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

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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 codas permitted other than glottal stops, as part of the following consonant. 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

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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), Chicham (Ruhlen, 1987), Andean B (Greenberg, 1960), and Macro-Chibchan (Mason, 1950). However, it is most often classified as lacking any known relatives, particularly in work that focuses on A'ingae data (Fischer & Hengeveld, ms). 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 fossilizations of earlier phonological processes (cf. Givón, 2000), though restricted patterns might be due to analogy instead (Ringe, 2003), so it is valuable to have additional concordant lines of evidence. 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 also is paralleled by known languages (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. Identifying these likely loanwords makes it possible to distinguish phonological patterns in the older stratum of inherited words, in which some of the tendencies suggested by the full native 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 glide-nasal sequences involving to glide /ʊ/. Coda nasals subsequently developed into nasality on vowels, with nasal spreading processes accounting for yet other instances of nasalized 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 serve to make the modern day language look substantially more characteristic of Amazonian languages.[2]

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

[2]A number of recent works such as Krasnoukhova, 2012, Birchall, 2014, and Epps & Michael, 2017 have

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). While the archaeological and historical evidence is quite sparse (see Kohn, 2002 and references therein), it too suggests that the historical A'i homeland 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). 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 in several respects has similar surface distributions of nasal consonants to other Amazonian languages, but has quite different phonological processes that produce them. First, nasal stops only occur with nasal vowels, but do not alternate with oral stops of any kind. Second, prenasalized voiced stops occur with a limited distribution similar to other Amazonian languages, yet are phonemically contrastive in the synchronic grammar with nasal stops 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 inventory 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

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.

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 interests are those that involve nasality contrasts: the nasal vowels, nasal stops, prenasalized voiced stops and affricates, and the approximants.

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.

(1) **Vowel phonemes of A'ingae:**

	Front	Central	Back
High	i ĩ	ɨ ɨ̃	o∼u[3] õ∼ũ
Mid	e ẽ		
Low		a ã	
Diphthongs	ai ãı oe õe oa õa oi õı ɨi ɨ̃ 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 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.

(2) **Consonant phonemes of A'ingae:**

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

	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	ɯ̨	
Tap			ɾ				

A'ingae syllables are (C)V in both word-final and medial positions. The only exception is 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 bisyllabic, (C)VCV, monosyllabic roots such as [ã] *an* 'eat', [i] *i* 'bring', [nã] *na* 'meat', and [p^hi] *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, t.a.b for detailed description and analysis of stress in A'ingae).

While we include the glottal stop in the consonant inventory in (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, t.a.b). If it is a consonant, it behaves like a coda, whereas A'ingae otherwise disallows coda consonants. Third, Repetti-Ludlow et al. (2020) argue that [ʔ] occurs in surface forms as a word-medial onset only in limited cases where they are derived from codas in underlying form

[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.

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/). In these cases, certain morphologically related forms involving the same root often appear with the glottal stop in this position (e.g. [ãɪʔ-ɲã] *ai'ña* person-CAUS 'to domesticate, civilize').[5] 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 nasality, to avoid committing to an analysis of the underlying nasality in cases where it is unclear.

2.2.1 Progressive consonant-induced vowel nasalization

Nasal onsets make following vowels nasal. In addition to being phonetically nasal, these vowels condition the same set of nasal allomorphs found after underlyingly nasal vowels. Thus, nasal consonants are always followed by phonologically nasal vowels. Vowels preceding nasal consonants are also phonetically nasal, though not as fully nasal as vowels following nasal consonants. The lack of prefixes in A'ingae makes it impossible to establish the phonological status of these vowels based on conditioned allophony. In contrast, oral approximants never occur next to nasal vowels; in subsequent sections, we will propose rules that explain this restricted distribution.

In theory, there are three possible explanations for the shared nasality of consonants and following vowels, (i) vowel nasality drives consonant nasality, (ii) consonant nasality drives vowel nasality, or (iii) nasality is a suprasegmental feature driving both consonant and vowel

[5]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, SS same subject, TOP topic, VER veridical.

nasality (as argued by Barnes (1999) et seq. for nearby Eastern Tukanoan languages). In the first case, oral approximants and nasals might not be phonologically contrastive, as they could be predicted by the nasality of the neighboring vowels. However, the existence of oral [ɯɻ], which lacks a nasal counterpart, and both [ɾ] and [n], which exhibit no evidence of alternating with each other, oppose this analysis. A suprasegmental analysis can even more clearly be ruled out for this reason.

Two pieces of data further suggest that nasal consonants spread nasality onto following vowels, rather than these vowels being underlyingly nasal and possibly causing the nasality of the preceding consonants. Nasal allomorphs themselves trigger nasal allomorphs in sequences of suffixes/enclitics, e.g. [tãⁿdã-ɲẽ-**ɲã**] *tandañeña* tie-PASS-IRR 'might/will be tied', and not *[tãⁿdã-ɲe-**ja**]. This indicates that the vowel following the nasal consonant has become phonologically nasal. There is little evidence that the glides occur before underlyingly nasal vowels, so the vowels within these suffixes are presumably oral in their underlying form. The same pattern of nasality is also consistently found in borrowings from Spanish, where vowel nasality is not phonologically active. In such borrowings, the vowel following a nasal consonant is always nasal, e.g. [daʔɲõ-**ɲẽ**] *da'ñu'ñe* 'to damage', not *[daʔɲo-**je**] (from Spanish *daño* 'damage').

2.2.2 Glide-nasal stop alternations

Several suffixes and clitics exhibit allomorphy between the oral glides and the nasals, conditioned by the nasality of the preceding vowel, as illustrated in (3). The nasals and oral approximants also have complementary distribution based on the neighboring vowels: Nasal consonants never occur next to oral vowels, while oral approximants never occur next to nasal vowels. However, as was discussed above, 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.

(3) **Alternating consonants in suffixes and enclitics:**

Morpheme	**V** ___	**Ṽ** ___
Infinitive [-je]/[-ɲẽ]	[shak**a**-je] *shakaye* 'to owe'	[k**ã**-ɲẽ] *kañe* 'to look'
Passive [-je]/[-ɲẽ]	[is**ɨ**-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]	[jaja-ʔje] *yaya'ye* 'deceased dad'	[mãm**ã**-ʔɲẽ] *mama'ñe* 'dec. mom'
Exclusive [-ji]/[-ɲĩ]	[tis**ɨ**-ji] *tisûyi* 'only themself'	[t͡ʃõn**ĩ**-ɲĩ] *chuniñi* 'only nutrias'
Elative [-je]/[-ɲẽ]	[t͡ʃã^{ŋ}g**o**-je] *changuye* 'from a hole'	[ɲ**ã**-ɲẽ] *ñañe* 'from me'

The relevant oral approximants are labiodental [ʋ] and palatal [j]. The third approximant, velar [ɰ], 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 infrequent, and beyond not occurring with nasal vowels, 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 for alternation with the alveolar tap [ɾ], although they are in complementary distribution with the former occurring adjacent to nasal vowels and the latter with oral vowels.

Despite these alternations, the nasals and glides seem to be contrastive phonemes. In addition to the morphemes that undergo alternation, there are suffixes with non-alternating nasals, e.g. Ablative [-nẽ] *-ne*, Locative *-ni -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.

The existence of such segments suggests that the alternating sounds are underlying oral glides

that become nasal after nasal vowels. Consistent with this direction of change, there is little evidence that the glides occur before underlyingly nasal vowels. Within roots, there are no definitive cases of glides before vowels that must be underlyingly nasal.[6] Across morpheme boundaries, such sequences are more common due to regressive nasal spreading from non-alternating suffixes, i.e. those that always begin with nasal or prenasalized consonants in contrast to those in (3). In such cases, the glide in the root remains unchanged, creating surface forms with some degree of nasality following a glide. For example, /ʃavo-ᵑga/ canoe-DAT produces the surface form [ʃavõᵑga] *shavunga* 'canoe (DAT)' rather than becoming [ʃamõᵑga]. There are also cases of glides next to vowels that are nasal because of the other spreading nasality processes that we discuss.

2.2.3 Nasal vowel spreading

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 spreading; they never occur between vowels that disagree in nasality. Suffixes/enclitics such as the imperfective [-he]/[-hẽ] *-je/-jen* and contrastive topic marker, [-ha]/[-hã] *-ja/-jan* exhibit regular alternations based on the nasality of the preceding vowel, as illustrated in (4).

(4) **Alternating vowels in suffixes and enclitics:**

[6]The one potential exception is [havõ] *javun* 'soap', borrowed from Spanish *jabón*. However, even in this example, it is unclear that the final vowel is truly fully nasal. Although impressionistically many tokens are clearly nasalized, morphologically complex forms with the oral glide alternant of alternating suffixes/clitics are attested. Additionally, this word does not appear to be fully adapted to the phonology of A'ingae, as it is consistently pronounced with final stress as in Spanish, even though final stress in polysyllabic words is not permitted in A'ingae surface forms.

Morpheme	**V** ___	**Ṽ** ___
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] *inja'un* 'many (aug)'

Similar to the consonant-initial suffixes above, there is an asymmetry between oral and nasal vowels in these suffixes. There are some glottal C-initial suffixes which alternate between oral and nasal vowels, there are no such suffixes which have a non-alternating oral vowel with such consonants. Conversely, there are two suffixes, [-ʔhĩ] *-'jin* CLF.TALL and [-(ʔ)ĩ] *-'in* MTM which have non-alternating nasal vowels, and one such clitic, [=ʔkã] *='kan* CMP (likely historically derived from [kã] *kan* 'look').

Beyond showing an asymmetry in nasal specification, these suffixes also provide some additional evidence for the progressive nature of nasal spreading. While we cannot use allomorph selection with alternating suffixes and clitics to test the phonological status, we can note that consonants which ordinarily only precede oral vowels, such as [ɾ] and [j], can occur as the onset of the preceding syllable (e.g. [^{n}daɾo-ʔhĩ] *daru'jin* 'a medicinal plant', [k^{h}ɨj-ĩ] *khûyin* 'while escaping').[7] As in the case of non-alternating suffixes and clitics with nasal consonants, this suggests that oral/nasal specification is not affected by that of following vowels synchronically. Finally, looking at the lexicon, glottal consonants are exceptionlessly opaque to nasal harmony such that we find words like [ɨ̃hĩ] *ûnjin* 'rain' and [ihi] *iji* 'armadillo' where both vowels agree in nasality, but no words such as *[ɨ̃hi] or *[ɨhĩ], with one oral and one nasal vowel.

Additionally, we can see that iterative spreading across glottal consonants is found, and reg-

[7]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 spreading, which typically is reflected in writing).

ularly reflected in written forms as well. We see this most clearly in the contrast between inflected forms of the roots [ʃokʰãe] *shukhaen* 'cook' and [rõⁿda] *runda* 'wait' in (5) (a borrowing from Spanish *rondar* 'to wait, hang around'). In the former case, (5a), the root ends in a nasal vowel and we see that both not only the suffix immediately following is nasal, but the subsequent one is as well. In contrast, with a root ending in an oral vowel as in (5b), the suffixes both contain oral vowels.

(5) a. [ʃokʰãeʔhẽhã]
shukhaen-'jen-jan
cook-IPFV-IMP
'Cook!'

b. [rõⁿdaʔheha]
runda-'je-ja
wait-IPFV-IMP
'Wait!'

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 alternating consonants of the sort in (3) similarly alternate following these vowels, as seen in the comparison between (6) and (7). In (6), the causative suffix [-ẽ] in the verb stem triggers not only the nasal allomorph of the imperfective /-he/, but also the allomorphs with nasal consonants of the switch reference /-pa/ and the veridical suffix /-ja/:

(6) a. [t͡ʃavõehẽᵐba]
*chava-en-je-**mba***
buy-CAUS-IPFV-SS

b. [t͡ʃavõehẽɲã]
*chava-en-je-**ña***
buy-CAUS-IPFV-VER

In contrast, in (7), we see that the verb stem ends in an oral vowel and triggers the non-nasal allomorphs of both suffixes:

(7) a. [ɾõ^{n}da-he-pa]
*runda-je-**pa***
wait-IPFV-SS

b. [ɾõ^{n}da-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 nasal spreading across them. In contrast to both, fricatives show a more gradient pattern. First, unlike the cases we have seen above, fricatives show no allomorphic alternation of any kind. Not only does the consonant itself not vary, we also do not see any variability in the 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.

Although fricatives do not exhibit alternations or active nasal spreading across morphological boundaries, the lexicon nonetheless shows some evidence that they are also prone to nasal spreading. There are many root-medial fricatives with oral vowel on either side or with nasal vowels on either side. However, we have identified no roots with a preceding oral vowel and following nasal vowel (e.g. *[asĩ]) and roots with a preceding nasal vowel and an oral vowel following are extremely rare and those that do exist have plausible recent origins, i.e. they were not roots in earlier forms of the language. In this latter category, we find potential borrowings – [ãsi] *ansi* 'salt' (cf. Secoya [ãʔsi] 'salt') – and forms which were possibly morphologically complex forms 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',

[kãk^{h}e] *kankhe* 'town').[8]

Within the lexicon, voiceless unaspirated stops show a similar pattern to fricatives. There are many roots with medial plain stops 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 (see Table 12 and surrounding discussion). In loanwords, nasality is often made to agree in these environments (e.g. Spanish *confesar* 'confess' → [kõf**ẽ**s**ẽ**] *kunfensen* 'confess', *cotón* 'cotton shirt' → [k**õ**tõ] *kuntun* 'cotton shirt').

Aspirated stops and affricates present a pattern that is in some ways quite similar to fricatives and unaspirated stops/affricates and in some ways quite different. There are no underlying forms with an aspirated stops following an oral vowel and preceding a nasal vowel. However, whereas the other obstruents with very few exceptions showed nasal spreading (i.e. the two flanking vowels are either both oral or both nasal), aspirated stops show a different pattern. When preceded by a nasal vowel, aspirated stops are roughly equally attested with a following oral or nasal vowel, as exemplified in (8). The counts for occurrence of roots with oral and nasal vowels next to aspirated consonants is given in (13). Aspirated stops and affricates show an overall tendency towards occurring surrounded by oral vowels. However, preceding nasal vowels are attested, and the following vowel shows no clear tendency when the preceding vowel is nasal.

(8)

$\mathbf{V}_{[Nasal]}$_____$\mathbf{V}_{[Oral]}$		$\mathbf{V}_{[Nasal]}$_____$\mathbf{V}_{[Nasal]}$	
[ãp^{h}i]	*amphi* 'fall'	[ãt^{h}ã]	*anthan* 'fish species'
[ãʔk^{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'	[hãʔt͡ʃ^{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 as initial syllables and additionally

[8]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, ['kãseje] *kanseye* has antepenultimate stress, whereas the unmarked stress pattern in A'ingae infinitives is to have penultimate stress.

shows left to right nasal spreading. Different classes of intervening consonants show different degrees of transparency to nasal spreading, ranging from glottal consonants, which are exceptionlessly transparent synchronically, to aspirated stops, for which differing nasality is attested and the distribution is more likely to be the result of a historical process. Outside of glides, nasal stops, and the tap, each of these consonant classes can be preceded either by 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 spreading, as will be discussed below. They almost always occur in underlying forms with a preceding nasal vowel and a following oral vowel, e.g. [kõᵑgi] *kungi* 'ant'; [kõᵑgɨ] *kungû* 'sweet potato'. Note that sometimes the following vowel may be nasal in its surface form due to nasality spreading from 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 (9a), partially productive reduplication processes (9b), and a wide range of other morphologically complex forms, as in (9c).

(9) a. [t͡ʃõᵐbĩᵐbi]
chumbimbi
turkey
'domesticated turkey' (cf. Spanish *chompipe* 'turkey')

b. [õⁿdɨ̃ⁿdɨ]
undû∼ndû
incline∼ITER
'nod one's head'

c. [sĩᵐbãᵐbi]
simba-mbi

fish-NEG

'didn't fish'

In this section, we have reviewed the phonology of present day A'ingae with a particular emphasis on nasality in both consonants and vowels. 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 spreading across certain classes of consonants. Beyond the pervasiveness of these nasal 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. As we will show in the next section, the conflicting synchronic phonological and lexical 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, along with nasal spreading and an allophonic alternation between unaspirated stops and prenasalized voiced stops.

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: velum closure occurs before the end of the consonant in order to preserve the contrastive lack of nasality on the following vowel. This pathway is a common source of prenasalized stops cross-linguistically, and depends on having contrastive vowel nasality (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 when preceded by a nasalized vowel and followed by an oral vowel: T > ⁿD/$\tilde{\text{V}}$_V. This source of prenasalized stops and affricates is paralleled in other languages. In Tupari, voiceless stops become fully nasal following a nasal vowel (Singerman, 2016). Mbya Guarani provides an even closer parallel to A'ingae (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.

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. 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 sequences. The difference between nasal + stop sequences and prenasalized stops is primarily phonological, and often does not align with any phonetic difference (Blumstein, 1991).

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 (10).

(10) **Alternating forms (from Fischer & Hengeveld ms)**

a. **-pa 'nominalizer'**

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

/hẽ-pa/ [hẽ^{m}ba] *jemba* 'sound-NMLZ'

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

/ʋa-ta/ [ʋata] *vata* 'this-TOP'

/hãʔɲõ-ta/ [hãʔɲõ^{n}da] *ja'ñunda* 'now-TOP'

Other suffixes and clitics consistently have prenasalized stops, as illustrated in (11). They trigger nasality of the preceding vowel; vowels preceding prenasalized stops are always nasal.

(11) **Non-alternating forms (from Fischer & Hengeveld ms)**

a. **-^{m}bi 'negation'**

/ʃaka-^{m}bi/ [ʃakã^{m}bi] *shakambi* 'fail-NEG; did not fail'

/hẽ-^{m}bi/ [hẽ^{m}bi] *jembi* 'sound-NEG; didn't sound'

b. **-^{ŋ}ga 'dative'**

/ijo-^{ŋ}ga/ [ijõ^{ŋ}ga] *iyunga* 'snake-DAT'

/ãi-^{ŋ}ga/ [ãi^{ŋ}ga] *ainga* 'dog-DAT'

Conversely, there are no suffixes or low level clitics that always occur with a 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.

3.2 Facts about the lexicon

The distribution of the voiceless 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 allophonic one.

As discussed above, voiceless unaspirated stops and affricates almost never occur between a nasal and oral vowel. Most exceptions are potentially borrowings, e.g. [tsãpi] *tsampi* 'forest'. Table 12 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', [ɨtɨkʰɨ] *ûtûkhû* 'rib') and less frequently between two nasal vowels (e.g. [õtĩ] *untin* 'gadfly', [tsẽtã] *tsentan* 'warp', [tɨ̃tɨ̃] *tûntûn* 'trumpeter bird'). 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 spreading.

Among the sparsely populated mismatching cells, Oral-T-Nasal and Nasal-T-Oral, the handful of attested forms are all candidates for borrowing, fossilized morphologically complex forms, or ideophones. We have included them here in order to be conservative in only excluding lexical items with clearly established etymologies. Although the modern language does seem to allow Nasal-T-Oral sequences, their rarity suggests historical processes which had eliminated them.

(12) **Vowel nasality next to unaspirated stops and affricates**

	Oral V follows	Nasal V follows
Oral V precedes	187	3
Nasal V precedes	5	34

The aspirated stops and affricates also exhibit patterns in the possible combinations of oral and nasal neighboring vowels. Table 13 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. Unlike the unaspirated consonants, the limitations seem to suggest not a requirement for nasality matching but a tendency for nasal vowels to not appear next to aspirated consonants.

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; Nurse et al., 1993, p. 167–168). 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.

(13) **Vowel nasality next to aspirated stops and affricates**

	Oral V follows	Nasal V follows
Oral V precedes	133	0
Nasal V precedes	10	10

The low overall frequency of nasalized vowels is 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 some 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 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, as shown in (14) and (15). They 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. [^{ŋ}gasorĩnã] *gasurina* ‘gasoline’, [^{m}bõ^{m}bijo] *bombiyo* ‘light bulb’.

(14) a. [mo̰e] *muen* ‘sent’

b. [^{m}boi] *bui* ‘row, paddle’

c. [poi] *pui* ‘both’

d. [p^{h}oi] *phui* ‘get down low’

(15) a. [mĩsĩ] *minsin* ‘worm, larva’

b. [^{m}bĩʃĩ] *binshin* ‘dog flea’

c. [pĩ^{n}do] *pindu* ‘hawk’

d. [p^{h}ĩmĩ] *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 ɪ̃ word-initially before nasals. This change would have eliminated the complementary distribution of voiceless and prenasalized stops, making them contrastive. Nasal ẽ and ɪ̃ are extremely infrequent word-initially in the modern language, relative to their oral counterparts and to other nasal vowels, as seen in (16), and never occur word-initially before prenasalized consonants or nasal consonants.

Although these two vowels differ in how they are phonologically categorized, they are phonetically similar (see Repetti-Ludlow et al., 2020, p. 438). 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.

(16) Comparison of vowel frequency

Vowel	Wordforms with initial oral V	Wordforms with initial nasal V
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 Adaptation in loanwords

Loanwords confirm the salience of some of the synchronic phonotactic patterns, though they do not necessarily demonstrate the history.

Post-nasal unaspirated stops are sometimes borrowed as prenasalized stops, e.g. Spanish *contar* 'tell' → [kõⁿda] *kunda*; and *compa(dre)* 'friend, companion' → [kõᵐba] *kumba*. Historically voiceless stops following nasals in Quechuan borrowings overwhelmingly result in prenasalized voiced stops. In contrast, such sequences in Spanish have varied outcomes, suggesting that the loanwords in A'ingae originate from the Ecuadorian and Colombian varieties of Kichwa which have post-nasal voicing of stops (Cole, 1982; Gómez-Rendón, 2007), 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 spreads across the consonant, producing nasal vowels on both sides, 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 cannot be followed by oral vowels.

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 voiced stops are from Spanish, e.g. *cobija* 'blanket' → [koʋiha] *kuvija*, so the manner of articulation may reflect a characteristic of Spanish lenition, rather than adaptation.

3.4 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 this phonological development: [tã^{n}dã] *tandan* 'tie'; [kõ^{ŋ}gõ] *kungun* 'rot'. However, reduplication is not a synchronically active process, 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, and can be formed productively, 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. [tʰɪ̃ʔⁿdɪ̃ⁿdɨ] *thû'ndûndû* 'tremble, shudder').

4 Reconstruction of coda nasals

The account of prenasalized consonants developing from vowel nasality encounters some problems that can be improved by instead reconstructing coda nasals. Nasal vowels are reconstructed as coming from vowels followed by coda nasals, and prenasalization is reconstructed as coming from reanalysis of nasal + unaspirated stop/affricate sequences as prenasalized segments. The development of prenasalization was perhaps also influenced by post-nasal voicing in Ecuadorian Kichwa, which has had extensive contact with A'ingae.

The first issue with the vowel nasality account is that it is not clear why the conditioning environment 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 vowel onto the beginning of an intervening consonant. It is possible that nasality within the consonant is more likely to be attributed to coarticulatory spreading and factored out in a fully nasal environment, but there is no clear diachronic parallel to establish the behavior of this condition.

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. [tãⁿdã] *tandan* 'tie'; [kõᵑgõ] *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 prenasalization and later developed

into vowel nasality in other environments, resolves these issues. VN > $\tilde{V}$ is an extremely common pathway for the development of vowel nasality (e.g. in several Romance languages, Sampson 1999; in Guaraní, Kaiser 2008), so this source of vowel nasality 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 orality of vowels after prenasalized consonants would reflect low frequency of coda nasals, perhaps exaggerated by restrictions on which syllables could have codas (e.g. only in initial vowels or only in stressed vowels). Subsequent nasal spreading 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. 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.

5.1 Palatal nasal

The palatal nasal /ɲ/ has a limited distribution that 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 consistent /ɲ/. The first is one of the allomorphs of the causative suffix, [-ɲa]. 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 follow 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*.[9]

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 the extra syllable of the [-ɲa] form retained based on minimal prosodic word preferences (possibly grammaticalized from a [-ja] suffix such as the veridical [-ja]).

The only other suffix with a consistent [ɲ] is the potentially related iterative/semelfactive [ɲãk^{h}a] *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 never occur next to nasal vowels, while the nasal consonants never occur next to oral vowels. There is synchronic spreading of nasality from nasal consonants to neighboring vowels, but the distribution is likely also the result of historical processes changing consonant nasality. In addition, both [ɲ] and [j] have shared distributional tendencies.

Given these facts, one may wonder whether [ɲ] and [j] should be considered synchronic allophones of a single phoneme, with their distribution conditioned be the nasality/orality of adjacent vowels. Borman (1962) briefly argues against a similar hypothesis: that [ɲ] arises from an underlying /ni/ sequence. The argument is based on the existence of a form [ɲõaʔmẽ] *ñua'me* 'really, truly' which they note would contain a triphthong [ioa] if [ɲ] were analyzed as a /ni/ sequence. However, we note that this form is morphologically complex, consisting of

[9]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.

the root [ɲõ] *ñu* 'good' plus a (non-productive) adverbializing suffix *-a've/-a'me* (cf. pairs like [ʋasɨi] *vasûi* 'slow' and [ʋasiaʔʋe] *vasia've* 'slowly' and [kĩ] *kin* 'strong' and [kiãʔme] *kia'mẽ* 'strongly'). Second, for the speakers of all ages with whom we have worked, this word is consistently pronounced [ɲãʔmẽ] and written *ña'me*, with a monophthong [a]. We speculate that this is a sign of grammaticalization, as this word impressionistically is extremely frequent in natural speech and the semantic composition may have become somewhat opaque.

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] and [j] occur before the high central vowel [ɨ], and both rarely occurred 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 §2.2.1-2.2.3 suggest that a diachronic account may be preferable. With suffixes that show an allomorphic alternation between a form with [ɲ] and one with [j], we see from allomorph selection on following suffixes, such as that of *-pa/mba* in (17), that the vowel's nasality is driven by that of the consonant.

(17) 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’

Conversely, in a case where a non-alternating nasal suffix causes nasalization of the vowel, this does not cause the consonant to alternate (e.g. we find [ĩⁿdijẽᵐbi] *indiyembi* rather than [ĩⁿdiɲẽᵐbi] *indiñembi*).

(18) 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’

While it may be possible to account for these facts by positing an allophonic relationship between [ɲ] and [j], these facts follow much more simply if the two are treated as distinct phonemes, with the nasality of the following vowel being phonologically conditioned by adjacent consonants.

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 (bigram) source of it. The causative suffix [-ɲa] would have been **nja*, occurring with monosyllabic roots due to pressures of minimal weight as the /n/ would provide a coda and make 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, though the form of nasality on the conditioning morpheme has changed.

Second, it explains the lack of [j] after nasal vowels. On the other hand, some cases of [j] with a following nasal vowel would be expected from **jVn* syllables. There is less evidence for the behavior of such sequences, because there are no prefixes; 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. They 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].

This source of [ɲ] is paralleled in reconstruction of several languages, e.g. in Brazilian Portuguese, along with the development of nasalized vowels (Wetzels, 1997). There are also synchronic examples of spreading nasality making glides into nasal stops (e.g. Kisi, Childs 1992-1994) or nasalized approximants (e.g. Tupari, Singerman 2016).

5.2 Bilabial nasal

Although the conditioned alternation of [m]∼[ʊ] 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 [ʊ]

that would be captured by a historical change of nʊ > m.

The synchronic alternations between [m] and [ʊ] suggest that the coalescence of n + glide was reflected in /ʊ/ like it was in /j/. However, other behavior of the modern /m/ make 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 A'ingae reconstruction.

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 postalveolar affricate can probably be reconstructed as the outcome of d + j. 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 or might have already been variable. This sort of variable syllabicity of glides and preceding unstressed homorganic vowels is paralleled in other languages, e.g. in the reconstruction of Vedic (Lindeman, 1965).

These A'ingae sequences with the palatal glide almost never occur after [d], similar to the absence of n + j sequences. Most instances of d + (i)j are clearly the result of roots ending

in /i/ followed by the causative [-ã] *-an*. If we assume that these sequences were historically **djV*, we can account for the distribution with a well paralleled palatalization process, dj > d͡ʒ. Only three potential counterexamples exist of roots with d + ijV sequences: [ts͡ĩⁿdija] *tsindia* 'tree species', [ⁿdijo]/[ⁿdjo] *diu* 'white-collared jay', and [ⁿdijo] *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 [t͡ʃ] and [t͡ʃʰ] 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 [tʰ] 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 [ãtijã] *antian* 'relative' and [tʰijot͡sʰe] *thiutshe* 'almost' (*-tshe* is an adverbializing suffix).

However, the voiceless post-alveolar affricate [t͡ʃ] is far more frequent than [ⁿd͡ʒ] or [ɲ], and also notably more frequent than [t͡ʃʰ], 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, for which there is a single voiceless series. Crucially, this change must have occurred after the development of prenasalized affricates, because otherwise it would predict additional instances of [ⁿd͡ʒ].

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. Stops do not participate in this constraint (e.g. [t͡ʃatʰɨje] *chathûye* 'to cut (once)'). Loan-

words 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. [t͡saiki] *tsaiki* (← Kichwa [t͡ʃaiɲan] 'rural road'), [ʋat͡sʰaraʔkʰo] *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.[10]

The post-alveolar affricates almost never occur before the vowel /e/, except across morphemes boundaries. There is only one exception of which we are aware: [met͡ʃẽʔɲõ] *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. On the other hand, 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.

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 [koɾauɻa] *kuraga* 'shaman' from Quechuan [kuɾaka] 'chief'. Some other items have plausible etymologies as loanwords but are less definitive, although most do not.

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 to between vowels and the association with [a] is paralleled in other languages,

[10] 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.

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* (*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. 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]: [feɯɻɪ̃^{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/_V[-back] change is seen in Iwaidja,

though just before /i/ (Evans, 2009, p. 162-3). Aguaruna, another Amazonian language of Ecuador, provides a particularly close parallel for the distribution of [ɯɰ], 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. [ãsãʔᵑge] *ansa'nge* 'be ashamed', [ⁿdãɲõᵑge] *dañunge* 'be damaged' (from Spanish *dañarse*). 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 [ɯɰ] 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.[11] 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

[11]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: [kʰɨiʊo] *khûivu* 'catfish' (cf. *khûi* 'lie, rest'), [t͡sʰat͡sʰaʔʊu] *tshatsha'vu* 'grater' (cf. *tshatsha* 'grate'), [putãẽᵑgo] *putae'ngu* 'rifle' (cf. *pu'taen* 'shoot'), and [tʰẽnãʔᵑgo] *thena'ngu* 'leg' (cf. *thenashu* 'limb muscle pain').

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, [ⁿd͡ʒai] *dyai* 'sit' has the causative form [ⁿd͡ʒãi-ɲã] *dyaiña* 'place a pole vertically in the ground' rather than one of the allomorphs which occur with multisyllabic roots.

Diphthongs are particularly uncommon word-initially, as was seen in Table 16. As we will discuss, most diphthongs in the modern language are the result of vowel-initial suffixes. 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 [-kʰia] *-khia*, but like other /ia/ sequences, this can be realized as two syllables. The manner/path marker *-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 [pãɲẽro] *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 them do not seem to be productive. Some forms exhibit coalescence of two vowels into one, e.g. /feuɻi-it^{h}o/ > [feuɻet^{h}o] *fegethu* 'widen a hole by scraping'. Many instances of [ɨi] have variants with just [i], suggesting a deletion process, e.g. [tɨrɨ̃] *tûrûin* 'yellow and black bird' also as [tɨrĩ] *tûrin*. Even for the same word, Borman (1976) lists *vatoa* (*vatua* in the modern orthography) alongside the form we have observed, [ʋatoʊa] *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. ai > oi before labial consonants, 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}dɪ̃ã] *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 are almost exclusively tropical plants and birds, and 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. [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. [oʧʰai] *uchhai* 'to hit' vs. [oʧʰaʔʧʰa] *uchha'chha* 'to hit repeatedly') and therefore suggest some sort of morphological process historically. Some borrowed words also seem to contain this morpheme, e.g. [kaʧai] *kachai* 'run into, grab' from Spanish *cachar* 'catch, grab'.

There are two main possible sources for such roots. First, A'ingae has some instances of 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. /oʧʰa-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. [ʤohi] *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 verb 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 this pattern. 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 reduplicated diphthongs. Of 6 possible cases, 5 are ideophones, with only the only apparent exception being [kõɪkõɪŋõ] *kuinkuiño* '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 [-^{m}bi] *-mbi* NEG plus the adverbializer [-e] *-e* ADV yields [-^{m}be] *-mbe* rather than *[-^{m}bie] (Fischer & Hengeveld, ms) and similarly [-t͡s^{h}i] *-tshi* ATTR plus [-e] *-e* ADV yields [-t͡s^{h}e] *-tshe*, not *-t͡s^{h}ie. For comparison, productive lexical uses of the same adverbial morpheme produces diphthongs freely (aside from the aforementioned constraints on licit diphthongs) such as [ɾeɾik^{h}oe] *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. Given that the glottal stop does not behave like the other consonants, it is likely that it has undergone recent changes, but it is not clear what to reconstruct; they may have been inserted or deleted in certain environments, and might be shifting away from being consonantal.

Synchronically, the behavior of the glottal stop might suggest that it is a suprasegmental feature rather than a consonant, as proposed by Dąbkowski (t.a.a). Similar analyses have been proposed for glottalization in Desano (Silva, 2016) and Cuzco Quechua (Parker & Weber, 1996). Comparative evidence in Tukanoan suggests that the Desano glottalization can be reconstructed as a glottal stop, though the reconstruction in Quechua is less clear. As a consonantal glottal stop, the A'ingae segment would likely have had a wider distribution in the past than it has currently. A'ingae glottalization primarily occurs in stressed syllables (see Dąbkowski, t.a.b 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 glottalization to stressed syllables in the modern language is not absolute, so this cannot be a productive synchronic rule.

7 Conclusions

Several lines of evidence point towards a relationship between the voiceless unaspirated series of stops and affricates and the prenasalized voiced series. We reconstruct a development of nasal + unaspirated stop/affricate to prenasalized stop/affricate, followed by development of nasal codas into nasality on vowels. 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/. We also propose a set of more speculative palatalization processes, changes 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 its form further in the past may facilitate identification of an affiliation with a language family and also facilitate identification of loanwords. Tables 19 and 20 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. Of course, internal reconstruction can provide evidence for splits but not mergers, so the actual phonological inventory of Pre-A'ingae is likely to have been larger than the reconstructed inventory given here.

(19) **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) (ãı) (oe) (õe) (oa) (õa) (oi) (õı) (ɨi) (ɨ̃i) (ao) (ão)		

(20) **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	ɯ̨	
Tap			ɾ				

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