loss of voicing contrast had not yet occurred, while Early Modern Lanna Tai had undergone such a change. Early Modern Lanna Tai was thus simply more archaic than Modern Lanna Tai in retaining a few more contrasts.

TABLE 26 Early Modern Lanna Tai phonology

Consonant inventory

		Labial	Alveolar	Palatal	Velar	Glottal
Stops	Asp.	pʰ	tʰ	cʰ	kʰ	
	Vl.	p	t	c	k	
	Vd.	ʔb~b	ʔd~d	ʔj~j		ʔ
Fricative		f	s		x	h
Nasal		m	n	ɲ	ŋ	
Approximant		w	r l	(j)		

Vowel inventory

	Front	Central	Back
High	i, iː	ɯ, ɯː	u, uː
Mid	e	ɤ, ɤː	o, oː
Low	ɛː	a, aː	ɔː
Diphthong	ia	ɯa	ua

TABLE 27 Early Modern Lanna Tai tones

Tone inventory					
	A	B	C	DL	DS
1	Tone 1	Tone 2	Tone 4		2
2					
3	Tone 0	Tone 3	Tone 5	3	?
4					

TABLE 28 Modern Lanna Tai phonology (adapted from Rungreuangsri, 1991)

Consonant inventory

		Labial	Alveolar	Palatal	Velar	Glottal
Stops	Vl.	p	t	c	k	ʔ
	Asp.	p^h	t^h		k^h [k^h~x]	
	Vd.	b	d			
Fricative		f	s			h
Nasal		m	n	ɲ	ŋ	
Approximant		w	l	j		

Vowel inventory

	Front	Central	Back
High	i, iː	ɯ, ɯː	u, uː
Mid	e, eː	ɤ, ɤː	o, oː
Low	ɛ, ɛː	a, aː	ɔ, ɔː
Diphthong	ia	ɯa	ua

TABLE 29 Modern Lanna Tai tones

Tone inventory					
	A	**B**	**C**	**DL**	**DS**
1 2	Tone1	Tone2	Tone4	Tone2	DS123[10]
3 4	Tone0	Tone3	Tone5	Tone3	DS4[11]

6 Conclusion

This study enhances our understanding of the phonological history of the Lanna Tai language. By comparing earlier research with the known endpoints in the phonological history of Lanna Tai, this study provides a detailed analysis of the development from Proto-Southwestern Tai to Modern Lanna Tai dialects. It also uncovers a relative chronology of the sound changes that characterize Modern Lanna Tai dialects and based on the relative chronology of these changes, tentatively periodizes Lanna Tai's phonological history into three periods. This study follows in the footsteps of previous studies that utilize philological evidence to illustrate language development. Further replication of such studies for other Tai languages with extensive written evidence is strongly encouraged.

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10 DS123 = A12 in the Chiang Mai(Wimolkasem 2006), Saraburi & Nakorn Pathom(Thianthavon 1998)DS123 = A34 in the Chiang Rai, Lampang, Thakhamsong(Nan) (Akharawatthanakun 2012).

11 DS4 = C4 in the Chiang Mai (Wimolkasem, 2006), Saraburi & Nakorn Pathom(Thianthavon 1998), Phrae(Chaengphrai 1977; Akharawatthanakun 2012), Nan and Lampang(Akharawatthanakun 2012)DS4 = C123 in the Thakhamsong(Nan) (Akharawatthanakun 2012) and Lopburi(Thianthavon 1998).

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