RECONSTRUCTING NON-CONTRASTIVE STRESS IN AUSTRONESIAN AND THE ROLE OF SCHWA IN STRESS SHIFT, GEMINATION, AND VOWEL SHIFT

1 INTRODUCTION In Austronesian comparative linguistics there are two main schools of thought on the reconstructed stress system of Proto-Austronesian (henceforth PAN) and often by extension, of Proto-Malayo-Polynesian (PMP). The first posits a system with predictable stress placement, typically with stress placed exclusively or primarily on the reconstructed penultimate syllable (Blust 1997, 2013, Brandstetter 1916, Smith 2018). The second posits a system of lexical stress with words unpredictably marked with stress either on the penult or the ultima (Pejros 1994, Ross 1992, Wolff 1991, Zorc 1978). This paper organizes a database of evidence in support of the first position, that stress in PAN and PMP was predictable; lexemes were stressed on the penultimate syllable with the additional observation that stress shifted to the final syllable under predictable circumstances. Triggers for stress-shift to the final syllable were 1) the presence of schwa in an open penultimate syllable and 2) morphological stress in word-class derivation as well as in vocative formation and as a marker of "closed class" words like negation, pronominals, and deictics. Additionally, the study provides a motivation for phonetically conditioned stress-shift beyond the assertion "schwa could not hold stress". It is proposed that schwa was, and often still is, a zero-mora vowel which did not add to lexical mora count. As a weightless vowel, schwa was unable to hold stress and additionally, that words of the shape CəCV(C) were sub-minimal (less than two mora), which led to multiple repair strategies in MP daughter languages that added an extra mora to words of this shape, thereby enforcing a two-mora word minimum.

1.1 PREVIOUS WORK ON PAN AND PMP STRESS Scholars working in Austronesian have long attempted to reconstruct a contrastive stress system to PAN or PMP, motivated by the belief that Philippine contrastive stress is a retention, rather than an innovation. In this section, select works dealing with stress reconstruction are reviewed along with some critical discussion. The focus is on studies that posit contrastive stress for PAN or PMP, as these hypotheses directly contrast with the present study's central claim that stress was predictable in PAN and PMP. The discussion begins with Wolf (1991) and Pejros (1994) who both attempt to reexamine the *t/*C contrast in PAN as stress-conditioned allophony. Second, Ross's 1992 proposal that Budai Rukai contrastive stress corresponds with contrastive stress in the Philippines, is discussed. Finally, the section discusses work by Zorc (1978) who attempts to demonstrate regular correspondence between word-final stress in Philippine languages with geminate consonants in Madureses. Zorc's paper also contains much useful information about the morphological role of stress, which will also be discussed.

1.1.1 STRESS AS A CONDITION FOR *t/*C At least two studies, Wolff 1991 and Pejros 1994, have claimed that PAN or a putative Proto-Formosan had contrastive stress and further that word stress conditioned the realization of PAN *t and *C. Under this hypothesis, *t and *C are collapsed together as a single phoneme *t with allophones *t and *C [ʦ] and the data in support of this claim come almost exclusively from Tsouic. A brief description of each study is given below beginning with Wolff and finishing with Pejros, with a few criticisms, although much of the critical analysis of these works can be found in Blust 2013.

Wolff (1991) claims that the distribution of PAN *t and *C [ʦ] was predictable based on two factors; 1) the position of stress in the word and 2) the length of the word as measured in syllables. PAN *t, under Wolff's analysis, was realized as [t] if it appeared *anywhere* in a two-syllable word with penultimate stress or in a three-syllable word with final stress. PAN *t was realized as [ʦ] if it appeared *anywhere* in a two-syllable word with final stress or in a three-syllable word with penultimate stress. The pattern can be presented in a schematic as follows:

1)	If	CV́CVC	or	CVCVCV́C	then	*/t/ > *[t]
	If	CVCV́C	or	CVCV́CVC	then	*/t/ > *[ʦ]

The main problem with this is that Wolff has described a highly unnatural condition. If rhythm truly conditioned the realization of *t there should be some observable relationship between the position of *t vs the position of stress that creates the split. The condition that Wolff suggests, however, does not care about the position of *t relative to stress, nor does it care about foot shape or stress position. Rather, *t *anywhere* in the word is realized as [t] if the penult is stressed *and* the word is two syllables, but if the penult is stressed and the word is a trisyllable, *t became [ʦ]. In example 2), *t is realized as [ʦ] or [t], even though it immediately follows a stressed penultimate vowel in both cases. This is clearly an unusual condition, and phonetically appears to be unmotivated.

2)	CVCV́tV	>	CVCV́[ʦ]V
	CV́tV	>	CV́[t]V

Beyond the issue of the unnaturalness of the condition necessary in Wolff's claim, Blust (2013:559-563) has also shown that the evidence itself does not support the hypothesis about *t/*C allophony, with numerous counterexamples that outweigh evidence in support of stress-conditioned *t/*C allophony. Wolff's study, therefore, does not seem to provide much insight into the stress system of PAN.

Pejros (1994) attempts a somewhat similar take on *t and *C as Wolff, proposing a single phoneme with allophones conditioned by stress. although the conditions on *t allophony proposed buy Pejros differ from Wolff's. According to Pejros, PAN *t surfaces as [ʦ] where it appears in the onset of a stressed syllable or in word-final position, whereas *t surfaces as [t] where it appears in any other position as well as in any word containing *S.

Pejros's conditions on *t realization are more natural than Wolff's, since he ties the realization ot *t to its position relative to stress. However, the patterns that Pejros points out are restricted to Tsouic languages in his work. Although he states (Pejros 1994:125) that "The double reflexes of *t are found in other languages of Taiwan where they correspond directly with Tsou *t* and *s.*" the other languages listed are also Tsouic (Kanakanavu and Saaora). Pejros states that it may be possible that Tsouic is the only subgroup that retains a stress system from Proto-Formosan, but without evidence from a second primary branch, this hypothesis cannot be tested. Additionally, the presence of a Proto-Formosan ancestor to all Formosan languages is not universally agreed upon, and many widely-cited higher-order subgrouping hypotheses (Blust 1999 and Ross 2009 for example) do not recognize such a group. This leaves the issue of stress and PAN unanswered, at least from the perspective of a stress-condition on *t and *C and its relation to stress in PAN.

1.1.2 BUDAI RUKAI AS A "MISSING LINK" BETWEEN FORMOSAN AND PHILIPPINE STRESS SYSTEMS. Budai Rukai provides some interesting comparisons for a theory of PAN contrastive stress. Budai is unlike many Formosan languages, even as opposed to other Rukai dialects, in that it has a synchronic system of contrastive stress. Ross (1992) has used Budai Rukai, in comparison with Philippine languages, to argue that i) PAN stress was lexically marked as falling either on the penultimate or ultimate syllable and can be reconstructed with cognate forms in Rukai and Philippine languages, ii) Schwa was able to bear stress in any position, including in open penultimate syllables, and iii) Unstressed vowels in penultimate syllables deleted in PMP giving rise to consonant clusters in many words. Blust 1997b has written a response to i) where he pointed out counter examples where Budai Rukai stress does not match with Philippine cognates and the reader may refer to this earlier work for more on these exceptions and their impact on Ross's hypothesis, but the other claims of Ross, that schwa was able to hold stress in open penultimate syllables and that unstressed penultimate syllables deleted in PMP, have not been critically analyzed as of yet. Like the comparisons between Budai and Philippine stress systems, the assertion that schwa could hold stress and that unstressed penults deleted in PMP face numerous counterexamples. Some of these are discussed below.

Regarding the stressability of schwa in penultimate syllables, Ross lists three reconstructions in support of his observation. He claims that if penultimate schwa was stressed in PAN that it was retained as schwa in PMP and shifted to *o in POC but if it was unstressed in PAN, it deleted in PMP and by extension did not appear in POC. The evidence that Ross presents is as follows:

3)	a.	PAN *CuqəláN 'bone'	PMP *tuqlan	POC *tula
	b.	PAN *baqə́Ruh 'new'	PMP *baqə́Ruh	POC *paqoRu
		PAN *qiCə́luR 'egg'	PMP *qitə́luR	POC *qatoluR

It is, of course, well-known that unstressed schwa *often* deleted in penultimate position, especially where it appeared in three-syllable words. This sound change is nearly universal in Philippine languages, for example. However, there are also numerous MP subgroups where schwa in penultimate syllables does not delete, and in these examples there appears to be no stress-condition. For example, although unstressed penultimate schwa supposedly deleted in PMP *tuqlan 'bone, from PAN *CuqəláN, schwa does appear in this word in several MP languages where is should have been deleted, including Kalamansig Cotabato *tuʔəlan*, Lampung *tuhəlan*, Palauan *dəʔóyl* (where schwa became Palauan *ó*), and Old Javanese *tahulan (with sporadic metathesis).

Similarly, the words that Ross reconstructs with a stressed penultimate schwa often reflect schwa deletion in MP languages. For example, although both PAN baqə́Ruh 'new' and PAN *qiCə́luR 'egg' are reconstructed with a stressed penultimate schwa, the retention rate of schwa in these two words varies greatly. Schwa is retained in Bintulu *təlu* 'egg' but deleted in *vaw* 'new'. The same is true in Mukah Melanau *təluh* 'egg' and *baʔəw* 'new', and in Rembong *təloʔ* 'egg' and *waru* 'new'. As before, the data is inconsistent with the stress-condition whereby schwa in penultimate syllables is retained or deleted as the result of contrastive stress. In the 'egg'/'new' examples consistent retention of a "stressed" schwa is expect but instead the pattern is of sporadic deletion in reflexes of *baqə́Ruh, which is reminiscent of what is found in reflexes of unstressed schwa.

The final point, that unstressed penultimate vowels of any quality, not only schwa, deleted in PMP, runs up against similar roadblocks. Ross lists five words that he claims support the inference that any unstressed penultimate vowel deleted in PMP which then gave rise to word-internal consonant clusters.

4)	a.	PAN *qali-məCáq ‘paddy leach’	> PMP *qali-mtáq
		PAN *paŋudáN ‘pandanus’	> PMP *paŋdán
		PAN *SamiCí ‘nightshade’	> PMP *amtí
	b.	PAN *qaNíCu ‘spirit’	> PMP *qanítu
		PAN *qali-mátək ‘forest leech’	> PMP *qalimátək

Again, the problem with these comparisons is that reflexes don’t agree with the reconstructions. For example, although Ross claimed that the schwa in PAN *qali-məCáq deleted in PMP, it appears in Palawano *limətaʔ*, Singi Land Dayak *rimotah*, and Hliboi *mutaʔ*. The opposite situation is found in reflexes of PAN *qaNíCu ‘spirit; ghost’. Although Ross reconstructs penultimate stress, the vowel is sporadically deleted in several MP languages: Malay *hantu*, Iban *antu*, Kayan *toʔ*, and Chamorro *anti*. The question one must ask is, why should irregular deletion of the penultimate vowel be evidence for final stress in PAN *qali-məCáq but not in PAN *qaNíCu?

Second, the reconstruction *SamiCí ‘nightshade’ is not completely agreed upon. Blust and Trussel (ongoing) list *SaməCi ‘nightshade’ with a schwa in the open penultimate syllable. A schwa penult lessens the impact of this comparison, because schwas delete throughout the AN family, as already shown. If schwa in penultimate syllables could not bear stress, then its widespread tendency for deletion may be straightforwardly explained as a product of a predictable stress pattern, not of contrastive stress.

This leaves PAN *paŋudáN ‘pandanus’ unexplained, as all evidence supports reconstructing PMP *paŋdan. This single word, however, cannot stand alone as evidence for a contrastive stress system. The incompatibility of Ross's stressable schwa hypothesis with MP data leaves us with little to work with. The hypothesis in the present study, that schwa was unable to hold stress in open penultimate syllables, is better supported by data from multiple primary branches of Austronesian.

These observations pose a problem for Ross’s claim that penultimate vowel deletion and retention at the PMP level was stress-conditioned, but follow naturally from a hypothesis whereby schwa was retained in PMP, and was deleted in various daughter languages as the result of phonetically motivated drift. Additionally, the observation that Budai Rukai has a contrastive stress system that is, at least superficially, similar to Philippine stress systems is intriguing, but the evidence does not appear to be conclusive. Here too, the question of PAN stress and of schwa’s stressability remains an open, if not contentious, issue.

1.1.3 ZORC, RECONSTRUCTING CONTRASTIVE STRESS TO PMP WITH PHILIPPINE EVIDENCE Zorc (1978) provides an important attempt to look beyond the Philippines to other Malayo-Polynesian languages for evidence that a contrastive stress system was present in PMP (Zorc uses “Proto-Hesperonesian, a subgroup that roughly corresponds with PMP). The study covers several topics. First, Zorc lays out the case for reconstructing contrastive stress to PPH, using evidence from Northern Luzon, Central Luzon, and Greater Central

Philippine languages. Second, he identifies word-final stress patterns that are conditioned by i) the presence of schwa in a reconstructed penult, and ii) the use of morphological stress. Third, he attempts to reconstruct both of these patterns to PMP through comparison with non-Philippine MP languages. He draws comparisons between Malay, Toba Batak, and Philippine languages to reconstruct phonetically-conditioned and morphological stress, but looks to Madurese as a non-Philippine witness for lexically marked stress at the PMP level.

Zorc's recognition that schwa may not hold stress in a penultimate syllable does not differ from the present study and the examples of where stress was utilized as a morphological marker provide useful additional insights into PAN and PMP stress. The conditions that determine predictable word-final stress from Zorc 1978 are listed below:

- stress shift to the final syllable after a penultimate schwa.
- stress shifts to the final syllable to denote a stative, with evidence from the Philippines, Toba Batak and Philippines.
- Stress shifts to the final syllable in Vocatives, with evidence from the Philippines, Toba Batak, and Malay/Indonesian.

Zorc also attempts to reconstruct lexically-marked contrastive stress to PMP by looking to Madurese. Zorc claims that gemination in Madurese, which is partially predictable by the presence or absence of a schwa in the penult, corresponds to final-stress in Philippine languages and therefore that contrastive stress may be reconstructed to PMP since Philippine and Madurese represent a genetically diverse group of languages in separate primary branches. Because final stress is predictable from schwa, the only relevant examples will be those where Madurese words have a geminate onset to the final syllable but follow from a proto-word with a vowel other than schwa in the penult. While Zorc's initial comparison is promising, with several examples of words where Philippine cognates have a vowel other than schwa in the penult and word-final stress that correspond to geminates in Madurese, Blust (2013: 555-556) was able to compile a second list with just as many examples of Philippine word-final stress failing to correspond with gemination in Madurese. So, although Zorc's study provides very important insights into the role of schwa and morphology in stress placement, it does not show convincingly that a lexically-marked system of contrastive stress is reconstructable beyond the Philippines.

1.2 SUMMARY AND OUTLINE This brief review on hypotheses of PAN contrastive stress was meant to give the reader a grasp on where the field is vis-à-vis the evidence supporting a contrastive stress system in PAN and PMP. While there are numerous arguments in support of such a hypothesis, they all tend to suffer from a lack of clear cognates beyond those that are restricted only to Philippine languages. Budai Rukai and Madurese evidence, which has been utilized in some of the strongest arguments for a contrastive stress system, does not appear to withstand close scrutiny, unless the many exceptions are somehow shown to be unimportant. Of the contrastive stress hypotheses, Zorc's reconstruction largely agrees with those being proposed in the current study. Namely, that stress could fall on an open penultimate syllable except where the penult contained a schwa nucleus. But again, Zorc's view differs from the present hypothesis in his reconstruction of a lexical stress system to PMP, based on comparisons between his PPH reconstructions and words with geminate consonants in the onsets of final syllables in Madurese. The present study asserts that stress was *regularly* penultimate, but shifted to the final syllable

under predictable phonetic conditions and as part of a system of morphological stress movement. There are three main hypotheses discussed in this study, described below:

- Stress was penultimate in PAN and PMP, but shifted to the final syllable if the penultimate syllable was open and its vowel schwa.
- Schwa's inability to hold stress stems from its status as a zero-weight vowel; it did not contribute to lexical mora count.
- Seemingly unrelated sound changes, consonant gemination, schwa deletion, and the shift of schwa to a full vowel in the penultimate syllable (but not in other syllables), may be united under a single hypothesis whereby words with a zero-mora schwa are sub-minimal and undergo diverse repair strategies as a result.

To reconstruct stress shift after schwa evidence from multiple AN primary branches is needed, which makes Formosan evidence crucial for the present hypothesis. As I show in the following sections, Formosan languages do indeed reflect a system where penultimate-syllable schwa caused stress to shift to the final syllable. This study's assumptions on AN higher-order subgroups follow Blust (1999) who posits ten primary divisions, nine Formosan plus Malayo-Polynesian. Malayo-Polynesian internal subgrouping follows Smith (2017d), who proposes nine primary branches.

FIGURE 1
AUSTRONESIAN AND MALAYO-POLYNESIAN SUBGROUPING (BLUST 1999)

AUSTRONESIAN	MALAYO-POLYNESIAN
Tsouic	Philippine
Western Plains	Western Indonesian
Northwest Formosan	Sumatran
Atayalic	Celebic
East Formosan	South Sulawesi
Bunun	Central-Eastern Malayo-Polynesian
Rukai	Moken
Puyuma	Chamorro
Paiwan	Palauan
Malayo-Polynesian	

Competing subgrouping proposals, specifically Ross's 2009 model, are generally compatible with the present hypothesis. Ross proposed that PAN diversified into four primary divisions, Rukai, Puyuma, Tsou, and Nuclear Austronesian. Although much of the evidence that will be presented in this study is restricted to Ross's "Nuclear-Austronesian", Puyuma also provides evidence of regular penultimate stress with stress shift after a penultimate schwa outside of Nuclear AN. The present hypothesis is therefore compatible with multiple subgrouping models, especially those which recognize the first-order diversity of Formosan languages.

From here the paper will dive into the details of why penultimate stress with stress-shift after schwa must be reconstructed to PAN, and later into the motivations for reconstructing schwa as a weightless vowel. Section 2 gives the preliminaries of PAN reconstruction; what do we know about PAN phonotactics and what evidence is there to treat schwa as "special"? From

here sections 3 and 4 provide evidence from MP and Formosan languages respectively that supports the reconstruction of penultimate stress with stress shift after a penultimate schwa. Section 5 provides the full reconstruction based on evidence from the previous sections. Section 6 presents the hypothesis of a zero-mora schwa, which also continues with a list of segmental phenomena found throughout MP that appear to be repair strategies targeting sub-minimal words with a schwa penult for mora-addition (listed earlier in this section). In section 7 a summary of the findings is presented, showing that schwa did not contribute to lexical mora-count, that stress was penultimate unless the penultimate syllable contained an unstressable schwa, and that multiple seemingly unrelated sound changes can be unified under a single analysis of the enforcement of a two-mora minimum.

2 PRELIMINARIES: PROTO-AUSTRONESIAN PHONOTACTICS This section provides a review of some of the phonotactic restrictions that can be reconstructed to PAN based on both previous research and further evaluation of the reconstructed lexicon. Reconstructions in this work are primarily from the *Austronesian Comparative Dictionary* (Blust and Trussel ongoing) unless otherwise noted. This section covers word-shape and vowel phonotactics, but not consonant phonotactics since they have little impact on the reconstruction of stress. The section begins with word-shape, which was constrained to a canonical two-syllable, two-mora word with no consonant clusters and closed syllables only in word-final position (Blust 2013, Chretien 1965, Dempwolff 1937, Ross1992). The sole exception is in reduplicated monosyllables, a class of words that contain a bound monosyllabic root which only appears in reduplicated contexts where the restriction on word-internal codas is lifted. Both canonical word shape and reduplicated monosyllable word shape are given in the following figure.

5)	Canonical word	CVCV(C)
	Reduplicated monosyllable	CVCCVC

The only monosyllabic words which are reconstructed to PAN, are of one of two types; 1) grammatical words and particles and 2) onomatopoetic words (with minimal attestation). Examples of monosyllabic grammatical words include PAN *ka ‘conjunctive particle, and’, *maS ‘and’, *na ‘linker marking emphatic attribution’ and some examples of onomatopoetic words include PAN *tik ‘sound of tapping or flicking’ and PAN *bəs ‘whizzing sound’. Blust (2013:539) made the same observation and noted that these words were phonologically bound to adjacent content words. The restriction against monosyllables therefore only stands with phonologically independent content words.

Regarding the vowels, there is consensus agreement on their basic phonetic properties. There were four vowels in PAN, which this study separates into two types, the “main” or “full” vowels *i, *a, and *u which had no phonotactic restrictions and were free to appear in any position, and *ə, which was the subject of numerous unique distributional restrictions. Some of these restrictions have been discussed in previous research (see citations below), but others are newly recognized.

- Schwa could not appear word-final position. (Blust 2000b:88)
- Schwa could not appear word-initial position, with only two exceptions; the numerals *əsa ‘one’ and * ənəm ‘six’.

- Schwa was absent from both prefixing and infixing morphology. The patient voice suffix *-ən was the only "schwa-full" affix.
- Schwa could not be immediately followed by a glide, *w or *y. (Mills 1975)

PMP inherited many of the same restrictions on schwa that were present in PAN, including a ban on schwa in word-final position and from both prefixing and infixing morphology. Schwa restrictions were lifted in word-initial position, however, and PMP has several examples of word-initial schwa in addition to the two PAN examples, *əsa 'one' and *ənəm 'six', including PMP *əma 'father's sister', *əmpu 'grandparent; grandchild', and *əpat 'four', among others. PMP also relaxed consonant cluster restrictions relative to PAN. Prenasalized stops were prevalent in intervocalic position in PMP and more generally, words of the shape CVCCVC became more common in PMP outside of reduplicated monosyllable contexts.

With these observations one can make relatively non-controversial generalizations about PAN word shape. i) Content words were minimally two-syllables. ii) The vowels are divisible into two classes, the main vowels and schwa. iii) Schwa was permitted in root-internal closed syllables, unless the syllable was closed with a glide. iv) Schwa was permitted in open penultimate syllables unless that syllable was followed by a glide, but not other open syllables. v) Consonant clusters were restricted to reduplicated monosyllables. Schwa was clearly a "special" vowel in PAN and PMP, and the nature of schwa's special status will be discussed more in the following sections with special attention to schwa's interaction with stress. As will be shown in the rest of this paper, MP and Formosan evidence supports the proposal that penultimate schwas were unstressable in PAN. In the following two sections, the MP evidence is separated from the Formosan evidence only because of the size of the subgroup. MP evidence is not more important from Formosan evidence, as both MP and Formosan subgroups are first-order subgroups, but MP evidence is more complex as a result of its size and necessarily involves much focused research.

3 STRESS AND SCHWA IN MALAYO-POLYNESIAN The MP evidence for stress shift after schwa is, to put it bluntly, overwhelming. Even in Philippine languages where stress may be phonemic there are numerous examples of stress shift after schwa. In those cases, stress is normally unpredictable, but its phonemic status is neutralized wherever there is a schwa in the penult. In cases where schwa has merged with some other vowel, one can still observe that historical schwa caused stress shift to the final syllable before the merger took place (see Zorc 1972 for an overview of Central Philippine languages where this is true). The Philippine subgroups where schwa caused observable stress shift are Central Luzon, Northern Luzon (sometimes referred to as Cordilleran), Greater Central Philippines, Sangiric, Minahasan, and Bilic. Other Philippine subgroups where stress-shift is not directly observed may nevertheless contain segmental evidence that schwa was historically unstressed. That evidence is also included below (see section 3.1 on Itbayaten). Outside of the Philippines, evidence that stress is repelled to the final syllable if the penult was schwa is found in Sumatran languages, numerous Western Indonesian languages (Central Sarawak, Kenyah, Malay), and the Sumba-Flores subgroup of Central Malayo-Polynesian, in addition to cases where stress-shift is not directly observed but segmental data provides indirect evidence that schwa was uniquely unstressed sometime in the past. This section begins with the Philippine data before moving westward and southward to the other languages.

3.1 ITBAYATEN Blust (2017) describes a historical process where words of the shape *$C_1əC_2VC_3$ are reflected by $aC_1C_2VC_3$ in Itbayaten. One interpretation of these data is that schwa deleted, causing a word-initial consonant cluster that was later divided between syllables through prothesis of a vowel, *a*. In Bashiic, Blust (2017:498) interprets the deletion of schwa as evidence for a past system where stress was penultimate but shifted to the final syllable when the penultimate vowel was schwa despite Yamada (1967:367), who described modern-day Itbayaten stress as word-final. This implies that before stress shifted to the final syllable across-the-board in Itbayaten that stress was historically penultimate and only shifted to the final syllable if the penultimate vowel was schwa. If stress were final throughout the history of Itbayaten, one might expect deletion of unstressed *i, *u, and *a as well as schwa. Several examples are organized in table 1 below which demonstrate the deletion of schwa in open penultimate syllables.

TABLE 1
ITBAYATEN PENULTIMATE SCHWA DELETION

PMP	Itbayaten	
*bəsuR	absoy	satiated
*dəkət	adkət	to stick; adhere
*dəpah	adpa	fathom
*təlu	atlo	three

Blust also entertains a competing hypothesis whereby the segments *Cə- underwent metathesis to *əC-, with schwa later merging with *a as Itbayaten *a*. This alternative scenario, although it does not acknowledge a deletion state, could still have been motivated by the prosodic qualities of schwa. Metathesis adds a support syllable to schwa which may have then acted as moraic, $əC^{\mu}.CVC^{\mu}$ with merger of schwa and *a occurring later. In any case, schwa in open penultimate syllables in Itbayaten acted in a way that suggests it had a special status and was unstressed.

3.2 CENTRAL LUZON This section on Central Luzon focuses on Kapampangan, a relatively well documented Central Luzon language that provides a solid example of how stress-shift to the final syllable after penultimate schwa is true even in Philippine languages where phonemic stress is widespread. Kapampangan has both shifted stress to the final syllable and deleted schwa in historically open penultimate syllables. Examples are organized in table 2 below:

TABLE 2
KAPAMPANGAN WORDS WITH STRESS SHIFT

PMP	Kapampangan	
*bəRək	abyák	suckling pig
*bəRas	abyás	milled rice
*ənəm	anám	six
*təbuh	atbú	sugarcane
*təlu	atlú	three

Like Itbayaten, schwa deletion in Kapampangan triggered vowel prothesis, but importantly, the newly innovated penultimate vowel (always *a*), is not stressed. Stress rather falls on the final

syllable even though penultimate syllables in Kapampangan may otherwise be lexically marked for stress. It can clearly bee seen that schwa caused stress shift if one compares reflexes of *ənəm ‘six’ and *qalun ‘wave’. Penultimate schwa in *ənəm triggered word-final stress followed by vowel prothesis, but *qalun retains *a in the penult and has no stress shift. The result is a synchronic distinction between stressed and unstressed vowels in the penultimate syllable, *anám* and *álun.*

3.3 NORTHERN LUZON Ilokano is one of the best documented Northern Luzon languages and also displays stress shift after PMP penultimate schwa even though stress in the modern language is phonemic. In the following tables, Table 3 shows cases where penultimate schwa caused stress to shift to the final syllable and where stress stays in place if the penultimate vowel is not schwa. Note that although there are also words that reflect a full vowel in the penultimate syllable and have final stress, the important fact is that there are *no* words that reflect a schwa penult and have penultimate stress.

TABLE 3
STRESS SHIFT AFTER SCHWA IN ILOKANO

	PMP	Ilokano	
*ə penult	*dəkət	dəkkát	paste; adhesive
	*dəpah	dəppá	length of outstretched arms
	*təlu	talló	three
	*təkən	təkkán	punting pole
full-vowel penult	*kaka	káka	elder sibling
	*kutu	kúto	louse
	*likaw	líkaw	curve; bend

Other Northern Luzon languages show the same pattern as Ilokano. Pangasinan, for example, has synchronic contrastive stress but reflects a more ancient pattern where stress shifted to the final syllable after penultimate schwa. Some examples include *əpat > *apát* ‘four’, *qapəju > *apgó* ‘gall; bile’, and *bəRək > *bəlák* ‘suckling pig’. Note that schwa is deleted in the environment VC_CV(C)# and is either retained as schwa or merged with *a elsewhere. Other than Pangasinan, at least Isnag, Ibanag, Central Cagayan Agta (Healey 1960), and Ifugao reflect the same stress-shift after penultimate schwa pattern. Stress shift in this environment can therefore be confidently reconstructed to Proto-North Luzon.

3.4 GREATER CENTRAL PHILIPPINES Zorc (1972) was the first to systematically describe the relationship between proto-word and stress in Central Philippine languages. In his description he notes that wherever schwa can be reconstructed in PPH or PMP open penultimate syllables, stress shifts to the final syllable in both Tagalog and Aklanon. The same pattern is observable in other Greater Central Philippine languages, like Cebuano Bisaya, where a survey of forms on the *ACD* reveals stress shift after historical schwa, in Palawan Batak where the same pattern is observed, and in Northern Subanen where Daguman (2004:47) makes the following observation, “In Northern Subanen, primary stress usually falls on the penultimate syllable of the phonological word... However, when the nucleus of a penultimate syllable is occupied by the mid-central vowel /ə/, primary stress falls on the final syllable...”. The same observation was

made by DuBois (1976) regarding the stress pattern of Sarangani Manobo. Some of the evidence is presented below in table 4 for Cebuano Bisaya and Palawan Batak. Examples for Northern Subanen can be found in Daguman's description.

TABLE 4
STRESS SHIFT AFTER SCHWA IN SOME GCP LANGUAGES

PMP	Palawan Batak	Cebuano Bisaya	
*bəRas	bəgás	bugás	uncooked rice
*qaləjaw	ʔaldáw	adláw	day
*kəsəR	ma-kəsə́g	kusúg	strength; vogor; force
*əsa	ʔəsá	usá	one

Like Northern Luzon, the pattern described for Greater Central Philippines is so widespread that it warrants reconstruction to Proto-Greater Central Philippines.

3.5 SANGIRIC Sangiric languages provide a mixed bag of sorts regarding stress placement and schwa. In Sangil, spoken in southern Mindanao, Philippines, Sneddon (1984:24) reports that stress is penultimate but shifts to the final syllable if the penultimate vowel is a schwa. He earlier states, however, that Sangir, closely related but spoken on the islands between Mindanao and northern Sulawesi, has regular penultimate stress regardless of the vowel. There are no examples to investigate and it is not clear which pattern is innovative and which is inherited. Sneddon claims that the stress shift pattern is innovative, but there is a complication. Sangiric is split into two primary branches, North Sangiric (which includes Sangil, Sangir, and Talaud), and South Sangiric (which includes Bantik and Ratahan). In South Sangiric both Bantik and Ratahan are reported with stress shift after penultimate schwa (Sneddon1984:53) which means both primary branches contain evidence for stress shifts to the final syllable after a penultimate schwa but only one, North Sangiric, contains languages that keep stress on schwa. This distribution strongly suggests that the regularized pattern, which is restricted to a single subgroup, is innovative and that the stress-shift-after-schwa pattern, which is present in all primary branches, is a retention. Sneddon cites the presence of geminate and preglottalised consonants after penultimate schwa in Sangir and Talaud as evidence that stress was historically on the penult, and shifted in languages that did not geminate or preglottalize stops. This argument has one major flaw, however: Sangil, which has stress shift, also geminates stops after schwa. It does not appear, then, that gemination and preglottalization are strictly associated with regular penultimate stress. Since only the stress-shift-after-schwa pattern is attested in both primary branches it is therefore best to reconstruct stress-shift-after-schwa to Proto-Sangiric and view Sangir and Talaud as having undergone stress regularization.

3.6 BILIC Bilic languages are spoken on Mindanao, and wherever descriptions are available show synchronic stress-shift to the final syllable if the penultimate syllable is a schwa. Schlegel (1971:7) states, for example, that Tiruray stress "…falls on the penult or antepenult of polysyllabic bases, except when the vowels of those bases are shortened, in which case stress is on the ultima." A shortened vowel, as per Schlegel's description on page 6, is schwa wherever it "…occurs in open syllables and in syllables in which the /e/ [schwa] follows a glottal stop and precedes a nasal that assimilates to the point of articulation of the following consonant." Tiruray

therefore continues a historical stress pattern that is reflected in all other languages described thus far.

3.7 TONDANO AND MINAHASAN Tondano is a Minahasan language, spoken in Minahasa on the eastern-most region of the northern peninsula on the island of Sulawesi. Genetically, Minahasan languages are Philippine and where adequate descriptions are available, Minahasan languages allow for penultimate stress except where the penultimate syllable is open and its vowel schwa. This is the case for Tondano, exemplified in table 5 below, where stress shifts to the final syllable of two and three syllable words with a schwa penult (Sneddon 1975).

TABLE 5
TONDANO STRESS SHIFT

PMP	Tondano	
*qatəluR	atəlú	egg
*səlaR (PPH)	səlá	big
*təlu	təlú	three
*qaləjaw	ədó	day

3.8 CHAMORRO Chamorro may represent a primary branch of Malayo-Polynesian, as implied by Blust (2000b) and argued for in Smith 2017d. Chamorro merged PMP schwa with *u as Chamorro *u* except where schwa appeared in a deletion environment. The deletion environment in Chamorro is VC_CV(C)#, just like in Ilokano, Tagalog, and several Formosan languages discussed later on. The merger of schwa with *u elsewhere allows us to order these changes. Schwa deletion must have happened before merger with *u, because *u did not regularly delete in the environment VC_CV(C)#. Schwa deletion is thus a more ancient phenomenon, motivated by the same inability for schwa to bear stress in open penultimate syllables that was present in both PAN and PMP. Blust (2000b:90-92) also interprets the data as implying an unstressed schwa, and notes that "pre-Chamorro schwa could not bear stress, whether the language had phonemic stress that agreed in cognate forms with the stress contrasts of Philippine languages, or not."

3.9 SUMATRAN LANGUAGES Sumatran, as the term is used here, is a linguistically defined subgroup and not simply "the languages of Sumatra". According to Smith (2017d), who based his analysis partially on the "Northwest Sumatra-Barrier Islands" subgroup proposed earlier by Nothofer (1986), Sumatran contains the Sumatran barrier island languages (Enggano, Mentawi, Nias, Sixule, Simeulue), Nasal, and the Batak languages. Many of these languages remain poorly documented and therefore cannot be discussed in any detail, but there is still some information on stress available. Adelaar (1981) reports that stress shifts from the penultimate to final syllable where the penultimate syllable was schwa in Karo and Dairi Batak. Adelaar continues to reconstruct stress shift after penultimate schwa as a feature of Proto-Batak (pg 17). Gayo, which Nothofer placed in Northwest Sumatra-Barrier Islands, follows the same stress pattern. Eades and Hajek (2006:112-113) note that the acoustic correlates of stress in Gayo are typically spread over a two syllable window in connected speech, except where a schwa appears in an open penultimate syllable, in which case the stress correlates are restricted to the final syllable.

3.10 WESTERN INDONESIAN Western Indonesian refers to a large and mostly lexically defined subgroup first proposed by Blust (2010) and later expanded upon by Smith (2017d). It includes all indigenous languages of Borneo, Malayic and related languages, the languages of Java, Bali, and Lombok, but excludes the Sumatran group. Like Sumatran, Smith (2017d) considers Western Indonesian a first-order daughter of PMP. Stress shift to the final syllable after penultimate schwa is widespread in Western Indonesian languages.

3.10.1 MALAY AND INDONESIAN Malay and Indonesian stress is often described as being penultimate in words with full vowels in the penultimate syllable and in words with schwa in a closed penultimate syllable. Where schwa appears in an open penultimate syllable, however, stress is described as falling on the final syllable (Macdonald and Darjowidjojo 1967).

3.10.2 KENYAH Kenyah languages form a primary subgroup within North Sarawak. A genetically diverse range of Kenyah languages have been described as having penultimate stress except where the penultimate vowel was schwa, in which case stress falls on the final syllable. Some examples include Long Wat, in which Blust (nd) recorded penultimate stress in *lúəh* from *duha 'two' and *búlun* from PMP *bulu(-n) 'body hair' but final stress in *təláw* from PMP *təlu 'three' and *təbáw* from PMP *təbuh 'sugarcane'. The same pattern was reported by Antonia Soriente (Blust 2007b via personal communication) in Òma Lóngh, a divergent Kenyah language spoken in Kalimantan that belongs to a separate primary branch from Long Wat.

3.10.3 CENTRAL SARAWAK Central Sarawak is a Bornean subgroup first proposed by Smith (2017a). It includes Melanau, Kajang, Punan, and Müller-Schwaner. In Mukah Melanau, Blust (1988c:178) notes that stress is typically on the penultimate syllable in phrasal contexts but that stress is on the final syllable if the penultimate syllable has a schwa nucleus. Smith 2017a also recorded final stress where the penultimate syllable contains a schwa in Sekapan (of the Kajang group), for example, *bəbaw* 'tall' is pronounced [bəbːáw], with exceptional word-final stress triggered by the presence of a schwa in the penult. See §6.3.5 for more on Sekapan and other Kajang languages.

3.10.4 KAYAN Kayan languages have penultimate stress, although Clayre and Cubit (1974) describe stress as being even on penultimate and final syllables in the dialect of Kayan spoken along the Baram river in Borneo (a typical realization of stress in even trochees). Wherever it is recorded, however, Kayan dialects actively shift stress to the final syllable if the penult is a schwa (Clayre and Cubit [1974] for Baram river Kayan and Smith [2017a] for Data Dian Kayan, spoken in Indonesia). Clayre and Cubit (1974) also note a difference in pronunciation between stressed and unstressed schwa with the word *mətəŋ* 'to ask', where schwa is pronounced [ʌ] if in a stressed final syllable: [mətʌ́ŋ].

3.11 SUMBA-FLORES, STRESS SHIFT IN CMP From the few descriptions that are available, a system of default penultimate stress with stress shift to the final syllable after a penultimate schwa is attested in a few Sumba-Flores languages, Kéo, Manggarai, and Ngadha, all three members of the Western-Central Flores division of Sumba-Flores. Baird (2002:53) provides the following description of stress in Kéo: "Stress in Kéo is predictable: it typically falls on the penultimate syllable of the word. The exception to this is in disyllabic words in which there is a schwa in the first syllable, in which case stress fall on the ultimate syllable". Regarding

Ngadha, Djawanai (1977:14) makes the following statement about stress, “The stress is always on the next to the last syllable (penultimate), which is the first syllable in most words. However, the stress may be shifted to the last syllable when the first syllable contains a schwa.” Manggarai was reported by Blust (2008) as having stress on the penultimate syllable unless the syllable has a schwa nucleus and was followed by a simplex consonant. There is therefore evidence from multiple languages for a system of default penultimate stress with stress-shift to the final syllable after a penultimate schwa in Sumba-Flores.

3.12 SUMMARY MP languages are quite diverse, but nevertheless show an unmistakable preference for penultimate stress an exceptional with word-final stress if the penult contained a schwa nucleus. The major exceptions in MP are Celebic and Palauan, which both have penultimate stress (synchronic and diachronic) regardless of the historical vowel. In both, schwa shifted to either *o* or *e*, so these examples can easily be explained as a process of stress regularization after the elimination of inherited schwa. With so much evidence from across multiple primary divisions the best course of action is to reconstruct a system where stress was penultimate but where stress shifted to the final syllable after a penultimate schwa all the way to PMP. This, in turn, will provide evidence that the same system was present in PAN after comparison with the Formosan evidence, discussed next.

4 STRESS AND SCWHA IN FORMOSAN LANGUAGES The synchronic stress systems of Formosan languages are diverse, with some languages displaying penultimate stress, some final, and at least one displaying contrastive stress. Tsouic, Western Plains, Paiwan, and most Rukai dialects have a default penultimate stress system (Budai Rukai has a phonemic stress system, but other Rukai languages do not [Li 1977]). Northwest and East Formosan have word-final stress and other Formosan subgroups (Bunun for example) have conflicting reports of stress in the literature. Despite their synchronic diversity, however, there are at least two types of evidence that modern Formosan languages descend from a proto-language where schwa could not bear stress in open penultimate syllables: 1) subgroups that maintain a system of stress-shift after penultimate schwa and 2) subgroups where penultimate schwa deletes, but other vowels do not. Type one subgroups are Western Plains and Paiwan, which shift stress to the final syllable if schwa appeared in the penult. Type 2 subgroups are East Formosan (Amis), Northwest Formosan (Saisiyat), Atayal, and Puyuma.

4.1 WESTERN PLAINS Western Plains is a Formosan, first-order Austronesian subgroup. Western Plains data comes from Thao, perhaps the best-known Western Plains language, which has a dictionary and descriptions of stress. According to Blust (2003b, 2013), Thao has penultimate stress except in words that historically had schwa in an open penultimate syllable. In these words, stress falls on the final syllable and schwa was deleted. The following data in table 6 are from Blust 2013:656) with supplemental evidence from the *ACD*. Stress markings have been added in accordance with Blust's description.

TABLE 6
SCHWA DELETES IN OPEN PENULTIMATE SYLLABLES AND STRESS SHIFTS TO THE FINAL SYLLABLE

	PAN	Thao	
*ə in open penult	*baqəRuh	faqlhúh	new
	*kəRiw	klhíw	hemp
	*kəRət	klhít	cut; sever
full-vowel in open penult	*bukəS	fúkish	head hair
	*RaməC	lhámic	root of tree or grass
	*ŋipən	nípin	tooth
*ə in closed syllable	*ləmləm	ma-rúmrum	dim; unlit
	*qaRəm	qálhum	pangolin
	*dakəp	sákup/sápuk	catch; seize

To review, Thao regularly stresses the penultimate syllable of words with a single historically-conditioned exception; if schwa appeared in an open penultimate syllable then stress is word-final and the penultimate schwa was deleted. Closed penultimate syllables did not undergo deletion or stress shift, regardless of the quality of the vowel.

4.2 PAIWAN Blust (1999) lists Paiwan as a primary branch of Austronesian and Chen (2004) provides a thorough description of Paiwan phonetics. In Paiwan, stress falls on the penultimate syllable except where the penultimate syllable is a schwa, in which case it shifts to the final syllable (Chen 2004:36–39). Chen provides the following examples of stress shift after schwa (example 6) and notes that the acoustic correlates of stress are longer duration, higher pitch, and greater intensity:

6) *kəmələ́ŋ* ‘to know’
masəŋsə́ŋ ‘to work’
mipərəpə́r ‘to fly’

Paiwan is thus similar to Thao in that stress regularly falls on the penultimate syllable, except where the penultimate syllable is schwa, in which case stress shifts to the final syllable. Unlike Thao, Paiwan did not undergo the additional deletion of unstressed penultimate schwa and also unlike Thao, Paiwan maintains stress shift as a synchronic property of its phonology.

Thao and Paiwan provide examples of Formosan subgroups that directly continue the reconstructed stress system of penultimate stress with stress shift to the final syllable after a penultimate schwa. They combine with MP to provide direct evidence from three primary branches of AN. Other Formosan languages do not have stress systems that allow for a direct investigation into stress shift. In Northwest and East Formosan, for example, stress falls regularly on the final syllable regardless of the quality of the penult. It is impossible, then, to compare the stress pattern of words that reflect a penultimate schwa versus those which reflect a main vowel in the penult; both will have word-final stress. There is, however, indirect evidence that even languages with synchronic word-final stress descend from an ancestor that had penultimate stress except when the penult was open and had a schwa. That evidence is discussed next.

4.3 AMIS Amis has regular word-final stress but also reflects a historical change where schwa deleted in open penultimate position but main vowels did not (compare to Itbayaten from earlier). This implies that schwa was unstressed in penultimate syllables before East Formosan languages shifted stress to the final syllable across the board. Amis presents certain difficulties, however, partially because stress has been inconsistently reported and also because of the ambiguous status of extra-short vowels that separate consonants in clusters. First, a table showing the deletion of schwa but retention of main vowels in the penultimate syllable are presented followed by a discussion of the difficulties associated with the status of the short transition vowels.

TABLE 7
SCHWA DELETION IN OPEN PENUNULTIMATE SYLLABLES AND RETENTION IN CLOSED SYLLABLES IN AMIS

PAN	Amis	
*baqəRuh	faʔloh	new
*pakəhu	pahko	edible fern
*Səmay	hmay	cooked rice
*kəmkəm	kəmkəm	to chew something hard
*bəjbəj	fədfəd	bound with lots of string
*kəRkəR	kəlkəl	heart response causing someone to shake
*kuməS	komәs	pubic hair
*liqəR	liʔəl	neck
*baŋəS	faŋәs	skin

These data are striking, and support the hypothesis that schwa in open penultimate syllables was not stressed given its deletability in this but not other positions. There are, however, apparent exceptions to this pattern that show schwa retention in the penult. Some examples are Amis *fəcol* 'satiated' from PAN *bəsuR, *səma* 'tongue' from PAN *Səma, and *təfos* 'sugarcane' from PAN *təbuS. These seem to lessen the strength of the comparisons in table 7, but phonetic studies of Atayal may shed light on why some entries were recorded with a penultimate schwa, and others without. According to Maddieson and Wright (1995), wherever schwa appears in the penultimate syllable of an Amis word it is not a true vowel, but a realization of the release of the word-initial consonant. Thus, what appear at first to be unconditioned exceptions to penultimate schwa deletion may in reality be variations in the transcription of the initial consonant release. Historically, then, it is likely that Amis deleted all open penultimate schwas, which created clusters in word initial position where the first consonant has an audible release into the second. This, in turn, suggests that schwa deleted in penultimate position as an unstressed vowel before stress shifted to the final syllable in Proto-East Formosan.

4.4 ATAYAL Huang (2018:271) states that "Proto-Austronesian (PAN) *ə in the final syllable has become /u/ in the final syllable in all Atayal dialects" and further, that "Squliq words with apparent consonant clusters before final syllables are reconstructed with a schwa between CC in Proto-Atayalic". Stated differently, schwa merged with *u in the final syllable but deleted in the penultimate syllable. One may point out that Atayal has across-the-board word-final stress, and

that the deletion of penultimate schwa follows from a recent stress-shift event and not a property of PAN stress. It should be noted, however, that only schwa deletes in unstressed penultimate vowels; the main vowels never delete in this position even though they are also unstressed. This once again implies that the synchronic word-final stress of Atayal is not responsible for penultimate vowel deletion, but that vowel deletion follows from a more ancient system where *only* schwa was unstressed in penultimate syllables.

4.5 PUYUMA Puyuma is a primary branch of Austronesian according to both Blust (1999) and Ross (2009). It has regular word-final stress and typically retains schwa in open penultimate syllables but deleted penultimate schwa in the environment VC_CV(C)# with a small number of exceptions. Some examples of these words are shown in Table 8.

TABLE 8
PUYUMA SCHWA DELETION

PAN	Tamalakaw Puyuma	
*ləmək	a-lmək	soft and flexible
*qaŋəRu	HaŋRu	odor of salted meat
*qaəŋəSəR	HaŋsəR	stinking of urine
*tagəRaŋ	tahraŋ	chest

Puyuma does not allow for complex onsets, so the retention of schwa in the penultimate syllable of two syllable words may be motivated by the ban on complex onsets; If a word of the shape CəCVC underwent unstressed schwa deletion it would have created an illicit cluster: CCVC. Schwa was therefore only able to delete in penultimate position if the resulting consonant cluster could be split between two syllables. This is confirmed in cases where two-syllable words are affixed, moving a previously non-deletable schwa into the environment VC_CV(C)# where it then deletes: Puyuma *Hasəy* 'smoky' > *Hasyan* (/Hasəy-an/) 'smoke', *ənəm* 'six' > *aʔnəm* (/a-ʔənəm/) 'six, of persons', and *kiŋəR* 'listen; hear' > *kiŋRi* (/kiŋəR-i/) 'listen (imperative)'. Since the main vowels do not delete in this position, it can safely be assumed that Puyuma descends from an ancestor language where schwa was unstressed in open penultimate syllables and that this motivated schwa deletion in three-syllable words.

4.6 SAISIYAT Saisiyat, like Puyuma, bans complex onsets and therefore only deleted penultimate schwa in the environment VC_CV(C)#. Also like Puyuma, a schwa that is outside of the deletion environment in root words may delete with affixation, for example, *kœhma* 'tonge', from /ka-həma/ in table 9. One may draw the same conclusion from these Saisiyat data that were drawn from the Puyuma data; namely, that schwa was historically unstressed in open penultimate syllables.

TABLE 9
SAISIYAT SCHWA DELETION

PAN	Saisiyat	
*Səma	kæ-hma	tongue
*səqun	kæ-hʔœŋ	horn
*kəRiw	ka-kLiw	hemp
*lisəqəs	Liʔʃiʃ	nit

4.7 REFLEXES OF PENULTIMATE SCHWA IN OTHER FORMOSAN LANGUAGES
Not all Formosan languages and subgroups have clearly analyzable stress systems. Some, such as Tsouic, Bunun, and Rukai have obscured the historical relation between schwa and stress or have irregularity in reflexes. Tsouic languages are ambiguous regarding the stressability of penultimate schwa for the following reasons. 1) Most Tsouic words with a final consonant added an echo vowel, which shifted the historically final syllable to penultimate position. Stress followed, and in most Tsouic languages it falls either on the synchronic penultimate syllable or on the penultimate mora if words end in a long vowel. Because the historical penultimate vowel is now in antepenultimate position, it is impossible to tell what the historical stress pattern was. In the one example from Tsou of a penultimate schwa in a word that did not add an echo vowel, the schwa merged with *u and stress regularized itself on the penultimate syllable, obscuring the historical position of stress: PAN *təlu > *turu* 'three'.

Rukai languages regularized stress to the historically penultimate syllable, which is the synchronic antepenult in many words that have added echo vowels. Schwa does not affect stress in Rukai, and it is the only Formosan language where stress is clearly unaffected by vowel quality.

Bunun, on the other hand, has a mixed pattern. Schwa usually became *u in closed syllables, a pattern that is by now familiar for Formosan languages. In open penultimate syllables, however, there is a mixture of retention and deletion. Schwa was deleted in *liv* 'hemp plant' from PAN *kəRiw, *pat* 'four' from PAN *Səpat, and *ma-tinʔun* 'to weave' from PAN *tənəqun but is retained in *qunul-an* 'animal haunt' from PAN *qəNuR-an, *tau* 'three' from PAN *təlu, and *paʔav* 'gall' from PAN *qapəju. It therefore shows a tendency for penultimate schwa deletion, but not as a strict sound change. To make matters worse, the synchronic stress pattern of Bunun is poorly understood. DeBusser (2009) states that stress falls mostly on the penultimate syllable, but Li (2019) states that stress may be penultimate or final. Some claim that younger speakers pronounce words with final stress, older speakers with penultimate stress, but overall there is a mixture. It may be worth noting that in Bunun, although penultimate schwa deletion is sporadic, the full vowels do not also delete. Full vowels are therefore regularly retained in open penultimate syllables but schwa is only sometimes retained.

4.8 REVIEW The Formosan evidence for reconstructing stress-shift after penultimate schwa is fairly robust. Western Formosan and Paiwan show direct evidence for stress shift after a penultimate schwa. Several other Formosan languages, Amis from East Formosan, Atayal and Saisiyat of Northwest Formosan, and Puyuma deleted schwa where it appeared in open penultimate syllables. In the case of Amis and Atayal, deletion occurs across-the-board, that is, no additional conditions need to be met for penultimate schwa deletion. Puyuma and Saisiyat have the additional requirement that penultimate schwa deleted only in three-syllable words

(either as part of a root or through affixation). I argue that schwa deleted in this position because, unlike the main vowels, schwa was always unstressed where it appeared in open penultimate syllables. Although a few subgroups do not provide good evidence for the present hypothesis, the fact is that evidence for stress-shift after schwa and penultimate schwa deletion are found in most Formosan subgroups, plus MP. This further implies that schwa was inherited from PAN without stress, a pattern that is maintained in Thao and Paiwan, and that schwa deletion in the penultimate syllables of other languages is a consequence of phonetically motivated drift.

5 PAN AND PMP STRESS RECONSTRUCTED The stress pattern of Austronesian languages appears to support the reconstruction of a stress system where penultimate syllables received primary stress unless the penultimate syllable contained a schwa. The evidence is of three types, 1) there are three subgroups, two Formosan (Western Plains and Paiwan) plus Malayo-Polynesian, where schwa cannot (or could not, as indicated by comparative evidence) hold stress in open penultimate syllables. 2) there are two Formosan subgroups, East Formosan and Atayalic, where schwa deleted in open penultimate syllables but other vowels did not. Stress vowels do not syncopate, so this is indicative of an unstressed schwa. 3) In three additional subgroups, Northwest Formosan, Bunun, and Puyuma, there is evidence that schwa deleted in open penultimate syllables but deletion is either i) sporadic, i.e., there are conflicting reflexes, some where schwa deletes and others where schwa is retained, or ii) schwa deletion in penultimate syllables was limited to three-or-more syllable words. That is, in the environment VC_CV(C)#. The conditioning of schwa deletion in these subgroups was likely motivated by a ban on word-initial consonant clusters. CəCVC could not reduce to CCVC without violating a ban on initial-clusters, but CVCəCVC could reduce to CVCCVC with no violation. Two additional subgroups, Tsouic and Rukai, don't offer insights into PAN stress. Table 10 provides a summary of this evidence.

TABLE 10
SUMMARY OF THE EVIDENCE FOR STRESS SHIFT AFTER SCHWA

Type of evidence	Subgroup
Final stress after penultimate schwa is directly attested	Western Plains
	Paiwan
	Malayo-Polynesian
Schwa deletes in open penultimate syllables	East Formosan
	Atayalic
Schwa deletes sporadically or in VC_CV	Northwest Formosan
	Bunun
	Puyuma
Ambiguous	Tsouic
	Rukai

If PAN and PMP had predictable stress, this implies that Philippine stress systems are innovative. Overall, this fits into much of what we already know about Philippine stress. Philippine contrastive stress has not been shown to correspond regularly to lexical stress systems outside of the Philippines, nor does it correspond regularly to segmental phenomena outside of the Philippines. The main driving force behind Philippine lexical stress innovation appears to be the

elimination of schwa with the maintenance of historically schwa-conditioned final stress, combined with lexicalization of words with derived stress-final patterns (especially stative/adjectival verbs) followed by the extension of morphological stress as a class-changing strategy to the rest of the lexicon. Indeed, Zorc (1972) has shown that only a fraction of final-stress words cannot be explained as following naturally from these conditions. For example, the *púnuq 'tree stump'/*punúq 'full' minimal pair is transparently derived from the stative stress pattern that places stress on the final syllable in *punúq 'full'. Near minimal pairs like *kítah 'see'/*kitá 'we' show a difference between regular stress and "closed class" stress, and items like *qitə́m 'black' or *pulá 'red' again show final-syllable stress as derivational morphology, now lexicalized. This is not to say that there are not truly interesting forms. The near-minimal pair *ásu 'dog'/*qasú 'smoke', for example, defies analysis, and stress-final lexemes like *qabú 'ashes' or *likúd 'back' do not easily follow from the predictable conditions outlined above. But importantly, these words don't regularly correspond to words in other languages that may be used to reconstruct lexically marked final stress. It is not surprising that Philippine languages with lexical stress would have innovated such a pattern from a proto-language which had predictable stress. Once schwa was eliminated from the phonology of major languages lexical stress was immediately introduced as a part of Philippine language grammars.

The full stress pattern that is reconstructed for PMP is given in 7, below. The evidence for morphological stress is so far restricted to MP languages. Thus, 7 a and b may be further reconstructed to PAN, but 7 c cannot.

7)	a.	Regular stress	CV́CV(C)		
	b.	Schwa-conditioned final stress	CəCV́(C)		
	c.	Closed class stress	(CV)CV́(C)		
		Stative verb formation	CV́CV(C)	→	CVCV́(C)
		Vocative formation	CV́CV(C)	→	CVCV́(C) + (-q/-ŋ)
		List intonation	CV́CV(C)	→	CVCV́(C)

6 WHY STRESS SHIFT? AN ARGUMENT FOR A ZERO-MORA SCHWA In the previous several sections I have argued that comparative evidence supports a PAN and PMP stress system where stress was penultimate but shifted to the final syllable if the penultimate vowel was schwa. In this section I argue that the motivation for stress shift was a product of quantity, not quality. That is to say, schwa was, and often still is, a zero-mora vowel. It did not contribute to lexical mora count and weightless vowels are unable to hold stress. To say that schwa was weightless is not simply an assertion, but is rather supported by subgroup-wide parallel developments in MP that can be all described as adding a mora to words with a schwa in the penult. There are two main changes of this type, each with distinct subtypes that will be fully explored in the remainder of this section. These are, 1) the gemination of final-syllable onsets after a penultimate schwa and 2) vowel shifts that eliminate schwa. A possible third piece of evidence that schwa was weightless comes from the special status of schwa in closed word-final syllables. As demonstrated earlier in section 2, schwa could not appear in final syllables without a coda. The role of codas in word-final schwa-syllables was to "support" schwa, by adding weight to the syllable through the phenomenon of variable coda weight. This evidence is investigated further at the end of this section.

6.1 WEIGHTLESS SEGMENTS IN LINGUISTIC LITERATURE The mora is a unit of syllable weight and typical syllables are described as bearing a single mora (light syllables) or two mora (heavy syllables). Mora affect weight-sensitive phenomena like stress placement and minimal word requirements as well as durational phenomena. Light syllables with a single mora typically do not have special stress-attracting properties nor are they able to satisfy minimal word requirements (a single light syllable cannot satisfy a two-mora requirement, rather, two light syllables are required to create a minimal word). Heavy syllables, on the other hand, tend to attract stress, are typically longer than light syllables, and they can also satisfy minimal word requirements without the need for a second syllable. The extra mora associated with heavy syllables can be linked either to the nucleus, resulting in a long vowel, or to the coda. Long vowels are universally two mora, but codas may or may not contribute to syllable weight.

Syllables are less commonly analyzed as "weightless" or, having no mora, but there are examples of such analyses. Cho and King (2003) parse consonants that violate the Sonority Sequencing Principle (SSP) into "semisyllables", which have no vowel and no mora, in Georgian and Polish clusters. Kager (1989) analyses "schwa syllables", or "schwallables" in Dutch, i.e., super-light syllables with a schwa nucleus, as nonmoraic. Féry (2003) extends this analysis to German and gives the example *miete* 'rent', [mi:tə], which is parsed $[[[mi:]^{\mu\mu}]^{\sigma}]^{\varphi}[tə]^{\sigma}]^{PrWd}$ and *mitte* `middle' [mɪtːə], parsed as $[[[[mɪt]^{\mu\mu}]^{\sigma}]^{\varphi}[tə]^{\sigma}]^{PrWd}$, both with no mora associated with the final schwa-syllable. The analysis that schwa may occupy a nonmoraic syllable follows naturally from the observation that schwa is cross-linguistically prone to unique processes, particularly regarding syllabicity and weight van Oostendorp (2003).

A weightless schwallable can have consequences for word-shape as well. For example, a two-syllable word with one light syllable and one zero-mora schwallable may violate a mandatory two-mora word minimum, even though it contains two syllables. This is attested in Malayalam, where gemination is triggered to repair a subminimal word of the shape CVCə (Cyran 2001, Namboodiripad et al. 2015). The Malayalam analysis, discussed in more detail below, complements this study's hypothesis that schwa was weightless in PAN and PMP.

Malayalam has a minimal two-mora word. Additionally, a schwa is automatically inserted at the end of words with a disallowed coda (Mohanan 1989). Schwa, however, is weightless where it is inserted at the end of a word and therefore is unable to contribute to lexical mora count (Cyran 2001). The inability of schwa to add to lexical mora count is demonstrated in Malayalam's treatment of English monosyllabic loan words, investigated by Namboodiripad et al. (2015). To summarize, English monosyllabic loans with a disallowed word-final coda were borrowed into Malayalam with word-final schwa epenthesis: English *pass* > Malayalam *paːsə*. In this example, the phonetically long vowel in English *pass* is borrowed as a phonemically long vowel in Malayalam. If an English monosyllable with a short vowel is borrowed into Malayalam, however, it is realized with a phonemically short vowel: English *bus* > Malayalam /bas/<ə>, [basːə]. In a word like 'bus', the short vowel contributes a single mora to the word, but the final schwa-syllable does not. The result is automatic gemination of the final-syllable onset as a last-resort repair strategy to fix the illicit subminimal word. As I will show in the following sections, a strikingly similar pattern is attested in many MP languages. Where a PMP word has a schwa nucleus in the penultimate syllable, the following consonant geminates. The motivation for this gemination is, just like the Malayalam examples, a two-mora requirement. Gemination repairs illicit subminimal words.

6.2 INTERACTION OF STRESS, GEMINATION, AND SCHWA IN AUSTRONESIAN

Gemination after a penultimate schwa, *CəCV(C) > CəC:V(C) is a widely recognized property of MP. Gemination effectively added a mora to the word, satisfying a two-mora minimum that could not otherwise be achieved with schwa in the penult. There are, however, misunderstandings about how gemination interacts with stress in the literature, and this section therefore attempts to answer a pressing question about gemination in MP languages, that is, are stress-shift and gemination conjoined elements of a single strategy or are they alternative strategies driven by the metrical properties of schwa. Put differently, do final-syllable onsets lengthen *only if stress is regularized such that it always falls on the penultimate syllable regardless of vowel quality* or do final-syllable onsets geminate *along with stress shift to the final syllable*? I conclude that both strategies are robustly attested in Austronesian and interpret this as evidence that gemination was not motivated by stress, i.e., the primary function of gemination was to eliminate subminimal words from the lexicon. The effects that gemination has on stress are secondary.

Explicit arguments regarding the relationship between stress shift and final-syllable onset gemination are difficult to come by in the literature. Generally speaking, however, it is often implied that gemination of final syllable onsets only occurs where the stress pattern regularizes such that stress falls only on the penult even if the vowel is schwa (for example Blust 1995, 2017, Mills 1975, Sneddon 1984). According to these analyses, gemination is motivated by schwa's inability to hold stress. Geminates are said to create a closed penultimate syllable through which schwa may take stress with coda support. Mills argues for this pattern only in the South Sulawesi group and Sneddon extends this analysis to Sangiric, but Blust (1995:132) makes the further generalization that schwa's unique properties were dealt with using only one of two strategies where he states that stress-shift and gemination are "*...alternative* strategies for coping with the extrasystematic shortness of schwa in relation to the other vowels rather than conjoined elements of a single strategy." (emphasis original). These studies all imply that wherever gemination occurs that stress must regularizes to the penult and wherever gemination does not occur that schwa must repel stress to the final syllable. This view is summarized below in example 8. In 8 a, gemination results in stress regularization. In 8 b, a lack of gemination results in stress remaining on the final syllable after a schwa. In 8 c, a pattern where gemination does not result in stress regularization is ruled out.

8)	a	CV́CVC	b	CV́CVC	c	*CV́CVC
		CəC:VC		CəCV́C		*CəC:V́C

This analysis links gemination to penultimate stress in such a way as to imply that where stress shifts to the final syllable that the motivation for gemination is lost. There is abundant evidence, however, that demonstrates the incorrectness of these claims. Evidence is found in languages where schwa in a penultimate syllable is associated with both gemination and stress shift to the final syllable. Previous studies tended to ignore such languages, but they form crucial evidence that the gemination of final-syllable onsets was not part of a stress-regularization strategy. The following three sections demonstrate the different types of gemination patterns, type one, gemination that does not result in stress regularization (geminate final-syllable onsets with word-final stress), type two, gemination that does result in stress regularization (geminate final-syllable onsets with penultimate stress), and finally, type three cases of ambiguous gemination where either both stress regularization and stress shift are found in closely related languages in a single

subgroup, where other factors might have played a role in stress, or where stress is inadequately described.

6.3 TYPE ONE: GEMINATOIN WITH STRESS SHIFT AFTER SCHWA In the following languages a pattern of final-syllable onset gemination is observed, but stress does not regularize itself to the penultimate syllable. Historically, words of the shape *CəCV́(C) became CəC:V́(C). The fact that stress remains on the final syllable implies that the mora associated with the geminate is also in the final syllable: Cə[C:$^{\mu}$V(C)$^{\mu}$]. If the geminate-consonant mora were in the coda of the penultimate syllable, the motivation for stress shift would be lost. Examples of these types of languages are found throughout ISEA, including in the Philippines, Borneo, and Lesser Sunda Islands.

6.3.1 ILOKANO AND OTHER NORTHERN LUZON LANGUAGES Gemination with stress shift after schwa is widespread in Northern Luzon. Ilokano, for example, regularly reflects singleton consonants as geminate consonants where they appeared in the environment ə_V(C)#. Several examples are organized below in table 11. Most words retain schwa unchanged, but note that the reflex of PMP *təlu ‘three’ has merged schwa with *a, but gemination remains. This is interpreted as evidence that gemination occurred first, lengthening the final syllable onset in *təlu, with the merger occurring after. Gemination is therefore a relatively old phenomenon.

TABLE 11
GEMINATION AFTER PENULTIMATE SCHWA IN ILOKANO

PMP	Ilokano	
*dəpah	dəp:á	length of outstretched arms
*dəŋəR	dəŋ:ág	hear; listen
*təkən	tək:án	punting pole
*təlu	tal:ú	three

Gemination and stress shift did not automatically occur after “full” penultimate vowels in Ilokano, for example, PMP *kaka ‘elder sibling’ > Ilokano *káka*, PMP *kutu ‘head louse’ > Ilokano *kúto*, and PMP *likaw ‘curve; bend’ > Ilokano *líkaw*. It is also worth noting that in Ilokano roots there are zero examples of stress occurring *before* a geminate consonant (CV́C:VC is unattested). This means that stress is always attracted to the syllable with a geminate in its onset, suggesting that the mora associated with the geminate is also in the onset. This pattern persists in synchronic gemination, where it is used as a marker of plurality. For example, where ‘younger sibling’ undergoes gemination of the consonant to form the plural ‘younger siblings’, the stress shifts along with gemination: *ádi* ‘younger sibling’ > *ad:í* ‘younger siblings’ (Rubino 2000).

Other Northern Luzon languages that show the same pattern of gemination after schwa include Isnag, Ibanang, Ga’dang, and Central Cagayan Agta (Healey 1960) and many others. Those familiar with literature on this topic may point out that Blust (1995, 2017) stated before that stress remains penultimate in Isnag where schwa caused the following consonant to lengthen. Examples from the *ACD* quickly demonstrate that this is not true, and that Isnag, like other Northern Luzon languages, shifts stress to the final syllable after a penultimate schwa even though the final-syllable onset lengthens.

TABLE 12
ISNAG GEMINATION AND STRESS SHIFT

PMP	Isnag	
*qahəlu	alːó	pestle
*həmut	amːút	cover the mouth with the hand
*dəpah	dapːá	fathom
*pənuq	panːó	full

6.3.2 FORTIS REFLEXES OF FINAL-SYLLABLE ONSETS AFTER PENULTIMATE SCHWA IN TIRURAY (BILIC) Tiruray provides additional evidence from the Philippines for a process of final-syllable onset gemination with stress shift to the final syllable. In Tiruray, a historical geminate consonant is reflected with fortis reflexes and singleton consonants with lenis reflexes. Blust (1992) made the following observations concerning these consonants:

- PMP *-k- became Tiruray *g except* when appearing in the onset of a final syllable after a penultimate schwa, in which case it remains *k*.
- PMP *-b- became Tiruray *w except* when appearing in the onset of a final syllable after a penultimate schwa, in which case it remains *b*.
- PMP *-d/j- became Tiruray *r except* when appearing in the onset of a final syllable after a penultimate schwa, in which case it remains *d*.

Examples of differential reflexes after schwa are numerous, and include Tiruray *fagəw* from *pakəhu 'edible fern' but *bəkah* from *bəkas 'to spring, of a trap', *lawuʔ* from *labuq 'to drop something' but *təbək* from *təbək 'to stab', and *farəy* from *pajay 'rice plant' but *fədəw* from *qapəju 'gall'. Tiruray has already been established as a stress-shift-after-schwa language in §3.6 as per Schlegel's 1971 description. Because stress shift after schwa was a property of PMP, it is more economical to posit stress shift after schwa throughout the history of Tiruray. Therefore, when consonants were geminate after schwa, stress remained word-final. Subsequent sound change has eliminated geminate consonants, but the differential reflexes after schwa show that gemination must have been part of the historical phonology of Tiruray.

6.3.3 THE SUMBA-FLORES SUBGROUP OF CMP Sumba-Flores is important because it represents the only known subgroup outside of "western" Malayo-Polynesian in this study that clearly reflects a pattern of final-syllable onset gemination where schwa appeared in an open final syllable. The evidence from Sumba-Flores is of two types: 1) differential reflexes of voiced obstruents after a penultimate schwa, with data from Kambera, and 2) synchronic gemination after penultimate schwa, with data from Hawu and Ngadha. The focus here is on Hawu and Ngadha, with the Kambera data in section 6.5.3. Hawu data is from Walker (1982:6) who gives only two examples, which are reprinted below in xx.

9) a. [ʔəlːa] 'wing'
b. [həɓːe] 'to mend (as a mat)'

Blust (2008) also notes that voiced stops after schwa were resistant to lenition in Hawu. PMP *d and *j typically became *r* word-medially, except where they followed a penultimate schwa, in which case they are reflected as *ɗ*, and that *b sometimes becomes *w* and other times *b* or *ɓ*. The weakened reflexes (*r* and w) never occur after a penultimate schwa.

Regarding stress, Walker 1982 is unclear on whether penultimate schwa may hold stress. In his description, Walker (1982:7) describes Hawu as having a "clear preference for penultimate stress" but does not give examples of schwa-syllables in penultimate syllables and does not indicate specifically whether schwa holds stress in this position. One is forced to rely on the implication that if Hawu prefers penultimate stress that schwa in penultimate syllables should also be stressed. However, another Sumba-Flores language, Ngadha, does have an adequate description of stress, which does not fall on penultimate schwa-syllables (as already described in §3.11). Stress shift after schwa in Ngadha co-occurs with gemination, where Djawanai (1977:6) states that "The schwa /ə/ is usually very short and causes the lengthening of the following consonants…" He then provides the following examples:

10) a. [bətʰːá] 'broken, as a string'
b. [bəkʰːá] 'have pity on'
c. [səpʰːá] 'chew leaves

At least one of these, *səpʰːá*, is a continuation of a PMP reconstruction, *səpaq 'chewed mass of food or betel nut in the mouth'. These examples, along with the description of Ngadha stress from §3.11 demonstrate that stress shift and consonant gemination in Ngadha are conjoined, i.e., gemination does not result in the regularization of stress on the penult.

6.3.4 GEMINATION IN KAYAN Kayanic languages do not typically appear in discussions of gemination because most dialects with descriptions do not make note of consonant length. In the dialect of Kayan spoken in Data Dian, however, gemination was recorded in Smith 2017a and is observed after a penultimate schwa but not after other vowels: *təpːáʔ* 'pound rice', *mətːáŋ* 'ask', *məjːúʔ* 'lift; carry', *səpːún* 'great grandparent', *dənːáʔ* 'slow', *məpːáh* 'to sweep', *bətːúŋ* 'swollen', *məpːáŋ* 'to gather together into a pile'. As noted earlier, Kayan usually has penultimate stress, but in examples with a schwa in the penult stress is word-final.

6.3.5 GEMINATION IN KAJANG (CENTRAL SARAWAK) In the Kajang group of Central Sarawak, consonants automatically geminate after a penultimate schwa but not after other vowels. In this section data is from Sekapan where gemination, like gemination in Kayan, is not phonemic due to its predictability. Some of the words where gemination is observed are *bəbaw* [bəbːáw] 'tall', pətəbeᷚ [pətəbːéᷚ 'to meet', *məjat* [məjːát] 'to pull', *məgəm* [məgːə́m] 'strong', and many others. As with all other example languages in this section, Sekapan typically has penultimate stress but shifts stress to the final syllable after schwa. This pattern was likely a property of Proto-Central Sarawak, since more distant Central Sarawak languages like Mukah Melanau also shift penultimate stress to the final syllable after a schwa.

6.4 TYPE TWO: GEMINATION AFTER SCHWA AND STRICT PENULTIMATE STRESS Languages of this type are the more typically referenced languages one finds in literature on gemination in Austronesian languages. In such languages, stress regularizes itself to the penultimate syllable after gemination: *CəCV́(C) > Cə́C:V(C). The regularization of stress

suggests that the mora associated with the geminate consonant is in the coda of the penult, allowing stress to fall on a historically unstressable schwa, [CəC$^{\mu}$][CV(C)$^{\mu}$]. Like Type one languages, examples of languages with stress-regularization after gemination are found throughout ISEA, with the following examples from Sulawesi, Borneo and the Philippines (Philippine examples are from Sama-Bajaw, a group of languages that do not subgroup with Philippine languages).

6.4.1 GEMINATION IN SOUTH SULAWESI Buginese, Makasarese, and Tae', three relatively well described South Sulawesi languages, all reflect an earlier system where the onsets of final syllables lengthen after schwa in an open penultimate syllable. In Makasarese and Tae', schwa has merged with *a, creating a phonemic distinction in words where gemination was historically predictable, but Buginese retains schwa unchanged. In Makasarese for example, *a* from *a is not automatically followed by a geminate consonant, PMP *balu > *balu* 'widow' and PMP *panaq > *pana* 'shoots', but *a* from *ə is, PMP *bəlaq > *balːa* 'splitting', PMP *təlu > *talːu* 'three', PMP *pənuq > *panːo* 'full'. Other examples, from Tae' and Buginese are Tae' *barːaʔ* 'husked rice' from PMP *bəRas and dalːe 'job's tears' from PMP *zəlay and Buginese ənːəŋ 'six' from PMP *ənəm and təbːu 'sugarcane' from PMP *təbuh.

South Sulawesi languages, including Makasarese, Buginese, and Tae', are described as having strict penultimate stress with no cases of stress shift after a penultimate schwa. This implies that after gemination, stress was able to regularize to the penultimate syllable. This further implies that the underlying structure of geminate consonants in South Sulawesi languages are the traditional split-geminate structure, which place the mora-bearing element of the geminate consonant in the coda of the schwa-syllable, providing support for stress.

6.4.2 GEMINATION IN SAMA-BAJAW Sama-Bajaw belongs to the Greater Barito group, located mostly in southern Borneo, although Sama-Bajaw languages are spoken throughout Island Southeast Asia (Blust 2007a). Sama-Bajaw languages are unique among Greater Barito languages in that they show gemination of final syllable onsets after schwa. Examples of gemination are from Abaknon and Yakan, both spoken in the Philippines. Both also have merged schwa with other vowels which implies an ordering relationship: schwa must have triggered gemination first before the vowels merged. This further implies that gemination after schwa is a more ancient phenomenon. Also, it is unlikely that gemination in these words arose through contact with Philippine languages, as the Philippine languages closest to Abaknon and Yakan do not have synchronic gemination. Sama-Bajaw languages are described as having strict penultimate stress (Brainard and Behrens 2002). They are therefore grouped with languages that utilized geminate consonants as a means to regularize their stress pattern.

TABLE 13
ABAKNON GEMINATION

PMP	Abaknon	
*bəli	balːi	to buy
*dəpah	dapːa	fathom
*pənuq	panːoʔ	full
*ləmək	lamːok	fat; stout; greasy

TABLE 14
YAKAN GEMINATION

PMP	Yakan	
*zəlaq	delːaʔ	tongue
*dəpah	depːe	fathom
*təkən	nekːən	push down
*pəñu	penːu	sea turtle

6.4.3 BARIO KELABIT Blust (2006, 2018) has written much on the topic of gemination, stress, and the historical phonology of Kelabit. In Kelabit stress regularly falls on the penultimate syllable of the word. If the penultimate-syllable vowel is schwa, the following onset geminates and stress remains on the penultimate syllable. Not all consonants in Kelabit are available for gemination, however, and words with /r/ in the onset of a final syllable after a penultimate schwa show no gemination and stress shifts to the final syllable. This offers compelling evidence that Kelabit has a split geminate structure that places the mora-bearing element of the geminate in the coda of the penultimate syllable, and that wherever gemination does not occur after penultimate schwa that schwa becomes unable to hold stress.

6.5 AMBIGUOUS CASES AND MIXED CASES The following languages are difficult to analyze for two reasons. The first, and most interesting, is from the Sangiric group of Philippine languages. Sangiric is interesting because in very closely related languages one finds both type one and type two languages. This suggests that stress regularization is a very recent phenomenon that occurred after the breakup of Proto-Sangiric. The second reason these languages may be difficult to analyze is due to subsequent sound change that obscures the effect, if any, that gemination had on stress. The details of these cases are discussed in each subsection below.

6.5.1 GEMINATION IN SANGGIRIC Gemination after penultimate schwa is found throughout Sangiric, with interesting language specific constraints, detailed more below with data from Talaud and Sangir. This section begin with Talaud, before describing the gemination pattern of Sangir. Geminate consonants in Talaud are from two sources, 1) gemination of historically word-final consonants after vowel epenthesis, and 2) after historically penultimate schwa. Regarding pattern 1, wherever a vowel was added to a word with a full vowel in the penult, the final consonant lengthened, for example PMP *alap ‘get; fetch’ became Talaud *alapːa* with vowel epenthesis and final consonant lengthening. Where the penultimate vowel was schwa, however, the innovative vowel did not trigger final consonant gemination. In these cases, gemination of the final consonant was blocked because schwa had already triggered gemination in the root. For example, PMP *ənəm ‘six’ became Talaud *anːuma* with gemination triggered by schwa (not **anumːa with final consonant gemination or **anːumːa with both gemination after schwa and final consonant gemination). Words with a schwa in the penult and an open final syllable also reflect final-syllable onset gemination after penultimate schwa. Some examples are listed in table 15 below.

TABLE 15
GEMINATION AFTER PENULTIMATE SCHWA IN TALAUD

PMP	Talaud	
*baqəRu	bak:u	new
*təlu	tal:u	three
*əpat	ap:ata	four
*qitəluR	tal:uka	egg

Sangir also reflects a system of final-syllable onset gemination after a penultimate schwa, but with constraints on permissible geminates. In Sangir gemination targets only sonorants, which lengthened after a penultimate schwa, but obstruents, which cannot geminate in Sangir, are reflected as complex pre-glottalized obstruents wherever they follow a schwa. Examples of gemination in sonorants and a lack of gemination in obstruents are shown below in table 16.

TABLE 16
SONORANT GEMINATION AND OBSTRUENT PREGLOTTALIZATION AFTER PENULTIMATE SCHWA IN SANGIR

	PMP	Sangir	
gemination of sonorants	*bəli	bəl:i	to buy
	*həmay	əm:e	rice in the field
	*ənəm	ən:uŋ	six
	*qənay	ən:e	sand
pre-glottalization of obstruents	*dəpah	dəʔpa	fathom
	*təkən	təʔkən	punting pole
	*əpat	əʔpat	four

In Sangir, although the realization of length differs in sonorant and non-sonorant final-syllable onsets, the motivation for both is the same; schwa in penultimate syllables triggered lengthening that resulted in a well-formed two-mora word.

Although gemination after schwa is widespread in Sangiric, the interaction of gemination and stress is not consistent. As described earlier, Sangil has a default penultimate stress system with stress shift to the final syllable if the penultimate vowel is a schwa but Sangir has regular penultimate stress regardless of the vowel. Gemination after schwa is a property of both Sangil and Sangir, so it is interesting that two languages so closely related to one another would have such opposite reactions to the innovation of geminate consonants. This is taken as evidence that the reason that final-syllables underwent gemination was not as part of a stress-regularization strategy, but rather as a mora-addition strategy, again with stress changes following as a secondary reaction to gemination.

6.5.2 GEMINATION IN SABAH In the Northeast Sabahan subgroup in northern Borneo, represented here by Idaan Begak, the onsets of final syllables geminated after penultimate schwa, and further, voiced geminates underwent terminal devoicing which gave rise to modern forms like *təbpu* from PMP *təbuh ‘sugarcane’.

TABLE 17
IDAAN BEGAK GEMINATION

PMP	Idaan Begak	
*təbuh	təbpu	sugarcane
*zəlay	dəlːay	job's tears
*dəpah	rəpːa	fathom

Goudswaard (2005) describes stress in Idaan as falling predictably on the final syllable. This makes it impossible to determine if gemination was originally associated with stress shift, in which case the penultimate stress on words with a full vowel penult would be analyzed as having changed to follow the exceptional word-final stress pattern, or if gemination was originally associated with stress regularization to the penult with stress-shift to the final syllable occurring later as an unrelated change.

Differential reflexes of voiced stops after schwa, which are indicative of a historical system of final-syllable onset gemination, are found in Southwest Sabah as well. Kadazan Dusun (K. Dusun), Timugon Murut (T. Murut), and Tombonuwo (Tmb) data are organized in table 18 and show that PMP *b is usually weakened between vowels, except where it appeared after a penultimate schwa in which case it is retained. Data are from Blust 2010.

TABLE 18
EVIDENCE OF PAST GEMINATION IN SOUTHWEST SABAH

Reflexes of *-əb-			Reflexes of *-Vb-		
PMP	K. Dusun		PMP	K. Dusun	
*Rəbaq	abaʔ	fall; collapse	*abaŋ	avaŋ	block; hinder
*ləbiq	hobi	more; extra	*qabu	avu	ashes
*təbuh	tobu	sugarcane	*iban (PWIN)	ivan	parents-in-law
PMP	T. Murut		PMP	T. Murut	
*Rəbaq	abaʔ	fall; collapse	*Rabun	gaun	cloud
*ləbəŋ	loboŋ	bury	*qabu	k-au	ashes
*təbək	tobok	stab; pierce	*tubuq	tuuʔ	grow
PMP	Tmb		PMP	Tmb	
*təbuh	tobu	sugarcane	*qabu	awu	ashes
*əbuk (PWIN)	obuk	head hair	*iban (PWIN)	iwan	parents-in-law

Numerous sources agree that stress in Southwest Sabahan languages typically falls on the penultimate syllable (see Prentice 1971 for examples from various Murutic languages, Pekkanen 1993 for Tatana', Kroeger 1993 for Kimarangan Dusun, Hurlbut 1993 for Labuk-Kinabatangan Kadazan, Harrisandchapple 1993 for Tagal, Spitzack 1993 for Kalabuan, and King 1993 for Tombonuwo). In Southwest Sabah PMP schwa is reflected as a full vowel, /o/, across-the-board and no languages maintain gemination as part of the synchronic grammar. This makes it impossible to determine if stress regularized itself to the penultimate syllable as part of the historical gemination of consonants, or if it did so afterward when schwa shifted to a full vowel.

6.5.3 KAMBERA (SUMBA-FLORES) In Kambera of the Sumba-Flores subgroup, reflexes of PMP *j and *b differ in the onset of final syllables depending on the preceding vowel. After a historical schwa there are fortis reflexes (*j > d and *b > b) but after other vowels there are lenis reflexes:

TABLE 19
DIFFERENTIAL REFLEXES OF VOICED STOPS IN KAMBERA

PMP	Kambera	
*pija	pira	how many
*ujuŋ	uru	nose
*tuba	tuwa	derris root
*babaq	wawa	beneath
*qapəju	ka-pidu	gall
*qaləjaw	lodu	day
*təbuh	tibu	sugarcane

Kambera subgroups with Hawu which, as described earlier, still has gemination after schwa as a synchronic process. The fortis reflexes in Kambera are therefore assumed to reflect an earlier stage where consonants automatically lengthened after penultimate schwa. Kambera has strict penultimate stress (Klamer 1998), but since there is no synchronic gemination and schwa has been totally eliminated through merger with full vowels, it cannot be determine if penultimate stress occurred during historical gemination or if it arose in later, unrelated changes.

6.5.4 GEMINATION IN MALAY Standard Malay does not have geminate consonants, regardless of the quality of the penultimate vowel. However, in the Sri Lankan dialect Adelaar (1991) observes that gemination occurs after historical penultimate schwa just as it does in the other languages discussed thus far. In Sri Lankan Malay schwa has since merged with the full vowels, but when compared with Standard Malay in table xx, it is clearly schwa that triggered gemination.

TABLE 20
SRI LANKA MALAY GEMINATION

Standard Malay	Sri Lanka Malay	
kəcil	kicːil	small
təman	tumːan	friend
pənuh	punːu	full

The stress system of Sri Lanka Malay is not described. Although standard Malay has penultimate stress with stress shift after schwa, it is unclear if a similar pattern is found in Sri Lanka Malay.

6.6 REVIEW There is evidence for gemination after schwa in multiple primary branches of Malayo-Polynesian: Philippine (Northern Luzon, Sangir, Bilic), Western Indonesian (Northeast Sabah, Southwest Sabah, North Sarawak, Central Sarawak, Sama-Bajaw, Malay, Kayan), South

Sulawesi, and CEMP (Hawu and Kambera from the Sumba-Flores group). Although one may argue that gemination after schwa is reconstructable to PMP based on its presence in multiple primary branches, the fact that gemination appears to be motivated by schwa means that it may also be a product of drift. In support of the drift analysis, the above sections have shown that gemination, although widespread, results in separate underlying geminate structures even in closely related languages such as Sangil and Sangir. Other subgroups show no evidence of gemination after schwa (Central Philippine or Sumatran, for example). Gemination-after-schwa in MP is therefore best described as drift, motivated by the emergence of a strict requirement that words be minimally two mora. The contrasting stress systems that emerged after gemination, moraic onsets in some languages, split geminates in others, shows that stress was not the motivation for gemination. The observed stress patterns are secondary effects of gemination dependent on which underlying structure wins out as the myriad MP languages began eliminating subminimal words.

6.6 THE MERGER OF SCHWA WITH FULL VOWELS In this section I describe cases where schwa was eliminated as a vowel from the grammars of many Austronesian languages, always via merger with a full vowel. Wherever schwa merged with a full vowel it gained weight, thus eliminating subminimality in words of the shape CəCVC. In many of the languages discussed in this section, merger of schwa with a full vowel happened early on, and results in the regularization of the stress system so that stress becomes strictly penultimate. Languages that have merged schwa with a full vowel more recently, i.e., after other minimal-word corrections were first implemented, are not included in this discussion. There are two types of languages that I recognize as having shifted schwa to some other vowel, i) languages where schwa shifted to a full vowel in all positions, effectively eliminating it from the phonemic inventory and ii) languages where schwa shifted to a full vowel only in the penultimate syllable. The discussion on type one languages will be brief, as the complete elimination of schwa is not considered part of the same minimal-word requirements as other phenomena like gemination. Type two languages, where schwa is shifted to a full vowel *only* in the penultimate syllable, are more interesting, as they point to a classic phonological conspiracy whereby subminimal words were corrected through diverse methods of mora addition.

6.6.1 CHAMORRO Chamorro was earlier described as deleting PMP schwa in the position VC_CV(C)#, but outside of this position, it merged schwa with the full vowel *u, including in penultimate position of two-syllable words. Regarding stress, it is described as being mostly penultimate (Topping 1973), except in a few cases where it is lexically marked as falling on either the ultima or antepenult. The cases of irregular stress do not appear to correlate with historical schwa, even in cases where schwa was deleted. Some examples are shown in table xx

TABLE 21
CHAMORRO PENULTIMATE STRESS CORRELATING WITH HISTORICAL PENULTIMATE SCHWA

PMP	Chamorro	
*dəŋəR	húŋok	hear
*ləməs	lúmos	to drown
*bəRas	púgas	uncooked rice
qaləjaw	átdaw	sun

Chamorro historical phonology suggests two stages. During the first stage, stress was default penultimate except where schwa occupied the penultimate syllable nucleus, in which case it was word final (inherited from PMP). At some point during this first stage schwa deleted in the environment VC_CV(C)#, and a strict penultimate stress system emerged.

6.6.2 PALAUAN Palauan is listed in Smith 2017c as a MP primary branch. Although Palauan has extensively altered PMP phonology (see Blust 2009) it clearly reflects *ə with either *o* or *e* without any known conditions. Modern day Palauan maintains stress on historically penultimate syllables, even those that were historically schwa (for example, Palauan *dəʔóyl* 'spine; backbone' from PMP *tuqəlan, although historically penultimate schwa-syllables are often no longer penultimate due to various sound changes including final-syllable vowel deletion.

6.6.3 CELEBIC There are no modern-day Celebic languages that retain the original PMP schwa. In all languages it has shifted to or merged with a full vowel and as a result all Celebic languages also display strict penultimate stress. Mead (2003) lists Tomini-Tolitoli, Bungku-Tolaki, Kaili-Pamona, Muna-Buton, Saluan-Banggai, Wotu-Wolio. According to Mead, Saluan-Banggai, Bungku-Tolaki, and Muna-Buton subgroup together in the "Eastern Celebic" subgroup, where the shift of PMP *ə to PEC *o forms part of the evidence. Tomini-Tolitoli, Kaili-Pamona, and Wotu-Wolio, are placed within Celebic but with an unclear level of relatedness to one another. Mead notes that *ə > /o/ is characteristic not only of Eastern Celebic, but all Celebic languages. Only a small number of exceptions there *ə merged with *a are known from the Kaili-Pamona and Wotu-Wolio subgroups. Tomini-Tolitoli, like Eastern Celebic, has also shifted *ə to *o in all cases. It may be the case that a general shift of schwa to *o was underway during Proto-Celebic and was completed in Eastern Celebic and Tomini-tolitoli, but that exceptions emerged in Kaili-Pamona and Wotu-Wolio before the change had a chance to stabilize in these groups. Whatever the case, however, schwa has been completely eliminated in all Celebic languages and did so apparently before any schwa-triggered metrical adaptations could surface.

6.6.4 CENTRAL MALAYO-POLYNESIAN Central Malayo-Polynesian languages reflects both schwa elimination and gemination, which is not surprising given CMP's status as more of a linkage than a traditional subgroup. By far, however, the majority of CMP languages appear to have merged schwa with a full vowel, usually *e* or *o*, while gemination is restricted to the Sumba-Flores subgroup which still has languages that maintain schwa without merger. Languages that reflect schwa-elimination also reflect the regularization of stress as strictly penultimate.

6.6.5 PENULTIMATE SCHWA SHIFT IN EASTERN MALAYO-POLYNESIAN (SHWNG AND OCEANIC) Eastern Malayo-Polynesian provides the most interesting case of schwa elimination via shift because of the positional conditions that acted on this change. Oceanic shifted *ə to *o in all positions, but South-Halmahera West-New Guinea reflect *ə as /o/ in the penult but not in the ultima. A possible interpretation of this is that the changes happened separately in PSHWNG and POC, but Blust (1978:211-212) points to another possibility where he states "… PAN *e [schwa] unconditionally yielded POC *o, but only penultimate *e [schwa] yielded Proto-SHWNG *o. In view of the other evidence to be considered, it is perhaps simplest to assume that penultimate *e [schwa] first shifted to *o in a language ancestral to the SHWNG and Oceanic groups, and that last-syllable *e [schwa] then followed this development in Proto-Oceanic, but merged with *a in SHWNG." As more data has become available, it is clear that *ə became *o in penultimate position but was left unchanged in the final syllable, although it did eventually merge with *a in several SCHWNG languages. Some examples from Ma'ya (11), Taba (12), and Buli (13) demonstrate this:

Ma'ya

11	a	*təlu	*tol* 'three'	b	*qinəp	*wenef* 'to sleep'
		*qatəluR	*tol* 'egg'		*bituqən	*tuen* 'star'
		*dəŋəR	*don* 'to hear'		*qitəm	*mat-ʻmetem* 'black'

Taba

12	a	*dəpa	*lof* 'a fathom'	b	*ənəm	*onam* 'six'
		*təlu	*tol* 'three'			

Buli

13	*qatəp	*yataf* 'roof'/ *fa-yatf-o* 'cover with tatch'
	*dəŋəR	*loŋa* 'to hear'
	*Rəbək	*opa* 'to fly'

Both Oceanic and SHWNG have stress on the historically penultimate syllable, with SHWNG languages further deleting most word-final vowels (Remijsen2001:111-113[1]). Although there is initially no seemingly natural motivation for shifting *ə to *o in penultimate but not in other positions, the hypothesis that Post-PMP languages changed to enforce a two-mora minimum predicts that such a change will take place; words of the shape CoCVC and CVCəC have two mora but words of the shape CəCVC has only one mora (recall that if a schwa is followed by a coda that it is not weightless). What occurred in MP, in this view, is a classic conspiracy. Two seemingly unrelated changes, i) the gemination of final-syllable onsets after a penultimate schwa and ii) schwa shift to a full vowel only in penultimate syllables with no change in final syllables, effectively eliminate subminimal words from the grammars of Malayo-Polynesian languages. The main difference between gemination and penultimate schwa shift in Malayo-Polynesian is frequency. Gemination occurred in numerous parallel innovations in MP languages but penultimate schwa shift is only attested once, in PEMP. Nevertheless, it provides crucial evidence that these changes are motivated by the same two-mora requirement and that this requirement reveals itself in reflexes of PMP words of the shape *CəCV(C).

[1] But see Lynch 2000 for an argument that POC stressed the penultimate *mora*, with codas acting as moraic segments.

6.7 SCHWA IN FINAL SYLLABLES AND VARIABLE WEIGHT A natural question that arises from the gemination of consonants after a penultimate schwa and the shift of schwa to a full vowel in open penultimate syllables is, if schwa is weightless regardless of its position why do we only see these phenomena triggered by penultimate schwa but not by schwa in final syllables? For example, in MP languages underlying /CVCəC/ always surfaces as [CVCəC], never as *[CVCːəC]. Under the weightless-schwa hypothesis, a word like PMP *daləm 'inside' would have one mora, violating the word minimum and worse yet, reduplicated monosyllables like PMP *bəjbəj 'to wind; tie up' would have no mora whatsoever.

The answer, it would seem, is that the coda in these words is contributing to syllable weight. This is an intuitive solution, since schwa is permitted in the final syllable *only* if the syllable is closed, and further, schwa in *closed* penultimate syllables does not display the same stress and gemination phenomena as does schwa in *open* penultimate syllables. This brings up an interesting problem, however: if codas contribute to syllable weight when the nucleus is a schwa, do they also contribute to syllable weight when the nucleus is a main vowel? There is no evidence that closed syllables were treated as heavy across-the-board in PAN or PMP. In Ilokano roots, for example, stress is sensitive to the quality of the vowel; it predictably never falls on a penultimate schwa. The presence or absence of a coda, on the other hand, is irrelevant for stress placement in a root. Similarly, in Malay stress avoids penultimate schwa, but is not attracted to closed syllables with a full vowel. It is therefore necessary to acknowledge a property of codas in Austronesian languages: codas contribute to syllable weight, but only if the syllable is otherwise degenerate, i.e., if the vowel is a schwa and therefore weightless. This is a type of variable coda weight (Rosenthall and van der Hulst 1999), a principle described in some languages but not generally applied to Austronesian.

An example of variable coda weight outside of Austronesian is found in Levantine Arabic, where Broselow et al (1997) states that "coda consonants bear weight in (non-final) CVC syllables... but in CVVC syllables, coda consonants are weightless, sharing a mora with the preceding vowel..." This pattern follows from a strict ban on tri-moraic syllables. Coda weight is only licit if the syllable has not reached the maximum two-mora-per-syllable count. In Austronesian, it is common for schwas to be unstressable except where they appear in closed syllables. In Standard varieties of Malay, for example, the stress pattern is default penultimate. Like many AN languages, stress shifts to the final syllable if the penultimate syllable is open and has a schwa nucleus. In closed penultimate syllables, however, the presence of a coda allows schwa to hold stress.

TABLE 23
CLOSED SCHWA STRESSABILITY IN MALAY

CV	Cə	CəC
táman 'garden'	təmán 'frient'	tə́mpat 'place; location'
láma 'long time'	ləmáh 'weak'	lə́mbah 'valley'

In the Malay examples, the presence or absence of a coda is only relevant where the vowel is schwa, a case of variable coda weight. In Malay, then, if a syllable has a weightless vowel, then the coda is able to share a mora with the nucleus, attaching directly to the mora. If a syllable has

a full vowel, however, then the coda attaches directly to the syllable head. The Malay pattern is a direct continuation of schwa's metrical properties from PAN.

Other languages reflect a similar phenomenon. Recall from earlier that Thao deleted schwa in open penultimate syllables and shifted stress to the final syllable but that schwa in a closed penultimate or closed final syllable did not delete and stress remained in penultimate position. In Amis, schwa deleted in open penultimate syllables but was retained in closed syllables, again suggesting that the coda supported schwa but not other vowels. In Philippine languages as well, Zorc (1972) pointed out that although stress shift to the final syllable after penultimate schwa in an open syllable, that there was no systematic system of stress shift if schwa was in a closed syllable.

Other types of phenomena, like those that target coda consonants, often have exceptions when the coda closes a schwa-syllable. One such case is Merap, where word-final voiceless consonants lost articulation features and collapsed together as glottal stop (Smith 2017):

TABLE 24
FEATURE LOSS IN MERAP WORD-FINAL STOPS

Proto-Kayanic	Merap	
*siap	hɛa̯ʔ	chicken
*əpat	paːʔ	four
*anak	nayə̯ʔ	child

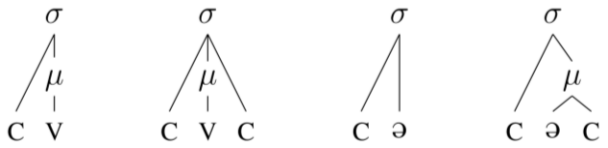
If codas closed a schwa syllable, however, the articulation features of the coda consonant are retained:

TABLE 25
FEATURE RETENTION IN MERAP WORD-FINAL STOPS

Proto-Kayanic	Merap	
*kələb	klap	turtle
*siŋət	hɲiə̯t	to sting
*utək	tuə̯k	brain

Merap codas after a schwa were able to hold on to their place features but lost them after other vowels. This may be a result of codas being linked directly to the mora in word-final schwa-syllables but to the syllable head in other word-final syllables. Taken together, schwa's requirement that it be supported by a coda consonant in order to hold stress, its restriction in word-final position to only closed syllables, its retention in closed but not open syllables in languages that deleted schwa, and its interaction with coda consonants in cases like Merap where schwa "protects" coda consonants from loosing place features support an analysis whereby schwa syllables share a mora with coda consonants wherever they are available. The fact that no similar phenomena are found with codas that close syllables with a full vowel suggests that coda weight was variable, and only surfaced in cases where the syllable was otherwise degenerate as a last minute repair strategy. The following figure presents the full inventory of syllable types available in PAN and PMP (ignoring onsetless syllables, which are not relevant for the present discussion).

FIGURE 2
PAN AND PMP SYLLABL STRUCTURES



7 CONCLUSION This study has gathered a database of evidence in support of the hypothesis that PAN stress fell regularly on the penultimate syllable, but that stress shifted to the final syllable if the penultimate syllable was open and contained a schwa nucleus. This position has been argued for in other works, but the present hypothesis combines the observation that schwa did not hold stress with a theory on schwa's weight as a motivator not only for stress shift, but for gemination of final syllable onsets and the shift of schwa to a full vowel in penultimate but not other syllables. Evidence for these claims are found throughout Austronesian and across primary divisions in AN subgroups. Western Plaines, Paiwan, and Malayo-Polynesian directly continue a system where stress was regularly penultimate but shifted to the final syllable if the penult was open and its vowel was schwa. Further, East Formosan and Atayalic, two first order Formosan subgroups, deleted schwa but not other vowels in open penultimate syllables. This suggests that schwa was unstressed in the ancestor to these languages, PAN. Other Formosan subgroups, Northwest Formosan, Bunun, and Puyuma, show deletion of schwa in penultimate syllables only in the environment VC_CV(C)#. These languages ban word-initial clusters, and schwas inability to delete in disyllables likely stems from this restriction. These languages nevertheless also confirm the hypothesis that schwa was unstressed in open penultimate syllables.

In MP, this study organized evidence for a subgroup-wide conspiracy to add a mora to words with schwa in an open penult. Mora addition could take the form of gemination, as is the case in a large number of MP languages where the onset of final syllables lengthened after a penultimate schwa where *CəCV(C) became CəC:V(C). A less often cited but important parallel sound change occurred in Eastern Malayo-Polynesian, where SHWNG languages reflect a vowel shift that affected penultimate schwa but left schwa in other (closed) syllables unchanged. In these cases, schwa shifted to a full vowel, *o, thereby adding a mora to the word: *CəCV(C)$^{\mu}$ > Co$^{\mu}$CV(C)$^{\mu}$. The reason that schwa would trigger both gemination and penultimate vowel shift stems from its weightlessness. Both sound changes succeeded in adding a mora to the word, albeit by two separate means, which is a classic example of a phonological conspiracy.

The recognition of this conspiracy in the development of MP languages explains, for example, why three syllable words with a schwa penult in many languages show no evidence of gemination even if gemination was triggered in two-syllable words with a schwa penult. All cases where gemination is not observed in words of the reconstructed shape CVCəCV(C) reflect schwa deletion, where *CVCəCVC became CVCCVC. After schwa deletes a new foot may be constructed on the remaining two syllables creating a well formed two-mora foot thus eliminating the motivation for gemination. This is the case throughout the Philippines where schwa deletion in this environment is nearly universal.

Not all MP languages repaired subminimal words, of course. Languages of the Sumatran group such as Batak, show no signs of gemination or penultimate vowel shift. In these languages,

however, schwa remains unable to hold stress on its own. The existence of some subgroups that did not repair subminimal words demonstrates that PMP allowed subminimal words. The requirement that words and feet be minimally two mora eventually came to outweigh faithfulness to the underlying form in many subgroups as the product of phonologically motivated drift. The history of the metrical development of AN languages is therefore largely a history of increased enforcement of a two-mora minimum stemming from schwa's inherited weightlessness and inability to participate in the formation of a minimal word.

REFERENCES

Adelaar, K. Alexander. 1981. Reconstruction of Proto-Batak phonology. In *Historical Linguistics in Indonesia Part 1*. Jakarta: Badan Penyelenggara Seri NUSA, Universitas Atma Jakarta: Atma Jaya.

Adelaar, K. Alexander. 1991. Some notes on the origin of Sri Lanka Malay. In *Papers in Austronesian Linguistics, Number* 1, ed. by H. Steinhauer. 23–37. Canberra: Pacific Linguistics.

Baird, Louise. 2002. *A grammar of Kéo: An Austronesian language of East Nusantara*. Doctoral Dissertation, Department of Linguistics, The Research School of Pacific and Asian Studies, The Australian National University.

Blust, Robert. 1978. Eastern Malayo-Polynesian: a subgrouping argument. In *Second International Conference on Austronesian Linguistics: Proceedings*, ed. by S. A. Wurm 181–234. Canberra: Pacific Linguistics.

Blust, Robert. 1988. Sketches of the morphology and phonology of Bornean languages 2: Mukah Melanau. In Papers in western Austronesian linguistics, Number 3, ed. by H. Steinhauer. 151–216. Canberra: Research School of Pacific Studies, Department of Linguistics, Australian National University.

Blust, Robert. 1992. On speech strata in Tiruray. In Papers in Austronesian Linguistics, Number 2, ed. by Malcolm Ross. 1–52. Canberra: Pacific Linguistics.

Blust, Robert. 1995. Notes on Berawan consonant gemination. *Oceanic Linguistics* 34(1): 123–138.

Blust, Robert. 1997. Rukai stress revisited. *Oceanic Linguistics* 36(2): 398–403.

Blust, Robert. 1999. Subgrouping, circularity and extinction: some issues in Austronesian comparative linguistics. In Selected Papers from the Eighth International Conference on Austronesian Linguistics, Number 1 in Symposium series of the Institute of Linguistics, Academia Sinica, ed. by Elizabeth Zeitoun and Paul. J. K. Li. 31–94. Taipei: Academia Sinica.

Blust, Robert. 2000. Chamorro historical phonology. *Oceanic Linguistics* 39: 83–122.

Blust, Robert. 2003. *Thao dictionary*. Number A5 in Language and Linguistics Monograph Series. Taipei: Institute of Linguistics, Academia Sinica.

Blust, Robert. 2006. The origin of the Kelabit voiced aspirates: a historical hypothesis revisited. *Oceanic Linguistics* 45: 311–338.

Blust, Robert. 2007a. The linguistic position of Sama-Bajaw. *Studies in Philippine Languages and Cultures* 15: 73–114.

Blust, Robert. 2007b. Òma Lóngh historical phonology. *Oceanic Linguistics.* 46: 1–53.

Blust, Robert. 2008. Is there a Bima-Sumba subgroup. Oceanic Linguistics 47(1), 45–113.

Blust, Robert. 2009. Palauan historical phonology: whence the intrusive velar nasal? *Oceanic Linguistics* 48:2 307–336.
Blust, Robert. 2010. The Greater North Borneo hypothesis. *Oceanic Linguistics.* 49: 44–118.
Blust, Robert. 2013. *The Austronesian languages.* 2 ed. Canberra: Pacific Linguistics.
Blust,Robert. 2017. Regular metathesis in Batanic (Northern Philippines)? *Oceanic Linguistics* 56(2): 491–504.
Blust, Robert. 2018. Two birds with one stone: the aerodynamic voicing constraint and the languages of Borneo. *Journal of the Southeast Asian Linguistics Society* 11(2): 1–18.
Blust, Robert. n.d. Fieldnotes on 41 languages of northern and central Sarawak.
Blust, Robert. and Stephen. Trussel (ongoing). Austronesian comparative dictionary. Online: http://www.trussel2.com/ACD.
Brainard, S. and D. Behrens. 2002. *A grammar of Yakan*. Manila: Linguistic Society of the Philippines.
de Busser, R. (2009). Towards a grammar of Takivatan Bunun: Selectid topics. Doctoral dissertation, Research Centre for Linguistic Typology, La Trobe University.
Chen, C. (2004). Phonetic structures of Paiwan. In P. Law (Ed.), Proceedings of the 11th meeting of the Austronesian Formal Linguistics Association (AFLA 11), pp. 30–44. Berlin: Zentrum Fr Allegemeine Sprachwissenschaft, Typologie und Universalienforschung (ZAS).
Cho, Y. and T.H. King (2003). Semisyllables and universal syllabification. In C. Féry and R. vande Vijver (Eds.), The Syllable in Optimality Theory, pp. 183–212. Cambridge: Cambridge University Press.
Chrétien, C. D. (1965). The statistical structure of the Proto-Austronesian morph. Lingua 14, 243–270.
Clayre, B. and L. Cubit (1974). An outline of Kayan grammar. Sarawak Museum Journal 22(43), 43–91.
Cyran, E. (2001). Parameters and scales in syllable markedness: the right edge of the word in Malayalam. Trends in Linguistic Studies and Monographs 134, 1–25.
Daguman, J. S. (2004). A grammar of Northern Subanen. La Trobe University, Research Centre for Linguistic Typology.
Dempwolff, O. (1937). Vergleichende Lautlehre des austronesischen Wortschatzes. Deduktive Anwendung des Urindonesischen auf austronesische Einzelsprachen. Berlin: Reimer.
Djawanai, S. (1977). A description of the basic phonology of nga'da and the treatment of borrowings. NUSA 5, 10–18.
DuBois, Carl D. 1976. *Sarangani Manobo: An introductory guide.* Philippine Journal of Linguistics, Special Monograph no. 6. Manila: Linguistics Society of the Philippines.
Eades, D. and J. Hajek (2006). Gayo. Journal of the International Phonetic Association 36(1), 107–115.
Féry,C.(2003). Onsets and nonmoraic syllables in German. In C. F´ery and R.v an de Vijver (Eds.), The syllable in Optimality Theory, pp. 213–237. Cambridge: Cambridge University Press.
Goudswaard, N. (2005). The Begak (Ida'an language os Sabah. Utrecht: Landelijke Onderzoekschool Taalwetenschaap (Netherlands Graduate School oé Linguistics).
Harris, S. A. and K. Chapple (1993). Tagal phonemics. In M. E. Boutin and I. Pekkanen (Eds.), Phonological descriptions of Sabah languages, pp. 71–80. Kota Kinabalu: Sabah Museum.

Healey,P.M.(1960). An Agta grammar. Manila: Bureau of Printing / Summer Institute of Linguistics.
Huang, H.-c. J. (2018). The nature of pretonic weak vowels in Squliq Atayal. Oceanic Linguistics 57(2), 265–288.
Hurlbut, H. M. (1993). Labuk-Kinabatangan phonemics. In M. E. Boutin and I. Pekkanen (Eds.), Phonological descriptions of Sabah languages, pp. 47–58. Kota Kinabalu: Sabah Museum.
Kager, R. (1989). A metrical theory of stress and destressing in English and Dutch. Dordrecht: Foris.
King, J. (1993). Tombonuwo phonemics. In M. E. Boutin and I. Pekkanen (Eds.), Phonological descriptions of Sabah languages, pp. 97–106. Kota Kinabalu: Sabah Museum.
Klamer, M. (1998). A grammar of Kambera. Berlin: De Gruyter Mouton. Kroeger, P.(1993). Kimarangan phonemics. In M.E. Boutin and I.Pekkanen (Eds.),Phonological descriptions of Sabah languages, pp. 31–46. Kota Kinabalu: Sabah Museum.
Li, Lillian. (2019). A grammar of Isbukun Bunun. Doctoral Dissertation, Institute of Linguistics, Tational Tsing Hua University, Taiwan.
Li, P. (1977). The internal relationships of Rukai. Bulletin of the Institute of History and Philology 49, 133–199.
Lynch, J. (2000). Reconstructing Proto-Oceanic stress. Oceanic Linguistics 39(1), 53–82. Macdonald, R.R. and S. Darjowidjojo (1967). Indonesian reference grammar. Washington, D.C.: Georgetown University Press.
Maddieson, I. and R. Wright (1995). The vowels and consonants of Amis – a preliminary phonetic report. Fieldwork Studies of Targeted Languages III. UCLA Working Papers in Phonetics 91, 45–65.
Mead, D. (2003). Evidence for a Celebic supergroup. In J. Lynch (Ed.), Issues in Austronesian historical phonology, pp. 115–141. Canberra: Pacific Linguistics.
Mills, R. (1975). Proto-South Sulawesi and Proto-Austronesian phonology. Ph. D. thesis, University of Michigan, Ann Arbor.
Mohanan, T. (1989). Syllable structure in Malayalam. Linguistic Inquiry 20(4), 589–625.
Namboodiripad, S., E. Bakovic, and M. Garellek (2015). Moraic geminates in Malayalam: evidence from minimal word effects and loanword adaptation. paper presented at the linguistic society of America's annual meeting: Portland oregon. https://pages.ucsd.edu/ snambood/abstracts/lsa15.pdf.
Nothofer,B.(1986). FOCALII: Papers from the Fourth International Conference on Austronesian Linguistics, Chapter The Barrier Islands languages in the Austronesian language family, pp. 87–109. Canberra: Pacific Linguistics.
Pejros, I. 1994. Some problems of Austronesian accent and *t ~ *C (Notes of an outsider). *Oceanic Linguistics* 33: 105–127.
Pekkanen, I. (1993). Tatana' phonemics. In M. E. Boutin and I. Pekkanen (Eds.), Phonological descriptions of Sabah Languages, pp. 15–30. Kota Kinabalu: Sabah Museum.
Prentice, D. (1971). The Murut languages of Sabah. Canberra: Pacific Linguistics.
Remijsen, A. C. (2001). Word-prosodic systems of Raja Ampat languages. Leiden: LOT.
Rosenthall, S. and H. van der Hulst (1999). Weight-by-position by position. Natural Language and Linguistics Theory 17(3), 499–540.
Ross, M. (1992). The sound of Proto-Austronesian: an outsider's view of the Formosan evidence. Oceanic Linguistics 31, 23–64.

Ross, Malcolm. 2009. Proto-Austronesian verbal morphology: a reappraisal. In *Austronesian historical linguistics and culture history: a festschrift for Robert Blust.* 295–326. Canberra: Pacific Linguistics.
Schlegel, S. A. (1971). Tiruray-English Lexicon. Berkeley: University of California Press.
Smith, Alexander D. (2015). On the classification of Kenyah and Kayanic languages. Oceanic Linguistics 53(2), 333–357.
Smith, Alexander D. (2017a). The languages of Borneo: a comprehensive classification. Ph. D. thesis, Department of Linguistics, University of Hawaii.
Smith, Alexander D. (2017b). Merap historical phonology in the context of a central Bornean linguistic area. Oceanic Linguistics 56, 143–180.
Smith, Alexander D. (2017c). Reconstructing Proto-Kenyah pronouns an the development of a true five number system. Journal of the Southeast Asia Linguistis Society (JSEALS).
Smith, Alexander D.(2017d). The Western Malayo-Polynesian problem. Oceanic Linguistics 56(2): 435– 490.
Sneddon, J. N. (1975). Tondano phonology and grammar. Canberra: Pacific Linguistics B-38.
Sneddon, J. N. (1984). Proto-Sangiric and the Sangiric languages. Canberra: Pacic Linguistics.
Spitzack, J.A.(1993). Kalabuan phonemics. In M.E. Boutin and I.Pekkanen(Eds.),Phonological descriptions of Sabah languages, pp. 81–96. Kota Kinabalu: Sabah Museum.
Topping, D. M. (1973). Chamorro reference grammar. Honolulu: University of Hawaii Press.
van Oostendorp, M. (2003). Schwa in phonological theory. In L. Cheng and R. Sybesma (Eds.), Studies in Generative Grammar, Volume 61, pp. 431–462. Berlin: Mouton de Gruyter.
Walker, A. T. (1982). A grammar of Sawu, Volume 13 of Linguistic Studies in Indonesian and Languages in Indonesia. Jakarta: Universitas Atma jaya.
Wolff, John. 1991. The Proto Austronesian phoneme *t and the grouping of the Austronesian languages. In *Currents in Pacific Linguistics: papers on Austronesian languages and ethnolinguistics in honour of George W. Grace*, ed. by Robert Blust. 535–549. Canberra: Pacific Linguistics.
Yamada, Y. (1967). Phonology of Itbayaten. The Philippine Journal of Science 94, 373–393.
Zorc, D.(1972). Current and Proto-Tagalic stress. The Philippine Journal of Linguistics 3, 43–57.
Zorc, David. 1978. Proto-Philippine word accent: Innovation or Proto-Hesperonesian retention? In, *Second International Conference on Austronesian Linguistics: Proceedings.* Fascicle 1, Western Austronesian, ed. by S.A. Wurm and Lois Carrington. 67–119. Canberra: Pacific Linguistics.