

A Tonal Study of an Endangered Language in China: The Case of Du'an Zhuang

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1. Introduction

- (1) A description of the tonal system of Du'an Zhuang (Tai-Kadai family) based on phonetic measurement is presented.
 - Traditional Chinese classification of tone is used commonly for understudied languages in China, but is inadequate.
 - A detailed phonetic study gives a more accurate portrayal of the tonal system.
- (2) Of 55 minority languages in China, Zhuang has the largest number of speakers.
 - The variety spoken in Wuming is considered the standard variety (Wei & Qin, 1980).
 - However there is a vast degree of dialectal difference within Zhuang.
 - Many Zhuang dialects are not mutually intelligible.
- (3) Recent research on understudied languages has similarly focused on phonetic measurements, and as a result has introduced a number of unknown phonetic features.
 - Elias-Ulloa (2010) on Shipibo
 - A Panoan language spoken in the Peruvian Amazon
 - A vowel can begin with modal voice, have a creaky voice portion in the middle, and then end with modal voice
 - Hargus (2007) on Witsuwit'en
 - An Athabaskan language
 - Detailed phonetic descriptions of the language
- (4) Du'an Zhuang is not mutually intelligible with Wuming Zhuang, mainly due to tonal differences.
 - We aim to describe these differences via phonetic measurement.
 - *There are 5 contrastive tones in Du'an Zhuang.*

2. Tone in Chinese and Southeast Asian languages

- (5) Tonal systems in Asian languages differ from those of African languages.
 - Asian languages tend towards monosyllabicity, and so a greater contrastive burden is placed on tone as well as laryngeal contrasts, while African languages mainly have high vs. low contrast (cf. Odden 1995).
 - As a result, a larger number of contrastive tones are commonly found in Asian languages.
 - A wide variety of tonal systems are found in Asian languages.
 - For example Burmese has 3 contrastive tones, Mandarin Chinese has 4 tones, Thai has 5 tones, Vietnamese has 6 tones.

(6) Modern descriptions use Chao Tone Letters (Chao, 1930).

- Tone is represented using the numbers 1 (lowest pitch) through 5 (highest pitch).
- Syllables are marked with a number representing the starting pitch and another representing the ending pitch.
 - I.e. 53 means the syllable starts with high pitch and falls to a mid-level pitch.

(7) Traditional descriptions of Chinese tones are based on a four-way contrast:

- Tone 1: High level tone [ma⁵⁵] ‘mother’
- Tone 2: Rising tone [ma³⁵] ‘hemp’
- Tone 3: Falling-rising tone [ma²¹⁴] ‘horse’
- Tone 4: Falling tone [ma⁵¹] ‘to scold’

(8) Zhuang is in the Tai-Kadai family of languages.

- Thai (also Tai-Kadai) has 5 tones:
 - 3 level tones: High, mid, low
 - 2 contour tones: rising, falling

(9) Wei & Qin (1980) summarize the tonal system of Zhuang as shown below.

Tone	1	3	5	7 short	7 long
Chao	24	55	35	55	35
Example	[na]	[na]	[na]	[nap]	[na:p]
Gloss	‘thick’	‘face’	‘arrow’	‘to put into’	‘to be stuck’

Tone	2	4	6	8 short	8 long
Chao	31	42	33	33	33
Example	[na]	[na]	[na]	[nap]	[na:p]
Gloss	‘field’	‘aunt’	‘meat’	‘to bind’	‘to turn in tax’

(10) Wei & Qin’s chart allows for as many as 10 contrastive tones.

- However, tone 3 and 7 short are both 55.
- Tone 7 long and tone 5 are both 35.
- Tones 6, 8 short, 8 long are all 33.
- Moreover, tones 7 & 8 only occur with obstruent codas (*stopped/checked syllables*); tones 1 to 6 only occur in open syllables or with sonorant codas (*unstopped/unchecked syllables*).

→ **This leaves 6 contrastive tones (to be revised).**

(11) Wei & Qin also assume a tonal register split:

- This split originates from the traditional descriptions of Chinese tone (4 tones split into two).
- Tones 2, 4, 6, and 8 are lower register, with tones 1, 3, 5, and 7 as the respective upper register equivalents.

3. Tone in Du'an Zhuang: an acoustic analysis

(12) Consultant

- One male native speaker of Du'an Zhuang in his mid 20's was recorded in a sound-proof booth at Rutgers University in 2007-2008.
- He received his education in Zhuang until middle school. Since then his education was in Mandarin Chinese.
- At the time of the elicitation, the consultant communicated with his immediate family members and relatives in Zhuang over the phone. In the US, however, he spoke Mandarin Chinese with his wife, who is a Miao descendant but only speaks Mandarin.

(13) Procedure

- Zhuang words were elicited from a list of Chinese characters. These words were pronounced in isolation to exclude possible tone sandhi effects.
- The tones for these words in Wuming Zhuang are known, facilitating comparison between the two dialects.

(14) Data: The number of tokens for each tone

Tone	1	3	5	7 short	7 long
N =	148	33	59	44	18
Tone	2	4	6	8 short	8 long
N =	112	39	31	36	9

- If the syllable shapes show a discrepancy, the data is excluded from consideration.
 - [bit] 'bile'
: Tone 1 in Wuming, but it has an obstruent coda in Du'an
 - [tou] 'to rain' [na] 'node'
: Tone 7 in Wuming, but no obstruent coda in Du'an
 - [ra:] 'root' [hu] 'pair'
: Tone 8 in Wuming, but no obstruent coda in Du'an

(15) Analysis

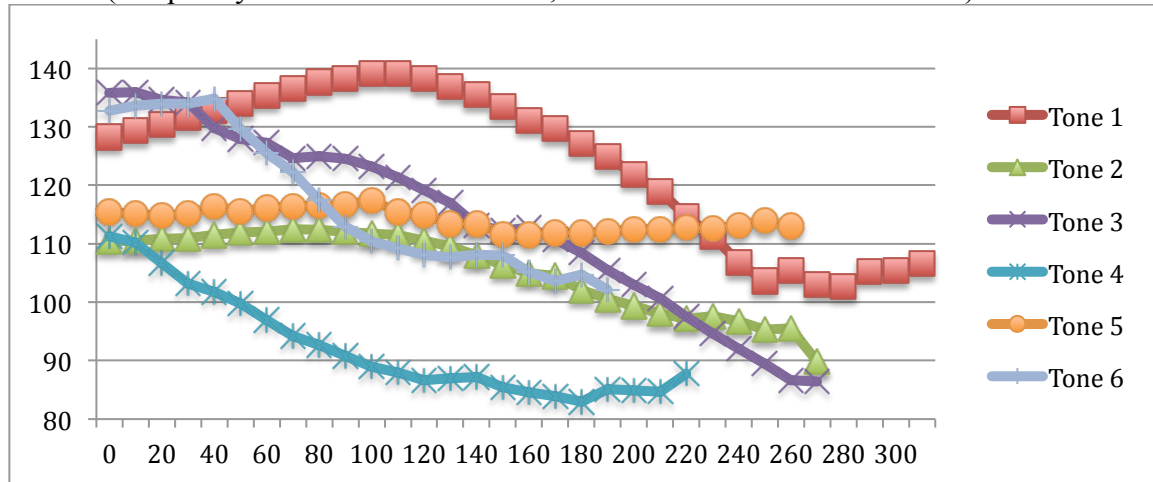
- The vowels were segmented using Praat (Boersma 2001).
- A script was written that extracted pitch track data.
- F0 measurements were recorded at 10 ms intervals.
- Mean F0's were computed at each interval for each tone.
- Duration of the vowels was measured as well.

3.1 Tones 1 to 6 (Unchecked syllables)

(16) Tones 1 to 6 are summarized below.

- Vowel length as transcribed in Wuming Zhuang, did not correspond to any differences in vowel length, nor of F0, in Du'an Zhuang.
- Thus, pitch tracks are plotted without regard to underlying vowel length.

- (17) Mean Pitch Tracks in Du'an Zhuang (Tones 1 to 6, unchecked syllables)
(Frequency in Hz on Vertical Axis; Time in ms on Horizontal Axis)



- (18) **Tones 3 & 6** are phonetically equivalent:
- Both are 51, with durations nearly equivalent.
 - Tone 3 mean: 0.175 ms, SD = 0.091
 - Tone 6 mean: 0.177 ms, SD = 0.068
 - These tones are level tones in Wuming, but falling in Du'an:
 - Tone 3 is upper register, with tone 6 as lower register in Wuming.
- (19) **Tones 1 & 5** are phonetically rising in Wuming; in Du'an Zhuang, tone 1 is rising-falling (453), and tone 5 is level (33) though.
- (20) **Tones 2 & 4** are falling tones in both Wuming and Du'an Zhuang.
- Both fall from approximately 110 Hz to 90 Hz for our speaker, indicating that there is no register split.
 - Instead, tone 2 falls towards the end and tone 4 falls early:
 - This corresponds to Chao Letters 331 (Tone 2) and 311 (Tone 4).
- (21) The tonal system of Du'an is significantly different from Wuming Zhuang:
- Tones 3 and 6 are identical in both pitch and duration
 - Tone 1 shows a rising-falling pitch
 - Tone 5 shows a level pitch
 - Tones 2 and 4 both fall from 110 Hz to 90 Hz. While tone 2 has an early fall, tone 4 has a late fall.
- ***There is no evidence of a split register tonal system in Du'an Zhuang.***

- (22) Comparison of Chao Tones for Wuming & *Proposed* Chao Tones for Du'an Zhuang

Tone	Wuming Wei & Qin (1980)	Du'an Zhuang	Du'an Zhuang Description
1	24	453	rising falling
2	31	331	lower late falling
3	55	51	falling
4	42	311	lower early falling
5	35	33	mid level
6	33	51	falling

3.2 Tones 7 and 8 (Checked syllables)

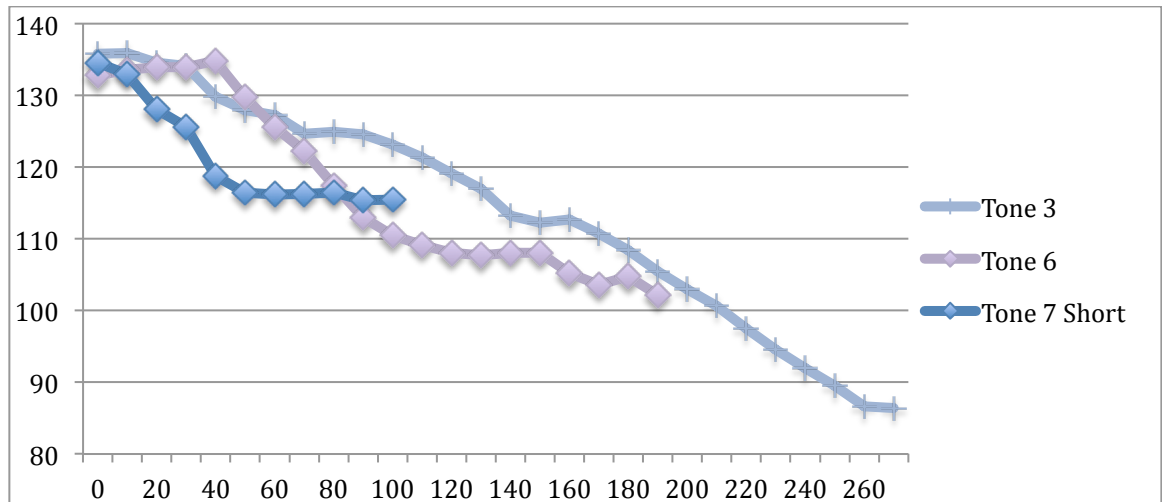
- (23) Vowels with tones 7 & 8 (with obstruent codas) are significantly shorter in duration, but the phonetic evidence presented here suggests that they are allotones of tones 1 to 6.
- Vowel length is predictably shorter in syllables with obstruent codas (Hubbard 1995 among others).
 - Tones 7 & 8 are thus allotones and should not be treated as contrastive.
 - Tones 7 & 8 Short do appear to be significantly shorter than the long versions, however, suggesting a vowel length contrast exists in checked syllables only.

- (24) Summary of Vowel Duration

Tone	Mean Duration (ms)
1	0.214
2	0.190
3	0.175
4	0.191
5	0.196
6	0.177

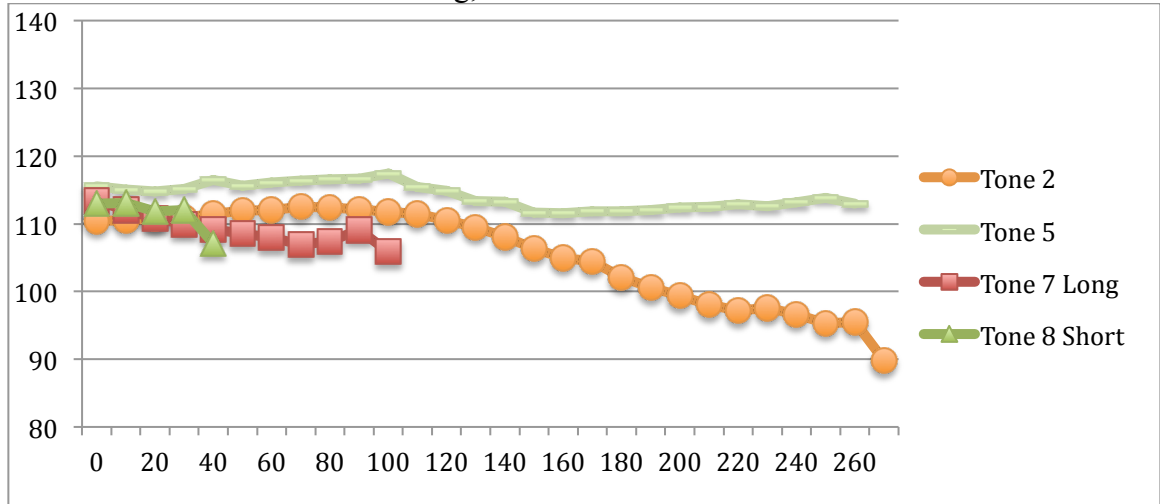
Tone	Mean Duration (ms)
7 Short	0.087
7 Long	0.131
8 Short	0.073
8 Long	0.116

- (25) Mean Pitch Tracks of Tone 7 Short and Tones 3 and 6 in Du'an

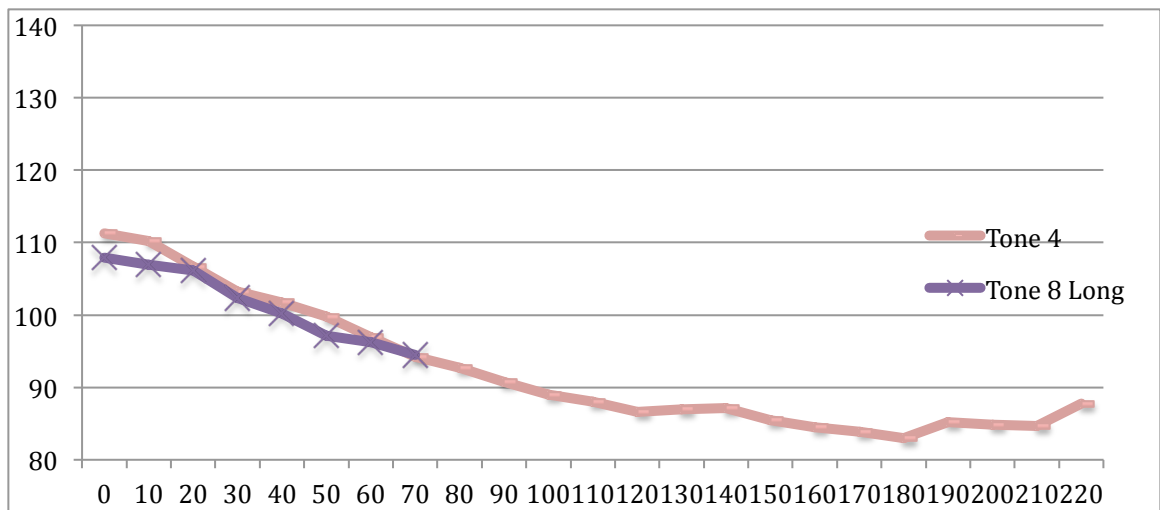


- (26) Tone 7 Short starts high, but unlike Wuming Zhuang where it is a level tone, it is a falling tone in Du'an Zhuang.
- Tone 7 Short is equivalent to a shortened allotone of Tone 3/Tone 6 (51).
 - We conclude that Tone 7 Short is the same underlying tone as Tone 3/Tone 6.
 - The presence of a coda accounts for the shorter duration.
 - The falling tone does not reach the bottom level (1) due to the shortening effect.

- (27) Mean Pitch Tracks of Tone 7 Long, Tone 8 Short and Tones 2 and 5 in Du'an



- (28) Tone 7 Long is rising in Wuming Zhuang, but is level mid tone in Du'an Zhuang, just like Tone 8 Short.
- Tone 7 Long & 8 Short are shortened allotones of either tone 5 (33) or tone 2 (31).
 - It is difficult to tell which of tone 5 or tone 2 corresponds to 7 Long or 8 Short, since the latter two are too short to demonstrate the complete falling contour.
- (29) Mean Pitch Tracks of Tone 8 Long and Tone 4 in Du'an



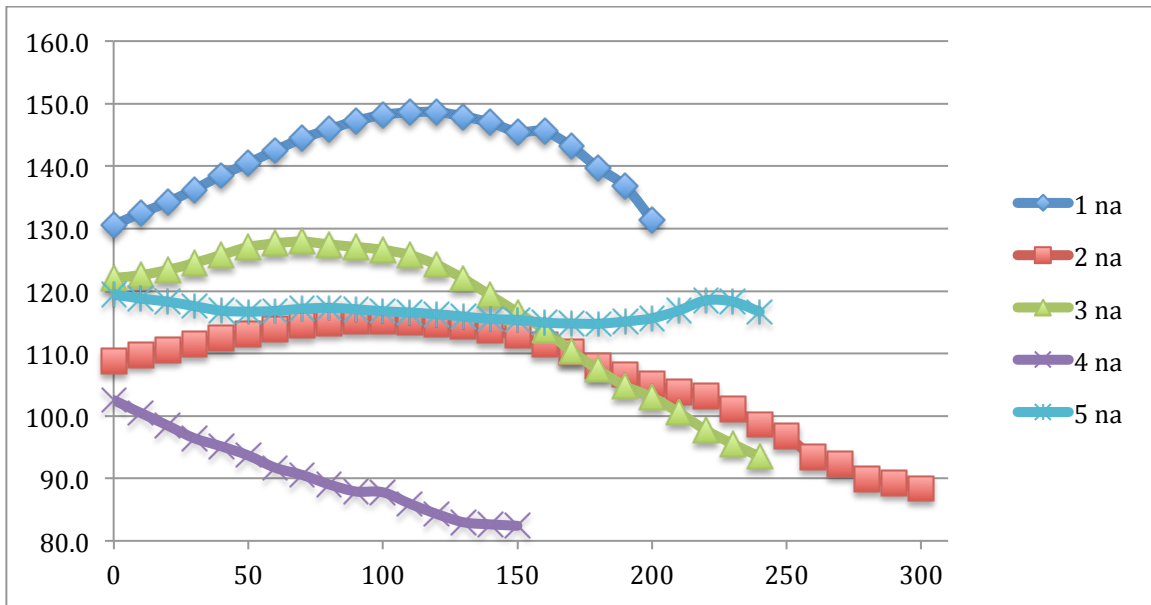
- (30) Tone 8 Long is falling in Du'an Zhuang, unlike Wuming Zhuang, where it is mid-level tone.
- Tone 8 Long appears to be a shortened allotone of tone 4 (311).

(31) Comparison of Chao Tones for Wuming & Du'an Zhuang in Checked Syllables

Tone	Wuming Wei & Qin (1980)	Du'an Zhuang	Du'an Zhuang Description
7 Short	55	53	upper falling
7 Long	35	33	mid level
8 Short	33	33	mid level
8 Long	33	31	lower falling

4. Discussion

- (32) Overview of this section
- Issues related to minimal pairs
 - Issues related to rising and falling tone in Wuming and Du'an Zhuang
 - Correspondence between level tones in Wuming and falling tones in Du'an
 - Tone in checked syllables
 - A suggestion for refining the Chao tone letter system
- (33) Near Minimal pairs with the shape, [na]
- Do the near-minimal pairs for [na] demonstrate the proposed tonal patterns in section 2?



- The minimal pairs for [na] generally accord with the averaged results from section 2.
 - The lone exception is that tone 3 here is initially rising, whereas our mean pitch track indicated it falls all the way through. The initial rise is specific only to this token.
- (34) Rising in tone 1 [453] in Du'an Zhuang
- Although the tone has a falling component at the end of the syllable, it is important to note the rising part [45] in the description of tone 1.
 - Tone 1 in Du'an Zhuang is the only tone with a phonetic rising component
 - This rising component corresponds with the tone 1 [24] in Wuming
- (35) Late fall in tone 2 and early fall in tone 4 in Du'an Zhuang
- The difference between tone 2 and tone 4 lies in the timing of the falling.
 - Tone 2 has a late phonetic fall, notated as [331], and it corresponds to [31] in Wuming Zhuang.
 - Tone 4 has an early phonetic fall, notated as [311], and it corresponds to [42] in Wuming Zhuang
 - While the details of the phonetics differ in both varieties of Zhuang, the phonological aspects of tone 2 and tone 4 are not different: the tones are contrastive in both dialects.
- (36) Level tones in Wuming correspond to the 51 tone in Du'an
- Tone has a tendency to downdrift as observed cross-linguistically in tone languages (Yip, 2002: 11)
 - Du'an Zhuang has reinterpreted this downdrift as a falling tone, resulting in the neutralization of different level tones into a single [51] tone.

- The level tone [33] in Du'an Zhuang corresponds to the upper rising tone [35] in Wuming. This could be because of a reinterpretation due to downdrift of the rise in [35] as a level [33] tone.
- (37) Tones in unchecked syllables and checked syllables
- The distinction between unchecked and checked syllables should also be taken into consideration in proposing tonal categories
 - Tone 7 and 8 (in checked syllables) are most likely to be allotones of unchecked syllables. We observed three distinctive allotones in checked syllables.
 - Without considering the syllable structure of checked syllables in determining tonal contrasts, the number of tones could easily be overestimated.
 - In our study, Du'an Zhuang shows 5 contrastive tones. Even Wuming Zhuang might only have 6 contrastive tones instead of 10 tones.
- (38) A suggestion: a possible refinement how to transcribe tone with Chao tone letters
- The middle number in Chao tone letters indicate the middle point of a contour: [ma²¹⁴] 'horse' (Fon & Chiang, 1999)
 - However, we suggest that Chao tone letters be used to indicate the timing of a contour if there is a contrast as in Du'an Zhuang: late-falling [331] vs. early-falling [311].
 - Without examining phonetic characteristics of tone, this difference would not have been adequately described.

5. Concluding Remarks

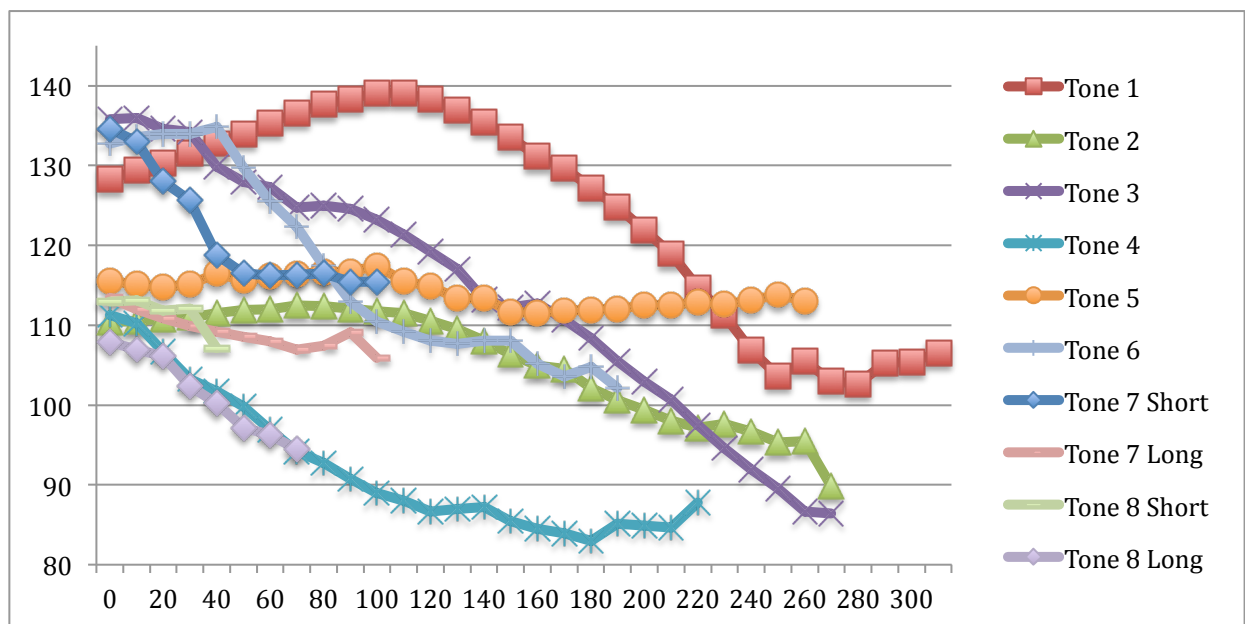
- (39) There are five contrastive tones in Du'an Zhuang, with only a three-way tonal contrast in syllables with obstruent codas.
- This is similar to the tonal system of Thai (also Tai-Kadai family), which has a five-tone system that is reduced to a two-way tonal contrast in syllables with obstruent codas (Ruangjaroon, 2006, Perkins, 2009).
 - The following table summarizes the tonal system implied by the phonetic study above:

- (40) Recommended Tonal Description for Du'an Zhuang (5 Tones)

Chao Letter Description	Description	Cf. Traditional Tone
453	upper fall	Tone 1
331	lower late fall	Tone 2
51	fall	Tone 3, 6, 7 Short
311	lower early fall	Tone 4, 8 Long
33	mid level	Tone 5, 7 Long, 8 Short

- (41) The traditional Chinese tonal description is inadequate: Du'an Zhuang tones are more accurately described using revised Chao Letters based on acoustic analyses of Zhuang tone.

Summary of All Du'an Zhuang Tones



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