Reconstruction of nasality and other aspects of A'ingae phonology*

Chelsea Sanker and Scott AnderBois

Abstract: We propose a reconstruction of several sound changes in the history of A'ingae, a language isolate spoken in Ecuador and Colombia, using evidence from the phonology and lexicon of the modern language. Crucial to this reconstruction process is distinguishing ordinary inherited lexical items from borrowed forms, ideophones, and forms which are morphologically complex, each of which may sometimes exhibit different patterns. The major element of the reconstruction is a set of related changes in nasality. We derive the prenasalized series of stops and affricates from the voiceless unaspirated series, based on reanalysis of preceding nasal codas, which would have been the only permitted codas other than glottal stops. The voiceless unaspirated and prenasalized series became contrastive word-initially as the result of deletion of certain word-initial nasal vowels. Coda nasals also coalesced with following glides, producing a new palatal nasal phoneme. Remaining nasal codas later developed into nasality on vowels. We also propose a set of more speculative palatalization processes, alterations to the velar approximant, and developments of diphthongs. All of these changes have substantially altered the phonological appearance of A'ingae. Improving our understanding of the form it had further in the past may facilitate identification of its affiliation with a language family or identification of loanwords.

Keywords: Sound change, internal reconstruction, A'ingae, language isolates, nasality, loanwords

*Our heartfelt thanks to the A'ingae speakers who have generously share their language and time on aspects of this project: Shen Aguinda, Jorge Mendua, Raúl Queta, and Martín Criollo. Thanks especially to Hugo Lucitante for his contributions on so many aspects of the project: intellectual, linguistic, and practical. Thanks also to Nicholas Emlen, Wilson Silva, and audiences at the Symposium on Amazonian Languages (SAL) 3 and CILLA IX. This project has been supported financially by NSF DEL Grant *#BCS-1911348/ 1911428* "Collaborative Research: Perspective Taking and Reported Speech in an Evidentially Rich Language" to Scott AnderBois and Wilson Silva.

1 Introduction

A'ingae (also Cofán or Kofán, ISO 639-3: con) is spoken in northeastern Ecuador and southern Colombia (the data here is from Ecuador), with an estimated ∼1,500-2,000 speakers. Some previous work has suggested classifying A'ingae with a range of language families, mostly based on geography rather than any systematic similarities: for example, Barbacoan (Rivet, 1924, 1952) or Chicham (Ruhlen, 1987). It has also included in some proposed macrofamilies, e.g. Andean B (Greenberg, 1960), and Macro-Chibchan (Jijón y Caamaño, 1941-43; Mason, 1950). However, it is most often classified as lacking any known relatives, particularly in work that focuses on A'ingae data (Fischer & Hengeveld, 2023). A'ingae has a substantial number of loanwords, which may be responsible for some of the proposed erroneous classifications. Many of the most clearly identifiable loanwords are recent borrowings from Spanish. There are also relatively recent Tukanoan loanwords, based on ongoing modern contact, and Kichwa loanwords, some of which seem to have a somewhat earlier origin (AnderBois et al., 2019). If A'ingae were to be related to another extant language, it is plausible to assume that the relationship may be distant, so having a picture of the language at a point further in the past may facilitate identifying a genetic relationship or reinforcing its status as an isolate. While potential genetic connections with other languages remain elusive, this paper presents evidence for a set of relatively recent yet substantial sound changes that reshaped the phonological system.

As a presumed language isolate with no clearly identified dialectal variation, the comparative method is of little use in understanding the prehistory of A'ingae. However, even within a language isolate, several lines of evidence facilitate internal reconstruction. Internal reconstruction often focuses on morphophonological patterns as potential fossilizations of earlier phonological processes. Some restricted patterns can be the result of analogy (Ringe, 2003), so it is valuable to have several concordant lines of evidence beyond morphophonological patterns. Typological information is useful for any reconstruction, but particularly for internal reconstruction, to establish that a posited sound change is possible and that the reconstructed

system is paralleled by known languages (Givón, 2000; Comrie, 2003). Distributional patterns in the lexicon can also point to historical processes (e.g. Landerman, 1998; Campbell & Grondona, 2007), and can be clarified by identifying and excluding loanwords from analysis (e.g. Emlen, 2017; Newman, 2014). A'ingae has many loanwords that remain transparent phonologically and semantically, especially ones from Kichwa and Spanish in the last century. Separating out these likely loanwords makes it possible to identify phonological patterns in the older stratum of inherited words, in which some of the tendencies suggested by the full lexicon become more apparent. The patterns in the lexicon are additionally somewhat obscured by morphologically complex forms. A'ingae has a substantial number of word forms which are morphologically decomposable diachronically.[1] Some patterns produced across the historical morpheme boundaries never occur within individual morphemes.

When loanwords and morphologically complex forms have been set aside, the modern phonology and lexicon of A'ingae provide evidence for several sound changes that restructured the phonology of the language. We draw on evidence from patterns of allomorphic alternations, phoneme frequency, and phoneme distributions in the lexicon of the modern language. The most far-reaching and notable sound changes we argue for are those which involve vowel and consonant nasality. First, we reconstruct the development of the series of 5 prenasalized stops and affricates from sequences of nasal coda followed by voiceless unaspirated stops and affricates. At this stage, nasal codas before the glide /j/ formed /ɲ/, and may have also created new instances of /m/ from nasal-glide sequences involving /ʊ/. Coda nasals subsequently developed into nasality on preceding vowels, with nasal spreading processes accounting for yet other instances of nasal vowels.

Beyond the fact that these sound changes affected many phonemes in the language, they are of broader importance for two reasons. First, broadly speaking, the sound changes

[1]This includes many words for seemingly basic vocabulary such as [mẽⁿd͡zãⁿd͡zaʔfa] *menzanza'fa* 'tongue' (cf. *menza* 'to stick out ones tongue'), [dɨsɨʔt͡ʃo] *dûsû'chu* 'egg' (cf. *dûsû* 'to conceive'), [ĩhãmãʔt͡ʃo] *injama'chu* 'heart' (cf. *injama* 'want, think'), [a͡iʔʊo] *ai'vu* 'body' (cf. *a'i* 'person') and [t͡sãⁿdie] *tsandie* 'man' (cf. *tsa'ndû* 'to marry a man').

serve to make the modern day language look substantially more characteristic of Amazonian languages. Contrastive vowel nasality, the existence of prenasalized voiced stops (at least as allophones), and nasal spreading processes are all features typical of the Amazonian linguistic area or perhaps an Eastern South American area (e.g. van Gijn 2014, Aikhenvald 2012).[2] While the archaeological and historical evidence is quite sparse (see Kohn, 2002 and references therein), these lines of evidence also suggest that the historical homeland of A'ingae speakers (the A'i) was located more in the Andean foothills, with later movement into Amazonia and therefore presumably increased contact with other Amazonian languages in recent centuries, convergent with the linguistic evidence here.

In addition to the importance of these historical sound changes for understanding the history of A'ingae itself, these features are of broader interest given the wealth of recent literature on the phonology of nasality across Amazonian languages (e.g. Thomas 2014, Wetzels & Nevins 2018, Stanton 2018, Lapierre & Michael 2017; Bruil & Stewart 2022). Having more information about the phonological history of A'ingae will improve our ability to identify loanwords and our understanding of A'ingae's language contact history. Of particular interest is that A'ingae has similar surface distributions of nasal consonants as are found in other Amazonian languages, but has quite different phonological processes that produce them. First, nasal stops only occur with nasal vowels, similar to the phonotactic restrictions of nasal stops in other Amazonian languages. However, A'ingae nasal stops do not alternate with oral stops of any kind (see Bruil & Stewart, 2022 for similar claims for neighboring Siona). Second, A'ingae prenasalized voiced stops occur with a limited distribution similar to other Amazonian languages, yet are phonemically contrastive with nasal stops in the synchronic grammar and have no evidence for a historical relationship with them.

The structure of the remainder of the paper is as follows: §2 describes the phonemic inven-

[2] A number of recent works such as Krasnoukhova, 2012, Birchall, 2014, and Epps & Michael, 2017 have argued that rather than Amazonia and the Andes as linguistic areas, Eastern and Western South America are better supported linguistic areas. We set aside this distinction here, as the details of the claims here are equally relevant for either conception.

tory and phonological processes of present day A'ingae; §3 argues that although phonemic in the modern language, prenasalized stops arose historically from a prior allophonic variant of voiceless stops; §4 explores the idea that contrastive nasality on vowels arose historically from coda nasals; §5 examines nasal stops, presenting evidence that some nasal stops arose historically from nasal-approximant sequences; §6 explores additional sound changes unrelated to nasality; §7 concludes by presenting the phonology of pre-A'ingae.

2 Modern A'ingae

2.1 Phonemic inventory

First we briefly summarize the phonological inventory of present-day A'ingae, as given by Repetti-Ludlow et al. (2020). The primary segments of interest are those that involve nasality contrasts: oral vs nasal vowels, oral approximants vs nasal stops, and voiceless unaspirated vs prenasalized voiced stops and affricates.

The vowel inventory appears in Table 1. Vowel nasality is contrastive, though there are also nasal spreading processes that can change the nasality of vowels, which we turn to in a moment. We will discuss the status of diphthongs in Section 6.3; they are rare within A'ingae and exhibit some patterns suggesting that they are a recent development. The diphthongs listed here are the only vowel-vowel sequences that are consistently realized as monosyllabic.

Table 1: Vowel phonemes of A'ingae

	Front	Central	Back
High	i ĩ	ɨ ɨ̃	o[3] õ
Mid	e ẽ		
Low		a ã	
Diphthongs	ai ãɪ oe õe oa õa oi õɪ ɨi ɨ̃ɪ ao ão		

The consonant inventory of A'ingae appears in Table 2. A'ingae contrasts three series of stops and affricates: aspirated /T^{h}/, voiceless unaspirated /T/, and prenasalized voiced /^{n}D/. There is also a series of fully nasal stops /N/. The first three series fully align in place

[3]While the quality of this vowel is variable and sometimes might be categorized as [u], it is generally closer to [o], and will be marked as such for the rest of the paper.

of articulation, while the nasals cover a different set of places of articulation. There are also three oral approximants and a tap, which do not fully align with any of the other series.

Table 2: Consonant phonemes of A'ingae

	Bilabial	Lab.-dent.	Alveolar	Post-alv.	Palatal	Velar	Glottal
Plosive	pʰ p ᵐb		tʰ t ⁿd			kʰ k ᵑg	ʔ
Affricate			t͡sʰ t͡s ⁿd͡z	t͡ʃʰ t͡ʃ ⁿd͡ʒ			
Fricative		f	s	ʃ			h
Nasal	m		n		ɲ		
Approx.		ʋ			j	ɯ̨	
Tap			ɾ				

A'ingae syllables are (C)V. The only exception is with the glottal stop, which can appear as a coda in word-medial syllables, making the maximal syllable (C)V(ʔ), if the glottal stop is to be analyzed as a consonant rather than glottalization on the vowel. While lexical roots tend to be disyllabic, (C)VCV, monosyllabic roots such as [ã] *an* 'eat', [i] *i* 'bring', [nã] *na* 'meat', and [pʰi] *phi* 'place, sit' are amply attested as well.[4] Stress generally falls on the penultimate syllable of a word in morphologically simplex forms, with some lexical exceptions as well as exceptions related to the glottal stop. A'ingae is an agglutinating language with large numbers of suffixes and enclitics being quite common. Stress exhibits complex interactions with the morphology, with suffixes and clitics impacting stress (or not) in a diversity of ways (see Dąbkowski, 2019, Dąbkowski, 2021 for detailed description and analysis of stress in A'ingae including the aforemnetioned exceptional cases).

While we include the glottal stop in the consonant inventory in Table 2, it does not behave like the other consonants in several respects. It cannot occur word-initially, a feature not shared with other consonants, with the likely exception of [ɯ̨]. Analyses differ in whether it is treated as a consonant (Repetti-Ludlow et al., 2020) or a suprasegmental feature (Dąbkowski, 2019, 2021). If it is a consonant, it behaves like a coda, while A'ingae otherwise disallows coda consonants. Repetti-Ludlow et al. (2020) argue that [ʔ] occurs in surface forms as a

[4]Throughout, we present A'ingae forms in IPA as well as in the standard orthography in use in A'i communities since around 2010. See Repetti-Ludlow et al. 2020 for details on this orthography.

word-medial onset only in limited cases where they are derived from codas in underlying form of the sort /VVʔ/, where VV is a diphthong independently found in the language (e.g. [aʔi] *a'i* 'person, Cofán person' from underlying /aiʔ/); the intervocalic glottal stop arises via metathesis, VVʔ > VʔV/___#. For these roots, morphologically related forms involving the same root often appear with the glottal stop as a coda (e.g. [a͡iʔ-ɲã] *ai'ña* person-CAUS 'to domesticate, civilize'). A morpheme containing a glottal stop will sometimes appear without the glottal stop in certain derived forms.

2.2 Nasality in modern A'ingae

There are several phonological processes in A'ingae that relate to nasality. Some of the nasal spreading processes make the underlying source of nasality ambiguous. However, a closer look at some of the distributions and alternations helps us establish a historical account of the phonological system. In our transcriptions, we give the surface forms and orthographic representations. This choice is primarily done in order to avoid committing to the phonologically underlying nasality of vowels and consonants in cases where it is unclear.

2.2.1 Oral-nasal consonant alternations

Several suffixes and clitics exhibit allomorphy between the oral glides and the nasals, conditioned by the nasality of the immediately preceding vowel, as illustrated in Table 3. The nasals and oral approximants are also in complementary distribution based on the neighboring vowels: Nasal consonants never occur immediately before or after oral vowels, while oral approximants never occur immediately before or after underlyingly nasal vowels (with some exceptions, which we will discuss). However, as will be discussed in Section 2.2.2, the predictability of following vowel nasality is largely due to spreading nasality from nasal consonants, rather than indicating that nasality among sonorants is not contrastive.

The relevant oral approximants are labiodental [ʋ] and palatal [j]. The third approximant, velar [ɯ̯], does not exhibit these alternations. It also differs from the other glides in several other ways. It has no nasal counterpart (i.e. [ŋ] does not exist in the language), is very

Table 3: Alternating consonants in suffixes and enclitics

Morpheme	**V** ___	**Ṽ** ___
Infinitive [-je]/[-ɲẽ]	[ʃak**a**-je] *shakaye* 'to owe'	[k**ã**-ɲẽ] *kañe* 'to look'
Passive [-je]/[-ɲẽ]	[is**i**-je] *isûye* 'be birthed'	[is**ɪ̃ã**-ɲẽ] *isiañe* 'be recorded'
Veridical [-ʔja]/[-ʔɲã]	[h**i**-ʔja] *ji'ya* 'did come'	[h**ĩ**-ʔɲã] *ji'ña* 'does exist'
Irrealis [-ja]/[-ɲã]	[^{n}d**a**-ja] *daya* 'might become'	[k^{h}**ɨ̃**-ɲã] *khûiña* 'might lay down'
Acc 2 [-ʋe]/[-mẽ]	[t^{h}es**i**-ʋe] *thesive* 'jaguar'	[kõʔs**ĩ**-mẽ] *kunsime* 'monkey'
Nom. Past [-ʔje]/[-ʔɲẽ]	[ja**j**a-ʔje] *yaya'ye* 'deceased dad'	[mãm**ã**-ʔɲẽ] *mama'ñe* 'dec. mom'
Exclusive [-ji]/[-ɲĩ]	[tis**i**-ji] *tisûyi* 'only themself'	[t͡ʃõn**ĩ**-ɲĩ] *chuniñi* 'only nutrias'
Elative [-je]/[-ɲẽ]	[t͡ʃã^{n}g**o**-je] *changuye* 'from a hole'	[ɲ**ã**-ɲẽ] *ñañe* 'from me'

infrequent, and beyond not occurring with a preceding or following nasal vowel, has a limited distribution not paralleled by the other glides, never occurring word-initially (see §6.2 for further discussion of this segment).

The relevant nasal stops are labial [m] and palatal [ɲ]. [n] has no glide counterpart. There is no evidence that [n] and [ɾ] alternate with each other, though the two of them are in near complementary distribution: [n] occurs with nasal vowels preceding and following and [ɾ] occurs with oral vowels preceding and following. In loanwords, sequences of the tap followed by a nasal vowel are permitted. For example, [ɾã^{n}de] *rande* 'big' (from Spanish *grande*) is clearly adapted to A'ingae phonology in other ways (e.g. simplification of the initial cluster), yet the tap preceding a nasal vowel is permitted.

To account for these patterns, we propose a synchronically active rule: C[-obstruent] > [+nasal]/Ṽ ___. Although the clearest evidence comes from the active alternations that are observed across morpheme boundaries, the patterns within roots are also consistent with this rule, so there is no reason to specify it as being conditioned by morpheme boundaries.

Despite these alternations neutralizing the contrast between nasals and glides when there is a preceding nasal vowel, the nasals and glides are contrastive phonemes. In addition to the morphemes that undergo alternation, there are suffixes with non-alternating nasals, e.g. Ablative [-nẽ] *-ne*, Locative [-nĩ] *-ni*, Accusative [-mã] *-ma*, Frustrative [-ʔmã] *-'ma*, and Causative [-ɲã] *-ña*. This causative marker has a phonologically restricted distribution (only

occurring with monosyllabic roots), and is the only suffix with a non-alternating /ɲ/. In Section 5.1, we discuss implications for the historical development of this sound. We argue that the alternating sounds are underlying oral glides that become nasal after nasal vowels, while the non-alternating sounds are underlying nasal consonants.

2.2.2 Progressive consonant-induced vowel nasalization

Nasal stops are always followed by nasal vowels. These vowels condition nasal allomorphs (see Table 3), indicating that they are phonologically nasal. However, they are not necessarily nasal in their underlying form. In theory, there are four possible synchronic explanations for the shared nasality of consonants and following vowels, (i) vowel nasality drives consonant nasality, (ii) consonant nasality drives vowel nasality, (iii) nasality is a suprasegmental feature driving both consonant and vowel nasality (as argued by Barnes (1999) et seq. for nearby Eastern Tukanoan languages and Sans (2011) for Bésiro), or (iv) the distributional pattern exists only due to historical processes and there is no active relationship. We analyze the co-occurrence of nasal consonants and following nasal vowels as reflecting a spreading process in which nasal consonant onsets trigger nasalization of the immediately following vowel.

If vowel nasality did drive consonant nasality, oral approximants and nasals might not be phonologically contrastive, as they could be predicted by the nasality of the neighboring vowels. In order to explain both the alternations between glides and nasal consonants after nasal vowels as well as the existence of word-initial nasal consonants, this analysis would require that a phonologically nasal vowel either preceding or following a glide would cause it to nasalize. There are no alternations that provide evidence for a regressive nasal assimilation rule in which nasal vowels make preceding glides nasal, though that does not in itself make such a rule implausible.

The distribution of oral approximants is informative in distinguishing between whether surface nasal vowels following nasal consonants are nasal in their underlying form or not, which can help with deciding between different potential explanations for the co-occurrence of nasal

stops and nasal vowels. There is little evidence that the glides occur before underlyingly nasal vowels. Within roots of native words, there are no definitive cases of glides before vowels that must be underlyingly nasal. There are some instances of such sequences in loanwords, e.g. [haʊõ] *javun* 'soap', borrowed from Spanish *jabón*, though the final vowel is not always fully nasalized, and morphologically complex forms with the oral alternant of alternating suffixes/clitics (as described in Section 2.2.1) are attested (e.g. 'soap (ACC)' is [haʊõʊe] *javunve* rather than **javume*).

Surface nasal vowels that are produced by nasal spreading across morpheme boundaries can occur with preceding glides. Non-alternating suffixes, i.e. those that always begin with nasal or prenasalized consonants (e.g. in (2) below), produce regressive spreading of nasality onto preceding vowels. In such cases, the glide in the root remains unchanged, creating many surface forms with a sequence of an oral glide followed by a nasal vowel. For example, /ʃaʊo-ᵑga/ canoe-DAT produces the surface form [ʃa**ʊõ**ᵑga] *shavunga* 'canoe (DAT)' rather than becoming *[ʃamõᵑga]. There are also other spreading nasality processes that produce sequences of an oral glide followed by a nasal vowel, for example in nasal diphthongs created by vowel-initial suffixes, e.g. [t͡ʃa**ʊõe**hẽɲã] *chava-en-je-ña* 'was selling (lit. causing to buy)'.

The surface co-occurrence of glides and nasal vowels provides evidence against nasal consonants being caused by following nasal vowels or both nasal consonants and nasal vowels being caused by a suprasegmental feature. While the lack of effect of these surface nasal vowels on the nasality of preceding consonants could potentially be explained by ordering the rules nasalizing vowels after a rule in which nasal vowels nasalize preceding consonants, there are also several other issues with such an account.

The main issue with proposing a rule which nasalizes glides before nasal vowels is that loanwords are not adapted in ways that are consistent with such a rule. Some loanwords contain a word-initial nasal consonant preceding a syllable beginning with a glide, e.g. [mõjo] *muyu* (from Spanish *mullo* 'mullet (fish)'). If nasal consonants exist only as allophones

produced by neighboring nasal vowels, then these word-initial nasals would need to be caused by following underlying nasal vowels. However, an underlying nasal vowel in the first syllable would nasalize the following glide; there is active evidence from alternations that glides after nasal vowels always become nasal consonants, as is discussed in the following section. There are also some loanwords in which glides seem to be licit before nasal vowels (e.g. [haʊ̃] *javun* 'soap'), as discussed above.

Another issue with explaining nasal stops as allophones of oral approximants that are conditioned by vowel nasality is that places of articulation of the nasal stops and oral approximants are not parallel. If nasal stops were allophones of oral approximants, their places of articulation should parallel their oral counterparts. Oral [ɯ] lacks a nasal counterpart. [n] is not in alternation with an oral counterpart; even if the tap [ɾ] were grouped together with the glides, there is no evidence that it is in alternation with [n].

Sequences of suffixes provide another line of evidence for nasal stops nasalizing following vowels. As discussed in Section 2.2.1, some suffixes begin with consonants that have allophones both as nasal stops and as oral glides, conditioned by the nasality of the preceding vowel. The vowels within these alternating nasal/glide suffixes are underlyingly oral, as the allomorphs with oral consonants trigger oral allomorphs of subsequent suffixes. The allomorphs with nasal consonants are realized with nasal vowels and trigger nasal allomorphs of subsequent suffixes, indicating that the underlyingly oral vowel has become nasal. In (1), we show that the form of the consonant in suffixes like the switch reference marker *-pa/-mba* is determined by the nasality of the preceding vowel, and that nasality of that vowel is determined by the preceding consonant. Note that in both of these examples, the switch reference marker is preceded by the passive marker, but the form of the passive marker is determined by the nasality of the final vowel in the root. We will return to prenasalization in more detail in Section 3.

(1) Alternating suffix *-pa/-mba* SS:

a. [ĩⁿdijepa]

indiyepa

indi-ye-pa

take-PASS-SS

'having been taken'

b. [tãⁿdãɲẽᵐba]

tandañemba

tandan-ñe-mba

tie-PASS-SS

'having been tied up'

In contrast, there are other suffixes in which the initial consonant is consistently prenasalized, which nasalizes a preceding vowel, as illustrated in (2). In these cases, the nasalized vowel does not cause the consonant to alternate (e.g. we find [ĩⁿdijẽᵐbi] *indiyembi* rather than *[ĩⁿdiɲẽᵐbi] *indiñembi*).

(2) Non-alternating suffix *-mbi* NEG:

a. [ĩⁿdijẽᵐbi]

indiyembi

indi-ye-mbi

take-PASS-NEG

'not get taken'

b. [tãⁿdãɲẽᵐbi]

tandañembi

tandan-ñe-mbi

tie-PASS-NEG

'not get tied up'

The patterns described in this section demonstrate that nasality on consonants is not entirely

predictable, which rules out a synchronic system in which nasality is suprasegmental or only present on vowels. Nonetheless, there is sufficient evidence to indicate a synchronically active relationship between nasality on consonants and on vowels. Thus, we propose that vowels become nasal when immediately preceded by a nasal stop.

Vowels preceding nasal stops are also usually phonetically nasal, though these vowels do not consistently exhibit nasality throughout their full duration, consistent with the nasality being caused by the following consonant. However, the lack of prefixes in A'ingae makes it impossible to establish the phonological status of these vowels based on conditioned allophony. In our transcriptions, vowels before nasal consonants are treated as being nasal in their surface forms.

2.2.3 Nasal vowel harmony

In addition to the above nasal processes involving nasal consonants, there is also a process of progressive nasal vowel harmony. Like many cases of nasal harmony, nasal harmony in A'ingae is sensitive to the properties of intervening consonants, spreading across certain classes of consonants, but not others. The clearest evidence for nasal harmony and for its direction being progressive rather than regressive comes from synchronic alternations in morphologically complex forms with suffixes and enclitics (recall that A'ingae has no prefixes or proclitics). The laryngeal consonants [ʔ] and [h] are fully transparent to nasal vowel harmony; they never occur between vowels that disagree in nasality. Suffixes/enclitics such as the imperfective [-ʔhe]/[-ʔhẽ] *-'je/-'jen* and contrastive topic marker, [-ha]/[-hã] *-ja/-jan* exhibit regular alternations based on the nasality of the preceding vowel, as illustrated in Table 4.

This pattern seems to be due to progressive nasal vowel harmony; preceding nasal vowels cause nasalization on following vowels divided only by a glottal consonant, while there is no evidence for nasality spreading from suffixes to produce nasality in an earlier vowel divided by a glottal consonant. For example, in contrast to Table 4, we find forms like [p**a**hĩ$^{\text{m}}$bi]

Table 4: Alternating vowels in suffixes and enclitics

Morpheme	**V** ___	**$\tilde{\text{V}}$** ___
Contrastive [-ha]/[-hã]	[k**e**-ha] *keja* 'as for you'	[ɲ**ã**-hã] *ñajan* 'as for me'
Imperative [-ha]/[-hã]	[ãsɨ̃^{n}d**e**-ha] *ansundeja* 'come up'	[t͡s**õ**-hã] *tsunjan* 'do it!'
Imperfective [-ʔhe]/[-ʔhẽ]	[ates**ɨ**-ʔhe] *atesû'je* 'knowing'	[ts**õ**-ʔhẽ] *tsun'jen* 'doing'
Augmentative [-ʔo]/[-ʔõ]	[t͡s**e**-ʔo] *tse'u* 'there (aug)'	[ĩh**ã**-ʔõ] *injan'un* 'many (aug)'

paji-mbi sick-NEG 'isn't sick' rather than *[pãhĩ^{m}bi], with nasality spreading from [ĩ] to the preceding [a].

Although the clearest evidence for nasal vowel harmony comes from the active alternations that are observed across morpheme boundaries, the patterns within roots are also consistent with nasal vowel harmony, as will be discussed further in Section 3.2.

Similar to the consonant-initial suffixes above, there is an asymmetry between oral and nasal vowels in these suffixes. There are some suffixes starting with glottal consonants which have vowels that alternate between being oral and nasal, but there are no such suffixes which have a non-alternating oral vowel with glottal consonants. Conversely, there are two suffixes, [-ʔhĩ] *-'jin* CLF.TALL and [-(ʔ)ĩ] *-'in* MTM which have non-alternating nasal vowels.

Beyond showing a contrast in vowel nasality, these suffixes also provide some additional evidence for the progressive nature of nasal spreading from vowels to neighboring consonants. Consonants which ordinarily only precede oral vowels, such as [ɾ] and [j], can occur with a following nasal vowel across a morpheme boundary (e.g. [^{n}daɾo-ʔhĩ] *daru'jin* 'a medicinal plant', [k^{h}ɨj-ĩ] *khûyin* 'while escaping').[5] Consistent with the evidence discussed in Section 2.2.1, this suggests that the oral/nasal realization of underlying approximants is not affected by following vowels synchronically. Finally, looking at the lexicon, glottal consonants are exceptionlessly transparent to vowel nasality, such that we find words like [ɪ̃hĩ] *ûnjin* 'rain'

[5]The motion cum manner morpheme [-ĩ] often lacks a glottal stop in the output, creating diphthongs instead. Underlying diphthongs often become monophthongized in surface forms, hence the surface form cited here, [k^{h}ɨj-ĩ] *khûyin*, arising from the root [k^{h}ɨja] *khûya* 'escape'. We leave it to future work to examine the phonetics of these output forms in detail, opting to use here the transcription that best matches how native speakers write the form (in stark contrast to progressive nasal vowel harmony, which typically is reflected in writing).

and [ihi] *iji* 'armadillo' where both vowels agree in nasality, but no words such as *[ɨ̃hi] or *[ɨhĩ], with one oral vowel and one nasal vowel.

Additionally, we can see that either iterative or long-distance progressive nasal vowel harmony across glottal consonants is found, and regularly reflected in written forms as well. We see this in the contrast between inflected forms of the roots [ʃokʰãɪ] *shukhaen* 'cook' and [ɾõⁿda] *runda* 'wait' in (3) (a borrowing from Spanish *rondar* 'to wait, hang around'). In the former case, (3a), the root ends in a nasal vowel and we see that not only is vowel in the immediately following suffix nasal, but the subsequent one is as well. In contrast, with a root ending in an oral vowel as in (3b), the suffixes both contain oral vowels.

(3) a. [ʃokʰãɪʔhẽhã]
shukhaen-'jen-jan
cook-IPFV-IMP
'Be cooking!'

b. [ɾõⁿdaʔheha]
runda-'je-ja
wait-IPFV-IMP
'Be waiting!'

Finally, as we have seen above in other cases, we can confirm that this nasalization is phonological in nature by the fact that morphemes with consonants with allophones conditioned by preceding vowel nasality similarly alternate following these vowels, as seen in the comparison between (4) and (5). These examples illustrate two alternations. One alternation is between glides and nasal stops; see Section 2.2.1 for a discussion of this process. The other alternation is between voiceless unaspirated stops and prenasalized stops; see Section 3.1 for a discussion of this process. In (4), the causative suffix [-ẽ] *en* in the verb stem triggers not only the nasal allomorph of the imperfective /-he/, but also the allomorphs with nasalized consonants of the switch reference /-pa/ and the veridical suffix /-ja/:

(4) a. [t͡ʃavʊõehẽᵐba]

*chava-en-je-**mba***

buy-CAUS-IPFV-SS

b. [t͡ʃavʊõehẽŋã]

*chava-en-je-**ñã***

buy-CAUS-IPFV-VER

In contrast, in (5), we see that the verb stem ends in an oral vowel and triggers the non-nasal allomorphs of both suffixes:

(5) a. [ɾõⁿda-he-pa]

*runda-je-**pa***

wait-IPFV-SS

b. [ɾõⁿda-he-ja]

*runda-je-**ya***

wait-IPFV-VER

Thus far, we have seen that whereas some consonants show alternations in their own realizations, glottal consonants productively allow for progressive nasal vowel harmony across them. Fricatives exhibit their own pattern. First, unlike the cases we have seen above, fricatives show no allophonic alternation of any kind. Not only does the consonant itself not exhibit alternations, we also do not see any alternations in the nasality of vowels that follow them. For example, the vowels in the suffixes [-si] *-si* DS, [-se] *-se* IMP3, and [-ʔfa] *-'fa* PL.SBJ remain oral regardless of the nasality of the final vowel in the stem to which they attach (e.g. [aʃãɪse] *asha-en-se* start-CAUS-IMP3 'please start', [t͡sõsi] *tsun-si* do.so-DS 'having done so', [ãʔfa] *an-'fa* eat-PL.SUBJ 'we/you all/they ate').

Although fricatives do not exhibit alternations or evidence of active nasal vowel harmony across them, the lexicon nonetheless shows some evidence that they are generally transparent to nasal vowel harmony, or at least were historically transparent. There are many root-medial

fricatives with oral vowel on either side or with nasal vowels on either side (e.g. [ãʃã] *anshan* 'weave', [kose] *kuse* 'night', [t͡ʃafɨɾɨ] *chafûrû* 'tailless'). However, we have identified no roots with a preceding oral vowel and following nasal vowel (e.g. *[asĩ]) and words with a preceding nasal vowel and an oral vowel following are extremely rare and are overwhelmingly forms which were possibly morphologically complex at least historically – [kĩse] *kinse* 'healthy, having force' (cf. [kĩ] *kin* 'vigorously') and [kãse] *kanse* 'live, be alive' (cf. [kãʔhẽ] *kan'jen* 'stay, live in a place', [kãkʰe] *kankhe* 'town').[6]

Within the lexicon, voiceless unaspirated stops and affricates show a similar pattern to fricatives. There are many roots with medial plain stops and affricates where both adjacent vowels are oral and a fair number where both are nasal, but few cases of roots in which nasality differs across an unaspirated stop or affricate. Table 5 provides a count of how many roots have unaspirated consonants between each possible combination of oral and nasal vowels, excluding clear borrowings. Items where the vowels are in different morphemes are also excluded; differences in vowel nasality are common across morpheme boundaries. The few apparent exceptions may also fall into one of these categories but do not have clear enough etymologies to exclude them. Unaspirated stops and affricates occur frequently between two oral vowels (e.g. [oti] *uti* 'nail', [ʃaka] *shaka* 'debt', [ɨtɨkʰi] *ûtûkhû* 'rib') and less frequently between two nasal vowels (e.g. [õtĩ] *untin* 'gadfly', [tsẽtã] *tsentan* 'warp', [õpãd͡zã] *umpanzan* 'cover up', [ãkã] *ankan* 'be in position'). Note that the cases of a nasal vowel both preceding and following could be due to nasality spreading from the following vowel, or both vowels being historically nasal, though most of our synchronic evidence points towards progressive nasal vowel harmony.

Among the sparsely populated mismatching cells, Oral-T-Nasal and Nasal-T-Oral, there are very few attested forms. While we cannot definitively demonstrate the existence of a prior stage of the language with no such forms, many of the small handful of attested forms appear

[6]In addition to the connection in the root itself, we can also note that [kãse] *kanse* shows an irregular stress pattern. For example, its infinitive form, [ˈkãseje] *kanseye* has antepenultimate stress, whereas the unmarked stress pattern in A'ingae infinitives is to have penultimate stress.

to be potential borrowings (e.g. [tsãpi] *tsampi* 'forest', potentially from Kichwa *champira* 'Chambira palm'[7]) or exhibit individual or dialect variation (e.g. [kũmãt͡sia] *kumantsia* 'ant sp.' is pronounced/written by some speakers as [kũmãⁿd͡zia] *kumanzia*). We have included them here in order to be conservative in only excluding lexical items with clearly established etymologies as loanwords or as morphologically complex. Although the modern language does seem to allow Nasal-T-Oral sequences, their rarity suggests historical processes which had eliminated them.

Table 5: Vowel nasality next to unaspirated stops and affricates

	$\_\_\_\_\mathbf{V}_{[Oral]}$	$\_\_\_\_\mathbf{V}_{[Nasal]}$
$\mathbf{V}_{[Oral]}\_\_\_\_$	187	3
$\mathbf{V}_{[Nasal]}\_\_\_\_$	5	34

In loanwords, nasality is often made to agree in these environments (e.g. Spanish *confesar* 'confess' → [kõf**ẽsẽ**] *kunfensen* 'confess', *cotón* 'cotton shirt' → [k**õ**tõ] *kuntun* 'cotton shirt'). In Spanish, the vowel preceding a nasal consonant is coarticulatorily nasalized; this coarticulatory vowel nasality or the nasality of the consonant is interpreted as a phonemic nasal vowel in A'ingae, because consonant-consonant sequences are prohibited (except when the first consonant is the glottal stop), as are word-final consonants.

The aspirated stops and affricates also exhibit clear phonotactic tendencies, frequently occurring next to oral vowels and much less frequently occurring next to nasal vowels. Table 6 provides a count of how many roots have aspirated consonants between each possible combination of oral and nasal vowels, excluding clear borrowings and items where the vowels are in different morphemes. Whereas the other obstruents with very few exceptions seem to be transparent to nasal vowel harmony (i.e. the two flanking vowels are either both oral or both nasal), aspirated consonants exhibit a different pattern. When preceded by a nasal vowel, aspirated consonants are roughly equally attested with a following oral or nasal vowel. Aspirated stops and affricates show an overall tendency towards occurring surrounded by oral

[7]There isn't clear evidence that this word was Quechuan in origin either. It is included here in the counts of inherited A'ingae words because it cannot be definitively identified as a loanword.

vowels. However, preceding nasal vowels are attested, and the following vowel shows no clear tendency when the preceding vowel is nasal. Table 7 provides examples of the infrequent but licit sequences of nasal vowels preceding aspirated stops.

The relationship between nasality and aspiration has been described previously (e.g. Ohala & Busà 1995); the spread glottis in high airflow segments like aspirated stops produces acoustic cues that are shared with nasality, including lowered amplitude and increased bandwidth of low formants. These acoustic cues can result in nasal consonants being inserted next to aspirated consonants (spontaneous nasalization), or the hypercorrective parallel, deleting nasals in this environment, as observed by e.g. Cresci (2019) in the Camuno variety of Eastern Lombard and Nurse et al. (1993, p. 167–168) in Sabaki. Given the parallels of nasal consonants being deleted in aspirated environments in other languages, it is likely that this pattern reflects a historical process in A'ingae that eliminated coda nasals in aspirated environments, rather than denasalizing nasal vowels (see Section 4 for a discussion of the evidence for reconstructing the development of nasal vowels from coda nasals). It isn't clear that the same process could oralize nasal vowels, given that the cues for nasality in the vowel extend for greater temporal distance than a nasal consonant.

Table 6: Vowel nasality next to aspirated stops and affricates

	____$\mathbf{V}_{[Oral]}$	____$\mathbf{V}_{[Nasal]}$
$\mathbf{V}_{[Oral]}$____	133	0
$\mathbf{V}_{[Nasal]}$____	10	10

Table 7: Aspirated stops by vowel environment

$\mathbf{V}_{[Nasal]}$____$\mathbf{V}_{[Oral]}$		$\mathbf{V}_{[Nasal]}$____$\mathbf{V}_{[Nasal]}$	
[ãp^{h}i]	*amphi* 'fall'	[ãt^{h}ã]	*anthan* 'fish species'
[ã?k^{h}o]	*an'khu* 'hook'	[õk^{h}ã]	*unkhan* 'surround'
[ãt^{h}e]	*anthe* 'stop'	[pɨ̃t͡s^{h}ã]	*pûntshan* 'lower, duck'
[sĩt^{h}ɨ]	*sinthû* 'bite'	[hã?t͡ʃ^{h}ĩ]	*jan'chhin* 'flat nose'
[ʃĩp^{h}i]	*shim'phi* 'young fem. rel.'	[t^{h}ɨ̃t^{h}ã]	*thûnthan* 'heart of palm'

Thus far we have seen that A'ingae allows nasal vowels in word-initial (and affix-initial)

syllables and additionally shows progressive nasal vowel harmony. Different classes of intervening consonants show different degrees of transparency to nasal vowel harmony, ranging from glottal consonants, which are exceptionlessly transparent synchronically, to aspirated stops, which can occur with differing nasality on the preceding and following vowels. The overall low frequency of nasal vowels next to aspirated stops is likely to be the result of a historical process rather than an active synchronic process. Outside of glides, nasal stops, and the tap, each of these consonant classes can be preceded by either oral or nasal vowels.

In stark contrast to each of these classes of consonants, however, are prenasalized voiced stops. Prenasalized stops and affricates block nasal vowel harmony, as will be discussed below. They almost always occur in underlying forms with a preceding nasal vowel and a following oral vowel, e.g. [kõ$^{\eta}$gi] *kungi* 'ant'; [kõ$^{\eta}$gɨ] *kungû* 'sweet potato'. Note that sometimes the following vowel may be nasal in its surface form due to anticipatory nasalization caused by a following consonant.

In contrast to the roots and other underlying forms in the language, surface forms with a prenasalized voiced stop with a nasal vowel on both sides are licit, appearing in a handful of borrowings (6a), partially productive reduplication processes (6b), and a wide range of other morphologically complex forms, as in (6c). It is perhaps important to note that all of these words have a second prenasalized consonant, so the nasality of the vowel following the first prenasalized consonant might be caused by the following consonant, rather than being underlyingly nasal.

(6) a. [t͡ʃõ^{m}bĩ^{m}bi]

chumbimbi

turkey

'domesticated turkey' (cf. Spanish *chompipe* 'turkey')

b. [õ^{n}dɨ̃^{n}dɨ]

undû∼ndû

incline∼ITER

'nod one's head'

c. [sĩ^{m}bã^{m}bi]

simba-mbi

fish-NEG

'didn't fish'

2.2.4 Summary of modern A'ingae nasality patterns

In this section, we have reviewed the phonology of present day A'ingae with a particular emphasis on nasality. We have shown that while nasality is contrastive in both vowels and consonants, there are also significant interactions across segments in the form of phonologically active consonant-induced vowel nasalization, allophonic alternations between glides and nasal stops, and nasal vowel harmony across certain classes of consonants.

Beyond the pervasiveness of these nasalization processes, one recurring theme is the asymmetry between the patterns we find licit in synchronic surface forms, and the patterns we find attested within the native lexicon, in particular within roots. Some patterns are completely consistent and seem to reflect active phonological processes: Glides become nasals after nasal vowels, unaspirated stops and affricates become prenasalized after nasal vowels, vowels become nasal after nasal consonants, and vowel nasality spreads progressively across glottal consonants. Other patterns are not consistent. Glides are rare but attested before nasal vowels and don't exhibit active alternations triggered by following nasal vowels. Vowel nasality usually agrees across an intervening fricative, voiceless stop, or voiceless affricate but there are some exceptions and no evidence for active alternations.

As we will show in the next section, the conflicting distributional and allophonic patterns can be readily explained diachronically by positing a reconstructed stage of the language in which underlying nasal vowels were far less frequent than they are in the modern language and several nasal spreading processes took place.

3 Reconstruction of prenasalization

The first component of our reconstruction is an account of how prenasalized stops and affricates developed in A'ingae, and how prenasalization became contrastive.

Many Amazonian languages have allophonic patterns in which nasal consonants have allophones with both oral and nasal components, predictable from the nasality of following vowels (e.g. Stanton 2018, Lapierre & Michael 2017, Wetzels & Nevins 2018). These patterns are explained as "shielding", with prenasalized stops arising from underlying or historical nasals via post-oralization: velum closure occurs before the oral closure of the consonant is released, in order to preserve the contrastive lack of nasality on the following oral vowel. This pathway is a cross-linguistically common source of prenasalized stops, and depends on having contrastive vowel nasality (Herbert 1986, Ch. 7; Stanton 2017; Wetzels & Nevins 2018). However, this pathway cannot be the source of prenasalization in A'ingae; the nasal series and prenasalized series do not exhibit any traces of a relationship. Their places of articulation are not parallel: There is no velar nasal corresponding to the prenasalized velar stop [ᵑg], nor a prenasalized palatal stop corresponding to the nasal [ɲ]. Moreover, there are also two prenasalized affricates, [ⁿd͡ʒ] and [ⁿd͡z], paralleling the voiceless and voiceless aspirated affricates; while a single prenasalized affricate could potentially be explained as the outcome of a prenasalized palatal stop, having both affricates is difficult to reconcile with an origin in nasal stops.

Prenasalized segments can also develop from voiced segments via nasal venting, to allow sustained voicing (Wetzels & Nevins, 2018). However, this account is also not well suited to explain A'ingae prenasalization, because it would not account for synchronic morphological alternations between the voiceless unaspirated series and prenasalized series, or the restrictions on the vowel nasality environment that each series occurs in.

Instead, we propose a tentative diachronic account in which plain voiceless stops and affricates became prenasalized and voiced when preceded by a nasalized vowel and followed by an oral

vowel: T > ^{n}D/$\tilde{V}$_V. This change is supported both by morphological alternations and also distributional patterns within the lexicon, as will be discussed in the following sections. This relationship between prenasalized and voiceless unaspirated stops (and affricates) is paralleled in other languages, e.g. Mbya Guarani (Thomas, 2014): Prenasalized stops and affricates occur only when preceded by an unstressed nasal vowel and followed by an oral vowel, while the voiceless stops and affricates occur between oral vowels and between nasal vowels. There are also active alternations in suffixes: the voiceless series becomes prenasalized following nasal vowels. As in A'ingae, both can also occur word initially. In Awetí and Sateré-Mawé, there is also a process by which oral stops are prenasalized after nasal vowels (Drude, 2006).

We will subsequently revise this proposal based on the reconstruction of coda nasals. Even within languages that have synchronic alternations between voiceless stops and prenasalized stops conditioned by nasality of vowels, nasality was not necessarily realized on the vowels at the time when the alternation developed. One reason for this is that prenasalized segments can also develop from reanalysis of nasal + stop sequences. Herbert (1977) lays out several processes that can produce such sequences, some of which end up behaving like contour segments rather than consonant-consonant sequences. The difference between nasal + stop sequences and prenasalized stops is primarily phonological, and often does not align with any phonetic difference (Blumstein, 1991; Maddieson & Ladefoged, 1993).

3.1 Allomorph selection

The first source of evidence for a historical relationship between voiceless stops and affricates and the corresponding prenasalized series is the synchronic relationship. Certain suffixes and clitics begin with voiceless unaspirated stops after oral vowels and prenasalized stops after nasal vowels, as illustrated in (7).[8]

[8]We note that these alternating forms are amply attested only for bilabial and alveolar stops. For alveolar affricates, palato-alveolar affricates, and velar stops we do not find such pairs. It is not clear however, if this is a principled absence since the only non-alternating forms we find here appear appear to historically be compounds (e.g. the similative suffix *-'kan* 'look like' comes from the lexical verb *kan* 'look') or otherwise exhibit greater prosodic separation (e.g. the second position clausal person clitic *=ki*).

(7) **Alternating forms (from Fischer & Hengeveld 2023)**

a. **-pa 'nominalizer'**

/ʃaka-pa/ [ʃakapa] *shakapa* 'fail-NMLZ; fault'

/hẽ-pa/ [hẽᵐba] *jemba* 'sound-NMLZ'

b. **=ta 'new topic marker'**

/ʋa=ta/ [ʋata] *vata* 'this=TOP'

/hãʔɲõ=ta/ [hãʔɲõⁿda] *ja'ñunda* 'now=TOP'

Other suffixes and clitics consistently have prenasalized stops, as illustrated in (8). They trigger nasality of the preceding vowel; vowels preceding prenasalized stops are always nasal.

(8) **Non-alternating forms (from Fischer & Hengeveld 2023)**

a. **-ᵐbi 'negation'**

/ʃaka-ᵐbi/ [ʃakãᵐbi] *shakambi* 'fail-NEG; did not fail'

/hẽ-ᵐbi/ [hẽᵐbi] *jembi* 'sound-NEG; didn't sound'

b. **=ᵑga 'dative'**

/ijo=ᵑga/ [ijõᵑga] *iyunga* 'snake=DAT'

/ãı=ᵑga/ [ãıᵑga] *ainga* 'dog=DAT'

Conversely, there are no suffixes or low level clitics that contain a non-alternating plain voiceless stop. However, there are a handful of high level clitics like that do not alternate, e.g. 2nd person marker [=ki] *=ki*. These clitics are often written by native speakers as separate words. The lack of alternation in these forms may indicate that the process occurs only within a lower level prosodic domain. Some prior work proposes a consistent level in the prosodic hierarchy (e.g. the clitic group or the prosodic word) that contains all clitics and the host that they cliticize to (e.g. Hayes, 1989; Nespor & Vogel, 1986). However, other work proposes that individual clitics can vary in what prosodic level they attach at (e.g. Peperkamp, 1999; Werle, 2009), based on asymmetries between proclitics and enclitics and variability across clitics in how they behave with regard to phonological processes. We follow the latter type of account, in order to explain the different behaviors across A'ingae clitics.

3.2 Facts about the lexicon

The distribution of the voiceless unaspirated series and prenasalized series within the lexicon also points towards a relationship, as they are in nearly complementary distribution. However, since they are contrastive word-initially, we take the relationship to be historical, rather than an active synchronic one.

As shown above in Table 5, voiceless unaspirated stops and affricates almost never occur between a nasal and oral vowel. Nasal vowels are also overall less frequent than oral vowels, consistent with our account below of their recent development from nasal codas.

Prenasalized stops and affricates overwhelmingly occur with a preceding nasal vowel and following oral vowel, e.g. [t^{h}ẽ^{m}ba] *themba* 'branch'; [t͡ʃã^{n}di] *chandi* 'became clear'; [ẽt^{h}ĩ^{ŋ}ge] *enthinge* 'middle'. Nasal spreading induced by suffixes and enclitics somewhat obscures aspects of this distribution synchronically, because suffixes beginning with prenasalized consonants make the preceding vowels nasal. However, we explain this synchronic pattern of nasal spreading as a later development, along with several other nasal spreading patterns.

There are a few word-internal exceptions to the distribution of prenasalized stops and affricates, where they are flanked by nasal vowels. Many of these cases seem to be the result of reduplication or analogical reshaping by comparison with other reduplicated forms, e.g. [tã^{n}dã] *tandan* 'tie', [kõ^{ŋ}gõ] *kungun* 'rot'. While it remains to be seen how general the observation is, one younger speaker pronounces and spells the root [tã^{n}da] *tanda* 'tie', but remains definitive that it selects for nasal allomorphs such as [tã^{n}dã-ɲẽ] *tandañe* 'to tie'. This may reflect historical nasality due to reduplication that has been lost analogically due to the prevailing pattern in the lexicon of prenasalized stops occurring before oral vowels, while the allomorphic patterns have been preserved.

Although their general distribution is predicted by the nasality of preceding vowels, prenasalized consonants also occur word-initially, where they contrast with voiceless unaspirated consonants and the other series of stops (and affricates), as shown in (9) and (10). Prenasalized

consonants are infrequent in this position (∼90 roots, vs. ∼450 roots with initial voiceless stops, though both series have similar frequency word-internally), and many cases are recent borrowings, e.g. [ᵑgasorĩnã] *gasurina* 'gasoline', [ᵐbõᵐbijo] *bombiyo* 'light bulb'.

(9) a. [mo̰e] *muen* 'sent'

b. [ᵐboi] *bui* 'row, paddle'

c. [poi] *pui* 'both'

d. [pʰoi] *phui* 'get down low'

(10) a. [mĩsĩ] *minsin* 'worm, larva'

b. [ᵐbĩʃĩ] *binshin* 'dog flea'

c. [pĩⁿdo] *pindu* 'hawk'

d. [pʰĩmĩ] *phimi* 'nick, dent'

To explain the word-initial cases, we propose a more speculative sound change that followed the conditioned prenasalization: deletion of nasal ẽ and ɨ̃ word-initially before prenasalized consonants and fully nasal consonants. This change would have eliminated the complementary distribution of voiceless and prenasalized stops, making them contrastive. Nasal ẽ and ɨ̃ are extremely infrequent word-initially in the modern language, relative to their oral counterparts and to other nasal vowels, as seen in (8), and never occur word-initially before prenasalized consonants or nasal consonants. Given the reconstruction of nasal vowels as developing from oral vowels followed by coda nasals (Section 4) and the evidence for nasal vowel harmony, the relative frequency among the nasal vowels should parallel the relative frequency among the oral vowels, but ẽ and ɨ̃ occur with lower frequency than would be expected. Their low frequency suggests that there was some process which either deleted or altered these vowels.

Although these two vowels differ in how they are phonologically categorized, they are phonetically similar (see Repetti-Ludlow et al., 2020, p. 438). Other Amazonian languages also exhibit historical relationships between /e/ and /ɨ/, e.g. e > ɨ/___# in Sorowahá (Dixon,

2004). The moderate F1 and F2 for both of these vowels are relatively close to the first and second nasal formants, which makes them less perceptually distinct from following nasal consonants than other vowels are, which could explain why these particular nasal vowels were deleted in this environment. The way that nasality interacts with other vowel characteristics can result in phonologically non-unified patterns of how vowels are impacted by nasality, e.g. Kiowa lowering/laxing of high vowels and raising/laxing of low vowels when followed by a nasal consonant, but no effect in mid vowels (Mielke, 2008, p. 144-145).

Suffix-initial prenasalized consonants might have a different origin. In Section 4, we propose that A'ingae used to have coda nasals, which were reanalyzed as components of other segments in several ways. Nasal consonants might also have been allowed in CC sequences at the beginning of suffixes, which probably would have been resyllabified as the coda of the preceding syllable, e.g. ʃaka+mbi [ʃakam.bi] fail-NEG 'did not fail'. As with word internal NT sequences, this would have resulted in a prenasalized consonant.

Table 8: Comparison of word-initial frequency of oral and nasal vowels

Vowel	#V	#Ṽ
i	19	16
e	17	2
a	58	50
o	32	19
ɨ	11	2
ai	9	1
oe	0	0
oa	0	1
oi	0	0
ɨi	0	0
ao	0	0

3.3 Laryngeal co-occurrence constraints

Modern A'ingae has a constraint against aspirated and voiceless unaspirated stops or affricates of the same place of articulation within a root (Repetti-Ludlow et al., 2020): Forms like [teti] and [t^{h}et^{h}i] are possible, while forms like *[t^{h}eti] or *[tet^{h}i] are not.

Prenasalized stops and affricates pattern with the voiceless unaspirated series for this constraint, pointing towards a history in which they came from the same series. They can co-occur with voiceless unaspirated stops of the same place of articulation, e.g. [kõ^{ŋ}gi] *kungi* 'ant'; [kõ^{ŋ}gɨ] *kungû* 'sweet potato'. There are also words with this co-occurrence which seem to be the result of reduplication, further supporting the phonological development of prenasalized consonants from the voiceless unaspirated series: [tã^{n}dã] *tandan* 'tie'; [kõ^{ŋ}gõ] *kungun* 'rot'. However, reduplication is not fully productive synchroncially, and the historical meaning indicated by reduplication is often not transparent, as in these examples here, so it is not possible to definitively confirm the historical source of these words.

In contrast, prenasalized stops do not co-occur with aspirated stops within roots. They do appear together in morphologically complex forms, across morpheme boundaries, as is also found for the aspirated and voiceless unaspirated series. There are a small number of cases in which the morphological structure is not entirely clear and/or which may be ideophones (e.g. [t^{h}ɪ̃ʔ^{n}dɪ̃^{n}dɨ] *thû'ndûndû* 'tremble, shudder').

3.4 Adaptation in loanwords

Loanwords confirm that the synchronic phonotactic patterns probably reflect active constraints, or else produce strong analogical pressure on new words. However, they do not necessarily demonstrate the history that produced the modern patterns; they might have been borrowed after the relevant sound changes had occurred.

Post-nasal unaspirated stops are sometimes borrowed as prenasalized stops, e.g. Spanish *contar* 'tell' → [kõ^{n}da] *kunda*; and *compa(dre)* 'friend, companion' → [kõ^{m}ba] *kumba*. Historically voiceless stops following nasals in Quechuan loanwords overwhelmingly result in prenasalized voiced stops. In contrast, such sequences in Spanish loanwords are sometimes borrowed with prenasalized voiced stops and are sometimes borrowed with voiceless stops, usually preceded by a nasal vowel. This difference between Quechuan and Spanish loanwords suggests that the Quechuan loanwords in A'ingae originate from the Ecuadorian and Colom-

bian varieties of Kichwa which have post-nasal voicing of stops (Muysken, 2019), rather than this being a characteristic of adaptation in A'ingae borrowing itself (AnderBois et al., 2019).

Where a voiceless unaspirated stop in a loanword remains voiceless after a nasal, it is usually also followed by a vowel that was nasalized by a following nasal consonant, e.g. Spanish *compañero* 'companion' → [kõpãɲẽro] *kumpañeru*; and *campana* 'bell' → [kãpãnã] *kampana*. Sometimes nasality from a coda also produces a nasal vowel earlier in the word, as described above (e.g. *cotón* 'cotton shirt' → [kõtõ] *kuntun*).

Word-initial nasals are sometimes borrowed as prenasalized stops, particularly when the following vowel is oral, e.g. Spanish *morcilla* 'sausage' → [^{m}bosija] *busiya*. This adaptation is consistent with A'ingae speakers' expectations that nasal consonants will not be followed by oral vowels (as described in Section 2.2.2, nasal consonants are always followed by nasal vowels), while prenasalized stops almost always will be (as described in Section 3.2). This may reflect a shielding process in the adaptation of loanwords, i.e. preserving the orality of the following vowel by post-oralizing a preceding nasal consonant.

Word-initial voiced stops are sometimes borrowed as glides rather than prenasalized stops, particularly when the following vowel is partially nasal due to a following nasal consonant, e.g. Spanish *banano* 'banana tree' → [ʋãnãnõ] *vananu*. Voiced stops between oral vowels are usually borrowed as glides, but most borrowings with apparent voiced stops are from Spanish, in which underlying voiced stops are lenited intervocalically, so the manner of articulation in A'ingae may reflect a characteristic of Spanish lenition, rather than adaptation, e.g. Spanish [koβiha] *cobija* 'blanket' → A'ingae [koʋiha] *kuvija*.

4 Reconstruction of coda nasals

The account of A'ingae prenasalization developing from nasality on a preceding vowel has some weaknesses that can be improved by instead reconstructing prenasalization as developing from nasal consonants. We reconstruct nasal vowels as coming from vowels followed by coda nasals, i.e. VN > $\tilde{\text{V}}$. For example, minsin > mĩsĩ 'worm, larva'. We reconstruct prenasal-

ized consonants as coming from reanalysis of nasal consonant + unaspirated stop/affricate sequences as prenasalized segments, i.e. T > ND/$\tilde{\text{V}}$_V. For example, pindo > pĩ$^{\text{n}}$do 'hawk'.

The development of prenasalized consonants was perhaps also influenced by post-nasal voicing in Ecuadorian Kichwa, which has had extensive contact with A'ingae (although this development in nearby Quechuan languages itself may be due to a mix of language-internal and contact-related factors). The lack of other codas within Pre-A'ingae might have contributed to the reanalysis of coda nasals as nasality on neighboring segments.

The first issue with the vowel nasality account is that it is not clear why the conditioning environment for prenasalization would require the following vowel to be oral. The orality of a following vowel is not threatened by the spread of nasality from a preceding nasal vowel onto the beginning of an intervening oral consonant. It is possible that nasality within the consonant is more likely to be attributed to coarticulatory spreading when the consonant has a nasal vowel both preceding and following, but there is no clear diachronic parallel to establish this perceptual effect.

The second issue with the vowel nasality account is that the conditioning environment does not seem to be absolute. While the vowel preceding prenasalized segments in modern A'ingae is always nasal, there are several exceptions for orality of the vowel following prenasalized stops, even in words that seem to be inherited. Most examples seem to be the result of reduplication or analogical reshaping by comparison with other reduplicated forms, e.g. [tã$^{\text{n}}$dã] *tandan* 'tie'; [kõ$^{\text{ŋ}}$gõ] *kungun* 'rot', as discussed above. However, the generalization has some exceptions, in stark contrast to the one concerning the preceding vowel.

Reconstructing coda nasals, which were reanalyzed as consonant prenasalization when followed by unaspirated stops and affricates and later developed into vowel nasality in other environments, resolves these issues. VN > $\tilde{\text{V}}$ is an extremely common pathway for the development of phonologically contrastive nasal vowels (e.g. in several Romance languages,

Sampson 1999; in word-final position in Shawi, Rojas-Berscia et al. 2020)[9], so this source of A'ingae nasal vowels is very likely and the larger question is the timing of when nasal vowels developed. Development of nasal vowels is also consistent with the language-contact history of A'ingae. Movement from the Andes to Amazonia, where contrastive vowel nasality is common (van Gijn, 2014; Aikhenvald, 2012), is supported by several lines of evidence (AnderBois et al., 2019).

The tendency for vowels after prenasalized consonants to be oral would reflect low frequency of coda nasals, perhaps exaggerated by restrictions on which syllables could have codas (e.g. only in morpheme-initial vowels or only in stressed vowels). Subsequent nasal spreading processes would have created additional nasal vowels and obscured some aspects of the distribution of vowel nasality. Many of the nasal vowels in modern A'ingae are predictable from the environment: neighboring nasal consonants, or nasal vowels in neighboring syllables.

5 Glides and nasals

The alternations between glides and nasals discussed above suggest a possible historical relationship between them, which is facilitated by the reconstructed coda nasals. Both the bilabial and the palatal nasal exhibit this alternation with glides. Additional evidence supports /ɲ/ having developed from /j/, though it is not clear that a similar history can be reconstructed for /m/, at least not in all cases. The other nasal consonant in the inventory of A'ingae is /n/. As discussed in Section 2.2.1, there is no evidence for /n/ having any alternation with /ɾ/ synchronically, and there is also no reason to reconstruct a historical relationship. This section will present the evidence for sound changes producing /ɲ/ and /m/; there is no evidence to suggest sound changes producing /n/.

[9]Sometimes the origin of nasality on vowels is not entirely clear, but is proposed based on indirect evidence. For example, some scholars reconstruct Proto-Tupi-Guaraní as already having phonologically nasal vowels, but others further reconstruct the nasality of these vowels as originating in coda nasals (e.g. Kaiser 2008).

5.1 Palatal nasal

The distribution of where the palatal nasal /ɲ/ occurs suggests its recent development as a conditioned variant of another sound. It is infrequent relative to other consonants, and is word-initial only in ∼10 roots. There are few suffixes beginning in /ɲ/, though there are many that alternate between [ɲ] and [j]. There are only two known suffixes beginning with a non-alternating /ɲ/. The first is one of the allomorphs of the causative suffix, [-ɲã]. In modern A'ingae, this allomorph only occurs with monosyllabic roots, e.g. [ⁿdo] *du* 'break, split (inch.)' vs. [ⁿdõɲã] *duña* 'cause to break, split'. With longer roots, two different causative suffixes are attested, conditioned by the root-final vowel and independent constraints on licit diphthongs. The allomorph [-ẽ] occurs following root-final /a/ and /o/ and their nasal counterparts (creating diphthongs [-ãı] *-aen* and [-õe] *-uen*), while the allomorph [-ã] occurs following root final /ɨ/, /e/, and /i/ producing a surface diphthong [-ıã] *-ian*.[10]

While the precise historical relationship between these allomorphs is unclear, we speculate that the [-ɲa] allomorph may be related to these other allomorphs historically, with an extra syllable in the [-ɲa] form that was retained based on minimal prosodic word preferences (possibly grammaticalized from a [-ja] suffix such as the veridical [-ja]).

The only other suffix with a non-alternating [ɲ] is the potentially related iterative/semelfactive [-ɲãkʰa] *-ñakha*, though the precise semantic connection with the verbal diminutive *-kha* is not apparent.

There are several observations that support a historical relationship between [ɲ] and [j]. First is the synchronic alternation between [ɲ] and [j] in several suffixes, conditioned by nasality of the preceding vowel. Second is their complementary distribution. The oral glides do not occur immediately preceding or following underlying nasal vowels within native roots, and the nasal consonants never occur next to oral vowels. There is synchronic spreading of

[10]Most roots ending in a diphthong are monosyllabic and hence take the [ɲa] allomorph if they allow the causative suffix. Of the few known cases of multisyllabic roots ending in diphthongs, the one case we are aware of which also accepts the causative suffix is [opɨi] *upûi* 'be covered with a blanket' which has the causative form [opıã] *upian* 'cover with a blanket', with the [-ã] allomorph.

nasality from nasal consonants to neighboring vowels, but the distribution is likely also the result of historical processes affecting consonant nasality. In addition, both [ɲ] and [j] have some shared phonotactic patterns, as will be described below.

Setting aside morphologically complex words, we find that [ɲ] and [j] show two parallel restrictions that support the existence of at least a diachronic relationship between the two. First, neither segment occurs within roots preceding a diphthong. There are a handful of morphologically complex forms exhibiting such sequences such as [fijõe] *fiyuen* 'to retract fingernails, legs, etc.', formed from a root [fijo] *fiyu* 'retract, curl up' plus the causative suffix *-en*, suggesting this is no longer an active phonological rule synchronically. Second, neither [ɲ] or [j] occur before the high central vowel [ɨ], and both rarely occur before front vowels. If historical **j* rarely occurred in these environments, this restricted distribution would be inherited by the [ɲ] outcomes.

While there is a temptation to treat [ɲ] and [j] as allophones of a single phoneme synchronically, patterns of nasal spreading in morphologically complex forms as discussed in §2.2.2-2.2.3 suggest that they are synchronically separate phonemes which merge in certain environments. Much of their largely complementary distribution can be explained with a diachronic relationship, even though they are contrastive phonemes in the modern language.

Returning now to the idea above that nasality arose historically from coda nasals, we propose that at a time when coda nasals were present, nj > ɲ. This change explains the distributional patterns of [ɲ], as well as the synchronic relationship between [ɲ] and [j]. First, it explains the low frequency of [ɲ], because there is only one main (bigram) source of it, along with the secondary allophonic [ɲ] produced synchronically from /j/ after nasal vowels. The causative suffix [-ɲa] would have been **nja*. The reason why this is the causative suffix that occurs with monosyllabic roots (rather than the other causative markers, [-ã] *-an* or [-ẽ] *-en*), might be that monosyllabic stems were disfavored due to a minimal weight constraint, though there isn't evidence for absolute restrictions on the weight of words. The /n/ in **nja* would have

provide a coda, making the preceding syllable heavy.

Suffixes beginning with /j/ would have had varied realizations depending on if the preceding word ended in a coda nasal or not. This process is still reflected in alternating suffixes (see Table 3), though the form of nasality on the conditioning morpheme has changed. For example, a form like the infinitive 'to look' would historically have been kan-je > kãɲe. In the modern language, the nasality of the suffix is conditioned by the nasality of the preceding vowel rather than a nasal consonant: /kã-je/ > [kãɲẽ].

Second, a change of nj > ɲ explains the lack of [j] after nasal vowels. However, some cases of [j] with a following nasal vowel would be expected to result from *jVn syllables, unless there was a subsequent j > ɲ/___$\tilde{\text{V}}$ change. There is relatively little evidence for the outcome of *jVn sequences; they might be a source of the few cases of word-initial [ɲ]. These instances of [ɲ] may also have arisen later from /j$\tilde{\text{V}}$/, as all are followed by a nasal or prenasalized consonant, or a nasal vowel in the next syllable. Instances of word-initial [ɲ] might also be the result of the deletion of nasal [ɪ̃] and [ẽ] word-initially before nasal consonants. Our proposed sound change also explains the parallel distributions of [ɲ] and [j]; any limitations on what vowel qualities *j could occur next to would also be reflected in the newly formed [ɲ].

A change of nj > ɲ is paralleled in reconstruction of several languages. There are synchronic examples of spreading nasality making glides into nasal stops (e.g. Kisi, Childs 1992-1994) or nasalized approximants (e.g. Tuparí, Singerman 2016).

5.2 Bilabial nasal

Although the conditioned alternation of [m]∼[ʋ] parallels [ɲ]∼[j], the bilabial nasal /m/ does not have a restricted distribution to point towards a development in which it arose only from a historical coda *n. It is moderately frequent both word-internally and word-initially, and begins several suffixes. There are also no environmental restrictions shared by [m] and [ʋ] that would be captured by a historical change of nʋ > m.

The synchronic alternations between [m] and [ʋ] suggest that the coalescence of n + glide was reflected in /ʋ/ like it was in /j/. However, other behavior of the modern /m/ makes it necessary to reconstruct *m as already existing within the phonological inventory before this sound change created additional instances of it.

6 Other sound changes

We also propose several more speculative sound changes, which are supported by fewer lines of evidence but are nonetheless worth considering as part of a thorough discussion of the internal reconstruction of A'ingae phonology.

6.1 Palatalization of alveolars

The postalveolar affricate [$^{n}\widehat{dʒ}$] is extremely low frequency. It occurs in approximately 16 roots as well as a number morphologically complex forms derived from these (some of which make use of no longer productive morphology). Parallel to the palatal nasal, the voiced post-alveolar affricate can probably be reconstructed as the outcome of ^{n}d + j, e.g. ^{n}djo > $^{n}\widehat{dʒ}$o *dyu* 'be afraid'. Such palatalization is extremely well attested, both synchronically and in reconstructed sound changes (Hall & Hamann, 2006; Bateman, 2007).

Although modern A'ingae does not have sequences which are consistently produced as consonant clusters, there are sequences which are variably realized as ijV and jV, e.g. [^{m}bijaʔa] and [^{m}bjaʔa] for *bia'a* 'long'. It is tempting to treat these as underlyingly disyllabic in the modern language, because A'ingae otherwise lacks consonant clusters, but the evidence is not conclusive (Repetti-Ludlow et al., 2020, p. 440). In the earlier stage of the language, they might have been monosyllabic, disyllabic, or already variable. This sort of variable syllabicity of glides and preceding unstressed homorganic vowels is paralleled in other languages, e.g. it is proposed to have occurred in Vedic (Lindeman, 1965).

These A'ingae sequences with the palatal glide almost never occur after [^{n}d], similar to the absence of n + j sequences. Most instances of ^{n}d + (i)j are clearly the result of roots ending in /i/ followed by the causative [-ãj] *-an*. If we assume that these sequences were historically

$*^{n}djV$, we can account for the distribution with a well paralleled palatalization process, ^{n}dj $> \widehat{\text{dʒ}}$. Only three potential counterexamples exist of roots with ^{n}d + ijV sequences: [$\widehat{\text{tsi}}^{n}$dija] *tsindia* 'tree species', [^{n}dijo]/[^{n}djo] *diu* 'white-collared jay', and [^{n}dijo] *diyu* 'type of cicada'. The latter two are likely instances of onomatopoeia, based on native speakers' intuitions; this is the case for many bird names in A'ingae. Consistent with being onomatopoeia, rather than the regular outcome of sound changes, *diu* 'white-collared jay' is phonologically exceptional in that it either has word-final stress, which is otherwise unattested in disyllabic native words, or else contains a consonant cluster.

It is also reasonably likely that the voiceless post-alveolar affricates [$\widehat{\text{tʃ}}$] and [$\widehat{\text{tʃ}}^{\text{h}}$] were similarly produced by historical palatalization of $*t$ and $*t^{h}$, respectively. Excluding cases of clear borrowings and occurrence across morpheme boundaries, there are 3 cases of [t] and 2 cases of [t^{h}] followed by (i)jV sequences. Moreover, 3 of these 5 are names of birds species, a semantic domain with frequent borrowings and words of ideophonic origin, leaving only [ãt(i)jã] *antian* 'relative' and [t^{h}(i)jo$\widehat{\text{ts}}^{\text{h}}$e] *thiutshe* 'almost' (*-tshe* is an adverbializing suffix). The former is also phonologically atypical in containing a glide before a nasal vowel, which is usually only observed in loanwords and across morpheme boundaries (see Section 2.2.1).

However, the voiceless post-alveolar affricate [$\widehat{\text{tʃ}}$] is far more frequent than [$^{n}\widehat{\text{dʒ}}$] or [ɲ], and also notably more frequent than [$\widehat{\text{tʃ}}^{\text{h}}$], so palatalization is unlikely to be its only source. The additional source probably was a segment without parallel aspirated or prenasalized segments, which points towards the fricatives, most likely the post-alveolar /ʃ/. Crucially, this change must have occurred after the development of prenasalized affricates, because otherwise it would predict additional instances of [$^{n}\widehat{\text{dʒ}}$].

The exact environment in which fricatives would have become affricates is unclear. The environment might have been obscured by other sound changes. In particular, sibilant co-occurrence constraints point towards a historical sibilant harmony process; among fricatives and affricates within a root, alveolars and post-alveolars never occur in neighboring syllables,

e.g. there are forms like [ʃõt͡ʃã] *shunchan* 'sniff', [t͡sosĩnã] *tsusina* 'ear', but there are no words like *[ʃõt͡sã] or *[t͡soʃĩnã]. However, sibilants differing in place of articulation do appear across morpheme boundaries, e.g. [ⁿdɨsɨʔt͡ʃo] *dûsû-'chu* conceive-SH:RND 'egg'. There isn't a parallel co-occurrence restriction for place of articulation of stops, e.g. there are roots like [t͡ʃatʰɨ] *chathû* 'cut (once)'.

Loanwords provide a potential source of evidence that [t͡ʃ] is a somewhat recent development. In several loanwords, [t͡ʃ] in the donor languages is borrowed as [t͡s] or [ʃ], e.g. the root in [t͡sai-ki] *tsaiki* (← Kichwa [t͡ʃai-ɲan] 'rural road'[11]) and [ʋat͡sʰara-ʔkʰo] *vatshara'khu* (← Spanish *guacharaca* 'chachalaca'). This adaptation would be consistent with [t͡ʃ] not existing in A'ingae at the time of borrowing; if [t͡ʃ] did exist, the motivation for the adaptation would be unclear.[12]

The post-alveolar affricates almost never occur before the vowel /e/, except across morpheme boundaries. There is only one exception of which we are aware: [mẽt͡ʃẽʔɲõ] *meche'ñu* 'cuckoo bird species'. The lack of such sequences could indicate that the palatal glide **j* did not occur before **e* at the time of palatalization. This sequence remains infrequent in the modern language; most instances are the infinitive marker [-je] *-ye*, or one of several other suffixes. [ji] sequences are similarly infrequent. However, post-alveolar affricates do occur before [i]. It is possible that both [j] and [i] conditioned palatalization, as alveolar stops are followed by [i] less frequently than would be predicted by the individual frequency of each; however, there remain more instances than can clearly be explained as borrowings.

[11]The roots to be compared are [t͡sai] in A'ingae and [t͡ʃai] in Kichwa. The ending *-ki* is independently attested in A'ingae forms such as *tueki* 'same path' from the root *tue* 'same' and Robert Halm (p.c.) suggests that [ɲan] similarly has Quechuan cognates meaning 'path'.

[12]One further aspect of this picture to note is that while some local Quechuan varieties have a phonemic alveolar affricate [t͡s], the Proto-Quechuan and most other modern varieties do not (Kohlberger, 2010). There is some evidence for alternations between [t͡s] and [t͡ʃ] within and across varieties, although the precise relationship between the two diachronically and synchronically remains unclear. It is also possible that some of the variation is due to languages differing in how each affricate was realized and thus which category best aligned with affricates in loanwords.

6.2 Velar approximant

The velar approximant [ɯɻ] only occurs word-medially, and is very rare. It is attested in only 27 roots, and in no suffixes or clitics. Some such roots are very likely loanwords, including [koɾaɯɻa] *kuraga* 'shaman' from Quechuan [kuɾaka] 'chief'. Some other items have plausible though less definitive etymologies as loanwords. Yet others have no suggestive loanword origin, though this of course does not demonstrate that they are inherited, given that A'ingae has no known relatives.

The velar approximant has a notably consistent distribution. The vast majority of instances (22/27) are before [a], and the rest occur before [ɨ]. The preceding vowel also exhibits strong tendencies: it is most often [a] (13/27), but more evenly split among the other vowels. The restriction of [ɯɻ] only occurring between vowels and the association with [a] is paralleled in other languages, even in those like A'ingae where it is a contrastive phoneme, e.g. in Arrernte (Graetzer, 2012, p. 8). Several processes could have contributed to this limited environment in A'ingae.

The Borman (1976) dictionary, based on data from the mid-20th century, suggests 5 additional words that may have (or may have had) [ɯɻ] alongside a variant with [ʊ]. In some cases such as orthographic *shago* (which would be *shagu* in the modern orthography), which our consultants uniformly pronounce [ʃaʊo] *shavu* 'canoe', these are specifically listed as coming from speakers along the San Miguel river (Colombia), as opposed to the Aguarico river (Ecuador), where our data here are from. In other cases, however, these variants are listed as free variants within the Aguarico variety (the Bormans also worked primarily with speakers along the Aguarico in Ecuador).

While it is unclear how much of these differences reflect synchronic dialectal variation or language change, working with Ecuadorian speakers, we have only found these words produced with [ʊ]; [ɯɻ] pronunciations are rejected. Notably, in all of these words, the approximant is followed by [o], the only round vowel, suggesting a recent change of ɯɻ > ʊ/__o, e.g. ʃaɯɻo

> ʃaʊo ‘canoe’. A similar labiality alternation is paralleled in other languages. In Ewe, the velar approximant /ɯɻ/ is realized as a labiovelar [w] before round vowels (Duthie, 1986, p. 354). In Iwaidja, the velar approximant /ɯɻ/ is realized as a labiovelar [w] before /u/ (Evans, 2009, p. 162-3).

There is some evidence that the velar approximant became palatal in certain environments, probably when followed by a front vowel. [ɯɻ] almost never occurs before front vowels. The only possible exception is [feɯɻet^{h}o] *fegethu* ‘widen a hole by scraping’, but the [e] in this word seems to be derived from /ɨi/, based on the existence of semantically related compounds with this root such as [feɯɻɨ]: [feɯɻɨ̃^{n}d͡ʒai] *fegûndyai* ‘adjust one’s seat’ (cf. [^{n}d͡ʒai] *dyai* ‘sit’). The restriction on the frontness of the preceding vowel is less clearly absolute, though many of the possible exceptions have plausible origins as loanwords. While relatively few languages have /ɯɻ/ at all, palatalization of other velars before front vowels is cross-linguistically extremely common. A similar ɯɻ > j/i_i change is seen in Iwaidja (Evans, 2009, p. 162-3). Aguaruna, another Amazonian language, provides a particularly close parallel for the distribution of [ɯɻ], with morphological alternations that provide evidence for what has produced the distribution (Overall, 2007, p. 45-46). This phoneme in Aguaruna only appears between vowels, and only in 3 vowel environments: /ɨ_u/, /ɨ_a/, and /a_a/. Based on morphological alternations, it is shown to be deleted /ɨ_ɨ/ and /u_u/, and palatalized to [j] before /i/.

There are no instances of the velar approximant after a nasal vowel. Some A’ingae verbs seem to be fossilized passives, but instead of the expected palatal glide [j] or palatal nasal stop [ɲ], there is a prenasalized velar stop, e.g. [ãsãʔ^{ŋ}ge] *ansa’nge* ‘be ashamed’, [^{n}dãɲõ^{ŋ}ge] *dañunge* ‘be damaged’ (from Spanish *daño ‘damage’*). One possible interpretation of these forms is that the passive suffix [-je] *-ye* historically began with the velar approximant, but that it became palatal due to the following vowel. This explanation would also require an earlier change in which the velar approximant [ɯɻ] became a prenasalized stop when it was preceded by a nasal vowel, or when preceded by a coda nasal, depending on the timing of

this change and the change of coda nasals to nasality on vowels, as proposed above.[13] The modern alternation between [je] and [ɲe], depending on the nasality of the preceding vowel, would be a later development, after the consonant was palatal.

6.3 Development of diphthongs

Diphthongs are uncommon in the modern language. Vowel-vowel sequences starting with /i/ are variably realized as disyllabic, though they also have monosyllabic realizations. There are also six vowel sequences which phonetically seem to be consistently realized as monosyllabic, rather than disyllabic: ɨi, ao, ai, oa, oi, oe. In addition to the phonetic evidence that they are monosyllabic, this phonological status is reflected in the fact that roots containing one of these sequences and no other vowels take the [ɲã] allomorph of the causative suffix, which only appears on monosyllabic roots. For example, [$^{n}\widehat{dʒ}$ai] *dyai* 'sit' has the causative form [$^{n}\widehat{dʒ}$ãɪ-ɲã] *dyaiña* 'place a pole vertically in the ground' rather than one of the allomorphs which occur with multisyllabic roots. We analyze the diphthongs as being a relatively recent development.

Diphthongs are particularly uncommon word-initially, as was seen in Table 8. As we will discuss, most surface diphthongs in the modern language arise when a vowel-initial suffix is attached to a vowel-final stem. As there are no prefixes in the language, it follows that no morpheme combinations would produce word-initial diphthongs, so this distribution provides additional evidence for our proposal.

These diphthongs do not occur within any clitics or affixes. Possible exceptions include the negative habitual participializer [-mãsia] *-masia* and the similative marker [-k^{h}ia] *-khia*, but like other /ia/ sequences, this can be realized as two syllables. The manner/path marker

[13]Beyond the velar approximant's present-day restriction to occurring following oral vowels, one other minor piece of support for this idea comes from the forms [aiʔʊo] *ai'vu* 'body' and [sĩᵑgo] *singu* 'black person'. For the former, Borman (1976) also lists a free variant *ai'go* (*ai'gu* in the modern orthography). Although the semantic contribution of [-ʊo]/[-ɯo]/[-ᵑgo] is not clear, these roots appear morphologically complex historically, related to the roots [aiʔ] *a'i* 'person' and [sĩ] *sin* 'black' respectively. Other semantically more opaque forms with the same apparent morpheme attached to an independently observable roots include: [k^{h}ɨiʊo] *khûivu* 'catfish' (cf. *khûi* 'lie, rest'), [$\widehat{ts}^{h}$at$\widehat{s}^{h}$aʔʊu] *tshatsha'vu* 'grater' (cf. *tshatsha* 'grate'), [putãɪᵑgo] *putae'ngu* 'rifle' (cf. *pu'taen* 'shoot'), and [t^{h}ẽnãʔᵑgo] *thena'ngu* 'leg' (cf. *thenashu* 'limb muscle pain').

-*ngae*, despite the spelling, is typically realized with a monophthong; this spelling is always realized as a monophthong word-finally, though elsewhere it is realized as [ai]. There is some evidence that /ae/ recently existed as a contrastive diphthong, not just based on spelling, but based on the realization of diphthongs when they are divided by a glottal stop. For example, [nãʔẽ] *na'e(n)* 'river' is consistent in the quality of each vowel, even though the realization changes when the vowels come together in derived forms such as [nãɪʔsɨ] *nae'sû* 'from the river', [nãɪʔki] *nai'ki* 'stream'.

The majority of vowel-vowel sequences, even those that are realized as a single syllable, are the result of a sequence of two vowels from separate morphemes, particularly roots followed by the causative [-ẽ] -*en*, the adverbializer [-e] -*e*, and the adjectivizer [-a] -*a*.

There are also several loanwords which retain diphthongs (e.g. [eskoeɾa] *eskuera* 'school' from Spanish *escuela*), though others exhibit adaptations to eliminate diphthongs. *cacao*, a Wanderwort of likely early date, is borrowed as /kakaʊo/ *kakavu*, with the diphthong broken up by a glide. Spanish *pañuelo* 'handkerchief' is borrowed as [pãɲẽɾo] *pañeru*, with the first half of the diphthong simply eliminated.

Vowel-vowel sequences produced morphologically within inherited words also exhibit some processes that eliminate diphthongs, though most of these processes do not seem to be productive. Some forms exhibit coalescence of two vowels into one, e.g. /feɯɨ-it^{h}o/ > [feɯet^{h}o] *fegethu* 'widen a hole by scraping'. Many instances of [ɨi] have variants with just [i], suggesting a deletion process, e.g. [tɨɾɨ̃ĩ] *tûrûin* 'yellow and black bird' also as [tɨɾĩ] *tûrin*. Some words may be variable: Borman (1976) lists *vatoa* (*vatua* in the modern orthography) alongside the form we have observed, [ʊatoʊa] *vatuva* 'caiman'. All of these changes are consistent with historical processes of monophthongization which have recently stopped being productive.

There are also additional processes which change diphthongs but do not eliminate them. There is a process ai > oi/[+labial]_, e.g. Spanish *bailar* → [^{m}boira] *buira* 'dance'. When

morphology would produce /ɨV/ or /eV/ sequences, unless the second vowel is /i/, the first vowel becomes [i], e.g. /t͡ʃo^{n}de-ã/ > [t͡ʃõ^{n}dɨã] *chundian* 'cause to loosen'.

The diphthongs are very infrequent, when excluding borrowings and forms where they are created across morpheme boundaries. [ao] appears in 9 items, which almost exclusively denote tropical plants and birds, and are therefore likely candidates for borrowings. [oa] appears in 5 items, 3 of which are ideophones. [oe] appears in 6 items. [ai] appears in 18 items, 9 of which are word-final in verbs, with a monophthongal counterpart in related words that suggests an /-i/ morpheme, which will be discussed in the following paragraphs. [oi] appears in 13 items, 8 of which are tropical birds and similar words; some are likely the result of ai > oi/[+labial]__. [ɨi] appears in 18 items; several are likely derivatives of the same root, several have variants with [i] rather than a diphthong, and 8 of them are word-final in verbs, often with a monophthongal [ɨ] counterpart in related words.

While many cases of diphthongs have transparent morphological components, there is also evidence for an /-i/ morpheme which existed historically, though it does not exist as a productive morpheme in modern A'ingae. The diphthongs [ai], [oi], and [ɨi] primarily appear in root-final position of verbs, many of which have related forms lacking [-i] in the final syllable (e.g. [ot͡ʃ^{h}ai] *uchhai* 'to hit' vs. [ot͡ʃ^{h}aʔt͡ʃ^{h}a] *uchha'chha* 'to hit repeatedly'), which is consistent with a historical /-i/ morpheme. Some borrowed words also seem to contain this morpheme, e.g. [kat͡ʃai] *kachai* 'run into, grab' from Spanish *cachar* 'catch, grab'.

There are two main possible sources for such roots and the speculative /-i/ morpheme. First, A'ingae has some serial verb-like verb-verb sequences, some of which have become lexicalized as single units, e.g. [piji-kã] *piyikan* 'turn to see' from [piji] *piyi* 'turn around' and [kã] *kan* 'see'. Some of the diphthongs could involve the root [i] *i* 'bring' (e.g. /ot͡ʃ^{h}a-i/ 'bring to hit'), albeit with semantic bleaching. A parallel historical development likely also explains the diachrony of the precumulative suffix [-hi] *-ji* from the lexical verb [hi] *ji* 'come' (e.g. [d͡ʒohi] *dyuji* 'get scared, come to be scared', [kõehĩ] *kuenjin* 'grow, come to

be grown'). Second, [-i] could be a detransitivizing suffix parallel to the one described in Secoya: Secoya has pairs of verbs like *sa* 'carry' and *sai* 'go', in which the [-i] suffix makes the verb intransitive or middle (Johnson & Levinsohn, 1990, §3.3). A'ingae and Secoya have several similarities and loanwords that suggest prolonged contact, which further supports this analysis. If the frequency of diphthongs in the root-final syllable of verbs is due to the frequency of stress in this position, rather than a morphological process, it would remain unexplained why it is specifically the [-i] diphthongs that exhibit a relationship with word-final position. Additionally, although diphthongs tend to occur in stressed syllables, the restriction is not absolute, as we can find morphologically complex surface forms like [fɨiˈtehi] *fûiteji* 'start to help' with stress on the penult and [ˈfɨ̃ⁿdɨi] *fundûi* 'sweep/swept' with initial stress (see Dąbkowski, 2019 for a more detailed discussion of the complex synchronic interactions between diphthongs and stress).

There are no clear cases of diphthongs in reduplicated formations. Of 6 possible cases, 5 are ideophones, with the only apparent exception being [kõɪkõɪɲõ] *kuinkuiñu* 'seed for necklaces'. The lack of reduplicated diphthongs is consistent with recent development of diphthongs: Reduplication is no longer a fully productive process, and no roots historically had diphthongs to reduplicate. The absence of reduplicated diphthongs cannot be explained as the result of word-length or stress restrictions; diphthongs can occur in long words, and as noted above, they are not entirely restricted to stressed syllables.

One final source of support for regarding diphthongs as a relatively recent development comes from (presumably grammaticalized) functional morphemes which show a monophthong rather than an otherwise expected diphthong. For example, the combination of [-ᵐbi] *-mbi* NEG plus the adverbializer [-e] *-e* ADV yields [-ᵐbe] *-mbe* rather than *[-ᵐbie] (Fischer & Hengeveld, 2023) and similarly [-t͡sʰi] *-tshi* ATTR plus [-e] *-e* ADV yields [-t͡sʰe] *-tshe*, not *-t͡sʰie. For comparison, productive lexical uses of the same adverbial morpheme produces diphthongs freely (aside from the aforementioned constraints on licit diphthongs) such as [ɾeɾikʰoe] *rerikhue* 'a little bit' (from *re'ri* 'little' plus the augmentative/shape classifier suffix

[k^{h}o] -*khu* plus [-e] -*e* ADV).

6.4 Glottal stop

Although the history of the A'ingae glottal stop is unclear, some of the characteristics of the glottal stop are worth mentioning in the interest of completeness. Some of these characteristics may be explained by recent sound changes involving the glottal stop, but it is not clear what to reconstruct. Glottal stops may have been inserted or deleted in certain environments, and might be shifting away from being consonantal. One potential origin for the glottal stop is from oral coda consonants; it is cross-linguistically not uncommon for coda consonants to be debuccalized, which can produce glottal stops with a limited distribution like this (e.g. Shawi, Rojas-Berscia et al., 2020). However, this possibility is highly speculative, as there is no evidence for glottal stops alternating with oral consonants. If there was a stage of the language in which there were two permissible codas, /n/ and /ʔ/, it might be expected that the glottal stop and nasal vowels would rarely appear in the same syllable, but there is no evidence for restricted co-occurrence in the modern language. If there ever was a relationship, it has been obscured by subsequent changes. As discussed above, many nasal spreading processes have occurred. There is also evidence for changes in the position of the glottal stop, based on synchronic alternations.

Dąbkowski (to appear) proposes that glottalization might be a suprasegmental feature rather than a consonant. If glottalization is suprasegmental, this was nonetheless probably a consonantal glottal stop in the recent past, in order to explain some of the patterns around it, e.g. the diphthong [ae] is not permitted but [aʔe] is permitted. The A'ingae glottal stop (or glottalization, depending on the analysis) primarily occurs in stressed syllables (see Dąbkowski, 2021 for further details); even within morphemes, it is sometimes lost when the position of stress is changed. It is possible that coda glottal stops were lost historically in unstressed syllables (cf. Capanahua, Elías-Ulloa 2009), although the restriction of the glottal stop to stressed syllables in the modern language is not absolute, so this cannot be a productive synchronic rule.

7 Conclusions

If correct, the reconstructed changes that we propose in the preceding sections would have substantially altered the phonological appearance of A'ingae. Tables 9 and 10 give a reconstruction of the pre-A'ingae phonemic inventory; segments in the modern language that we do not reconstruct are included in parentheses in gray.

Several lines of evidence point towards changes in the phonology of nasality. We reconstruct a development of nasal + unaspirated stop/affricate to prenasalized stop/affricate (Section 3), followed by development of nasal codas into nasality on vowels (Section 4). The voiceless unaspirated and prenasalized series became contrastive word-initially as the result of deletion of word-initial [ẽ] and [ɨ̃] before nasal and prenasalized consonants. Coda nasals also coalesced with following glides, producing a new phoneme /ɲ/ as well as new instances of /m/ (Section 5). Based on these reconstructed changes, the reconstructed inventory lacks nasal vowels, prenasalized consonants, and /ɲ/.

We also propose a set of more speculative palatalization processes, changes to the velar approximant, and developments of diphthongs (Section 6). Based on these reconstructed changes, the reconstructed inventory lacks diphthongs. Due to the more limited evidence for the origins of the post-alveolar affricates, they are still included in the reconstructed inventory.

Of course, internal reconstruction can only provide evidence for conditioned changes. If there were unconditioned mergers in the history of A'ingae, the actual phonological inventory of Pre-A'ingae could have been substantially larger than the reconstructed inventory given here. Nonetheless, improving our understanding of the historical phonology of A'ingae may facilitate identification of an affiliation with a language family and also facilitate identification of loanwords.

Table 9: Reconstructed vowel phonemes of A'ingae

	Front	Central	Back
High	i (ĩ)	ɨ (ɨ̃)	o∼u (õ∼ũ)
Mid	e (ẽ)		
Low		a (ã)	
Diphthongs	(ai) (ãi) (oe) (õe) (oa) (õa) (oi) (õi) (ɨi) (ɨ̃i) (ao) (ão)		

Table 10: Reconstructed consonant phonemes of A'ingae

	Bilabial	Lab.-dent.	Alveolar	Post-alv.	Palatal	Velar	Glottal
Plosive	p^h p (^{m}b)		t^h t (^{n}d)			k^h k (^{n}g)	ʔ
Affricate			$\widehat{ts}^h$ $\widehat{ts}$ ($^n\widehat{dz}$)	$\widehat{tʃ}^h$ $\widehat{tʃ}$ ($^n\widehat{dʒ}$)			
Fricative		f	s	ʃ			h
Nasal	m		n		(ɲ)		
Approx.		ʋ			j	ɯ	
Tap			ɾ				

Glossing Abbreviations:

For morphologically complex forms, the following abbreviations are used: ACC accusative, ADV adverb, ATTR attributive, CAUS causative, CLF nominal classifier, DAT dative, DS different subject, ELAT elative case, EXCL exclusive, IMP imperative, INF infinitive, IPFV imperfective, IRR irrealis, ITER iterative, MTM movement manner, NEG negation, NMLZ nominalizer, PASS passive, PL.SBJ plural subject, SH:RND round shpae classifier, SS same subject, TOP topic, VER veridical.

References

Aikhenvald, Alexandra Y. (2012) *Languages of the Amazon.* Oxford University Press.

AnderBois, Scott, Nick Emlen, Hugo Lucitante, Chelsea Sanker, & Wilson Silva (2019) Investigating Linguistic Links between the Amazon and the Andes: the case of A'ingae, presentation at Congreso de Idiomas Indígenas de Latinoamerica (CILLA) IX.

Barnes, Janet (1999) Tucano. In *The Amazonian Languages*, Cambridge University Press, 207–226.

Bateman, Nicoleta (2007) *A crosslinguistic investigation of palatalization*. Ph.D. thesis, University of California at San Diego.

Birchall, Joshua (2014) *Argument Marking Patterns in South American Languages*. Ph.D. thesis, Radboud Universiteit.

Blumstein, Sheila E. (1991) The relation between phonetics and phonology. *Phonetica* **48**: 108–119.

Borman, Marlytte Bub (1976) *Vocabulario Cofán: Cofán-Castellano, Castellano-Cofán*. Institute Lingüístico de Verano (Summer Institute of Linguistics).

Bruil, Martine & Jesse Stewart (2022) Phonetics and phonology of nasality in Ecuadorian Siona. *Phonological Data & Analysis* **4**(3): 1–34.

Campbell, Lyle & Verónica Grondona (2007) Internal reconstruction in Chulupí (Nivaclé). *Diachronica* **24**(1): 1–29.

Childs, G. Tucker (1992-1994) Language typology and reconstruction: The prenasalized stops of Kisi. *Studies in African Linguistics* **23**(1): 65–79.

Comrie, Bernard (2003) Reconstruction, typology and reality. In *Motives for language change*, Raymond Hickey, ed., Cambridge University Press, 243–257.

Cresci, Michela (2019) VN > V in Camuno: An alternative historical pathway to nasal loss. *Italian Journal of Linguistics* **31**(1): 61–92.

Dixon, R.M.W. (2004) Proto-Awawá Phonology. *Anthropological Linguistics* **46**(1): 1–83.

Dąbkowski, Maksymilian (2019) The morphophonology of A'ingae verbal stress, unpublished BA Thesis, Brown University.

Dąbkowski, Maksymilian (2021) The morphophonology of A'ingae verbal stress. In *Proceedings of the 38th West Coast Conference on Formal Linguistics*, 137–146.

Dąbkowski, Maksymilian (to appear) Laryngeal feet in A'ingae: Implications for metrical theory. In *Proceedings of the 39th West Coast Conference on Formal Linguistics*.

Drude, Sebastian (2006) On the position of the Awetí language in the Tupí family. In *Guarani y Maweti-Tupi-Guarani. Estudios historicos y descriptivos sobre una familia lingüistica de America del Sur*, Lit Verlag, 11–45.

Duthie, Alan S. (1986) Phonetic Features. In *The phonological representation of suprasegmentals: Studies on African languages offered to John M. Stewart on his 60th birthday*, Foris, 337–358.

Elías-Ulloa, José (2009) The distribution of laryngeal segments in Capanahua. *International Journal of American Linguistics* **75**(2): 159–206.

Emlen, Nicholas Q (2017) Perspectives on the Quechua–Aymara contact relationship and the lexicon and phonology of Pre-Proto-Aymara. *International Journal of American Linguistics* **83**(2): 307–340.

Epps, Pattie & Lev Michael (2017) The Areal Linguistics of Amazonia. In *The Cambridge Handbook of Areal Linguistics*, Raymond Hickey, ed., Cambridge University Press, 934–963.

Evans, Nicholas (2009) Doubled up all over again: Borrowing, sound change and reduplication in Iwaidja. *Morphology* **19**: 159–176.

Fischer, Rafael & Kees Hengeveld (2023) A'ingae (Cofán). In *Amazonian languages: An International Handbook*, vol. 1, Patience Epps & Lev Michael, eds., De Gruyter Mouton, 65–124.

Givón, Talmy (2000) Internal reconstruction: As method, as theory. *Typological Studies in Language* **43**: 107–160.

Graetzer, N. Simone (2012) *An acoustic study of coarticulation: Consonant-vowel and vowel-to-vowel coarticulation in four Australian languages*. Ph.D. thesis, University of Melbourne.

Greenberg, Joseph H (1960) The general classification of Central and South American languages. In *Men and cultures: Selected papers of the 5th International Congress of Anthropological and Ethnological Sciences (1956)*, Anthony Wallace, ed., University of Pennsylvania Press, 791–794.

Hall, T. A. & Silke Hamann (2006) Towards a typology of stop assibilation. *Linguistics* **44**: 1195–1236.

Hayes, Bruce (1989) The prosodic hierarchy in meter. In *Rhythm and Meter: Phonetics and Phonology, Volume 1*, Paul Kiparsky & Gilbert Youmans, eds., Academic Press, 201–260.

Herbert, Robert K (1986) *Language Universals, Markedness Theory, and Natural Phonetic Processes*. Mouton de Gruyter.

Herbert, Robert Kevin (1977) *Language universals, markedness theory, and natural phonetic processes: The interactions of nasal and oral consonants*. Ph.D. thesis, Ohio State University.

Jijón y Caamaño, Jacinto (1941-43) *El Ecuador interandino y occidental antes de la conquista castellana*. Quito.

Johnson, Orville E. & Stephen H. Levinsohn (1990) *Gramatica Secoya*, *Cuadernos Etnolingüísticos*, vol. 11. Quito: Instituto Lingüístico de Verano.

Kaiser, Eden (2008) Nasal spreading in Paraguayan Guaraní: Introducing long-distance continuous spreading. *AMERINDIA* **32**: 283–300.

Kohlberger, Martin (2010) *Cotopaxi Quichua: A Phonological Description and an Analysis of Stops and Affricates in Central Highland Ecuadorian Quichua*. Master's thesis, University of Edinburgh.

Kohn, Eduardo (2002) Infidels, Virgins, and the Black-Robed Priest: A Backwoods History of Ecuador's Montaña Region. *Ethnohistory* **49**(3): 545–582.

Krasnoukhova, Olga (2012) *The Noun Phrase in the Languages of South America*. Ph.D. thesis, Utrecht.

Landerman, Peter (1998) Internal reconstruction in Aymara and Quechua. In *The Life of Language: Papers in Linguistics in Honor of William Bright*, Jane H. Hill, P.J. Mistry, & Lyle Campbell, eds., De Gruyter Mouton, 35–58.

Lapierre, Myriam & Lev Michael (2017) Nasal segments in Tupí-Guaraní: a comparative synthesis, presentation at CILLA VIII, UT Austin.

Lindeman, Fredrik Otto (1965) La loi de Sievers et le début du mot en indo-européen. *Norsk Tidsskrift for Sprogvidenskap* **20**: 38–108.

Maddieson, Ian & Peter Ladefoged (1993) Phonetics of Partially Nasal Consonants. In *Phonetics and Phonology 5: Nasals, Nasalization, and the Velum*, Marie K Huffman & Rena A. Krakow, eds., Academic Press, 251–301.

Mason, J. Alden (1950) The languages of South American Indians. In *Handbook of South American Indians*, Julian H. Steward, ed., United States Government Printing Office, 157–317.

Mielke, Jeff (2008) *The Emergence of Distinctive Features*. Oxford University Press.

Muysken, Pieter (2019) *El kichwa ecuatoriano: orígenes, riqueza, contacto*. Ediciones Abya-Yala.

Nespor, Marina & Irene Vogel (1986) *Prosodic Phonology*. Foris Publications.

Newman, Paul (2014) The Range and Beauty of Internal Reconstruction: Probing Hausa Linguistic History. *Studies in African Languages and Cultures* **48**: 13–31.

Nurse, Derek, Thomas J Hinnebusch, & Gérard Philipson (1993) *Swahili and Sabaki: A linguistic history*. University of California Press.

Ohala, John J. & M. Grazia Busà (1995) Nasal loss before voiceless fricatives: a perceptually-based sound change. *Rivista di Linguistica* **7**: 125–144.

Overall, Simon E. (2007) *A grammar of Aguaruna*. Ph.D. thesis, La Trobe University.

Peperkamp, Sharon (1999) Prosodic words. *GLOT International* **4**(4): 15–16.

Repetti-Ludlow, C., H. Zhang, H. Lucitante, S. AnderBois, & C. Sanker (2020) A'ingae (Cofán). *Journal of the International Phonetic Association: Illustrations of the IPA* **50**(3): 431–444.

Ringe, Don (2003) Internal Reconstruction. In *The handbook of historical linguistics*, Brian D. Joseph & Richard D. Janda, eds., Blackwell, 244–261.

Rivet, Paul (1924) Langues américaines, II: Langues de l'Amérique du Sud et des Antilles. In *Les langues du monde*, Antoine Meillet & Marcel Cohen, eds., Société Linguistique de Paris, 639–712.

Rivet, Paul (1952) Affinités du kofán. *Anthropos* **47**: 203–234.

Rojas-Berscia, Luis Miguel, Andrés Napurí, & Lei Wang (2020) Shawi (Chayahuita). *Journal of the International Phonetic Association* **50**(3): 417–430.

Ruhlen, Merritt (1987) *A Guide to the World's Languages. Vol. 1: Classification*. Stanford University Press.

Sampson, Rodney (1999) *Nasal vowel evolution in Romance*. Oxford University Press.

Sans, Pierric (2011) Is nasality an autosegmental feature in Bésiro (aka Chiquitano). *Línguas e culturas Tupí* **2**: 237–248.

Singerman, Adam Roth (2016) Nasal harmony and phonotactic well-formedness in Tupari. *International Journal of American Linguistics* **82**(4): 453–485.

Stanton, Juliet (2017) *Constraints on the Distribution of Nasal-Stop Sequences: An Argument for Contrast*. Ph.D. thesis, MIT.

Stanton, Juliet (2018) Environmental shielding is contrast preservation. *Phonology* **35**(1): 39–78.

Thomas, Guillaume (2014) A split analysis of nasal harmony in Mbya. *Revista Linguíſtica* **10**(2).

van Gijn, Rik (2014) The Andean foothills and adjacent Amazonian fringe. In *The Native Languages of South America. Origins, Development, Typology.*, Cambridge University Press, 102–125.

Werle, Adam (2009) *Word, phrase, and clitic prosody in Bosnian, Serbian, and Croatian*. Ph.D. thesis, University of Massachusetts Amherst.

Wetzels, Leo & Andrew Nevins (2018) Prenasalized and postoralized consonants: The diverse functions of enhancement. *Language* **94**(4): 834–866.