

## 0. Introduction

Mundari (Mandari, Chir, Kir; ethnologue code [mq]) is an Eastern Nilotic, Eastern Sudanic, Nilo-Saharan language. It is related to Bari, Kuku, and Kakwa. These have a mutual-intelligibility percentage with Mundari high enough to be considered by some to be dialects of the same language. The Ethnologue lists the lexical similarity of Mundari to be 71% with Bari, 66% with Kuku, and 61% with Kakwa (Lewis et al. 2013). There may be approximately 70,000 speakers of Mundari who live on both sides of the Nile in Terakeka county, north of Juba in South Sudan.

This paper describes phonological features of Mundari<sup>1</sup>, with special emphasis on [ATR] vowel harmony and [-ATR] mid vowels that are raised to [+ATR] high vowels through [+ATR] spreading. The analysis is based on about 1500 words collected in grammar awareness workshops in Juba, South Sudan. The workshops were conducted in May 2012 and May 2013 for Mundari speakers from Tarakeka. Although all words were checked for vowel quality, only approximately 200 nouns and 100 verbs were checked for tone by comparison and contrast. Thus, the tone of some of the words in this paper was not elicited, and as a result is left unmarked. For a complete list of words, see the *Mundari Dictionary* (Wani and Goke 2013).

I first discuss consonant and vowel phonemes, showing contrastive pairs and their distribution in sections 1-2. I discuss syllable structure and interpretation of ambiguous segments in 3. After describing some tone features in 4, I discuss various morphological processes in 5-8, the most extensive of which is [ATR] harmony in 8. Throughout these sections, comparisons are made between the related languages Bari, Kuku, and Kakwa and Mundari—particularly regarding vowel harmony. The related languages help to explain how Mundari may have arrived at various pairs of affixes which can synchronically be analyzed as being morphologically distinct. Finally in 9, I compare [-ATR] mid vowel raising in Mundari with that of Laru and Fur—the only other languages where it has been documented so far.

## 1. Consonants

The 19 consonant phonemes of Table 1 are found in Mundari.

Table 1: Consonant phonemes

	Labial	Alveolar	Palatal	Velar	Glottal
Voiceless plosives	p	t		k	ʔ
Voiced plosives	b	d	ɟ	g	
Implosive		ɗ			
Fricative		s			
Nasals	m	n	ɲ	ŋ	
Approximants	w	r, l	y		
Implosive approximant			ɸ		

The symbol /y/ is used for the palatal approximant instead of the IPA /j/ so as to be more easily seen in the data in contrast with /ɟ/. The symbol /ɸ/ is used for the palatal implosive approximant as there is no IPA or non-IPA symbol available for this unique phoneme.

In Table 2, Mundari phonemes are shown in comparison with those of the related languages Bari, Kuku, and Kakwa. Unlike the other three languages, Mundari does not have a labial implosive /ɸ/. Nor does it have any labial-velars, such as /g<sup>w</sup>/ as in Bari, or /kp/, /gb/, /ŋm/ as in Kuku and Kakwa. It has no retroflex plosives /ɬ/, /ɗ/ or prenasalized plosives /<sup>m</sup>b/, /<sup>n</sup>d/, /<sup>n</sup>d/, /<sup>n</sup>g/, /<sup>m</sup>gb/ as in

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Kakwa. As in all three other languages, Mundari has no voiceless palatal plosive that pairs with the voiced palatal plosive /ʃ/.

Table 2: Consonant phoneme comparison in related languages

	Mundari	Bari (Hollman 1992)	Kuku (Cohen 2000)	Kakwa (Onziga and Gilley 2012)
Voicelss plosives	p t  k ʔ	p t  k ʔ	p t  k kp ʔ	p t t̥ k kp
Voiced plosives	b d  ʃ g	b d  ʃ g g <sup>w</sup>	b d  ʃ g gb	b d d̥ g gb
Implosives	ɗ	ɓ ɗ	ɓ ɗ	ɓ ɗ ɗ̥
Prenasalized plosives				<sup>m</sup> b <sup>n</sup> d <sup>n</sup> d̥ <sup>ŋ</sup> g <sup>ŋm</sup> gb
Fricative	s	s	s	s
Nasals	m n ɲ ŋ	m n ɲ ŋ	m n ɲ ŋ ŋm	m n ɲ ŋ ŋm
Approximants	l r w y	l r w y	l r w y	l r w y
Palatal implosive approximant	f	f	ʔy <sup>3</sup>	

### 1.1 Consonant distribution

All of the words of (1) are analyzed to be monomorphemic in that they cannot reasonably be divided into two or more attested roots or affixes found in the data. The data show that all Mundari consonants can occur word-initially and intervocally, except the glottal plosive /ʔ/ which only occurs intervocally<sup>4</sup>. Nasals and the approximant /r/ surface word-finally, but not the lateral approximant /l/. The voiceless plosives /p/, /t/, /k/ and the fricative /s/ occur word-finally in

<sup>2</sup> Kakwa (Onziga and Gilley 2012:1) is analyzed to have a palatal implosive /ʃ/ and not a palatal implosive approximant as in Mundari and Bari.

<sup>3</sup> Kuku (Cohen 2000:5) is analyzed to have a glottal palatal glide /ʔy/ and not a palatal implosive approximant as in Mundari and Bari.

<sup>4</sup> There is no phonetic contrast between a word-initial glottal and a word-initial vowel, or a phonetic contrast between a word-final glottal and a word-final vowel. As discussed in section 7, a glottal is inserted between the root-final and suffix-initial vowels in *mɪŋɛ/mɪŋɛ-ʔat* ‘deaf person/deaf persons’, whereas the root-final vowel becomes an on-glide of the suffix syllable in *ʃamɛ/ʃam-ʔat* ‘word/words’. Thus, there is no firm evidence for root-final glottals. Rather, I analyze the glottal to be inserted between vowels when some morphemes are joined.

underlying form, but in such position, surface as voiced unreleased plosives. They are analyzed as voiceless in the underlying form since they surface as voiceless when a vowel-initial suffix is added. For example, in /g<sup>u</sup>ék/ [g<sup>u</sup>ég<sup>u</sup>] ‘raven’, the root-final underlying /k/ surfaces as unreleased [g<sup>u</sup>], but in /g<sup>u</sup>ékàn/ [g<sup>u</sup>ékàn] ‘ravens’ with plural suffix –an, the same underlying /k/ surfaces intervocalically as [k]. Similarly, the root-final underlying /p/ surfaces as unreleased [b<sup>u</sup>], but underlying /p/ surfaces intervocalically as [f] in /ɲédépàn/ [ɲédéfàn] ‘tongues’, which is just how /p/ surfaces in the root kóbò [kófò] ‘cup’. The alveolar fricative /s/ does not occur word-finally in nouns, either in underlying or surface form. In verbs, an underlying final /s/ surfaces as the voiced unreleased palatal plosive [ʃ<sup>u</sup>]. In this way among others, the alveolar voiced plosive /s/ is treated as the phonological voiceless pair of the voiced palatal plosive /ʃ/.

(1)	Word-initial	Intervocalic	Word-final
<b>p</b>	pèrì ‘bed’	kópò [kófò] ‘cup’	ɲédép [ɲédéb <sup>u</sup> ] ‘tongue’
<b>t</b>	tókót ‘field’	lúték ‘roof’	d <sup>u</sup> ət [d <sup>u</sup> əd <sup>u</sup> ] ‘bull’
<b>s</b>	sòŋ ‘water’	ùsùr ‘tax’	tós [tój <sup>u</sup> ] ‘picked’
<b>k</b>	kàdí ‘house’	sòkàrè ‘otter’	g <sup>u</sup> ék [g <sup>u</sup> ég <sup>u</sup> ] ‘raven’
<b>ʔ</b>		kúʔú ‘shield’	
<b>b</b>	bóyì ‘net’	róbé ‘sorcerer’	
<b>d</b>	dílí ‘hole’	kùdú ‘rain’	
<b>j</b>	jàkó ‘animal’	míjì ‘mouse’	
<b>g</b>	gélé ‘shoulder’	mógór ‘hunger’	
<b>ɖ</b>	ɖúŋít ‘herd’	dúɖé ‘cloud’	
<b>m</b>	méré ‘mountain’	gùmót ‘wind’	ɲom ‘face’
<b>n</b>	nukuanit ‘rope’	kíné ‘goat’	kàyìn ‘hand’
<b>ɲ</b>	ɲúrút ‘food’	mèréɲè ‘grandfather’	gúrèɲ ‘cat’
<b>ŋ</b>	ŋǎ <sup>u</sup> ŋ ‘hyena’	búŋó ‘flock’	àlàn ‘salt’
<b>l</b>	líŋgò ‘fox’	búlòk ‘crowd’	
<b>r</b>	riŋít ‘power’	kírèŋ ‘cow’	júr ‘village’
<b>w</b>	wálé ‘knife’	ɔwa ‘wedding’	
<b>y</b>	yápá ‘moon’	kóyí ‘road’	
<b>f</b>	fə ‘visit’	lɔɲufom ‘heel’	

In the singular noun *k<sup>u</sup>éré* ‘Tamarind tree’, the root-final /l/ does not surface as it does in the plural *k<sup>u</sup>érèl-át*, where –at is a common plural suffix and –lat is unattested as a suffix. Thus, it is analyzed that a constraint such as (2) prohibits word-final [l] from surfacing.

(2) Word-final constraint

The lateral approximant /l/ does not surface word-finally.

In Kuku, where there is a phonetic contrast between word-final vowels and word-final glottals (*ké* ‘guess’, *kéʔ* ‘fry’), a syllable-final /l/ surfaces as /ʔ/ (*gbíríʔ/gbírí-l-à* ‘spine/spines’) (Cohen 2000:22-23). Since Mundari has no phonetic contrast between word-final vowels and word-final glottals, and since Mundari does not have root-medial consonant codas, there is no apparent alternation of /l/ with /ʔ/. In Kakwa, there is no glottal phoneme and no consonant codas (Onziga and Gilley 2012).

1.2 Consonant contrasts

The words with contrastive pairs of consonants in (3) show that each of the consonants are phonemes. All words are monomorphemic unless they contain a hyphen to indicate a morpheme boundary.

(3)	<b>p – b</b>	par ‘coffin’	<b>bár</b> ‘flood’
	<b>b – m</b>	bar ‘flood’	<b>mâr</b> ‘chief’
	<b>b – w</b>	bər ‘buy’	<b>wər</b> ‘survey, look, ride’
	<b>m – w</b>	múrí ‘mosquito’	<b>wúrí</b> ‘warthog, pig’

<b>t – d</b>	tək	‘cut, slash’	<b>dək</b>	‘wrap’
<b>t – s</b>	túk	‘tell, relay (message)’	suk	‘gather, collect (grain)’
<b>d – d̥</b>	duk	‘push, sell’	<b>ɗuk</b>	‘lift up, build’
<b>d – n</b>	dək	‘wrap’	<b>nək</b>	‘burn, dry (leaves)’
<b>d – r</b>	ɗɪp	‘cook’	ɾɪp	‘put together, sew’
<b>d – l</b>	ɗuru	‘grass’	lùrù	‘mist’
<b>d̥ – n</b>	ɗu	‘fall, result’	<b>nək</b>	‘bury’
<b>d̥ – r</b>	ɗe	‘hide, keep, store’	re	‘sweep, spread’
<b>d̥ – l</b>	ɗók	‘carry, lift, bring’	lók	‘catch, fish’
<b>n – r</b>	nək	‘bury’	rùk	‘answer, reply’
<b>n – l</b>	nək	‘burn, dry (leaves)’	lók	‘catch, fish’
<b>r – l</b>	kírɛŋ	‘cow’	kílɛŋ	‘small furry animal’
<b>ɟ – ɲ</b>	ɟɔla	‘extend (hair braids)’	<b>ɲɔla</b>	‘dig, scrape surface’
<b>ɟ – y</b>	ɟik	‘pull, lead’	yik	‘bury’
<b>ɟ – f</b>	ɟam-et	‘word-VN’	ɟal-et	‘credit, loan-VN’
<b>ɲ – y</b>	ɲár	‘love, want’	yar	‘prepare, make, label’
<b>y – f</b>	ya	‘take (produce) to market’	fa	‘add, increase, cause’
<b>k – g</b>	kɛlɛ	‘tooth’	gɛlɛ	‘shoulder’
<b>g – ŋ</b>	gək	‘prevent, hinder, stop’	ŋək	‘mark, cut (tree, field)’
<b>g – w</b>	gɔr	‘war, insurrection’	wór	‘stream’
<b>ŋ – w</b>	ŋək	‘mark, cut (tree, field)’	wòk	‘beat’
<b>s – ʃ</b>	suk	‘comfort’	ʃú	‘advise’
<b>m – n</b>	mòk	‘catch, hold, arrest’	nək	‘burn, dry (leaves)’
<b>n – ɲ</b>	nək	‘nurse, suck’	<b>ɲək</b>	‘explain, report, repeat’
<b>n – ŋ</b>	nək	‘burn, dry (leaves)’	ŋək	‘mark, cut (tree, field)’
<b>ɲ – ŋ</b>	ɲŋ	‘be quick’	ŋŋ	‘be in agony, suffer’
<b>p – ʔ</b>	kàpɛ [kàfɛ]	‘yeast’	ɟáʔɛ	‘rainy season’
<b>t – ʔ</b>	máráte	‘somebody’	ɟáʔɛ	‘rainy season’
<b>k – ʔ</b>	sòkàrɛ	‘otter’	kɔʔane	‘priest’
<b>s – ʔ</b>	ùsúr	‘tax’	kúʔú	‘shield’
<b>d̥ – ʔ</b>	dúɗɛ	‘cloud, sky’	kórúʔɛ	‘widow’
<b>l – ʔ</b>	túlú	‘ax’	kúʔú	‘shield’
<b>f – ʔ</b>	lɔŋɔʃum	‘heel’	kúʔú	‘shield’
<b>y – ʔ</b>	kayɔ	‘first-born child’	làʔú	‘cloth’
<b>w – ʔ</b>	owa	‘wedding’	kɔʔane	‘priest’

In (4), voiced and voiceless plosives, as well as /s/ with /ʃ/, are shown to be contrastive at the beginning (B) and middle (M) of words. However, this contrast is neutralized at the end (E) of words.

(4) Neutralization of voicing contrast for word-final plosives

<b>p – b</b>	<b>B</b>	par	‘coffin’	<b>bár</b>	‘flood’
	<b>M</b>	kàpɛ [kàfɛ]	‘yeast’	babe	‘cat type’
	<b>E</b>	róp [rɔbʔ]	‘paid’	----	
<b>t – d</b>	<b>B</b>	tək	‘cut, slash’	<b>dək</b>	‘wrap’
	<b>M</b>	yiti	‘chain, iron’	kídí	‘arm’
	<b>E</b>	mát [madʔ]	‘drank’	----	
<b>s – ʃ</b>	<b>B</b>	suk	‘comfort’	<b>ʃú</b>	‘advise’
	<b>M</b>	nugusu	‘discouragement’	ʃyɔ	‘mouse’
	<b>E</b>	tós [tɔʃʔ]	‘picked’	----	
<b>k – g</b>	<b>B</b>	kɛlɛ	‘tooth’	<b>gɛlɛ</b>	‘shoulder’
	<b>M</b>	təkɔr	‘witness, confess, interpret’	tògór	‘hunt’
	<b>E</b>	gàk [gakʔ]	‘chased’	----	

The word-final underlying phonemes surface as voiceless in the intervocalic environment resulting when the plural noun suffix *-an* or the imperative verb suffix *-ɛ* are attached. We can assume the

word-final phonemes are voiceless in the underlying form and are unchanged in the intervocalic environment.

## (5) Word final /p/, /t/, /s/, /k/

	Underlying	Surface		Underlying	Surface	
<b>p</b>	ɲédé <b>p</b>	[ɲédé <b>b</b> ʰ]	‘tongue’	ɲédé <b>p</b> àn	[ɲédé <b>f</b> àn]	‘tongues’
<b>t</b>	kúdà <b>t</b>	[kúdà <b>d</b> ʰ]	‘bread’	kúdà <b>t</b> án	[kúdà <b>t</b> án]	‘breads’
<b>s</b>	a tós	[a tó <b>ʃ</b> ʰ]	‘picked (nuts)’	tòsè	[tò <b>s</b> è]	‘Pick!’
<b>k</b>	ʃùrà <b>k</b>	[ʃùrà <b>g</b> ʰ]	‘bag’	ʃùrà <b>k</b> àn	[ʃùrà <b>k</b> àn]	‘bags’

In Mundari, there is no contrastive consonant length in roots, although geminate consonants are a common result when consonants are joined together at morpheme boundaries (see section 6). The only non-borrowed roots found to have consonant sequences are those of (6). Thus, it is likely that these words were originally composed of more than one morpheme. Only nasal-voiced plosive sequences are formed through the productive morphology of section 6 and not nasal-voiceless plosive sequences. There are few if any compound words in which speakers are aware of the two roots joined, and speakers are not aware of more than one morpheme in the words of (6).

## (6) Roots with consonant sequences

<b>nt</b>	mántá	‘field, garden’
<b>rn</b>	ɲornan	‘how much in length or time’
<b>ɲk</b>	tɔɲk <sup>o</sup> et	‘cuboard, corner of house’
	ɲkɔɔ	‘please’
<b>ɲg</b>	líɲgò	‘fox’
	rúbɔɲga	‘sacrifice’

Alternatively, these words could be borrowed, although if so, speakers are not aware of the words being borrowed. Kakwa has prenasalized voiced plosives, but not prenasalized voiceless plosives (Onziga and Gilley 2012), and Bari and Kuku have no prenasalized plosives. Thus it is more likely that the nasal-voiceless plosive sequences /nt, ɲk/ of the words of (6) resulted through joined morphemes than from words borrowed from a related language.

## 2. Vowels

There are eight Mundari vowel phonemes that can be divided into [+/- ATR] sets. The [-ATR] phonemes /ɛ/, /ɔ/ become partially [+ATR], indicated with the symbols [ɛ̄], [ɔ̄], in words with [+ATR] vowels. The allophones [ɛ̄], [ɔ̄] do not occur in words without other [+ATR] vowels.

Table 3: Vowel phonemes

[-ATR]		[+ATR]	
i	u	i	u
ɛ	ɔ	(ɛ̄)	(ɔ̄)
a		ə	

In comparison with its related languages, Mundari is the only language of the four with 8 underlying vowel phonemes. Bari and Kuku are both claimed to have 10 vowel phonemes, and Kakwa to have 7 vowel phonemes, as shown in Table 4. Kakwa has the allophones [e] and [o] for /ɛ/ and /ɔ/ respectively in words with [+ATR] vowels (Onziga and Gilley 2012:7).

Table 4: Vowel phoneme comparison of related languages

	Mundari	Bari (Hall and Yokwe 1981)	Kuku (Cohen 2000)	Kakwa (Onziga and Gilley 2012)
[-ATR]	i	i	i	i
	u	u	u	u
	ɛ	ɛ	ɛ	ɛ

	ɔ	ɔ	ɔ	ɔ
	a	a	a	a
[+ATR]	i	i	i	i
	u	u	u	u
	(ɛ)	e	e	(e)
	(o)	o	o	(o)
	ə	ə	ə	ə

### 2.1 Vowel distribution in word positions

All Mundari vowels occur in word-initial, word-medial and word-final position.

(7)	Word-initial	Word-medial	Word-final
i	ijə 'elder, master'	mɪk 'grain'	kəʃɪ 'town, cattle camp'
ɪ	ɪmɪ 'there'	dɪr 'valley'	yɪnɪ 'co-wife'
ɛ	ɛrɔn 'long time ago'	ɲɛr 'sibling'	ɲɔdɛ 'lame person'
ə	əpú 'crime'	tɔr 'island'	gidə 'duty, responsibility'
a	át'án 'night'	mâr 'chief, king'	yápá 'moon, month'
u	utun 'crop ripe for harvest'	júr 'village'	budu 'feast, banquet'
ʊ	usan 'favor'	nʊŋ 'your (FEM.SG)'	yárú 'hippo'
ɔ	ólót 'flour'	wɔr 'stream'	kìdɔ 'chest, authority'

### 2.2 Vowel contrasts

The words with contrastive pairs of vowels in (8) show that each of the vowels are phonemes.

(8)	i - ɪ	mɪrɪ 'government'	mɪrɪ 'expert, scholar'
	i - ɛ	yɪk 'bury'	yɛk 'transport, carry'
	ɪ - ɛ	dɪŋ 'call by name'	dɛŋ 'taste'
	ɛ - ə	mɛt 'look, see'	mət 'greet'
	ɛ - a	mɛt 'look, see'	mát 'drink'
	u - ʊ	suk 'gather, collect (grain)'	suk 'comfort'
	u - ɔ	túr 'chase'	tɔr 'tie'
	ʊ - ɔ	mʊŋ 'body'	mɔŋ 'mother-in-law'
	ɔ - ə	mɔr 'join, meet, accompany'	mər 'try, test'
	ɔ - a	lók 'fish, catch'	lak 'untie, loosen'
	ə - a	kák 'release'	kak 'split'

### 2.3 Functional load of [ATR]

As shown in (9-10), the functional load of [ATR] for distinguishing lexemes of the same word category and for distinguishing lexemes of different word categories is significant.

#### (9) [ATR] minimal pairs in the same word category

	[-ATR]	[+ATR]
V	mát 'drink'	mət 'greet'
	man 'hate'	mən 'stay, wait'
	lak 'untie, loosen'	lək 'save'
	kak 'split'	kák 'release'
	wàr 'become, change'	wər 'ride, survey, look around'
	fa 'add, increase, cause'	fə 'visit'
	tík 'defeat, over power'	tik 'close, shut, throw out'
	lim 'be taller than'	lɪm 'visit, check, see, find out'
	ʃín 'sit, set, happen'	ʃɪn 'begin, start'
	pur 'praise, give thanks'	pùr 'smear, press'
	mu 'fall on, sit on'	mu 'build fence'

	suk	‘comfort’	suk	‘gather, collect’
	sók	‘push down’	suk	‘gather, collect’
	lu	‘mate’	lú	‘yell, wait’
	kut	‘blow, play instrument’	kut	‘return’
	yuk	‘graze, care for’	yuk	‘insult’
	mír-ún	‘copy, study under’	mir-un	‘be in order, correct’
<b>N</b>	mírí	‘expert, scholar’	mírì	‘government’
	kídí	‘water well’	kídí	‘arm’
	yìní	‘co-wife’	yini	‘medicine’
	k <sup>u</sup> ê	‘eye’	k <sup>u</sup> ê	‘head’
	sar-èt	‘law’	sər-èt	‘miracle’

## (10) [ATR] minimal pairs in the different word categories

[-ATR]			[+ATR]		
<b>V</b>	ɪ̯a	‘draw, suck blood’	<b>N</b>	ijə	‘master, elder’
<b>V</b>	ki	‘climb’	<b>N</b>	kí	‘sky, heaven’
<b>V</b>	kin	‘lock, close’	<b>N PL</b>	kín	‘dung, feces’
<b>V</b>	aŋ	‘be barren’	<b>MOD</b>	əŋ	‘foolish’
<b>N</b>	bár	‘flood’	<b>V</b>	bər	‘buy’
<b>N</b>	mâr	‘chief’	<b>V</b>	mər	‘try, test’
<b>N</b>	kàk	‘earth’	<b>V</b>	kók	‘release’
<b>N</b>	rúbé	‘sorcerer’	<b>V</b>	rube	‘do bad action’
<b>N</b>	ŋúrí	‘person’	<b>POS N</b>	ŋuri	‘your (sg) mother’
<b>DEM</b>	kíné	‘those (of fem pl n)’	<b>N</b>	kíné	‘goat’
<b>DEM</b>	lú	‘that (of mas sg n)’	<b>V</b>	lú	‘yell, wait’
<b>DEM CON</b>	lú	‘of, that’	<b>V</b>	lú	‘yell, wait’
<b>CON</b>	ka	‘when, if’	<b>PRON</b>	kə	‘they, them’
<b>CON</b>	ka	‘when, if’	<b>V</b>	kə	‘leave’
<b>MOD</b>	kàd̥í	‘alone’	<b>N</b>	kəd̥í	‘pumpkin’
<b>PRON</b>	yí	‘we, us’	<b>V</b>	yí	‘swallow’
<b>POS PRON</b>	nít	‘his, her (of fem sg n)’	<b>V</b>	nit	‘make tools’

In addition, [ATR] quality distinguishes second person plural possessive pronouns from third plural possessive pronouns.

(11)	[-ATR]			[+ATR]		
		2PL POS			3PL POS	
Singular	d’óŋ	lúkà	‘your (PL) male dog’	d’óŋ	lúkə	‘their male dog’
Noun	d’óŋ	núkà	‘your (PL) female dog’	d’óŋ	núkə	‘their female dog’
Plural	díjìn	kúlúkà	‘your (PL) male dogs’	díjìn	kúlúkə	‘their male dogs’
Noun	díjìn	kúnúkà	‘your (PL) female dogs’	díjìn	kúnúkə	‘their female dogs’

2.3 Vowel distribution in two adjacent syllables of roots

In (12), an x indicates an attested root with the vowel pair in adjacent syllables, where the vowel along the top of the chart is in the second syllable. A dash indicates the vowel pair is not found in roots. All possible combinations of [-ATR] vowels in adjacent syllables are attested, and all combinations of the [+ATR] vowels /ə/, /u/, /i/ are attested. However, there are no roots with only the [+ATR] allophones [ɔ] or [ɛ], as these only occur along with one or more of the [+ATR] phonemes /ə/, /u/, or /i/. The [-ATR] vowel phonemes /ɔ/, /ɛ/ are partially [+ATR] when in roots with /ə/, /u/, or /i/. Otherwise, vowels in adjacent syllables of roots are only ever of the same vowel quality—either both [-ATR] or both [+ATR]. The non-high vowels /ɔ/, /ɛ/ do not occur in adjacent syllables of roots with the non-high [+ATR] vowel /ə/. It is not common for /ɔ/ or /ɛ/ to follow high [+ATR] vowels /u/ or /i/ in adjacent syllables, and it is even less common for /ɔ/ or /ɛ/ to precede /u/ or /i/ in adjacent syllables.

(12)	[-ATR] vowel pairs					[+ATR] vowel pairs				
	ɔ	ε	a	u	i	ɔ [ɔ]	ε [ɛ]	ə	u	i
ɔ	x	x	x	x	x	-	-	-	x	x
ε	x	x	x	x	x	-	-	-	-	x
a	x	x	x	x	x	-	-	x	x	x
u	x	x	x	x	x	-	x	x	x	x
i	x	x	x	x	x	x	x	x	x	x

## (13) Vowel combinations in adjacent syllables of roots

[-ATR]			[+ATR]		
ɔ, a	ɔwa	'wedding'	ɔ [ɔ], ə	-----	
ɔ, ɔ	tɔbɔk	'calf, heifer'	[ɔ], [ɔ]	-----	
ɔ, ε	mɔdɛ	'blind person'	[ɔ], [ɛ]	-----	
ɔ, u	tɔdʊ	'hill'	ɔ [ɔ], u	kɔbúkà̀n	'wings'
ɔ, i	lólì	'basket, bowl'	ɔ [ɔ], i	lɔpɪtɔt	'male sheep or goat'
ε, a	dɛka	'number (N)'	ε [ɛ], ə	-----	
ε, ɔ	ɲérɔt	'south'	[ɛ], [ɔ]	-----	
ε, ε	pérék	'fishing spear'	[ɛ], [ɛ]	-----	
ε, u	legula	'tile of roof or floor'	ε [ɛ], u	-----	
ε, i	mɛlɪŋ	'dry season'	ε [ɛ], i	bɛtɪn	'resembling (MOD)'
a, a	paran	'day'	ə, ə	kəmá̀rì	'fish'
a, ɔ	warɔ	'thread'	ə, ɔ [ɔ]	-----	
a, ε	káré	'river'	ə, ε [ɛ]	-----	
a, u	jàkú	'animal'	ə, u	káruʔé	'widow'
a, i	talɪŋ	'peace'	ə, i	pà̀rì	'bed'
u, a	rɔbat	'bandage'	u, ə	gùmát	'wind'
u, ɔ	búŋɔ	'flock, group'	u, ɔ [ɔ]	-----	
u, ε	túrɛ	'stick, staff'	u, ε [ɛ]	gúrè	'dove'
u, u	purut	'dew'	u, u	buđu	'feast, banquet'
u, i	múđŋ	'field, countryside'	u, i	đuŋít	'herd, group'
i, a	rímà	'blood'	i, ə	lipə	'soil'
i, ɔ	mɪŋɔ	'crown'	i, ɔ [ɔ]	kɪʔ	'grinding stone'
i, ε	mɪŋɛ	'deaf person'	i, ε [ɛ]	kíné	'goat'
i, u	lɪfùŋ	'lamb'	i, u	mìrú	'lion'
i, i	dìŋít	'time, season'	i, i	pìrì	'hair'

The vowel height constraint of (14) prohibits the following pairs in roots (monomorphemic words): (ə, ɔ), (ə, ε), (ɔ, ə), (ε, ə).

## (14) Vowel height [+ATR] constraint

The non-high vowels /ɔ/, /ε/ do not occur in adjacent syllables of roots with the non-high [+ATR] vowel /ə/.

In Mundari, there is no contrastive vowel length. Neither are there unambiguous vowel sequences with two non-high vowels. However, the on and off vowel glides of (15) have been attested, and are either [+ATR] or [-ATR] in vowel quality. On-glides are more common than off-glides. As discussed in section 3, the words of (15) are analyzed to have vowel glides, rather than labialized or palatalized consonant onsets, for the sake of having a fewer number of consonant phonemes. Vowel glides are also attested in Bari (Hall and Yokwe 1981), Kuku (Cohen 2000) and Kakwa (Onziga and Gilley 2012).

## (15) Vowel glides

off-glides	[-ATR]		[+ATR]		
	a <sup>u</sup>	ba <sup>u</sup>	'plank, timber, splint'	ə <sup>u</sup>	ŋə <sup>u</sup> ŋ
a <sup>i</sup>	ka <sup>i</sup> na	'donkey'	ə <sup>i</sup>	wə <sup>i</sup> d <sup>i</sup> ɔ	'sorrowful (MOD)'
ɔ <sup>u</sup>	lɔ <sup>u</sup> s	'compare'	ɔ <sup>u</sup> [ɔ <sup>u</sup> ]	-----	



	ɔ'	-----	ɔ' [ɔ']	-----
	ɛ <sup>u</sup>	lɛ <sup>u</sup> s 'change, exchange'	ɛ <sup>u</sup> [ɛ <sup>u</sup> ]	-----
	ɛ'	-----	ɛ' [ɛ']	-----
<b>on-glides</b>	<sup>u</sup> a	nyàʃ <sup>u</sup> à 'gazelle type'	<sup>u</sup> ə	d <sup>u</sup> àt 'bull'
	<sup>u</sup> ɔ	k <sup>u</sup> ɔrək 'dry (ADJ)'	<sup>u</sup> ɔ [ʊɔ]	-----
	<sup>u</sup> ɛ	g <sup>u</sup> ék 'raven'	<sup>u</sup> ɛ [ʊɛ]	k <sup>u</sup> ɛ 'head'
	<sup>u</sup> ɪ	k <sup>u</sup> ɪlɪsɛt 'window'	<sup>u</sup> ɪ	-----
	'a	d'áŋ 'famine'	'ə	r'íŋŋ 'be amazed (V)'
	'ɔ	d'ɔŋ 'dog'	'ɔ [ʊɔ]	wə'd'ɔ 'sorrowful (MOD)'
	'ɛ	l'ɛp 'insult, abuse (V)'	'ɛ [ʊɛ]	mil'ɛ-ʃu 'promise, take oath'
	'u	-----	'u	ɲ'ú 'begin to come'

In Mundari, it is not uncommon for roots to contain intervocalic approximants /y/ and /w/. Such roots are contrastive with on and off glides in roots, as shown in (16). In all the words on the left, /y/ or /w/ separates vowels in two different syllables, whereas in all the words on the right, the corresponding vowels are a glide in the same syllable.

(16) Contrasts of approximants /y/, /w/ with on and off glides

<b>ɪ.ya</b> – 'a	bì.yá 'similar, better (MOD)'	b'ia	'also (MOD)'
<b>a.yu</b> – a <sup>u</sup>	ka.yu 'first-born child'	ba <sup>u</sup>	'plank, timber, splint'
<b>a.yɪ</b> – a'	a.yɪn 'not, without (MOD)'	ka'.na	'donkey'
<b>u.yə</b> – 'ə	lu.yəki 'apostle'	r <sup>u</sup> ʒ.kə	'darkness'
<b>e.yi</b> – ə'	kə.yɪn 'hand'	ŋə'	'increase (V)'
<b>u.wa</b> – 'a	ku.waran 'next day, tomorrow'	k <sup>u</sup> a.k <sup>u</sup> a.rak-sə	'moth'

As discussed in section 9, when vowels are joined through morphology, a glottal plosive can be inserted between the vowels and is the onset of the syllable containing the second vowel. A few roots contain intervocalic glottal plosives, and such roots are also contrastive with on and off glides, as shown in (17). As mentioned, roots with glottal plosives may have originally been composed of more than one morpheme.

(17) Contrasts of the glottal plosive with on and off glides

<b>aʔu</b> – a <sup>u</sup>	làʔú 'cloth'	ba <sup>u</sup>	'plank, timber, splint'
<b>aʔɪ</b> – a'	tɔnaʔɪt 'playfulness'	ka'.na	'donkey'
<b>uʔa</b> – 'a	dʊʔa 'leprosy, dropsy'	ɲàʃ <sup>u</sup> à	'gazelle type'
<b>uʔɛ [uʔɛ]</b> – 'ɛ [ʊɛ]	kórúʔɛ 'widow'	k <sup>u</sup> ɛ	'head'

### 3. Syllable structure

Mundari has the syllable types V, CN, CNC, and rarely VC. The nucleus is most often one of the 8 vowels of Table 2, but in CN and CNC can also be one of the on or off glides of (15). Unlike Kakwa, which has no consonant codas (Onziga and Gilley 2012), Mundari is similar to Bari and Kuku which allow for various root-final consonants such as voiceless plosives, nasals and approximants, but not /l/ (Hollman 1992; Cohen 2000).

(18) Syllable types

<b>V</b>	ì	'in, at, from'	
<b>VC (rare)</b>	ék	'drive in'	
<b>CN</b>	lé	'milk'	l'ʒ 'my (MAS.SG)'
<b>CNC</b>	gɔr	'war'	lɔ <sup>u</sup> s 'compare'

In non-borrowed roots, the syllable types V and VC only occur word-initially, and the syllable type CNC only occurs word-finally, except in the words of (6) which are analyzed to originally be polymorphemic. The majority of monomorphemic verbs are monosyllabic (CNC or CN), whereas monomorphemic nouns are most commonly disyllabic, then monosyllabic, then trisyllabic.

(19) Syllable structures in words

<b>V.CV</b>	atɪ	‘again’
<b>V.CVC</b>	ólót	‘flour’
<b>CV.CV</b>	kùdú	‘rain’
<b>CV.CVC</b>	lakat	‘week’
<b>V.CV.CV</b>	arɪɪ	‘afternoon’
<b>V.CV.CVC</b>	aparan	‘day’
<b>CV.CV.CV</b>	lókóré	‘meat’
<b>CV.CV.CVC</b>	lódúlòk	‘animal like badger’

Ambiguous nasal-plosive consonants such as *[nt]*, *[ŋg]* are analyzed as consonant sequences rather than as single units, for the following reasons. Only the roots of (6) were found to have nasal-consonant sequences. Since it is common for there to be nasal-consonant sequences across morpheme boundaries (see section 6), it is likely that the words of (6), and the four repeated in (20), were originally composed of more than one morpheme. Further, there are no word-initial unambiguous consonant sequences (\*#CCV), all word-initial consonants fit the C slot in CV or CVC syllable types, and all word-final consonants fit the C slot in CVC syllable types. So, there is no need for an analysis with additional syllable types or prenasalized plosive phonemes.

(20) Nasal-consonant sequences

<b>nt</b>	mántá	‘field, garden’
<b>rn</b>	ɲɔrnán	‘how much in length or time’
<b>ŋk</b>	tɔŋk <sup>u</sup> et	‘cuboard, corner of house’
<b>ŋg</b>	líŋgò	‘fox’

Adjacent ambiguous vowels in the same syllable such as *[uɛ]*, *[iɛ]* in the words of (21) are analyzed as single units (glides) rather than as vowel sequences, for the following reasons. There are no unambiguous vowel sequences, such as two consecutive non-high vowels. Rather, all adjacent vowels involve at least one high vowel. Further, there is no contrastive vowel length. When analyzed as glides, all adjacent vowels of the same syllable fill the nucleus slot of CN or CNC syllable types, and there is no need for an analysis with additional syllable types (such as CVV or CVVC).

(21) Adjacent vowels in the same syllable with high vowel first

<b>ʷɛ</b>	g <sup>u</sup> ék	‘raven’
<b>ʷɛ</b>	l'ɛp	‘insult, abuse (v)’

The consonants preceding adjacent vowels are not analyzed as being labialized or palatalized for the following reasons. There are at least 11 consonants that can precede a high back vowel *[u, u]* before an adjacent vowel in the same syllable, and at least 8 consonants that can precede a high front vowel *[i, i]* before an adjacent vowel in the same syllable. Analyzing these consonants as being labialized and palatalized requires an additional 20 phonemes. Further, such an analysis would have no way to explain the phonetic difference between [-ATR] */k<sup>u</sup>ɛ/* ‘eye’ and [+ATR] */k<sup>u</sup>ê/* ‘head’, as both would underlyingly be analyzed as */k<sup>w</sup>ɛ/*. Although Kuku (Cohen 2000:25) only allows for velar and alveolar places of articulation for consonants before high vowel glides in roots, Mundari also allows for bilabial and palatal consonants in such positions.

(22) Consonants preceding high vowel glides

	<b>[ʷ], [ʷ]</b>		<b>[ʷ], [ʷ]</b>	
<b>p</b>	p <sup>u</sup> ək	‘ten’		
<b>t</b>	t <sup>u</sup> ər	‘be sour, bitter’	át'áj	‘night’
<b>s</b>	s <sup>u</sup> ót	‘ear, side’		
<b>k</b>	k <sup>u</sup> ê	‘eye’		
	k <sup>u</sup> ê	‘head’		
<b>b</b>			b'a	‘also’
<b>d</b>	d <sup>u</sup> ât	‘bull’	d'áj	‘famine’

<b>d</b>			<b>dʹóŋ</b>	‘dog’
<b>j</b>	ɲàj <sup>u</sup> à	‘gazelle type’		
<b>g</b>	g <sup>u</sup> ék	‘raven’		
<b>m</b>	m <sup>u</sup> ən	‘sleeping deeply (MOD)’		
<b>n</b>			<b>nʹô</b>	‘my (FEM.SG)’
<b>ɲ</b>			<b>ɲʹú</b>	‘begin to come’
<b>l</b>	lʹək	‘save, provide for’	<b>lʹɛp</b>	‘insult, abuse (V)’
<b>r</b>	rʹə	‘dark (ADJ)’	<b>rʹəŋ</b>	‘be amazed (V)’

In the set of adjacent vowel combinations, there are high vowels occurring either first or second. When occurring second as in *le<sup>u</sup>s* ‘change, exchange’, it is not favorable to interpret the high vowel as an approximant [w] since there are no unambiguous complex consonant codas (\*CVCC). Similarly, it is not favorable to interpret the high vowel of *ka'na* ‘donkey’ as an approximant [y] since word-medial consonant sequences (VC.CV) are extremely rare, and likely result from two adjacent morphemes.

(23) Adjacent vowels in the same syllable with high vowel second

<b>e<sup>u</sup></b>	<b>le<sup>u</sup>s</b>	‘change, exchange’
	<b>lɔ<sup>u</sup>s</b>	‘compare’
	<b>ka'na</b>	‘donkey’

When adjacent vowels in the same syllable are word-final, they could be interpreted as having a final approximant as in *[baw]* ‘plank’, *[lay]* ‘announce’, since the approximant /r/ is attested word-finally as in *tár* ‘island’. However, in being consistent with other words containing syllable-final adjacent vowels such as *ka'.na* ‘donkey’, they are interpreted as being word-final off-glides *[baʷ]* ‘plank’, *[laʷ]* ‘announce’.

(24) Word-final adjacent vowels in the same syllable

<b>a<sup>u</sup></b>	<b>ba<sup>u</sup></b>	‘plank, timber, splint’
<b>aʹ</b>	<b>laʹ</b>	‘announce, preach’

High vowels [i], [ɪ], [u], [ʊ] inbetween two consonants are analyzed as vowels, rather than as glides or as being in a vowel sequence. As shown in (7), high vowels can be in word-initial, medial, or final position as can other vowels, and are the nuclei in V, CV, or CVC syllable types.

(25) High vowels inbetween two consonants

	V	CV	CVC
<b>i</b>	ijə ‘elder, master’	kəjɪ ‘town, cattle camp’	mɪk ‘grain’
<b>ɪ</b>	ɪmɪ ‘there’	yɪnɪ ‘co-wife’	dɪr ‘valley’
<b>u</b>	utun ‘crop ripe for harvest’	budu ‘feast, banquet’	ʃur ‘village’
<b>ʊ</b>	usan ‘favor’	yárú ‘hippo’	nŋ ‘your (FEM.SG)’

Intervocalic approximants [y], [w] are analyzed as consonants and syllable onsets, rather than as vowel glides or as being in vowel sequences. These approximants can be word-initial as can other consonants, and always fill the C slot in CV or CVC syllable types.

(26) Intervocalic approximants

	CV	CVC
<b>w</b>	wálé ‘knife’	tawer ‘cut, circumcise’
<b>y</b>	yúmú ‘heart’	kəyɪn ‘hand’

#### 4. Tone

The tone analysis of Mundari is based on the tone of approximately 200 nouns and 100 verbs, and is still tentative. As in its related languages, Mundari is analyzed to have two underlying level tones, High and Low. Contour tone consists of more than one level tone on the same syllable. The

syllable is the tone-bearing unit, and at most two tones are allowed on the same syllable. Falling tone is only attested on the final syllable of words. The only words attested with a syllable having rising tone are  $\eta\acute{\epsilon}^u\eta$  ‘hyena’ and  $r^u\acute{\epsilon}.k\grave{\epsilon}$  ‘darkness’. The lexical and grammatical function of tone is low in that there are few tone minimal pairs and few if any grammatical distinctions made solely by tone.

(27)	<b>H</b>		pé	‘be tired’		wók	‘arrive’
	<b>L</b>		pè	‘show, reveal, shoot (gun)’		wòk	‘beat’

Noun tone melodies are represented by the nouns in isolation of (28-29), where the number of nouns with the given tone and syllable structure is shown to the left of each noun. There are four tone melodies in CVCV and CVCVC syllable structure of nouns, besides combination tone melodies, which indicates a system with two underlying level tones.

(28)		CV		CVC		CVCV				
	<b>H</b>	6	ró	‘word’	21	mók	‘waist’	32	kídí	‘arm’
	<b>L</b>				1	kàk	‘earth’	7	pèrì	‘bed’
	<b>HL</b>	4	η̂	‘thing’	10	môt	‘foot’	10	mírì	‘government’
	<b>LH</b>				1	η̂ <sup>u</sup> η	‘hyena’	14	kəjí	‘cattle camp’
	<b>LHL</b> <sup>5</sup>							5	kəđí	‘pumpkin’

(29)		CVCVC		CVCVCV		CVCVCVC				
	<b>H</b>	19	múrút	‘neck’	3	lókóré	‘meat’			
	<b>L</b>	4	kàkàt	‘door’	1	səkàrè	‘otter’			
	<b>HL</b>	8	kúdât	‘bread’	2	η̂úbúri	‘horn’	1	lódúìlùk	‘badger’
	<b>LH</b>	6	pàrát	‘ax’				1	kùlòpít	‘window’
	<b>LHL</b>	5	đìη̂t	‘time’	5	mèrèjè	‘grandfather’	1	kòbúkèn	‘wings’
	<b>HLH</b>							1	títì?ít	‘sparrow’

In (30), verb tone melodies are represented in verb roots in past tense form, which are commonly said following the auxillary à ‘be, was’ with low tone.

(30)	Verb Tone Melodies; past form (in frame $\eta\acute{\epsilon}$ à ____ ‘he X’)						
	CV		CVC				
	<b>H</b>	18	yé	‘think’	50	wúr	‘smear’
	<b>L</b>	3	pè	‘shoot’	22	pùr	‘draw’

I now discuss morphophonology of Mundari. Sound alternations across morpheme boundaries may include tone alternations (section 5), consonant assimilation (section 6), vowel alternations (section 7), [+ATR] spreading including vowel raising (section 8). Noun plural formation is briefly described at the end of section 6 to assist the reader in following the noun examples of later sections. For further explanation of Mundari morphology and syntax, see the *Mundari Grammar Book* (Lutwori et al. 2013).

## 5. Tone morphophonology

I now discuss the tone changes across word and morpheme boundaries that were attested with beginning tone analysis. There are few changes in noun tone as a result of the tone of surrounding words. However, when morphemes are attached, there can be tone replacement to the root of verbs and polar tone or no underlying tone in the suffixes of nouns.

Each tone melody of disyllabic nouns is listed under various frames in (31). The nouns were elicited in the frames following High and Low tone of verbs and preceding High and Low tone of

<sup>5</sup> The LHL melody of (28-29) includes both LHL words and some words such as  $\acute{d}\eta\eta\acute{t}/\acute{d}\eta\eta\acute{t}-\acute{a}\eta$  ‘time’ in (34) that are analyzed to have LHL melody, where (l) is a floating Low tone that only surfaces when it is phrase-final.

adverbs. The tone of the nouns is the same as in isolation, except for the LHL noun *kə̀dĩ* ‘pumpkin’ which surfaces as L,H *kə̀dĩ* with a following High tone. As discussed below, when the plural suffix with no underlying tone is attached, the root-final Low tone again does not surface *kə̀dĩ-ə̀t* ‘pumpkins’. Thus, such as root-final tone could be analyzed as a floating Low tone, that surfaces phrase-finally or with a following Low tone. Kuku (Cohen 2000:9-10) is documented to have a similar phenomenon in that Low tone only surfaces along with High tone in word-final syllables that are phrase final.

## (31) Tone of nouns following and preceding Low and High tone

Root tone	Noun in isolation	<i>ɲé à rém</i> ‘he speared X’ H before	<i>ɲé à lim</i> ‘he checked X’ L before	<i>ɲé à lim kák</i> ‘he checked X down’ H after	<i>ɲé à lim pàrik</i> ‘he checked X well’ Low after	
H	túlú	túlú	túlú	túlú	túlú	‘ax’
L	kùŋù	kùŋù	kùŋù	kùŋù	kùŋù	‘knee’
HL	mírì	mírì	mírì	mírì	mírì	‘government’
LH	kùdú	kùdú	kùdú	kùdú	kùdú	‘rain’
LHL	kə̀dĩ	kə̀dĩ	kə̀dĩ	kə̀dĩ	kə̀dĩ	‘pumpkin’

The noun singular suffix *-sə* and plural suffixes *-i*, *-a*, *-ni* can be analyzed as having polar tone (P) in that opposite tone surfaces on these suffixes from the root-final tone to which they are attached. The same phenomenon is reported for noun suffixes in Kuku (Cohen 2000:38-39). In Mundari, there is some evidence for a floating High tone (h) on the root-final syllable of *kábilf-sə/kábilī* ‘sheep’ in that High tone only surfaces on the root-final syllable when a suffix is attached with Low tone. There is also some evidence for a floating Low tone (l) on the root-final syllable of *àmá-sə/àmá* ‘sandal’ in that Low tone only surfaces on the root-final syllable when there is no suffix attached. The polar tone is opposite the floating High tone but ignores the floating Low tone.

(32)		Singular <i>-sə</i> (P)	Plural		Singular	Plural <i>-i</i> (P)		
H	3	mérók- <b>sə̀</b>	mérók	‘enemy’	4	márin	márin- <b>i</b>	‘wall’
L					1	kàkàt	kàkàt- <b>f</b>	‘door’
HL	2	tírən- <b>sə̀</b>	tírən	‘goods’	1	álan	álan- <b>f</b>	‘salt’
LH	5	təlók- <b>sə̀</b>	təlók	‘egg’				
LHL	3	kòròpò- <b>sə̀</b>	kòròpò	‘leaf’				
HLh	1	kábilf- <b>sə̀</b>	kábilī	‘sheep’				
LHl	1	àmá- <b>sə̀</b>	àmá	‘sandal’				

In (33), when the suffix *-a* (P) attaches to roots with final vowels with High tone, the High tone remains regardless of whether the final vowel becomes an on-glide as in *wálé/wál-â* ‘knife’ or is elided as in *jàkú/jàk-â* ‘animal’, resulting in HL tone on the suffix.

(33)		Singular	Plural <i>-a</i> (P)		Singular	Plural <i>-ni</i> (P)		
H	12	wálé	wál- <b>â</b>	‘knife’	6	kíná	kíná- <b>ni</b>	‘year’
	3	món	món- <b>â</b>	‘mother-in-law’				
L	1	kìbèr	kìbèr- <b>â</b>	‘anthill’	2	ɲàf <sup>u</sup> à	ɲàf <sup>u</sup> à- <b>ni</b>	‘gazelle’
HL	3	mémèŋ	mémèŋ- <b>â</b>	‘gum’	3	lórò	lórò- <b>ni</b>	‘voice’
LH	1	jàkú	jàk- <b>â</b>	‘animal’	2	kìrò	kìrò- <b>ni</b>	‘scorpion’
LHL					3	lìkírò	lìkírò- <b>ni</b>	‘hare’

The plural suffixes *-at* and *-an* can be analyzed as having two tonal allomorphs—one with polar tone (P) and one with no underlying tone (0). A suffix with no underlying tone takes the root-final tone, except that it ignores Low floating tone as in *kə̀dĩ/də̀dĩ-ə̀t* ‘pumpkin’. As to which tonal allomorphs attach to roots with which tone melodies, is not predictable. Rather, the same tone

melody with the same syllable structure and suffix have differing surface tone by different suffix tonal allomorphs (see *kùdú/kùd<sup>u</sup>-át* ‘rain’ and *mìrú/mìr<sup>u</sup>-át* ‘lion’; *dìḡít/dìḡít-án* ‘time’ and *ḵràk/ḵràk-án* ‘bag’).

(34)	<u>Singular</u>			<u>Plural</u>				<u>Singular</u>			<u>Plural</u>		
				<b>-at (0), -at (P)</b>							<b>-an (0), -an (P)</b>		
<b>H</b>	7	búḡó	búḡ <sup>u</sup> -át (0)	‘flock’	14	dúḡít	dúḡít-án (P)	‘herd’					
<b>L</b>	3	kùḡò	kùḡ <sup>u</sup> -át (P)	‘knee’	1	kàk	kàk-án (P)	‘earth’					
<b>HL</b>	2	mírì	mír <sup>i</sup> -át (0)	‘government’	4	kúḡát	kúḡát-án (P)	‘bread’					
<b>HI</b>					1	mí	mí-án (P)	‘custom’					
					1	bóyì	bóyì-án (0)	‘net’					
<b>LH</b>	2	kùdú	kùd <sup>u</sup> -át (P)	‘rain’	3	pàrát	pàrát-án (P)	‘ax’					
	2	mìrú	mìr <sup>u</sup> -át (0)	‘lion’	1	ḡùmát	ḡùmát-án (0)	‘wind’					
<b>LHI</b>	3	kèḡí	kèḡ <sup>i</sup> -át (0)	‘pumpkin’	3	dìḡít	dìḡít-án (0)	‘time’					
					2	ḵràk	ḵràk-án (P)	‘bag’					
<b>HLH</b>					1	títìḡít	títìḡít-án (P)	‘sparrow’					

In some verb forms, the suffix causes tone replacement to the root. Although the underlying tone of *wúr* ‘smear’ is High and the underlying tone of *pùr* ‘draw’ is Low, there is Low replacement tone when the imperative suffix *-ε* is attached, and HL replacement tone when the subordinate suffix *-ḵere* is attached.

(35) Tone changes in verbs with imperative *-ε* and subordinate *-ḵere* suffixes

	Past	Imperative	Subordinate	
<b>H</b>	à wúr	wùr-ε	wúr-ḵèrè	‘smear, press’
<b>L</b>	à pùr	pùr-ε	pùr-ḵèrè	‘draw’

## 6. Consonant morphophonology

I now discuss sound changes when consonants are joined at morpheme boundaries—mainly when consonant-initial suffixes are joined to consonant-final *verbs*. Only three consonant-initial suffixes are joined to consonant-final *nouns*, and for such there is no alternation.

There are five consonant-initial verb suffixes that are joined to consonant-final verbs: *-ḵi*, *-ḵε*, *-ḵa*, *-ḵiri/ḵere*, *-ni*. The resulting alternations are predictable, although complex. The indicative suffix *-ḵi* and subordinate suffix *-ḵiri/ḵere* have underlying initial *-ḵ*, as seen in (36) when these suffixes are attached to verbs with root-final vowels or the approximant /r/, as in *ḡa-ḵi* ‘wants’ and *tur-ḵi* ‘chases’. However, the suffix-initial *-ḵ* assimilates to the place of articulation of the root-final consonant (In *ḵḡḡi* ‘take’, the suffix *-ḵi* becomes *-ḡi*). Further, the root-final consonant assimilates to the voiced feature of the suffix-initial consonant. (In *tḵḡi* ‘pick’, the root-final consonant *s* becomes *ḡ*. In this way, the alveolar voiced plosive /s/ is again treated as the phonological voiceless pair of the voiced palatal plosive /ḡ/). Both processes take place in some verbs. (In *kebbi* ‘follow’, the suffix *-ḵi* becomes *-bi*, and the root-final consonant *p* becomes *b*). In the indicative and subordinate forms of verbs with most root-final segments, a consonant sequence or geminate plosive results. However, the phonemes /d/ and /l/ are not allowed in consonant sequences, even through morphology, and the insertion vowel /a/ is required between the adjoining consonants. The imperative form with suffix *-ε* is given for comparison to help determine the root.

(36) Consonant alternations at verb morpheme boundaries

<u>Root-Suffix = Result</u>	<u>Past</u>	<u>Indicative</u>	<u>Subordinate</u>	<u>Imperative</u>	
		<b>-ḵi</b>	<b>-ḵiri/ḵere</b>	<b>-ε</b>	
<b>p - ḵ = bb</b>	kéḡ	keḡb-bi	keḡb-biri	kèḡ-ε	‘follow’
<b>t - ḵ = dd</b>	mèt	məd-di	məd-diri	mèt-ε	‘greet’
<b>d - ḵ = daḡ</b>	púḡ <sup>6</sup>	puḡḡ-ḵi	púḡḡ-ḵèrè	pùḡ-ε	‘appear’

<sup>6</sup> The phoneme /d/ is never found to surface word-finally. It may be required that the vowel /a/ is inserted between /d/ and a word boundary, as well as before a consonant-initial suffix, as stated in (38).

<b>s - j = ʃʃ</b>	tós	tɔʃ-ʃɪ	tɔʃ-ʃìrì	tòs-è	‘pick’
<b>k - j = gg</b>	ék	ɛg-ɡɪ	ɛg-ɡìrì	èk-è	‘pound, drive in’
<b>m - j = mb</b>	kám	kam-bɪ	kám-bìrì	kàm-è	‘row’
<b>n - j = nd</b>	kòn	kɔn-dɪ	kón-dìrì	kòn-è	‘do’
<b>ɲ - j = ɲʃ</b>	gɔɲ	gɔɲ-ʃɪ	gɔɲ-ʃìrì	gòɲ-è	‘give’
<b>ŋ - j = ŋg</b>	jóŋ	jɔŋ-ɡɪ	jóŋ-ɡìrì	jòŋ-è	‘take’
<b>l - j = laj</b>	gá <sup>7</sup>	gala-ʃɪ	gálà-ʃìrì	gàl-è	‘find’
<b>r - j = rj</b>	túr	tur-ʃɪ	túr-ʃèrè	tùr-è	‘chase’
<b>ɛ - j = j</b>	pè	pɛ-ʃɪ	pé-ʃìrì	pè-ʔè	‘shoot’

Similarly, the negative suffix *-ni* has underlying initial *-n*, as seen when the suffix joins verbs with root-final vowels or the approximant /r/, as in *pɛ-ni* ‘does not shoot’ and *tur-ni* ‘does not chase’. However, the suffix-initial *-n* takes on all the features of the root-final consonant. Again, the insertion vowel /a/ is required following /d/ and /l/ before another consonant.

(37) Consonant alternations at verb morpheme boundaries

<u>Root-Suffix = Result</u>	<u>Past</u>	<u>Negative</u> <b>-ni</b>	<u>Imperative</u> <b>-ɛ</b>	
<b>p - n = pp</b>	kép	kep-pɪ	kèp-è	‘follow’
<b>t - n = tt</b>	mèt	mət-tɪ	mèt-è	‘greet’
<b>ɖ - n = ɖan</b>	púɖə	puɖə-nɪ	pùɖ-ə	‘appear’
<b>s - n = ss</b>	tós	tɔs-sɪ	tòs-è	‘pick’
<b>k - n = kk</b>	ék	ɛk-kɪ	èk-è	‘pound, drive in’
<b>m - n = mm</b>	kám	kam-mɪ	kàm-è	‘row’
<b>n - n = nn</b>	kòn	kɔn-nɪ	kòn-è	‘do’
<b>ɲ - n = ɲɲ</b>	gɔɲ	gɔɲ-ɲɪ	gòɲ-è	‘give’
<b>ŋ - n = ŋŋ</b>	jóŋ	jɔŋ-ŋɪ	jòŋ-è	‘take’
<b>l - n = lan</b>	gá	gala-nɪ	gàl-è	‘find’
<b>r - n = rn</b>	túr	tur-nɪ	tùr-è	‘chase’
<b>ɛ - n = n</b>	pè	pɛ-nɪ	pè-ʔè	‘shoot’

Because of the consonant constraint of (38), the insertion vowel /a/ separates consonant-initial suffixes attached to verbs with root-final /d/ or /l/.

(38) Consonant constraint

No consonant may directly follow /d/ or /l/.

The voiceless plosives /p, t, s, k/ and voiced plosives /b, d, ʃ, g/ have contrastive length intervocalically through morphology. As shown in (39), the resulting voiceless geminate plosives of negative verb forms are contrastive with root-final plosives in imperative forms. The resulting voiced geminate plosives of indicative forms are contrastive with intervocalic plosives in roots such as *kibər* ‘anthill’, *pádə* ‘gold’, *kəʃɪ* ‘town’, and *məgɔ* ‘banquet’. The alveolar plosive /d/ has no length contrast or voicing contrast in roots or through morphology. Similar to non-alveolar plosives, nasals have contrastive length intervocalically through morphology. The resulting geminate nasals of negative verb forms are contrastive with root-final nasals in imperative forms.

(39)

<u>Root</u>	<u>Past</u>	<u>Imperative</u>	<u>Indicative</u> <b>-ɲɪ</b>	<u>Negative</u> <b>-ni</b>	
<b>p</b>	kép	kèp-è	kep-bɪ	kep-pɪ	‘follow’
<b>t</b>	mèt	mèt-è	məd-di	mət-tɪ	‘greet’
<b>ɖ</b>	púɖə	pùɖ-ə	puɖə-ʃɪ	puɖə-nɪ	‘appear’
<b>s</b>	tós	tòs-è	tɔʃ-ʃɪ	tɔs-sɪ	‘pick’
<b>k</b>	ék	èk-è	ɛg-ɡɪ	ɛk-kɪ	‘pound, drive in’
<b>m</b>	kám	kàm-è		kam-mɪ	‘row’

<sup>7</sup> Although /l/ occurs word-finally in underlying forms, it is not allowed to surface in word-final position.

<b>n</b>	kən	kən-è		kən-nɪ	‘do’
<b>ɲ</b>	gɔɲ	gɔɲ-è		gɔɲ-nɪ	‘give’
<b>ŋ</b>	ʃɔŋ	ʃɔŋ-è		ʃɔŋ-nɪ	‘take’

The consonant-initial noun suffixes *-nɪ*, *-ka*, *-ɲn*, *-kə*, *-nə*, *-sɪk* are only attached to vowel-final noun roots. The suffixes *-sɔ*, *-tɪ*, *-sɪ* can be attached to consonant-final noun roots, but there are no alternations, as shown in (40).

## (40) Consonants at noun morpheme boundaries

Suffix	Root-final	Singular	Plural	
<b>-sɔ</b>	<b>p</b>	dakap-sɔ	dakap	‘gold’
	<b>t</b>	dukat-sɔ	dukat	‘messenger’
	<b>k</b>	kimak-sɔ	kimak	‘ruler’
	<b>n</b>	tetən-sɔ	tetən	‘young person’
	<b>ɲ</b>	mɔɲɲ-sɔ	mɔɲɲ	‘finger’
<b>-tɪ</b>	<b>ŋ</b>	padŋ-sɔ	padŋ	‘reed’
	<b>r</b>	mâr	mâr-tɪ	‘chief’
	<b>n</b>	kəyɪn	kəyɪn-tɪ	‘hand’
<b>-sɪ</b>	<b>m</b>	ŋɔm	ŋɔm-sɪ	‘face’

In section 1, it was claimed that /l/ does not surface word-finally. The morphology of (41-42) shows that word-medial /l/ does surface, such as when a noun plural suffix is attached as in (41) or when a verb suffix is attached as in (42). The same suffixes are shown to attach to roots with final /l/ and to roots with other final segments.

(41)	Root-final /l/			Other root-final segments		
<b>-an</b>	mî	mîl-àn	‘custom’	par	par-an	‘coffin’
	tɔɖ	tɔɖl-an	‘hill’	mɛlɲ	mɛlɲ-an	‘dry season’
	bɪɔ	bɪɔl-an	‘person who stutters’	kɪlɛŋ	kɪlɛŋ-àn	‘animal type’
<b>-at</b>	k <sup>u</sup> èrê	k <sup>u</sup> èrêl-ât	‘Tamarind tree’	mɪŋɛ	mɪŋɛ-at	‘deaf person’
<b>-a</b>	lɪŋgɔ	lɪŋgɔl-â	‘fox’	mɔɲ	mɔɲ-â	‘mother-in-law’
<b>-a</b>	gélé	gélél-â	‘shoulder’	múnú	mún-â	‘snake’
<b>-ələ</b>	lipə	lipəl-ələ	‘soil’	gúrɛ	gúr-ələ	‘dove’

(42)	Root-final /l/		Other root-final segments	
	<u>Past</u>	<u>Passive</u>	<u>Past</u>	<u>Passive</u>
		<b>-a</b>		<b>-a</b>
	a gá ‘found’	gal-a ‘is found’	a kám ‘rowed’	kam-a ‘is rowed’
	a ɔ ‘touched’	ɔl-ɔ ‘is touched’	a tós ‘picked’	tɔs-ɔ ‘is picked’
	a kə ‘allowed’	kəl-ə ‘is allowed’	a mət ‘greeted’	mət-ə ‘is greeted’

Before proceeding to discuss Vowel and [ATR] morphophonology, a brief explanation of noun plural formation should prove helpful to the reader.

As shown in table 5, nouns can attach a suffix to mark the singular form as in *kəɔɔpɔ-sɔ* ‘leaf-SG’, the plural form as in *kɪɔɔ-nɪ* ‘chest-PL’, or both as in *ɔnɔ-sɔ/ɔnɔ-nɪ* ‘clothe-SG/clothe-PL’.

Table 5: Three ways of forming singular and plural nouns

Suffixes	Singular noun	Root	Plural noun	
<b>-sɔ/-</b>	kəɔɔpɔ-sɔ	kəɔɔpɔ		‘leaf’
<b>-/-nɪ</b>		kɪɔɔ	kɪɔɔ-nɪ	‘chest’
<b>-sɔ/-nɪ</b>	ɔnɔ-sɔ	ɔnɔ-	ɔnɔ-nɪ	‘clothe around waist’

The noun system has multiple singular and plural marker suffixes, the most common of which are listed in (43-45). They are listed according to the number of nouns attested to attach the suffix. The suffixes are mostly unpredictable as to which root they attach, by either the root-final segments or



by the semantics of the root. However, most suffixes only attach to roots with final vowels, or roots with final consonants.

(43) Nouns singular suffixes

#	Root-final	Suffixes	Singular	Plural	
54	con./vow.	-sɔ/-	àmá-sɔ	àmâ	'sandal'
5	con./vow.	-i/-	múr-ì	môr	'mosquito'

(44) Nouns plural suffixes

#	Root-final	Suffixes	Singular	Plural	
82	vow.	-/nɪ	kídó	kídó-nì	'chest, authority'
65	con.	-/an	pàrát	pàrát-àn	'ax'
40	vow.	-/at	kùŋù	kùŋù-át	'knee'
25	con./vow.	-/a	kídí	kíd'-â	'water well'
23	con.	-/ɪ	álàŋ	álàŋ-í	'salt'
6	vow.	-/ka	ŋòdé	ŋòdé-ka	'lame person'
5	con.	-/ɔn	wôr	wôr-ɔn	'stream'
4	vow.	-/ɔ	mòdɛ	mòd'-ɔ	'blind person'
2	vow.	-/ɟɪn	ŋô	ŋô-ɟɪn	'thing'
2	con.	-/in	dir	dir-in	'valley'
2	vow.	-/kə	yìní	yìní-kə	'co-wife'
2	con.	-/in	mòdɔŋ	mudɔŋ-in	'elderly person'
2	vow.	-/nə	kàjí	kàjí-nə	'town, cattle camp'
2	con./vow.	-/ələ	gúrɛ	gúr-əlɛ	'dove'
2	vow.	-/ɔt	dódɛ	dód'-ɔt	'story'
2	con./vow.	-/'a	múnú	mún-'î	'snake'
2	con.	-/tɪ	mâr	mâr-tɪ	'chief, king'
2	vow.	-/sɪk	kàdí	kàdí-sɪk	'house'
2	con./vow.	-/sɪ	ŋɔm	ŋɔm-sɪ	'face'
6	con./vow.	-/kʊ-	mɔye	kʊ-mɔye	'his.father'

(45) Nouns singular and plural combination suffixes

#	Root-final	Suffixes	Singular	Plural	
9	vow.	-sɔ/-nɪ	ɔnɔ-sɔ	ɔnɔ-nɪ	'clothe around waist'
4	vow.	-sɔ/-at	bòdɔ-sɔ	bòdɔ-ʔat	'expert'
3	con.	-sɔ/-an	kʰakʰarak-sɔ	kʰakʰarak-an	'moth'

## 7. Vowel morphophonology

I now discuss sound changes when vowels are joined at morpheme boundaries. The most common alternation in nouns is a resulting vowel glide, and the only alternation in verbs is an inserted glottal plosive.

The vowel-initial noun suffixes *-an*, *ɪ*, *-ɔn*, *-in*, *-in* are only attached to consonant-final roots. The suffixes *-at*, *-a*, *-ɔ*, *-ɔt*, *-ələ*, *-'a* and other less common vowel-initial suffixes can be attached to vowel-final noun roots, with one of four alternations, as shown in (46). The number of nouns with the the root-final vowel is given, all of which attach the suffix *-at*. The most common result of joining vowels at morpheme boundaries in nouns is that the root-final vowel becomes an on-glide for the suffix vowel. In this process, the non-high root-final vowels /ɛ/ and /ɔ/ become the high on-glides /ʰ/ and /ʰʷ/ respectively as in *jàmɛ/jàm-ʰat* 'word' and *búŋɔ/búŋʰ-ʰat* 'flock'. A similar process is documented for Kuku (Cohen 2000:21). When the Mundari nouns listed under vowel glides in (46) are said slowly, depending on how slow the utterance, they begin to have three syllables and a weak glottal introducing the suffix as in *lɔli-ʔat* 'basket', rather than two syllables and a vowel glide as in *lɔl-ʰat*. However, because they are two syllables at normal speed and the root-final vowels /ɛ/ and /ɔ/ are raised to high, all such words are analyzed to have vowel glides.

(46) Alternations when vowels are joined by attaching the plural suffix -at

	Suffix	Root-final	#	Singular	Plural	
<u>Vowel glides</u>	<b>-at</b>	<b>ɪ</b>	3	lólì	lól'- <b>ât</b>	'basket, bowl'
		<b>ʊ</b>	3	kùŋù	kùŋ' <b>-ât</b>	'knee'
		<b>i</b>	15	wəli	wəl' <b>-at</b>	'gap, space'
		<b>u</b>	9	duru	dur' <b>-at</b>	'grass'
		<b>ɛ</b>	1	jàmé	jàm' <b>-ât</b>	'word'
		<b>ɔ</b>	1	búŋɔ	búŋ' <b>-ât</b>	'flock, group'
<u>Root vowel elision</u>		<b>ʊ</b>	1	làʔú	làʔ' <b>-ât</b>	'cloth'
		<b>u</b>	1	kúʔú	kúʔ' <b>-ât</b>	'shield'
<u>Glottal insertion</u>		<b>ɛ</b>	1	mɪŋɛ	mɪŋɛ-ʔ <b>at</b>	'deaf person'
		<b>ɛ</b>	1	jàʔé	jàʔé-ʔ <b>ât</b>	'rainy season'
<u>Suffix vowel elision</u>		<b>a</b>	1	dɛka	dɛka- <b>t</b>	'number'
		<b>ɛ</b>	1	kórúʔé	kórúʔé- <b>t</b>	'widow'

The second most common result of joining vowels in nouns is root vowel elision. Alternatively, it could be analyzed that the final vowel of the singular form, such as *ʊ* in *làʔú/làʔ-ât* 'cloth', is a suffix instead of belonging to the root. However, such an analysis requires four additional singular suffixes *-ʊ*, *-i*, *-a*, *-ɛ* to account for the final vowels in the singular forms listed under root vowel elision in (46-47). Although only attested in five nouns, it is common for a weak glottal plosive to be inserted between root-final vowels and initial vowels of suffixes in verbs, as shown in (48). Since the root-final vowel /ɛ/ of *mɪŋɛ/mɪŋɛ-ʔat* 'deaf person' and *jàʔé/jàʔé-ʔât* 'rainy season' is not raised, these nouns of (46) are not analyzed to have vowel glides in the plural form. Finally, there are two nouns in which the suffix vowel is elided. Alternatively, the plural forms of such nouns could be analyzed as having the suffix *-t* instead of *-at*. However, suffixes without a vowel are extremely rare in Mundari.

The first three alternations are shown in nouns with other suffixes in (47).

(47) Alternations when vowels are joined by attaching other plural suffixes

	Suffix	Root-final	#	Singular	Plural	
<u>Vowel glide</u>	<b>-a</b>	<b>ɪ</b>	3	kílí	kíl'- <b>â</b>	'line in battle'
		<b>i</b>	2	dílí	díl'- <b>â</b>	'hole'
		<b>ɛ</b>	8	tóré	tór'- <b>â</b>	'stick, staff'
		<b>-ɔ</b>	2	mɔdɛ	mɔd'- <b>ɔ</b>	'blind person'
		<b>-ɔt</b>	2	dódɛ	dód'- <b>ɔt</b>	'story'
		<b>-ɛ</b>	1	luyəki	luyək'- <b>ɛ</b>	'apostle'
<u>Root vowel elision</u>	<b>-a</b>	<b>ʊ</b>	1	jàkú	jàk'- <b>â</b>	'animal'
	<b>-an</b>	<b>ɪ</b>	1	bóyì	bóy'- <b>án</b>	'net'
	<b>-əɔ</b>	<b>ɛ</b>	1	gúrè	gúr'- <b>əɔ</b>	'dove'
	<b>-a</b>	<b>u</b>	1	múnú	mún'- <b>â</b>	'snake'
	<b>-ɛn</b>	<b>u</b>	1	yúmú	yúm'- <b>ɛn</b>	'heart'
	<b>-ɛnə</b>	<b>a</b>	1	mántá	mánt'- <b>ɛnə</b>	'field, garden'
	<b>-ok</b>	<b>i</b>	1	míjì	míj'- <b>ok</b>	'mouse'
	<b>-i/-</b>	<b>a</b>	1	ŋúbúr-ì	ŋóbárà	'horn'
	<b>-ut/-</b>	<b>ɪ</b>	1	wúy-ùt	wúyí	'buttock'
<u>Glottal insertion</u>	<b>-sɔ/-at</b>	<b>ɔ</b>	1	bɔdɔ- <b>sɔ</b>	bɔdɔ-ʔ <b>at</b>	'expert'
	<b>-ku-</b>	<b>a</b>	2	aba	<b>ku-</b> ʔaba	'father'

In verbs, the vowel-initial suffixes of (48) can be attached to vowel-final roots such as *pɛ* 'shoot'. A glottal is inserted between each root-final vowel and initial vowel of the suffix. The verb *góm* 'throw' with root-final /m/ is given for comparison.

(48) Verb suffixes which insert a glottal when attaching to root-final vowels

Verb suffix <sup>8</sup>	Root-final vowel	Root-final consonant	
<u>imperative</u>	<b>-ε</b>	pè-ʔè ‘Shoot!’	gòm-è ‘Throw!’
<u>passive</u>	<b>-a</b>	pe-ʔa ‘is shot’	gum-a ‘is thrown’
	<b>-u</b>	pe-ʔu ‘is shot’	gum-u ‘is thrown’
<u>subordinate</u>	<b>-ari</b>	pe-ʔari ‘when is shot’	gum-ari ‘when is thrown’
<u>repetitive</u>	<b>-ajɪ</b>	pe-ʔajɪ ‘shoot repeatedly’	gum-ajɪ ‘throw repeatedly’
	<b>-aju</b>	pe-ʔaju ‘shoot repeatedly’	gum-aju ‘throw repeatedly’
<u>abitive</u>	<b>-ara</b>	pe-ʔara ‘shoot going’	gum-ara ‘throw going’
<u>ventive</u>	<b>-un</b>	pe-ʔun ‘shoot coming’	gum-un ‘throw coming’
	<b>-unda</b>	pe-ʔunda ‘shoot coming’	gum-unda ‘throw coming’
	<b>-unde</b>	pe-ʔunde ‘shoot coming’	gum-unde ‘throw coming’
<u>applicative</u>	<b>-an</b>	pe-ʔan ‘throw for’	gum-an ‘throw for’
	<b>-andɪ</b>	pe-ʔandɪ ‘throw for’	gum-andɪ ‘throw for’
	<b>-andu</b>	pe-ʔandu ‘throw for’	gum-andu ‘throw for’
<u>verbal</u>	<b>ka-anɪt</b>	ka-pe-ʔanɪt ‘shooter’	ka-gum-anɪt ‘thrower’
<u>nouns</u>	<b>ka-ak</b>	ka-pe-ʔak ‘shooters’	ka-gum-ak ‘throwers’
	<b>-et</b>	pe-ʔet ‘shooting; gun’	gum-et ‘throwing’
	<b>-etti</b>	pe-ʔetti ‘shootings; guns’	gum-etti ‘throwings’

In (49), the verbal noun suffix *-et*, applicative suffix *-an*, and ventive suffix *-un* are attached to verbs with eight different root-final vowels. The glottal can be inserted between the vowels in each case. In quick speech of some speakers, such verb forms can approximate one syllable instead of two. However, since non-high vowels such as /ε/ in *pe-ʔan* ‘shoot for’ and /ɔ/ in *kɔ-ʔan* ‘bit for’ are not raised to high vowels, the verb forms of (49) are not analyzed as containing vowel glides.

(49) Root-final	Past	Verbal noun -et	Applicative -an	Ventive -un
<b>a</b>	gá ‘wanted’	ga-ʔet ‘wanting’	ga-ʔan	ga-ʔun
<b>ε</b>	pè ‘shot’	pe-ʔet ‘shooting; gun’	pe-ʔan	pe-ʔun
<b>ɔ</b>	kó ‘bit’	kɔ-ʔet ‘biting; teeth’	kɔ-ʔan	kɔ-ʔun
<b>i</b>	pì ‘asked’	pɪ-ʔet ‘asking’	pɪ-ʔan	pɪ-ʔun
<b>u</b>	jú ‘advised’	ʃu-ʔet ‘advising; advice’	ʃu-ʔan	ʃu-ʔun
<b>ə</b>	ɲá ‘ate’	ɲə-ʔet ‘eating; spoon’	ɲə-ʔan	ɲə-ʔun
<b>i</b>	yí ‘swallowed’	yi-ʔet <sup>9</sup> ‘swallowing’	yi-ʔan	yi-ʔun
<b>u</b>	lú ‘yelled’	lu-ʔet ‘yelling; cry, shout’	lu-ʔan	lu-ʔun

The glottal is also inserted between the verbal noun prefix *ka-* and vowel-initial verb roots, as shown in (50).

(50) Past	Singular verbal noun ka-anɪt	Plural verbal noun ka-ak	
a ék ‘drove in’	ka-ʔek-anɪt	ka-ʔek-ak	‘person driving in’
a ðlɔŋ ‘stayed’	ka-ʔɔlɔŋ-anɪt	ka-ʔɔlɔŋ-ak	‘person staying’
a ɔ ‘touched’	ka-ʔɔ-ʔanɪt	ka-ʔɔ-ʔak	‘person touching’

## 8. [ATR] morphophonology

Just as the discussion in section 2 showed that the [-ATR] vowels *a*, *i*, *u* and [+ATR] vowels *ə*, *ɪ*, *ʊ* function as distinct sets in roots, I now show that these also function as distinct sets across morpheme boundaries. In Mundari, [+ATR] quality spreads from roots to suffixes, suffixes to roots, or from roots to prefixes. [+ATR] is dominant, spreading to all vowels unspecified for [ATR] in words. Vowels that are not specified for [ATR], or do not have an [ATR] association through spreading, surface as [-ATR] by default. The process can be stated simply as in the rule of (51).

<sup>8</sup> The function and meaning of many verb suffixes has yet to be determined or confirmed.

<sup>9</sup> This form needs to be checked with a native speaker.

- (51) [+ATR] rightward spreading  
 [+ATR] quality spreads from right to left or from left to right in words, to vowels unspecified for [ATR], unless vowels are separated by a mid vowel /ε/, /ɔ/.

The [+ATR] quality does not spread to the verbal noun prefix *ka-*, which can be analyzed as being underlyingly specified as [-ATR]. [+ATR] quality does not spread across the mid vowel /ε/ in *ʔɛttɪ* ‘spoons’, although the mid vowel itself takes on partial [+ATR] quality, as do other mid vowels in roots with [+ATR] vowels.

I first discuss rightward spreading from roots to suffixes (8.1), then leftward spreading from roots to prefixes (8.2), then partial spreading to mid vowels (8.3), then leftward spreading from suffixes to roots, including mid vowel raising (8.4), and finally allomorphic suffixes differing by vowel height (8.5).

### 8.1 Rightward [+ATR] spreading

In Mundari, [+ATR] quality spreads from roots to suffixes unspecified for [ATR], in both nouns and verbs. As shown in (52), when the plural suffix *-ni* attaches to nouns with [+ATR] vowels, it becomes the [+ATR] suffix *-ni*. When the plural suffix *-an* attaches to nouns with [+ATR] vowels, it becomes the [+ATR] suffix *-an*.

(52)	Root	Singular	Plural -ni		Singular	Plural -an	
[-ATR]	a	yápá	yápá-nì	‘moon, month’	pàrát	pàrát-àn	‘ax’
	ε	mèrépè	mèrépè-ní	‘grandfather’	ɲédép	ɲédép-àn	‘tongue’
	ɔ	lórɔ	lórɔ-ní	‘voice’	bóyì	bóy-án	‘net’
	ɪ	likírɔ	likírɔ-ní	‘hare’	dìŋít	dìŋít-án	‘time’
	u	nugusu	nugusu-ni	‘discouragement’	búlòk	búlòk-án	‘crowd’
[+ATR]	ə	pádà	pádà-nì	‘gold’	mák	mák-ən	‘waist’
	i	bilili	bilili-ni	‘tower’	rìŋít	rìŋít-ən	‘power’
	u	budu	budu-ni	‘feast, banquet’	múrút	múrút-ən	‘neck’

The noun plural suffixes *-at*, *-a*, *-ka*, *-i*, *-a*, *-ti*, *-sik* also become [+ATR] when attached to nouns with [+ATR] vowels.

(53)		[-ATR]		[+ATR]		
-at	kòŋò	kòŋ <sup>u</sup> -át	‘knee’	duru	dur <sup>u</sup> -ət	‘grass’
-a	kídí	kídí-â	‘waterwell’	kídí	kídí-â	‘arm’
-ka	ɲòdé	ɲòdé-kà	‘lame person’	yini	yini-kə	‘medicine’
-i	álàn	álàn-í	‘salt’	lugulusən	lugulusən-i	‘vulture’
-a	gélé	gélé-â	‘shoulder’	múnú	mún-â	‘snake type’
-ti	mâr	mâr-tí	‘chief’	kàyìn	kàyín-ti	‘hand’
-sik	kàdí	kàdí-sik	‘house’	kùmè	kùmú-sik	‘nose’

In verbs, the indicative suffix *-ɸ*, and the directional suffixes *-ara* and *-un* become [+ATR] when attached to roots with [+ATR] vowels.

(54)	Root	Past	Indicative -ɸ	Abitive -ara	Ventive -un	
[-ATR]	a	a gá	ga-ɸ	ga-ʔara	ga-ʔun	‘want’
	ε	a pè	pε-ɸ	pε-ʔara	pε-ʔun	‘shoot’
	ɔ	a kó	kɔ-ɸ	kɔ-ʔara	kɔ-ʔun	‘bit’
	ɪ	a pì	pɪ-ɸ	pɪ-ʔara	pɪ-ʔun	‘ask’
	u	a ɸú	ɸu-ɸ	ɸu-ʔara	ɸu-ʔun	‘advise’

[+ATR]	ə	a ɲə	ɲə-ʝi	ɲə-ʝərə	ɲə-ʝun	'eat'
	i	a lim	lim-ʝi	lim-ərə	lim-un	'check'
	u	a lú	lu-ʝi	lu-ʝərə	lu-ʝun	'yell'

The verb suffixes of (55) also become [+ATR] when attached to roots with [+ATR] vowels.

(55) Verb suffix		[-ATR]		[+ATR]	
<u>indicative</u>	-ja	gum- <b>ba</b>	'throw'	tur- <b>ʝə</b>	'chase'
<u>passive</u>	-a	gum- <b>a</b>	'is thrown'	tur- <b>ə</b>	'is chased'
	-u	gum- <b>u</b>	'is thrown'	tur- <b>u</b>	'is chased'
<u>subordinate</u>	-ari	gum- <b>ari</b>	'when is thrown'	tur- <b>əri</b>	'when is chased'
<u>repetitive</u>	-ajɪ	gum- <b>ajɪ</b>	'throw repeatedly'	tur- <b>əjɪ</b>	'chase repeatedly'
	-ajɔ	gum- <b>ajɔ</b>	'throw repeatedly'	tur- <b>əjɔ</b>	'chase repeatedly'
<u>ventive</u>	-unda	gum- <b>unda</b>	'throw while coming'	tur- <b>unda</b>	'chase while coming'
<u>applicative</u>	-an	gum- <b>an</b>	'throw for'	tur- <b>ən</b>	'chase for'
	-andɪ	gum- <b>andɪ</b>	'throw for'	tur- <b>əndɪ</b>	'chase for'
	-andu	gum- <b>andu</b>	'throw for'	tur- <b>əndu</b>	'chase for'
<u>negative</u>	-ni	gum- <b>ni</b>	'not throw'	tur- <b>ni</b>	'not chase'
	-ani	gum- <b>ani</b>	'is not thrown'	tur- <b>əni</b>	'is not chased'

In Bari (Hall and Yokwe 1981:57) and in Kuku (Cohen 2000:16), [+ATR] quality is documented to spread rightward to noun and/or verb suffixes similar to those of Mundari.

## 8.2 Leftward [+ATR] spreading from roots to prefixes

Similarly, [+ATR] quality spreads from roots to prefixes unspecified for [ATR] in both nouns and verbs. As shown in (56-58), [+ATR] quality spreads to the noun prefix *ku-* and the causative prefixes *tɔ-* and *tu-*, all of which are underlyingly unspecified for [ATR].

(56)		<u>Singular</u>	<u>Plural</u>	
			<b>ku-</b>	
	[-ATR]	aba	<b>ku-ʝaba</b>	'father'
		ama	<b>ku-ʝama</b>	'mother'
		məyɛ	<b>ku-məyɛ</b>	'his.father'
		ɲərə	<b>ku-ɲərə</b>	'his.mother'
	[+ATR]	muyi	<b>ku-muyi</b>	'your(sg).father'
		ɲuri	<b>ku-ɲuri</b>	'your(sg).mother'

(57)	<u>Root</u>	<u>Non-causative</u>	<u>Causative</u>	
			<b>tɔ-</b>	
	[-ATR]	a saka 'sit'	<b>tɔ-saka</b>	'make person sit'
		ɛ gɛrək 'one'	<b>tɔ-gɛrək</b>	'first'
		ɔ kər 'divide, separate'	<b>tɔ-kər</b>	'testify, confess, interpret'
		ɪ gɪrɪpuk 'nine'	<b>tɔ-gɪrɪpuk</b>	'ninth'
		u ʝú-lɪŋ 'friends'	<b>tɔ-ʝu-lɪŋ</b>	'befriend'
	[+ATR]	i ɪʝə 'big, important'	<b>tɔ-ɪʝə</b>	'honor someone'
		u ʝup 'dress oneself'	<b>tɔ-ʝup</b>	'dress someone'

(58)	<u>Root</u>	<u>Non-causative</u>	<u>Causative</u>	
			<b>tu-</b>	
	[-ATR]	a kayu 'first born child'	<b>tu-kayu</b>	'birthright'
		ɛ ləm-an 'be healed, beautiful'	<b>tu-ləm-a</b>	'heal, make beautiful'
		ɔ mənət 'five'	<b>tu-mənət</b>	'fifth'
		ɪ l'əŋ-an 'disappear, be lost'	<b>tu-l'əŋ</b>	'loose something'
	[+ATR]	ə bər 'buy'	<b>tu-bər</b>	'sell'
		i r'əŋ 'be surprised'	<b>tu-r'əŋ</b>	'surprise someone'

| u | pùr 'lay, place something' | tu-pur-u 'lay something down'

However, as shown in (59), [+ATR] quality does not spread to the prefix *ka-* of singular and plural verbal nouns, which may be underlyingly specified as [-ATR]. The only other prefix in Mundari is the incomplete CV- where the first root consonant and vowel are copied and prefixed to the root.

(59) Root	Past		Verbal noun singular	Verbal noun plural	
a	a gá	'wanted'	ka-ga-ʔanɪt	ka-ga-ʔak	'wanter'
ɛ	a pè	'shot'	ka-pe-ʔanɪt	ka-pe-ʔak	'shooter'
ɔ	a kó	'bit'	ka-kɔ-ʔanɪt	ka-kɔ-ʔak	'biter'
ɪ	a pì	'asked'	ka-pɪ-ʔanɪt	ka-pɪ-ʔak	'asker'
u	a ʃú	'advised'	ka-ʃu-ʔanɪt	ka-ʃu-ʔak	'adviser'
ə	a ɲó	'ate'	ka-ɲə-ʔənɪt	ka-ɲə-ʔək	'eater'
i	a lim	'checked'	ka-lim-ənɪt	ka-lim-ək	'checker'
u	a lú	'yelled'	ka-lu-ʔənɪt	ka-lu-ʔək	'yeller'

In Bari (Hall and Yokwe 1981:57) and Kuku (Cohen 2000:17), [+ATR] quality is documented to spread leftward to a causative verb prefix similar to that of Mundari.

### 8.3 Partial [+ATR] quality on /ɛ/, /ɔ/

As shown in (13) and repeated in (60), the vowel phonemes /ɛ/, /ɔ/ have partial [+ATR] quality when they occur in roots with [+ATR] vowels.

#### (60) Vowels /ɛ/ and /ɔ/ with [+ATR] vowels in the same root

bɛtin	'resembling (MOD)'	kínɛ	'goat'
lɔpɪʃɔt	'male sheep or goat'	kɪʃɔ	'grinding stone'
kɔbúkən	'wings'	gúrɛ	'dove'

When the singular suffix *-sɔ* is attached to nouns with [+ATR] vowels, it also has partial [+ATR] quality *-sɔ*.

(61)	Root	Singular -sɔ	Plural	
[-ATR]	a	àmá-sɔ	àmâ	'sandal'
	ɛ	mèdɛ-sɔ	lù-médè	'neighbour'
	ɔ	tólók-sɔ	tólók	'egg'
	ɪ	rɪma-sɔ	rɪma	'fetas'
	u	kùyú-sɔ	kùyú	'bone'
[+ATR]	ə	l'ənə-sɔ	l'ənə	'foreigner'
	i	dírɪ-sɔ	dírɪ	'unmarried girl, virgin'
	u	pùrú-sɔ	pùrú	'flea'

Similarly, the singular verbal noun suffix *-ɛt* has partial [+ATR] quality *-ɛt* when attached to verb roots with [+ATR] vowels. Although, the plural verbal noun suffix *-ɛttɪ* has partial [+ATR] quality *-ɛttɪ* when attached to verb roots with [+ATR] vowels, the final vowel *ɪ* of the suffix does not have [+ATR] quality. In this suffix, the mid vowel /ɛ/ may act as a barrier for the [+ATR] spreading.

(62)	Past verb	Verbal noun singular	Verbal noun plural	
a	a gá 'wanted'	ga-ʔɛt	ga-ʔɛttɪ	'wanting'
ɛ	a pè 'shot'	pe-ʔɛt	pe-ʔɛttɪ	'shooting; gun'
ɔ	a kó 'bit'	kɔ-ʔɛt	kɔ-ʔɛttɪ	'biting; tooth'

<b>i</b>	a pì	‘asked’	pi-ʔet	pi-ʔetti	‘asking’
<b>u</b>	a ʔú	‘advised’	ʔu-ʔet	ʔu-ʔetti	‘advising; advice’
<b>ə</b>	a ɲó	‘ate’	ɲə-ʔet	ɲə-ʔetti	‘eating; spoon’
<b>i</b>	a lìm	‘checked’	lim-ɛt	lim-ɛtti	‘checking’
<b>u</b>	a lú	‘yelled’	lu-ʔet	lu-ʔetti	‘yelling; cry, shout’

The verb suffixes of (63) also have vowels that have partial [+ATR] quality when attached to roots with [+ATR] vowels.

(63)		[-ATR]		[+ATR]
	<u>indicative</u>	-je	gum-be ‘throw’	tur-je ‘chase’
	<u>imperative</u>	-e	gòm-è ‘Throw!’	tùr-è ‘Chase!’
	<u>subordinate</u>	-jere	góm-bèrè ‘when throws’	túr-jèrè ‘when chases’
	<u>ventive</u>	-unde	gum-unde ‘throw while coming’	tur-unde ‘chase while coming’

#### 8.4 Leftward [+ATR] spreading from suffixes to roots

There are various noun and verb suffixes that are underlyingly specified as [+ATR] and spread their quality leftward onto the root. As stated in (64), the vowels /ɛ/, /ɔ/ are raised to /i/, /u/ respectively through leftward [+ATR] spreading. This raising process only occurs when [+ATR] quality spreads from suffixes to root, and not when [+ATR] spreads from roots to suffixes or from roots to prefixes.

#### (64) [+ATR] vowel raising

When [+ATR] quality spreads leftward from suffixes onto the root vowels /ɛ/, /ɔ/, they are raised to /i/, /u/ respectively.

As shown in (65), the [+ATR] noun singular suffix *-i* attaches to roots that are unspecified for [ATR] quality. In such nouns, the singular form surfaces as [+ATR] even though the plural form surfaces as [-ATR]. For *dên* ‘trees’, the vowel /ɛ/ is raised to /i/ (*dìn-i* ‘tree’). For *ɲorɔp* ‘stones’, the vowel /ɔ/ is raised to /u/ (*ɲurup-i* ‘stone’).

(65)		<u>Singular</u>	<u>Plural</u>	
		<b>-i</b>		
	<b>[-ATR]</b>	múr-ì	môr	‘mosquito’
		dìn-í	dên	‘tree type’
		ɲurup-i	ɲorɔp	‘stone’
		ɲúbúr-ì	ɲóbórà	‘horn’
	<b>[+ATR]</b>	pir-i	pir	‘hair’

In (66-67), the [+ATR] plural suffixes *-kə* and *-in* attach to roots with the result that the plural noun surfaces as [+ATR], even though the singular form surfaces with [-ATR].

(66)		<u>Singular</u>	<u>Plural</u>	
			<b>-kə</b>	
	<b>[-ATR]</b>	yìní	yìní-kə	‘co-wife’
		rúbé	rúbé-kə	‘sorcerer’

(67)		<u>Singular</u>	<u>Plural</u>	
			<b>-in</b>	
	<b>[-ATR]</b>	bórɔŋ	búrúŋ-in	‘harmful animal (such as lion)’
		mɔdɔŋ	mudun-in	‘elderly person’

Note that the *-ka* suffix in *ɲ̀d̀d̀é/ɲ̀d̀d̀é-kà* ‘lame person’ and possibly in *yini/yini-kə*<sup>10</sup> ‘medicine’ of (68) is underlyingly unspecified for [ATR] and takes the [ATR] quality of the root. However, the *-kə* suffix in *yini/yini-kə* ‘co-wife’ of (66) is underlyingly specified as [+ATR] and causes the root to be [+ATR]. As with other noun suffixes, the suffixes *-ka* and *-kə* are unpredictable as to which roots they attach, either by root-final segments or by the semantics of the root. Similarly, the *-m* suffix of (69) is underlyingly unspecified for [ATR], and the *-in* suffix of (67) is underlyingly specified for [+ATR], again unpredictable as to which roots they attach.

(68)	<u>Singular</u>	<u>Plural</u>	
		<b>-ka</b>	
<b>[-ATR]</b>	ɲ̀d̀d̀é lɔ̀ɛ	ɲ̀d̀d̀é-kà lɔ̀ɛ-kà	‘lame person’ ‘baby, small child’
<b>[+ATR]</b>	yini	yini-kə	‘medicine’

(69)	<u>Singular</u>	<u>Plural</u>	
		<b>-in</b>	
<b>[-ATR]</b>	d̥ir d̥aŋ	d̥ir-in d̥aŋ-in	‘valley’ ‘time’

In (70), the [+ATR] quality of noun suffixes spreads leftward to the root, also resulting in [+ATR] forms, even though the other form surfaces as [-ATR]. The suffix *-san* is particularly unusual in that it surfaces as [-ATR], but causes the root it is attached to to become [+ATR].

(70)	<u>Singular</u>	<u>Plural</u>	
<b>-/-<sup>1</sup>əŋə</b>	mántá	mánt- <sup>1</sup> əŋə	‘field, garden’
<b>-/-sək</b>	médé	mídí-sək	‘family, household, house’
<b>-sə/-in</b>	aŋ-sə	əŋ-in	‘baren person or animal’
<b>-k/-ən</b>	kúrú-k	kúr- <sup>1</sup> ən	‘mouth, beak, language’
<b>-nit/-k</b>	túmú-nit	tómó-k	‘slave, servant’
<b>-isɔ/-ɔt</b>	ɲ̀bɔl-isɔ	ɲ̀bɔl-ɔt	‘tree type’
<b>-t/-san</b>	óló-t	úlú-sàn	‘flour’
	wèlé-t	wilí-sàn	‘oil’

There is also one causative allomorph prefix *tə-* that causes the root of the verb of (71) to become [+ATR]. Presumably this is a morphologically distinct prefix from the causative prefix *tə-* in *tə-gerək* ‘first’ and distinct from the causative prefix *tə-* in *tə-lem-a* ‘heal, make beautiful’. These were both shown in (57-58) and do not spread [+ATR] quality to the root.

(71)	<u>Past</u>	<u>Causative</u>	
		<b>tə-</b>	
	dén ‘know, think’	tə-din	‘teach’
	dén ‘know, think’	tə-din-ə	‘learn’

In addition, there are two noun suffixes *-nə*, *-ə* that only attach to [+ATR] roots. These could be analyzed as underlyingly unspecified for [ATR] and taking the [+ATR] quality of the root, or as underlyingly specified as [+ATR] and spreading their quality without change to the root.

(72)	<u>Singular</u>	<u>Plural</u>	
		<b>-nə</b>	
<b>[+ATR]</b>	kəŋí ri	kəŋí-nə ri-nə	‘town, cattle camp’ ‘tree type’

<sup>10</sup> In the noun *yini/yini-kə* ‘medicine’, the suffix can be analyzed as underlyingly unspecified for [ATR] and taking the [+ATR] quality of the root, or as underlyingly specified as [+ATR] and spreading its quality without change to the root.



(73)	<u>Singular</u>	<u>Plural</u> -ələ	
[+ATR]	lipə gúrɛ	lipəl-ələ gúr-əlɛ	‘soil’ ‘dove’

In verbs, there are two suffixes underlyingly specified as [+ATR] which spread their quality leftward onto roots with mid vowels. Unlike [+ATR] noun suffixes which can spread their quality onto roots with any of the 8 vowel phonemes, [+ATR] verb suffixes only spread their quality onto mid vowels. In (69), the [+ATR] passive suffix *-u* and ventive suffix *-un* are attached to roots that surface as [-ATR] in the past form, but [+ATR] in poassive and ventive forms. For *kép* ‘followed’, the root vowel /ɛ/ is raised to /i/ (*kip-u* ‘is followed’). For *wɔk* ‘beat’, the root vowel /ɔ/ is raised to /u/ (*wuk-u* ‘is beaten’).

(74)	<u>Root</u>	<u>Past</u>	<u>Passive</u> -u	<u>Ventive</u> -un
ɛ	a kɛp ‘followed’ a ɛk ‘drove in’	kip-u ‘is followed’ ik-u ‘is driven in’	kip-un ‘follow coming’ ik-un ‘driving in coming’	
ɔ	a wɔk ‘beat’ a ɔt ‘removed’	wuk-u ‘is beaten’ ɔt-u ‘is removed’	wuk-un ‘beat coming’ ɔt-un ‘remove coming’	

However, as was seen in (54-55) and can again be seen in (75), passive verbs may also have the suffix *-u* and ventive verbs may also have the suffix *-un*.

(75)	<u>Root</u>	<u>Past</u>	<u>Passive</u> -u	<u>Ventive</u> -un
ɛ	a mɛt ‘looked’ a pɛ ‘shot’	met-u ‘is looked at’ pɛ-ʔu ‘is shot’	met-un ‘look coming’ pɛ-ʔun ‘shot coming’	
ɔ	a rɔp ‘paid’ a kɔn ‘did’	rɔp-u ‘is paid’ kɔn-u ‘is made’	rɔp-un ‘pay coming’ kɔn-un ‘did coming’	

The suffixes *-u* and *-un* of (75) are underlyingly unspecified for [ATR] and take the [ATR] quality of the root, whereas the suffixes *-u* and *-un* of (74) are underlyingly specified as [+ATR] and cause the root to be [+ATR]. As with noun suffixes, these verb suffixes are unpredictable in their attachment to root-final segments or by the semantics of the root. Thus, they are analyzed to be morphologically distinct—the one undergoing [+ATR] spreading, the other causing root vowels to be raised and to become [+ATR].

In Bari (Hall and Yokwe 1981:57, 59) and Kuku (Cohen 2000:17, 43), [+ATR] quality is documented to spread leftward to the root from noun and verb suffixes similar to those of Mundari. However, since Bari and Kuku have 10 vowel phonemes including the [+ATR] mid vowel /e/ and /o/, and since Mundari has only 8 vowel phonemes, not including these [+ATR] mid vowels, here there are some differences for Mundari.

In both Bari and Kuku, [+ATR] root mid vowels /e/ and /o/ are raised to /i/ and /u/ respectively when [+ATR] suffixes are attached. However, at least in Kuku, [-ATR] vowels of verbs are not raised<sup>11</sup> as they are in Mundari, as shown in table 6. Apparently, the assimilation process of mid root vowels raising in Bari and Kuku is more productive with [+ATR] suffixes than with [-ATR] suffixes.

Table 6: Mid vowel raising compared in related languages

Bari (Hall and Yokwe 1981:59)	Kuku (Cohen 2000:17)	Mundari
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<sup>11</sup> In Kuku (Cohen 2000:42-43), the [-ATR] mid vowel /e/ and /o/ are documented to be raised to [+ATR] high vowels in the nouns *másír-ə̀tót/másér* ‘cattle ticks/cattle tick’ and *kətùlúk-ùti/kàtèlɔk* ‘egg/eggs’, but in general, [-ATR] mid vowels are not raised in Kuku or Bari, as they are in Mundari.

	Ventive <sup>12</sup>			Ventive				Ventive		
<b>o</b>	són	sún-ún	‘send’	tók	túk-ún	‘chop’	ɔ	wək	wuk-un	‘beat’
<b>e</b>	rém	rím-ún	‘spear’	kéʔ	kíl-ún	‘fry’	ɛ	kép	kip-un	‘follow’
<b>ɔ</b>				jók	jók-ún	‘hit’	ɔ	róp	rɔp-un	‘pay’
<b>ɛ</b>				gbéʔ	gbél-ún	‘contribute’	ɛ	mèt	met-un	‘look’
<b>a</b>				ɲán	ɲán-ún	‘dismantle’	<b>a</b>	kám	kam-un	‘row’
<b>i</b>				díp	díp-ún	‘support’	<b>i</b>	pì	pi-ʔun	‘ask’
<b>u</b>				dúk	dúk-ún	‘push’	<b>u</b>	ʃú	ʃu-ʔun	‘advise’
<b>ə</b>				kár <sup>13</sup>	kár-ún	‘spoil’	ə	mət	mət-un	‘greet’
<b>i</b>				dǐp	dǐp-ún	‘sound’	<b>i</b>	lim	lim-un	‘check’
<b>u</b>				dúk	dúk-ún	‘build’	<b>u</b>	túr	tur-un	‘chase’

In comparing Mundari ventive forms with Kuku ventive forms in table 6, we can see a diachronic reason for the two ventive suffixes in Mundari. Kuku also has ventive suffixes that involve similar morphological processes to Mundari ventive suffixes. In Kuku, and presumably in Bari from the vowel rules of Hall and Yokwe (1981:59), a [+ATR] ventive suffix *-un* is predictably attached to roots with [+ATR] vowels (in which root vowels /e/ and /o/ are raised), whereas a [-ATR] ventive suffix *-un* is attached to roots with [-ATR] vowels, including the [-ATR] root vowels /e/ and /ɔ/. Whereas in Kuku and Bari, only [+ATR] root mid vowels are raised, and are predictably raised, in Mundari, [-ATR] root mid vowels are unpredictably raised. Which root vowels are raised in Mundari is unpredictable from a synchronic point of view, but most likely are in the lexemes which have [+ATR] mid root vowels in Kuku and Bari. We can imagine that Mundari may at one time have had phonemic [+ATR] mid vowels which were raised in ventive verbs as in Kuku and Bari. Although these mid vowels in Mundari are no longer contrastive with [-ATR] mid vowels, they still undergo the raising process.

### 8.5 Suffixes differing by vowel height

Just as there are the noun and verb pairs of suffixes *-ka/-kə*, *-u/-u*, *-on/-un* with underlyingly different [ATR] vowels, there are also noun and verb pairs of suffixes *-an/-ən*, *-a/-ə*, *-ara/-arə*, *-ari/-ari*, *-aju/-aju* that are also unpredictable by root-final segments or by the semantics of the root.

Although rare, the noun plural suffixes *-ən* and *-ə* of (76) only differ in vowel height from the common plural suffixes *-an* and *-a* of (52-53) and repeated in (77). But both pairs of suffixes are unpredictable as to which root they attach, as are many of the other noun plural allomorphs listed in (44).

(76)	Root	Singular	Plural		Singular	Plural
			<b>-ən</b>			<b>-ə</b>
	ɛ	pérék	pérék-ən	‘fish spear’	lókóré	lókór-ə
	ɔ	wôr	wôr-ən	‘stream’	lɔŋɛ	lɔŋ-ə

(77)	Root	Singular	Plural		Singular	Plural
			<b>-an</b>			<b>-a</b>
	ɛ	ɲédép	ɲédép-an	‘tongue’	tómé	tóm-â
	ɔ	bóyì	bóy-án	‘net’	kóŋé	kóŋ-â

Similarly, the verb suffixes *-arə*, *-ari*, and *-aju* of (78) only differ in vowel height in some vowels from the suffixes *-ara*, *-ari*, and *-aju* of (79) respectively, and can be analyzed as unpredictable allomorphs of the same morphemes.

(78)	Past	Abitive	Subjunctive	Repetitive
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<sup>12</sup> This verb form is not labeled in (Hall and Yokwe), but glossed as having meaning which might indicate a ventive form.

<sup>13</sup> Cohen (2000:6) uses the symbol *i* for the central [+ATR] vowel *ə*.

		<b>-ɔɔ</b>	<b>-ɔɪ</b>	<b>-ɔʃʊ</b>	
<b>ɛ</b>	a kɛp	kɛp- <b>ɔɔ</b>	kɛp- <b>ɔɪ</b>	kɛp- <b>ɔʃʊ</b>	‘follow’
<b>ɔ</b>	a wɔk	wɔk- <b>ɔɔ</b>	wɔk- <b>ɔɪ</b>	wɔk- <b>ɔʃʊ</b>	‘beat’

(79)	<u>Past</u>	<u>Abitive</u> <b>-ara</b>	<u>Subjunctive</u> <b>-ari</b>	<u>Repetitive</u> <b>-aʃʊ</b>	
<b>ɛ</b>	a mèt <i>looked</i>	met- <b>ara</b>	met- <b>ari</b>	met- <b>aʃʊ</b>	‘look’
<b>ɔ</b>	a róp <i>paid</i>	rɔp- <b>ara</b>	rɔp- <b>ari</b>	rɔp- <b>aʃʊ</b>	‘pay’

By contrast, the subordinate verb suffix *-jere/jiri* is predictable according to the vowel height of the root. When attached to a root with final high vowel as in (80), the suffix surfaces with the non-high vowel /ɛ/ or [ɛ̃]. When attached to a root with final non-high vowel as in (81), the suffix surfaces with the high vowel /i/ or /ĩ/.

(80)	<u>Root</u>	<u>Past</u>	<u>Subordinate</u> <b>-jere</b>
<b>[-ATR]</b>	<b>ɪ</b>	a pì ‘asked’	pí- <b>jèrè</b> ‘when asked’
	<b>ʊ</b>	a ʃú ‘advised’	ʃú- <b>jèrè</b> ‘when advised’
<b>[+ATR]</b>	<b>i</b>	a yí ‘swallow’	yí- <b>jèrè</b> ‘when swallowed’
	<b>u</b>	a lú ‘yelled’	lú- <b>jèrè</b> ‘when yelled’

(81)	<u>Root</u>	<u>Past</u>	<u>Subordinate</u> <b>-jiri</b>
<b>[-ATR]</b>	<b>a</b>	a kám ‘row’	kám- <b>bìrì</b> ‘when rowed’
	<b>ɛ</b>	a pè ‘shot’	pé- <b>jìrì</b> ‘when shot’
	<b>ɔ</b>	a kó ‘bit’	kó- <b>jìrì</b> ‘when bit’
<b>[+ATR]</b>	<b>ə</b>	a kó ‘left’	kólə- <b>jìrì</b> ‘when left’

Thus Mundari has predictable vowel change in the subordinate suffix *-jere/jiri*, as well as a host of affixes unspecified for [ATR] that take the [ATR] quality of the root. It has unpredictable vowels in other suffixes, including the pairs *-ka/-kə*, *-u/-u*, *-un/-un* with underlyingly different [ATR] vowels, and the pairs *-an/-ɔn*, *-a/-ɔ*, *-ara/-ɔɔ*, *-ari/-ɔɪ*, *-aʃʊ/-ɔʃʊ* with underlyingly differing vowel heights.

Again in comparing Mundari forms with Kuku and Bari forms, we can see a diachronic reason for the pairs of suffixes in Mundari with differing vowel heights, as shown in table 7. Kuku and Bari also have pairs of suffixes differing in vowel height. In Kuku, a [+ATR] abitive suffix *-arəʔ* is predictably attached to roots with [+ATR] vowels, whereas a [-ATR] abitive suffix *-araʔ* is attached to roots with [-ATR] vowels. However, the vowels of the [+ATR] suffix *-arəʔ* are raised to mid vowels (*-oroʔ*) when attached to roots with [+ATR] mid vowels /o/ or /e/. A similar process occurs in Bari for the passive suffix *-ə* when attached to roots with [+ATR] mid vowels. Whereas in Kuku and Bari, the suffix vowel *ə* is only raised to *o* when attached to roots with [+ATR] root mid vowels, and is predictably raised in this environment, in Mundari, suffixes with the vowel *ɔ* are unpredictably attached to roots with [-ATR] mid vowels. The vowels in roots to which Mundari *ɔ* suffixes attach are likely in the lexemes which have [+ATR] mid root vowels in Kuku and Bari. We can imagine that Mundari may at one time have had *ə* suffixes raised to *o* when attached to roots with [+ATR] mid vowels, as in Kuku and Bari. Although Mundari roots with mid vowels no longer have an [ATR] contrast, the suffixes that differ in vowel height still attach to the corresponding historic [ATR] quality of mid root vowels.

Table 7: Suffix vowel height differences compared in related languages

	<u>Bari (Hall and Yokwe 1981:58)</u>			<u>Kuku (Cohen 2000:16)</u>			<u>Mundari</u>			
	Passive			Abitive			Abitive			
<b>o</b>	tók	tók-ð	‘cut’	tók	tók- <b>órðʔ</b>	‘chop’	<b>ɔ</b>	wɔk	wɔk- <b>ɔɔ</b>	‘beat’
<b>e</b>	péʔ	pél-ð	‘roast’	kéʔ	kél- <b>órðʔ</b>	‘fry’	<b>ɛ</b>	kép	kép- <b>ɔɔ</b>	‘follow’

ɔ		ʝók	ʝók-árâ?	'hit'	ɔ	róp	róp-ara	'pay'
ε		gbé?	gbél-árâ?	'contribute'	ε	mèt	met-ara	'look'
a		ɲán	ɲáj-árâ?	'dismantle'	a	kám	kam-ara	'row'
i		díp	díp-árâ?	'support'	i	pì	pi-ʔara	'ask'
u		dúk	dúk-árâ?	'push'	u	ʝú	ʝu-ʔara	'advise'
ə		kár	kár-érâ?	'spoil'	ə	mèt	mət-ərə	'greet'
i	wíŋ wíŋ-ə <sup>14</sup>	díp	díp-érâ?	'sound'	i	lìm	lim-ərə	'check'
u		dúk	dúk-érâ?	'build'	u	túr	tur-ərə	'chase'

### 9. [ATR] vowel raising compared with that of Laru and Fur

There are two other languages attested to have the [-ATR] mid vowels /ε/ and /ɔ/ raised to the [+ATR] high vowels [i] and [u] through morphology: Laru, a Niger-Kordofanian, Heiban group language and Fur, a Nilo-Saharan isolate. Both have the same 8 vowel phonemes as Mundari. In addition, both have leftward and rightward [+ATR] spreading, where the spreading is from roots to affixes and affixes to roots, as in Mundari. Also, the [+ATR] spreading occurs fully on high and low vowels, but only partially (or not at all) on mid vowels, as in Mundari.

Further, all three languages have cooccurrence restrictions for mid vowels with other vowels. In Laru, the most restrictive of the three languages, mid vowels /ε/, /ɔ/ do not occur in roots with [+ATR] vowels. In fact, they do not even occur in roots with [-ATR] vowels /i/, /u/ (Abdallah 2012:19). In Fur, mid vowels do not occur in roots preceding [+ATR] vowels /i/, /u/, /ə/. Mid vowels do occur following [+ATR] vowels, and like in Mundari, have only partial [+ATR] quality [e], [o] in this position (Kutch Lojenga 2012:37-38). Mundari's restriction of mid vowels with the [+ATR] vowel /ə/ and limited occurrence of mid vowels with other [+ATR] vowels is not surprising, when compared with the restrictions in these other languages with the same 8 vowel phonemes.

Table 8: Vowel cooccurrence restrictions compared in related languages

Laru (Abdallah 2012:19)		Fur (Waag 2010:33, Kutsch Lojenga 2012:37)				Mundari												
	ɔ [ɔ]	ε [ε]	ə	u	i		ɔ [ɔ]	ε [ε]	ə/a	u	i		ɔ [ɔ]	ε [ε]	ə	u	i	
ɔ [ɔ]	-	-	-	-	-	ɔ [ɔ]	-	-	-	-	-	ɔ [ɔ]	-	-	-	x	x	x
ε [ε]	-	-	-	-	-	ε [ε]	-	-	-	-	-	ε [ε]	-	-	-	-	-	x
ə	-	-	x	x	x	ə	x	x	x	x	x	ə	-	-	x	x	x	x
u	-	-	x	x	x	u	x	x	x <sup>15</sup>	x	x	u	-	x	x	x	x	x
i	-	-	x	x	x	i	x	x	x	x	x	i	x	x	x	x	x	x

Finally, in all three languages, mid root vowels /ε/ and /ɔ/ are predictably raised to the [+ATR] high vowels [i] and [u] when [+ATR] affixes are attached to the root. In addition to the [+ATR] imperative suffix *-di* shown in table 9, Laru also has [+ATR] suffixes for passive/reflexive *-ni*, dative *-ji*, and imperative passive/reflexive *-nə* which also cause mid root vowels to be raised (Abdallah 2012:25). In addition to the [+ATR] nominalizer suffix *-iŋ* attached to adjectives shown in table 9, Fur also has a third person plural suffix *-l* with floating [+ATR] feature, which also causes mid vowels to be raised in past verbs, such as *k-ɛllɔ* 'we pulled' / *k-illɔ-l* 'they pulled' (Kutch Lojenga:40-41). In Mundari, mid vowels are similarly raised in roots when [+ATR] affixes are attached, although perhaps not as often as in Laru and Fur.

Table 9: Mid vowel raising compared in other languages

Laru (Abdalla 2012:25)		Fur (Kutch Lojenga 2012:39)		Mundari	
Infinitive	Imperative	Adjective	Adjectival Noun	Singular	Plural

<sup>14</sup> Hall and Bokwe (1981:55) use the symbol *ö* for the low central [+ATR] vowel *ə*.

<sup>15</sup> In Fur, only [a] follows /u/ and /i/ in roots and not [ə] (Waag 2010:33)

ɔ	rɔ	ru-di	‘grind’	tɔy	tɔy-iŋ	‘old’	mɔdɔŋ	mudɔŋ-in	‘person’
ɛ	dɛdɛ	di-di	‘cut’	tɛyy-â	tɛyy-iŋ	‘clean’	médé	mídí-sək	‘house’
a	ŋaŋa	ŋəŋə-di	‘rub’	əpp-â	əpp-iŋ	‘big’	mántá	mənt- <sup>1</sup> ənə	‘field’
i	dagɾi	dəgri-di	‘chew’	kùrr-â	kùrr-iŋ	‘tall’	yini	yini-kə	‘cowife’
u	ru	ru-di	‘change’	sikk-â	sikk-iŋ	‘sharp’	kúru-k	kúri-ən	‘mouth’

The languages differ, however, in mid vowels being raised in affixes attached to [+ATR] roots. I have found no affixes with mid vowels in the descriptions of Laru. In Fur, affixes as well as roots have mid vowels raised to high [+ATR] vowels, although the raising in both roots and affixes only occurs when preceding [+ATR] vowels, as this is the environment where mid vowels are not allowed (Kutch Lojenga 2012:42, Waag 2010:35). In Mundari, although there are mid vowels in affixes which have partial [+ATR] quality when attached to [+ATR] roots, only the mid vowels of roots are ever raised to high [+ATR] vowels, as when [+ATR] affixes are attached.

Further, the reason for mid vowels being raising is different for Mundari than for Laru and Fur. The raising of mid vowels in Laru and Fur can be argued to result because co-occurrence restrictions. Namely, Laru never allows a mid vowel to occur with a [+ATR] vowel, and Fur never allows a mid vowel to precede a [+ATR] vowel. To prevent mid vowels from occurring in these environments through morphology, both languages raise mid vowels to [+ATR] vowels, thus overting the restrictions.

But as seen in the previous section, mid vowels in Mundari are raised because of diachronic reasons, rather than because of any co-occurrence restrictions. Mundari can be argued to previously have had phonemic [+ATR] mid vowels, which were raised in roots with various [+ATR] suffixes attached (as still occurs in Bari and Kuku, where the raising assimilation process is stronger with [+ATR] high vowel suffixes than with [-ATR] suffixes). Although in Mundari these mid vowels are no longer contrastive with [-ATR] mid vowels, they still undergo the raising process.

Mundari has the co-occurrence restriction of (14)—that mid vowels never occur in adjacent syllables of roots with the non-high [+ATR] vowel /ə/. However, this restriction only applies to roots, and cannot be analyzed as the cause of most of the mid vowels that are raised. When mid vowels follow /ə/ through morphology, as in /<sup>1</sup>ənə-sɔ/ /<sup>1</sup>ənə ‘foreigner’ or /<sup>1</sup>ə/ /<sup>1</sup>ə-ʔɛt ‘ate/spoon’, they are not raised to High vowels. Further, the majority of Mundari mid vowels that are raised are in roots that attach suffixes with high vowels, as in (82).

(82)	din-i	‘tree’	dɛn	‘trees’
	mɔdɔŋ	‘elderly person’	mudɔŋ-in	‘elderly persons’
	kép	‘followed’	kip-u	‘is followed’
	wək	‘beat’	wuk-u	‘is beaten’

The only mid vowels being raised that could be analyzed as due to the co-occurrence restriction with /ə/ are the nouns of (83), and the last two of these are doubtful since the suffix vowel surfaces as [-ATR].

(83)	médé	mídí-sək	‘family, household, house’
	śís-t	úlú-sàn	‘flour’
	wèlé-t	wílí-sàn	‘oil’

## 10. Summary

Mundari has 8 phonemic vowels which function in two sets in roots and across morpheme boundaries: /i, ə, u/ are [+ATR], and /ɪ, ɛ, a, ɔ, ʊ/ are [-ATR]. [+ATR] quality is dominant and spreads to vowels not underlyingly specified for [ATR], either from roots to affixes or from affixes to roots, only being limited by word boundaries. Root mid vowels /ɛ/ and /ɔ/ are predictably raised to the [+ATR] high vowels [e] and [o] when [+ATR] affixes are attached, just as has been

documented for Laru and Fur. However, as can be seen from Kuku and Bari with 10 vowel phonemes, the Mundari mid vowels that are synchronically raised may have at one time been [+ATR], since Kuku and Bari have [+ATR] mid vowels that are raised through the same morphology as Mundari—when suffixes with [+ATR] high vowels are attached. Thus, mid vowels in Laru and Fur are raised because of vowel co-occurrence restrictions, whereas Mundari mid vowels can be argued to be raised for a diachronic reason involving vowel height assimilation through [+ATR] spreading.

## References

- Abdallah, Nabil Kuku 2012. Laru Vowel Harmony. *Occasional Papers in the Studies of Sudanese Languages*. Summer Institute of Linguistics. Juba, South Sudan 10:17-34.
- Cohen, K. Bretonnel. 2000. *Aspects of the Grammar of Kuku*. Lincom-Europa.
- Hall, Beatrice L. and Eluzai M. Yoke. 1981. Bari Vowel Harmony: The Evolution of a Cross-Height Vowel Harmony System. *Occasional Papers in the Studies of Sudanese Languages*. Summer Institute of Linguistics. Juba, South Sudan 1:55-63.
- Hollman, John W. 1992. *Reading Skills in an African Language: Processing Bari Orthography*. Submitted for PhD Dissertation at University of Reading.
- Kutch Lojenga, Constance. 2012. Lexical and Postlexical Vowel Harmony in Fur. *Occasional Papers in the Studies of Sudanese Languages*. Summer Institute of Linguistics. Juba, South Sudan 10:35-44.
- Lewis, M. Paul, Gary F. Simons, and Charles D. Fennig (eds.) 2013. *Ethnologue: Languages of the World, Seventeenth edition*. Dallas, Texas: SIL International. Online version: <http://www.ethnologue.com>.
- Lutwori, Allen Pitya, Enike Amina Wani, Lodu Philip Jembeke, Robert Gajuk Paul Wanit, Martin Lomu Goke, and Augustino Laku Buli. 2013. *Reading and Writing Mundari Book 2*. Juba, South Sudan. SIL-South Sudan. Online version: <http://Mundari.webonary.org/language/grammar>.
- Lutwori, Allen Pitya, Enike Amina Wani, Lodu Philip Jembeke, Robert Gajuk Paul Wanit, Martin Lomu Goke, and Augustino Laku Buli. 2013. *Mundari Grammar Book*. Juba, South Sudan. SIL-South Sudan. Online version: <http://Mundari.webonary.org/language/grammar>.
- Onziga, Yuga Juma and Leoma Gilley. 2012. Phonology of Kakuwâ (Kakwa). *Occasional Papers in the Study of Sudanese Languages*. Summer Institute of Linguistics. Juba, South Sudan 10:1-16.
- Waag, Christine 2010. *The Fur Verb and its Context*. Rüdiger Köppe Verlag. Cologne, Germany.
- Wani, Enike Amina and Martin Lomu Goke. 2013. *Mundari Dictionary*. Juba, South Sudan. SIL-South Sudan. Online version: <http://Mundari.webonary.org>.