Defying aerodynamics: The plain voiceless bilabial trill in Malekula languages

Tihomir Rangelov & Mary Walworth
Department of Linguistic and Cultural Evolution
Max Planck Institute for Evolutionary Anthropology, Leipzig

The Fifth Edinburgh Symposium on Historical Phonology
Edinburgh / online
6-8 December 2021

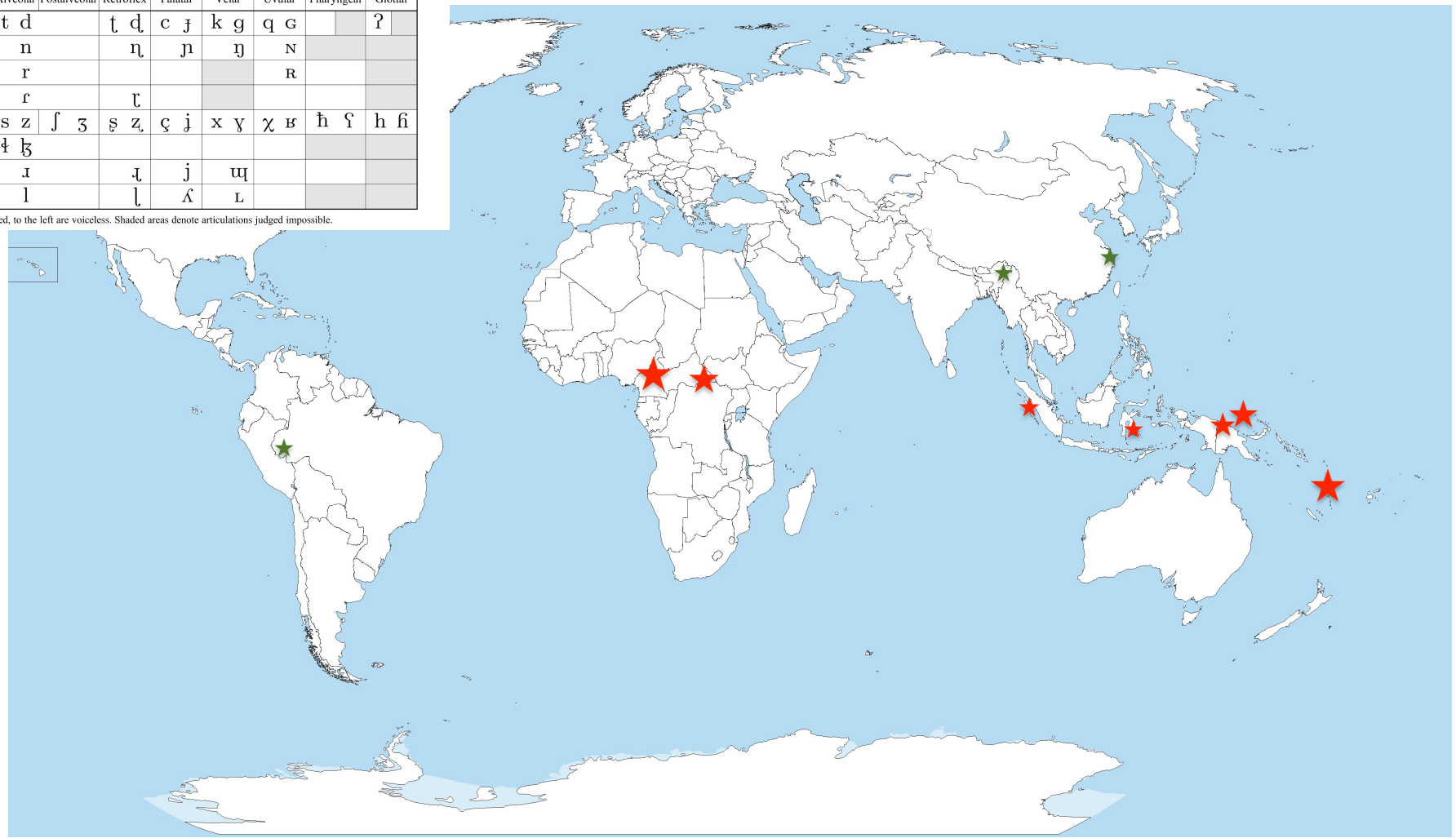
Bilabial trills are cross-linguistically rare sounds

THE INTERNATIONAL PHONETIC ALPHABET (revised to 2020)

CONSONANTS (PULMONIC) ©①◎ 2020 IPA

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k g	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			r					ʀ		
Tap or Flap		ⱱ		ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

Symbols to the right in a cell are voiced, to the left are voiceless. Shaded areas denote articulations judged impossible.



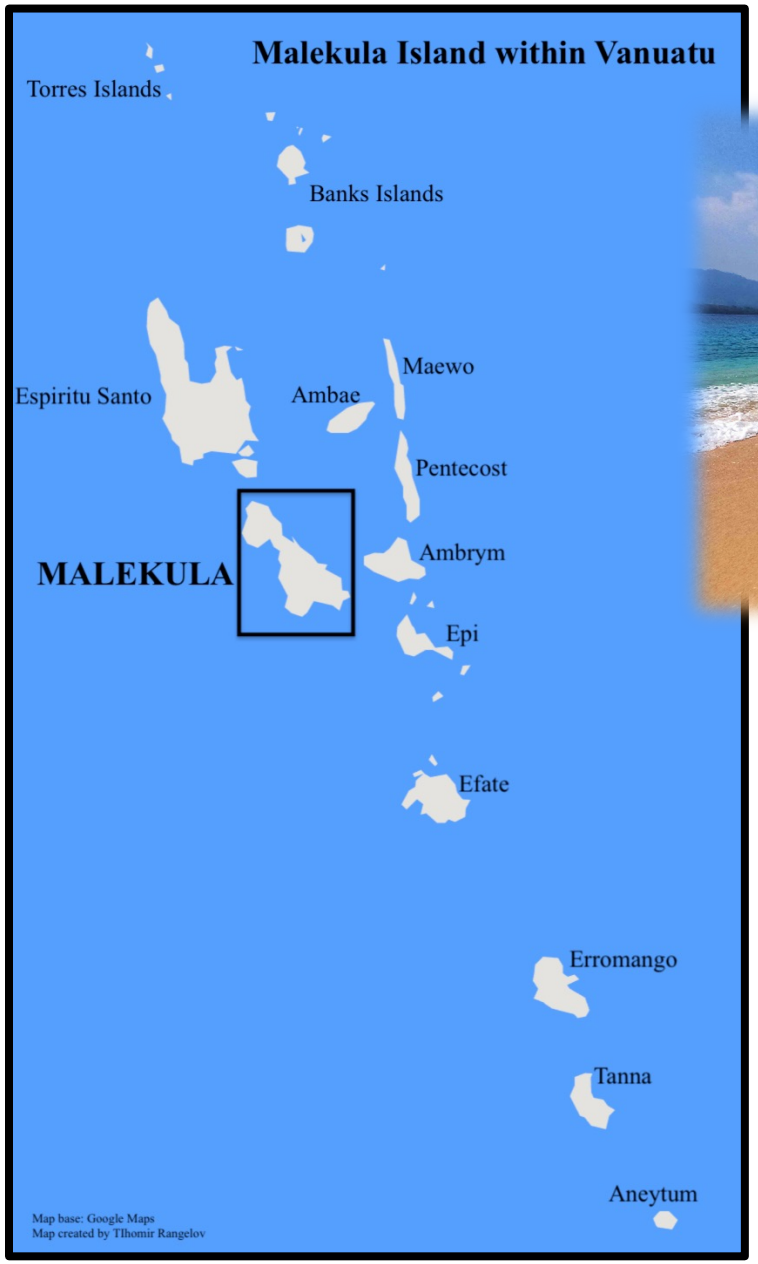
^{m}B̥

B

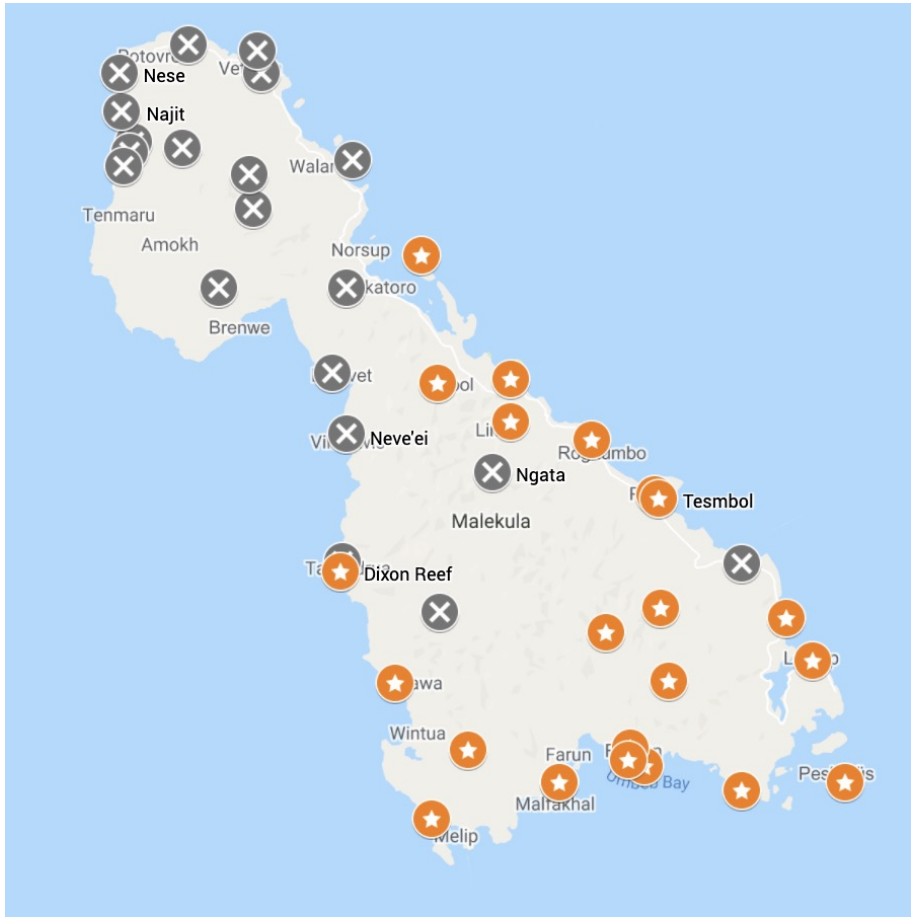
t͡B̥

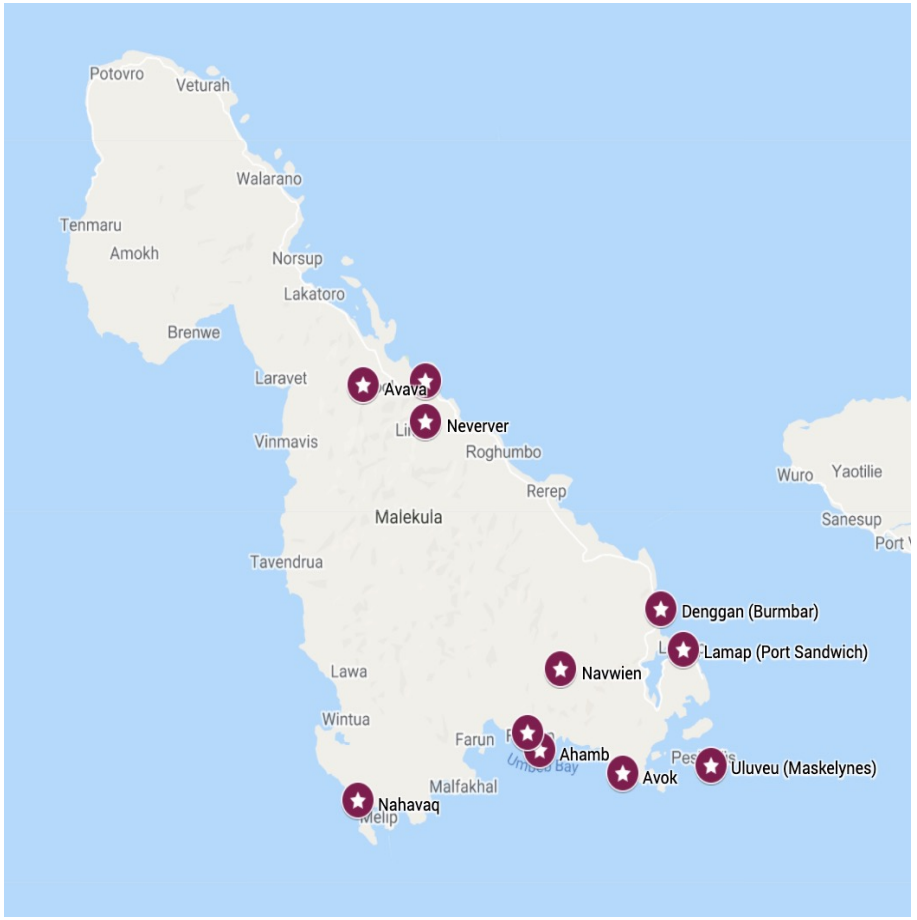
Keating (**2007**): Around 50 languages have bilabial trills

Malekula Island, Vanuatu



23 lgs have ᵐʙ (phonemic in 6)
11 of them also have ʙ̥ (phonemic in 2)





Bilabial trills in Malekula languages – data from published and unpublished sources

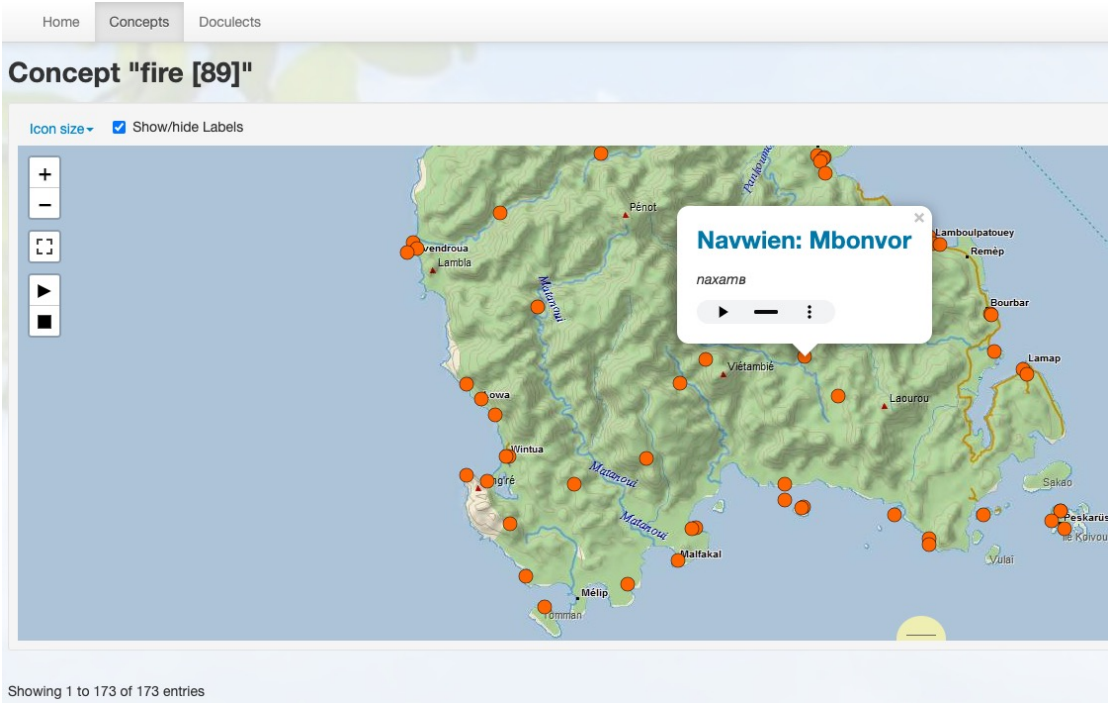
Language (Glottocode | ISO 639-3 code)	**Publication / source**
Ahamb (axam1237 | ahb)	Rangelov (2019, 2020a, 2020b)
Aulua (aulu1238 | aul)	Keating (2007: 113) (cites Martin Paviour-Smith p.c.)
Avava (katb1237 | tmb)	Crowley (2006)
Avok (avok1244 | -)	Rangelov (2018)
Denggan (Burmbar, Banam Bay) (burm1263 | vrt)	Brittany Hoback (p.c. 2021)
Lamap (Port Sandwich) (port1285 | psw)	Williams (2019); Rangelov (2018); Jocelyn Aznar & Romarik Tavo (2015)
Na'ahai (malf1237 | mlx)	Maddieson (1989: 94); Anastasia Riehl (p.c. 2019)
Nahavaq (sout2857 | sns)	Dimock (2009)
Nati (nati1244 | -)	Crowley (1998)
Neverver (ling1265 | lgk)	Barbour (2012a, 2012b)
Ninde (labo1244 | mwi)	Murray (2018); Keating (cites Pike 1963:94); Maddieson (1989)
Nitita (Viar) (niti1249 | -)	Keating (2007: 124) (cites Crowley 2004)
Uluveu (Maskelynes) (mask1242 | klv)	Healey (2013)
Unua (unua1237 | onu)	Pearce (2015, 2018)
Uripiv (urip1240 | -)	McKerras (2001a, 2001b); Maddieson (1989)
Vivti (vivt1234 | -)	Keating (2007: 126) (cites Crowley 2004)

Rangelov & Barbour (2019)

Data from the Vanuatu Voices database

Language (Glottocode | ISO 639-3 code)	Number of doculects with trills	Number of words with $^{m}\beta$	Number of words with β	Data from other sources for this language?
Ahamb (axam1237 | ahb)	2	7	2	Yes
Aulua (aulu1238 | aul)	1	1	-	Yes
Avava (katb1237 | tmb)	4	13	2	Yes
Avok (avok1244 | -)	2	9	4	Yes (marginal)
Denggan (Burmbar/Banam Bay) (burm1263 | vrt)	1	2	1	Yes
Dixon reef (dixo1238 | dix)	1	1	-	No
Lamap (Port Sandwich) (port1285 | psw)	2	2	2	Yes
Letemboi-Repanbitip (lete1241 | nms)	3	6	-	No
Na'ahai (Malfaxal) (malf1237 | mlx)	4	5	-	Yes
Nahavaq (sout2857 | sns)	3	8	-	Yes
Nasvang (nasv1234 | -)	1	2	-	No
Nati (nati1244 | -)	1	2	-	Yes
Navwien (navw1234 | -)	1	8	2	No
Neverver (ling1265 | lgk)	3	7	-	Yes
Ninde (labo1244 | mwi)	4	11	-	Yes
Nisvai (nisv1234 | -)	2	8	3	No
Nitita (Viar) (niti1249 | -)	1	7	-	No
Rerep (Pangkumu) (rere1240 | pgk)	2	5	-	No
Tesmbol (- | -)	2	10	-	No
Uluveu (Maskelynes) (mask1242 | klv)	2	9	3	Yes
Unua (unua1237 | onu)	2	6	-	Yes
Vivti (vivt1234 | -)	2	8	1	Yes

https://vanuatuvoices.clld.org/ (MPI-EVA)
(Shimelman et al. 2020)



Why are bilabial trills rare?

Easy to articulate in isolation

but

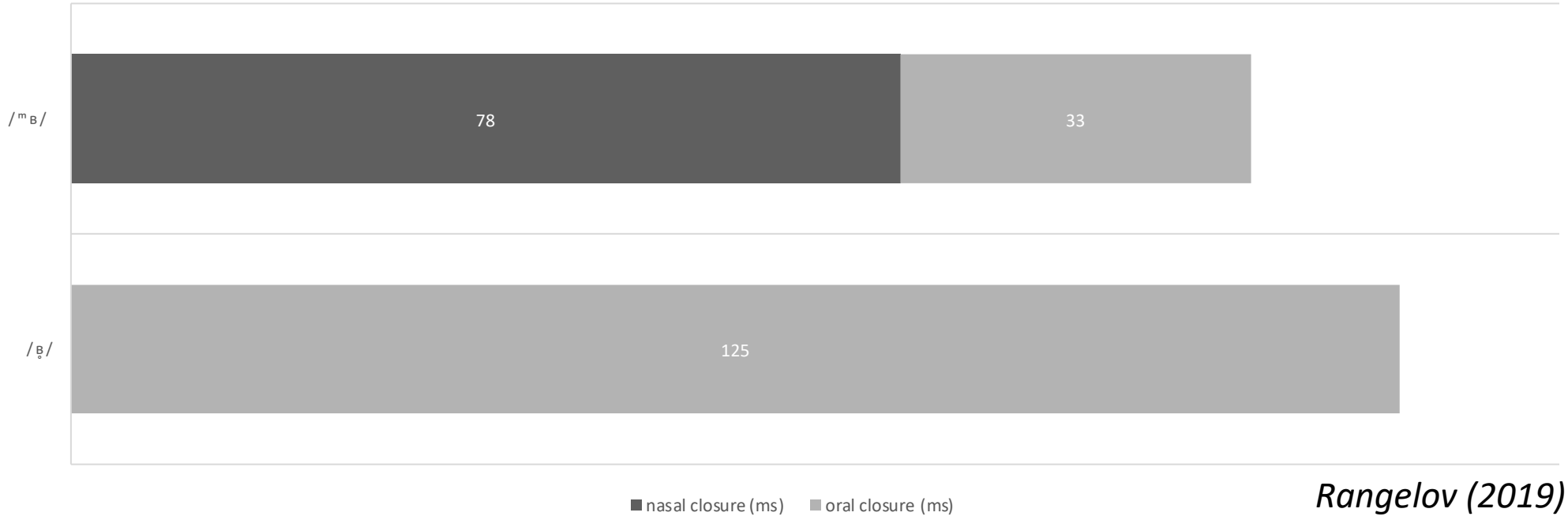
- Difficult to integrate into connected speech (Maddieson 1989: 92)
- Low functional load (Rangelov 2019)

Maddieson (1989): *mbu > ᵐʙ (cross-linguistically)

- Aerodynamic conditions:
  - nasal airflow, short complete closure = low intraoral pressure
  - labial setting, narrow lip aperture = Bernoulli effect = oscillations of the lips

- Lynch (2016) confirms that PNCV/POc *ᵐbu > ᵐʙ
  - 7 cognate sets from 4 Malekula languages

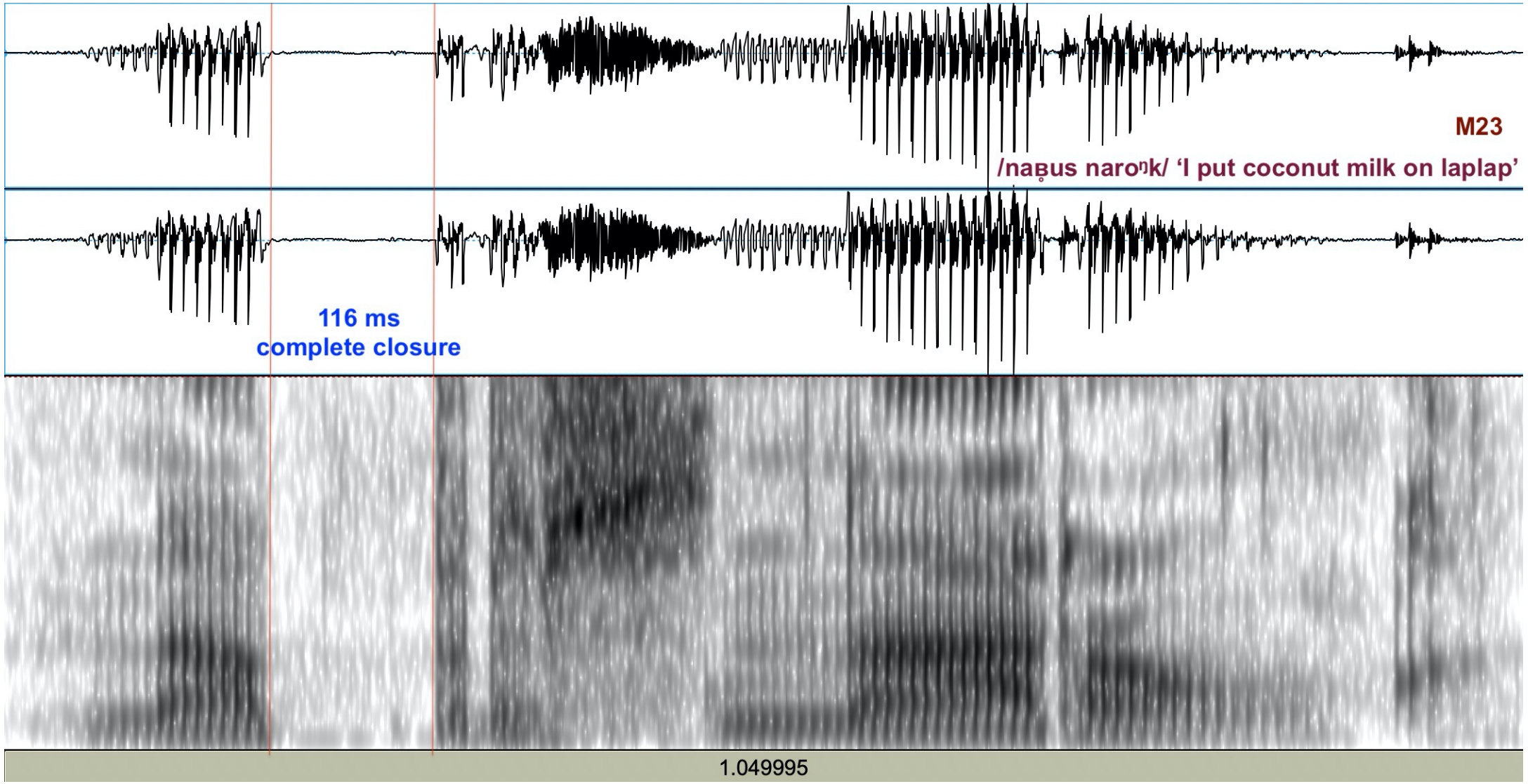
Bilabial closure and prenasalization duration in ᵐʙ and ʙ̥ in Ahamb



Rangelov (2019)

- Nasal airflow – 70% of bilabial closure for ᵐʙ (111 ms in total)
- Long complete closure in ʙ̥ – suggests rise in intraoral pressure (Zemlin 2011)

Measuring the bilabial closure in ʙ

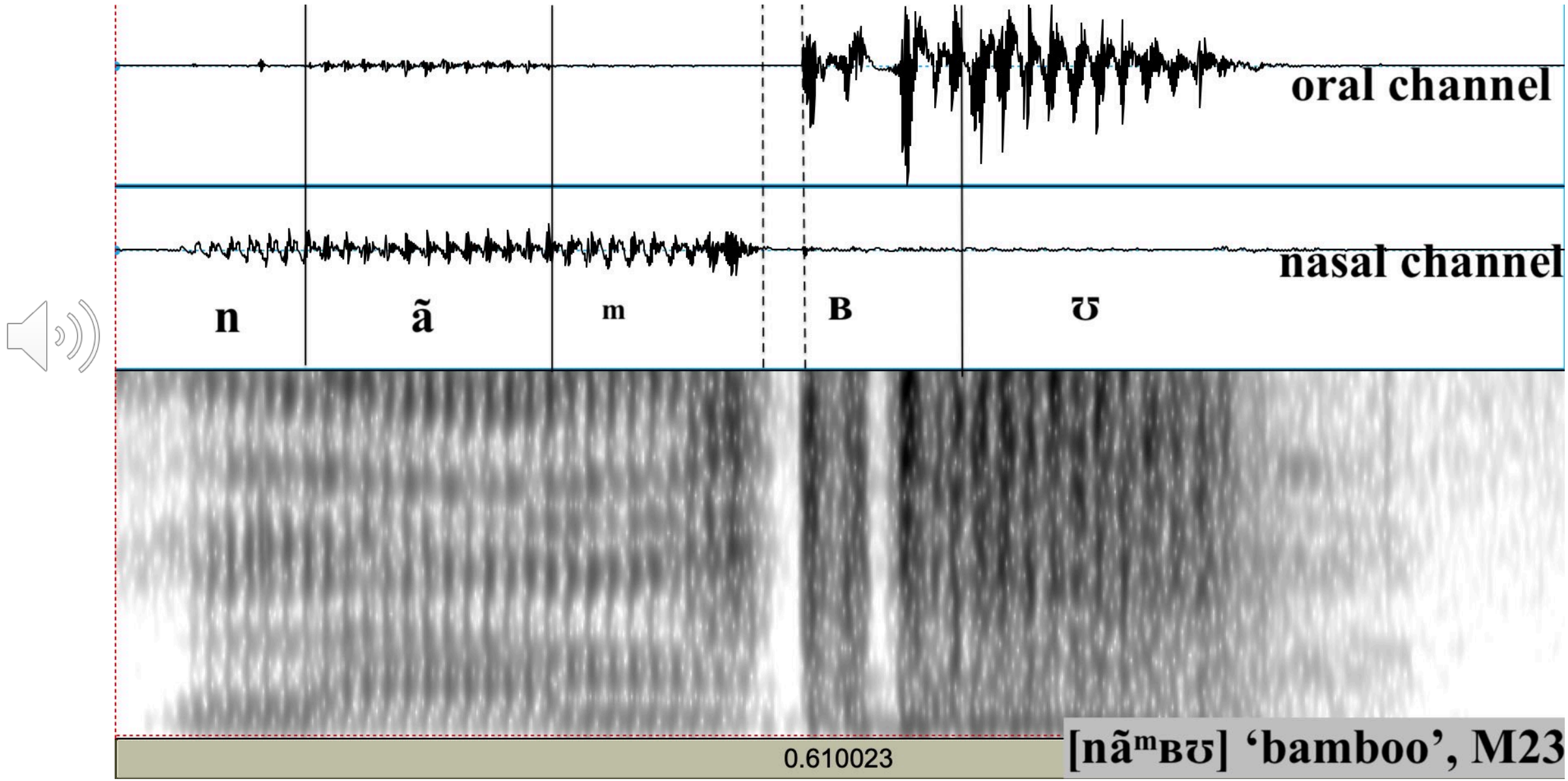


Measuring the bilabial closure and prenasalization in ᵐʙ

Stewart and Kohlberger (2017)
Earbuds: A Method for Analyzing Nasality in the Field

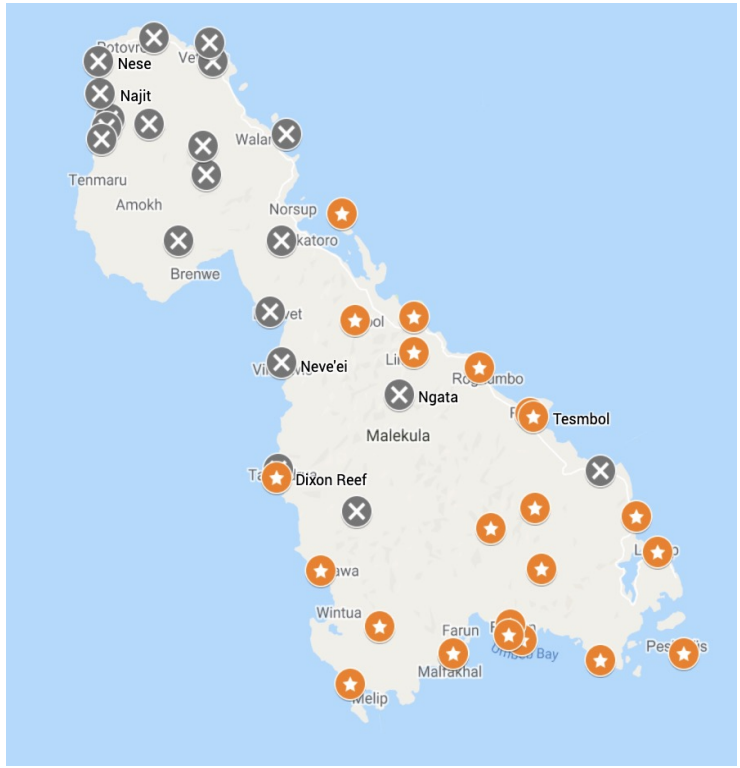
A method for determining:
- presence of nasality in the speech signal
- timing and duration of nasal gestures

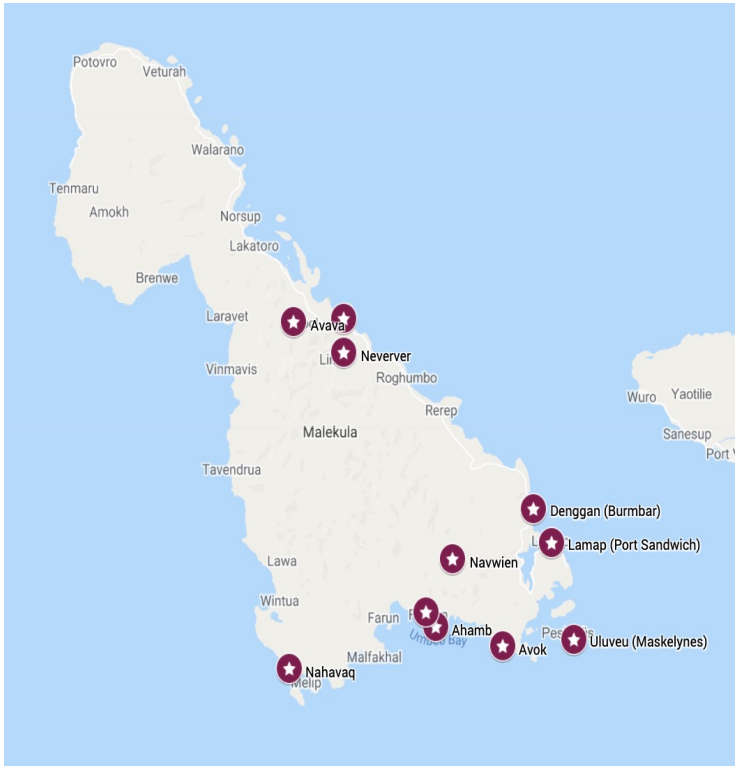
Sinsan Peter


oral channel
nasal channel
n
ã
m
ʙ
ʊ
0.610023
[nãᵐʙʊ] ‘bamboo’, M23

Given the unfavourable aerodynamic conditions in ʙ̥, how did it emerge and persist?

- What can the distribution of ᵐʙ and ʙ̥ in Malekula languages tell us?
- What is the historical source of ʙ̥?
- How did ᵐʙ emerge and persist?
- What forces counteracted the unfavourable factors?





- ᵽ is only found in languages that have ᵐʙ
- ᵽ is only contrastive in languages where ᵐʙ is contrastive
- ➢ ᵽ likely emerged after ᵐʙ was established

What is the historical source of ᵬ?

- Database:
  - 1390 words from 23 Malekula languages
    - 1314 examples of ᵐʙ
    - 76 examples of ᵬ
- 40 cognate sets
- Comparisons with PNCV and POc reconstructions (Clark 2009; Ross, Pawley & Osmond 1998, 2007, 2008, 2011, 2016)

*ᵐbu > ᵐʙ

In syllable onset:

PNCV ***ᵐbue 'bamboo'**	
Ahamb	na-ᵐʙu
Avava	vunuᵐʙu
Lamap	na-ᵐʙu
Nahavaq	na-ᵐʙu
Neverver	ni-βin-ᵐʙu
Nitita	βiβiᵐʙu
Uliveo	ᵐʙu 'knife'
Unua	na-ᵐʙu
Uripiv	na-ᵐʙu
Vivti	nəβuᵐʙu

PNCV ***ᵐbukasi 'pig'**	
Ahamb	na-ᵐʙwas
Avava	a-ᵐʙuah
Lamap	ᵐʙuas
Na'ahai	ni-ᵐʙuas
Nahavaq	ni-ᵐʙʷuwes
Neverver	ni-ᵐʙuas
Uliveo	ᵐʙuaj
Vivti	ni-ᵐʙuɑsɣɑh 'boar'

In syllable coda:

PNCV ***kaᵐbu 'fire'**	
Ahamb	n-xaᵐʙ
Avava	a-aᵐʙ
Avok	n/xaᵐʙ
Lamap	na-xaᵐʙ
Letemboi-Repanbitip	na/xaᵐʙ
Na'ahai	na-ɣaᵐʙ
Navwien	n/xaᵐʙ
Neverver	na-xaᵐʙ
Ninde	nəᵐʙ 'firewood'
Nisvai	n/xaᵐʙ
Nitita	na/xaᵐʙ
Rerep	no/xoᵐʙ
Unua	no-xoᵐʙ
Uripiv	naᵐʙ
Vivti	na/xaᵐʙ

- Final *u was subsequently lost – final vowel loss is well documented in Malekula languages (Lynch 2014)
- **ᵐʙ likely became contrastive word-finally (Lynch 2016)**

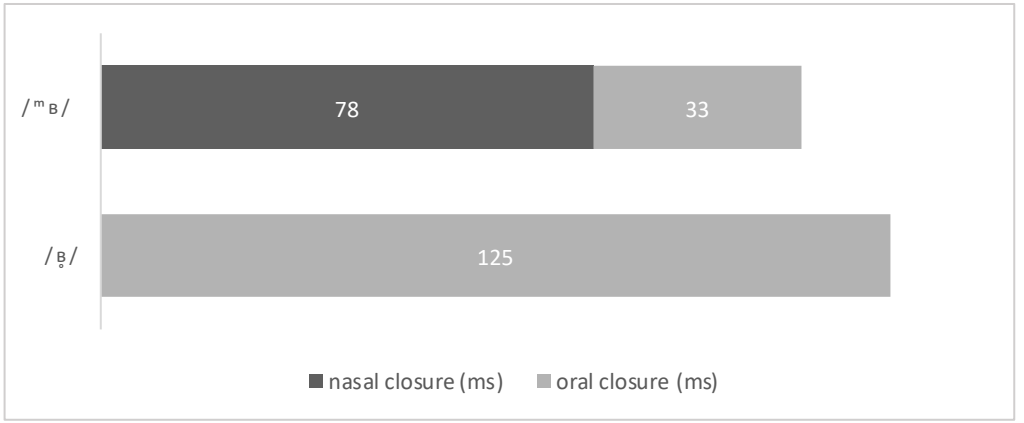
*#vu [βu] > ʋ

POc *puRas ‘spray water from the mouth’ // *puRuk ‘to spray spittle etc. from the mouth for magical purposes’ PNCV: ***vur**a-i ‘spit’	
Ahamb	ʋure ‘spit’
Avava	-ʋura ‘spit’
Avok	ʋyje / ᴘule ‘spit’
Lamap	ʋuj ‘spit’
Navwien	ʋəraj ‘spit’
Nisvai	-ʋuraj ‘spit’
Uluveo	ʋulaj ‘spit’

POc *puso ‘foam froth slime’ PNCV ***vusa**/*ᵐbusa (*ᵐbuso) ‘foam’	
Ahamb	ʋus ‘to foam (for sea water), break (for waves)’
Avok	ʋys ‘to foam (for sea water), break (for waves)’

Historical-comparative analysis

- *ᵐbu > ᵐʙ confirms existing hypotheses
  - Maddieson's (1989) aerodynamic conditions are met in both *ᵐbu and ᵐʙ
- *#βu > ʙ̥
  - The aerodynamic conditions are met in βu but not in ʙ̥



Other factors that played a role in the emergence and presistence of ᵐʙ and ʙ̥

- Structural (phonological) factors
- Language contact
- Sociolinguistic factors

Phonological factors

- Prenasalisation, labial consonants, trilling are salient features of these languages
- ⁿr is also found in Austronesian languages with bilabial trills outside of Malekula (e.g. Blust 2007), reconstructible to PAn (Maddieson 1989: 111)

		labial	coronal	palatal	velar	labio-velar
Nasals		m	n		ŋ	
Plosives	**Plain**	**p**	**t**		**k**	
	Prenasalised	**ᵐb**	**ⁿd**		**ᵑg**	
Fricatives		v	s		x	
Affricates			tʃ			
Trills	**Plain**	**ʙ**	**r**			
	Prenasalised	**ᵐʙ**	**ⁿr**			
Approximants			l	j		w

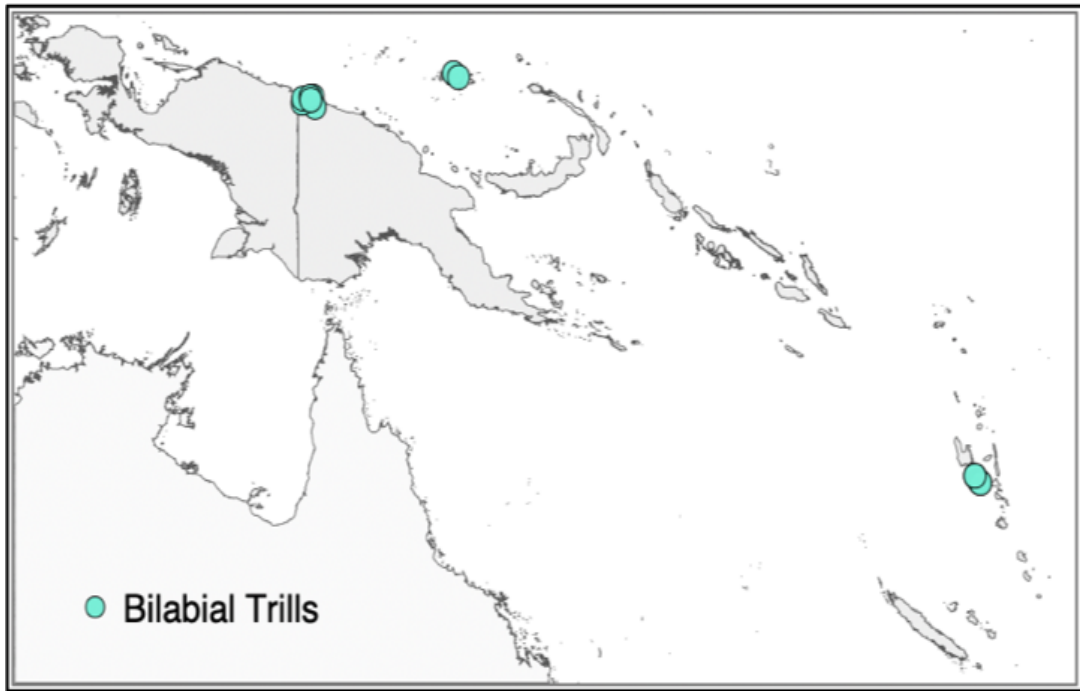
Consonant inventory of Ahamb

	Bilabial		Alveolar	Velar
	labialized	non-labialized		
Non-prenasalized plosive	**pʷ**	**p**	t	k
Prenasalized plosive	**ᵐbʷ**	**ᵐb**	ⁿd	ᵑg
Nasal	**mʷ**	**m**	n	ŋ
Fricative		**β**	s	
Affricate			dʒ	
Trill		**ᵐʙ**	r	
Flap			ɾ	
Lateral			l	
Approximant	**w**		j	

Consonant inventory of Uripiv (McKerras 2001)

Contact with Papuan languages

- Blust (2005b, 2008), Donohue & Denham (2008): many unusual features of Vanuatu languages, including bilabial trills, can be attributed to contact with Papuan languages
- Genetic research (Posth et al. 2018) confirmed early mixing with various Papuan-speaking populations.

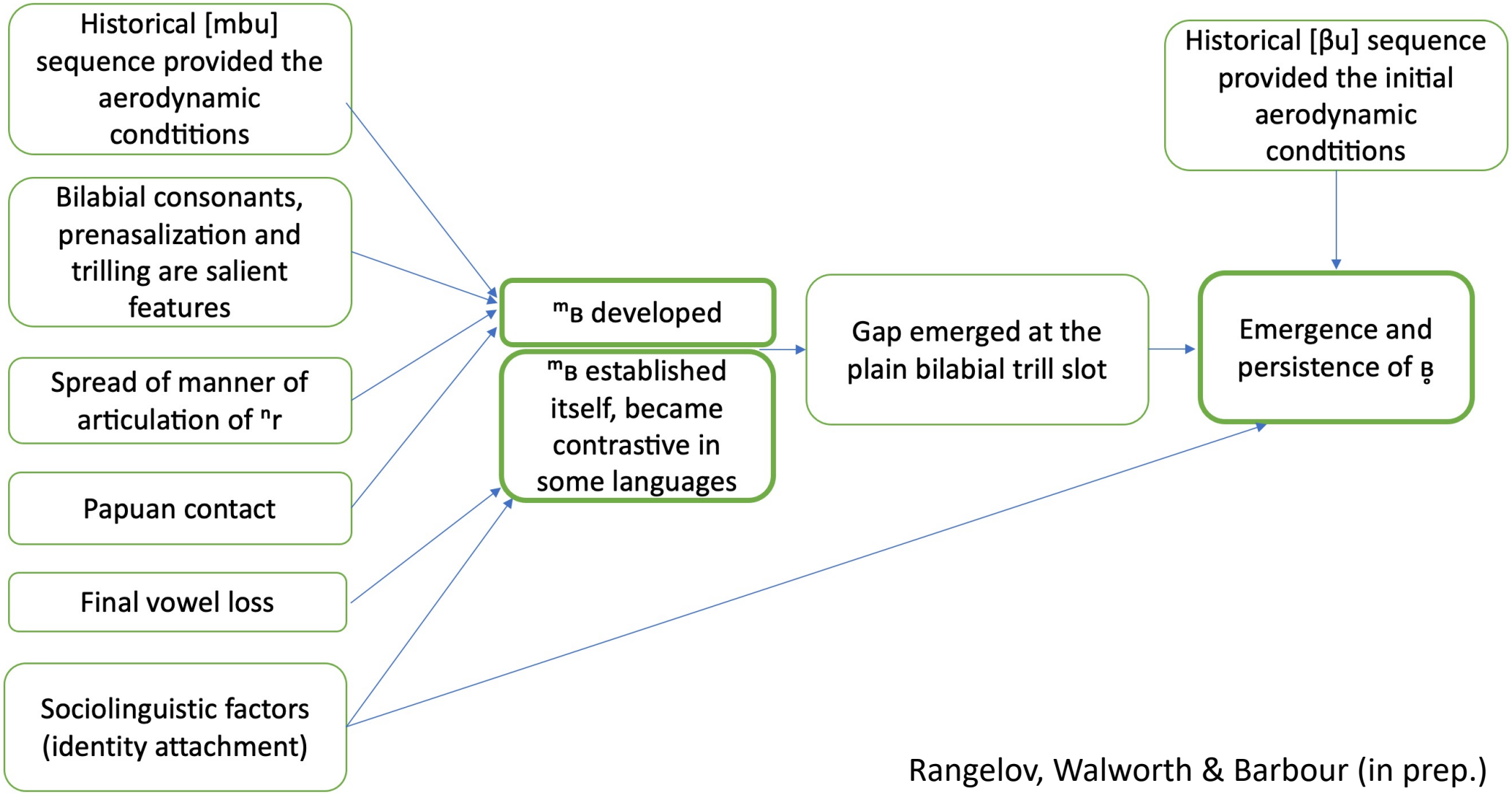


Walworth (2019)

Sociolinguistic factors

- Vernacular languages are an important expression of local identities in Vanuatu (Barbour, Wessels & McCarter 2018; Rangelov, Bratrud & Barbour 2019; Daly & Barbour 2019)
- Relationship between identity attachment and marked speech (Labov 1972; Trudgill 1972; Walworth 2017)
- Identity attachment as historical motivation for linguistic divergence in Vanuatu more specifically (François 2012)
- Crowley (2006: 30) described the bilabial trills in Avava as a feature that is “immediately obvious and particularly salient to any observer, even to a non-linguist being exposed to the language for the first time… Speakers of neighboring Neve’ei often comment on the presence of these sounds in Avava, which they regard as rather comical.”

Proposed pathway for the emergence and persistence of bilabial trills in Malekula languages



Rangelov, Walworth & Barbour (in prep.)

Takeaways

- Intraoral pressure is likely relatively high in b̥, which is an unfavourable aerodynamic condition for trilling
- Different factors counteracted this
  - suitable historical environment
  - the presence of (contrastive) ᵐв, prenasalization as contrastive feature, trilling, bilabial consonants, ⁿr
  - language contact
  - identity attachment
- Rare phonological change can be explained by a multi-faceted approach, looking at phonetic, structural and social factors (Blust 2005a)

References (1)

- Barbour, Julie. 2012a. *A grammar of Neverver.* Berlin: De Gruyter Mouton.
- Barbour, Julie. 2012b. *Nossorian an Neverver: Neverver word list.* Hamilton, New Zealand: University of Waikato. Unpublished manuscript.
- Barbour, Julie, Kanauhea Wessels & Joe McCarter. 2018. Language contexts: Malua (Malekula Island, Vanuatu). *Language Documentation and Description* 15. 151-178.
- Blust, Robert. 2005a. Must sound change be linguistically motivated? *Diachronica* 22(2). 219-269. https://doi.org/10.1075/dia.22.2.02blu
- Blust, Robert. 2005b. The Oceanic languages (review). *Oceanic Linguistics* 44(2). 544-558. https://doi.org/10.1353/ol.2005.0030
- Blust, Robert. 2007. The prenasalised trills of Manus. In Jeff Siegel, John Lynch & Diana Eades (eds.), Language description, history, and development: *Linguistic indulgence in memory of Terry Crowley*, 297–311. Amsterdam: John Benjamins.
- Clark, Ross. 2009. **Leo Tuai: A comparative lexical study of North and Central Vanuatu languages.* Canberra: Pacific Linguistics.
- Crowley, Terry. 2004. *Unpublished field notes: Avava (1) July – Oct. 2004.* Unpublished manuscript.
- Crowley, Terry. 2006. *The Avava language of central Malakula (Vanuatu)*. Canberra: Pacific Linguistics. Edited by John Lynch.
- Crowley, Terry. 1998. A salvage sketch of Nati (Southwest Malakula, Vanuatu). In Darrell T. Tryon (ed.), *Papers in Austronesian Linguistics (No. 5)*, 101-148. Canberra: Pacific Linguistics.
- Daly, Nicola & Julie Barbour. 2021. 'Because, they are from here. It is their identity, and it is important': Teachers' understanding of the role of translation in vernacular language maintenance in Malekula, Vanuatu. *International Journal of Bilingual Education and Bilingualism* 24(9). 1414-1430. https://doi.org/10.1080/13670050.2019.1604625
- Dimock, Laura. 2005. The bilabial trill in Unua. *Wellington Working Papers in Linguistics* 17. 17-33.
- Dimock, Laura. 2009. *A grammar of Nahavaq (Malakula, Vanuatu)*. Wellington: Victoria University of Wellington doctoral thesis.
- Donohue, Mark & Tim Denham. 2008. The language of Lapita: Vanuatu and an early Papuan presence in the Pacific. *Oceanic Linguistics* 47(2). 433-444.
- François, Alexandre. 2012. The dynamics of linguistic diversity: Egalitarian multilingualism and power imbalance among northern Vanuatu languages. *International Journal of the Sociology of Language* 214. 85-110. https://doi.org/10.1515/ijsl-2012-0022
- Healey, David Stephen. 2013. *A grammar of Maskelynes: The language of Uluveu Island, Vanuatu.* Port Vila: University of the South Pacific doctoral thesis.

References (2)

- Keating, Christine. 2007. *A cross-linguistic overview of bilabial trills*. Dallas, TX: Graduate Institute of Applied Linguistics MA thesis.
- Labov, William. 1972. *Sociolinguistic patterns*. Philadelphia, PA: University of Pennsylvania Press.
- Lynch, John. 2014. Unexpected final vowel retention in Malakula. *Open Linguistics* 1. 1-16. https://doi.org/10.2478/opli-2014-0001
- Lynch, John. 2016. Malakula internal subgrouping: Phonological evidence. *Oceanic Linguistics* 55(2). 399-431.
- Maddieson, Ian. 1989. Aerodynamic constraints on sound change: The case of bilabial trills. *UCLA Working Papers in Phonetics* 72. 91-115.
- McKerras, Ross. 2001a. *Uripiv phonology and grammar*. Unpublished manuscript, SIL.
- McKerras, Ross. 2001b. *Uripiv-English dictionary*. Unpublished manuscript, SIL.
- Murray, Jean. 2018. *Ninde: A grammar sketch and topics in nominal morphology*. Hamilton, New Zealand: University of Waikato MA thesis.
- Olson, Kenneth. 2015. The bilabial trills in Port Sandwich (Vanuatu) in 1774. *Diachronica* 32. 105-114. http://doi.org/10.1075/dia.32.1.04ols
- Pearce, Elizabeth. 2015. *A grammar of Unua.* Berlin: De Gruyter Mouton.
- Pearce, Elizabeth. 2018. *Unua word list*. Melbourne Australia: University of Melbourne.
- Pike, Eunice V. 1963. *Dictation exercises in phonetics.* Santa Ana, CA: Summer Institute of Linguistics.
- Posth, Cosimo, Kathrin Nägele, Heidi Colleran, Frédérique Valentin, Stuart Bedford, Kaitip W. Kami, Richard Shing, Hallie Buckley, Rebecca Kinaston, Mary Walworth, Geoffrey R. Clark, Christian Reepmeyer, James Flexner, Tamara Maric, Johannes Moser, Julia Gresky, Lawrence Kiko, Kathryn J. Robson, Kathryn Auckland, Stephen J. Oppenheimer, Adrian V. S. Hill, Alexander J. Mentzer, Jana Zech, Fiona Petchey, Patrick Roberts, Choongwon Jeong, Russell D. Gray, Johannes Krause & Adam Powell. 2018. Language continuity despite population replacement in Remote Oceania. *Nature ecology & evolution* 2(4). 731-740. https://doi.org/10.1038/s41559-018-0498-2
- Rangelov, Tihomir. 2019. The bilabial trills of Ahamb (Vanuatu): Acoustic and articulatory properties. In Sasha Calhoun, Paola Escudero, Marija Tabain & Paul Warren (eds.), *Proceedings of the 19th International Congress of Phonetic Sciences (ICPhS), Melbourne, Australia 2019*, 1292-1296. Canberra: Australasian Speech Science and Technology Association Inc. https://assta.org/proceedings/ICPhS2019/papers/ICPhS_1341.pdf
- Rangelov, Tihomir. 2020a. *A grammar of the Ahamb language (Vanuatu)*. Hamilton, New Zealand: University of Waikato doctoral thesis. https://hdl.handle.net/10289/14038

References (3)

- Rangelov, Tihomir. 2020b. *Documenting Ahamb, a small-island language of Vanuatu*. London: SOAS, Endangered Languages Archive (ELAR). http://hdl.handle.net/2196/00-0000-0000-000F-E780-0
- Rangelov, Tihomir & Julie Barbour. 2019. *On the origins of bilabial trills in the languages of Malekula, Vanuatu*. Paper presented at the 11th International Austronesian and Papuan Languages and Linguistics Conference (APLL11), Leiden.
- Rangelov, Tihomir, Tom Bratrud & Julie Barbour. 2019. Ahamb (Malekula, Vanuatu) – Language contexts. *Language Documentation and Description* 16. 86-126. http://www.elpublishing.org/docs/1/16/ldd16_04.pdf
- Ross, Malcolm, Andrew Pawley & Meredith Osmond (eds.). 1998. *The lexicon of Proto Oceanic: The culture and environment of ancestral Oceanic society*. *Volume 1: Material culture.* Canberra: Australian National University.
- Ross, Malcolm, Andrew Pawley & Meredith Osmond (eds.). 2003. *The lexicon of Proto Oceanic: The culture and environment of ancestral Oceanic society. Volume 2: The physical environment.* Canberra: Australian National University.
- Ross, Malcolm, Andrew Pawley & Meredith Osmond (eds.). 2008. *The lexicon of Proto Oceanic: The culture and environment of ancestral Oceanic society. Volume 3: Plants.* Canberra: Australian National University.
- Ross, Malcolm, Andrew Pawley & Meredith Osmond (eds.). 2011. *The lexicon of Proto Oceanic: The culture and environment of ancestral Oceanic society. Volume 4: Animals.* Canberra: Australian National University.
- Ross, Malcolm, Andrew Pawley & Meredith Osmond (eds.). 2016. *The lexicon of Proto Oceanic: The culture and environment of ancestral Oceanic society. Volume 5: People: Body and mind.* Canberra: Australian National University.
- Shimelman, Aviva, Mary Walworth, Lana Takau, Tom Ennever, Iveth Rodriguez, Tom Fitzpatrick, Marie-France Duhamel, Giovanni Abete, Daria Dërmaku, Laura Wägerle, Heidi Colleran, Paul Heggarty, Kaitip W. Kami, Hans-Jörg Bibiko and Russell Gray. 2020. *Vanuatu Voices* (Version v1.0) [Data set]. Zenodo. http://doi.org/10.5281/zenodo.4309141
- Stewart, Jesse & Martin Kohlberger. 2017. Earbuds: A method for analyzing nasality in the field. *Language Documentation & Conservation* 11. 49-80
- Trudgill, Peter. 1972. *Sex, covert prestige and linguistic change in the urban British English of Norwich.* Language in Society 1(2). 179-195. https://doi.org/10.1017/S0047404500000488
- Walworth, Mary. 2017. Reo Rapa: A Polynesian contact language. *Journal of Language Contact* 10(1). 98-141. https://doi.org/10.1163/19552629-01001006
- Walworth, Mary. 2019. *Language contact and change on the Ocean(ic) highway.* Plenary address at the 24th International Conference on Historical Linguistics (ICHL). Canberra: Australian National University.
- Williams, Claudia. 2019. *Lamap: A grammar sketch of the simple verbal clause*. Hamilton, New Zealand: University of Waikato MA thesis.
- Zemlin, Willard R. 2011. *Speech and hearing science. Anatomy and physiology.* Boston: Allyn and Bacon.