VOWELS IN KOTIRIA AND WA'IKHANA:

A DIACHRONIC AND SYNCHRONIC ANALYSIS

by

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Vowels in Kotiria and Wa'ikhana: A Diachronic and Synchronic Analysis

Thesis directed by Associate Professor Zygmunt Frajzyngier

This study first postulates a set of vowels for Proto-Kotiria and Wa'ikhana informed by previous studies which reconstructed the vowels for Proto-Tukanoan, the family to which Kotiria and Wa'ikhana belong, and by the modern vowel inventories of these languages. Then, a comparative description of vowel pronunciation between two time points, 1905 and 2010, is undertaken. This description reveals that, while there has not been a change in vowel inventory, there are differences in speakers' production of vowels between these two times. The suprasegmental systems as well as the aspiration patterns of each of these languages is also looked at as possible explanation for changes in pronunciation.

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1 Introduction

1. Introduction

The purpose of this paper is twofold; first, to reconstruct the set of vowels in Proto-Wa'ikhana and Kotiria[1] and, second, to examine and explain the distribution of those vowels in the modern forms in comparison to the distributions of vowels in other related languages and to the distribution of those vowels in data from 1905. To accomplish this, data from Kotiria and Wa'ikhana, as well as from three other Tukanoan languages (Tukano, Desano, and Tuyuka)[2] will be examined. This data is comprised of words from both the modern day, collected in 2010, and the turn of the century, collected in 1905 (Stenzel, 2013 and personal communication, and Koch-Grunberg, 1912).

Both Kotiria and Wa'ikhana belong to the Tukanoan family of languages (Mason, 1950; Waltz and Wheeler, 1972). The family has two primary branches; Eastern Tukanoan and Western Tukanoan. The languages Kotiria and Wa'ikhana, along with Barasano, Kubeo, Siriano, Desano, Tuyuka, Tukano, Bará, Pápiwa, Siriano, Tatuyo, Carapano, and Macuna comprise the Eastern Tukanoan branch and are primarily located the Rio Negro region along the Vaupes, Papuri, and Piraparana Rivers and their tributaries in Colombia and Brazil (Epps and Stenzel, 2013). Correguaje, Siona, Macaguaje, Cuyabeno Secoya, Yuvineto Secoya, Angutero, Teteté, and Orejón comprise the Western Tukanoan branch (Waltz and Wheeler, 1972).

All languages studied in this paper belong to the Eastern Tukanoan branch. As with other members of this branch of the Tukanoan family of languages, both the Kotiria and the Wa'ikhana practice linguistic exogamy (the practice of marrying outside one's own linguo-cultural group).

[1] This is to say, the language spoken after the split from Proto-Tukanoan but before the split into Kotiria and Wa'ikhana.

[2] Desano: Silva (2012), Tukano: Welch (2000) Tuyuka: Malone (2000)

Among the Kotiria, marriage traditionally took place through either seizure of wives from or political agreement with groups considered acceptable under the exogamic system (Chernela, 1993: 27). Marriages were often used to end conflicts between groups; one group would give a wife to the other group to right a wrong or make up for stolen wives. Groups which are considered siblings, and therefore un-marriageable, under this system may call upon their brothers for aid in raids or in resolving conflicts with other groups. An example of two groups who fall into this category are the Wa'ikhana and the Baniwa (Chernela, 1993). These complex relationships of give and take, calling for aid and providing it, mean that the groups in this region are in constant contact with one another. Additionally, members of these groups do not cut off ties with their family when they have married into another group and often travel large distances to visit their blood relatives and the other members of their birth group (Stenzel, personal communication). All of this creates a level of multilingualism beyond what even a rich trading system might engender. The marriages between groups mean that each individual must be highly multi-lingual in order to operate in society successfully (Stenzel, 2013). Though there has not been much written about marriage practices among the Wa'ikhana, their history and the history of the Kotiria are closely intertwined and the general facts and patterns can be assumed to be closely related (Stenzel, 2005). The Kotiria and the Wa'ikhana consider one another 'brothers' within this system and as such do not intermarry with each other. Marriage partners from the Desano are common for both groups, hence that language's inclusion in this study (Chernela, 1993). An example of a possible exogamic marriage pattern is presented below (Stenzel, 2005).

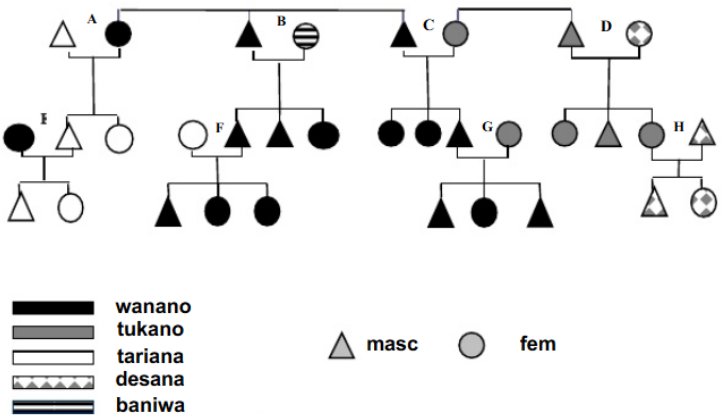

Figure 1.1: Exogamic Marriage Possibilities[3]

Section **1** continues in **1.1** and **1.2** with a summary of previous work in Proto-Tukanoan consonant and vowel inventories, including an analysis of the relative strengths and weakness of each inventory. Section **2** shows the correspondences and cognate sets gathered for this study as well as the methodology utilized. Section **3** discusses the modern vowel inventories of each of the languages in question. Section **4** provides the discussion of the data and results as well as the methodology behind the results. Section **5** reviews the conclusions reached in this study and proposes ideas for further work. Following the conclusions are two appendices which include the data referenced through this work, a set of changes between the 1905 data and the 2010 data for Kotiria and Wa'ikhana, and a listing of conversions between Koch-Grünberg's transcription and standard IPA.

1.1 Consonant Inventories. This section will discuss first the Proto-Tukanoan consonant inventory as described by multiple researchers as well as the Proto-Tukanoan vowel inventory.

[3] This figure utilizes the term 'Wanano' for the Kotiria. This is common in the literature.

This is to provide a framework for understanding both the data presented and the formulation of the Proto-Kotiria/Wa'ikhana vowel inventory.

A few previous studies have been done to define the phonemic proto-inventories (both consonantal and vocalic) of the Tukanoan languages. Waltz and Wheeler (1972) is primarily a study of cognate sets and a classification of Tukanoan languages based on percentage similarity between the 278 word cognate sets from 16 languages (1972:1). It also discusses the populations and geographic distributions of each group.

Figure 1.2: Location of the Kotiria and Wa'ikhana in Amazonia

Figure 1.2 (Stenzel, 2005) above illustrates the current primary locations of the groups that comprise the Eastern Tukanoan family of languages which do differ from the locations cited by Waltz and Wheeler. The names on the map represent the largest concentrations of speakers. In this figure the Kotiria are referred to as the Wanano and the Wa'ikhana are called the Piratapuyo (common names for these groups).

Barnes (1999) provides a general overview of the features of the Tukanoan family of languages. The study utilizes the classifications from Waltz and Wheeler (1972). Chacon (2014) is the most recent reconstruction of the inventories discussed in this study. His study focuses on revising the previous proposals of proto-consonant inventories and presenting the phonetic change rules in each language that result in the modern forms. Additionally, he presents a revised classification and reconstruction of the Tukanoan family.

Note that the organization and symbols present in the following tables have been maintained from the original sources. Any ambiguity or variance from modern IPA is discussed following the table in which the symbol is present.

Waltz and Wheeler (1972) first described the consonant inventory of Proto-Tukanoan as:

	bilabial	*alveolar*	*alveo-palatal*	*palatal*	*velar*	*Glottal*
voiceless stop	*p	*t			*k	*kʷ
voiced stop	*b	*d			*g	*gʷ
approximate		*r				
voiceless fricative		*s	*S	*č		
voiced fricative		*z	*Y	*j		
nasal	*m	*n			*h	*ʔ
glides	*w		*y			

Table 1.1: Proto-Tukanoan Consonant Inventory (Waltz and Wheeler, 1972: 129)

However, the authors did not offer any discussion of this analysis. It is interesting to note that they postulate labialized velars (something which Barnes does not propose and Chacon does, but with some variation, discussed below). Also of note is the inclusion of both *j and *y; whereas both Chacon and Barnes only include *j. Waltz and Wheeer also include far more alveolars than either of the others. The alveo-palatals *S and *Y represent sounds with known variation either in place of articulation (*S is always a fricative but may be alveolar, post-alveolar, or palatal) or

manner of articulation (*Y is always palatal but may be a fricative or not). The approximates and glides are also separated in this table, for reasons which are not discussed by Waltz and Wheeler.

Barnes (1999) proposed a different consonantal phoneme inventory, shown below in Table 1.1, as did Chacon (2014), shown in Table 1.3.

	bilabial	*alveolar*	*velar*
Voiceless stop	*p	*t	*k
Voiced stop	*b	*d	*g
Voiceless sibilant		*s	
Voiced semi-vowel	*w		*j

Table 1.2: Proto-Tukanoan Consonant Inventory (Barnes, 1999)

Barnes proposes a very minimal consonant inventory compared to those shown in Tables 1.1 and 1.3. This is a safe proposal since the phonemes listed are quite typologically basic. Notably missing are nasals, something which the other inventories discussed int his sections have at least two of. These are very interesting phonemes not to include since nasality is such an important feature of many Tukanoan languages in the modern day. Barnes assumes that nasalization is a purely suprasegmental feature as early as Proto-Tukanoan (Barnes, 1999: 209). This assumption is one that Koch-Grünberg adhers to in his data (discussed in section 2), though he does also include true nasals. However, Koch-Grünberg is not concerned about representing underlying structure or any other sort of abstract representation.

	Bilabial	*Coronals*			*Velar*	*Glottal*
		Alveolar	*Alveo-palatal*	*Palatal*		
Laryngealized stops	*p’	*t’	*tj’		*k’ (*k^{w})	
Stops	*p	*t	*tj	*c	*k (*k^{w})	*ʔ
Geminate stops		*tt				
Fricatives		*s				*h
Approximates	*w			*j		
Nasal stops	*m	*n				

Table 1.3: Chacon’s proposed Proto-Tukanoan Consonant Inventory

Chacon's inventory is second in size to Barnes's. His 2014 article discusses the proto-inventory in depth, especially focusing attention on the laryngealized consonants which have not been previously proposed for this family. Laryngealized consonants, he says, were produced with creaky voice and very few have been retained in the modern languages. Such stops are articulatorially complex sounds which is easy to reduce by simply deleting or lessening a single articulatory feature of that sound. The following image is an example of a laryngeal voiceless consonant becoming a non-laryngeal version of that sound through the loss of the constriction of the glottis.

$$\begin{bmatrix} +\,velar \\ -\,voice \\ +\,constricted\ glottis \\ -\,cont \end{bmatrix} \rightarrow \begin{bmatrix} +\,velar \\ -\,voice \\ -\,cont \end{bmatrix}$$

Figure 1.3: Laryngealized stop becomes non-laryngeal

Also intriguing are the geminate stops present in the set. Chacon cites evidence from Desano and Siriano as supporting his proposed geminate stops, as well as rules for their expression in the modern languages. Chacon uses the laryngealized stops to explain pre-aspiration in certain cases in the modern data (for example when C is a stop; *CC → hC/V_V in Tukano, Tuyuka, Desano, and others).

For the purposes of this study, the modern consonantal phonemic inventories of Kotiria and Wa'ikhana have been retained without alteration from the data (discussed in Sections 2 and 3). All three consonant inventories propose bilabials, alveolars, and velars. This implies that these can be taken to be the most basic categories for Tukanoan consonants, as they are in many other world languages.

1.2 Proto-Tukanoan Vowel Inventory. Waltz and Wheeler (1972; 129) proposed the following vowel inventory (which Barnes and Chacon do not dispute).

	front	*Central*	*back*
High	*i	* ɨ	*u
Low	*e	*a	*o

Table 1.4: Proto-Tukanoan Vowel Inventory

This is an unremarkable vowel inventory and so their lack of argument is unsurprising. The typologically common vowel inventory is /i/, /e/, /a/, /o/, and /u/. Though an inventory of /i/, /u/, and /a/ would be more distinct, words need to be quite a bit longer to remain distinct from each other than words constructed utilizing a 5-vowel inventory. This same issue arises when languages have small consonant inventories, see Hawaiian for a typical example of a language which operates in this way. The only divergence from this efficient inventory is the addition of a high central vowel /ɨ/. The prescence of a high central vowel frming a 6 vowel inventory is actually quite common in Amazonia (Aikenvald, 2012: 109-112).

2. Data/Methods

As previously stated, the goals of this work are to first establish a reasonable Proto-Kotiria/Wa'ikhana vowel set, and secondly, to describe the changes in distribution of vowels between 1905 and 2010. While there is no evidence that the vowel inventory has undergone change from the Proto-Kotiria/Wa'ikhana inventory discussed in Section 4, even a cursory read of the data reveals that the pronunciation of the vowels by speakers has changed. This change will be explored in detail in the following sections.

The data, which consists of 100 lexical items in each of five languages, was compiled from various sources, including Stenzel (2013, and personal communication[4]) for Kotiria and

[4] In this case the 2010 word lists are unpublished and provided from Stenzel to the authors.

Wa'ikhana, Silva (2012) for Desano, Welch and West (2000) for Tukano, and Malone (2000) for Tuyuka. Historical data came from Koch-Grünberg (1912). Koch-Grünberg's orthography was standardized to the rest of the data, though some orthographic distinctions for sounds whose nature was unclear given Koch-Grünberg's descriptions were preserved. A listing of changes made in standardizing Koch-Grünberg's data is provided in Appendix A (pp. 33 of this text), as is the reasoning behind each change in most cases based on a definition or clarification from Koch-Grünberg.

Correspondences from Tuyuka, Tukano, and Desano were used to help confirm that Koch-Grünberg's words have not been erroneously transcribed or interpreted. For example, Koch-Grünberg provides [pxtxáka-mɛː-no] for 'smoke' while the modern word in Kotiria is [hú]. There is not an equivalent discrepancy between the historical form and the modern form in the words for 'smoke' in Wa'ikhana (1905: [hōmę́] and 2010: [òméò]). This difference is due to the fact that Koch-Grünberg's elicited word is actually a compound which means 'fire-smoke'. Also of note; the 1905 version of the word in Kotiria is, at least in part, cognate to both Wa'ikhana forms. The *mɛː* in the Kotiria word is also present in Wa'ikhana *hō**mę́*** and *ò**mé**ò*. Each word list is comprised of 100 words selected from the 200-word Swadesh list as well as some common verbs. Though there are a few gaps in the data, it comprises a roughly equal set of correspondences. All lexical items are expressed phonetically.

The full lists of correspondences are available in Appendix A and are organized in the following format (exemplified in Table 2.1 below): first the column(s) of English glosses (which are organized into semantic categories; e.g. 'body parts' or 'animals'). The second column gives historical data for each language, followed by the modern data column(s). If there are multiple

sources for a single language (as in the case of Kotiria and Wa'ikhana), the more robust list is given first, followed by the sparser. Each column is headed by the name of the source researcher.

	English	Kotiria	
		Koch-Grunberg (1905)	Stenzel (2010)
body parts	tongue	jamá-nɔ, jaʔmáː-no	ɲãʔmã́-nṍ
	lip	dexsé-rɔ, dʌxséː-ro	dihse-dɨhse
	tooth	piːri, píːri, píːdi	pírí, pírí-á-ká
	nose	kɛː-nó, kéː-no	kẽ́-nṍ

Table 2.1: The organization of the data in Appendix A.

Kotiria and the Wa'ikhana speakers strongly disprefer uninflected verb roots. This is especially apparent in the Wa'ikhana data where verbs are typically presented with the imperative morpheme *–ga* or the nominalizing morpheme *-nene*. Though the Kotiria data reflects this same pattern in the past (see the Koch-Grunberg verb forms which have a much higher occurrence of some sort of inflectional morpheme than we find in the modern data) speakers often provide uninflected roots for dictionary and base forms (Stenzel, personal communication and 2013 data). Other classes of words, such as nouns and pronouns, do not show the same patterns that defer to inflected roots over uninflected. However, morphemes have been maintained in the data where the speakers of the language provided them in the citation form. These morphemes include classifiers, such as *–phi* 'CLS:long, blade-like', plural/singular markers *-ro* 'SG', *-a* 'PL', verbal morphology, as well as the frequently-occurring *-nene* 'nominalizer' found in derived nominals (Stenzel, 2014; pp.79). There are two types of multi-morphemic words found in the data: those with grammatical morphemes affixed to the root and those composed of compound roots (which may or may not have additional affixed grammatical morphology). Grammatical affixes are indicated in the standard manner with hyphens, e.g. affix-root-affix. Compound roots are indicated using a '+' symbol, e.g. affix-root+root-affix. In most cases the affixes may occur in sequences which are

always root initial, e.g. root-affix-affix. It is important to note that some historical data has not been segmented. For example, in the Kotiria word *iːeáːn̥buroxkara-ga* 'to pull' the classifier *–ga* has been segmented, but it was not possible to confidently identify additional morpheme boundaries based on the correspondesnces found in the synchronic data.

The historical data is quite good in general; it was collected by Koch-Grünberg in the early part of the twentieth century and as such is subject to a certain level of scrutiny, since there are no recordings, and Koch-Grünberg does not indicate a degree of certainty or uncertainty about certain sounds. Additionally, Koch-Grünberg does not include systematic indications of nasalization or tone on vowels, though he does mark what he calls 'word accent', and there are indications of pre-nasalization of consonants. Nasalization is now considered to be suprasegmental feature in Eastern Tukanoan languages (Barnes, 1999, Gomez-Imbert, 2011, and Stenzel, 2013). While these suprasegmental features are not explicitly present in the historical data, Koch-Grünberg does indicate them in certain ways; i.e. the suffix *–ro* is recorded as *–no* following what is now recognized as a nasal noun root indicating a process of nasal spread. Additionally, only the words which appear to correspond to modern forms (i.e. those which have only undergone phonological change and not complete loss or replacement) have been included in the data.

The attempt has been made for the word lists to be representative of the sound inventories of each language, however, an expanded list is needed to confidently account for the variation in vowel inventory distribution present in the data.

3. Results

3.1 Modern Vowel Inventories. By comparing the distributions of the vowels present in the modern data, the following common vowel inventory has been determined;

	front	*central*	*back*
High	i	ɨ	u
Low	e	a	o

Table 3.1: Modern Kotiria and Wa'ikhana vowel inventory.

Note that there is an /ɨ/ here instead of the [ʉ] which sometimes occurs in the data. This is due to an orthographic convention among the people who speak Kotiria and Wa'ikhana. The use of <ʉ> rather than <ɨ> is both for ease of readability and because speakers of these languages believe the <ʉ> distinguishes their language orthographically from closely related languages such as Tukano or Desano.

Both Kotiria and Wa'ikhana have the same modern inventory, which has not changed since the Proto-Tukanoan inventory. However, the distribution of the pronounced vowels is quite different (see section 2.3) between 1905 and 2010.

3.2 Proposed Reconstructed Inventory. Based upon the data gathered for this paper, there is no apparent difference between the modern inventories, the Proto-Wa'ikhana/Kotiria inventory, and the Proto-Tukanoan inventory (table 1.4 above).

	front	*central*	*back*
High	*i	*ɨ	*u
Low	*e	*a	*o

Table 3.2: Proto-Kotiria/Wa'ikhana Vowel Inventory

This conclusion was arrived at by comparing the vowels present in the modern data to the vowels present in the historical data, and by looking at the modern inventory (tables 3.1 and 1.4) and the historical inventory (section 1.2). It is important to note that while the above table illustrates the proposed proto inventory it does not claim that the vowels spoken in the time of Proto-Kotiria/Wa'ikhana are used in the same contexts as they are in 1905 or 2010.

3.3 Distributions of Modern Inventories. Once the data was compiled and standardized, a list of changes both towards and away from each vowel was gathered. Careful attention was paid to the other vowels in words, as well as a change in word from the 1905 data to the modern data. From these correspondences and observations a set of rules was derived to account for the modern vowel distributions.

The analysis of vowel distributions began with first counting up all the instances of the individual vowels in each Kotiria and Wa'ikhana. Vowels in affixes that did not change between 1905 and 2010 are not included in this count.

In the modern data the vowel numbers are as follows;

	/i/	**/ɨ/**	**/u/**	**/e/**	**/a/**	**/o/**
Kotiria	45	29	14	20	88	65
Wa'ikhana	50	31	14	38	82	63

Table 3.3: Vowel frequencies in KOT and WAI.

However, this does not truly illustrate the changes in pronunciation that have taken place. Take, for example, the word for 'to burn'; KOT: *h̃ʉ́* and WAI: *ʉ̀h̃á*. For now, we are ignoring the presence of the final vowel in the WAI word since it is a grammatical morpheme which is not in use in in this word in Kotiria. One might expect [u] to have the same distribution since it occurs the same number of times in each of the two languages. Since this is not true, examples such as this illustrate the need for a set of rules which help to clarify the distributions of the vowels in each of these languages.

Tables 3.4 and 3.5 below illustrate the number of changes both towards and away from each target vowel in both the Kotiria's and Wa'ikhana's inventories. A full listing of contexts for changes away from a target vowel and changes towards that vowel is available in Appendix B.

	/i/	**/e/**	**/ɨ/**	**/u/**	**/o/**	**/a/**	**none**
Kotiria	0	10	1	2	2	2	2
Wa'ikhana	4	8	0	5	3	5	0

Table 3.4: Changes Away from Target Vowel

	/i/	**/e/**	**/ɨ/**	**/u/**	**/o/**	**/a/**	**none**
Kotiria	3	2	8	3	3	1	0
Wa'ikhana	1	3	12	3	4	2	0

Table 3.5: Changes To Target Vowel

Though the rules which govern these changes will be discussed in Section 4 (below), it is interesting to note that the patterns apparent in these tables. The column headed by 'none' refer to places without a vowel (either were a vowel was not originally pronounced and now is, or where a vowel was originally pronounced and is no longer). There appears to be a strong tendency to move away from the mid-front vowel [e] and toward the high central vowel [ɨ] in a raising and backing process. Additionally, the vowel [i] appears to be the most stable, that is, it has the least number of changes both towards and away. In Kotiria, [a] may also share the claim of stability, but it is more active in Wa'ikhana. It can also be postulated from the data that the historical occurrence of the high central vowel [ɨ] was far less common than the 2010 forms.

4. Analysis and Discussion

For each of the vowels in the inventory which Kotiria and Wa'ikhana share the following steps were taken. First, the full dataset was reduced to only include words that contained the vowel in question. If the vowel was contained within any word of any language (historical or non-

historical) that entire correspondence was included in the table. Once the set of words containing the target vowel had been gathered into a table, a list of environments was made and compared between languages. Finally, from these lists a set of rules was proposed to account for variation between the synchronic and historical data.

The tables provided in the following sections organize the rules that have been formulated from these comparisons and illustrate examples. The examples are not the only occurences of the variation unless otherwise stated. Additionally, rules in the table indicate changes in which the focus vowel was the end result, whereas rules affecting the target vowel and changing it into another are discussed in the text.

The term ‘rules’ is used throughout this section. This term is not exactly appropriate as there is not enough data avaliable to assert than a given ‘rule’ applies in all occurences of the listed context in the language in question. It is, however, an apt term to describe the form and function of the conditions which appear to have elicited a change in vowel form from 1905 to 2010.

4.1 [i].

There is a notable difference in the number of morphemes which contain [i] between Kotiria and Wa’ikhana. I have disregarded examples in the data that have [i] in the historical data but not in the modern form when the historical occurrence is present in a morpheme that cannot be reliably reconstructed in the modern form. These discarded examples were primarily from Kotiria, which has a greater incidence of morpheme dropping (Stenzel, 2012 and Waltz, 2002).

[i]	Rules	Examples		
		1905	2010	English gloss
Kotiria	1. [e] → [i] /_[ʰs]	de(x̰)séɾɑ, dẹ̰xsɛ́ɾɔ	diʰsebeʔru	lip

	2. [e] → [i] / N_[h]	nehíː-no-ka, jehíː-no-ka	nihi-no-ka	child
	3. V[5] → [i] / [pʰ]_[t͡ʃ]	pxtxá-ka, pxtxáː-ka	pʰìt͡ʃá-ká	fire
	4. [u] → [i] / N_[h]	nuhá, nʊxhá	Nɨ̀htɨ́	ashes
Wa'ikhana	5. [u] → [i] / #_[ʰp]	uxpiː-ri	ìhpí-dí, ìhpí-dí-á	tooth

Table 4.1: The rules that derive [i] in modern Kotiria and Wa'ikhana.

Rule 1, [e] → [i] /_[ʰs], applies only when preceding a pre-aspirated [s]. There are counter examples for other pre-aspirated sounds; 1905: *uɛxté*, *uɛxte+benáni-na* goes to 2010: *wèʰté* 'dirty'. Unfortunately, there are no examples in the data of other pre-aspirated fricatives or stops to determine the true scope over which this rule applies.

Rule 2 applies only in the context of a nasal followed by a [h]. Any other sound preceding the /e/ means the rule will not apply, despite the [h]; 1905: *jeh͡éi-ri-sáː-ga* goes to 2010: *jèhé-rí-nɨ́* ('to breathe'). There is a smiliar rule that applies to the high back vowel [u], as we see in Rule 4.

The last rule, which applies only to Kotiria, is also conditioned by aspiration, in this case the extreme devoicing of a vowel when following an post-aspirated consonant and preceding an pre-aspirated consonant (Stenzel and Demolin, 2013). Koch-Grunberg did not record any vowel in the first syllable of the word for 'fire' in Kotiria, but, the modern data shows an [i] in that position. Either an [i] has been inserted over the course of the last 100 years, or there was already a vowel in that position that was so heavily devoiced that Koch-Grunberg did not distinguish it from the surrounding environment. The second of these theories is the more likely given typological patterns the world over. This vowel could have been an [i] or it could have been any other vowel. If it was another vowel then there are two possibilities; first, the vowel was a front

[5] Where 'V' is a specific, but unknown, vowel.

vowel and the rule in the above table applied over time changing the vowel to [i] since the surrounding aspiration is high and front in the mouth and two, the vowel was a back vowel and became [u] over time (see section 4.3 below). Overall, there appears to be a pattern of raising and fronting for the vowels in this context.

The single rule listed for Wa'ikhana [u] → [i] / #_[^{h}p] includes both preceding and following context since the rule is derived from a single instance in the data and it is unclear which context is the vital one (or if both are required). It is interesting that this rule occurs in Wa'ikhana since it appears to contradict Rule 1 in Kotiria where [i] occurs preceding a pre-aspirated sibilant and does not occur preceding a pre-aspirated stop.

Though the vowel [i] acts as a seed vowel for various other changes in Wa'ikhana, there are no changes from [i] to another vowel in Kotiria. Thus, [i] appears to be a relatively stable seed vowel in Kotiria and a less stable vowel in Wa'ikhana, acting as a target more often than it does a source.

4.2 [ɨ].

This sound often occurs at the end of words where [e] previously occurred in the historical cognate. However, change from [e] → [ɨ] is not universal since [e] still occurs in CVC, CV, and VC contexts. Additionally, despite the number of instances of [e] going to [ɨ] when immediately preceding a word or morpheme boundary, [e] may still occur in the word/morpheme final position. This indicates that this is likely a change still in process. It is likely that, given enough time, all morpheme final occurences of [e] will become [ɨ].

[ɨ]	Rules	Examples		
		1905	2010	English gloss

Kotiria	1. [e] → [ɨ] /_[ɨ]	jeʌ́	jɨʔɨ́	1S
Wa'ikhana	2. [a] → [ɪ̃] / #_[ʰta]	axtɐ́-ka	ɪ̃̀ʰtɐ̃́	stone
	3. [e] → [ɨ] / [n]_[ʔk]	nekɵ́-li	nɨ̃̀ʔkɵ́	root
Both	4. [e] → [ɨ] / C_#	sé	sɨ́ɨ́	sun (KOT)
		j(i)uxkɐ́-kɐ	jùkɨ́	tree (WAI)

Table 4.2: Rules that derive [ɨ] in Modern Kotiria and Wa'ikhana

Note that Kotiria also demonstrates a level of vowel harmony (in the example with the 1SG pronoun, Rule 1). Vowel harmony may be present in Wa'ikhana as well, but the data is less clear. In Kotiria the data from 1905 clearly shows that the morpheme/word final vowel is [ɨ]. Rules 1-3 illustrate a possible glottal conditioning environment, though more data is needed to confidently state that [e] → [ɨ] / __[+glottal]. The [e] → [ɨ] change is a pattern that is not unique to the Kotiria/Wa'ikhana sub-branch of the Tukanoan family;

Tukano: 1905: *jeɐ́* 2010: *jʉʔʉ́*

Desano: 1905: *(n)jēɐ́* 2010*: jʉ̀ʔʉ́*

Tuyuka: 1905: *jüiɨ̰, yi*ō 2010: *jʔɨ́*

These examples imply that the morpheme final [ɨ] in the Kotiria data from 1905 is likely the result of a rule similar to like Rule 4 described above and that the vowel harmony follows from there in an ordered manner. However, Rule 4 does not account for the transition from the various vowels present in the 1905 data to [ɨ] in the other three languages unless the rule for morpheme final vowels going to [ɨ] is a process observed more generally in the family. Note the epithesized glottal stop in all examples above. It is not clear whether this is an epithesis that has taken place between 1905 and 2010, or if it was simply not recorded by Koch-Grünberg.

Wa'ikhana demonstrates a vowel dissimilation pattern which runs in contrast to the general pattern of assimilation present in both the Kotiria and Wa'ikhana data; [a] → [ɐ̃] / #_[ʰta]. There is evidence that pre-aspirated stops affect the preceding vowel (see section 4.8) in Wa'ikhana and Kotiria which may be the case in this instance, however, there are other examples of dissimilation, for example *uamɐ́-a* → *w̃ɐ̃̀mɯ̃́-ɐ̃̀* 'neck'. As with the example provided in the table for Rule 2 there is an alternate explanation to the occurrence of disimilation, in this case the previously noted pattern of morpheme final change from [e] to [ɨ]. More data is needed to properly determine whether or not these are instances of dissimilation that happen to also occur in places where other rules apply, or if there is no dissimilation and these are simple examples of the other rules.

Finally, Rule 3, [e] → [ɨ] / [n]_[ʔk] might be a case of simple raising and backing, or it might fall under the umbrella of morpheme final change if the *–ko* was considered to be a separate morpheme at any point in time. Given the general shape and construction of roots in Wa'ikhana it is possible that *–ko* was a separate morpheme that became grammaticalized.

4.3 [u]

The vowel [u] is one of the most stable vowels in these two languages. The six rules in table 4-3, below, illustrate the only six instances of a vowel changing to [u] in either Kotiria or Wa'ikhana[6]. With 7 transitions from and 6 transitions to [u] appears to be equally un-productive as a seed vowel as it is a resultant vowel.

[u]	Rules	Examples		
		1905	2010	English gloss
Kotiria	1. [ɨ́] → [u] / _]	hʌ́-a	h̃ṹ	To burn

[6] Note that for the other vowels discussed thus far the rules and examples were only a sample of available examples of a change while these are the *only* 6 examples in the data.

	2. V → [u] / [pʰ]_[ʰk]	n̥do-pʰkó:-ro, je:pxkó	pʰòʰkó-rò pʰùʰkó-rò	Mother
Wa'ikhana	3. [o] → [u] / [k]_[d]	axkő̀ro	ɔ̀ʔmɛ́ò+kùdù	cloud
	4. [e̥] → [u] / (aspiration)_[t]	(m)b(e̥)xtó-po-lɪ́-ka-ne	pʰùʰtó	straight
	5. *[oe] → [u] / [k]_]	ōaxkő̀ē-te-re	w̃ɑ̀̃hkṹ	to think
Both	6. [o] → [u] / _]	uamó:+muχka, uamó:+pama	wɑ̃́mṹ-kɑ̃́	hand
		axkő̀ro	ɔ̀ʔmɛ́ò+kùdù	cloud

Table 4.3: Rules that derive [u] in Modern Kotiria and Wa'ikhana

Rule 1 is notable given its similarity to Rule 3 in section 4.1 (above), where an unknown undetermined vowel becomes [u] when surrounded on both sides by aspiration resulting in the devoicing of that vowel (V → [u] / [pʰ]_ [ʰk]). In this case the rule applies to back vowels. These two rules could be more accurately summarized in a single place-matching rule;

$$[+\text{syllabic}] \rightarrow [+\text{syllabic}, +\text{high}]/[+\text{spread glottis}]\_[+\text{spread glottis}]$$

This place-assimilation rule takes a given vowel of any place (front, central, back) and raises that vowel. This accounts for our lack of knowledge about the vowels that occurred in this position in 1905 while still allowing for the modern expression.

Rule 2 for Kotiria is an interesting case, since it is rare in this data for [ɨ] to act as the initial state vowel rather than the resultant vowel. This unique case of backing is likely an assimilation to the back morpheme [-a] that has since been dropped in the modern forms. This is the only such case in the data.

There are no diphthongs in Kotiria or Wa'ikhana, therefore the [oe] → [u]/ [k]_# rule might be interpreted as a diphthong simplification rule. However, it is more likely that the final –e is actually a morpheme that was previously required by the language and that has been lost (like the

morphemes *–te* and *–re* in this word). In this case the rule would simply be [o] → [u] / _] which is a rule in both Kotiria and Wa'ikhana.

The rule [o]→[u] / [k]_[d] presents an issue. While there are numerous examples of [o] becoming [u] either following [k] or preceding [d], there are also examples of this exact context in which [o] does not undergo this change. For example; 1905: *paxkő́ro*, 2010: *pàhkódò*. This difference might be attributed to the change between 1905 and 2010 from [r] to [d] in these contexts. Perhaps [o] → [u] only in front of [r] and in some cases the [r] changed to [d] too quickly for the vowel to follow. The opposite scenario would be that the change only occurs preceding [d] and that [d] has not been present long enough to motivate the change across the entire corpus, is less likely. Cross-linguistically, [d] → [r] /V_V is a more common change and is one that occurs in other Tukanoan langauges (Stenzel, personal communication).

4.4 [e]

The phoneme [e] displays the largest difference in number of occurences between the two languages with 18 more instances in Wa'ikhana than in Kotiria. The full listing of correspondences for both front vowels is available in Appendix A.

At least four of the instances of [e] in Wa'ikhana can be interpreted as being a part of morphology that has been preserved in Wa'ikhana but not in Kotiria. An example of this is the verb 'to fall' which is *bòrá* in Kotiria and *bòdá+kèà* in Wa'ikhana. This preservation is pervasive across the data; the Wa'ikhana do not like uninflected forms in general and were apparently

uncomfortable allowing those forms into a dictionary or wordlist at the time that the data was collected.[7]

There are no transitions to [e] from any other sound in Kotiria. If [e] is involved in a change it is the initial sound, and it changes primarily to [ɨ] (with one instance of change to [a], likely conditioned by vowel harmony). This change from [e] to [ɨ] is a pattern which has already been discussed (see section 4.2) as being in process since [e] does occur in all possible environments in Kotiria.

[e]	Rules	Examples		
		1905	2010	English gloss
Wa'ikhana	1. [a] → [e] / [m]_[n]	manó	ɲḗʔmḗ-nṓ	tongue
	2. [i] → [e] / [h]_[d]	hīri+toā́-ro-ne	hédí-nḗ	to breathe

Table 4.4: Rules for the expression of [e] in Modern Wa'ikhana

Wa'ikhana shows two types of transition to [e]. In a nasal environment [a] becomes [e] (Rule 1). There are examples of [a] remaining stable in non-nasal contexts; e.g. 1905: *daxpṹa* 2010: *dàhpúà* 'head', though it is worth noting that this word is also an instance of [e] → [a] in Kotiria (1905: *deχpú꞉e/daχpúe*, 2010: *dàhpú*). So, the pronunciation of [e] in place of [a] may actually be a case of an earlier change in Wa'ikhana that had not yet taken hold in Kotiria. The word for 'foot' 1905: *napṍka* and 2010: *dàʔpóká* illustrates that so long as the current context is non-nasal the [a] may remain. The word 'neck' *ṽ̀ãmṹ-ã̀* (WAI) is an excellent illustration of two rules; first the /a/ directly following the nasal [m] goes to [e] (unseen) and then, because this [e] is morpheme final is becomes [ɨ].The second [a] is not affected as it belongs to a separate morpheme.

[7] This preference for longer forms (either more richly inflected or compounded) is still present in the data today. (Stenzel, personal correspondence, Feb. 2015.)

Input	Rule	Output
uamɑ́-a	[a] → [e] / N _	**uame-a*
**uame-a*	[e] → [ɨ] / C_#	*w̃ɑ̀mɨ́-ɑ̀*

Table 4.5: Sequential Rule Application

So; [*uamɑ́-a*] → [*uame-a*] → [*w̃ɑ̀mɨ́-ɑ̀*]. Other examples of Rule 1 ([a] → [e] / N _) in action include; 1905: *paanoɑ́(nene)* to 2010: *mɛ̀ʔnɔ́* 'small', while *abɑ́lene* → *àʔbálìdò* 'rotten' and *k(e)nɔ́are* → *kɛ̀ʔnɔ́ɑ̨́nɛ́* 'good' show that it does not apply at a distance (i.e. the [a] must be directly next to the nasal consonant to undergo change). The word for 'bad' 1905: *jeɑ́nine* and 2010: *ɲɑ́nɛ̀* appears to have undergone a multistage change as well with the [j] → [ɲ] before the [e] was lost (thereby protecting the [a] from change).

Pronouns do not appear to follow this same pattern; 1905: *mɑ̄li*, 2010: *mɑ̀nɔ́/mɑ̀lɨ́* '1PL-inclusive'. This is perhaps due to strong influence from neighboring languages; Desano 1905: *mɑ̄li* and 2010: *mɑ̃ɾĩ,* Kotiria 1905: *maːri* 2010: *mɑ̀rɨ́*. It is common for pronouns and other grammatical words/morphemes to fall into a separate class, affected by different rules than the other words in a language.

The second transition in Wa'ikhana is a lowering from [i] → [e] in the context of [h]_[d] where [h] is a true phoneme and not an instance of aspiration. This is a relatively rare occurrence in the data with only four other instances of phonemic (non-aspiration) /h/ in Wa'ikhana (2010: *ìhpídí/ìhpídíá* 'tooth', *nɨ̀hɨ́nɔ̀* 'child', *dùhí* 'to sit', and *wèhéà* 'to pull). The vowel [i] occurs both following [h] and preceding [d] in Wa'ikhana, so neither of these sounds on its own is enough to condition this change, nor does dissimilation work as an explanation, since words such as 'tooth' 1905: *uxpiːri* 2010: *ìhpídí/ìhpídíá* occur. 'Tooth' is also an example of _[d] while 2010: *nɨ̀hɨ́nɔ̀* 'child' shows the [h]_ context. Therefore, the only explanation is that the full context [h]_[d] is

required as a conditioning environment. This hypothesis cannot be confirmed at this time as this is the only example of the context in the data.

4.5 /o/

The vowel [o] is more often the target of changes than it is a seed vowel source of change in both Kotiria and Wa'ikhana.

In Kotiria, [o] comes from the other two back vowels, [u] and [a], as well as the high front vowel [i] in morpheme-final context and following the consonant [j]. In Wa'ikhana [o] changes from the front and back high vowels, [i] and [u], and in the same general contexts observed for Kotiria, following [j] and morpheme-finally.

[o]	Rules	Examples		
		1905	2010	English gloss
Kotiria	1. [u] → [o] / __]	maánu-ka	˜mɜ̃ʔnɔ̃-kɜ̃	small
	2. [u] → [o] / [ja]__	jaua-ró:-ga(hira)	jò(a)-érà-rò	short
	3. [a] → [o] / [p]_[ʰt]	pa̧xió:-ti-ra	pòʰtó	straight
Wa'ikhana	4. [u] → [o] / #_	umu(x)-ká	ɔ̃̀mɔ̃́-kɜ̃́	hand
	5. [u] → [o] / [m]_]	umu(x)-ká	ɔ̃̀mɔ̃́-kɜ̃́	hand
Both	6. [i] → [o] / [l]_#	māli	mɜ̃́nɔ̃́~mɜ̀lɪ̃́	1P incl
	7. [u] → [o] / [j]_[a]	jeuɜ́-li(nene)	jòá-jè	long
	8. [u] → [o] / [j]_[e]	jeuɛ́ia(nene)	jòédó	short

Table 4.6: The modern distribution of [o] in Kotiria and Wa'ikhana.

Kotiria shows one unique conditioning environment for a change to [o] and one environment which that may be shared with Wa'ikhana (Rule 2). The unique environment is shown in Rule 3, in which the surrounding aspiration leads to a raising and backing of [a] to [o].

In Wa'ikhana, morpheme initial [u] when it is not interpreted as a [w] by modern researchers, becomes [o].

Both Kotiria and Wa'ikhana share the morpheme final position context (Rule 6 from the table). This rule only applies in a non-nasal context when the following morpheme does not begin with a voiceless consonant. In a nasal context the voicing of the following consonant does not matter. For example, Wa'ikhana 1905: *tẹaú-re* 2010: *tʉ̀ʔó* 'to hear' follows the rule, but 1905: *(n)duxkʉ́ja* 2010: *dùhkú* 'to stand' does not, which implies that the final morpheme *–ja* was dropped before this change took place. A Kotiria example of this same phenomenon (a dropped morpheme which leads to a voiceless following environment), is 1905: duxkú:-ga 2010: dùhkú 'to stand'.

Kotiria and Wa'ikhana also share the post-[j] conditioning environment for change from [u] to [o]. This may be in part due to the vowel-like nature of [j].

4.6 [a]

The vowel [a] is among the most stable vowels in Kotiria, second only to [u], with only two changes from and a single change to the vowel. The Wa'ikhana [a] is slightly more active with five changes from and two changes to the vowel. Overall there is a strong trend away from this vowel in Wa'ikhana. All changes from [a] go to non-back vowels in Wa'ikhana and to back vowels (specifically [o]) in Kotiria. Changes to [a] come from [o] in Kotiria and from [o] and [e] in Wa'ikhana.

[a]	Rules	Examples		
		1905	2010	English gloss
Kotiria	[o] → [a] / [n]_[m]	nomó:-no, je:na:-mó	nãmṍ-nõ̀	wife

Wa'ikhana	[e] → [a] / [as]_]	ka(x)sé̱-ro	kàʔsá-dó	skin
	[o] → [a] / [k]_[a]	yapīkoa	ŋã̰ʔpíkã̰ã̰	star

Table 4.7: Modern Expression of [a] in Kotiria and Wa'ikhana

The single change to [a] in Kotiria may have been conditioned by a dissimilation pattern. The word for 'wife' *nə̃mə́-nə̰̀* (where *nə̃mə́* is the root and *–nə̰̀* is an affix) shares a similar form across the three comparison languages from the Tukanoan family (there is no data for the 1905 version of this word in Wa'ikhana);

Desano: 1905: *nome* 2010: *mãɾãpo*

Tukano: 1905: *nemó* 2010: *dɨ̃bõ*

Tuyuka: 1905: *~dɨbo* 2010: *jé-nemo*

All four languages exhibit vowel alternation between the historical and modern examples, though the alternations are not always the same. This implies that the alternations in this word occurred after the languages had already split from their proto-Tukanoan roots.

4.7 Suprasegmental Effects on the Vowels.

Kotiria and Wa'ikhana have rich suprasegmental systems which include nasalization, aspiration, tone, and velarization.

4.7.1 Nasalization. Nasalization is a prevalent feature in Amazonian languages. In typological classification it has been used as a defining feature to order languages (Tovar and Tovar, 1982) and multiple families are shown to have contrastive nasalization; Arawakan, Chocoan, Jivaroan, Hup, Pano-Tacanan, and Tukanoan among others (Campbell, 2012). Nasalization may be native to a morpheme or occur due to phonological conditioning; take the

case of rhinoglottophilia in Arawakan languages in which a vowel may be nasalized when adjacent to a /h/ (and in some cases /ʔ/). After Kaye's 1971 work which first proposed nasalization as a suprasegmental rather than something inherent to the morpheme this has become the standard view in this particular branch of the Tukanoan family. This is reflected in the vowel sets presented at the beginning of this work. They do not include multiple sets of vowels as earlier works might have; one set of nasalized vowels, one of oral vowels which was sometimes called plain, and in some cases one of laryngealized vowels. The analysis of nasalization as a feature which may be applied to all voiced sounds results in nasal allophones of all underlying oral phonemes. "All morphemes [are] lexically marked as inherently nasal [+nasal], inherently oral [-nasal], or as unmarked (Ønasal) "chameleons"[8] to which the [±nasal] feature of the previous morpheme spreads" (Stenzel, 2007; pp. 341). This act of nasalization spreading from a nasal morpheme to a non-nasal morpheme may be referred to as nasal harmony (Campbell, 2012; pp. 268). In both Kotiria and Wa'ikhana all roots and clitics (and many affixes) have an unalterable [±nasal] quality. Therefore, only the set of unmarked, or (Ønasal), affixes is available for nasal spreading/harmony (Stenzel, 2007; 342).

Take, for example, the words for fire and stone in Kotiria; *pʰɨ̀tʃá-ká* 'fire' has the root *pʰɨ̀tʃá* which is [-nasal] and therefore the suffix *-ká* is also [-nasal], but the word *tã́ã́-kã́* 'stone' in which the root is [+nasal] also has a [+nasal] *–kã́*[9]. Also, note that the root *tã́ã́* does not include a nasal allophone to condition this, the nasalization is inherent to the root.

[8] First coined by Jones and Jones (1991), this term is borrowed from Stenzel's 2007 work on suprasegmentals in Kotiria (called Wanano in that work). It is the standard way to refer to this sort of morpheme.
[9] This *–ka* should not be confused with the inherently nasal -~*ka* (a diminutive marker).

Nasal spreading may be blocked by a [-nasal] morpheme and does not extend beyond the boundary of the word in question.

Though nasalization is a very productive and contrastive suprasegmental in Kotiria and Wa'ikhana, it does not appear to have an effect on vowel quality in either language. There are cases of the same vowel in both an oral and nasal context in the historical data with no change in the modern expression that cannot be explained by other portions of the conditioning environment.

	English	Kotiria		English	Wa'ikhana	
		1905	2010		1905	2010
NASAL	'tongue'	jamánɑ, ja'mɐ̃nɔ	ɲɐ̃ʔmɐ̃nɔ̃	'bad'	jeɐ̃nine	ɲɐ̃nɛ̃
ORAL	'eye'	kɑ̰ʰpáli, kɑ̰ʰpɐ́di	kʰàpárí	'eye'	jekaʰpɛ̰́a	káʰpédíá

Table 4.8: Examples of nasalization in KOT and WAI

As can be seen in the table above nasalization existing or not existing in the word (and therefore as a suprasegmental on the vowels) does not result in a changed vowel. Examples of cases where Kotiria is nasalized and Wa'ikhana is not are relatively rare and are not found in the data gathered for this study.

4.7.2 Tone. Eastern Tukanoan languages have been recognized as having something resembling either a 'tone' or 'pitch-accent' system for many years. However, researchers have not yet come to a consensus as to which of these is the true pattern. Barnes (1999) discusses a pitch-accent system which would encompass all Eastern Tukanoan (ET) languages. This system is based upon a distinction of a low pitch and a high pitch which is typically associated with the accent of a word. While this analysis does explain data from languages such as Tatuyo and Tukano, it neglects to fully account for the patterns present in other languages. For example, Barasana as discussed by Gomez-Imbert (2011), which Barnes included in her study as a pitch-accent language, aligns more closely with the typical model of a tonal language (Stenzel, 2007; pp. 346). Both

analyses acknowledge that there are only high (H) and low (L) pitches/tones available to speakers of ET languages. Any pitches/tones which appear to be a contour are actually high tones that have been affected by the environment or by a more dominant high tone (i.e. the tone on the accented vowel) and are still considered H.

Despite these debates as to the status of tone as a suprasegmental feature in Eastern Tukanoan languages (Stenzel, 2014 and 2007; pp. 345) it will be treated as such for the purposes of this study. This is for a number of reasons, the most important of which is that tone acts in much the same way as nasalization. Though it begins as a feature inherent to a morpheme it spreads to 'chameleon' morphemes in the same manner as nasalization. Additionally, Kotiria tone behaves similarly to that of Barasana. Unlike nasalization, tonal spread cannot be blocked. As with nasalization, tone spreads in Kotiria and Wa'ikhana. The basic tonal patterns in Kotiria are tri-tonal. This is expressed in interesting ways on the canonical bimoraic root. The third tone is only discoverable when a 'chameleon' is suffixed to the root; the final tone (which was unexpressed when only the root was present) appears on this chameleon. The final tone spreads over the rest of the word in cases of longer words. There are four possible combinations for tone in Kotiria; LHL, LH, HL, and H. The tonal melodies begin at the leftmost edge of a word and carry through. In an uninflected bimoraic root or other word with only two vowels the difference between LHL and LH is not discoverable until the word gains a third vowel through affixation of a morpheme (Stenzel, 2007; pp. 348). There have not been any works published about tone in Wa'ikhana, however, it behaves in the same was as tone in Kotiria and all guidelines discussed for KOT may be applied to WAI (Stenzel, personal communication, 2015).

English	Kotiria		Wa'ikhana	
	1905	2010	1905	2010
'ashes'	nuhá, nɔxhá	nɪ̀ʰtɪ́	niʰti	nʊ̀hɐ́
'red'	soá:-ga:	sõʔɐ̃-nõ	soa-purɪ́-ka-ni-ni	sõʔɐ̃́-nõ

Table 4.9: Tones in Kotiria and Wa'ikhana

The standard notation for a low tone is ` while the high tone is ′. The first example above, 'ashes', shows a LH tone without the final tone expressed, therefore the final tone is undiscoverable. This also illustrates the possible connection between Koch-Grunberg's "word accent" and the high tone, though he does not mark for any paradigm of tonal melody or accent in Wa'ikhana. The second example, 'red', illustrates the LHL tone with the final L falling on the suffix *–no*. It is also an excellent illustration of the disparity in the number of morphemes preferred by speakers of Wa'ikhana and Kotiria; though they are now the same word in pronunciation, the 1905 versions looked drastically different from one another.

In these examples it does not appear that tone has an effect on the vowels. The tones in Kotiria and Wa'ikhana are the same, but the vowels are different. As with nasalization, there are relatively few cases of differing tones between the languages, none of which occur in the data gathered for this study.

4.8 Aspiration.

Both Kotiria and Wa'ikhana have two types of aspiration; the more typologically common post-aspiration and a more unique pre-aspiration phenomenon. While post-aspiration is a phonetic occurrence and is not a part of the underlying form of a word, pre-aspiration is phonological. When post-aspiration and pre-aspiration occur in the same general area (most commonly on either side of the same vowel) they devoice the medial sound. This produces a large variety of devoiced

vowels in the languages. Devoicing acting on a vowel may have an effect on the perceived quality of that vowel. An example of a possible environment to produce this result is below;

English	Kotiria		Wa'ikhana	
	1905	2010	1905	2010
'fire'	pχ̂tχ̂áka, pχ̂tχ̂á̱ka	phìt͡ʃáká	pexká̱ka	pèhkámə̀ə̀

Table 4.10: Possible conditioning environments for vowel devoicing in KOT and WAI

In the 1905 data [x] represents velar aspiration. When this occurs directly before a stop it represents pre-aspiration and when it occurs directly after a stop it is post-aspiration. Note that when these occur together in the historical data (as in Kotiria) the vowel is then different than when they do not occur together in the historical data (Wa'ikhana). This is a possible case of vowel devoicing causing a change in the vowel quality. The position of the aspiration may pull the vowel towards that position. For example, in Kotiria, though we do not know the vowel that was present in 1905's *pχ̂tχ̂áka* in the position *pχ̂_tχ̂áka*, we do know that in the modern data the vowel is an [i] which shares much of the same articulatory features as the aspiration surrounding it. Therefore, if the vowel was not originally an [i] it is a logical conclusion that the vowel moved towards this sound.

5. Conclusions

This study focused on describing the patterns of change between 1905 and 2010 expressions of vowels in the Kotiria/Wa'ikhana subgroup of Eastern Tukanoan. It was established that, while Proto forms of the vowels have not undergone phonological change, the expressed phonetic forms have. The vowels that are in use by modern speakers of these languages have a different distribution than the vowels produced by speakers in 1905.

There has been a general trend away from mid-height vowels and towards the high vowels, both front and back, as was illustrated in Section 4 and in Appendix B. For example, the [ɨ], which saw only sparse usage in 1905, is now a common vowel typically originating from [e] or [i]. Other vowels have remained more stable in their expressions. The vowels [a] and [u] in both Kotiria and Wa'ikhana underwent relatively few transitions to other vowels and those transitions that did occur tended to be conditioned by vowel harmony or dissimilation, alternately for ease of pronunciation and disambiguation of segments.

The following table summarizes the differences in pronunciation between 1905 and 2010 explored in this study. The arrows indicate a change from one vowel to another. For example, the arrow from [u] to [i] indicates that there is at least one instance of a vowel being pronounced as [u] in 1905 and [i] in 2010.

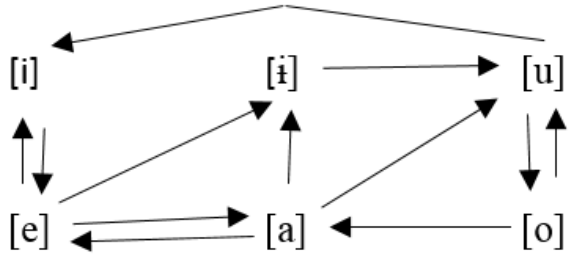

Table 5.1: Changes in Vowel Pronunciation.

The rich suprasegmental system in Tukanoan languages provided an interesting backdrop for many of these changes. But, in general the suprasegmental features appear not to have had an effect on the vowel quality in either language. However, aspiration appears to have had an effect on the expression of certain vowels (sections 4.2 and 4.3).

More data is needed to continue this study to its fullest extent; a reconstruction of the Proto-Wa'ikhana and Kotiria vowel distribution system. While data is available for the modern day forms

of words and constructions from researchers currently working to document these languages (Stenzel, Chacon, and others), Koch-Grünberg is the only source of comparative data from any time before the present. As time moves forward, gaps in the data that informs this study will be filled by the continued work of the research community and a full reconstruction will be available in the future.

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Appendix A:

Conversions from Koch-Grunberg:

Theodor Koch-Grunberg provides an explanation of all letters used in his transcription (Koch-Grunberg, pp 433). This information was used to convert his notation. The following are the changes made to convert Koch-Grünberg's field data into a more standard notation;

- a, e, i, u need no change (they are the German vowels)
- /o/ is said to be 'usually open' and 'similar to the Portuguese [o]' so they have been replaced with / ɔ/
- V́ marks what he calls 'word accent'
- V̄ is the same as V: and has not been altered
- /e̯/ → /ɛ/
- /e̯/ is 'like the u in *hut*' so I have used /ʌ/
- /a̲/ is said to be both 'between a and o' and 'like the *a* in *walk*' so I've decided to use /ɑ/
- /u̲/ is said to be 'between u and o' so I have called it /ʊ/
- /w/ needs no change ('like in *water*')
- /y/ → /j/

Full Listing of Data:

English	Kotiria			
	K-G	1905	Stenzel	Chacon
tongue	yamáṇa̲, ya'mā́no	jamá-nɔ, jaʔmá:-no	n̥ã́ʔmā́-nṍ	~jaba
lip	de(x̲)séra̲, de̯xsḗro	dexsé-rɔ, dʌxsé:-ro	dihse-be'ru	
tooth	pīri, pī́ri, pī́di	pi:ri, pí:ri, pí:di	pírí, pírí-á-ká	pidiaka
nose	ke̯nó, ké̯no	kɛ:-nó, ké:-no	kḗ-nṍ	~ke
eye	k(a)xpáli, k(a)xpā́di	ka̯χpá-li, ka̯χpā́-di	khàpá-rí	
ear	kamṍno, ka'mṍno	kamó:-no, kaʔmó:-no	khã́ʔmṍ-nṍ	
head	dexpṹe, daxpúe	deχpú:e, daχpúe	dàhpú	
hair	kōá	ko:á	poa-da, poa-ro	
hand	uamṍmuxka, uamṍpama	uamó:+muχka, uamó:+pama	wã̀mṹ-kã́	
leg	d(e)xsó, ye̯xt̯ḗke	de̯χsó, jextxé:ke	n̥ṹt͡ʃṹ-kʉ	~jɨtʃɨ
foot	dapóro, da'pṍpama	dapó-ro, daʔpó:-pama	dàʔpó-ró	
neck	ūamé̯e, uamé̯a	u:amʌ́-e, uamʌ́-a	w̃ã̀mṹ-ã̀	
belly	pā́ro	pá:-ro	phàà-ró	
skin	ka(d)zā́ro, ka(x)sā́ro	ka̯ʤá:-ro, ka̯χsá:-ro	kàʔsá-ró	
bone	koá	koá	khõ̀ʔã́	~kʰo'a

blood	(n)di, dii, dī, dīi	n̥di, dii, di:, di:i	dĭi	di
heart	yahīdiaka, yehḗripona	yahīdiaka, yehḗripona	.	
water	kó	kó	kóó	ko
river	(n)diá, diá	n̥diá, diá	dìá	dia
fire	pxt̰xáka, pxt̰xā́ka	pxtxá-ka, pxtxá:-ka	pʰìtʃǎ-ká	
smoke	pxt̰xákamḛ̄no, mḛ́	pxtxáka-mɛ:-no, mɛ́	hú	
ashes	nuhá, nu̱xhá	nuhá, nʊxhá	nĩ̀htĭ́	
sky	mḛ́se, mḛ́se̱	mɛ́:-se, mɛ́:-sɛ	mŭ́ǎ-nő	
cloud	koréx̱teri, mḛ̄kuruli, kő̄roix̱teri	kor-xéχteri, mɛ́:-kuru-li, kó:ro-ixteri	mɛ́ɛ́-kùrù-à	
fog	tsá, buīdi, buīri	tsá, bui:-di, bui:-ri	mɛ́ɛ́-kùrù-à	
wind	ui(d)nő̄no, ui̱'nő̄no	uin̥dnó:-no, ui͡ʔnó:-no	wḭ̀ʔnő-nǒ̀	~wido
sun	sé	sé	sṵ́ṵ́	
year	puido, kḛ́kḛma	pui-do, kʌ́kʌma	kǔ̀ʔmǎ́	
star	yapītx̱oaka, yapītx̱oa	japītx̱oa-ka, japītx̱o-a	n̥ǎ̀ʔpḭ́t͡ʃǒ̀ǎ̀	
earth/ground	ya(e)pá, ya(x)pá, ya(h)pá, ya'pá, di'tá	jaę̱pá, jax̱pá, jan̥pá, jaʔpá, diʔtá	dìʔtá	
mountain	tḛ́ke	té:-ke	thŭ́-kŭ́	
stone	tā́ka̱, tā́ka	tá:-kɔ, tá:-ka	tā́ǎ́-kǎ́	
salt	moá	moá	mő́ǎ́	
man (human?)	mḛ́no	mʌ́-no	mŭ́-nǒ	~ɨbɨ́
husband	manḛ́nę̰, yēmāné	manʌ́-nʌ, je:ma:-né	mā̃nŭ́-nǒ	
father	(n)dofʰkḭ́ro, mai	n̥dopʰkí:-ro, mai	pṵ̀hkṵ́-rò	pʰɨkɨ́
mother	(n)dofʰkő̄ro, yēpxkó	n̥dopʰkó:-ro, je:pxkó	phòhkó-rò~phùhkó-rò	
wife	nomő̄no, yēnāmó	nomó:-no, je:na:-mó	nā̃mő-nǒ	~dabo
child	nehḭ̄noka, yehḭ̄noka	nehí:-no-ka, jehí:-no-ka	w̃ḭ̀ʔā́-rì-rò	
dog	(n)diḛ̄ro, (n)diḛ̄do, dḛ́airo, diáido	n̥diḛ̄-ro, n̥diɛ́:-do, dḛ́ái-ro, diái-do	dìé-ró	
fish	uai	uai	w(v)àʔí	wa'i
snake	pinő̄no	pinó:-no	phĩ̀nő-nő	~aja
bird	minitx̱aka, minitx̱āka	minitxa-ka, minitxa:-ka	mḭ̃nḭ́t͡ʃǎ̀-kǎ̀	
egg	(n)diḗri, diḗri	n̥dié:-ri, diʌ́-ri	k̲hàpá-rí	die
tree	y(u)xḳ́ḳę̰, yuxḳ́gę̰	ju̱xkʌ́-kʌ, juxkʌ́-gʌ	jùhkṵ́-kṵ́	
bark	y(u)xḳ́kasaro, yuxḳ́gę̰ka'sāro	ju̱xkʌ́+kasa-ro, juxkʌ-gʌ+kaʔsa:-ro	kàʔsá-rí	
root	nę̰(e)kó, yuxḳ́gę̰neko	nʌę̰kó, juxkʌ́-gʌ+neko	nǔ̀ʔkő	~dɨ'ko
seed	yuxḳ́dea	juxkʌ́+dea	kàhpá	
fruit	tóaga, yuxḳ́dea	tóa-ga, juxkʌ́+dea	dìht͡ʃá	tʰoa
grass	tā́	tá:	tháá	tʰaa
1S	yeę̰	jeʌ́	jṵ̀ʔṵ́	jɨ'ɨ
2S	mę̰é	mʌé	mṵ̀ʔṵ́	

1P incl	māri	ma:ri	mə̀rə́	~baha ('people')
1P excl	.	.	sə́	
3P	tíkina	tíkina	tínə̀	
this	ő	ó:	õ	
that	tḯkinoaáre	tí:-kino-aá:re	sí-ró	
big	pḯro	pí:-ro	phíí-rò	
small	maánuka	maánu-ka	˜mə̀ʔnő-kə̀	
long	yoáńina	joá:-ni-na	yoa-ro	
wide	sáńina	sá:-ni-na	sáá-rò	
fat	sę(e)tinina	sɛę-ti-ni-na	séé	
thin	k(a)xkúalirokīro	kąxkúa-li-ro-ki:ro	sə́ə́-mə̀-nə̀-nə̀	
short	yauarő́ga(hira...)	ya-ua-ró:-ga(hira)	yò-érà-rò	
straight	p(a)xiő́tira(...)	pąxió:-ti-ra	pòhtó	
cold	yę̱xséáro	jʌxsé-á:-ro	jùhs-ú̱à-rò	jisi
warm	sḯro	sí:-ro	síphù-tì-rò	ahi
dry	uę̱ákaliro	uʌá:-ka-li-ro	wúá	
wet	sáliro	sá:liro	wáá-rí-rò	
rotten	báro	bá:-ro	báá-rò	
good	noáńina	noá:-ni-na	nő́ńnə̀	
bad	yáńina	já:-ni-na	n̩áá́-nə̀	
white	yę̱'sę̱a	jɛʔsɛ́-a	jèʔsé-rò	bo'ta
black	yḯ(g)ā	jí:ga: (/g/ is devoiced)	nḯḯ-rì-rò	~jii
dirty	uę̱xt̨ę̱, uę̱x̱tebenę̱nina	uɛxtɛ́, uɛxte+benʌ́-ni-na	wèhté	
red	soá́(g)ā	soá:-ga: (/g/ is devoiced)	sə̀ʔá́-nə̀	~so’a
green	ya'sága	jaʔsá:-ga	jáʔsá-rò	
yellow	ę̱uę̱	ɛuʌ́	èwú̱	
here	ő	ó:	ə̀-ḯ	
near	yę̱kaái	jʌkaá-i	khàʔá-kə̀	
there	soő́pę̱	soó:-pʌ	tó-ì	
to breathe	yehę́i̱risága	jehe͡i-ri-sá:-ga	yèhé-rí-nə́	
to burn	hę̱a	hʌ́a	ə̃hű	
to think	uaxkű́ga	uaxkú:-ga	.	
to eat	tx̱ę́ga	txʌ́-ga	chú̱	
to fall	bōdá̱ga	bo:dá:-ga	bòrá	
to fly	uę́ya	uʌ́-ja	w(v)ù̱ú̱	
to flow	mę̱(m)bę̱róara	mʌm̨bʌ-ró-a-ra	kóótḭə̀-nò	
to dig	saá̱ga	saá:-ga	sàʔá	
to hear	tę̱ő́ra, tę̱ő́da	tʌó:-ra, tʌó:-da	thù̱ʔó	
to cut	dę̱xt̨ę̱ra	dʌxtɛ́-:ra	khə́-tà	dite
to swim	bá̱(a)da, bá̱(a)ra	bá̱(a)da, bá̱(a)ra	bàá	
to see	yę́na	yʌ́-na	n̩ű	

to sing	baxsápe̱ro	baxsá-pɛ:-ro	bàhsá	
to sit	duhĺ́da, duxhĺ́ra	duhí:-da, duxhí:-ra	dùhí	duhi
to stand	duxkṵ́ga	duxkú:-ga	dùhkú	
to die	yaliāda	jalia:-da	jàríá (ia, diff mora)	
to drink	si'nī(g)a	siʔni:-ga (/g/ is devoiced)	sɨ̀ʔnɨ́	
to throw	doxkā́ga	doxká:-ga	.	
to pull	īeā́(m)buroxkaraga	i:eá:m̥buroxkara-ga	wàhá-kàʔà	

English	Wa'ikana			
	K-G	K-G	Stenzel	Chacon
tongue	manó	manó	ɲɛ̃ʔmɛ̃nɔ́	
lip	esērṓrodeka	esērṓrodeka	-	
tooth	uxpīri	uxpi:ri	ìhpídí, ìhpídíá	
nose	ekéa	ekéa	ɛ̃̀hkɛ̃́ã̀	
eye	yekaxpé̱a	yekaxpé̱a	káhpédíá	
ear	kamṓno	kamṓno	kã̀ʔmṓnɔ́	
head	daxpṵ́a	daxpṵ́a	dàhpúà	
hair	poā́li, pùā́li	poā́li, pùā́li	-	
hand	umu(x)ká	umu(x)ká	ɔ̃̀mɔ́kã́	
leg	yeχ̱kai	yeχ̱kai	dàpóká	
foot	napṓka	napṓka	dàʔpóká	
neck	uamā́a	uamā́a	w̃ã̀mṵ̃ã́	
belly	yeuxpā́ka	yeuxpā́ka	pàá	
skin	ka(x)sḗro	ka(x)sḗro	kàʔsádó	
bone	koā́	koā́	kɔ̃̀ʔã́	
blood	(n)dī̱i	(n)dī̱i	dɨ̌i	
heart	hĺ́riponā	hĺ́riponā	.	
water	axkó	axkó	àhkó	
river	parĺ́ma, pálima	parĺ́ma, pálima	dìá mã̀ã́, mã̀ã́ŋ̃ã	
fire	pexkā́ka	pexkā́ka	pèhkámɛ̃̀ɛ̃̀	

smoke	hōmę́	hōmę́	òméò	
ashes	ni(x̱)ti	ni(x̱)ti	nṵ̀hã̰	
sky	āema̋se(e), āemő̋se(e)	āema̋se(e), āemő̋se(e)	.	
cloud	axkő́ro	axkő́ro	ò̰ʔmḛ́òkùdù	
fog	hōmę̱akeé̱rone	hōmę̱akeé̱rone	bùédí	
wind	uį̱nő́no	uį̱nő́no	wḭ̀ʔnő́nò̰	
sun	axsé	axsé	àhsú	
year	axkónomere	axkónomere	kṵ̀ʔmã	
star	yapīkoa	yapīkoa	ɲã̰ʔpḭ́kã̰ã̰	
earth/ground	ditá	ditá	dìʔtá	
mountain	kę́mę̱	kę́mę̱	kṵ́kṵ́	
stone	axtã́ka	axtã́ka	ṵ̀htã̰	~kɨta
salt	.	.	mõ̰ã̰	
man (human?)	ę́mę̱no	ę́mę̱no	mà̰hsṵ́nò̰	
husband	.	.	mã̰nṵ́nò̰	
father	topaxkī́ro	topaxkī́ro	pàhkúdò	
mother	paxkő́ro	paxkő́ro	pàhkódò	
wife	.	.	nḭ̀hī́nò̰	
child	.	.	nḭ̀hī́nò̰	
dog	dīró	dīró	dìédó	
fish	huai	huai	wàʔí	
snake	pinōnó	pinōnó	pḭ̀nő́nő́	
bird	miniχ̱kę̱	miniχ̱kę̱	mĩnĩkhṵ̀	
egg	(n)diḗri	(n)diḗri	díé	
tree	y(i)uxkę́kę̱	y(i)uxkę́kę̱	jùkú	
bark	y(i)uxkę́kasēri	y(i)uxkę́kasēri	jùhkúkàʔsèdò	
root	nekő́li	nekő́li	nṵ̀ʔkő́	
seed	.	.	kàhpá	

fruit	y(i)uxkɛ́liteká	y(i)uxkɛ́liteká	jùsúànɰ̃ùjéédò	
grass	tāá	tāá	tàá	
1S	(n)yēɛ́	(n)yēɛ́	jù?ú	
2S	maɛ́	maɛ́	mɰ̃hsɑ̃	
1P incl	māli	māli	mɑ̃nɔ́~mɑ̃lɪ̃	
1P excl	.	.	ɰ̃hsɑ̃	
3P	tɪ́hireni	tɪ́hireni	tíkɪ̀nɑ̃ ~ tínɑ̃	
this	.	.	õ?õ	
that	.	.	síkídó ~ sídò	
big	paɻpolɪ́ka(nene)	paɻpolɪ́ka(nene)	pàhídò	pahi
small	paanoɑ́(nene)	paanoɑ́(nene)	mɛ̀?nɔ́	
long	yeuɑ́li(nene)	yeuɑ́li(nene)	jòájè	
wide	.	.	è?sádò	
fat	(n)dīipxɛ́nene	(n)dīipxɛ́nene	ù?sé	
thin	axkóalene	axkóalene	dì?imɑ̃rédìkìdò	
short	yeuɛ́ia(nene)	yeuɛ́ia(nene)	jòédó	
straight	(m)b(ɐ̨)xtópolɪ́kane	(m)b(ɐ̨)xtópolɪ́kane	phùtó	
cold	yixseapolɪ́ka(nene)	yixseapolɪ́ka(nene)	jù?súà	
warm	kaxsɪ́li(nene)	kaxsɪ́li(nene)	àhsí pùhsù	
dry	tsipīalene	tsipīalene	wùálìdò	
wet	kɔ́pxene	kɔ́pxene	wéédìdò	
rotten	abɑ́lene	abɑ́lene	à?bálìdò	
good	k(e)nɔ́are	k(e)nɔ́are	kɛ̀?nɔ́ɑ̃ɲɛ́	
bad	yeɑ́nine	yeɑ́nine	ɲɑ̃nɛ̀	
white	yeesɛ́ninani	yeesɛ́ninani	jè?sédò	
black	yɛ́nini	yɛ́nini	nɪ̃ɪ̃nɔ̃	
dirty	uextɐ̨puɐ́line	uextɐ̨puɐ́line	wèhtébuhu	
red	soapurɪ́kanini	soapurɪ́kanini	sɔ̀?ɑ̃nɔ̀	
green	ya(x)sɑ́ye	ya(x)sɑ́ye	jà?sájè	

yellow	tsoa̋ye	tsoa̋ye	èwúdó	
here	ōóx(n)de	ōóx(n)de	ɔ̃ʔɔ́	
near	.	.	kàʔáŋã̀	
there	soőpere	soőpere	sɔ̃ʔɔ́	
to breathe	hīritoa̋rone	hīritoa̋rone	hédíně	
to burn	uiχ̱iaį̱ya	uiχ̱iaį̱ya	ũ̃hã́	
to think	ōaxkɔ́ētere	ōaxkɔ́ētere	w̃ãhkṹ	
to eat	(e)saį̱kiáiina	(e)saį̱kiáiina	ìʔá, ìʔjá	
to fall	bōrákeare	bōrákeare	bòdákèà	
to fly	uę́are	uę́are	wúúkàʔà	
to flow	humā́kare	humā́kare	òhkótùhtùdò	
to dig	tseē̲ya	tseē̲ya	sèʔé	
to hear	tę̱aúre	tę̱aúre	tùʔó	
to cut	yiulēya	yiulēya	duhté, tàʔá	
to swim	bā̋penene, ku(x)sā́-	bā̋penene, ku(x)sā́-	báá	
to see	īyaį̱ye	īyaį̱ye	ĩ̃ã̀	
to sing	hiaōruxkuyá	hiaōruxkuyá	ùhsédó, mɛ̃̀ʔnã̀, bàhsá	
to sit	(n)duxhḯya	(n)duxhḯya	dùhí	
to stand	(n)duxkṹya	(n)duxkṹya	dùhkú	
to die	.	.	jàríá (ia, same mora)	
to drink	tsinīya	tsinīya	sĩ̀ʔnḯ	
to throw	(n)doxkɛ̃́iya	(n)doxkɛ̃́iya	dòhkéò	
to pull	uxę́aų̱ye	uxę́aų̱ye	wèhéà	

English	Desano PG72		
	K-G	Wilson Silva	Chacon
tongue	nę̱́riru	nɛ̃ɾũ	
lip	diχ̱sibero	-	

tooth	guhīkuli	uhkuɾiɾu	
nose	īninu	ĩŋĩɾũ	~i’gi
eye	kuīri	kuiɾu	
ear	gā'mīno	ŋãmĩɾõ	
head	dexp̋ṹru	dihpuɾu	
hair	póali	poaɾi	
hand	mohő́pama	mõhõtõ	
leg	-	gubuɾo	
foot	gub̋ṹpama	gubu	
neck	uę̃nű́(g)ō	ũŋũtuɾu	
belly	páru	paɾu	
skin	dīro	gahsiɾo	
bone	goá	ŋõã	~goa
blood	dī	di-	dii
heart	tsiúpona	sĩpõ	
water	dexkó	dehko	deko
river	diá	dia	dia
fire	pḗáme	peamẽ	
smoke	ōmú	mũɾũ	
ashes	nuxhoá	nũhã	
sky	ēmę̃tsi	ũmũsĩ	
cloud	imīkakuruli	ĩmĩkã	
fog	-	.	
wind	mīnu	mĩɾũ	~bidu
sun	ābé̋	bũ’ɪʔpu	
year	-	bohoɾi	
star	né̋yaxka	nẽʔkã	
earth/ground	nixkú	nĩhkũ	
mountain	elē̋	buɾu	
stone	ę̃xtā	ũhtãye	~ita
salt	.	mõã	
man (human?)	ę̃mę̃(g)é̋	ũmũŋũ	~ibi
husband	yégolopę̃, yégoropę̃	mãɾãpu	
father	yéę̃pę̃, yépę̃	pagu	pagi
mother	yéę̃po, yépo	pago	
wife	nomé̋	mãɾãpo	
child	maxī(g)é̋	mãhĩ	
dog	diaį̃yi	diaye	
fish	uai	wa’i	wa’i
snake	minimá̋(g)ēndiuli	pĩɾũ	~aja
bird	minimā(g)ē	mĩɾã	

egg	minimā́(g)ēndiuli	diú	
tree	yuxkᵩ́gᵩ	yʉhkʉgʉ	jukɨ
bark	yuxkᵩ́gaxisīro	gahsiɾo	
root	nū(g)(e)ā	nŭŋŭ	~dugu
seed	yuxkᵩdᵩxká	ye’e	
fruit	yuxkᵩdᵩxká	yʉhkʉduhka	
grass	dā́	Táá	taa
1S	yeᵩ́	yʉʔʉ	jɨ’ɨ
2S	mᵩé, meé	mŭʔŭ	
1P incl	mā̄li	mãɾĩ	
1P excl	.	gʉa	
3P	īná	ẽɾã	
this	iyᵩ̄	i	
that	.	sĩ	
big	uᵩalő́gelo	wʉa-	pahi
small	āmī(g)ī́(g)ā	ãmẽ-	
long	yuā́logᵩ̄	yoaɾi	
wide	ᵩ̄(e)yā́lo	eya-	
fat	uᵩagᵩ́ero	ʉye	
thin	gägúāmi	esebẽ’dɪ̃-	
short	yoā́bᵩ̄a	yoabiɾi (long-neg)	
straight	.	.	
cold	yeᵩ̄sā́nika	yʉhsa-	jɨsa
warm	axisīnika	dihsi	asi
dry	boxhoáa	bohoɾo	
wet	deᵩ̄kópakana	webo-	
rotten	boā́ya	boaɾi	
good	oā́pᵩ̄nīka, oā́pᵩ̄līka	wãʔã-	
bad	yᵩ̄pᵩ̄nīka, yᵩ̄pᵩ̄līka	ɲẽẽ-	
white	bōlᵩ́riyᵩ̄	boɾeɾi	bo(de)
black	nyīnimi	nĩŋŭ	~jii
dirty	gᵩláli	gʉɾaɾi	
red	dialiyᵩ̄	diáɾi	
green	ya(a)īsāli	yahsadiɾu	
yellow	bōlᵩ́	.	
here	iyᵩ̄	ãɾõ	
near	yᵩ́polo, yᵩ́poro	-poɾo	
there	tsōgᵩ́	sõ-	
to breathe	tsioaíni	.	

to burn	ehéaiyā(ni)	.	
to think	gūnyabirikā́(ni)	peʔpi-	
to eat	bā́li, bā́ri	baʼa-	
to fall	yūlikā(ni)	yuɾi	
to fly	ueli	wʉʔʉ-	
to flow	oxhoamī(ni)	.	
to dig	tsé̱āli	puɾi-	
to hear	pē̱ri	peʔe	
to cut	tápe̱ri	tabe	
to swim	bā́li	.	
to see	īyāli	ɲãʔã	
to sing	bā́yā́li	bayá-	
to sit	doā́li	doʔá	
to stand	nī(g)īni	nʉ̃ŋʉ̃-	
to die	tsīnini	sĩɾĩ-	
to drink	īriri, ī(e)riri	iɾi	
to throw	be̱ó̱li	kõã-	
to pull	tāláuo̱li	taɾa-	

English	Tukano		
	K-G	Betty Welch	Chacon
tongue	igmeno	ɲɛ̃ʔmɛ̃ɾ̃ ðʰ	~jebe
lip	upper lip: sepīm, isému lower lip: séka	-	
tooth	opirl	upíka	upi
nose	enkēn	ẽʔkẽã	~e'ke
eye	ome̱pado, kaxpéa	kapéa	
ear	ame̱peró	õʔbẽpero	
head	depoá	dɨpóa	
hair	poali	poári	
hand	amōpamō	õbõkã	
leg	mi̱xkanga, dipodiá	dɨʔpókã	
foot	depopamá	dɨʔpókã	
neck	uhamotá	wãbɨ̃ta	
belly	inénye, timana, pā	pá̱ága	
skin	ani, kaise̱ró	kaséro	
bone	auá, oá	õʔã	~oʼa
blood	dī	díí	dii
heart	heriponá	.	
water	akó	okó, akó	oko
river	diá	diá	dia

fire	pekame	pekábẽʔẽ	
smoke	omẹ̲a	õʔbẽ́	
ashes	pekánohá	dl̃hã	
sky	imuitsé	ɨ̃ʔbɨ̃sé	
cloud	huipó	õʔbẽkuruá	
fog	níano	õʔbẽ́duhise	
wind	īmano	wɪ̃ʔrõ	~widu
sun	moipo, muhuipó	bũhɪ̃pũ	
year	köemá, köamá	˜kɨ bà	
star	miakōa (big), bōléká (small)	jõkõã́wɨ̃	
earth/ground	nokukua	diʔtá	
mountain	uaná	ɨ̃rɨ̃gɨ̃	
stone	ixtaia	ɨ̃tã	~ɨta
salt	.	bõã	
man (human?)	uamá, ömé	ɨ̃bɨ̃	~ɨbɨ
husband	manpui, ponakü	bãrãpɨ́	
father	paxkü	pakɨ́	pakɨ
mother	yépaxkó	pakó	
wife	nemó	dɨ̃bõ	~dɨbo
child	kimaxkó	wɪ̃ʔbãgɨ̃́	
dog	diaiyü	diáji	
fish	waii	waʔí	wa’i
snake	pinó	ãjã́	~aja
bird	munika, mokopi	bɪ̃rɪ̃kɨ̃́	
egg	diīri	dié	die
tree	aui, yuxküpaiki	jukɨ́	jukɨ
bark	kaséde	kaséro	
root	auxtesé	dɨ̃ʔkṍrĩ	~dɨ’ko
seed	auli	otesé	
fruit	.	jukɨdiká	toa
grass	.	táá	taa
1S	yüixẹ̲, yiō	jɨʔɨ́	jɨ’ɨ
2S	māax, maẹ̲	˜bɨ̈ɨ̈ hà=˜bɨ ã́	
1P incl	manipuanam, manitanihi	ɨ̃sã	
1P excl	.	bãŕɨ́	
3P	.	dã	
this	anitaninẹ̲	aʔtí ~ aʔtó	
that	séi	in /sí/ ani /sɪ̃ʔɪ̃/́	
big	paxiró	pahigɨ́	
small	kanuagá	kãʔrõãkã	
long	eyóado, youktiáka	joaseˊ	

wide	esaro, e̯xtsautiáka	eʔsaróʰ	
fat	leitiyu, diu̯xkiru	ɨʔsé	
thin	deimani, úān	ɨsebɛ̃rɪ̃ˊse	
short		joátiro	
straight	diakinó	diakʰɨ́	
cold	diyiχ̣siani, niχ̣tseró	jɨsɨáse	jɨsɨa
warm	axsiniga, axtsiró	asisé	
dry	boxpoapū	boposé	
wet	aboxpoigindiaba	puusé	
rotten	.	boasé	
good	aiyūni	ãjũsé	
bad	miámimi, mianū	jãʔãsé	
white	buxtigi, buxtiró	butisé	bu(ti)
black	niingī, diīnró	jɪ̃ɪ̃sé	~jii
dirty	uinimbrī	ũʔɪ̃ɾɪ	
red	soansé, soanó	sõʔãsé	~soʼa
green	uimasé, igatsarima	jaʔsasé	
yellow	yatsasé, buxtiró	sɨ ɾí-rì-sè, bòdéá-rì...	
here	ató	aʔtó	
near	yuauré, atoáka	pɨʔtó	
there	isoapu	sõʔõ	
to breathe	heditalyo, herikosá	ehéribɪ̃se	
to burn	.	ɨ̃hɨ̃ˊpehase	
to think	.	wãkũsé	
to eat	baya, báatse̯	baʔasé	
to fall	muiriró	bɨ ɾɨ keʔase	
to fly	uiyū	wɨɨsé	
to flow	akostoadu, akostaró	õʔbãbɨrɨse	
to dig	.	seʔesé	
to hear	teaiya, teroti	tɨʔosé	
to cut	.	dɨtesé	
to swim	.	baapése	
to see	.	ɪ̃ʔãsé	
to sing	batsatsé	basasé	
to sit	doxia, duxitse̯	duhisé	duhi
to stand	nyakapi	dũʔkũsé	
to die	.	wɛ̃rɪ̃sé	
to drink	senia, senitsé	sɪ̃ʔrɪ̃sé	
to throw	kaingá, doxke̯tse̯	dokéose	
to pull	buxe̯yá	wehéose	

English	Tuyuka		
	K-G	Terrell Malone	Chacon
tongue	yeméno	ɲẽ’mɛɾ̃õʰ	
lip	e̥xsérobeto	.	
tooth	uxp̆i	u’pii	
nose	ex̥kéa	ẽ’kẽã	
eye	kaxp̆éa	ka’pea	
ear	kam̋o̥p̆ero	kãbõ’pero	
head	dexp̆ú(u)	du’pua, dɨ’poa	
hair	p̆oa	.	
hand	uamóp̆ama	wã’bõpãbã	
leg	nix̥ká, (n)yexkáˊ	jɪ̃’kãã	
foot	de(x̥)p̆o̥p̆ama	dɨ’poo	
neck	uámea	wã’bɨ̃ã	
belly	p̆a̋ga	’paaga	
skin	kaxseró	kase’ro	
bone	koá	kõ’ã	
blood	(n)dī, dī(i)	’dii	
heart	yɛ́reo̥p̆ona	.	
water	oxkó	o’ko	
river	(n)dia	’dia	
fire	p̆ex̥kámene	pe’kabe	
smoke	omé	ũ’be	
ashes	huá	dũ’ã	
sky	émese	ɨ̃’bɨ̃kasero	
cloud	oxkókuruli	ũbẽbɨrɨ’a	
fog	omé	ũ’be	
wind	uinó	dɨ̃’bõ, wɪ̃’dõ	
sun	muhīp̆u	abe	
year	ke̥má, tx̥ix̥ka̋ke̥ma	kɨ̃’bã	
star	yaxkoá	jõkõãwɨ̃ʱ	
earth/ground	ditá	di’ta	
mountain	e̥xtá€	ɨ̃ɾ̃ɨ̃’gɨ	
stone	extáˊ(a)	ɨ̃’tã	
salt	.	’bõã	
man (human?)	e̥mé̥	ɨ̃’bɨ	
husband	yémane	bã’dɨ	
father	paxke̥	pa’kɨ	
mother	paxkó	pa’ko	

wife	yénemo	dɨ̃bõ	
child	uḗmae	wɪ̃ʼbãgɨ	
dog	(n)díeyi	ʼdiaji	
fish	uai	waʼi	
snake	pinó	ãʼjã	
bird	minimaxké	bɪ̃dɪ̃bãʼkɨ	
egg	(n)die	dɪ́je	
tree	yuxkę́kę	juʼkɨ	
bark	yuxkę́(kę)kaxsero	kaseʼro	
root	yuxkę́(kę)nexko	dɨ̃kõ	
seed	yuxkę́(kę)dexka	-pe	
fruit	vuxkę́(kę)dexka	juʼkɨdɨka	
grass	tā́	´taa	
1S	yę́	jɨʼɨ	
2S	mę́	ʼbɨ̃ã	
1P incl	māli, maliya, māli-	ɨ̃sã	
1P excl	??	bãʼdɪ	
3P	kę́a	ʼkɨ̃ã	
this	ánomania	aʼti-	
that	iní	ʻi-	
big	p̆ę̆iriuika	pai-	
small	p̆ę́didi̯e	ʼpee-gã	
long	yoā́liui̯	joʼa	
wide	exs̆ā́roga	eʼsa-	
fat	diī́p̆(a)xkagę	ɨʼse	
thin	kāleṕtiuālike	dimãrĩ-	
short	axkā́(g)ē(g)ā	joʼe	
straight	diā́maxke	diabãʼkɨ	
cold	vex̆(t)seā́nī(g)a	jɨsiʼa	
warm	ax(i)seā́nī(g)a	aʼsi	
dry	boxp̆ṓlo	boʼpo	
wet	púkoa(d)yę	ʼpuu	
rotten	bóakoa(d)yę	ʼboa-	
good	ādyū́na, āyū(g)ē, hḗ-	aʼju	
bad	yayánia	jãjã-	
white	buxiī́re	buti	
black	(n)yī́ne	ʼjɪ̃ɪ̃-	
dirty	hoēni	hũɪ̃rɪ	
red	tsoā́le	sõã-	
green	tsiméne	sɨ̃bẽ-	

yellow	euá	e’wɨ	
here	anó	ã’dõ	
near	y(e)ɛ̌p̌(e)to	pɨ’togã	
there	ő p̌e̯	hõ’õ	
to breathe	yɛ́risā(g)a	je’erisã	
to burn	tsóai̯ya	hɨ̃’ɨ	
to think	uaxkóime	wã’ku	
to eat	yā́lige	já’a	
to fall	yā́lige	jã’ã	
to fly	ué̯lige	wɨ’ɨ	
to flow	k(e)xtúai̯i	.	
to dig	(t)sɛ́rige	koa	
to hear	teólige	tɨo	
to cut	pálige	’taa	
to swim	bā́lige	’báape	
to see	iyálige	ɪ̃’jã, ɨ̃’jã	
to sing	baxsálige	ba’as	
to sit	baxsálige	du’i	
to stand	noxkúlige	dũ’ku	
to die	diáko(a)i	di’áhõã	
to drink	tšīnirige	sɪ̃’dɪ	
to throw	koákoalige	’deeko	
to pull	uɛ́koi̯ya, uɛ́koya	we’e	

Appendix B

Changes from a Target Vowel

Kotiria	**K-G: IPA**	**Stenzel**	**/i/**	**/e/**	**/ʉ/**	**/u/**	**/o/**	**/a/**	**none**
			0	**10**	**1**	**2**	**2**	**2**	**2**
lip	dexsé-rɔ, dʌxsé:-ro	dihse-be'ru		e--> i/d_hse					
hand	uamó:+muχka, uamó:+pama	wə̃mű-ka̋					o-->u/_]		
leg	dẹχsó, jextxé:ke	ɲű͡ʧű-kʉ		???					
fire	pxtxá-ka, pxtxá:-ka	phìt͡ʃá-ká							none --> i/ph_t͡ʃ
ashes	nuhá, nʊxhá	nı̀htı́				u --> i/n_h			
sky	mɛ́:-se, mɛ́:-sɛ	mű̋ă-nő		ɛ́-->ű/_]					
sun	sé	súʉ́		e--> ű/_#					
mountain	té:-ke	thű-kű		e--> ű/_] and #					
father	ndo-pʰkí:-ro, mai	pʉ̀hkʉ́-rò		???					
mother	ndo-pʰkó:-ro, je:pxkó	phòhkó-rò~phùhkó-rò							none-->u/ph_hk
wife	nomó:-no, je:na:-mó	nə̃mő-nő					o--> a/n_m oo		
child	nehí:-no-ka, jehí:-no-ka	nihi-no-ka LHL		e-->i/n_h					
1S	jeʌ́	jʉʔʉ́		e--> ʉ/_ʉ					
2S	mʌé	mʉ̀ʔʉ́		e--> ʉ/ʉ_					
small	maánu-ka	˜mə̃ʔnő-kə̀				u-->o/_]			
short	yaua-ró:-ga(hira)	yò(a)-érà-rò						au-->o/_ (root)	
straight	pąxió:-ti-ra	pòhtó						a-->o/p_ht	
cold	jʌxsé-á:-ro	jʉ̀hsʉ́-à-rò		e--> ʉ/_]					
to burn	hʌ́-a	h̃ű*			ú-->u/_]				
Wa'ikhana	**K-G**	**Stenzel**	**/i/**	**/e/**	**/ʉ/**	**/u/**	**/o/**	**/a/**	**none**

			4	**8**	**0**	**5**	**3**	**5**	**0**
tongue	manó	n̥ḗʔmḗ-nṓ						a-->e/m_n (o)	
tooth	uxpiː-ri	ìhpí-dí, ìhpí-dí-á				u-->i/#_hp (ii)			
hand	umu(x)-ká	ɔ̀̃mṓ-kā́				u-->o/#_, m_]			
neck	uamā́-a	w̃ɐ̀̃mṵ̄-ɐ̀̃						a-->ṵ̄/m_] (a_)	
skin	ka(x)sḗ-ro	kàʔsá-dó		e-->a/as_]					
cloud	axkṓro	ɔ̃̀ʔmḗò+kùdù					o-->u/(k_d) (d_#)		
sun	axsé	àhsʉ́		e-->ʉ/hs_# (a_)					
star	yapīkoa	n̥ɐ̀̃ʔpḯkɐ̀̃ɐ̀̃					o-->a/k_a		
mountain	kẹ́mẹ	kṵ́kṵ́							
stone	axtā́-ka	ɯ̃̀htā́						a-->ɯ̃/#_hta	
father	to-paxkī́-ro	pàhkʉ́-dò	i-->ʉ/ahk_]						
bird	miniɨ̂xkẹ	mĩnĩkhɯ̃̀		ẹ-->ɯ̃̀/k_#					
tree	y(i)uxkẹ́-kẹ	jùkʉ́		ẹ-->ʉ/k_]					
bark	y(i)uxkẹ́+kasē-ri	jùhkʉ́+kàʔsè-dò		ẹ-->ʉ/k_]					
root	nekṓ-li	nɯ̃̀ʔkṓ		ẹ-->ʉ/n_ʔk					
fruit	y(i)uxkḗ+li-teká	jùsʉ́+àŋɯ̃̀jéédò							
1S	(n)yēḛ́	jùʔʉ́		(e-->ʉ/j_ʔ)ẹ-->ʉ/ʔ_#					
1P incl	māli	mɐ̃̀nṓ~mɐ̀̃lḯ	i-->o/l_#						
small	paa-no-ā́(nene)	mɛ̀̃ʔnṓ						a-->e/m_ʔ	
long	yeuā́-li(nene)	jòá-jè				u-->o/j_a			
short	yeuḗia(nene)	jòédó				u-->o/j_e			
straight	(m)b(ẹ)xtó-po-lḯ-ka-ne	phùtó							

cold	yixsea-po-lí-ka(nene)	jù?súà	(i-->ù/j_?)	(e-->ù/s_a)					
yellow	tsoǻ-ye	èwú-dó							
to breathe	hīri+toǻ-ro-ne	hédí-nḗ	i-->e/h_d						
to burn	uiχia-i̯ya	ù̃hǻ				u-->ù̃/#_(aspir)			
to think	ōaxkṓē-te-re	w̃ə̀hkṹ					oe-->u/k_]		
to fly	uę́a-re	wúú-kà?à						a-->u/w_]	
to hear	tę́aú-re	tù?ó							

Changes toward a Target Vowel

Kotiria	**K-G: IPA**	**Stenzel**	**/i/**	**/e/**	**/ɯ/**	**/u/**	**/o/**	**/a/**
			3	**2**	**8**	**3**	**3**	**1**
lip	dexsé-rɔ, dʌxsé:-ro	dihse-be'ru	e--> i/d_hse					
hand	uamó:+muχka, uamó:+pama	wə̀mṹ-kǻ				o-->u/_]		
leg	dę̥χsó, jextxé:ke	n̥ṹt͡ʃṹ-kɯ			???			
fire	pxtxá-ka, pxtxá:-ka	phìt͡ʃǻ-ká	none --> i/ph_t͡ʃ					
ashes	nuhá, nʊxhá	nì̃htḯ	u --> i/n_h					
sky	mɛ́:-se, mɛ́:-sɛ	mṹǻ-nṓ			ɛ́--> ṹ/_]			
sun	sé	súú			e--> ṹ/_#			
mountain	té:-ke	thṹ-kṹ			e--> ṹ/_] and #			
father	n̥do-pʰkí:-ro, mai	pɯ̀hkɯ́-rò			???			
mother	n̥do-pʰkó:-ro, je:pxkó	phòhkó-rò~phùhkó-rò				none-->u/ph_hk		

wife	nomó:-no, je:na:-mó	nə̃mə́-nə̀						o--> a/n_m oo
child	nehí:-no-ka, jehí:-no-ka	nihi-no-ka LHL	e--> i/n_h					
1S	jeʌ́	jʉ̀ʔʉ́			e--> ʉ/_ʉ			
2S	mʌé	mʉ̀ʔʉ́			e--> ʉ/ʉ_			
small	maánu-ka	˜mə̃ʔnə́-kə̃					u--> o/_]	
short	yaua-ró:-ga(hira)	yò(a)-érà-rò					au--> o/_ (root)	
straight	pąxió:-ti-ra	pòhtó					a--> o/p_ht	
cold	jʌxsé-á:-ro	jʉ̀hsʉ́-à-rò			e--> ʉ/_]			
to burn	hʌ́-a	ĥű				ú-->u/_]		

Wa'ikhana	**K-G**	**Stenzel**	**/i/**	**/e/**	**/ʉ/**	**/u/**	**/o/**	**/a/**
			1	**3**	**12**	**3**	**4**	**2**
tongue	manó	ɲḗʔmḗ-nə́		a--> e/ m_n (o)				
tooth	uxpi:-ri	ìhpí-dí, ìhpí-dí-á	u--> i/#_hp (ii)					
hand	umu(x)-ká	ə̀mə́-kə́					u--> o/#_, m_]	
neck	uamə́-a	w̃ə̀mʉ́-ə̀			a--> ʉ́/m_] (a_)			
skin	ka(x)sḗ-ro	kàʔsá-dó						e--> a/as_]
cloud	axkə́ro	ə̀ʔmḗò+kùdù				o--> u/(k_d)(d_#)		

sun	axsé	àhsʉ́			e-- >ʉ/hs_ # (a_)			
star	yapīkoa	n̰ã̀ʔpḯkã̀ã̀						o-- >a/k_a
mountain	kẹ́mẹ	kʉ̃́kʉ̃́						
stone	axtā́-ka	ʉ̃̀htã́			a-- >ʉ̃/#_hta			
father	to-paxkī́-ro	pàhkʉ́-dò			i-- >ʉ/ahk_]			
bird	miniχkẹ	mĩ̀nĩ̀khʉ̃̀			ẹ-- >ʉ̃̀/k_#			
tree	y(i)uxkẹ́-kẹ	jùkʉ́			ẹ-- >ʉ/k_]			
bark	y(i)uxkẹ́+kasē-ri	jùhkʉ́+kàʔsè-dò			ẹ-- >ʉ/k_]			
root	nekṍ-li	nʉ̃̀ʔkṍ			ẹ-- >ʉ/n_ʔk			
fruit	y(i)uxkḗ+li-teká	jùsʉ́+àŋʉ̃̀jéédò						
1S	(n)yēẹ́	jùʔʉ́			(e-->ʉ/j_ʔ)ẹ-->ʉ/ʔ_#			
1P incl	māli	mã̀nṍ~mã̀lḭ́					i-->o/l_#	
small	paa-no-á(nene)	mɛ̀ʔnṍ		a-->e/m_ʔ				
long	yeuā́-li(nene)	jòá-jè					u-->o/j_a	
short	yeuḗia(nene)	jòédó					u-->o/j_e	
straight	(m)b(ẹ)xtó-po-lḭ́-ka-ne	phùtó				Ø-->u/(aspir)_t		
cold	yixsea-po-lḭ́-ka(nene)	jùʔsʉ́à			(i-->ù/j_ʔ)(e-->ù/s_a)			
yellow	tsoā́-ye	èwʉ́-dó						
to breathe	hīri+toā́-ro-ne	hédí-nḗ		i-->e/h_d				

to burn	uixia-iya	ù̃h̃á			u-- >ù̃/#_(aspir)			
to think	ōaxkṓē-te-re	w̃ãhkṹ				oe-- >u/k_]		
to fly	uẹ́a-re	wúú-kàʔà			a-- >u̇/w_]			
to hear	tẹaú-re	tùʔó						