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NOTES ON KODI PHONOLOGY

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Abstract

This paper describes aspects of the phonology of Kodi, an Austronesian language of Sumba, Indonesia. Based on the analysis of recordings of an elicited word list, the description covers the segmental phonology, syllable structure, stress and the spreading of palatalization and labialization features. A pervasive feature of Kodi is a number of morphophonological processes that result in most words alternating between a longer and shorter form. These include antepenultimate vowel reduction, paragoge and apocope, as well as productive synchronic metathesis of a word-final vowel and the preceding consonant. When a word with identical vowel qualities in the two final syllables undergoes metathesis, it results in a double vowel. By measuring hundreds of vowel lengths in our data, we show that double vowels are phonetically distinct in length from stress-induced vowel lengthening in Kodi.

Keywords: Kodi, Austronesian, phonology, metathesis, double vowels
ISO 639-3 codes: Kodi [kod], Hawu [hvn], Kambera [xbr], Laboya [lmy], Wejewa [wew], Wanukaka [wnk], Anakalang [akg], Mamboru [mvd], Termanu [twu], Tetun [tet], Ili'uun [ilu], Indonesian [ind], Selaru [slu], Balangao [blw], Kwara'ae [kwf], Leti [lti], Helong [heg], Amarasi [aaz], Luang [lex]

1 Introduction

This paper is an initial study of the phonology of Kodi, an Austronesian language spoken on the island of Sumba in Indonesia.[1] This section gives further background on the language, previous studies, the nature of the data and where it can be accessed, as well as a brief introduction to alternations between the underlying long form of words and various methods of shortening words. These alternations are ubiquitous in Kodi, and are a prerequisite to a discussion of Kodi phonology.

Section 2 covers the segmental phonology of Kodi. Section 3 presents syllable structures and the distribution of sounds in the syllable. Section 4 explains the interplay between stress, vowel length, consonant length and syllable weight. Section 5 presents an apparent exception to the normal stress pattern resulting from insertion of a paragogic vowel. Section 6 is a description of different phonological processes that delete or reduce a vowel or syllable, thereby creating phonetic forms that differ significantly from the underlying phonological patterns. Section 7 is a description of another synchronic phonological process: metathesis. Metathesis results in vowel sequences that do not occur in the underlying forms of words,

[1] We would first like to thank our Kodi language consultants: Rufina Kaleka, Yacub Ra Mone, and especially Mensiana Tamo Inya. We would also like to thank Yustinus Ghanggo Ate and Marian Klamer for their comments on earlier drafts of this paper. We owe thanks for feedback from the audiences at three conferences (Balle & Lovestrand 2019a; Lovestrand & Balle 2019; Lovestrand, Balle & Edwards 2021a) where aspects of this research were presented, and to two anonymous JSEAL reviewers for their constructive comments. Parts of this research were funded by the INOVASI project *Pengembangan bacaan kreatif dan materi pembelajaran dalam bahasa Kodi* carried out by Suluh Insan Lestari in 2019.

including double vowels. Section 8 describes the distribution of palatalized and labialized consonants which in some, but not all cases can be considered the results of a phonological alternation. Section 9 is a brief conclusion.

1.1 Language context

Kodi is an under-described Malayo-Polynesian (Austronesian) language spoken by approximately 100,000 people on the island of Sumba in the Nusa Tenggara Timur (NTT) region of eastern Indonesia.[2] The nine or more languages of Sumba, along with Hawu (the language of the nearby islands of Savu) together form the Sumba-Hawu group of Malayo-Polynesian languages whose relationship to the rest of the language family is not entirely clear (Blust 2008; Gasser 2014; Klamer 2009).

Sumba is one of the less-developed islands of Indonesia. Klamer (1998:3) estimated that up to 90% of the population were subsistence farmers in the 1990s. The island is well known for being one of few places where ancient traditional religious rites, referred to as *marapu*, are still practiced. However, some of the traditional cultural practices of Sumba are under threat of extinction along with the ceremonial forms of language that express them (Kuipers 1998:2–3).

The national language of Indonesian has significantly grown in its use in recent decades. Urban families in Sumba regularly report that their children have not learned any of the languages of Sumba. There have also been reports of the increased use of Indonesian in more domains in village contexts as well (Simanjuntak 2018; Vel 2008:51). For more on the sociolinguistic context of Kodi, see Ghanggo Ate (2020). For an overview of the current state of language documentation and description of the languages of Sumba, see Lovestrand (2021).

1.2 Previous studies

There have been at least two pedagogical publications on Kodi. The first is a Kodi-Indonesian lexicon of about 1,500 words (Kemdikbud 2003). The Kodi material is written in an orthographic script without any further description of the language. The second publication is a literacy primer aimed at children in their third year of school (Labu Djuli, Ratu Koreh & Tanda Kawi 2005). This work identifies most of the phonemes of Kodi, recognizes the existence of long consonants, and makes some remarks on the morphology and syntax. However, it is not a work of linguistic analysis, and so it leaves many phonological questions unanswered. Both of these works were published by the Indonesian government under the Ministry of Education and Culture (*Dinas Pendidikan dan Kebudayaan*). Neither publication is in circulation.

There are some brief discussions of Kodi phonology in previous academic publications. These primarily focus on the phonemic inventory of the language. The introduction to Hoskins' (1994) anthropological work includes a description of the transcription system employed by the author. This provides an overview of the phonemic inventory and some passing remarks concerning phonological alternations in the language. A phonemic inventory is also found in a short article by Ekayani, Mbete & Putra (2014), as well as in the introduction to the MA thesis of Ghanggo Ate (2018:5–7). The current study expands on previous works on Kodi by presenting a first analysis of the phonology beyond the phonemic inventory. In some cases, it also challenges the conclusions of previous publications.

There have been previous efforts to collect Kodi language data, but without much phonological analysis. Interlinearized Kodi texts written in an orthographic form are included in the appendix of Sukerti (2014). A Kodi word list (with minimal phonetic detail) collected by Leif Asplund and Yustinus Ghanggo Ate is available online as part of the Austronesian Basic Vocabulary Database project (Greenhill, Blust & Gray 2008). Kodi word lists were also recorded for a study of linguistic and genetic variation in Sumba (Lansing et al. 2007), but the data are not accessible. A Kodi speaker, Christian Hadi Hongu, graciously gave us access to a word list of over 4,000 Kodi words that he has typed out in an orthographic form. This was a significant help in knowing where to search for certain sounds in the language. However, given the lack of phonetic detail presented by previous researchers and the lack of availability of past recordings, much of the data gathered for this phonological study has been an unfortunate duplication of previous efforts.

On the topic of Kodi syntax, the MA thesis by Ghanggo Ate (2018) describes reduplication. An MA thesis by Sukerti (2014) discusses grammatical relations, as does a paper by the same authors (Sukerti &

[2] The estimated number of Kodi speakers is from 2010 census data as reported in Lovestrand (2021).

Ghanggo Ate 2016). While these works shed light on a few aspects of Kodi syntax, the grammar of the language as a whole remains largely undescribed, as is the case for most languages of Sumba. The most substantial linguistic description of any language of Sumba is Klamer's (1998) grammar of Kambera (among other works on the same language). Another noteworthy linguistic study of a closely related language is Verdizade's (2019) thesis on aspects of Laboya phonology and morphosyntax.

1.3 Data gathered

This research on the phonology of Kodi is an extension of a community-oriented collaboration between the Indonesian non-profit organization *Suluh Insan Lestari* and the local government school authorities in Sumba. The project was sponsored by the Australian-Indonesian partnership fund *Inovasi untuk Anak Sekolah Indonesia* (INOVASI) with the goal of publishing children's reading material in Kodi for use in the local school system (Balle 2020).[3] The first two authors (with the assistance of Yustinus Ghanggo Ate) organized a participatory workshop with Kodi speakers to check the phonological assumptions of previous linguistic work, and to build consensus toward a standardized alphabet. This effort raised several questions about the phonology of Kodi which this paper aims to address.

The data for this study were recorded by Misriani Balle in Sumba, primarily in the town of Waitabula in the regency (*kabupaten*) of Sumba Barat Daya between September and December 2018, and at various dates in the first half of 2019. The speakers who contributed to these recordings are all from the Bangedo dialect of Kodi. The dialectical variations that have been observed between Kodi groups are occasional lexical distinctions and minor pronunciation differences. The recordings were of elicited responses, not naturalistic data. This is because of the need to have a more manageable and controlled dataset with which to begin the investigation of the phonology of the language.

A list of 403 words was recorded in 2018, followed by another 397 words recorded in 2019. However, in many cases, the second set of recordings repeated lexemes from the first in order to record different forms of the same word. This is because it was only during the process of recording the first list that it became clear that nearly all words have at least two phonological forms, and that the first list had not systematically captured both forms. The two lists together cover 495 unique items, 434 of which are recorded in both a longer form and a shortened form (Section 1.4). The recorded audio data used in this paper are archived with PARIDISEC (Balle & Lovestrand 2019b). For ease of archiving, the recordings were combined into two large files, then segmented with time-aligned transcriptions in an EAF file. Examples used in this paper include the number of the recording as annotated in the EAF files. Other data cited are from recordings archived with PARIDISEC in a file named "Kodi phrases", and are referenced by the number in the EAF annotation number prefixed by "kodiphrases", such as "kodiphrases.02". A duplicate of the word list recordings and annotations is archived with Zenodo (Lovestrand, Balle & Edwards 2021b). The Zenodo deposit also contains the Praat files (TextGrid) and spreadsheets which were used for measuring vowel formants and lengths in the quantitative studies discussed in Section 2.3 (Figure 9), Section 4 (Table 3). and Section 7 (Table 4).

1.4 Long and short forms in Kodi

Any discussion of Kodi phonology has to take into account a pervasive feature of the language. Nearly every word in Kodi has at least two possible pronunciations. There is a long form, which we take to be the underlying form of the word, and then there are a number of phonological processes that can shorten the long form. The fact that there are longer forms and shortened forms is important background for discussing segmental phonology (Section 2), syllable structure (Section 3), stress and syllable weight (Section 4). Examples (1) through (5) illustrate possible ways of shortening the pronunciation of Kodi words. We explain the rules that derive short forms in Sections 6 and 7. The possible ways of shortening a word appear to be predictable based on the underlying form of the word. Note in example (3) that two of the processes can co-occur in the same word. There is sometimes notable phonetic variation between the different repetitions of a word, in which case transcriptions are marked with a subscript marking them as the first second or third repetition, as in example (3). If unmarked, only the first repetition is transcribed.

[3] For more on INOVASI, see https://www.inovasi.or.id. For Suluh Insan Lestari, see https://suluh.org.

	underlying	**long form**	**antepenultimate vowel deletion**		
(1)	/maⁿduru/	[manˈduˑ.ɾu]	[m̩ˑˈnduˑɾʊ]	‘to sleep’	252
	underlying	**long form**	**apocope**		
(2)	/jamma/	[ˈjamːɐ]	[jam]	‘we (excl.)’	24
	underlying	**long form**	**antepenultimate vowel deletion & apocope**		
(3)	/kanejo/	[kɐˈnæjɔ]	[knæj]$_{1,2}$ [ˈknæjɞ̆]$_{3}$	‘intestine’	129
	underlying	**long form**	**-jV deletion**		
(4)	/ɣajo/	[ˈɣaˑjɔ]	[ɣaˑʔ]	‘wood’	727
	underlying	**long form**	**metathesis**		
(5)	/api/	[ˈʔa̤pi]	[ʔa̤ɛpˀ]	‘fire’	45

This analysis is reflected by what Hoskins (1994:xix) was told by Kodi speakers in 1979: “they knew quite well how to write it with ‘Indonesian’ letters, but that Kodi, like English, is a language that is not always written the way it is pronounced.” Apparently, these Kodi speakers were aware that each word has an underlying form that they wanted to write out in full, but they also knew that at the phonetic level the pronunciation of the words could be significantly different.

The short forms seem to be more common in regular speech. Some Kodi speakers report that in their natural/everyday speech they use short forms, but if somebody asks a question with an expectation to reply in one word, they will use the full/long form of the word. In this respect, the use of long and short forms in Kodi appears to be similar to the use of alternating forms in Kwara’ae (Solomon Islands). In Kwara’ae metathesized (short) forms are the everyday normal forms with the unmetathesized (longer) forms used only in certain contexts, such as clarification (Heinz 2005:4) or calling out (Watson-Gegeo & Gegeo 1986:19). However, given the limited data collected so far, it is not possible to determine in what contexts short and long forms are used. Other relevant factors may be the phonological context of the word or, as in some languages in the region with similar patterns, different forms may have particular grammatical or pragmatic functions.

2 Segmental phonology

This section presents the phonemic segments of Kodi—consonants and vowels. It also includes a discussion of allophones and potentially ambiguous sequences such as long phones and approximants (or high vowels).

2.1 Consonants

There are up to twenty-one phonemic consonants in Kodi, as shown in Table 1.

Table 1: *Phonemic consonants in Kodi*

	bilabial	**dental/ alveolar**	**palatal**	**velar**	**glottal**
voiceless stop	p	t	(c)	k	
implosive	ɓ	ɗ	(ʄ)		
prenasalized stop	ᵐb	ⁿd	(ⁿʄ)	ᵑg	
fricative				ɣ	h
nasal	m	n	(ɲ)	ŋ	
approximant	w		j		
lateral		l			
tap		r			

There are five places of articulation in Table 1. Four of the five palatal consonants are written in parenthesis because their phonemic status is marginal. There are three series of stops with different manners of articulation: voiceless, implosive and prenasalized. Note that there are no plain (non-nasal) voiced stops. This is unlike most Malayo-Polynesian languages, but the contrast between voiced implosive stops and prenasalized stops without any plain voiced series is regionally common. It occurs in the Rote languages and several languages of Southeast Sulawesi. In Sumba, the same pattern is reported for Kambera (Klamer 1998:11) and Wejewa (Kuipers 1998:xxvii).[4] As in Kambera, loan words from Indonesian with voiced stops are generally prenasalized in Kodi, as in examples (6) and (7).

(6) [mˈbuˑku] ‘book’ from Indonesian *buku*

(7) [mˈboˑla] ‘ball’ from Indonesian *bola*

The stops occur at four places of articulation: bilabial, dental (or alveolar), palatal and velar. Some discussion of the phonetic details of the coronal consonants is needed. Firstly, the voiceless plosive /t/ is dental [t̪], while the implosive /ɗ/ is usually slightly post alveolar [ɖ̠] and occasionally approaches retroflex [ɖ]. The prenasalized plosive /ⁿd/, nasal /n/ and the liquids /l/ and /r/ are usually alveolar. Regarding the palatal series, Hoskins (1994:xix) describes the palatal stops in Kodi as alveolar affricates (/t͡ʃ/ and /ⁿd͡ʒ/). In many languages, palatal stops are affricated and pronounced as [c͡ç] and [ɟ͡ʝ], respectively, which are acoustically very similar to alveolar affricates (Pullum & Ladusaw 1986:84). However, in Kodi, the palatal stops are often phonetically pronounced as stops.

Phonemically, the status of the palatal stops (as well as the palatal nasal) is debatable. They are relatively rare sounds. Out of 495 unique lexemes (recorded in isolation), the voiceless palatal stop, [c], occurs phonetically in eleven lexemes, the voiced prenasalized stop, [ⁿɟ], occurs in two lexemes, the palatal nasal, [ɲ], occurs in nine lexemes and the palatal implosive, [ʄ], only occurs in one lexeme, shown in example (11). These four palatal consonants are restricted in their distribution. They almost always occur immediately following the high front vowel [i], as in examples (8) through (11).[5]

	underlying	**long form**	**short form**		
(8)	/katiⁿdolo/	[ˌkatɪɲɟˈjəlɔ]	[kə̆tɪɲɟjĭˈɔl]	‘worm’	495
(9)	/karaⁿgito/	[karạŋˈgɪcɔ]	[kə̆rạŋˈgiːc]	‘mosquito’	496
(10)	/ɓinːa/	[ˈɓiɲːa]	[ɓiɲə̆̆]	‘door’	610
(11)	/iɗolo/	[ʔɪˈʃɔˑlɔ]	[ʔɪˈɟɔˑl]$_{1,3}$ [ʔɪˈʃɔˑl]$_2$	‘flirtatious’	401

Since with other words in the language there are cases of alternation between dental/alveolar and palatal consonants (Section 8), it may be posited that all palatals are underlyingly dental/alveolar consonants which become palatals when preceded by a high vowel. The exception to this rule is that a consonant is not palatalized when immediately followed by a high vowel, as in examples (12), (13) and (14).

	underlying	**long form**	**short form**		
(12)	/pitu/	[ˈpiˑt̪u]	[piːt̪̯w̥]	‘seven’	75, 563
(13)	/inu/	[ˈʔiˑnu]		‘to drink’	224
(14)	/witi/	[ˈβ̥iːt̪i]	[ˈβ̥iːt̪]	‘leg/foot’	148, 407

[4] In contrast, the related languages Laboya (Verdizade 2019), Wanukaka (Mitchell n.d.) and Anakalang (Keane 1997: xxviii) do have plain plosive sounds, but do not have prenasalized plosives. See Lovestrand (2021) for more discussion.

[5] Note that not all repetitions in our recording of the word in example (11) have implosion. We take this to be the effect of the relative articulatory difficulty of palatal implosive leading to them bring produced as a palatal stop phonetically.

In only four lexemes in our data is a palatal stop not preceded by a high front vowel, as shown in examples (15) through (18). The negation marker in (15) is can also be pronounced as an alveolar stop, suggesting its underlying form is /ⁿdo-/ (Section 8). Example (16) has four syllables and may be a (fossilized?) compound word of which the second element is *toyo* 'person'. According to Ghanggo Ate (personal communication), the more standard form of this word is *waricoyo*, as transcribed in the ABVD Kodi word list (Greenhill, Blust & Gray 2008), and the insertion of the [a] vowel instead of [i] is unstructured variation (i.e., not a dialectal distinction). Example (18) is likely a borrowing from Indonesian *mengancam* 'threaten'. Note that neighboring local languages do have palatal stops, and so are also potential sources of borrowed words containing these sounds.

	underlying	**long form**	**short form**		
(15)	/ⁿdoɗo/	[ɲɟˈɟɪ̥ɔɗɔ]	[nˈɟˈɟɪ̥ɔʔt̚]	'no, not'	554
(16)	/wara cojo/	[βaɾaˈcɔˑjɔʔ]	[β̞arˈcɔˑjɔ]	'woman'	160
(17)	/hecco/	[ˈhecːɔ]	[hec]	'spicy'	775
(18)	/ⁿgeⁿgecam/	[ˈŋgeˑŋgɛcəm]		'threaten'	673

A third explanation for palatal stops (in addition to phonological alternations and contact) is that these sounds may be historical retentions from a few words where these sounds are preserved despite being lost elsewhere in the language. Despite the marginal status of these three palatal consonants, Kodi speakers are aware of the palatal stops as distinct sounds in the language, perhaps due to contact with Indonesian. This may be part of the reason why previously published phonemic inventories consider these sounds to be phonemes.

Hoskins (1994:xix) includes a glottal stop in the Kodi phonemic inventory. We have found no evidence that the glottal stop is a contrastive phoneme in Kodi, though vowel initial words receive an automatic epenthetic glottal stop in phrase initial position. Thus, the glottal stop in Kodi has the same status as the glottal stop in Kambera (Klamer 1998:11).[6] In addition, a phonetic glottal stop appears to play a role in the realization of long implosive consonants, as discussed in Section 2.2.

Implosive stops occur at three places of articulation: bilabial, dental/alveolar and (marginally) palatal. This follows a common pattern where implosives are more commonly found at places of articulation towards the front of the mouth. The alveolar implosive can have a retroflex articulation. Some past studies of Kodi have also included a velar implosive in their transcriptions (Ekayani, Mbete & Putra 2014; Ghanggo Ate 2018). Our recordings show that this velar sound is a voiced velar fricative, as described by Hoskins (1994:xix). This is true when the phoneme appears intervocalically or at the end of a word, as in the short forms in examples (19) and (20), as well as in a word-initial position, as in example (4) above. Slight devoicing is often heard in phrase final position, and other possible allophones are a voiced velar approximant and, occasionally, a voiced velar stop.

	underlying	**long form**	**apocope**		
(19)	/ŋaɣa/	[ˈŋaɣa]	[ŋaːɣ]	'rice (cooked)'	19
(20)	/iɣa/	[ˈʔɪɟa]$_1$ [ˈʔɪɣa]$_2$ [ˈʔɪɣʲa]$_3$	[ʔɪɣ]	'fish'	53

The other fricative sound is a voiceless glottal fricative. This glottal fricative is undoubtedly a reflex of Proto-Sumba *s, as in most other languages of Sumba (Klamer 1998:12; Verdizade 2019:23). There are nasal consonants in at least three places of articulation—the phonemic status of the palatal nasal being unclear. There are two approximants sounds—palatal and labial (varying between labial [β̞] and labio-velar [w]). These are clearly phonemes when occurring the onset position of a syllable. The glides can also occur in the first position of a complex nucleus, CyV(C) or CwV(C), in which cases they are transcribed in

[6] In preliminary work on our recordings of related languages, Laboya and Wanukaka, we do find evidence for treating the glottal stop as phonemic (cf. Mitchell n.d.; Verdizade 2019).

superscript. In at least some cases, this palatalization and labialization appears to be the result of a phonological process (Section 8).

The last two phonemes are an alveolar lateral and an alveolar rhotic. The rhotic can either be pronounced as a tap or a trill. The basic pattern of distribution appears to be that the flap occurs between two vowels, and the trill elsewhere, as in the two forms of the word in example (21) shown in Figure 1 and Figure 2.

	underlying	**long form**	**antepenultimate vowel deletion**			
(21)	/pariŋi/	[paˈɾiːŋi]	[ˈpriːŋi]	‘wind’	42	Figure 1 and Figure 2

Figure 1: *Spectrogram of long form in example (21) with flap [ɾ]*

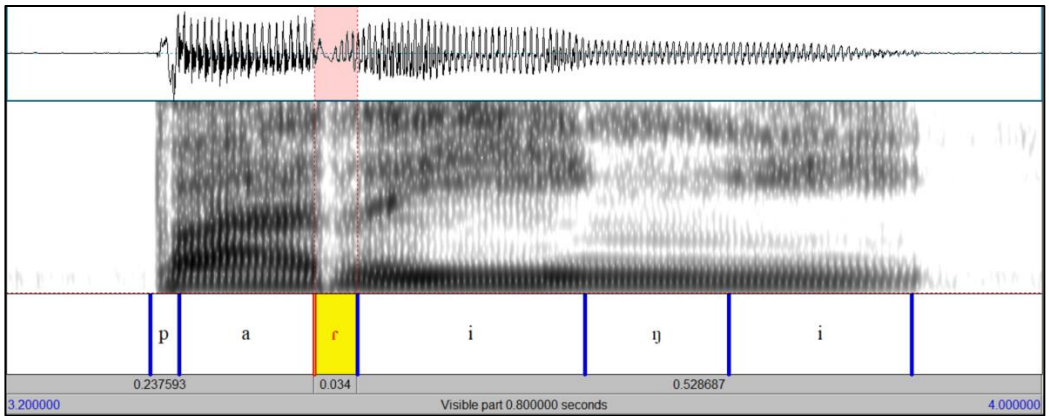
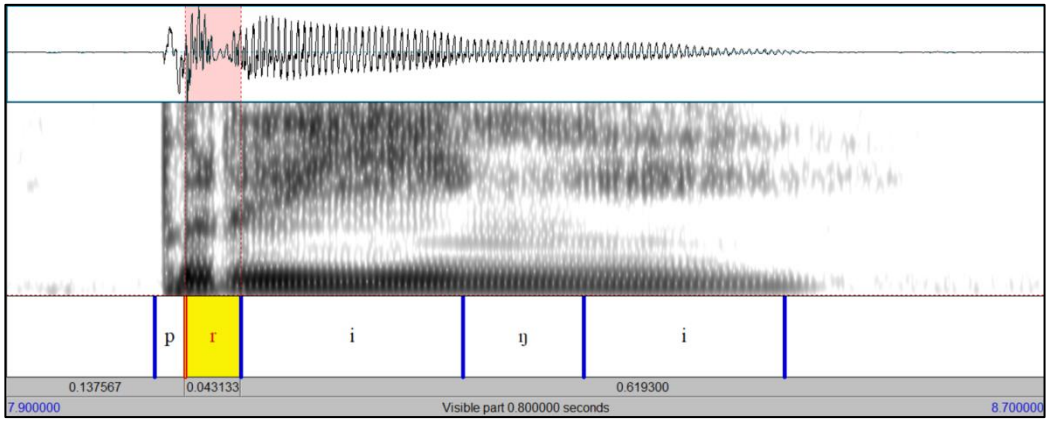


Figure 2: *Spectrogram of short form in example (21) with trill [r]*



2.2 Long consonants

Previous works on Kodi include transcriptions of consecutive identical consonants, but do not give any further description of the phonology of these double consonants. For example, Ghanggo Ate (2018:73) analyzes the word *nommo* ‘six’ as a heavy CVC syllable /nom/ followed by a light CV syllable /mo/, without commenting on the potential status of the /mm/ sequence—phonetically, a long consonant [mː]. In our data there are several minimal pairs (and near minimal pairs) for consonant length, of which the clearest case is shown in example (22) and in Figure 3 and Figure 4. Near minimal pairs are shown in examples (23) and (24), as well as Figure 5 and Figure 6.

		underlying	**long form**			
(22)	a.	/poto/	[ˈpɔːt̪ɔ]	‘four’	72	Figure 3
	b.	/potto/	[ˈpɔt̪ːɔ]	‘type of bamboo’	13	Figure 4

(23)	a.	/tama/	[ˈt̪a·ma]	‘to enter’	267, 693	Figure 5
	b.	/lamma/	[ˈlam:a]	‘tongue’	121, 431	Figure 6
(24)	a.	/ⁿdoko/	[ˈndɔ·kɔ]	‘gold’	745	
	b.	/tokko/	[ˈt̪ɔk:ɔ]	‘stick’	467	

Figure 3: *Spectrogram of example (22) with regular dental stop measuring 11.7 ms*

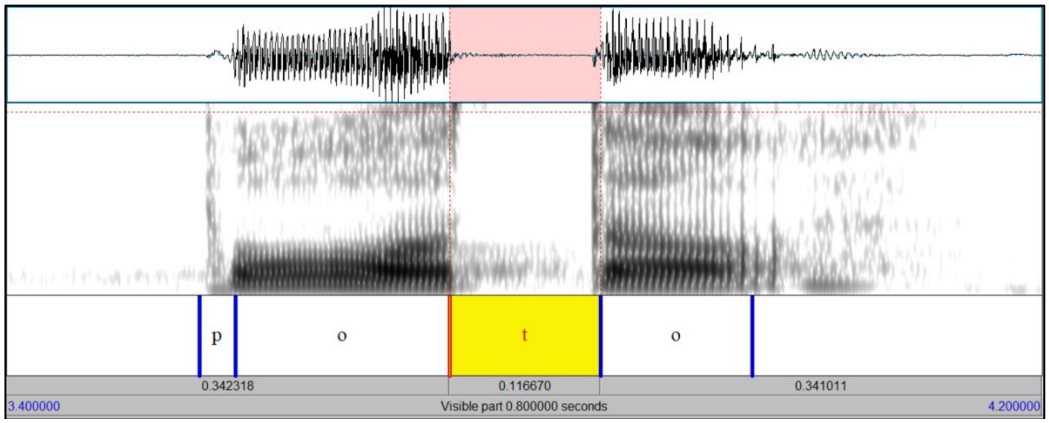


Figure 4: *Spectrogram of example (22) with long dental stop measuring 19.8 ms*

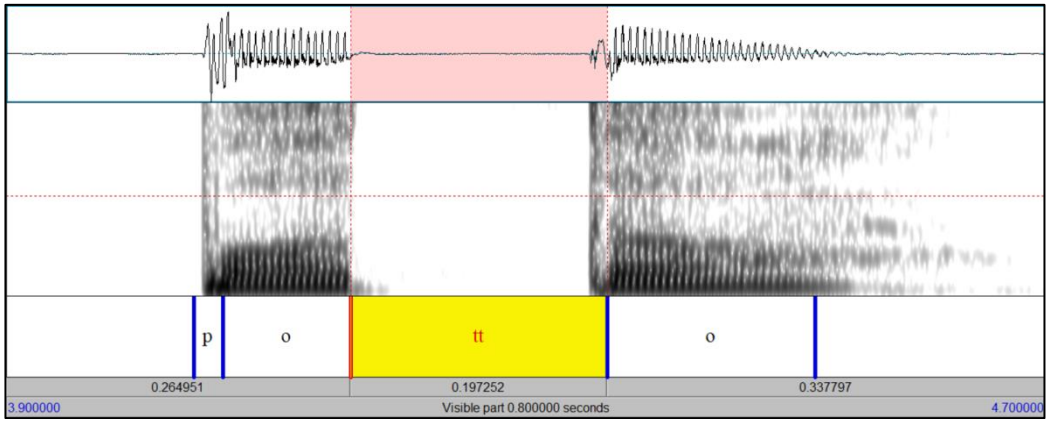


Figure 5: *Spectrogram of example (23) with regular bilabial nasal measuring 9.9 ms*

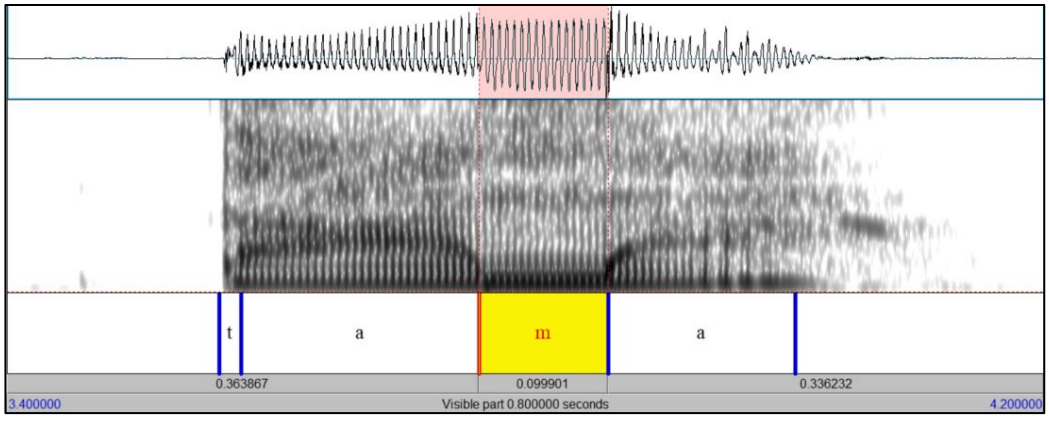
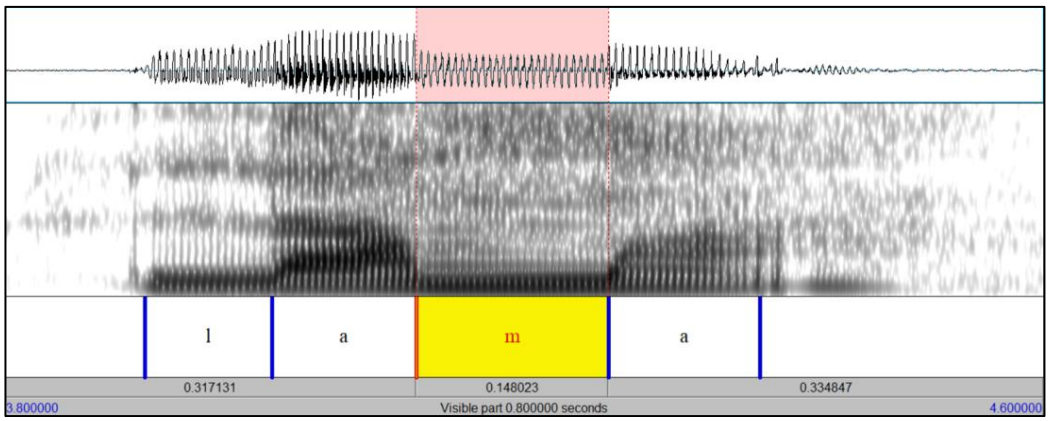


Figure 6: *Spectrogram of example (23) with long bilabial nasal measuring 14.8 ms*



Note that in examples (22) through (24) the words without a long consonant have a slightly longer vowel in the stressed syllable. This is because of a stress-induced vowel-lengthening process which does not occur when the stressed nucleus is followed by a long consonant (Section 4). It is important to note that it can be seen in the spectrograms that there is a noticeable difference in the phonetic length of the consonants, as well as the vowels. This contrasts with two related languages, Kambera (Klamer 1998:13) and Laboya (Verdizade 2019:18), in which there is a phonemic contrast in vowel length, and no consonant length distinction (see also Lovestrand 2021).

Our transcriptions include most of the consonants in Kodi occurring in a long form with the exception of a long velar fricative, long labio-velar approximant and a long prenasalized palatal stop. However, the lack of clear-cut endpoints for the consonant make it difficult to measure length. Note that in the case of prenasalized stops, what we interpret as a long consonant is phonetically a long nasal followed by a stop of standard length, as in examples (25) and (26). Spectrograms for example (26) are shown in Figure 7 and Figure 8.

		underlying	***long form***	***apocope***			
(25)	a.	/ka^{m}ba/	[ˈka·mba]	[ˈka:mb̥]	‘thread’	196, 687	
	b.	/ru^{m}b:a/	[ˈrum:ba]	[rum·b̥]	‘grass’	502	
(26)	a.	/ko^{n}do/	[ˈkɔ:ndɔ]$_{1}$ [ˈkɔndɔ]$_{2, 3}$	[ˈkɔ:nd]	‘to dig’	291, 480	Figure 7
	b.	/to^{n}d:o/	[ˈt̪ɔn:dɔ]	[t̪ɔn·d̥]	‘to plant’	473	Figure 8

Figure 7: *Spectrogram of example (26) with regular prenasalization measuring 9.7 ms*

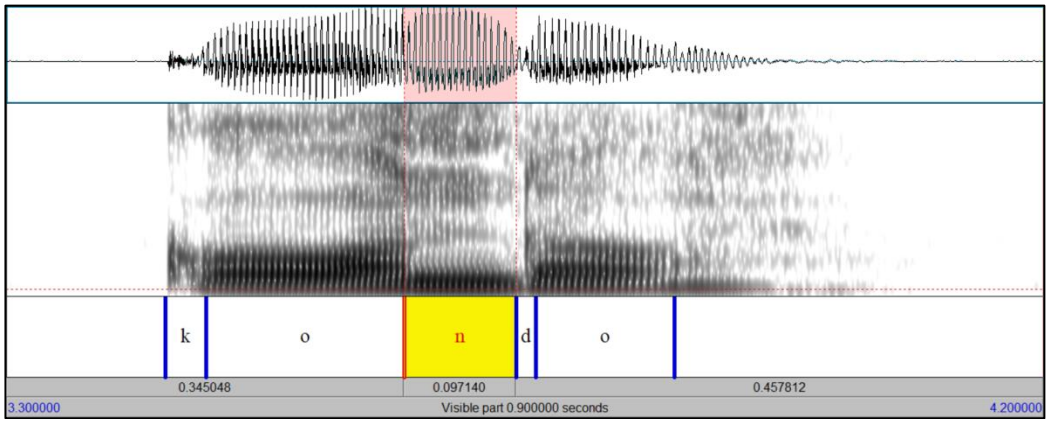
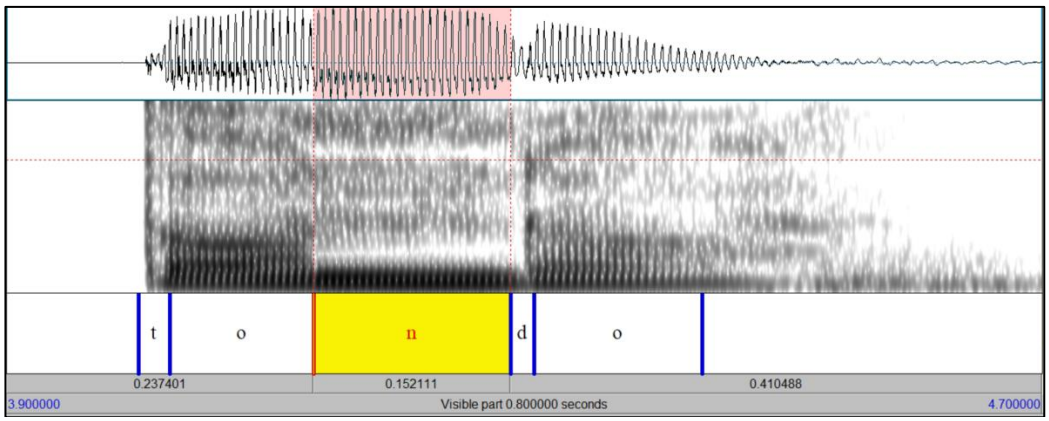


Figure 8: *Spectrogram of example (26) with long prenasalization measuring 15.2 ms*



In the case of long implosive consonants, the realization begins with a glottal stop. This was previously noted by Ekayani, Mbete & Putra (2014) who only transcribe glottal stops immediately before an implosive consonant. Examples of pre-glottalized long implosive stops contrasted with a regular implosive stop are shown in examples (27) and (28).

		underlying	**long form**		
(27)	a.	/laɓa/	[ˈlaˑɓa]	‘nauseous’	N/A
	b.	/laɓɓa/	[ˈlaʔɓa]	‘betel nut’	9
(28)	a.	/lodɔ/	[ˈlɔˑdɔ]	‘sing’	363
	b.	/lodɗo/	[ˈlɔʔdɔ]	‘day’	364

Long consonants seem to always occur in the position following the stressed syllable in a root, the penultimate syllable (Section 4). We follow Ghanggo Ate (2018:73) in analyzing long consonants as a sequence of identical consonants in the underlying form, one occupying the coda of the stressed syllable, and the other occupying the onset of the next syllable. Homorganic consonant clusters are the only type of consonant cluster found in underlying forms in our analysis with a few exceptional words (Section 3). All other non-homorganic consonant clusters in our data can be analyzed as the result of a phonological alternation where a word can be pronounced with or without a certain unstressed vowel (Section 6.1).

2.3 Vowels and diphthongs

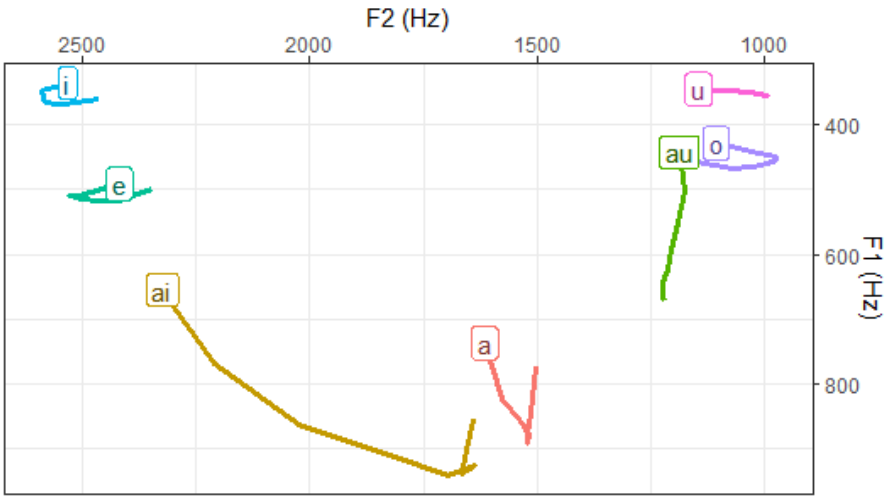
There are five vowel phonemes in Kodi, shown in Table 2. As already mentioned, Kodi does not have contrastive long vowels, but vowels vary in length due to stress (Section 4) and morphological alternations (Section 7). There is also vowel lengthening that is commonly seen when a vowel is at the end of a word spoken in isolation (phrase final). This lengthening is acoustically distinct from the lengthening that happens to a stressed vowel. Word-final vowel lengthening always involves a decreasing intensity and often a devoicing of the vowel. This type of lengthening is not noted in the phonetic transcriptions to avoid confusion with the lengthening of stressed vowels.

Table 2: *Vowel phonemes in Kodi*

	Front	**Mid**	**Back**
High	i		u
Mid	e		o
Low		a	

Figure 9 shows a plot of average F1 and F2 formants for the five vowels when occurring in a stressed syllable, plus the formants of two (phonetic) diphthongs resulting from metathesis (Section 7).[7] The low vowel /a/ is listed in Table 2 as a mid vowel, but its phonetic pronunciation is often further forward, [a̟], but not usually as far forward as the English vowel [æ]. Ekayani, Mbete & Putra (2014) report that the mid vowels in Kodi each have two allophones. The front vowel /e/ can be pronounced [e] or [ɛ], and likewise the back vowel /o/ can be pronounced [o] or [ɔ]. There is a similar alternation of the high vowels [i] ~ [ɪ] and [u] ~ [ʊ] with the lower allomorphs appearing as frequently or more often than the higher allomorph. This lowering of the mid vowels appears to happen most frequently in closed syllables, but it also is found in other environments. We calculated average formants for vowels in closed syllables compared to open syllables and did not find any clearly significant difference.

Figure 9: *Kodi stressed vowel and diphthong (metathesis) average formants*



Previous publications state that Kodi has four diphthongs: /au/, /ai/, /ou/ and /ei/ (Hoskins 1994:xx; Ekayani, Mbete & Putra 2014:9). Phonetically, certain vowel sequences are fairly common in Kodi, but we find that there is not sufficient evidence in our data to consider diphthongs part of the phonemic inventory of contrastive vowel sounds. Note that the proposed diphthongs end in the high vowels /i/ and /u/, which can also be analyzed as approximant consonants /j/ and /w/. In many cases, what are phonetically diphthongs are the result of a word pronounced without a word-final vowel (Section 6.2), as in examples (29) through (33). In this context, it is more straightforward to analyze these segments as a single vowel followed by an approximant consonant.

	underlying	**long form**	**apocope (& antepenultimate vowel reduction)**		
(29)	/wawa/	[ˈw̥aˑw̥a]	[w̥aːw̥]	‘below’	541
(30)	/patanaja/	[paṯaˈnaja]	[pə̆ṯɐˈnaj]	‘to tie’	279
(31)	/lowo/	[ˈlɔˑβ̞ɔ]	[loːβ̞]	‘sarong’	660
(32)	/wejjo/	[ˈβ̞ejːɔ]	[β̞ej]	‘water’	33
(33)	/mujo/	[ˈmuˑjɔ]	[muːj]	‘to eat’	219

The vowel sequences /au/ and /ai/ do occur as two vowels in a single nucleus, but these diphthongs are the result of a process of metathesis of the final vowel and final consonant (Section 7), as in examples (34) through (36). Phonetically, the second vowel in these series is a mid vowel, as also seen in Figure 9. Since there are no other non-identical vowel sequences elsewhere in the language these can be analyzed as a case

[7] Vowel formants were extracted from Praat and plotted in R following a procedure developed by Matt Winn (Listen Lab 2021). Number of tokens for each vowel/diphtong are: i (n=82), e (n=93), a (n=146), o (n=136), u (n=45), ai (n=21) and au (n=9). Formants were measured at 10 intervals per vowel/diphthong. All recordings measured are of the same female speaker taken from the audio file kod_wordlist_790.

of a high vowel lowering when immediately following a low vowel. Note that in metathesized forms a shortened (and typically devoiced) trace vowel may occur after the final consonant, as in example (36).

	underlying	**long form**	**metathesis**		
(34)	/watu/	[ˈβa̤a̤ʊ]	[βa̤.oʊ̤̆]	‘stone’	37
(35)	/api/	[ˈʔa̤pi]	[ʔa̤ɛp̆]	‘fire’	45
(36)	/marapu/	[maˈraˑpʊ]	[mə̆rɐɔpʊ̥̆]	‘spirits’	260

When the mid rounded vowel /o/ occurs in a stressed syllable following the lateral consonant it is sometimes pronounced with a glide, diphthong or labialization, as in examples (37) and (38). This appears to be a phonetic effect that speakers are generally not aware of, and distinct from the labialization patterns discussed in Section 8.

	underlying	**long form**	**short form**		
(37)	/loko/	[ˈlɔo̤kɔo̤] / [ˈlɔˑkɔ]	[loːů̥ɻ]	‘river’	34, 400
(38)	/ᵐbaloloɣo/	[mbalɔˈlɔˑɣɔ]$_{1}$ [mbalɔˈlo̤ɔɣo]$_{2,3}$	[mblɔˈlɔo̤ɣɔ]	‘type of snake’	61

Finally, one recording with a phonetic diphthong [ˈma.uk] ‘to yawn’ (229) is considered by Kodi speakers to be a rapid pronunciation that omits an intervocalic velar fricative: /maɣuk/. In conclusion, vowel sequences are common in Kodi at a phonetic level, but the evidence suggests that all of the vowel sequences are derived, and are not part of the underlying forms.

3 Syllable structures

The syllable structure patterns in Kodi differ significantly between long and short forms of words. This section will primarily describe the underlying structure of words. The structure of short forms (at a phonetic level of description) will be further discussed in Sections 6 and 7. Ghanggo Ate (2018:6) describes the basic syllable structures of Kodi as V, CV and CVC. We can further add that syllables without onsets are restricted to the beginning of a word, where they may be pronounced with a glottal stop onset, especially if at the beginning of a phrase.

The examples Ghanggo Ate (2018:73) gives of a heavy syllable are disyllabic words with a long consonant, such as *nom.mo* ‘six’, where the long consonant occupies both the coda position of the first syllable and the onset of the second syllable (Section 4).[8] There are a few examples in our data of intervocalic consonant clusters that are not geminate, prenasalized or the result of a phonological process, such as examples (39) and (40).[9] Most examples are either loanwords or (historic) compounds.

	underlying	**long form**		
(39)	/rante/	[ˈrantɛ]	‘necklace’ (cf. Malay rantai)	737
(40)	/arwejo/	[ʔarˈβe̤jɔ]	‘wife’	168

As mentioned previously, CVC structures commonly occur phonetically at the end of the short form of a Kodi word when the final vowel is dropped (Section 6.2) or metathesized (Section 7). There are also about 40 words in our data with a long (underlying) form ending in a consonant. These words end in one of the following consonants: /t, k, h, l, r, n, ɲ, ŋ/, as in examples (41) through (45).[10] Note the placement of stress in these examples. If these words follow the basic pattern of placing stress on the penultimate syllable of the underlying root (Section 4), then this is evidence that the coda consonants are really in the final syllable of the word and not a result of apocope of a final underlying vowel.

[8] The same analysis does not apply to intervocalic pre-nasalized consonants, which we analyze as only occupying a single slot in the syllable structure, except in the case of long pre-nasalized consonants.

[9] The word for ‘wife’ is written as *àri wènya* in the ABVD Kodi word list (Greenhill, Blust & Gray 2008).

[10] This collection of possible underlying root-final consonants is very similar to those that can occur at the end of a root Kambera: /l, r, h, t, k, ŋ/ (Klamer 1998:13).

	underlying	**long form**		
(41)	/kaɓeɓek/	[kaˈɓɛ·ɓɛk]	‘butterfly’	109
(42)	/walah/	[ˈwa·lah]	‘to answer’	239
(43)	/toŋol/	[ˈt̪ɔ·ŋɔl]	‘drum’	208
(44)	/lulur/	[ˈlu·lur]	‘shin’	147
(45)	/awuŋ/	[ˈʔa·wuŋ]	‘cloud’	41

There are generally no complex onsets in the underlying forms of Kodi words, however, a vowel reduction process often results in a consonant cluster in shortened forms (Section 6.1). Another possible exception to the absence of complex onsets is the analysis of palatalized consonants. In most cases, palatalized consonants are the result of a phonological process triggered by a preceding high vowel (Section 8). However, there are a few words with ambiguous sequences that could be interpreted as diphthongs or stop-glide clusters, such as examples (46) through (48). These cannot currently be explained by a systematic rule, but could be the result of borrowing or compound words.

	underlying	**long form**		
(46)	/kjoto/	[kĭˈɔt̪ɔ]	‘knife’	212, 629
(47)	/ɗjete/	[ɗĭˈɛt̪ɛ]	‘above’	539
(48)	/ela ɗwolo/	[ʔɛlaˈɗwɔlə]	‘inside’	538

4 Stress, length and syllable weight

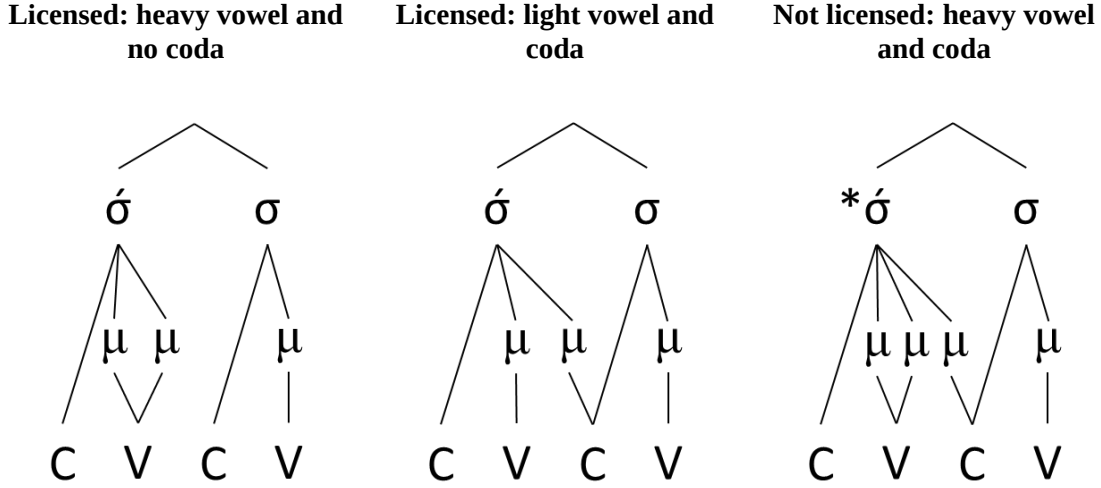
Ghanggo Ate (2018:76–82) describes stress in Kodi. With relatively few exceptions (Section 5), stress in Kodi falls on the penultimate syllable of a word’s underlying root form. Examples (49) through (51) show that stress is on the penultimate syllable irrespective of the number of syllables in the root. Our data does not systematically cover morphology, but it appears that stress is not assigned to affixes or clitics, and these morphemes do not alter the stress pattern of a word.

	underlying	**long form**		
(49)	/ŋaɣa/	[ˈŋa·ɣa]	‘rice (cooked)’	19
(50)	/kalama/	[kʰɐˈla·mɐ]	‘rattan’	11
(51)	/karoᵐboko/	[kɐɾɔmˈbo·kɔ]	‘dust’	47

We take the primary realization of stress to be a higher intensity. There does not appear to be any consistent or reliable correlation between stress and pitch. Vowel lengthening occurs in stressed syllables, but this is constrained by syllable weight. The difference in the length of a single stressed vowel when followed by a regular consonant compared to a long consonant can be seen by comparing Figure 3 with Figure 4, Figure 5 with Figure 6, and Figure 7 with Figure 8. The vowel of a stressed syllable is not lengthened if it is followed by a long consonant. This can be accounted for by a theory of syllable weight. We assume that a short vowel has the weight of one mora, a long vowel has the weight of two mora, and a coda consonant has the weight of one mora. Stress requires a heavy syllable with at least two moras. This can be accomplished by lengthening the vowel so that it takes up two moras in the syllable (Ghanggo Ate 2018:76). However, a long consonant following the stressed syllable occupies the coda slot of the stressed syllable, so the syllable is already heavy. It is not necessary to lengthen the vowel to create a super-heavy syllable of three moras.[11] The two types of heavy syllables are illustrated in Figure 10.

[11] However, super-heavy syllables do occur as a result of metathesis (Section 7).

Figure 10: *Illustrations of possible and impossible syllable weights in disyllabic forms*



In order to confirm vowel lengthening patterns, we averaged the measurements of the lengths of vowels in different phonotactic contexts. Table 3 shows the average lengths of single vowels in four contexts. Vowels in an unstressed antepenultimate syllable, typically the first syllable of a word, are relatively short, averaging 8.9 ms. A single vowel in a stressed, light syllable averages almost twice as along at 16.1 ms. A single vowel in a stressed syllable which is followed by a long consonant (and therefore in a heavy syllable) has an average length of just 9.3 ms. This is close to the average length of unstressed, antepenultimate vowels, and not a statistically significant difference (z-test: $p > 0.142$).[12] Finally, we see that word final (or phrase final) vowels in our data are also relatively long, averaging 12.3 ms, but they are also characterized by a falling intensity and progressive devoicing.

Table 3: *Average single vowel lengths by phonotactic context in long forms*

Phonotactic context		**Average length**	**Tokens measured**
Antepentulimate vowel	C<u>V</u>CVCV	8.9 ms	120
Stressed vowel (light syllable)	C<u>V</u>CV	16.1 ms	433
Stressed vowel (heavy syllable)	C<u>V</u>C:V	9.3 ms	112
Final vowel	CVC<u>V</u>	12.3 ms	550

We again note that this analysis of Kodi is strikingly different from Klamer's (1998:16–17) analysis of Kambera and Verdizade's (2019) analysis of Laboya. Klamer states that, "(C)VV syllables can only occur under main stress, where they contrast with (C)V syllables." In other words, vowel length is contrastive, but only in stressed syllables. Stressed syllables do not have to be heavy. This difference correlates with the fact that there is no contrastive consonant length in Kambera and Laboya.

5 Antepenultimate stress and paragogic vowels [o] and [a]

There are 25 (of 495) words in our data that do not appear to follow the pattern of penultimate stress in the long form of the word. Instead, stress is on the antepenultimate syllable. Ghanggo Ate (2018:77–81) also notes that several words have antepenultimate stress. In 23 of these 25 words, the final vowel in the word is /o/, as in examples (52) through (54).

[12] All of the other differences, including the average difference in length between a final vowel and a stressed vowel in a light syllable, are statistically significant (z-test: $p < 0.001$).

	underlying	**long form**	**no paragoge (& antepenultimate vowel reduction)**		
(52)	/kawohol-o/	[kʁˈwɔːhɔlɔ]	[ˈkwɔːhɔl]	‘lump’	634, 399
(53)	/ɓolet-o/	[ˈɓɔˑlɛt̪ɔ]	[ˈɓɔˑlɛt]	‘to lie, fib’	698
(54)	/ᵐbeɣel-o/	[m̩ˈbɛˑɣɛlɔ]	[m̩ˈbɛˑɣɛl]	‘tired’	781

We posit that the final vowel [o] in these cases is a paragogic (epenthetic) vowel optionally added to prevent a word-final consonant coda in the phonetic form. This analysis is similar to Klamer’s (1998:19) analysis of Kambera as adding a paragogic vowel [u] to the end of words when the underlying root ends in a consonant (cf. Klamer 2002:368). However, unlike Kambera, the addition of a word-final vowel to consonant final roots does not appear to be obligatory in Kodi. We currently do not have enough data to determine what conditions paragogic vowels in Kodi.

In two words with antepenultimate stress, examples (55) and (56), the final (paragogic) vowel is /a/. We do not have an explanation for why the quality of the paragogic vowel differs in these two words, but we note that in data provided by Onvlee (1984) Wejewa and Mamboru often have a final paragogic /a/ in environments where Kambera has paragogic /u/.[13]

	underlying	**long form**	**no paragoge**		
(55)	/pipiˈrimok-a/	[pɪpɪˈriˑmɔkʁ]	[pɪpɪˈriˑmɔk]	‘some’	733
(56)	/ˈleten-a/	[ˈlɛˑt̪ɛnʁ]	[ˈlɛˑt̪ɛn]	‘hill’	641

6 Vowel and syllable deletion

In this section, we describe processes that delete a vowel or reduce a vowel through minimized intensity, centralizing or devoicing. The context in which this occurs is the reduction of the low vowel /a/ in the first syllable of a three-syllable root. The second is apocope—the deletion of a word-final vowel. The third process described is lexically-constrained deletion of a final syllable yo.

6.1 Antepenultimate vowel deletion or reduction

The process of vowel reduction described here is a process that only applies to the low vowel /a/, and only in the first syllable of a trisyllabic word.[14] Ekayani et al. (2014:10) make note of this alternation, and the ABVD word list for Kodi has one word that is transcribed with and without its first vowel: *mringi*/*maringi* ‘cold’ (Greenhill, Blust & Gray 2008). Antepenultimate vowel reduction can also be seen in two of the spectrograms presented by Ghanggo Ate (2018:79, 81).

The underlying form and a shortened form of several words that can undergo vowel reduction are shown in examples (57) through (63), as well as in Figure 11 and Figure 12. In some cases, the reduced vowel is not pronounced at all in the short form. In other cases, it is reduced to a shorter and more centralized vowel. In the latter case, the vowel is marked with a breve, e.g. [ə̆] or [ĕ], in our phonetic transcriptions. Note that all of these roots are trisyllabic in the long form, and the stress falls on the penultimate syllable, so the initial, antepenultimate syllable is unstressed.

[13] Regional cognates of /leten-a/ ‘hill’ are disyllabic. Examples include: Termanu (Rote) *lete-k* ‘mountain’ (Jonker 1908: 308), Tetun (Timor) *leten* ‘above, overhead’ (Morris 1984: 130), and Ili'uun (Wetar) *lete, leten* ‘mountain’ (de Josselin de Jong 1947: 124). All these forms are possibly from Proto-Central Malayo-Polynesian *letay ‘above’ (Blust & Trussel 2020).

[14] The process is somewhat similar to the reduction of the central vowel in Indonesian in some words beginning in *se-* such as *sekarang/skarang* ‘now’ or *sekali/skali* ‘once’.

	underlying	**long form**	**antepenultimate vowel reduction/deletion (& no paragoge)**		
(57)	/ᵐbarojo/	[mbɐˈɾɔjɔ]	[m̩ˈbrɔjɔ]	‘far’	89
(58)	/halajo/	[haˈlajɔ]	[ˈhlayɔ]	‘sand’	38
(59)	/kaɓijo/	[kaˈɓiˑjɔ]	[kə̆ˈɓiˑjɔ]1,3 / [kˈɓiˑjɔ]2	‘flesh/meat’	152
(60)	/katudîl-o/	[kɐˈt̪ʊdîlɔ]	[ˈkt̪ʊːdɪl]	‘short’	87
(61)	/laɣijo/	[laˈɣiˑjɔ]	[lə̆ˈgiˑjɔ]1,2 / [lə̆ˈɣiˑjɔ]3	‘son-in-law’	165
(62)	/paneɣeŋ/	[pɐˈnɛˑɣɛŋ]	[pˈnɛˑɣɛŋ]	‘to speak’	236
(63)	/maⁿduru/	[mɐnˈdʊˑɾu]	[m̩ˑnˈdʊˑɾu]	‘to sleep’	252

Figure 11: *Spectrogram of long form of example (58) with penultimate vowel*

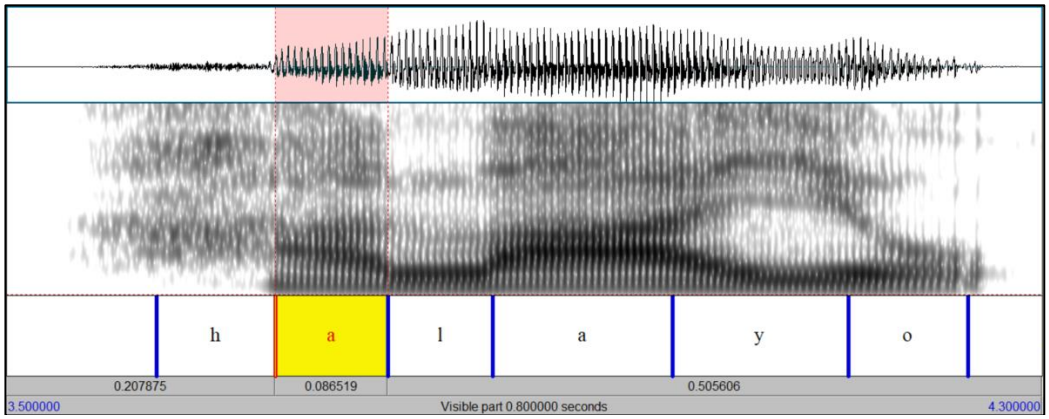
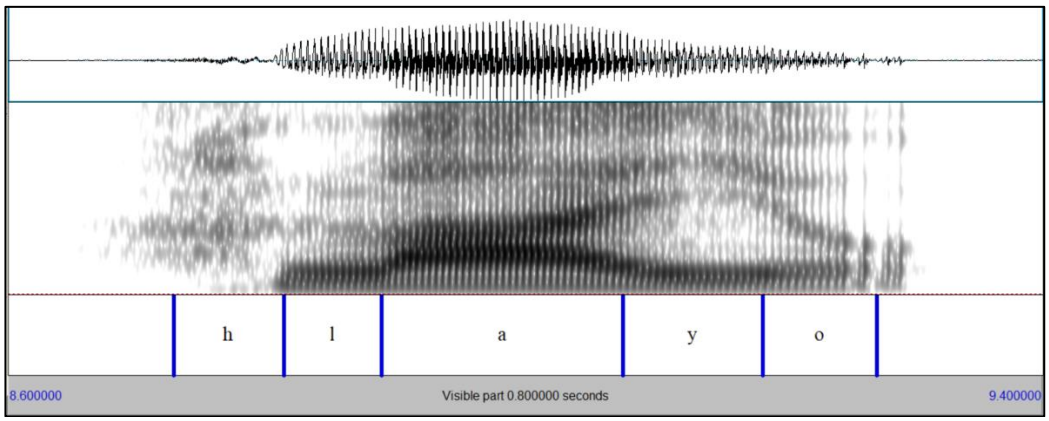


Figure 12: *Spectrogram of short form of example (58) without penultimate vowel*



Of 172 instances of antepenultimate vowel deletion or reduction in our data, in 117 cases the initial consonant is /k/. The word-initial consonant in the other cases is one of: /p, h, ᵐb, m, l/. This short list of consonants suggests a morphological restriction on this alternation. The vowel that is reduced is the vowel of a prefix. Not much is known about Kodi morphology. Ghanggo Ate (2018:16, 81) mentions there are causative prefixes /pa-/ and /ha-/ and a fossilized anticausative prefix /ma-/.[15] The frequency of the /ka-/ prefix suggests that it may also be a productive prefix, and a similar form is common for prefixes in other languages in the area, but the available descriptions of Kodi morphology do not mention this form as a prefix. Further data is needed to determine whether /ka-/ is part of the morphology or a fossilized prefix.

[15] Kambera has prefixes that use similar consonants: /pa-/, /ha-/, /ka-/, /la-/ and /ma-/ (Klamer 1998: 177–197, 247–262).

6.2 Apocope

Another way in which short forms of words are formed is the deletion of a word-final vowel. This process can be seen in a few words of the ABVD word list such as: *wul(a)* 'moon', *wil(o)* 'dull, blunt', and *ler(o)* 'to fly'. Several examples of final-vowel elision are shown in examples (64) through (68). Note that both the reduction of the antepenultimate vowel and the elision of a word-final vowel can co-occur, as in example (68).

	underlying	**long form**	**apocope (& antepenultimate vowel reduction)**		
(64)	/ura/	[ˈʔʊra]	[ʔʊr]	'rain'	35
(65)	/mutta/	[ˈmöt̪ːa]	[möt̪]	'to vomit'	225
(66)	/kiku/	[ˈkikʊ]	[kɪːk]	'tail'	63
(67)	/ruppa/	[ˈröpːɐ]	[röp]	'face'	112
(68)	/kanejo/	[kaˈnæjɔ]	[knæj]	'intestine'	129

In at least some cases, the word-final vowel might not be entirely deleted, but rather devoiced. This is not systematically included in the transcriptions, since it is often not possible to distinguish a slightly audible release from a devoiced vowel, without being able to observe the shape of the lips of the speaker. For example, Coward and Coward (2000:21) describe devoicing of word-final high vowels in Selaru where "the mouth and tongue are shaped just as for the vowels, but no sound or air is expelled." Another issue in the analysis of apocope is that when a word with a long consonant undergoes apocope, it is not always clear how to analyze the length of the word-final consonant in the short form. In some cases, it appears that the consonant is held for a relatively long period before the final release. Since our data consist of words in isolation, we cannot rule out that this may be an utterance-final effect. Data with examples of apocope in the context of natural speech would be needed in order to determine whether words with long consonants retain phonetic or phonologically-relevant length under apocope.

As mentioned in Section 5, apocope (final vowel deletion) can be distinguished from paragoge (final vowel epenthesis) by vowel quality and stress. Paragogic vowels result in words with an antepenultimate stress pattern on the phonetic word, and the final vowel is /o/ or /a/. In contrast, in examples of apocope, it is not possible to posit that the word-final vowel is an addition to an underlying form without a vowel. There is no rule that could predict which vowels should be added to the end of a word. It must be assumed that these vowels are part of the underlying root, and are deleted in the short form of the word. Deleting a word-final vowel does not affect the stress pattern of the word. Stress remains on the penultimate syllable of the underlying form.

6.3 -jV deletion

In addition to the common cases of apocope in which a word-final vowel is deleted (Section 6.2), there are also ten lexical items in our data in which a word-final syllable with /j/ as the onset deleted in the short form, as in examples (69) through (73) (see also Ghanggo Ate 2018:35). Unlike apocope, this shortening process does not create a word that ends in a consonant, but one that still ends in a vowel.[16]

	underlying	**long form**	**-jV deletion**		
(69)	/d̪ijo/	[ˈd̪iˑjɔ]	[d̪iʔ]	'she, he'	22
(70)	/ɣajo/	[ˈɣaˑjɔ]	[ɣaːʔ]	'wood'	727
(71)	/rijo/	[ˈriˑjɔ]	[ˈrɪˑ]	'bone'	417
(72)	/pad̪d̪aja/	[paʔˈdaja]	[paʔˈdaːʔ]	'to extinguish'	299
(73)	/hiᵐbaja/	[hɪˈmbjaja]	[hɪˈmbʲa]	'to receive, welcome'	653, 725

[16] Note that words with a penultimate high front vowel /i/, as in examples (69) and (71), there is a possibility that the approximant /j/ is not deleted by rather phonetically merges with the penultimate vowel following apocope of the final vowel. Further evidence would be needed to confirm each case individually.

In the case of the verbs in examples (72) and (73), it may appear that the final syllable could be the third-person singular accusative clitic /=ja/ (Ghanggo Ate 2018:8), but this would not explain the stress patterns. There may be a diachronic explanation for some examples. The glide may be a historic insertion, as in PMP *ia > /ɗiyo/ ‘she, he’ (compare Wejewa /nia/ ‘she, he’ (Onvlee 1984:381) with no medial glide), or PMP *duRi > **rui > /rijo/ ‘bone’ (Kambera <rí> /rii/ ‘bone, thorn’, Wejewa /ruwi/ (Onvlee 1984:381)). However, this explanation is not comprehensive as other examples in which a medial glide has been inserted retain this glide in the short form. Two examples are /tojo/ → /toj/ ‘person’ from PMP *tau (Kambera /tau/ ‘person’, Mamboru <tu> (Onvlee 1984:486)) and /wujo/ → /wuj/ ‘fruit’ from PMP *buah (Kambera /wua/ (Onvlee 1984:541)).[17] Finally, there is one form in which final [gaŋ] is deleted in the short form, given in example (74). Note, again, that the stress patterns suggest that the deleted syllable is not an affix or clitic. We currently have no explanation for this exceptional word.

	underlying	**long form**	**short form**		
(74)	/maⁿgaŋ/	[ˈmaˑŋgaŋ]	[ˈmaːŋ]	‘to wait’	556

7 Metathesis and double vowels

Synchronic metathesis is attested in many Austronesian languages of the Wallacea area of Eastern Indonesia. Schapper (2015:135–138) presents a map of 31 Austronesian languages with synchronic metathesis, such as Balangao (Shetler 1976), Kwara’ae (Sohn 1980; Heinz 2005), Rotuman (Besnier 1987), Leti (Hume 1998), Helong (Bowden 2010; Balle 2017). Recent work has also been done on metathesis in Amarasi (Edwards 2018; 2020). The function(s) of metathesis in Kodi remain unknown due to the relative lack of data and analysis of the grammar of the language. However, speakers are aware of the alternation and are able to give metathesized forms of words in isolation. These forms were recorded and analyzed in our word list.

Metathesis in Kodi occurs at the end of words. The final vowel and its preceding consonant switch their positions, from CV# to VC#. This results in the underlying final vowel being adjacent to the underlying penultimate vowel. There appear to be constraints on which words are eligible to undergo metathesis in Kodi based on vowel quality, as well as requiring the absence of an intervening long consonant. One context in which metathesis occurs in when the penultimate vowel and final vowel are identical. We discuss this type of metathesis later in this section. We first present cases of metathesis in which the underlying form has the low vowel /a/ in the penultimate syllable and a high vowel /i/ or /u/ in the final syllable, as in examples (75) through (79). There is also one case of metathesis in our data involving the mid-vowel /o/ as the penultimate vowel, shown in example (80).[18]

	underlying	**long form**	**metathesis**		
(75)	/watu/	[ˈβ̤aʈʊ]	[β̤a.oʈ̚]	‘stone’	37
(76)	/api/	[ˈʔa̤pi]	[ʔa̤ɛp̚]	‘fire’	45
(77)	/kaɗu/	[ˈkaˑɗʊ]	[kaʌt̚]1,2 [kɐ̈ʊ̈ʈʰ]3	‘horn’	62
(78)	/mati/	[ˈmaˑʈɪ]	[maɛʈ̚]	‘to die’	259, 462
(79)	/kaᵐbu/	[ˈkaˑmbʊ]	[kaɛmbw]	‘stomach’	313
(80)	/koki/	[ˈkɔˑki]	[ˈkœɪk]	‘monkey’	759

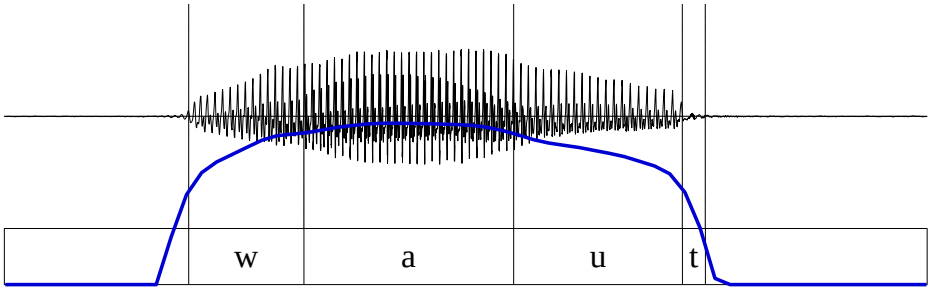
In the metathesized forms shown in examples (75) through (80), partial assimilation of the final vowel often occurs with high vowels lowering to mid and often also being somewhat centralized. This can also be seen in the average formants for these two types of metathesis in Figure 9 (Section 2.3). In example (80), the penultimate vowel, a mid vowel /o/, fronts in the metathesized form, thus partially assimilating to the place of the following front vowel. In a metathesized form resulting in adjacent, non-identical vowels, the two vowels can optionally coalesce into a single phonetic syllable, but this is not an obligatory process and both

[17] The medial glide in /ɣajo/ ‘wood’ may be retained from an earlier form, as PMP *kahiw ‘wood’ often develops into **kaju (as in Indonesian *kayu* ‘wood’). An earlier medial glide is probably attested by Wejewa /wazu/ ‘wood’, with glide fortition *j > **dʒ > z.

[18] Note, in example (79), that the transcription includes a trace of the original vowel in word-final position, as previously mentioned in regard to example (36) in Section 2.3.

vowels can also be realized with separate syllable peaks, as in the short form of 'stone' in example (75). The intensity for a recording of this word is shown in Figure 13. The intensity (solid blue line) has a peak near the middle of the first vowel in the sequence, rather than at the beginning with steady decline towards the end. Note that in Section 4 we proposed that super-heavy syllables are strongly dispreferred in Kodi. Under this assumption, the adjacent vowels of a metathesized form remain in separate syllables to avoid forming a single syllable with two vocalic moras in the nucleus in addition to the mora in the coda. We take the ability of speakers to avoid diphthongizing metathesized vowel sequences as positive evidence for this analysis.

Figure 13: *Intensity (blue line) over waves of metathesized form in example (75)*



A further condition on metathesis is that intervening consonant should not be long, as in example (81). In these cases, metathesis does not occur. The short form is instead made by apocope. We take this to confirm our analysis of long consonants as spanning two syllables phonologically (Section 3). Note that this restriction does not apply to (single) prenasalized stops, as in examples (79) and (84). This is further evidence that prenasalized stops function as a single phonemic segment (Section 2.1).

	underlying	**long form**	**apocope**		
(81)	/haɗɗu/	[ˈhaʔɗu]	[ˈhaɖ̚]	'to be hurt'	627

Metathesis can also occur when the penultimate and final vowels are identical, resulting in a metathesized form that has a double vowel. A double vowel is a sequence of two identical vowels in the phonology, pronounced phonetically as a single long vowel (as seen, for example, in Amarasi; Edwards 2020:96). Examples of metathesis involving identical vowels are given in examples (82) through (84). Figure 14 and Figure 15 show the long form and metathesized forms of example (83).

	underlying	**long form**	**metathesis (resulting in double vowel)**		
(82)	/jaja/	[ˈjạja]	[jạːj]	'I'	20
(83)	/mete/	[ˈmeːt̪ɛ]	[meːt̪]	'black'	64
(84)	/paⁿdeⁿde/	[paˈndɛndɛ]	[pə̆nˈdɛːnd]	'to cook'	296

Figure 14: *Spectrogram of example (83) with single vowel measuring 16.4 ms*

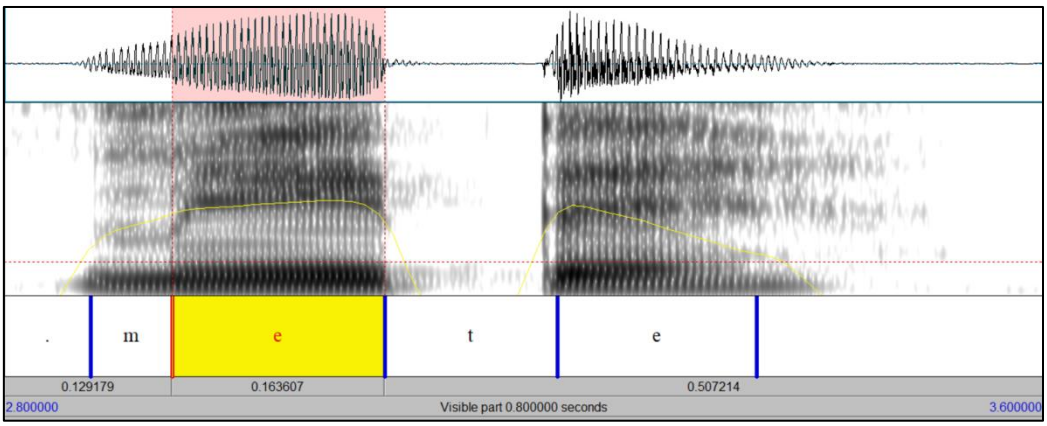
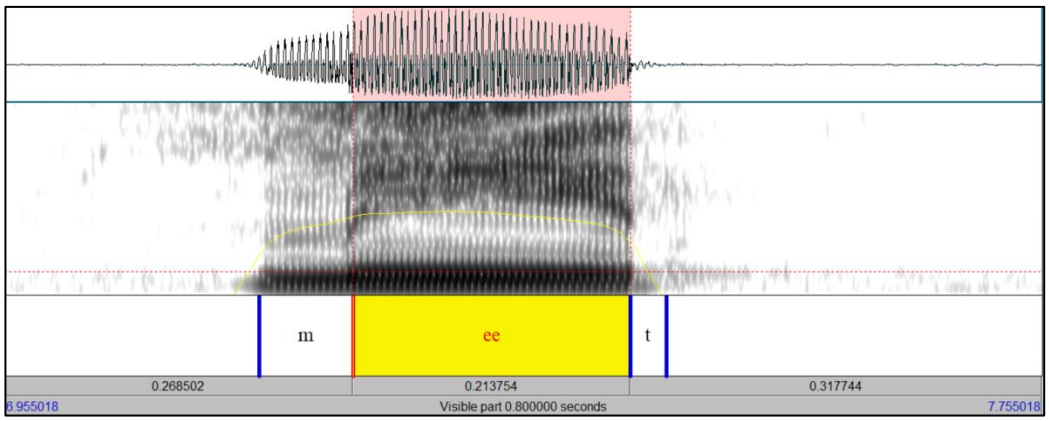


Figure 15: *Spectrogram of example (83) with double vowel measuring 21.4 ms*



As discussed in Section 4, stressed vowels can be slightly lengthened. This is indicated in our transcriptions with the IPA half long symbol. Syllable length also varies with word length. The length of each nucleus tends to be longer in words with fewer syllables, and shorter in words with more syllables. Since vowel length is relative, not absolute, it is not possible to distinguish various kinds of vowel lengthening in isolation. In order to distinguish the length of double vowels compared with compensatory lengthening accompanying apocope, we measured the lengths of the stressed nucleus in 131 words, each repeated three times in both a long form and a short form.[19] We compared the first utterance of the long form with the first utterance of the derived form, the second with the second, and the third with the third, and calculated the average difference in the length of the nucleus of the stressed syllable. These averages were categorized by each type of putative morphophonemic alternation, as shown in Table 4.

Table 4: *Average lengthening of stressed nucleus by type of morphophonemic alternation*

Type of alternation	**# of words**	**Example**	**Gloss**	**Avg. nucleus lengthening**
Only antepenultimate vowel	15	/manihi/ → /mnihi/	‘thin’	5.2%
Long C Apocope: CVCC(V)	31	/rutta/ → /rut/	‘blood’	6.8%
No paragogic vowel	5	/leteŋ-o/ →/leteŋ/	‘to throw’	9.7%
Apocope: CVC(V)	19	/kalejo/ → /klej/	‘left’	12.9%
Metathesis: Double vowel	43	/mete/ → /meet/	‘black’	33.8%
Onsetless apocope: VC(V)	3	/iɣa/ →/iɣ/	‘fish’	37.9%
Metathesis: Diphthong	15	/kati/ → /kait/	‘to bite’	46.8%

In all cases, there is a tendency for the length of the stressed nucleus to lengthen when the length of the word is shortened. This lengthening is least pronounced when the shortened form has only deleted an antepenultimate vowel, but retained the final vowel, and in cases where the stressed nucleus is followed by a long consonant. In these cases, the stressed vowel of the short form is around 5% to 7% longer than the stressed vowel in the long form. Lengthening is slightly more noticeable in words which can either end in a paragogic vowel or a consonant (Section 5), and in cases of apocope without a long consonant. In these cases, the stressed nucleus in the shorter version of the word is, on average, about 9% and 13% longer than the stressed nucleus in the longer form of the word.

There is no statistical significance to the differences between the average lengthening of those four alternations,[20] but there is a significant difference between the lengthening of the stressed nucleus in those alternations, and the lengthening of a two-vowel nucleus resulting from metathesis compared to a single

[19] Three of the words were only repeated twice. See Lovestrand, Balle and Edwards (2021b) for the data used in these calculations.

[20] By z-test, the *p* values comparing the first four categories in Table 4 range between 0.046 and 0.595.

vowel nucleus.[21] In the indisputable cases of metathesis—those in which the two vowels are of distinct qualities—the stressed nucleus of the metathesized form is, on average, 46.8% longer than the stressed single-vowel nucleus of the unmetathesized form. In the case of metathesis resulting in double vowels (phonetically pronounced as a long vowel), the length of the stressed nucleus in the metathesized form is, on average, 33.8% longer than the stressed nucleus of the unmetathesized form. This is slightly less of a difference than in the case of metathesis resulting in diphthongs, but it is still triple the average lengthening of a stressed nucleus resulting from apocope. This evidence demonstrates a clear distinction between long vowels resulting from metathesis (i.e. double vowels), and other types of vowel lengthening in Kodi. The existence of double vowels is also confirmed by native speaker intuition (Ghanggo Ate, personal communication).

Our measurements also showed three outliers—cases in which apocope resulted in extreme lengthening of an average of 37.9%. These three words are of the onsetless VCV syllable structure. We do not have an explanation for the amount of lengthening that occurs in these words. More data is clearly needed to determine whether this is a regular pattern.

8 Palatalization and labialization

The basic phonological process described in this section is a high vowel, [i] in the case of palatalization or [u] in the case of labialization, affecting the pronunciation of a following syllable. However, there are also a few cases where palatalization or labialization is lexicalized, and not triggered by a phonological environment. In our data, there are more cases of palatalization, so palatalization will be discussed in more detail than labialization.

When palatalization and labialization are the result of a phonological process there is some variation in our data. In two recordings of the same word, palatalization might be found in one instance and not in the other. This is even true when the recordings are of the same speaker. In example (85), the underlying form has a high back vowel in the first syllable, which can trigger labialization of the second syllable. Likewise, in example (86), the high front vowel in the first syllable can trigger palatalization in the second syllable.

	underlying	**long form**	**short form**		
(85)	/tukka/	[ˈt̪ʊkːɐ] ~ [ˈtʊkːʷɐ]	[ˈt̪ʊ̈k]	‘near’	88, 332, 601
(86)	/limma/	[ˈlɪmːa] ~ [ˈlɪmːʲa̰]	[limˑ]	‘hand’	135, 404

Palatalization has a different phonetic realization when the onset consonant is dental/alveolar. Instead of a consonant-glide combination, there is a change of place of articulation from dental/alveolar to palatal, as shown in example (87).

(87) **Palatalization of dental/alveolar consonants**
/ⁿd/ → [ⁿɟ]
/n/ → [ɲ]
/t/ → [c]

The alternation between alveolar and palatal consonants can also be seen when palatalization occurs across a word boundary. In this context, the high vowel triggering palatalization is in a preceding word. Example (88) shows the phonetic pronunciation of the phrase *rehi ndaha* ‘better (lit. more good)’. The final vowels of each word are not pronounced, and the underlying prenasalized alveolar stop of the second word can be pronounced at the palatal place of articulation. Here the phonological context that most plausibly motivates palatalization is the high front vowel /i/ from the preceding word.[22] Note that in example (88) the phrase was

[21] By z-test, comparing any of the first four categories in Table 4 with the “Double vowel” or “Diphthong” category, the *p* value is < 0.001 in all instances. The difference between “Double Vowel” and “Diphthong” also appears to be significant, with a *p* value of 0.002.

[22] Hoskins’ (2002:808) orthographic representation of two Kodi phrases shows palatalization across a word boundary. Compare the phrase written <ana mbella>, literally ‘child box’, with <bei mbyella> ‘large box’. The high vowel at

pronounced both with and without palatalization. Just as is the case within a word boundary, there also appears to be some variation in palatalization across word boundaries.

(88) [ɾɛhn̪ˈɟah] ~ [ɾɛhn̪ˈdah]
rehi ndaha
more good
better (kodiphrases.02)

Where there is a phonological motivation for palatalization or labialization, the trigger normally appears to precede the target. However, in example (89) palatalization is a result of the amalgamation of a prenasalized dental/alveolar and a following palatal approximant. The head noun is followed by two pronominal clitics, a genitive and basic form of the same pronoun. Sukerti and Ghanggo Ate (2016) analyze the underlying form of these clitics as *nda* and *yicca*. The first line of example (89) shows how this word is pronounced phonetically. The vowel /a/ is dropped from each of the pronominals, and the prenasalized dental/alveolar stop /ⁿd/ and the palatal approximant /j/ amalgamate, forming a single consonant: the prenasalized palatal stop /ⁿɟ/. The underlying palatal approximant triggers a change of place of articulation from dental/alveolar to palatal.

(89) ʔʊmanˈɟɟɪc͡
umma=nda=jicːa
house=1PL.INCL.GEN=1PL.INCL
our house (kodiphrases.32)

In the above examples, there is a plausible phonological explanation for palatalization, but in other cases it is not so clear what causes the change, such as in the pronunciation of the name *Pati* in example (90). If the trigger is a high front vowel, in this case (and others like it in our data) it is not the final vowel of the preceding word that causes palatalization, but the first vowel of the preceding (bisyllabic) word.

(90) ˈjaˑ̪ ʔɪcɛ ˈpɪ̆a̪t͡
jajo itːe pati
1SG see Pati
I see Pati. (kodiphrases.26)

Another hypothesis for example (90) is that, like Selaru (Coward & Coward 2000:22), Kodi words can end in glides that are barely perceptible phonetically, but which can have an effect on a following syllable. For example, the underlying form might include a shortened version of the third-person singular accusative clitic *=ya* which is not easily detected phonetically, yet it causes palatalization of a following consonant. Another possible explanation for the presence of palatalization in example (90) is that palatalization is an autosegmental feature or prefix/infix with a grammatical function, as found in some Chadic languages (e.g. Gravina 2014). For example, Hoskins (1994:xx) reports:

> The /y/ sound is also inserted after the first consonant of a proper name to indicate that reference is in the third person (somewhat akin to the Indonesian practice of referring to an absent person as "Si Someone"). The insertion of this syllable changes the consonant /t/ to /c/ and the consonant /nd/ to /nj/ and may affect the way other parts of the word are pronounced.

Under this analysis, the final word in example (90) would be analysed as having an infix, /j/ or /i/, with this infix signaling a proper name, thus /p<j>ati/ '<PROP.N>Pati'.

The palatalization in examples (91) and (92) raises even more questions about what causes palatalization. In both examples the verb 'know' is palatalized without any apparent phonological

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the end of *bei* appears to trigger palatalization of the first consonant in the following word. A similar process of "high vowel spreading" across a word boundary is found in Luang (Taber & Taber 2015:24).

motivation. One possible hypothesis is that the negation marker *nda* phonemically ends in a glide, /ndaj/, which spreads to the following consonant.

(91) ˈjœˑjœ ɪndˀ ɸʲejɪŋ
jojo nda peɣeŋ
2SG NEG know
You don't know. (kodiphrases.45)

However, in example (92), there is also palatalization of the verb despite the presence of a pronominal clitic between the negation and the verb. In this case, we might hypothesize that the underlying high vowel /u/ of the pronoun is causing palatalization of the first consonant of the verb. This is somewhat similar to Luang (Southwest Maluku), where Taber and Taber (2015:24) describe a process whereby the high-back vowel /u/ metathesizes with certain following consonants and "assimilates" resulting in a palatal glide, as in Luang /woru/ 'two' + /la/ 'in' → /worlja/. Whether or not a similar process might occur in Kodi requires more data to determine.

(92) ˈjaˌˑj ŋɟɔk pʲejɪ̌ŋ
jajo nda=ku peɣeŋ
1SG NEG=1SG.NOM know
I don't know. (kodiphrases.44)

A further complication is that the initial consonant of the negation marker is palatalized in example (92), but not in example (91). Note that the phonological material before the negation marker in both examples is nearly identical. In a dozen other examples in our data, the same pattern appears to hold. A pronominal clitic following the negation marker appears to trigger palatalization of the initial consonant of the negation marker. In the examples with palatalization of the negation marker, the additional consonant from the clitic pronoun changes the syllable structure around the negation marker from a light, open syllable (CV) to a closed, heavy syllable (CVC). It is possible that heavy or closed syllables are one condition required for palatalization to take place, at least in some contexts.

Finally, recall that in a few cases, as discussed for examples (46) through (48) in Section 3. palatalization or labialization appear to be part of the underlying lexical form of the word. That is, there is no (synchronic) phonological explanation for the appearance of a glide, and the inclusion of the glide sound seems to be obligatory in all contexts. In summary, palatalization and labialization can appear under certain phonological conditions, but those conditions do not fully explain the distribution of palatalization and labialization in Kodi. These features also appear to be lexicalized in some cases, and are potentially autosegmental elements with semantic or morphosyntactic meaning. The precise contexts that trigger the palatalization process and any semantic role it may play are not yet clear.

9 Conclusion

This paper contributes to the analyses of Kodi by refining our understanding of the phonemic inventory, and working out the basic parameters of some common phonological alternations. The marginal nature of the palatal consonants is raised for the first time, in relationship to a process of palatalization. However, the contexts in which palatalization occurs are still very poorly understood.

Most of the phonological processes examined in this paper reduce the length of the word relative to the underlying form, mainly vowel deletion/reduction and metathesis. We confirm that there is phonetic evidence for the existence of double vowels resulting from metathesis, distinct from stress-induced lengthening. The types of morphophonological alternations are fairly clear, and appear to predictable based on vowel quality and phonotactics. Paragoge is limited to roots that are underlyingly consonant-final, and is lexically conditioned. Metathesis is restricted to words whose final and penultimate vowels are either identical or the penultimate vowel is the low vowel /a/ and the final vowel is a high vowel. Metathesis is further restricted to words without long consonants. Apocope is the elsewhere case. Antepenultimate vowel reduction varies independently of other alternations, and it is restricted to words with a (historical) prefix with the vowel /a/.

The different contexts in which long and short forms of words are used are not yet understood. The next steps for Kodi phonology research will be to look at naturalistic texts to observe where these alternations take place. This may soon be possible due to a recent small grant from The Endangered Languages Fund received by Yustinus Ghanggo Ate to purchase equipment for video documentation of Kodi.[23]

Our findings have important implications for the ongoing development of a standardized writing system for Kodi. Even though the palatal sounds [c], [ⁿɟ] and [ɲ] are arguably allophones and not phonemes in the language, we can still recommend writing them in the alphabet. Kodi speakers are very aware of these sounds and have no problem distinguishing them in writing. This may be due to exposure to Indonesian, or because palatalization is a "post-lexical" process (Snider 2011).

A second important issue for writing Kodi is to determine whether words should be written in their underlying long form, or in their more common short form. Kodi speakers appear to fall on both sides of this issue. Some find the long forms to be too rigid and formal. Others find the short forms to be incomplete and difficult to decipher. The tension may be between a "shallow" orthography and a "deep" orthography. A shallow orthography follows the pronunciation more closely, and so would write more short forms in Kodi. A deep orthography represents the analysis of the underlying form. Shallow orthographies are thought to be easier for new readers, while deep orthographies are more efficient for mature readers (Katz & Frost 1992:72). If this is the case in Kodi, it may be appropriate to use a shallow orthography to help new readers, for example, children in a multilingual education program. However, a standardized version of the orthography might instead write out the full forms of most words, including letters that are not pronounced to allow for faster word recognition by mature readers. These conclusions remain tentative pending the possibility for further research and testing. More research is also needed on the morphology of Kodi in order to the interaction of the basic phonology presented here with the system of affixes and clitics, as well as the implications of morphological analysis for writing word breaks for the Kodi orthography.

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