

Phonetics and phonology of Ngkolmpu

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1 Introduction¹

Ngkolmpu is the westernmost language of the Yam family (Evans et al. 2018); it is one of the few Yam languages spoken entirely in Indonesia (Figure 1). There are two distinct dialects of Ngkolmpu: Ngkontar and Bedi. Ngkontar is the variety traditionally spoken in the vicinity of Yanggandur whilst Bedi is spoken in the coastal region near the contemporary village of Osnggaya.

As indicated in Figure 1, Ngkolmpu is a member of the Tonda-Kanum group within the Yam family. The two other groups are Nambu in the east and Yei in the northwest, see Kashima (this volume) on Nmbo for an example of a Nambu language. The Yei group consists of a single language with multiple dialects based on fieldwork observations in 2019.

Ngkontar Ngkolmpu is spoken by at most 200 people, the majority of whom reside in the village of Yanggandur. There is also a substantial community of speakers, around 50 people from my own observations in 2017, residing in Rawa Biru. The language is used as a means of everyday communication alongside the national language Indonesian, Papuan Malay and other local languages. Unlike Ngkontar, Bedi is no longer spoken as a language of day-to-day communication. A visit to Onggaya in 2017 confirmed six elderly people, the youngest in their 60s, who remembered many words in the language but were no longer using the language. The variety described in this paper is Ngkontar with all data drawn from firsthand fieldwork in Yanggandur.

The primary descriptive resource for Ngkolmpu is Carroll (2016). This article is based on that earlier resource; where there is a contradiction between these two sources this article supersedes. As with most languages of the region, there is very little published on the phonetics and phonology of Ngkolmpu; there is a single paper (Carroll 2019) on the phonetic characteristics of voice in prenasalised stops. Some previous work on the language referred to the language as Kanum (Boelaars 1950; Donohue 2008, 2011, 2015). Since the term Kanum is used by speakers of Ngkolmpu and related languages to refer to at least three distinct but closely related languages (Ngkolmpu, Smerki and Nggarna) the more specific Ngkolmpu term will be used in this article.

In terms of its phonemic inventory, the language is fairly typical of a Yam language. There is a primary distinction between oral and prenasalised stops. Ngkolmpu, like closely related Smerki and Nggarna, lacks the large inventory of fricatives found in the eastern Tonda-Kanum languages (Evans et al. 2018). As has been described for other

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Yam languages (Evans & Miller 2016; Döhler 2019), the distribution of schwa [ə] is entirely predictable from the phonotactics and is thus treated as non-phonemic (§3.2).

Sound files have been provided for almost all examples. The seven examples which lack a sound file are indicated with a superscript plus sign (+). These are morphologically infrequent examples which have been recorded from speakers but for which no suitable sound file is available. All data used in this paper has been recorded from one of three speakers: Karel Dimar (KD), Magdelena Ndiken (MN) and Yonas Gelambu (YG). All three are in their 50s;² Karel Dimar and Yonas Gelambu are male and Magdelena Ndiken is female.

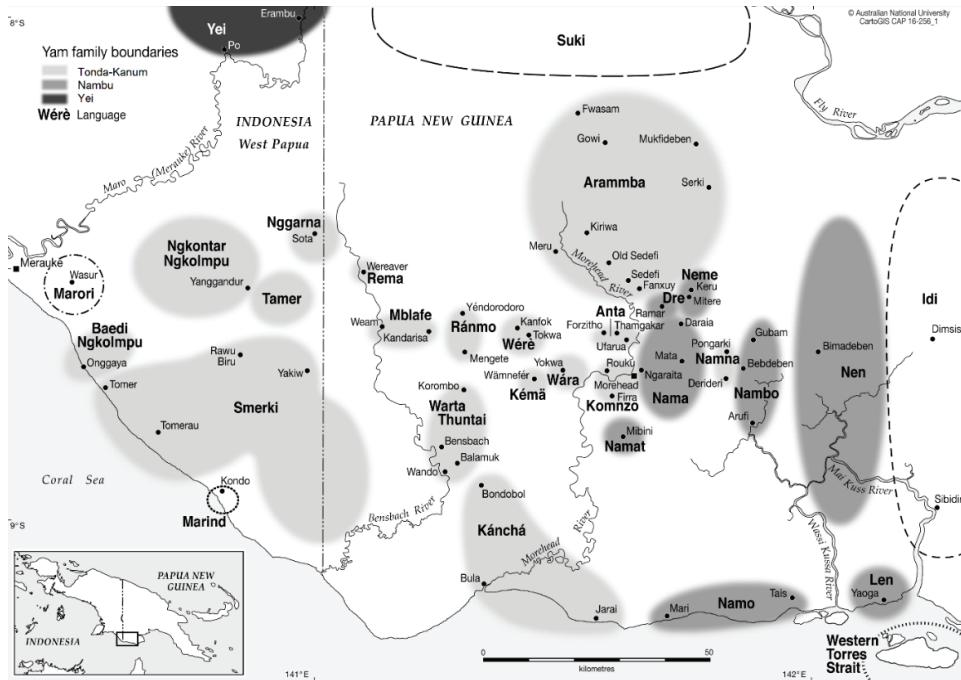


Figure 1. Locations of the Yam languages

2 Consonants

Table 1 presents the inventory of phonemic consonants in Ngkolmpu. Minimal pairs for consonants at similar places of articulation are provided in Table 5 (§2.3).

² Providing more precise ages is not possible.

Table 1. Phonemic inventory of consonants³

	Bilabial	Coronal	Velar
Voiceless stop	p	t	k
Prenasalised stop	^m p	ⁿ t	^ŋ k
Nasal	m	n	
Voiced stop	b		g
Fricative		s	
Prenasalised fricative		ⁿ s	
Trill		r	
Lateral		l	
Glide	w	j	(w)

All but one consonant are at one of just three possible places of articulation: bilabial, alveolar and velar. The single exception is the palatal glide /j/. To enhance readability, the palatal glide and the alveolar consonants are treated as a single coronal column in Table 1. The labiovelar approximant /w/ has been included in both the bilabial and velar positions in the chart as it is a single co-articulated phoneme. Unlike many other Yam languages, e.g., Nen (Evans & Miller 2016) and Yei, Ngkolmpu has no labial-velar coarticulated stops. These have been simplified to the voiced bilabial stop; compare the words for mosquito: /ba/ (Ngkolmpu), /gbən/ (Yei) and /gbəŋ/ (Nen).

Phonotactically, there is a core distinction between approximants and non-approximants. The non-approximants are oral and prenasalised stops and fricatives and nasal stops, while approximants are the liquids and glides. Non-approximants may occur in syllable-initial position. They never occur in second position in onset clusters and may only occur in codas word-finally. Approximants are unrestricted in their distribution and may occur in all syllable positions as long as they satisfy the other phonotactic constraints (§4).

The primary distinction in the stop series is not voicing but rather prenasalisation, with a voiceless oral stop series and a prenasalised series at all three places of articulation. The prenasalised stops are articulatorily complex as they are phonetically voiceless for the duration of the oral portion of the stop as discussed in §2.1.2 and Carroll (2019). There are nasal stops at the bilabial and alveolar places, although there is no plain velar nasal. There is a single voiced stop in the bilabial position. There is a voiced velar stop but this is only found in loan words, e.g., *tgu* ‘leg’ from Marori, *garam* ‘salt’ from Indonesian. There are two voiceless alveolar fricatives, one of which is prenasalised. The prenasalised fricative has two different orthographic representations based on allophonic realisation conditioned by the following vowel (§2.1.4).

The approximant consonants are either liquids or glides. The liquids include a trill /r/, which is sometimes realised as a tap [ɾ], and a lateral /l/. There are also two glides: the labiovelar approximant /w/ and the palatal /j/.

³ The orthography largely aligns with the IPA symbols. The differences are: (1) prenasalised stops are written as multigraphs <mp>, <nt>, <ngk>; (2) the prenasalised fricative /n̪s/ is written differently for its two allophones <ns> for [n̪s] and <nc> for [n̪tʃ]; (3) /j/ is written as <y>.

2.1 Non-approximants

2.1.1 Oral stops

There are three voiceless stops, /p/ /t/ and /k/, which correspond to three places of articulation: bilabial, alveolar and velar. These occur in syllable-initial position both word-initially and word-medially. They also occur in coda position word-finally. These consonants have a long voice onset time (VOT) (Table 2). However, when following continuant consonants across syllable boundaries, the VOT is reduced and they are realised unaspirated. When occurring word-finally, there is typically an exaggerated release, represented here with a capital H.⁴ In all allophones, these elements are phonetically voiceless and the distinction between allophones is a matter of degree of aspiration. The alveolar /t/ is sometimes articulated as a dental [t̪]; this is phonologically unconditioned and certain speakers will typically prefer one or the other but never a single one exclusively.⁵

Table 2. Mean Voice Onset Time (ms) for oral stops

#	V_V	C_V
/p/	28.7	31.8
/t/	30.5	37.9
/k/	45.0	23.4

- | | | | |
|-----|-------|-------------------------------|---|
| (1) | /p/ → | [p] / C_ | <i>kolpi</i> ['kɔlpi] 'fish sp.' ⁽¹⁾ |
| | | [p ^H] / _# | <i>ntop</i> [n ^H ɔp ^H] 'big' ⁽²⁾ |
| | | [p ^h] / elsewhere | <i>bopan</i> [bɔ p ^h an] 'rice' ⁽³⁾ |
| (2) | /t/ → | [t] / C_ | <i>mplangku</i> [m ^H p̥eltaŋk ^H] 'fly (n.)' ⁽⁴⁾ |
| | | [t ^H] / _# | <i>pwt</i> [p ^H ɛ'wət ^H] 'ashes' ⁽⁵⁾ |
| | | [t ^h] / elsewhere | <i>teya</i> ['t ^h eja] 'banana' ⁽⁶⁾ |
| | | | <i>kota</i> ['k ^h ɔtha] 'grass' ⁽⁷⁾ |
| (3) | /k/ → | [k] / C_ | <i>mlku</i> [m ^H lkɔ] 'yam for seed' ⁽⁸⁾ |
| | | [k ^H] / _# | <i>watik</i> [watik ^H] 'enough' ⁽⁹⁾ |
| | | [k ^h] / elsewhere | <i>kkae</i> [k ^h ɛ'k ^h æ] 'melaleuca sp.' ⁽¹⁰⁾ |

Voiceless stops exhibit a complete occlusion of the vocal tract, which characterises the stop. Once released, there is a period of voicelessness before the onset of voicing for the following vowel (VOT). Spectrograms of each of the voiceless stops in intervocalic position are provided in Figures 3-5, in which the voiceless quality is clearly visible. The average length of the VOT of each of the voiceless stops across the phonotactic environments for a single female speaker in her 40s is presented in Table 2. For the word-initial and intervocalic positions, this is a mean over 20 tokens; following a consonant, only three tokens were available since this is a much more restricted environment. We can see that the length of the VOT is dependent on the place of articulation, with anterior consonants displaying shorter VOT as is typical cross-linguistically (Maddieson 1997). In

⁴ I am using a non-standard representation here as there is no existing mechanism in the IPA for representing degree of aspiration.

⁵ It seems fairly safe to assume that this is not true free variation and further studies of a larger sample of speakers would be revealing as to the nature of this variation.

addition, we can see that stops following another consonant have a reduced VOT and are best described as unaspirated voiceless stops.

There is a single voiced stop /b/. This occurs in syllable-initial position both word-initially and word-medially. There are no attested examples of it occurring in coda position.⁶ Phonetically, it is distinguished from the voiceless stop /p/ as it is voiced throughout the articulation as clearly shown by the spectrogram in Figure 6. It has no allophonic variation. There are numerous minimal pairs between /b/ and /p/, e.g., /br/ ‘canoe’ vs /pr/ ‘tree.’ It is the only native voiced stop and historically is cognate with the co-articulated labial-velar stop /gb/ found in other Yam languages.

- (4) /b/ → [b] / *br* [bər] ‘canoe’⁽¹⁴⁾
 kober ['kʰəber] ‘fat (n.)’⁽¹⁵⁾

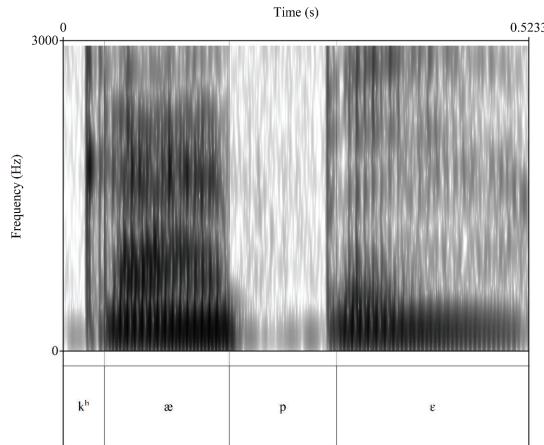
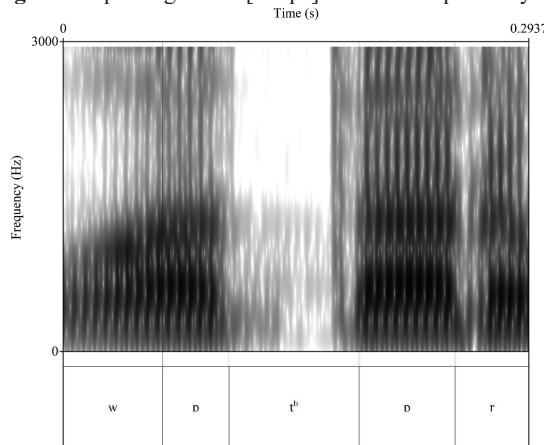
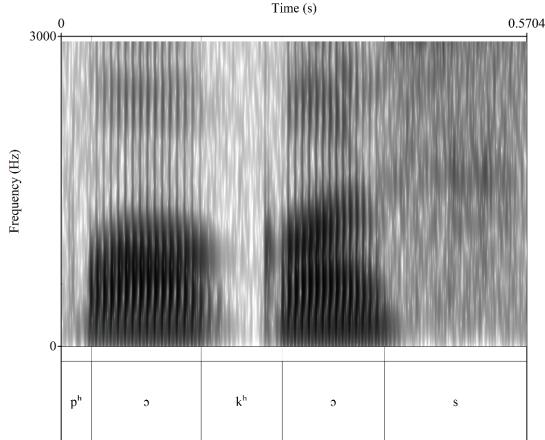
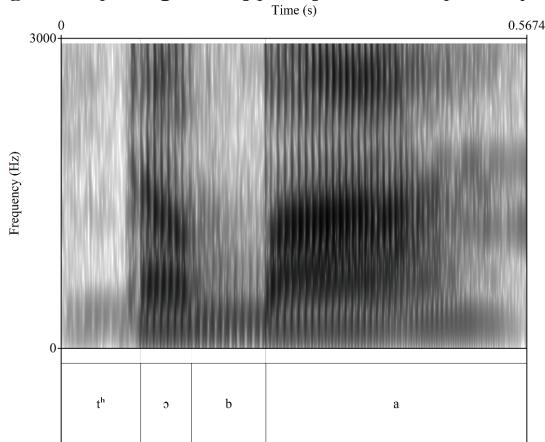


Figure 3. Spectrogram of ['kæpə] ‘cockatoo’ spoken by KD(11)



⁶ Following a suggestion made by Dineke Schokkin (p.c.), it may be the case that /b/ is neutralised to [p] word-finally. Final devoicing has been reported for related language Komzō (Döhler 2018) and so this lends credence to the possibility. However, since Ngkolmpu does not possess any other plain voiced consonants in native words, we would require systematic exploration of all [p]-final words followed by an appropriate vowel suffix to find evidence of this. While a systematic exploration has yet to be conducted, current textual data does not provide any evidence in support of this analysis.

Figure 4. Spectrogram of [‘wɔtpɔr] ‘year’ spoken by KD₍₁₂₎**Figure 5.** Spectrogram of [‘pɔkɔs] ‘excellent’ spoken by KD₍₁₃₎**Figure 6.** Spectrogram of [tɔ'ba] ‘many’ spoken by YG₍₁₆₎

There is a marginal voiced velar consonant /g/. This is only found in a few loan words, although some of these are very commonly used. These include /tgu/ *tegu* ‘leg’⁽¹⁷⁾ from Marori, /ngu/ *ngu* ‘cloth’ from Marind and /garam/ *garam* ‘salt’ from Indonesian. However, speakers are clearly aware of the distinction between the /g/ and the /k/, and any attempt to use /k/ in these words is corrected. This voiced element has clearly entered the system as the voiced member of a pair through the gap in the system. Phonetically, it is characterised identically to the voiceless velar stop except with continued voicing for the duration of the articulation.

2.1.2 Prenasalised stops

There are three prenasalised voiceless stops, /m̚p/ /n̚t/ and /ŋ̚k/, which correspond to three places of articulation, bilabial, alveolar and velar. These display the same distribution as the standard voiceless stops. They occur in syllable-initial position both word-initially and word-medially. They also occur in coda position word-finally. As with the voiceless stops, phonetically these consonants have a long VOT and are aspirated by default. When following continuant consonants, the VOT is reduced and they are unaspirated. Word-finally, they are more heavily aspirated.

- (5) /^mp/ → [^mp] / C_{_} Ngkolmpu ['^vk<sup>hɔl^mpu] 'Ngkolmpu'(18)
 [^mp^H] / _# kongkomp ['k<sup>hɔŋkɔ^mp^H] 'time'(19)
 [^mp^h] / elsewhere mpowr [^mp^howər] 'cassowary'(20)
 smpo ['se^mp^{hɔ}] 'again'(21)</sup></sup>
- (6) /ⁿt/ → [ⁿt] / C_{_} srrnteme [sərərⁿteme] 'they will work it'(22)
 [ⁿt^H] / _# pant [paⁿt^H] 'platform'(23)
 [ⁿt^h] / elsewhere ntop [ⁿt^hɔp^H] 'big'(24)
 sento ['seⁿt^{hɔ}] 'bird'(25)
- (7) /^vk/ → [^vk] / C_{_} ngolngkol [^vk<sup>hɔl^vkɔl] 'peak'(26)
 [^vk^H] / _# mpngk [^mp<sup>hɔŋk^H] 'cold/wet'(27)
 [^vk^h] / elsewhere ngko [^vk^{hɔ:}] 'I (1.SG.ABS)'(28)
 kongko ['kɔ^vk^{hɔ}] 'sun'(29)</sup></sup>

Rather unusually, these prenasalised stops are voiceless for the oral portion of the articulation as demonstrated in Carroll (2019). These involve a period in which there is a full oral occlusion at the place of articulation with the soft palate lowered and the velum open for a period of nasal voicing. Before the stop is released, the voicing ceases and the velum rises, stopping the nasalisation. The consonant is then released, and there is a period of time before the voicing begins for the following vowel, the VOT. Spectrograms are provided for these stops in intervocalic position in Figures 7-9. The voiceless quality is clearly visible in the spectrograms. The duration of voicelessness appears shorter than the previous examples; however, this is a result of the longer words used as tokens in these examples. To confirm this, the VOT for prenasalised consonants displays an almost identical duration to the standard voiceless stop. The average VOTs for all phonotactic positions for prenasalised stops are presented in Table 3. These are the average over 20 tokens for word-initial and intervocalic positions and just three of post-consonantal position as these are more restricted examples. These are clearly phonetically voiceless for the oral period. To test if the difference in means represents a significant difference, a two-sample T-test was conducted; the results show that we have insufficient evidence to conclude a definitive difference between the two means (Table 4). Note, however, that the voiceless period is only for the stop part of the phoneme and not for the nasalisation.

It is important to note here that when these sounds are word-medial and follow a consonant, i.e. following a closed syllable, there is a phonetic tendency to lenite the stop, which can drastically reduce the VOT. These clusters are rather infrequent in the language, with only a few tokens of each; however, as we can see in Table 3, there is a shortening of VOT by around 30% compared to word-initial position. In the cases of the bilabial stops, this reduces the VOT to around 15ms. This is extremely short and difficult to hear, but is still greater than zero and therefore characterised as voiceless.

Table 3. Average VOT (ms) of prenasalised stops

	#	V_V	C_V
/ ^m p/	22.4	29.3	15.9
/ ⁿ t/	24.6	26.8	17.3
/ ^v k/	36.7	34.7	25.9

Table 4. Difference between VOT (ms) of oral and prenasalised stops in intervocalic position

	Oral	Prenasalised	Difference	p	df
Bilabial	31.8	29.3	2.5	0.7825	34
Alveolar	37.9	26.8	11.1	0.9897	34
Velar	41.4	34.7	16.7	0.8519	36

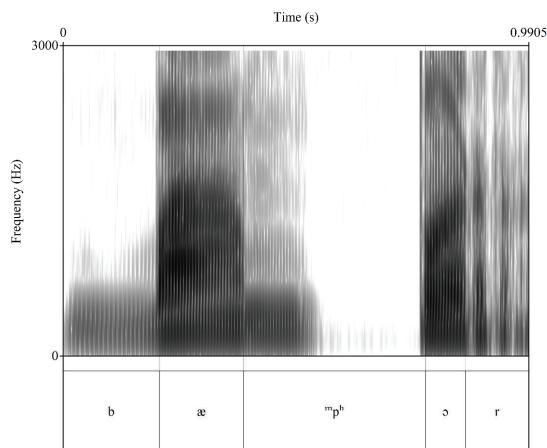


Figure 7. Spectrogram of [‘baem^mper] ‘snake’ spoken by KD₍₃₀₎

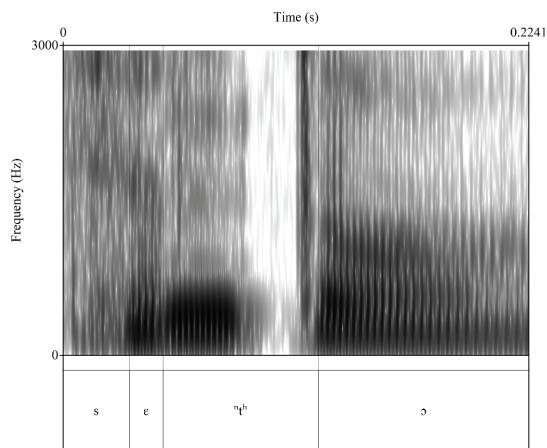


Figure 8. Spectrogram of [se’nto] ‘bird’ spoken by YG₍₃₁₎

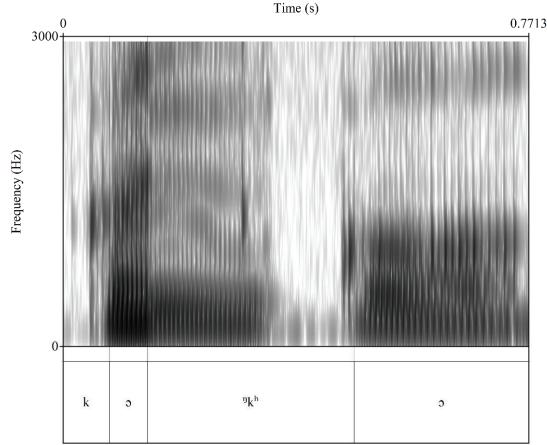


Figure 9. Spectrogram of [‘kae^ŋko] ‘sun’ spoken by KD₍₃₂₎

Prenasalised elements are single phonemes rather than sequences of a nasal and obstruent.⁷ We can see this with evidence from the phonotactics, phonetics and the general organisation of the phonemic inventory. The first simple evidence comes from the fact that /ŋ/ is only found preceding /k/. The second piece of evidence comes from duration. The prenasalised segments are longer than standard voiceless stops, at around 97ms for a prenasalised stop and 89ms for a voiceless stop averaged over 20 tokens from a single speaker. Yet, they are considerably shorter than the combination of a nasal and stop, which is around 167ms. This is fairly typical of prenasalised elements cross-linguistically (Ladefoged 1996: 126). Finally, the most robust evidence comes from the phonotactics, which treat these elements as a single unit. Phonotactics are discussed in §4, where I demonstrate that all clusters must involve elements which are at least two steps apart on the sonority hierarchy. The sequence of a nasal plus stop does not meet such a criterion and would thus be an illicit cluster. However, as we have seen, these frequently occur in the form of prenasalised stops. If these elements were a sequence of nasal plus stop then they should trigger the insertion of an epenthetic vowel and this is what happens when such a cluster does occur, typically as a result of inflection. In example (8), we see that the sequence of nasal plus stop at the same place of articulation occurs phonemically as the result of inflection; however, in the phonetic realisation these are always separated by an epenthetic vowel. Compare this to the prenasalised elements in (9), which are not epenthesis in almost identical contexts.

- | | | | | |
|-----|-------------------------|---|--------------------------------------|----------------------------------|
| (8) | a./n-tinpitr/ | → | [nə. t̪hi.nə.pi.t̪hər] | 'he/she/it covers you' |
| | b./kr̩emun-t/ | → | [kr̩.mu.nət̪] | 'for kremun (a ceremonial food)' |
| (9) | a. /n̪t̪ɔp/ | → | [n̪t̪ɔp̪] | 'big' ⁽³³⁾ |
| | b. /pa ^{n̪} t/ | → | [p ^{n̪} a ^{n̪} t̪] | 'platform' ⁽³⁴⁾ |

2.1.3 Nasals

There are two nasal stops: the bilabial /m/ and the alveolar /n/. There is no corresponding velar nasal. These display no phonologically-predictable allophony. They occur in syllable-initial position word-initially and word-medially. They also occur in codas word-finally.

- | | | | | | |
|------|-----|---|-----|--|-----------------------------------|
| (10) | /m/ | → | [m] | <i>montena</i> ['mo ^{n̪} t̪əna] | 'yesterday' ⁽³⁵⁾ |
| | | | | <i>knume</i> ['kənume] | 'Kanum' ⁽³⁶⁾ |
| | | | | <i>prnm</i> ['p ^h ərnəm] | 'with a stick' ⁽³⁷⁾ |
| (11) | /n/ | → | [n] | <i>nel</i> [nəl] | 'earth' ⁽³⁸⁾ |
| | | | | <i>snm</i> ['sənəm] | 'betel with lime' ⁽³⁹⁾ |
| | | | | <i>kamplen</i> ['k ^h əmplen] | 'bag' ⁽⁴⁰⁾ |

Articulatorily, these consist of a full oral closure at the place of articulation with an open velum allowing air to pass into the nasal cavity.

2.1.4 Fricatives

The voiceless alveolar fricative /s/ occurs in syllable onset position word-initially and word-medially. It also occurs in codas word-finally. The /s/ displays no allophony.

⁷ A prenasalised alveolar fricative is analysed the same these elements and discussed in §2.1.4.

(12)	/s/	→	[s]	supl eser bos	['su:pʰəl] ['esər] [bəs]	'yam' ⁽⁴¹⁾ 'four' ⁽⁴²⁾ 'pandanus sp.' ⁽⁴³⁾
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Phonetically the /s/ is slightly more fricated than /s/ in English. This is not a true affricate in the sense that there is a point of complete occlusion, but the tongue is raised slightly closer to the alveolar ridge than a typical fricative, which creates a higher level of frication.

There is also a prenasalised alveolar fricative /n̪s/. It occurs in syllable initial position word-initially and word-medially. This phoneme occurs in codas word-finally. It has the allophone [n̪tʃ] when occurring before the front vowels /i/ and /ɛ/ and before consonants in complex onset clusters; as indicated earlier, it is written <nc> in those environments in conformity to Indonesian orthography.

(13)	/n̪s/ →	[n̪tʃ] / _ [+front]	mpunce	[m̪pʰuŋtʃe]	'wife'	⁽⁴⁴⁾
		[n̪tʃ] / _ C	ncuen	[n̪tʃwən]	'1.NSG.DAT'	⁽⁴⁵⁾
			krencrntei	[kren̪tʃrən̪tei]	'they will chew'	⁽⁴⁶⁾
		[n̪s] / elsewhere	nson	[n̪sən]	'1.SG.DAT'	⁽⁴⁷⁾
			konsapor	[kʰən̪sapʰɔr]	'day'	⁽⁴⁸⁾
			yons	[jɔ̃s]	'meat'	⁽⁴⁹⁾

Phonetically, there are two elements worth noting. Firstly, as with the standard alveolar fricative /s/, this prenasalised alveolar fricative is also slightly affricated compared to English. The level to which this occurs appears to vary between speakers. This higher energy frication can easily be explained as due to the nature of prenasalisation. In this consonant, there is a period of oral closure in which the velum is lowered for the nasalisation. After this short period of nasalisation, the oral closure is released and the fricative is articulated. This release naturally has some fortition effect on the quality of the fricative. However, it should be noted that whilst the fricative form is more fortis than in English, it is still considerably less affricated than its allophone [n̪tʃ].

This phoneme and its allophone are phonetically voiceless. As with the prenasalised stops, there is a period of voiced nasalisation, which is followed by a clear period of voicelessness before the release until the voicing commences again for the vowel. The average VOT over 20 tokens for speaker KD for [n̪s] was 292 milliseconds and for [n̪tʃ] was 289 milliseconds. These figures are comparable to the other voiceless consonants.

2.2 Approximants

There is an alveolar trill /r/ which is often realised as an alveolar tap [ɾ] depending on speech rate. It occurs in onset position word-initially and word-medially, and codas word-medially and word-finally. When occurring in the second position of onset clusters, it is always tapped as [ɾ].

(14)	/r/ →	[r] / C_	prok	['prəkʰ]	'hunger'	⁽⁵⁰⁾
		[r]~[ɾ] / elsewhere	raekum	['rækʰum]~['rækʰum]	'fish sp.'	⁽⁵¹⁾
			kure	['kʰure]~['kʰure]	'bamboo flute'	⁽⁵²⁾
			trmpo	['tɔ̃m̪pʰɔ]~['tɔ̃m̪pʰɔ]	'mouth'	⁽⁵³⁾
			pr	[pʰər]~[pʰər]	'tree'	⁽⁵⁴⁾

The lateral approximant /l/ may occur in all positions within the word. It occurs in onsets in both initial and second positions, both word-initially and word-medially. It also occurs in codas word-medially and word-finally. It does not display any allophonic variation.

(15)	/l/ → [l]	<i>liko</i> ['likʰɔ] 'river' ⁽⁵⁵⁾ <i>kelimu</i> ['kʰɛlimu] 'forest' ⁽⁵⁶⁾ <i>kaemplen</i> ['kʰæ̃plɛn] 'small bag' ⁽⁵⁷⁾ <i>Ngkolmpu</i> ['ŋkʰɔl̩mpu] 'Ngkolmpu' ⁽⁵⁸⁾ <i>nel</i> [nel] 'earth' ⁽⁵⁹⁾
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From my observations, the /l/ is pronounced with the tip of tongue slightly further back in the mouth than in English. However, it is never pronounced so far back for it to be considered a retroflex.

The two glides /w/ and /j/ occur in onsets in both initial and second positions both word-initially and word-medially. They also occur in codas word-medially and word-finally. In coda position they are realised as an off-glide. In second position when following a continuant and preceding an inserted epenthetic schwa, /w/ is typically realised as slightly more syllabic, represented here as an on-glide, with the inserted schwa clearly audible. Whilst these are not true diphthongs, they are acoustically very similar.

(16)	/w/ → [w] / [+cont] _{-ə}	<i>ncuen</i> [n̪tʃwən] '1NSG.DAT' ⁽⁶⁰⁾
	[_w] / V ₋ ⁸	<i>nyowkoi</i> [n̪iɔ̃wkoɪ] 'we see' ⁽⁶¹⁾
	[w] / elsewhere	<i>wola</i> ['wɔla] 'sea' ⁽⁶²⁾
		<i>kwr</i> [kwɔ̃r] 'pig' ⁽⁶³⁾
(17)	/j/ → [j] / V ₋ _σ	<i>taei</i> [tæi] 'be patient' ⁽⁶⁵⁾
	[j] / elsewhere	<i>yons</i> [jɔ̃s] 'meat' ⁽⁶⁶⁾
		<i>mpiae</i> [m̪pjæ:] 'thing' ⁽⁶⁷⁾

2.3 Minimal Pairs

Table 5 shows the minimal pairs for consonants at similar places of articulation.

⁸ The |_σ symbol indicates a syllable boundary. The consonantal position immediately before a syllable boundary is coda final position.

Table 5. Minimal pairs for consonants

Phonemes	Word	Phonemic	Phonetic	Translation
/p/ - / ^m p/	powr mpowr	/pɔwr/ / ^m p ^h ɔwr/	[p ^h ɔwər] [^m pɔwər]	‘wash (n.)’ ⁽⁶⁸⁾ ‘cassowary’ ⁽⁶⁹⁾
/p/ - /b/	pr br	/pr/ /br/	[p ^h ər] [bər]	‘tree/wood’ ⁽⁷⁰⁾ ‘canoe’ ⁽⁷¹⁾
/p/ - /m/	po mo	/pɔ/ /mɔ/	[p ^h ɔ:] [mɔ:]	‘coconut’ ⁽⁷²⁾ ‘wallaby’ ⁽⁷³⁾
/ ^m p/ - /m/	mper mer	/ ^m pər/ /mer/	[^m p ^h ər] [mer]	‘husband’ ⁽⁷⁴⁾ ‘neck’ ⁽⁹⁹⁾
/b/ - /m/	bi mi	/bi/ /mi/	[bi:] [mi:]	‘buttocks’ ⁽⁷⁵⁾ ‘night’ ⁽⁷⁶⁾
/t/ - / ⁿ t/ - /s/	ni nti si	/ni/ /t̪i/ /si/	[ni] [ⁿ t̪i:] [si:]	‘1NSG.ABS’ ⁽⁷⁷⁾ ‘sick’ ⁽⁷⁸⁾ ‘eye’ ⁽⁷⁹⁾
/k/ - / ⁿ k/	kolmpu Ngkolmpu	/kɔl ^m pu/ /ŋkɔl ^m pu/	[k ^h ɔl ^m pu] [ⁿ k ^h ɔl ^m pu]	‘jaw’ ⁽⁸⁰⁾ ‘Ngkolmpu’ ⁽⁸¹⁾
/s/ - / ⁿ s/	iso ⁺ inso	/i-sɔ/ /i ⁿ sɔ/	[isɔ] [i ⁿ sɔ]	‘(He) minces (it)’ ‘mucus’ ⁽⁸²⁾
/r/ - /l/	br bl	/br/ /bl/	[bər] [bəl]	‘canoe’ ⁽⁸³⁾ ‘seed’ ⁽⁸⁴⁾
/w/ - /j/	were ⁺ yere	/wɛrə/ /jɛrə/	[wɛrə] [jɛrə]	‘bright’ ‘older man (respectful)’ ⁽⁸⁵⁾

3 Vowels

The vowel inventory of Ngkolmpu is summarised in Table 6. Vowels are divided into three height distinctions with a distinction between front, central and back. The back vowels are all rounded. The mid-central vowel schwa [ə] is included in the charts as it is very prevalent in the language; however, it is important to note that it is non-phonemic. The non-central low vowels /æ/ and /ɒ/ are written as digraphs in the orthography, <ae> and <ao> respectively.

Table 6. Phonemic inventory of vowels

	Front	Back
High	i	u
	<j>	<u>
	ɛ	ɔ
	<e>	<o>
Low	æ	ɒ
	<ae>	<ao>

There are no diphthongs in Ngkolmpu at the phonemic level. Any diphthong that occurs phonetically is the result of an off-glide or on-glide occurring in either the onset or coda as appropriate. These off-glides and on-glides are typically written as a sequence of two vowels in the orthography; however, phonotactically, they are non-syllabic, as discussed below.

3.1 Phonetic realisation of vowels

There is a certain amount of phonetic variation in the realisation of vowels. The high vowels /i/ and /u/ are sometimes realised as their near-high counterparts [ɪ] and [ʊ] respectively. The mid front and back vowels, /e/ and /ɔ/ show some variation in height, occasionally being realised as [e] and [o] respectively. At the current stage of research, it is not clear if there is any conditioning environment, and if so, what those conditions are. Vowels are typically lengthened in open monosyllabic words without codas, although this is only a tendency. Figures 9 and 10 represent the mapping of the first and second formants of the vowels for a female and male speaker respectively, for approximately 120 tokens across all vowels. The ellipses represent approximately those which fall into 68% confidence level around the mean of each vowel.

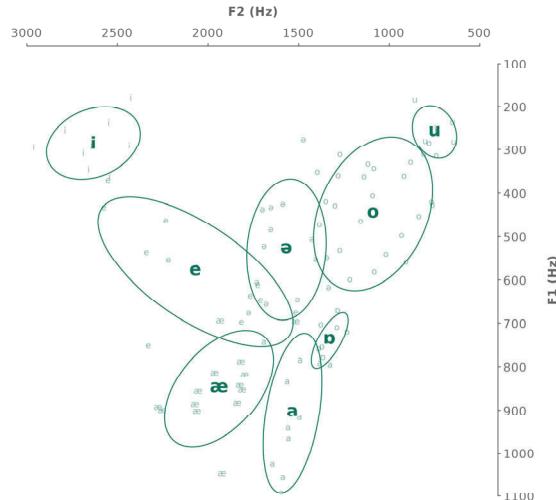


Figure 9. F1 vs. F2 plot for a single female speaker (MN)

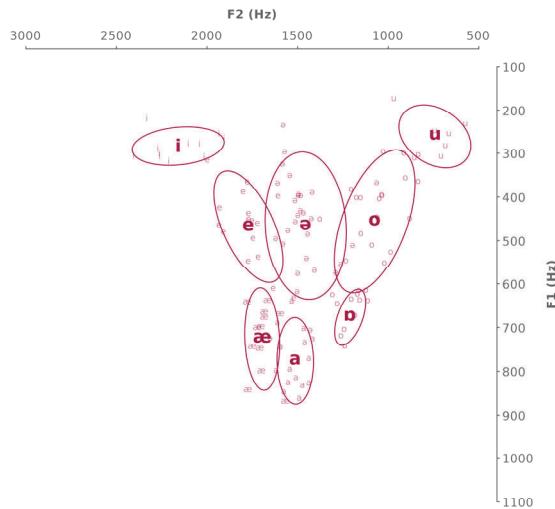


Figure 10. F1 vs. F2 plot for a single male speaker (KD)

3.2 Phonemic status of central vowel

The most frequent phonetic vowel in Ngkolmpu is a short central vowel schwa, [ə]. The occurrence of this vowel is entirely predictable and therefore non-phonemic. The schwa is inserted to create syllable nuclei in otherwise illicit clusters according to a series of phonotactic constraints discussed in §4. In this section, I simply argue for the non-phonemic status of schwa.

Epenthetic vowels such as these have been described for a number of Papuan languages, most famously in Kalam (Pawley 1966, Blevins and Pawley 2010). Similar systems have been described across the Yam family languages, in particular Komnzo (Döhler 2018) and Nen (Evans & Miller 2016). Under the typology presented in Hall (2006), the Ngkolmpu vowels would be considered “epenthetic” rather than intrusive, i.e. the vowels are inserted to repair illicit structures rather than arising from phonetic transitions between consonants.

We can say that schwa is not phonemic in Ngkolmpu since its occurrence is always predictable. Schwa only ever occurs between consonants that otherwise form illicit clusters and never occurs word-finally. It is the only vowel with this distribution. The strongest evidence for these vowels being epenthetic comes from resyllabification of stems in the presence of inflectional morphology. For example, the stem for the verb *onekutrai* ‘to kick’, /nekutr/, ends with the illicit cluster *[tr] |₀. Typically when the word ends with this cluster, such as in the present tense singular actor form, the illicit cluster is broken up with an epenthetic vowel (18). However, when this cluster is followed by a vowel, such as the present tense plural actor marker /-i/⁹, the /r/ is reanalysed as part of an onset cluster (19). In this case, we can see that the vowel is not present underlyingly; rather, it is inserted where appropriate after morphological material has been added.

- | | | |
|----------------------|-----------------------------------|-----------------|
| (18) /i-nekutr/ | → [?i. 'ne.k ^h u.tɔ̄r] | 'He kicks him' |
| (19) /i-nekutr-i/ | → [?i. 'ne.k ^h u.tri] | 'They kick him' |

⁹ Note that this is actually the segment /J/ which is underspecified as to whether it is a vowel or a glide. However, it is always realised as a vowel in this position before the application of epenthesis so for simplicity's sake I have treated this as a vowel in this section.

3.3 Minimal pairs

Table 7 provides minimal pairs for closely articulated vowels. No minimal pair could be found for the pair /a/ and /ɒ/; however, there is a near minimal pair, as shown in the table, and there does not appear to be any conditioning environment.

Table 7. Minimal and near minimal pairs of vowels

Phonemes	Word	Phonemic	Phonetic	Translation
/i/ - /ɛ/ - /æ/	<i>mi</i>	/mi/	[mi:]	'night' ⁽⁸⁶⁾
	<i>me</i>	/mɛ/	[mɛ:]	'sweet' ⁽⁸⁷⁾
	<i>mæ</i>	/mæ/	[mæ:]	'breath (n.)' ⁽⁸⁸⁾
/a/ - /æ/	<i>kaikai</i>	/kaikai/	[kʰaɪkai]	'feast (n.)' ⁽⁸⁹⁾
	<i>kaeikaei</i>	/kæikæi/	[kʰæɪkæɪ]	'skin' ⁽⁹⁰⁾
/a/-/ɒ/	<i>mpar</i>	/mɒɒr/	[mɒɒr]	'bone' ⁽⁹⁸⁾
	<i>mpaormpoar</i>	/mɒɒrmɒɒr/	[mɒʰɒrmɒʰɒr]	'wet season' ⁽⁹⁷⁾
/ɒ/ - /ɔ/	<i>pao</i>	/pɒ/	[pɒ:]	'invitation'
	<i>po</i>	/pɔ/	[pɔ:]	'coconut' ⁽⁹¹⁾
/a/ - /ɔ/	<i>alu</i>	/al-u/	[?alu]	'father-SG.ERG' ⁽⁹²⁾
	<i>olu</i>	/ɔlu/	[?ɔlu]	'sago tool' ⁽⁹³⁾
/ɔ/ - /u/	<i>iso⁺</i>	/i-sɔ/	[isɔ]	'(He) minces (it)'
	<i>isu⁺</i>	/i-su/	[isu]	'(He) folds (it)'

4 Phonotactics

The phonotactics of Ngkolmpu are organised around a phonetic syllable structure. The unrestricted maximal syllable structure for Ngkolmpu is [CCVC]_σ, extended to [CCVCC]_σ in word-final syllables. The minimal syllable structure is [CV]_σ. We can schematise this as in (20).

$$(20) \quad [C_1(C_2)V(C_3)(C_4)]_\sigma$$

C_1 is obligatory and may be any consonant phoneme in the language; this has already been exemplified for each phoneme in the individual sections above. If C_1 is not phonemically present at the start of the word, a glottal stop is inserted.

C_2 may be any of the approximant consonants, that is, /r/, /l/, /w/ or /j/. C_2 may only occur if C_1 is sufficiently less sonorous than C_2 . For example, the liquid consonants /r/ and /l/ may only occur in C_2 position if C_1 is a stop, whereas the glides /w/ and /j/ may occur in C_2 if C_1 is any non-approximant. Thus, this suggests the sonority hierarchy in (21) in which the internal member of any cluster, in this case C_2 , must be at least two steps higher along this hierarchy than the external member, i.e. C_1 . This use of a sonority scale is in line with works such as Selkirk (1984), Clements (1990) or Blevins (1995), which propose similar hierarchies, or sonority sequencing principles, as a constraint on possible syllable structures. The more unusual two step gradation of sonority distance within clusters, presented here for Ngkolmpu, is what has been called Minimal Sonority Distance (Zec 2007) and is similar to the analysis presented by Selkirk (1984) for Spanish.

- (21) vowels > glides > liquids > nasals/fricatives¹⁰ > stops

A vowel must occur in the V position as the syllable nucleus; this may be any vowel in the language. Any illicit clusters are “repaired” by the insertion of an epenthetic vowel as discussed in §3.2.

Word-initially, it often appears that there is no onset and that the syllable consists of only a vowel at the start of a word. In these cases, a consonant is inserted to rectify the syllable structure. Typically, this is a glottal stop [?]; however, high vowels in this position may occur with a short on-glide occurring in free variation with the glottal stop. Thus, phonetically, these words in fact start with a consonant plus vowel sequence.

C_3 may be any of the approximants, i.e. /r/ /l/ /w/ /j/. In word-final position, it is possible to have a C_4 position. If there is a C_4 , then it may be filled by any of the non-approximants. This then conforms to the restrictions imposed by the sonority hierarchy in (21). As stated, C_4 is restricted to word-final position only. If it is a stop, there is a phonetic tendency to have an exaggerated release in this position, typically resulting in a heavy aspiration as already discussed. Since C_4 is restricted to word-final position, complex clusters are only present word-finally (22), usually as a result of suffixation to the word (22b-c).

- (22) a. /t-rəwrt/ → ['trə.wərt^b] ‘(He) follows (him)’⁽⁹⁴⁾
 b. /næ^mpr-t/ → ['næ.^mp^hərt^b] ‘one at a time’⁽⁹⁵⁾
 c. /s-rtrəw-ŋk/ → [sər. 'trəwŋk] ‘(He) destroyed (it) (REM.PERF)’

An interesting result of the above rules is that the approximants /w/ and /j/ may only occur in C_3 if the vowel in the syllabic nucleus is phonologically specified. Otherwise, they become part of the onset in either C_2 or C_1 position. This can be seen in the examples in (23). In (23a) we see the /w/ being realised as the off-glide and occurring in the syllable coda. However, in example (23b), where there is no syllable nucleus, the /w/ is realised as part of the onset.

- (23) a. /s-r-trəw-ŋk/ → [sər. 'trəwŋk] ‘(He) destroyed (it) (remote) (perfective)’
 b. /kwr/ → [k^wər] ‘pig’⁽⁹⁶⁾

5 Transcription of recorded passage

A transcribed and glossed version of the North Wind and the Sun Story has been included to illustrate the elements and processes described in this article. The story was interpreted and translated from Indonesian into Ngkolmpu by Bapak Yonas Gelambu of Yanggandur. The north wind has been changed to the east wind (*wowr kue*, lit. ‘monsoon wind’) to match local weather patterns. Pak Yonas carefully translated the story by himself over two days. He then showed his translations and the original Indonesian to other members of the community and adjusted the translation based on their comments. He then wrote the story out in Ngkolmpu orthography and was recorded reading the final translation. The transcription below is based on that recording.

There are four lines of glossing. The first line is a broad phonetic transcription of the passage. Phonetic features entirely determined by context, such as aspiration, have been omitted from the transcription. Morphologically complex words are segmented into their constituent morphological formatives, except for verbs which are given a unified gloss.

¹⁰ In this hierarchy fricatives and nasals are treated as a single group which I have simply labelled nasals/fricatives. Prenasalised stops are treated as stops.

This is to ensure readability given the complexity of the verbal morphology. Readers interested in the details of the verbal morphology are encouraged to read Carroll (2016).

- (1) [^mpana 'wɔwər k^wɛ je ^mpana 'kɔŋkɔ 'bəl̩t] *mpana* *wowr* *kue* *je* *mpana* *kongko*
 old.man.HON monsoon wind 3SG.COP old.man.HON sun
 bl-t
 round.object-COM
 'The East Wind and the Sun.'
- (2) [[']eibəntai ^ŋki ^ŋkensen ^mpøjæ je] *eibentai* *ngki* *ngkensen* *mpiae* *je*
 story this this.DAT thing 3SG.COP
 'This story is about them.'
- (3) [^mpana 'wɔwər k^wɛ, ^mpana 'kɔŋkɔ 'bəl̩t ^mpjæwa anə'karai ərə sə'rɔ̄nt 'tepewa] *mpana* *wowr* *kue* *irau* *mpana*
 old.man.HON monsoon wind 3SG.REM.COP old.man.HON
 kongko *bl-t* *mpyae-wa* *ankarai*
 sun round.object-COM thing-CAUS RECP.NSG.REM.contradict
 oro *sront* *tepe-wa*
 who 3SG.REM.PFV strong-ADJ
 'There was the East Wind and the Sun, they disputed each other who was the strongest.'
- (4) [pø'no 'tepi sə'ntɔru 'næmpr ju'wæi juwæi i'repe, nə'gu 'ku^mpørwa aka'kaiwa 'jirau] *pno* *tepi* *sntoru* *naempr* *yuayyuay*
 that.time just 3SG.REM.PFV.arrive one wander_around
 irepe *ngu* *kumpr-wa* *akakai-wa* *irau*
 person clothes bundle-ADJ tie.INF-ADJ 3SG.REM.COP
 'One time a traveller came; he was wrapped in a cloak.'
- (5) [^je^mpøka mə'l mɔ'rɔ ta'tunæntai 'pənət ^mpana 'wɔwər k^wɛ 'mɔrɔ sə'tənɔ̄ntu iⁿta'kənæjət 'nɔrwa ^mpjæt ju'wæi ju'wæi i'repe pi nə'gu e'siprait] *yempoka* *mel* *moro* *tatunaentai* *pnt*
 two head how RECP.NSG.REM.agree like.that
 mpana *wowr* *kue* *moro* *stnontu*
 old.man.HON monsoon wind how 3SG>3.REM.PFV.craft
 intaknaei-t *nor-wa* *mpyae-t* *yuayyuay*
 convince.INF-PURP what-CAUS thing-PURP wander_around
 irepe *pi* *ngu* *esiprai-t*
 person that clothes unclothe.INF-PURP
 'They agreed for the East Wind to try and convince the man to open his cloak.'
- (6) [pənət pi sə'krowle i'repe 'tepe 'pewa] *pnt* *pi* *s=krole* *irepe* *tepepe-wa*
 like.that 3.ABS IRR=SG.IRR.become man very.strong-ADJ
 'So that he would be the strongest one.'

- (7) [sə'̐m̐pɔ̐ '̐m̐pana 'wɔ̐wər k̐w̐ pi k̐w̐ 'm̐r̐ se'lusijaŋk pj̐n 't̐penəmt̐]
smpo mpana wowr kue pi
 again old.man.HON monsoon wind 3.ABS
kue moro selusiangk pien tepe-nm-to
 wind how SG>3.REM.PFV.blow 3.DAT strong-INST-ADV
 'Then, the East Wind blew with all his strength.'
- (8) [k̐w̐ 'm̐r̐ su'lisién pi t̐'mæ 'm̐r̐ a'waŋt̐k̐ 'tepe 'tepe 'p̐t̐]
kue moro sulisién pi tmae
 wind how SG>3.REM.IPFV.blow he SG.PFV.hold
moro awantoko tepe~tepe peto
 how SG.enter strong~INTS very
 'He began to blow wind, he pulls in the wind for the most power.'
- (9) [ju'wæi ju'wæi i'repeu 'piɛŋku 'm̐r̐ s̐'lapinəŋk n̐'gu 'p̐ne pi ka'tei]
yuay~yuay irepe-u piengku moro slapinngk
 wander_around person-SG.ERG he.ERG how SG>3.REM.PFV.embrace
negu pene pi katai
 clothes 3SG.POSS that pity
 'The traveller pulls his cloak to him, what a shame.'
- (10) ['̐m̐pana 'wɔ̐wər k̐w̐ pi 'ŋkɔlŋkɔlwa 'towləŋk]
mpana wowr kue pi ngkolngkol-wa
 old.man.HON monsoon wind 3.ABS peak-ADJ
towlengk
 SG.REM.PFV.become
 'The East Wind had tried his hardest.'
- (11) [pɔ̐'̐m̐pa 'sə̐m̐pɔ̐ '̐m̐pana 'kɔŋkɔ b̐l pien t̐'n̐sobru '̐m̐piæt 'præwa 'wərenəm
 s̐r̐'markərənt 'p̐nəm̐]
pompa smpo, mpana kongko bl pien
 from.there again old.man.HON sun round.object 3.SG.DAT
tonsobru mpyae-t prae-wa were-nm
 SG.REM.PFV.shine thing-PURP heat-ADJ light-INS
srmarkrnt pnm
 SG>3.IRR.DUR.burn 3.INS
 'Then, the Sun shone to burn the man with the hot light.'
- (12) ['sə̐m̐pɔ̐ pə'no 'tepi ju'wæi ju'wæi i'repe pi n̐'gu 'm̐r̐ ε'sipəru]
smpo pno tepi, yuay~yuay irepe pi
 again that.time just wander_around person 3.ABS
negu moro esipru
 clothes how SG.REM.DUR.undress
 'Then, the traveller opened his cloak.'
- (13) [pɔ̐'̐m̐pa '̐m̐pana 'wɔ̐wər k̐w̐ 'm̐r̐ t̐r̐'suŋk 'ɔ̐nt̐ al 'kɔŋkɔ b̐l j̐'rau 'tepepewa
 'ɔ̐nt̐ '̐m̐pana 'wɔ̐wər k̐w̐ 'tepe 'm̐enwa 'j̐rau]
pompa mpana wowr kue moro
 from.there old.man.HON monsoon wind how
torsungk, onto al kongko bl
 SG.REM.PFV.admit can father sun round.object

- irau* *tepepe-wa*, *onto* *mpana* *wowr*
 3SG.REM.COP very.strong-ADJ can old.man.HON monsoon
- kue* *tepemen-wa* *irau*
 wine weak-ADJ 3SG.REM.COP
 ‘Then, the East Wind confessed that the Sun was the strongest.’
- (14) [‘pə̄ke ‘tepi ji’rei ‘ŋkone ‘eibə̄ntai ‘kiki al ‘kɔ̄ko bəl ra:t al ‘wɔ̄wər kʷet]
pngke *tepi* *irei* *ngkne* *eibentai* *kiki*, *al*
 to.there just 3SG.HOD.COP this.FOC story word father
- kongko bl* *ra-t,* *al* *wowr*
 sun round.object who-COM father monsoon
- kue-t*
 wind-COM
 ‘The story of the Sun and the East Wind goes until here.’
- (15) [tə'baip]
tebaip
 enough
 ‘The story is finished.’

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