

Prenasalization and trilled release of two consonants in Nias

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*This paper presents an acoustic study of the phonetic realization of two consonants in Nias (Indonesia), orthographically represented as **mb** and **ndr**. These consonants have been analyzed by Catford (1988) and Brown (2001, 2005) as a bilabial trill and an apical trill, respectively. My own cross-dialectal observations indicate that these consonants have multiple realizations in each dialect. This paper presents evidence for four broad phonetic realizations of both **mb** and **ndr**: most commonly a plain stop, but also a prenasalized stop, a stop with trilled release, and stop with fricated release. It seems that the variable character of the two phonemes is the only consistent feature that distinguishes them from the regular stops in the same places of articulation, and from the regular alveolar trill.**

1. Introduction

This paper presents an acoustic study of the phonetic realization of two consonants in Nias, an Austronesian language of Indonesia (ISO 639-3 code *nia*) belonging to the Barrier Islands group and spoken by about 800,000 people on the island of Nias (Lewis 2009). The two consonants in this study have been analyzed by Catford (1988) and Brown (2001, 2005) as a bilabial trill and an apical trill, respectively. My own observations have shown that the two consonants have multiple realizations. This paper uses acoustic speech analysis in an effort to describe these realizations more precisely.

The bilabial trill in Nias has been addressed several times in the literature (Catford 1988, Maddieson 1989, Brown 2001, 2005), being typologically far more unusual than the apical trill. In most of the fifteen-odd languages of the world that have bilabial trills, the segment arose historically from the nasal + stop + high-back vowel sequence [mbu] (Ladefoged and Maddieson 1996). Maddieson (1989:92) says that in this phonetic environment trilling “develops spontaneously.” Nias is unique in that the bilabial trill can occur before any vowel, not only [u] as in other languages (Maddieson 1989:98; see Brown 2001:25 for a list of words with the bilabial trill preceding each of the six vowels). The study of Nias trills in Catford (1988) is based on a list of 260 words taken from both the northern and southern dialects, in which there are thirteen occurrences of the bilabial trill. His acoustic study shows that the bilabial trill is “often, but not always, prenasalized” (153). Prenasalization never occurs in a word-initial bilabial trill, but often occurs in other positions. The trill is endolabial, with the lips “somewhat everted and held loosely together so that their inner surfaces are in contact” (153). Brown (2001) states that in the southern dialect, prenasalization rarely occurs at all except in slow, deliberate speech. The bilabial trill is often pronounced as a fricative in the southern dialect (Brown 2005:563).

Maddieson (1989) traces the historical development of the bilabial trill in Nias from Proto-Austronesian, finding that it comes from the nasal + stop sequence [mb]. Brown (2001) corroborates this finding, showing how all the historical sources of the bilabial trill include the [mb] sequence. The bilabial trill is now a phoneme in Nias (Brown 2001).

The apical trill in Nias is interesting because according to Catford (1989) there are two trills in this position: a regular alveolar trill and another, slightly retroflexed trill. According to Catford, the slightly retroflexed trill arose historically from a nasal + stop sequence [nd], paralleling the bilabial trill. Brown

* I am grateful to Eldwin and Christina Truong, who collected several of the wordlists for this study. Eldwin sent me many of the recordings after I had left Indonesia. I am also grateful to John Clifton and Joan Baart for their many helpful comments on various drafts of this paper.

(2005) calls Catford's slightly retroflexed trill a stop with trilled release (564). Catford's phoneme inventory includes three trills [ʙ], [r] and [ɽ], while Brown's inventory contains two trills [ʙ] and [r], and one stop with trilled release [dʳ]. Both sources agree that one apical trill is a "normal" alveolar trill, while the other apical segment arose historically from a nasal + stop sequence like the bilabial trill. This paper seeks to describe more precisely the phonetic correlates of [ʙ] and [ɽ]/[dʳ]. For the sake of simplicity, I will refer to these two phonemes as **mb** and **ndr**, following orthographic convention. As we will see below, acoustic analysis of **mb** and **ndr** often shows no actual trill at all.

2. Methodology

The Western Indonesia Survey Team of SIL Indonesia conducted a rapid appraisal sociolinguistic survey of Nias in early 2009, focusing on the southern part of the island. Fieldwork was carried out on three successive trips. During these trips we collected twelve 358-word lists from local Nias speakers. Our field notes showed inconsistency in the articulation of **mb** and **ndr**, as they were sometimes trilled, sometimes prenasalized, and sometimes articulated as a regular voiced stop.

I chose three of the twelve research sites for this study. They are listed in Table 1, along with a short description of each.

Table 1. Location of the wordlists

<i>Village</i>	<i>Dialect Area</i>
Idano Gawo	North-central dialect
Gunung Sitoli	Northern dialect (The political and commercial center of Nias Island)
Gomo	South-central dialect

I chose between fifteen and twenty words per location, selecting words where **mb** and **ndr** were in initial or medial positions.¹ No syllable codas occur in the language. I was not able to get exactly the same set of words for each area, first because there were lexical dialectal differences, and second because I did not have direct access to all the recordings. Table 2 presents a list of the words from each site used in this study.

The Idano Gawo and Gunung Sitoli lists (first two columns) are nearly identical because I selected the words from these two sites for this paper. I included more examples of **mb** than **ndr** because cross-linguistically it is more unusual. I added the words from Gomo later from recordings I had on hand, but was not able to fill in all the holes because I was in the USA at the time and the complete set of recordings was in Indonesia.

The wordlists were recorded with an Edirol R-09HR digital recorder. In each village, the team found a local person representative of the variety spoken there, then one researcher took this speaker to a relatively quiet place and elicited the list, recording with the Edirol and transcribing at the same time. Each word was repeated twice, in isolation. It was often impossible to find a quiet place in which to record, so there is some background noise in most recordings.

¹ Initial and medial in terms of the prosodic phrase rather than the word, since some items in the data have more than one word (ex. 'lightning', lit. 'lightning of sky'). Word-initial **mb**, **ndr** on the second word behave like word-medial **mb**, **ndr**.

Table 2. Words with bilabial and apical trills, by research site

<i>Idano Gawo</i>	<i>Gunung Sitoli</i>	<i>Gomo</i>
Words with initial apical trills:		
ndro ‘blood’	ndro ‘blood’	ndro ‘blood’
		ndroŋa ‘husband’
		ndroŋa ‘wife’ ²
ndri ‘mosquito’	ndri ‘mosquito’	ndri ‘mosquito’
		ndraha ‘branch’
ndruhu ‘grass’		ndruʔu ‘grass’
ndrəfi ‘star’	ndrəfi ‘star’	ndrəfi ‘star’
		ndrəfi ‘year’ ³
		ndri manu ‘fly’
		ndrindi ‘fly’
Words with medial apical trills:		
sumindro ‘stand’		
		sindruhu ‘correct’
		ndrindri ‘fly’
baʃandruhe ‘door’	baʃandruhe ‘door’	
tandraʎa ‘pillow’	tandraraʎa ‘pillow’	tandraʎa ‘pillow’
		bagandrə ‘here’
mondri ‘bathe’	mondri ‘bathe’	mondri ‘bathe’
Words with initial bilabial trills:		
mbanua ‘sky’	mbanua ‘sky’	
mbisi ‘calf (of leg)’	mbisi ‘calf (of leg)’	
Words with medial bilabial trills:		
tʃumbu ‘grow’	tʃumbu ‘grow’	tʃumbu ‘grow’
humombo ‘fly’	humombo ‘fly’	
uguʔugu mbanua ‘thunder’	uguʔugu mbanua ‘thunder’	
karikari mbanua ‘lightning’ ⁴	kila mbanua ‘lightning’	
simbo ‘smoke’	simbo ‘smoke’	
simbi ‘forehead’	simbi ‘forehead’	
tambəni ‘rice chaff’		
tajmba ‘mud’	tambu ‘mud’	

I removed each target word and saved it as an individual file. I then worked from the smaller files. I used the computer program *Praat* to carry out the acoustic analysis.⁵ Because of the various realizations of **mb**, **ndr** as prenasalized stops, stops with fricative release, and stops with trilled release, I inserted

² **ndroŋa** appears to be the word for spouse of either gender. Since we elicited for both ‘husband’ and ‘wife’, there are four tokens of this word.

³ **ndrəfi** ‘star’ and **ndrəfi** ‘year’ are homonyms. There is only one token of **ndrəfi** ‘year’, so there are a total of three tokens with the phonological shape **ndrəfi**.

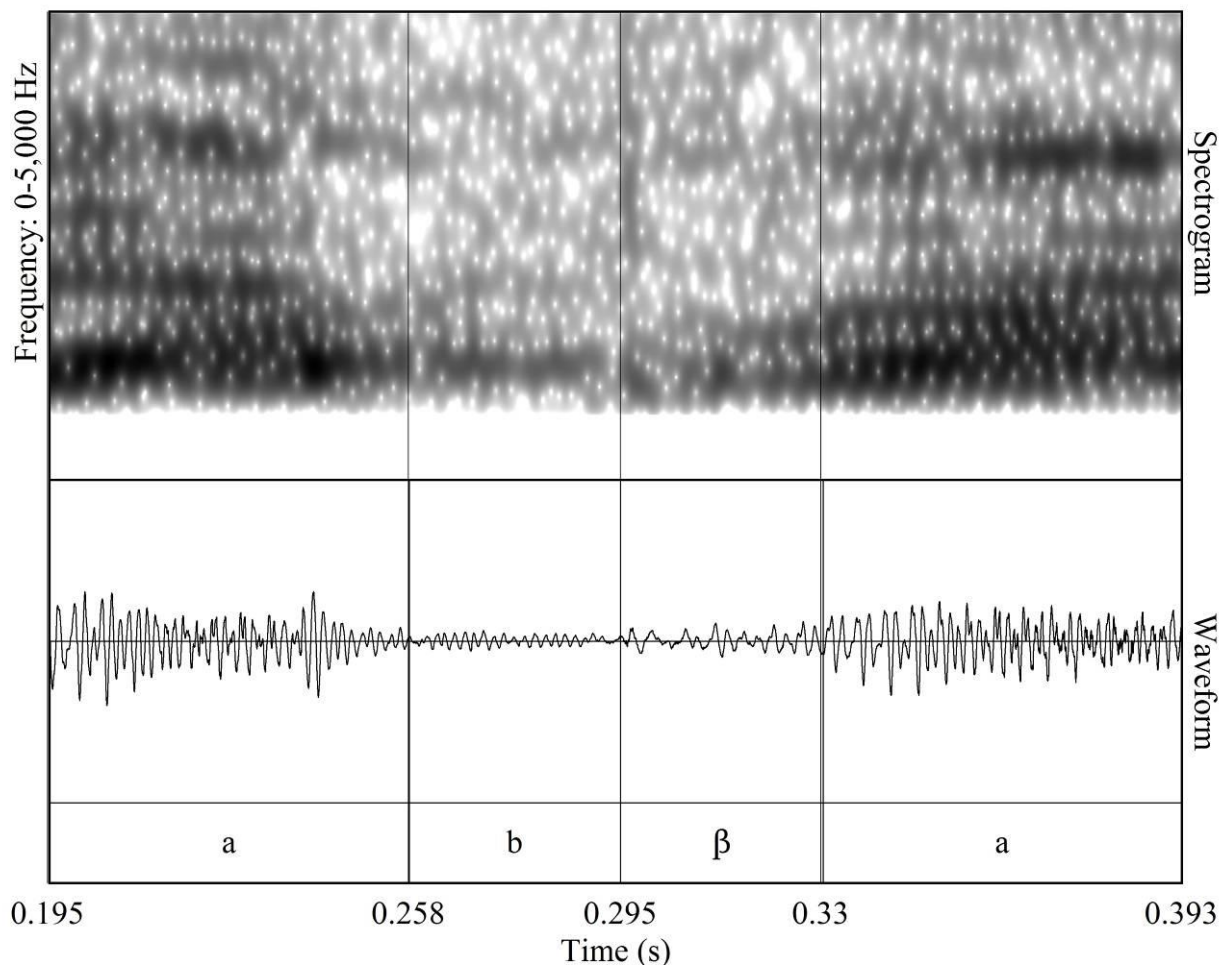
⁴ Only one token of this word.

⁵ *Praat* is available for free download at www.praat.org.

segment boundaries in *Praat* to mark the following transitions: vowel to nasal, vowel to stop, nasal to stop, stop to trill, stop to fricative and stop to vowel. I always interpreted the stop burst on the waveform as the end of the stop. If there was only one burst, I considered the segment a stop. If there were multiple bursts, I considered the first burst to be the release of the stop and the subsequent bursts to be associated with taps. Onsets for word-initial stops were marked if the stop showed voicing in the waveform. If there was no voicing, only the burst was marked on word-initial stops and the duration of the stop was not measured.

In some cases, there was only one burst but periodicity did not begin for a time after the burst. This interval was 20-30 ms long and looked like it could be a partially articulated tap (also generally 20-30 ms long). An example of this is in Figure 1 below. There is an obvious burst of the stop, followed by 27 ms of irregular noise, and then periodicity of the following vowel.

Figure 1. A section of **kila mbanua** 'lightning' from Gunung Sitoli, showing fricated release

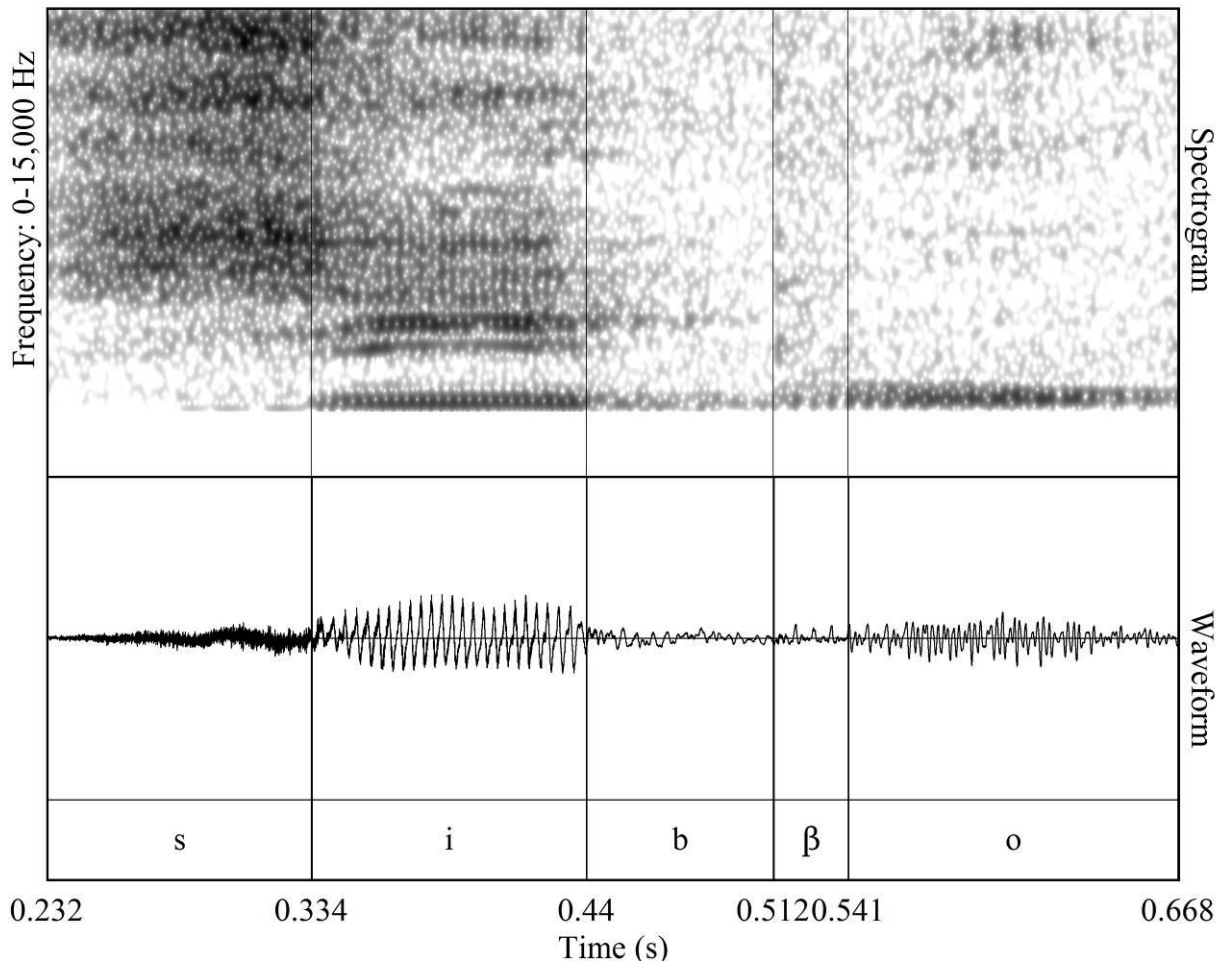


Since there was a good deal of frication involved, I called this frication and kept the measurements separate from the measurements of taps.

I marked vowel boundaries based on the beginning or end of periodicity. With frication moving into a vowel, I marked the boundary at the spot where the vowel's periodicity became more prominent in the waveform than the frication. Figure 2 shows an example of a transition from a fricative (β) to a vowel (o). The waveform shows a definite change to regular periodicity where the end of the fricative is marked, but

a faint formant reading in the spectrogram begins a few milliseconds later. In this case I have chosen to mark the transition based on the waveform since the formant reading is so faint. The fricative is 27 ms long.

Figure 2. **simbo** ‘smoke’ from Gunung Sitoli, showing a transition from bilabial fricative to vowel

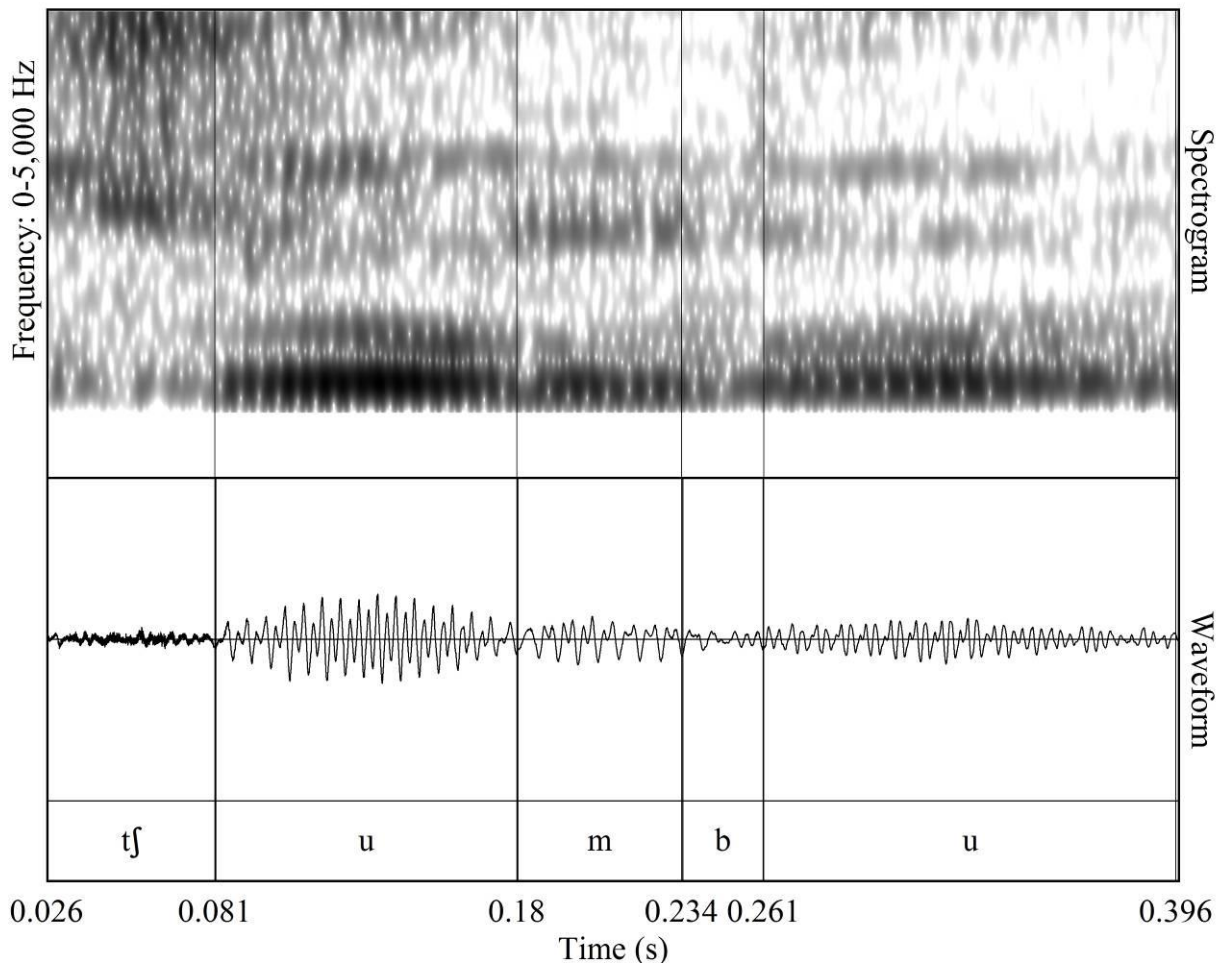


As Figure 2 shows, the exact spot to place the boundary was rather subjective. For nasals I marked the boundary between nasals and vowels where the waveform changed. Occasionally this was a long gradient, but most of the time it was a rather short transition that was not difficult to mark.

I used the default spectrogram settings in Praat for determining most of the segment boundaries (view of 0-5,000 Hz, window length = 5 ms, dynamic range = 50 dB). Occasionally I changed the dynamic range to 70 or 75 dB to see voicing and formants more clearly in consonants. I also sometimes changed the view to 10,000 or 15,000 Hz to check breaks for stop bursts and taps.

3. Results

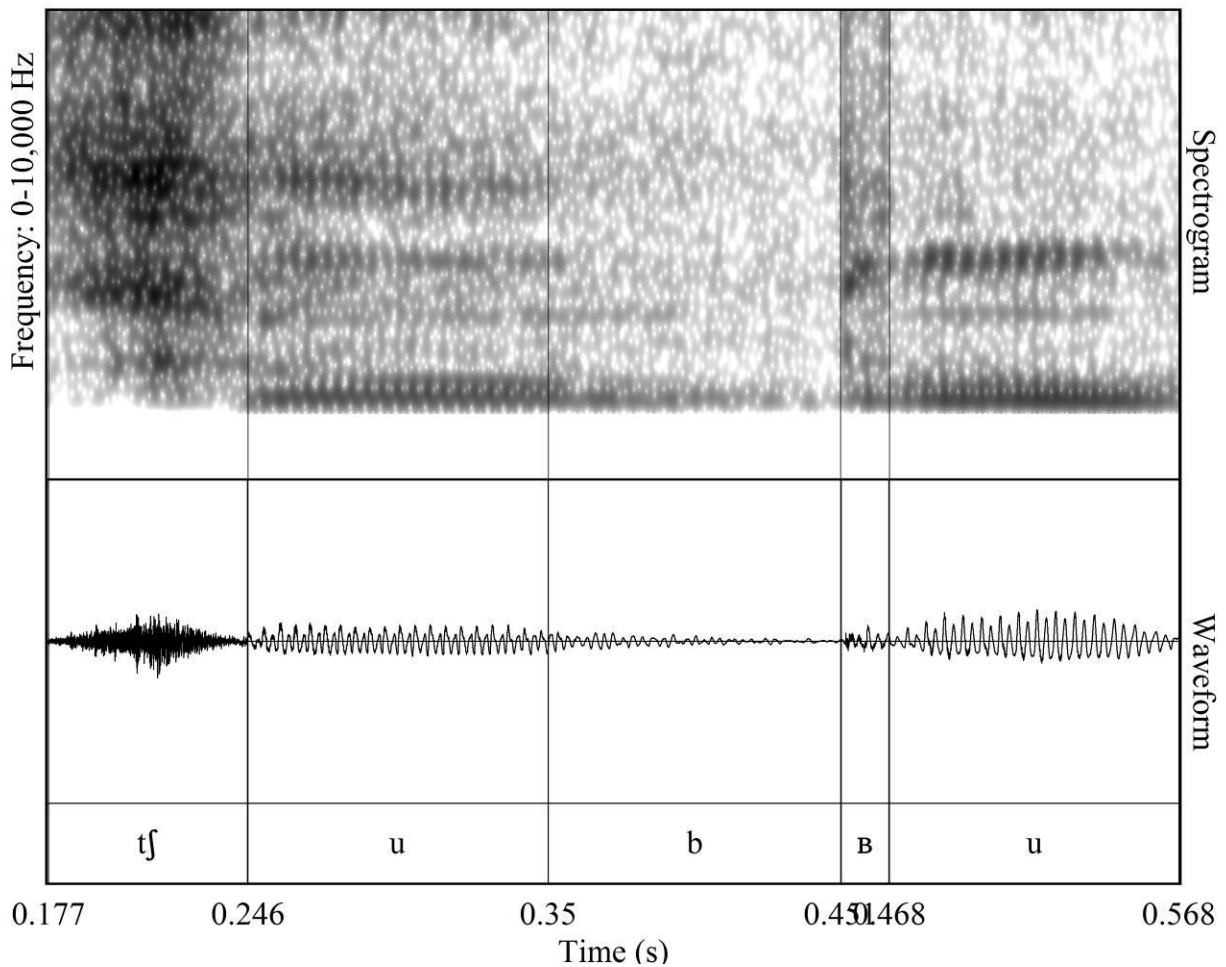
We will look at each of the acoustic realizations of **mb**, **ndr** in turn: prenasalized stop, stop with trilled release, stop with fricated release, and plain stop. **mb** and **ndr** are realized as prenasalized stops nine times in the data. Figure 3 presents an example of a medial **mb** realized as a prenasalized stop, from Idano Gawo.

Figure 3. Prenasalized bilabial stop of *tfumbu* ‘grow’, Idano Gawo

One might argue that an instance like this should be analyzed as two separate segments, a nasal and a stop. However, since these are the only instances of consonant sequences in the language (other than two affricates, which are analyzed as single phonemes), it is better to consider the two to be a single unit. Since the bilabial trill arose historically from a [mb] sequence, the occurrence here might be argued to be a conservative pronunciation.

The segments **mb**, **ndr** occur as stops with trilled release twenty-two times in the data. Apical trilled releases occur both initially and medially, but bilabial trilled releases only occur medially (cf. Brown 2001 and Catford 1988). Most trilled releases have only one tap in a sequence, although there are a few apical trills with more than one tap. Any occurrence of bursts after the initial stop burst was counted as a trilled release. The following example *tfumbu* ‘grow’ (see Figure 4) is the same word as the one in Figure 3 above, this time from Gomo. This is a stop with a trilled release where the trilled release consists of a single tap.

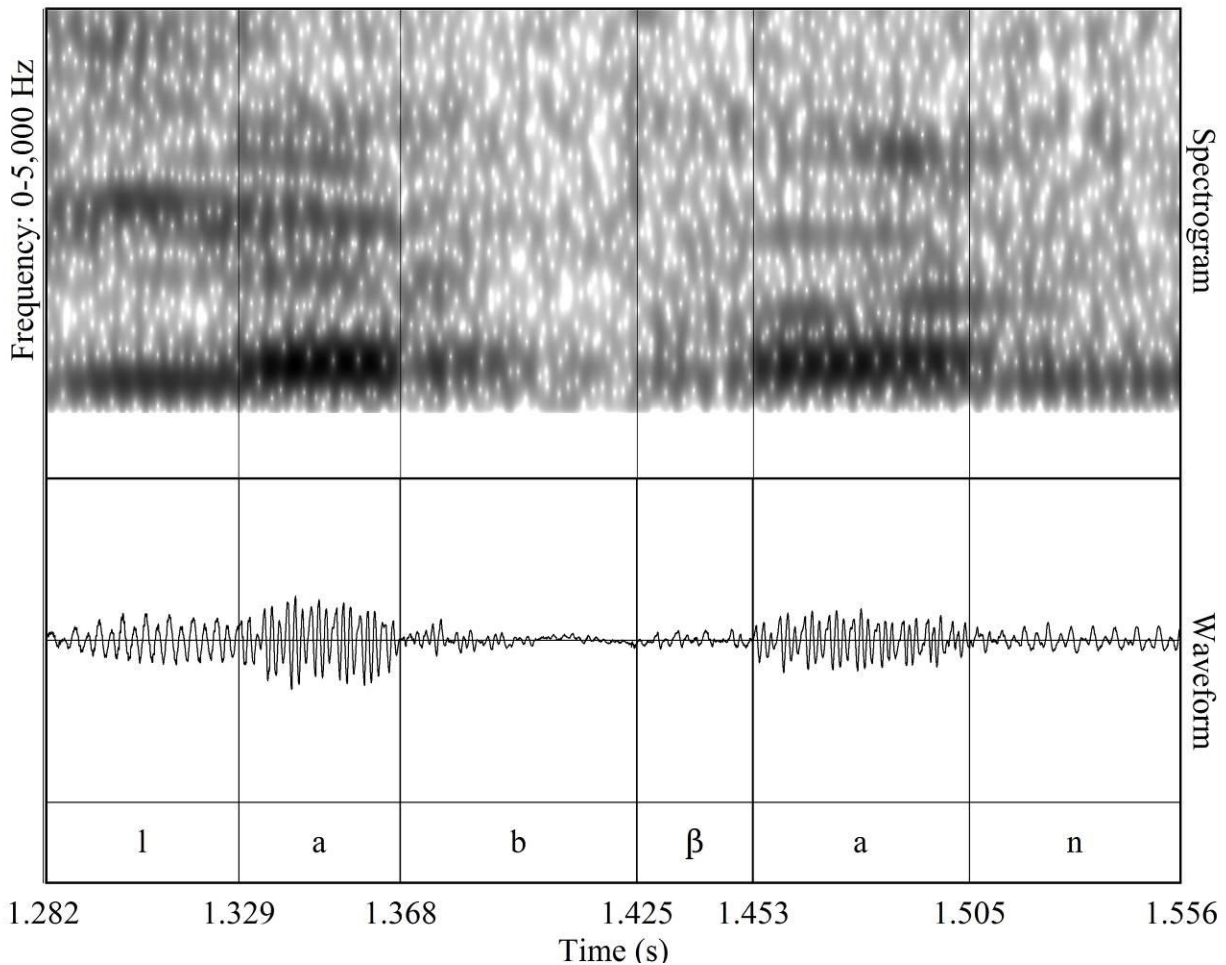
Figure 4. Bilabial stop with trilled release of **tʃumbu** ‘grow’, Gomo (dynamic range of 60 dB)



This word has two obvious bursts about 25 ms apart and is a clear case of a stop with a trilled release, where the trilled release consists of one tap.

In many of the words, **mb** and **ndr** do not have a second burst and are therefore not clear cases of trilled release. However, like stops with trilled release, they have about 25-35 milliseconds of space between the stop burst and the onset of full periodicity and formant structure for the vowel. These segments look like occurrences of stop with trilled release, but without the second burst. The space is filled with frication of some sort, and a sort of irregular periodicity like that seen in the space between bursts in taps. This only occurs in medial stops except for a few words in Gomo. Below is a close-up example of this (see Figure 5).

Figure 5. A section of **kila mbanua** ‘lightning’ from Gunung Sitoli, showing fricated release

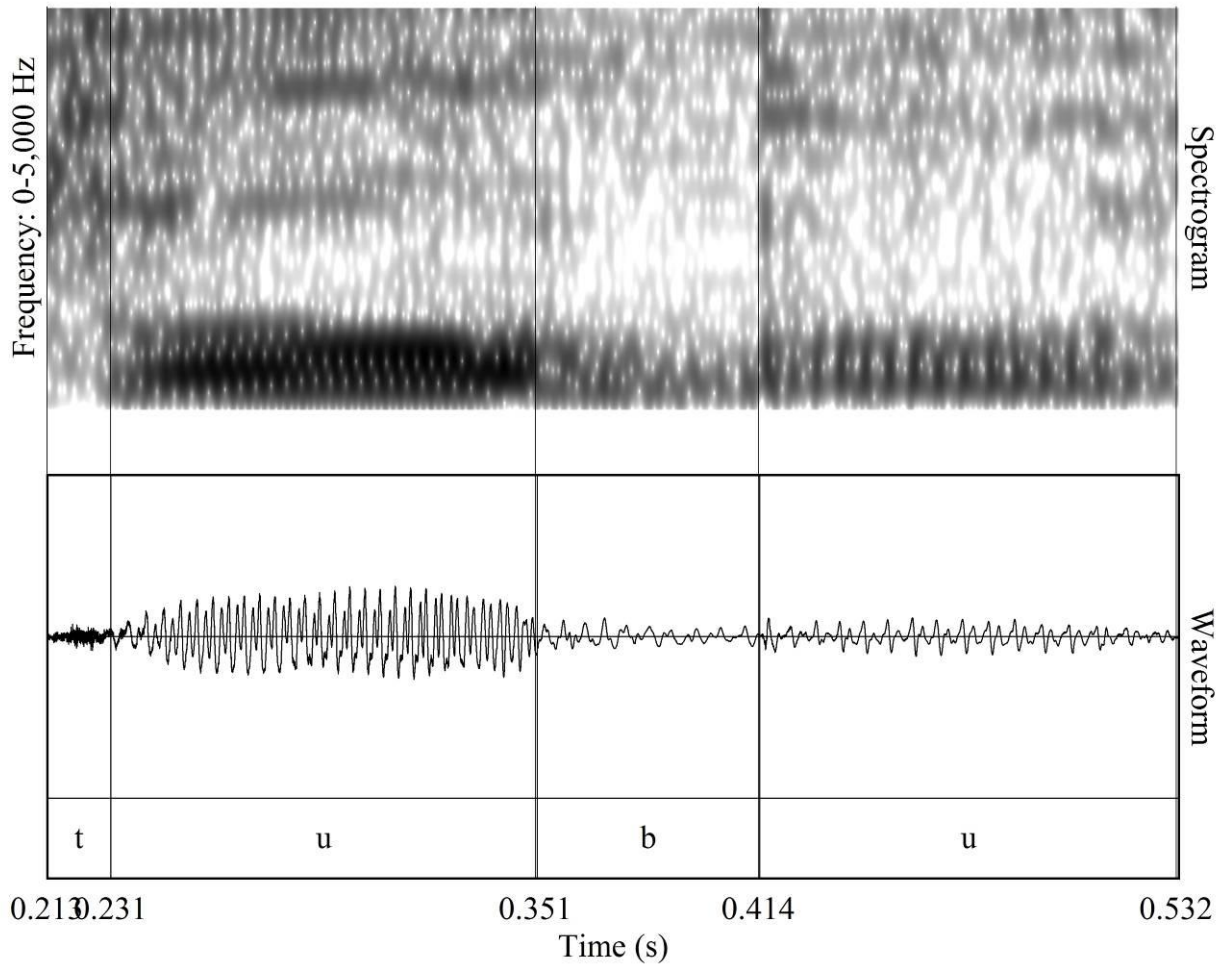


Here there is a definite stop burst, visible in both the waveform and the spectrogram. After the burst, there is a period of 27 ms where there is no regular periodicity, but there is voicing. There are twenty occurrences of fricated release in the data.

The most common realization of **mb**, **ndr** is the plain stop. Initial **mb** is always realized as a plain stop,⁶ while initial **ndr** can be realized as a plain stop, but also with trilled or fricative release. All medial occurrences of **mb**, **ndr** can have any of the four realizations. Some initial plain stops are voiceless, but they are always voiced medially. Figure 6 shows *tumbu* ‘grow’, the same word as seen above in Figures 3 and 4,⁷ but in this occurrence realized as a plain stop.

6 Initial **mb** can be distinguished from initial **b** by its behavior when placed after a (vowel-final) word. The initial **mb** in **mbanua** ‘sky’ is always realized as a plain stop, but it shows all four variants in the phrases **karikari mbanua** ‘lightning’ and **ugu?ugu mbanua** ‘thunder’.

7 [t] occurs in the northern dialects where [tʃ] occurs in the southern dialects.

Figure 6. **tumbu** 'grow' from Gunung Sitoli, plain stop

The difference between the plain stop realization of **mb** in Figure 6 and its realization as a fricated release in Figure 5 is in the release. In the case of the plain stop, the stop burst is immediately followed by regular periodicity in the vowel, while in the fricated release there is a short period of irregular frication between the stop burst and the beginning of the periodicity of the vowel.

Now that we have looked at some acoustic properties of each of the phonetic realizations of **mb**, **ndr**, we turn to their distribution. There is no immediately obvious pattern to their distribution. Some possibilities include phonologically conditioned distribution (e.g., allophonic variation or complementary distribution), dialectal variation, or differences in individual speakers. Table 3 lists the number of occurrences of each realization, by location.

Table 3. Occurrences of prenasalization, trilled release, fricative release, and plain stops by location

		<i>Bilabial</i>			<i>Apical</i>		
		IdanoGawo	GunungSitoli	Gomo	IdanoGawo	GunungSitoli	Gomo
initial	prenasalized	0/4	0/4	---	0/8	0/6	0/18
	trilled release	0/4	0/4	---	1/8	0/6	11/18
	fricative release	0/4	0/4	---	0/8	0/6	3/18
	plain stop	4/4	4/4	---	7/8	6/6	4/18
medial	prenasalized	6/15	0/14	0/3	2/8	0/6	1/9
	trilled release	0/15	4/14	1/3	0/8	2/6	3/9
	fricative release	2/15	6/14	2/3	1/8	2/6	4/9
	plain stop	7/15	4/14	0/3	5/8	2/6	1/9

The bilabial consonant **mb** in initial position is always realized as a plain stop. Initial **ndr** is also usually realized as a plain stop, except in Gomo where trilled release is common. In medial position there is fairly even distribution of the various realizations, with nine occurrences of prenasalization, ten of trilled release, seventeen of fricative release, and nineteen of the plain stop. In terms of dialectal variation, there are a few tendencies. There is more trilled release in initial apicals in Gomo, while the other two locations prefer plain apical stops. This is not true of medial trills, where there is more even distribution. There are no medial trilled releases in Idano Gawo but several in each of the other locations. All locations have a few instances of medial fricative release and all but Gomo have several medial plain stops. With the available data it is not possible to distinguish between dialectal variation and individual speaker variation, since we only have data from one speaker in each location. The tendencies could possibly correlate with either one.

None of the factors in Table 3 shows much promise as a correlate of the various realizations of **mb**, **ndr**. Is it possible that there are no consistent correlates that can predict which of the variants will occur? Perhaps they are in some sort of free variation. An argument for this is the fact that a few words were produced differently by the same speaker in the same recording session. For example, Figure 7 and Figure 8 show the first and second repetitions of the word **mondri** ‘bathe’ by the speaker in Gomo. He repeated each word twice in isolation – here the first token has a trilled release while the second token, repeated immediately after it, is a plain stop.

These two, along with several other examples of the same sort, are a potential argument for free variation between the various realizations of **mb**, **ndr**.

Figure 7. **mondri** 'bathe' from Gomo, token 1, with trilled release

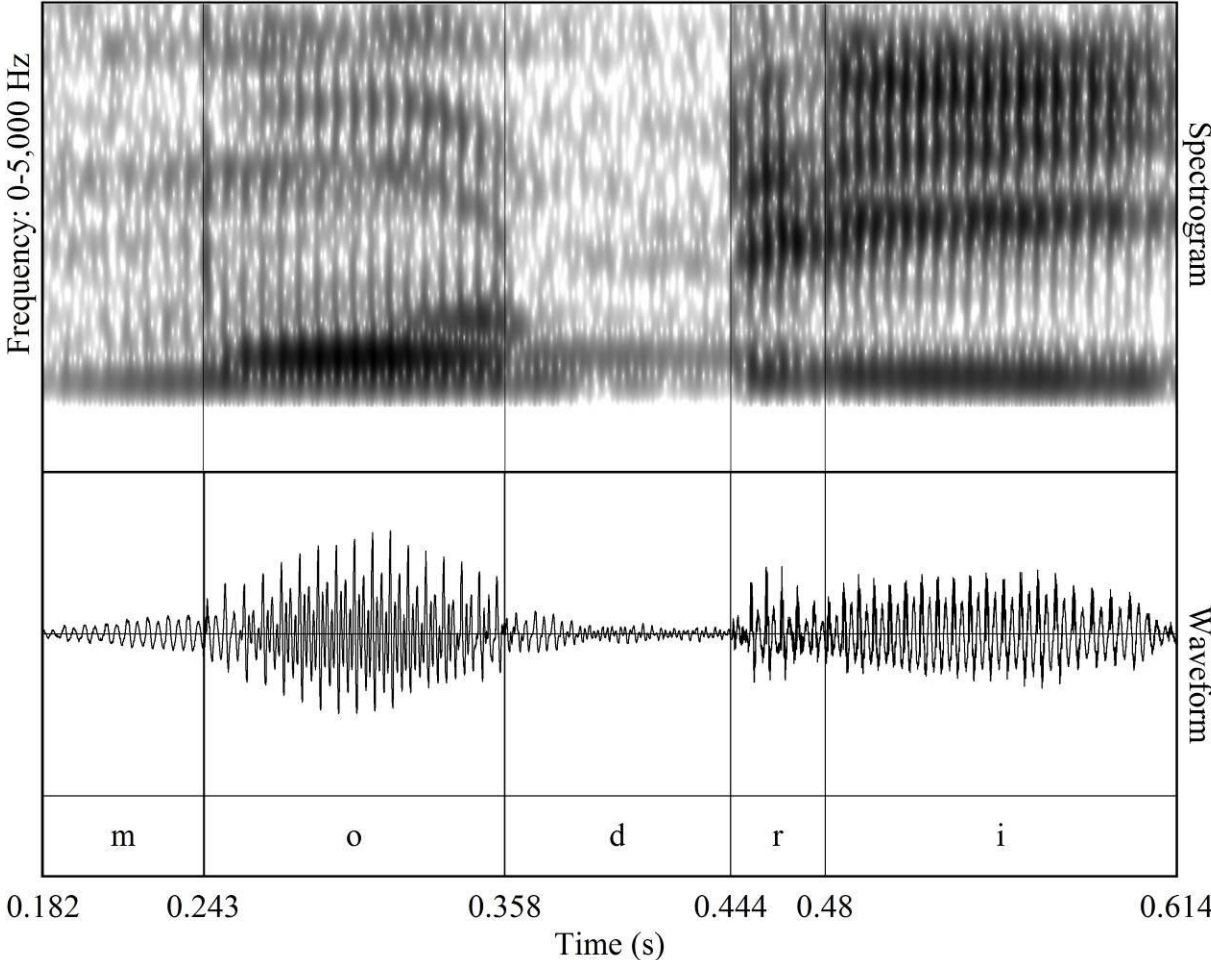
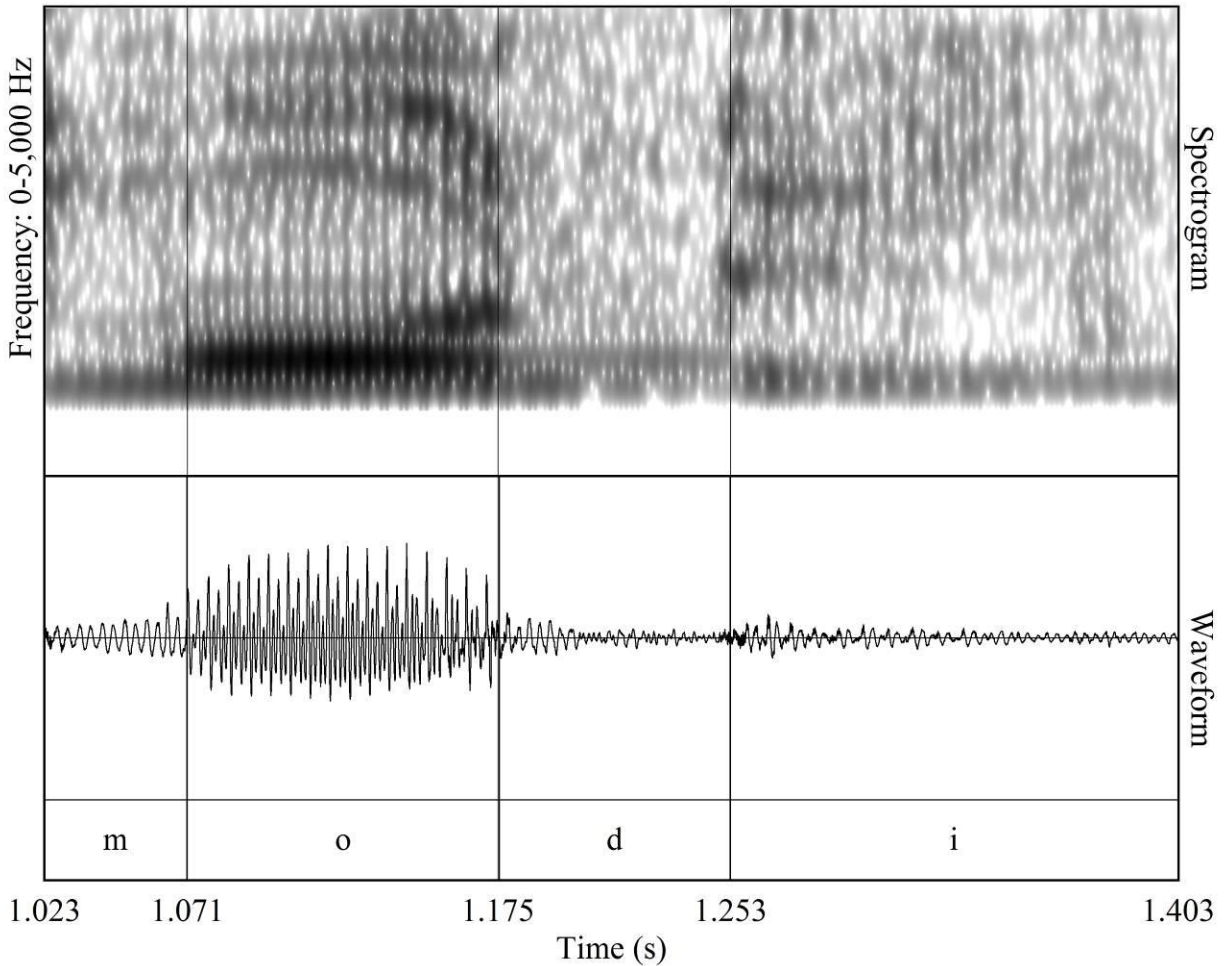


Figure 8. **mondri** 'bathe' from Gomo, token 2, without trilled release

4. Discussion

The Nias consonants **mb** and **ndr** show a great deal of variation in their phonetic realization, including prenasalized stop, stop with trilled release, stop with fricated release, and plain stop. The situation seems to be more complicated than that suggested in the literature discussed above (Catford 1988, Maddieson 1989, Brown 2001), where **mb**, **ndr** are presented as having a single phonetic realization. Our findings corroborate Maddieson's (1989) claim that **mb** can occur after any vowel in Nias but contrary to Brown (2001), we found no occurrences of **mb** realized as a fricative.

The trilled release and fricated release seem to be on two extremes of a gradient, with some tap bursts clearly evident and others hardly visible. When the tap burst after the initial stop burst is hardly visible but still present, it is difficult to know whether the segment should be classified as a fricative release or a trilled release. Fricated release and plain stop also seem to be on two extremes of a gradient, with some fricated releases as short as 10 ms and others as long as 35 ms. The short fricated releases closely resemble plain stops, while the longer ones more closely resemble trilled release. Prenasalization, on the other hand, is not on a gradient. There is either clear, distinct prenasalization or there is none. Prenasalization never co-occurs with fricated or trilled release.

Our initial review of possible correlates to the variation in the realization of **mb**, **ndr** has not yielded any definite results. The variation does not appear to correlate with phonological features, dialect, or

variations in individual speaker pronunciation. Further research is needed to see if there is any correlation of the phonetic variation in **mb**, **ndr** with something else.

5. Conclusion

The bilabial and apical phonemes that arose from historic [mb] and [nd] sequences have four phonetic realizations in Nias, most commonly a plain stop but also including a prenasalized stop, stop with trilled release, and stop with fricated release. It seems that their variability is the only property that distinguishes them from regular stops in the same places of articulation and from the regular alveolar trill.

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