A Reconstruction of Proto-Segai-Modang

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Segai-Modang languages, located primarily in East Kalimantan, Indonesia, and directly descended from Proto-Kayanic (PKAY), are of a phonological type far removed from Proto-Malayo-Polynesian and most of its daughter languages. Segai-Modang languages are stress-final and have innovated sesqui- and monosyllabic canonical word forms with expanded vowel inventories. They share these characteristics with a few other, individual languages of Borneo (Sa'ban, Merap, certain Bidayuh languages, including Hliboi), and with Chamic languages of mainland Southeast Asia. In Borneo, however, Segai-Modang is the only large subgroup in which every known member has undergone these phonological innovations, and thus provides a unique opportunity for reconstructing an Austronesian proto-language (Proto-Segai-Modang [PSM]) whose daughter languages are entirely sesqui- or monosyllabic and which was not influenced through linguistic contact. The present study provides evidence for a hypothesis that PSM was itself sesquisyllabic, that the penultimate syllable was reduced to schwa, and the features of PKAY penultimate vowels were transferred to the onsets of the final syllable. This created distinct regular, palatalized, and labialized consonants in final-syllable onsets position at the PSM level. These features were later transferred to the final-syllable vowels resulting in diverse reflexes of PSM vowels in the daughter languages. The reconstruction, therefore, posits that final-syllable onsets were complex but that vowels remained phonemically conservative. The vowels *a, *aː *u, and *i are reconstructed to the final syllable, and *ə to the penultimate sesquisyllable. The reconstruction also posits conditioned allophony for many of the PSM final-syllable vowels, which became distinct only after the breakup of PSM.

1. INTRODUCTION. Segai-Modang is a subgroup within the larger Kayanic group, located primarily in East and North Kalimantan, Indonesia. While many Kayanic languages are not particularly phonologically innovative, the Segai-Modang group stands out for its sesquisyllabic and monosyllabic word structure and phonological innovation in both syllable and vowel complexity. Most Segai-Modang languages have between 10 and 15 vowel distinctions, including diphthongs and triphthongs, an areal feature of central Borneo. Segai languages have further innovated complex onsets after the deletion of penultimate vowels caused C_1 and C_2 in words of the shape C_1VC_2VC to become adjacent. These changes give Segai-Modang a more mainland

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Southeast Asian typology, a feature they share with genetically more distantly related languages in Borneo like Merap (Smith 2017b), Sa'ban (Blust 2001), and several Bidayuh languages, including Hliboi (Smith 2017a, 2019). Segai-Modang also shares these features with Chamic (Thurgood 1999, 2005) located on or near the Southeast Asian mainland. Segai-Modang, however, is the only large subgroup of Borneo in which all known member languages are sesqui- or monosyllabic, suggesting that these features are reconstructable to PSM itself, which is the main purpose of this paper.

Segai-Modang languages have been the subject of several studies (Revel-Macdonald 1982; Guerreiro 1983, 1989, 1996; Smith 2017a, b) and data papers (Astar et al. 2002; Wati et al. 2002), but there has been no attempt to reconstruct the phonology of Proto-Segai-Modang (PSM). In this case, the reconstruction of PSM can give insights into the movement from fully disyllabic Proto-Kayanic (PKAY) to sesqui- and monosyllabic Segai-Modang. In particular, the reconstruction hypothesizes that (a) PSM was already sesquisyllabic (schwa was the only penultimate vowel and stress was on the ultima) and (b) that the labial and palatal features of PKAY penultimate *u and *i had been transferred to the onset of the final syllable, resulting in a contrast between regular, palatalized, and labialized consonants in this position. Palatalized and labialized consonants conditioned differential reflexes of final-syllable vowels that eventually became contrastive through subsequent sound change. Example (1) demonstrates the proposed canonical word shape of PSM with a mark for stress, length, and an optional sesquisyllable:

(1) *(Cə)ˈCV(ː)(C)

The remainder of this paper is organized as follows. Section 2 provides a brief summary of the evidence for a Segai-Modang subgroup in Kayanic, based on Smith (2017), that includes all the languages contained in this study. Section 3 presents an argument that as penultimate vowels reduced to schwa that the features of penultimate vowels spread iteratively first to the onsets of final syllables at PSM then later to the final-syllable vowels themselves. The reconstructed consonant inventory is presented at the end of the section. In sections 4 through 6 the vowels are discussed and 41 correspondence sets are shown to reflect a PSM series of 5 vowels, 4 full vowels in the final syllable, *a, *aː, *i, *u, and the reduced vowel *ə that was restricted to prefinal syllables. Section 4 focuses on reflexes of central vowels and includes a justification for reconstructing a length distinction between *a and *aː, a distinction that is hypothesized to have been inherited from PKAY. Section 5 is on the high vowels and includes a reconstruction of conditioned allophony whereby *i was realized as *[i], *[e], *[əj], and *[aj] and *u as *[u], *[o], *[əw], and *[aw]. Section 6 discusses reflexes of the word-final diphthongs, *-ay, *-aw, *-iw, *-uy.

The reconstruction relies on linguistic data from six varieties of Segai-Modang: Wahau, Gaai, Kelai, Mei Lan, Woq Helaq, and Long Gelat. Mei Lan and Woq Helaq are spoken in the same community, but there are measurable differences in their historical phonology, so both are listed here. All data

FIGURE 1. KAYANIC INTERNAL SUBGROUPING (SMITH 2017a)

- KAYANIC
  - a. Kayan-Murik
    - i. Kayan
    - ii. Murik-Merap
  - b. Segai-Modang
    - i. Segai (Gaai, Kelai, Wahau)
    - ii. Modang (Mei Lan, Woq Helaq, Long Gelat)

are primary, but some additional data can be found in Astar et al. (2002) and Wati et al. (2002), two collections of Swadesh lists from numerous languages in Borneo. Throughout the paper I follow the convention of writing [j] as y and [ɲ] as ñ, even where square brackets are used. I provide some examples within the text, but the complete dataset appears in the appendix, organized by cognate set.

2. SUBGROUPING AND PHONEMICS. Modern Segai-Modang languages can be typologically and genetically divided into two groups, (a) the mostly sesquisyllabic Modang languages, which have a CəCV(C) basic word shape and (b) the mostly monosyllabic Segai languages, which have a CCV(C) word shape. Smith (2017a) placed Segai-Modang in the Kayanic subgroup, which contains Kayanic and Murik-Merap languages in a separate primary branch. Figure 1 presents the subgrouping that informs the reconstructions throughout this paper, from Smith (2017a).

Within Kayanic, there is little doubt that Segai and Modang form a subgroup. Smith (2017a) identified several innovations that define the subgroup, including two unconditioned splits in initial position and a narrowly conditioned merger of *b and *w in intervocalic position. The evidence is presented in the following three tables with a brief introduction to each. Note that in table 1 and throughout this paper, that some vowel-final reconstructions are reflected with a final *-n* in some languages. This is an obligatory marker of inalienable possession, most often found on body-part terms.

Split in reflexes of *b:

In initial position, *b either weakened to *w* or remained unchanged. Where *b weakened in one S-M language, it implies that it also weakened in other S-M languages.

Split in reflexes of *l:

In initial position, *l was either deleted or retained. Where *l was deleted in one S-M language, it implies that it was also deleted in other S-M languages, as seen in table 2.

Conditioned merger of *b and *w:

*b merged with *w in the environment *u_a, but remained distinct elsewhere, as seen in table 3.

The exact internal subgrouping of Segai-Modang remains to be worked out. Gaai and Kelai share several changes that suggest they form a subgroup,

TABLE 1. UNCONDITIONED FORTIS AND LENIS SPLIT IN REFLEXES OF *b-

PKAY	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
*bəhuaŋ	wəhguaŋ	wahguaŋ	wahguaŋ	wahguaŋ	wahguaŋ	wahguaŋ	‘bear’
*batu	əltaw	utaw	utaw	wətaə̯	wəta	uta	‘stone’
*bəʔaya	wəjəʔ	wahjoʔ	wajɛʔ	wahjawʔ	wahjawʔ	wahjawʔ	‘crocodile’
*bəhəʔat	bəhæt	bəhat	bəhæt	bəheə̯t	bəheə̯t	bəhit	‘heavy’
*bulu	blun	bloə̯n	bloə̯n	bələwn	bələwn	bələn	‘body hair’
*bəsuh	psɒh	psɒwh	psɒh	pəsoh	pəsoh	pəsoh	‘satiated’

TABLE 2. UNCONDITIONED RETENTION AND DELETION OF *l-

PKAY	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
*laŋit	əlŋet	alŋeə̯t	lŋeə̯t	ləŋeyt	ləŋeyt	ləŋit	‘sky’
*lumut	ləmut	almoə̯t	lmut	ləməwt	ləməwt	ləmət	‘moss’
*laʔu	ləʔaw	alʔaw	ləʔaw	ləʔaə̯	ləʔa	ləʔa	‘hungry’
*las	læs	las	læs	leə̯s	leyh	lih	‘skin’
*lubaŋ	guaŋ	guə̯ŋ	guə̯ŋ	guə̯ŋ	guə̯ŋ	guə̯ŋ	‘hole’
*lima	məʔ	moʔ	mɛʔ	mawʔ	mawʔ	mawʔ	‘five’
*liuʔ	jəwʔ	jɒʔ	jɒʔ	jəwʔ	jəwʔ	jəwʔ	‘island’
*ləpaw	peə̯	peə̯w	–	peə̯	peə̯	piə̯	‘granary; hut’

including the complete deletion of penultimate vowels and several shared vowel shifts. Modang languages changed *l to *n* in coda position and have several unique vowel shifts. Wahau, not studied in Smith (2017a), appears to be a Segai language; it has mostly deleted penultimate vowels and appears to reflect the Segai vowel shifts. There are still areas of East Kalimantan where linguistic work is needed, however, and a complete internal subgrouping will have to wait for a later study after more Segai-Modang languages are investigated.

Another difficulty associated with the data is distinguishing between phonetic detail and phonemic representation. Throughout this paper, I provide full phonetic detail for words in modern S-M languages. Variation in pronunciation that is conditioned by coda quality, a major factor in pronunciation, is not considered phonemic, but is included because it contains phonetic detail relevant for reconstruction. Providing a confident list of vowel phonemes in each language is also difficult, since these languages remain mostly under-described,

TABLE 3. ORDERING RELATIONSHIPS OF *b > *w AND *w > *g^{w}.

PKAY	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
*abu	əwaw	awaw	awaw	əwaə̯	awa	awa	‘ashes’
*sawa	səguə̯n	sguə̯n	–	səguə̯n	səguə̯n	səgün̯	‘spouse’
*lubaŋ	guaŋ	guə̯ŋ	guə̯ŋ	guə̯ŋ	guə̯ŋ	guə̯ŋ	‘hole’

and any statement of phonemic inventory is bound to change upon closer analysis. However, Smith (2017b) gave the following inventories: Gaai, /i e a ə u o ɒ/, Kelai /i e ɛ æ ə u o ɒ a/, Long Gelat /i e a u o ə/, Modang (Woq Helaq) /i e a aː u o ə/. In Modang, the phoneme aː, [əa̰], may not be distinctive since it occurs only before alveolar consonants. However, in the Mei Lan dialect where *s became *h* in coda position, the alveolar condition was lost and aː is unambiguously phonemic. Smith (2017b) also lists the diphthongs and triphthongs in each language as follows, Gaai /iw uy əw oy ay aw aːy/, Kelai /iw ew æw ao̰ aḭ aḛ oy uy/, Modang /io̰ eo̰ ey əw oy uy ay aw ao̰/, and Long Gelat /io̰ ey əw oo̰ uy ay aw/. Gaai has an additional triphthong /eo̰w/. Finally, Wahau, a language included in this study but not featured in earlier works on Segai-Modang, has not yet been the subject of phonemic analysis.

3. PENULTIMATE VOWEL REDUCTION, SESQUISYLLABICITY, AND FINAL-SYLLABLE ONSETS. As already stated, modern Segai-Modang languages have either a sesquisyllabic or monosyllabic canonical word shape that developed through the reduction and eventual deletion of PMP penultimate vowels, ultimately associated with across-the-board stress shift to the final syllable. However, the features associated with reconstructed penultimate vowels were not lost and are retained in the daughter languages albeit transferred to the final syllable. The relationship between PMP penultimate vowels and Segai-Modang final-syllable vowels is most clear where PMP (or PKAY) had *i or *u in the penult and *a in the ultima (*CiCaC or *CuCaC). In these cases the final-syllable reflex of *a has taken on the reconstructed penultimate vowel features in modern Segai-Modang. Thus, PKAY *CuCaC became C(ə)CuC and *CiCaC became C(ə)CiC, with several languages showing a schwa-like off-glide, -Cuo̰C or -Cio̰C. I will refer to these patterns as RAISED VOWEL REFLEXES. Table 4 shows some of the more striking comparisons from PKAY to Segai-Modang that display this phenomenon. In this and other tables it is important to note that raised vowel reflexes in Long Gelat are always /u/ but are nevertheless triggered by both *i and *u in the reconstructed penult.

Three competing hypotheses could explain these data. First, we may posit metathesis between the penultimate vowel and the final-syllable onset whereby *-uC- became *-Cu- and *-iC- became *-Ci-, with subsequent sound change giving rise to modern forms. PKAY *kitan, for example, would have gone through the following stages in Kelai: *kitan > *ktian > *ktin*.* Second, we may

TABLE 4. SEGAI-MODANG RAISED VOWEL REFLEXES

PKAY	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
*kitan	–	tio̰n	ktin	kətin	kətin	kətuo̰n	‘binturong’
*sipan	ñəmpio̰n	jəl̰pin	jəlpin	ñəmpin	ñəmpin	ñəmpuo̰n	‘centipede’
*pitan	səptio̰n	japtin	jəptin	səptin	səptin	səptuo̰n	‘nine’
*utaʔ	tuo̰ʔ	tuʔ	tuʔ	tuo̰ʔ	tuo̰ʔ	tuʔ	‘vomit’
*bulan	wluo̰n	uluo̰n	uluo̰n	wəlun	wəlun	uluo̰n	‘moon’
*kulat	kluo̰t	kluo̰t	kluo̰t	kəlut	kəluo̰t	kəluo̰t	‘mushroom’

posit vowel harmony whereby the height of the penultimate vowel triggers height assimilation with the ultima, followed by place assimilation in most languages. Under such an analysis, *kitan would have gone through the following stages in Kelai: *kitan > *kitɨn > *kitin > *kətin > *ktin* and in Long Gelat: *kitan > *kitɨn > *kətɨn > *kətuə̯n*. The key difference between the two languages is the eventual assimilation of frontness in Kelai but not in Long Gelat. Third, we may posit iterative feature spreading whereby the palatal feature of *i and the labio-velar feature of *u in the penultimate vowel spread to the onset of the final syllable and eventually to the final-syllable vowel. Under such a scenario, PKAY *iCa became PSM *əC^{y}a, and PKAY *uCa became PSM *əC^{w}a. Reflexes of *kitan would have thus passed through the following stages in Kelai: *kitan > *kət^{y}an > *ktin* and in Long Gelat *kitan > *kət^{y}an > *kətun.*

In the remainder of this section I will argue for the latter hypothesis: that the palatal and labio-velar features spread to the onset of the final syllable at PSM and later to the final-syllable vowels themselves. I will first demonstrate where the first two hypotheses fail to predict the observed sound changes and will conclude with a defense of the feature-spreading hypothesis and a reconstruction of the PSM consonant inventory.

3.1 THE METATHESIS HYPOTHESIS. Long Gelat provides the strongest argument against metathesis as an explanation for raised vowel reflexes in Segai-Modang. In Long Gelat, like all Segai-Modang languages, both penultimate *i and *u are reduced but not before causing changes to final-syllable vowels. These changes are seen in table 4, where Long Gelat reflects *a as *u*(*ə̯*) in words that are reconstructed with a high vowel in the penultimate syllable. Long Gelat is unique in this case, since all other Segai-Modang languages in this study reflect *a as a high-front vowel after penultimate *i and as a high-back vowel after *u. Example (2) compares reflexes of *kitan 'binturong' and *kulat 'mushroom' in Long Gelat (2a) and Woq Helaq (2b) with raised vowel reflexes in bold.

(2) a. Long Gelat: *kitan > *kət**uə̯n*** *kulat > *kəl**uə̯t***
b. Woq Helaq: *kitan > *kət**i**n* *kulat > *kəl**uə̯t***

A metathesis hypothesis cannot account for this. Under such a hypothesis the Long Gelat words must have gone through the following stages: from PKAY *kulat 'mushroom', *kulat > *kluat > *kəluat > *kəluə̯t* but from *kitan, would have gone through an inexplicable stage where *ia became *uə̯*: *kitan > *ktian > *kətian > *kətuə̯n*.

A second criticism for the metathesis analysis regards the syllable structure of modern languages. There are two parts to this criticism: first, modern languages all reflect a single nucleus, whereas the metathesis hypothesis creates a syllable boundary between the onset of the final syllable and the coda. PKAY *kitan would thus have created *kti.an. No language retains this extra syllable boundary, and the syllable structure itself is extraordinary, with a complex onset word initially but no onset in the final syllable. Second, the metathesis

hypothesis posits complex onsets in PSM that were eventually separated with a schwa: *kitan > *ktian > *kətian. This, again, is not supported by the data. Segai are the only languages that regularly deleted penultimate vowels, whereas Modang retains them as schwa. As a result, Segai languages have several assimilations that arose because of complex onsets. In Gaai, for example, voiceless stops gained voicing where they were immediately followed by a voiced segment in a complex onset: *tubuq 'to grow' became Gaai *dbəwʔ*, and *kahiw 'wood; tree' became Gaai *gjaw* (PMP *kahiw > PKAY *kayu > PSM *[kəˈʤaw] > *kjaw > *gjaw*). No such assimilatory processes are observable in Modang where complex onsets must have existed under a metathesis hypothesis. This, in turn, suggests that the full deletion of the penultimate vowel occurred only in Segai, and we must reconstruct some sort of vowel in the penultimate syllable to PSM.

3.2 THE HARMONY HYPOTHESIS. The second hypothesis posits a stage where vowel harmony affected final-syllable vowels in two stages. First, final-syllable vowels assimilated to the penultimate-syllable vowel for height. Thus, *-uCa- became *uCɨ, and *iCa became *iCɨ. Under the harmony hypothesis, this stage is reconstructed to PSM giving PSM *kitɨn 'binturong' and *kulɨt 'mushroom'. Differentiation occurred after the breakup of PSM, which then accounts for the Long Gelat reflexes. In Long Gelat, harmony ceased, and *ɨ shifted to *u: PSM *kitɨn > pre Long Gelat *kətɨn > Long Gelat *kətuᷱn* and PSM *kulɨt > pre-Long Gelat *kəlɨt > Long Gelat *kəluᷱt*. In other languages there was a second stage in harmony where final-syllable vowels assimilated to the frontness and backness of the penultimate vowel. In Woq Helaq we, therefore, must posit the following: PSM *kitɨn > pre-Woq Helaq *kitin > modern Woq Helaq *kətin* and PSM *kulɨt > pre-Woq-Helaq *kulut > modern Woq Helaq *kəluᷱt*. On the Long Gelat pattern alone, the harmony hypothesis is superior to the metathesis hypothesis in that it can accurately account for the identical reflexes of *a after penultimate *u and *i. There are, however, specific cases outlined in the following subsections where the harmony hypothesis fails to accurately predict final-syllable reflexes, outlined in the following sections.

3.2.1 NEUTRAL PENULTIMATE VOWELS BUT RAISED VOWEL REFLEXES IN THE FINAL SYLLABLE. There are multiple cases where *a in the final syllable is reflected as a raised vowel despite the absence of *i or *u in the reconstructed penult. I have placed a few of these examples in table 5:

A strict harmony hypothesis, where raised vowel reflexes are triggered by the quality of the penultimate vowel, fails to explain these comparisons. With neutral penultimate vowels the expected reflexes of *həcan are, for example, Wahau **həsæn, Gaai **can, Kelai **cæn, Mei Lan and Woq Helaq **həseᷱn, and Long Gelat **həsiᷱn (based on correspondence set one in table 10, section 4). What these words have in common, however, are labial or palatal onsets in the reconstructed final syllable. PKAY *-c- and *-y- (which itself became PSM *-j-) triggered *i* reflexes in Wahau, Gaai, Kelai, Mei Lan and

TABLE 5. RAISED VOWEL REFLEXES WITH A NEUTRAL PENULT

PKAY	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
*həcan	həsɪn̰	ciə̰n	–	həsin	həsin	həsun	‘stairs/ladder’
*ayam	jɪə̰m	jim	jiə̰m	jim	jim	jum	‘domesticated animal’
*sawa-n	səguə̰n	sgoʔ	sagoʔ	səguə̰n	səguə̰n	səgun	‘spouse’

TABLE 6. REVERSED FINAL-SYLLABLE REFLEXES

PKAY	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
*ucan	–	ciə̰n	ciə̰n	sin	sin	sun	‘rain’
*niwaŋ	ŋwaŋ	–	məŋuŋ	əŋŋuə̰ŋ	məŋuə̰ŋ	haŋuə̰ŋ	‘skinny’

Woq Helaq and an *u* reflex in Long Gelat. PKAY *w (which became PSM *g^{w}) triggered *u* reflexes in all languages. In these cases, it is the onset of the final syllable, not the penultimate vowel, that appears to be triggering raised vowel reflexes. This complicates a hypothesis whereby vowel harmony alone triggered raised vowel reflexes.

3.2.2 REVERSED RAISED VOWEL REFLEXES. The harmony hypothesis fails again where a penultimate vowel is reconstructed with *i or *u, but the final syllable in modern languages reflects the opposite quality, that is, where *-uCa- becomes -Ci-, and *-iCa- becomes -Cu-. Two cases, shown in table 6, have been identified and it is clear why we have the reverse reflexes; onset quality overrides penultimate-syllable vowel quality.

In a harmony analysis, *ucan would have first become *ucɨn, then *ucun, and finally *cun*, and *niwaŋ[1] would have become *niwɨŋ, then *niwiŋ, and finally, *nəwiŋ*. Instead the reflexes are reversed; modern *i* follows a *u penult, and *u* follows an *i penult. The final-syllable vowel depends instead on the quality of the final-syllable onset as *-c- triggers a front-vowel reflex even if preceded by *u, and *w triggers a back-vowel reflex even if preceded by *i. Once again, a hypothesis that relies on vowel harmony fails to account for these patterns.

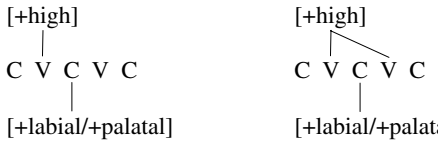
3.3 BLOCKING METATHESIS OR HARMONY? One could try to save either of these hypotheses by making palatal consonants (*c, *j, *ñ) and labiovelar consonants (*g^{w}) exceptional regarding metathesis or harmony, but such an analysis lacks clear phonetic motivation. Regarding metathesis, there is no obvious reason why a palatal consonant would act as a blocker. There are no

1.. PKAY *niwaŋ is supported with Kayan evidence as well: Bahau niwaŋ, Data Dian ñiweə̰ŋ, Balui Liko ñiwaŋ. The PSM form is thought to have gone through the following stages: *niwaŋ > *[nĩw̃ãŋ] > *[nĩŋ^{w}ãŋ] > PSM *ŋ^{w}aŋ. PSM deleted the initial syllable and nasalized the glide as a result of progressive nasalization from *n- (see Blust 1997 for more). This happens in other Segai-Modang words, for example, PKAY *ŋayaw ‘headhunting’ has a nasal reflex of *y in Kelai *ñ̃iw*, Mei Lan *ənñ̃iw*, Woq Helaq *ənñ̃i*, and Long Gelat *ŋəñ̃u*.

studies as far as I am aware which suggest that palatal and labio-velar consonants are less prone to metathesis than other consonants.

Regarding harmony, there are two main approaches to vowel harmony, one where harmony can occur at a distance (Clements 1989, 1991; Odden 1994), and a second where harmony is strictly local (Gafos 1999; Bakovic and Wilson 2000; Ní Chiosáin and Padgett 2001; Rose and Walker 2004; Nevins 2010). Long-distance harmony is just as unlikely to be blocked by an intervening consonant as metathesis, since theories of long-distance harmony separate the harmonizing feature from the consonant tier, allowing harmony to skip over intervening consonants as in example (3).

(3)



Vowel harmony in a theory of long-distance assimilation should not be affected by intervening segments, again, since the vowel features are formally separated from the consonant features. Strictly local harmony, where features spread iteratively through intervening segments, however, is better equipped to explain all these data. I refer to this second type simply as iterative feature spreading in the following sections. In an iterative feature spreading approach we will see the features of the penultimate vowel were first passed on to the final-syllable onset, before continuing to the final vowel.

3.4 FEATURE SPREADING AND THE PALATALIZATION AND LABIALIZATION OF FINAL-SYLLABLE ONSETS. We have observed that although the quality of reconstructed PMP and PKAY penultimate vowels often predicts the quality of Segai-Modang final-syllable vowels, the reconstructed penult alone cannot explain all reflexes. In cases where a neutral penultimate vowel was followed by either a palatal final-syllable onset or a labio-velar final-syllable onset, we find raised vowel reflexes despite the neutrality of the reconstructed vowel. In cases where the quality of reconstructed penultimate vowels clashes with the palatal and labial features of final-syllable onsets, the onsets win. These observations lead to the first proposition of this paper; PSM final-syllable onsets had separate regular, palatalized, and labialized (labio-velarized) series. From PSM it was the quality of the onset that conditioned varying reflexes of final-syllable vowels, including the raised vowel reflexes discussed earlier. The proposed consonant inventory is shown in table 7.

The palatal series inherently had a palatalizing effect on the following vowels, and there were no labialized palatal consonants. Even where a labial penultimate vowel should have produced a labialized consonant, palatal consonants were immune, as already discussed. PMP *b became *w in the onset of final syllables in PSM, eliminating the possibility of *b^{y} and *b^{w}. Inherited *w

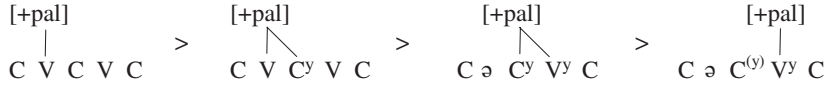
TABLE 7. PROTO-SEGAI-MODANG CONSONANTS

	Labial	Alveolar	Palatal	Velar	Glottal
Voiceless plosive	*p$^{(w/y)}$	*t$^{(w/y)}$	*c	*k$^{(w/y)}$	*ʔ$^{(w/y)}$
Voiced plosive	*b	*d$^{(w/y)}$	*j	*g$^{(w/y)}$	
Nasal	*m$^{(w/y)}$	*n$^{(w/y)}$	*ñ	*ŋ$^{(w)}$	
Fricative		*s$^{(w/y)}$			*h$^{(w/y)}$
Lateral		*l$^{(w/y)}$			
Glide	*w		*y		

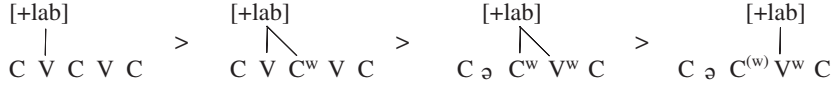
hardened to *g^{w} in PSM, which explains the absence of *w^{w}. Where a velar nasal would have palatalized to **ŋ^{y}, it instead shifted to a full palatal *ñ (see section 3.5). The onsets gained palatal and labio-velar features through iterative feature spreading. Penultimate vowels transferred their features to the following final-syllable onset and then reduced to schwa. If the onset already had secondary features, then the feature spreading was blocked and the features themselves were deleted as the vowel reduced.

By and large the modern languages do not retain the regular-palatalized-labialized distinction, although there are certain caveats. The main advantage of this approach is that it can explain both words with raised vowel reflexes after reconstructed penultimate *i and *u as well as words with raised vowel reflexes after *-c-, *-j-, *-ñ-, and *g^{w}. In all cases, onsets had palatal or labio-velar features that were transferred to the final syllable after the breakup and diversification of PSM. A segment-by-segment spreading of features can be reconstructed, as schematized in example (4). The features appear to have "followed" stress, as it moved to the final syllable and penultimate vowels were reduced to schwa. In (4a) and (4b) features spread freely to the final-syllable onset and on to the final-syllable vowel. In (4c) spreading is blocked because of the presence of a palatal feature on the final-syllable onset. The labio-velar feature is deleted as the penultimate vowel is reduced and the inherited onset features spread to the final-syllable vowel in its place.

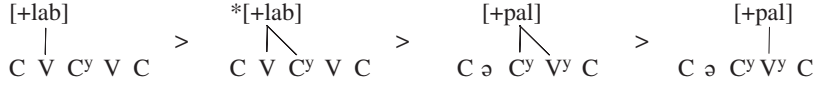
(4) a.



b.



c.



In the case of Long Gelat, palatal and labial features did not spread completely to the final syllable, and reflexes fell together as *u*. Long Gelat raised vowel reflexes are thus conditioned directly by adjacent C$^{y/w}$, not by harmony, as shown by the existence of raised vowel reflexes without a high vowel in the penult. The fact that a palatal feature already on the onset may block labial feature spreading from the penultimate vowel is motivated by the observation that segments tend to have either palatal or labial features but only rarely both.

3.5 AN OBJECTION TO PALATALIZED AND LABIALIZED ONSETS. A potential objection to the reconstruction of palatalized and labialized onsets of final syllables may be that I am proposing an intermediate stage that arose, caused a necessary change, and was later deleted; that is, palatalization and labialization exist only to derive vowel reflexes. The main argument against such an objection is that certain segments do retain the earlier stage. For example, where *ŋ appeared after *i, as in PKAY *təliŋa 'ear', it is reflected as a palatal in the modern languages: Wahau *kəlñɪa̯n*, Mei Lan and Woq Helaq *kəñin*, and Long Gelat *kəñua̯n*. Importantly, the Long Gelat word reflects palatalization of *ŋ even though the modern raised vowel reflex is *ua̯*, demonstrating that historical feature spreading is responsible for the change *ŋ > *ñ*. In these words we can see a clear transfer of the palatal feature to the onset of the final syllable, resulting in full palatalization of *ŋ to PSM *ñ. Second, Wahau is unique among the languages appearing in this study in that it sometimes maintains labialization on final-syllable onsets as a variable pronunciation. PSM *ŋ-k^{w}ah 'to sell', for example, was pronounced *ŋk^{w}ah* in Wahau, even though most recordings of words that reflect *C^{w}a in Wahau are pronounced with either *u* or *ua̯*. Other examples of coarticulated onsets that were recorded in Wahau are *l^{y}ak* 'floor', *l^{w}ua̯n* 'to move one's body', and əŋ^{w}aʔ 'to hit with a stick'. Third, it is clear from words like Kelai *cia̯n* and Mei Lan *sin* (both < *quzan) that the onset of the final syllable, not the quality of the penultimate vowel, is the main determiner of final-syllable vowel reflexes. The hypothesis that PSM had palatalized and labialized onsets of final syllables historically conditioned by the quality of PKAY penultimate vowels is thus supported by the historical facts of final-syllable vowel reflexes.

Palatalized and labialized final-syllable onsets are also found in the historical phonologies of languages outside Austronesian. Ostapirat (2018), for example, reconstructs palatalized and labialized consonants in a parallel development in Kra-Dai. In those examples, the quality of proposed Proto-Austro-Tai penultimate syllables passed their features onto the onsets of final syllables, eventually resulting in their complete transfer to the final-syllable nucleus. A representative example comes from Proto-Austro-Tai *utaq 'vomit', which Ostapirat reconstructs as *r^{w}a:k in Proto-Tai but as *uta:k in Proto-Kra-Dai. It is reflected in several modern languages with a labialized vowel: Yay *ruak*, Mak *du:k*, Maonan *ndo:k*, and Lingao *duak*, which provides outside evidence supporting a directional change from *uCa to C^{w}a and *iCa to C^{y}a, and this may be further associated with stress shift to the final syllable as both Segai-Modang and Kra-Dai are

either monosyllabic or sesquisyllabic with stress on the final syllable but descend from a proto-language that had penultimate stress (Smith 2018).

Finally, onsets trigger vowel assimilation in other Austronesian languages as well, perhaps most famously in Marshallese. In his analysis of Marshallese vowel phonemics, Bender (1963) demonstrates that front and back vowels are predictably triggered by the preceding consonant where palatal and velar consonants result in front and back vowel realizations, respectively. The onset-triggered vowel splits we find in Segai-Modang are, therefore, not unique cross-linguistically. They are only notable from an areal perspective, being rare in Borneo where they are generally associated with stress shift.

3.6 REVIEW. This section has argued that the features of PKAY penultimate vowels were transferred to the onsets of word-final syllables, resulting in a series of regular, palatalized, and labialized onsets in PSM. The feature-spreading analysis can explain both why penultimate vowels affected final-syllable vowel reflexes and why *-c-, *-j-, *-ñ-, and *-g^{w}- result in raised vowel reflexes regardless of the quality of the penultimate vowel. Iterative feature spreading palatalized and labialized onsets first and final-syllable vowels second but was blocked where final-syllable onsets already had labial or palatal features. Raised vowel reflexes were directly conditioned by the onset and only indirectly by the quality of the penultimate vowel.

4. SEGAI-MODANG REFLEXES OF PKAY *a:, *a, AND *ə. After recognizing the need to reconstruct regular, palatalized, and labialized final-syllable onsets we may move on to the final-syllable vowel reflexes.[2] Reflexes of PMP and PKAY final-syllable vowels are complex and conditioned by multiple factors. The presence or absence of palatalized and labialized onsets caused splits in reflexes of all vowels, which phonemicized after the loss of palatalization and labialization. Further splits were caused by both the presence/absence and quality of final-syllable codas. This section organizes reflexes of PKAY *a:, *a, and *ə in the final syllable by correspondence set. Later sections (5 and 6) discuss the high vowels and diphthongs, respectively.

Reflexes of PKAY central vowels have at least 16 distinct correspondence sets conditioned by the secondary features of final-syllable onsets and the presence, absence, and quality of codas. I argue for two phonemic central vowels in PSM final syllable, *a: and *a. Reflexes of PSM *a: are fronted in most daughter languages, but as shown in table 8, Gaai maintains a more central vowel reflex in correspondence set one and Mei Lan and Woq Helaq do so in correspondence set two. PSM *a ultimately reflects a conditioned merger of PMP *ə and *a, and was phonetically realized as [ə] after palatalized and labialized onsets. The 16 sets are given below this paragraph with reflexes in the six

2. There is no need to reconstruct the quality of penultimate vowels, since PSM was fully sesquisyllabic and had only schwa in the penult. All reconstructed vowels refer to those that appear in word-final syllables.

TABLE 8. CENTRAL-VOWEL CORRESPONDENCE SETS

Set number	PSM	Phonetic details	Condition	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat
1	*a:	[æ/eə̯]	C_[alv]	æ	a	æ	eə̯	eə̯	iə̯
2	*a:	[æ/eə̯]	C_[ʔ, h]	æ	ay	æ	əa̯	əa̯	e
3	*a:	[æ/eə̯]	C_[lab	eə̯	eə̯	æ	ay	ay	iə̯
4	*a:	[æ/eə̯]	C_[vel]	eə̯	eə̯	–	eə̯	eə̯	i
5	*a:	[a:]	C^{w}_[alv]	uə̯/ua̯	uə̯	uə̯	u	u	üə̯
6	*a:	[a:]	C^{w}_[vel]	uə̯/wa	uə̯	uə̯/u	uə̯	uə̯	uə̯
7	*a:	[a:]	C^{w}_[ʔ, h]	uə̯/wa	u	u	uə̯	uə̯	uə̯
8	*a:	[a:]	C^{y}_[alv]	ɪə̯	i/iə̯	i/iə̯	i	i	üə̯
9	*a:	[a:]	C^{y}_[ʔ, h]	ɪə̯	i	i	iə̯	iə̯	u
10	*a:	[a:]	C^{y}_[lab]	ɪə̯	i	i	i	i	u
11	*a:	[a:]	C^{y}_[vel]	ɪə̯	eə̯	eə̯/iə̯	iə̯	iə̯	uə̯
12	*a	[a]	C_C	a	a	a	a	a	a
13	*a	[ə]	C^{y}_ʔ	ə	o	ɛ	aw	aw	aw
14	*a	[ə]	C^{w}_ʔ	ə	o	o	aw	aw	aw
15	*a	[ə]	$C^{y/w}$_[vel]	ə	o	əw	aw	aw	a
16	*a	[ə]	$C^{y/w}$_[alv]	ə	o	a	o	aw	oə̯

languages used in this study. Sets 1–11 reflect PSM *a:. Within this set, numbers 5 through 11 have raised vowel reflexes conditioned by labialized and palatalized onsets in modern Segai-Modang. Sets 12–16 reflect *a. In this and other tables I indicate both phonemic and phonetic forms where appropriate. See section 4.7 for more on this.

4.1 JUSTIFICATION FOR PSM *a: AND *a FROM KAYANIC. As discussed at length in Blust (2002) many Kayan languages reflect both the deletion of inherited word-final glottal stops (from earlier PMP *-q) and the innovation of glottal stops in historically open word-final syllables (*-a became *-aʔ*, but *-aʔ became *-a*). Blust proposed that vowels in final syllables were phonetically lengthened before inherited glottal stops and that innovative glottal stops were later added to open final syllables that had short vowels. The result was a distinction between long and short vowels only before final glottal stop. The following relative chronology in example (5) is reprinted from Smith (2017a) and shows the stages that glottal stop insertion and vowel lengthening took place.

(5)

	*mata ‘eye’	*m-ataq ‘raw’	*bulu ‘body hair’	*buluq ‘bamboo’	*tali ‘rope’	*putiq ‘white’
lengthen vowels before *-ʔ	–	*m-ata:ʔ	–	*bulu:ʔ	–	*puti:ʔ
add ʔ after *-V	*mataʔ	–	*buluʔ	–	*taliʔ	–
lower short vowels	–	–	*buloʔ	–	*taleʔ	–
result	*mataʔ*	*m-ata:ʔ*	*buloʔ*	*buluʔ*	*taleʔ*	*putiʔ*

This specific history of vowel lengthening, glottal stop addition, short vowel lowering, and optional glottal stop deletion after long vowels is unique to Kayan and Murik-Merap, but Segai-Modang languages offer an intriguing glimpse into the stages that glottal stop insertion and vowel lengthening took place. As Blust notes, vowels were lengthened before *inherited* glottal stop, and where glottal stop was added, vowels remained short. Although Segai-Modang languages did not add glottal stop after high vowels, as is the case in Kayan-Murik, we do find glottal stop insertion after word-final *a. More importantly, this study reconstructs a long vowel, *aː, before inherited glottal stop but a short vowel before innovated glottal stop, matching the Kayan-Murik data. It follows from this that Proto-Kayanic itself had lengthened *a in closed syllables and closed open syllables with a glottal stop, but only where those syllables had the vowel *a as a nucleus, creating a long–short distinction before word-final glottal stop that was then inherited in both PSM and Proto-Kayan-Murik (PKM).

Reconstructing *aː all the way to Proto-Kayanic may be questioned by pointing to the fact that Blust reconstructs lengthening only before word-final glottal stop. This, however, is not an issue. Blust reconstructs a *phonemic* contrast of long and short vowels before glottal stop, but it remains a possibility that all instances of *a were long in closed word-final syllables in PKAY, and that a phonemic distinction arose only after the later addition of glottal stop. Segai-Modang data support such a reconstruction.

4.2 A NOTE ON *-AʔAND *-ƏC IN PKAY. It is well understood that PMP *-aq became PKAY *-aːʔ, and that PMP *-a became PKAY *-aʔ, providing a newly innovated length contrast only before word-final glottal stop, but what of PMP *-əq, which would have become PKAY *-əʔ? Interestingly, PMP *-əq and *-aq had merged at some point before PKAY. This is evidenced by reflexes of *tanəq, which show identical final-syllable reflexes as, for example, *m-ataq ‘raw’, as seen in table 9.

From this, we can infer that PMP *-əq had been eliminated through merger at the pre-PKAY level. The next question one must ask is on the phonemic status of *-aʔ. After *-əq was eliminated and glottal stop was added to close *a in open final syllables, a complementary distribution arose. PKAY *-əC (where C is any consonant except glottal stop) was in complementary distribution with PKAY*-aʔ. Complementary distribution itself does not indicate a single phoneme, of course, but these two sets eventually merged in PSM as *-aC. The PKAY reconstruction, which recognizes their complementary distribution, provides some inherent motivation for their eventual merger in PSM through reanalysis.

TABLE 9. MERGER OF SCHWA AND *a BEFORE PKAY GLOTTAL STOP

PMP	Pre-PKAY	PKAY	Long Naah	Data Dian	Balui Liko	Ngorek	
*tanəq	*tanaʔ	*tanaːʔ	tana	tanaːʔ	tana	tana	‘land’
*m-ataq	*m-ataʔ	*m-ataːʔ	ata	ataːʔ	ata	ata	‘raw’

After directly comparing Segai-Modang and Kayan-Murik reflexes of PMP *a, we find ample support for reconstructing a length distinction between *a: and *a in both groups, which can then be reconstructed to PKAY. The evidence was (a) agreement in cognates between Kayan and Murik-Merap, justifying their reconstruction to Proto-Kayan-Murik-Merap, (b) long reflexes of *a after inherited glottal stops and short reflexes after innovated glottal stops in Segai-Modang, (c) and complementary distribution between short *a and *ə in final syllables. The remainder of this section follows from this observation.

4.3 CORRESPONDENCE SETS 1–4. Correspondence sets 1–4 reflect a single phoneme *a: and are thus listed together in this section. All four appear after regular onsets with the following conditions; set 1 is found before alveolar codas, set 2 before glottal codas, set 3 before velars, and set 4 before labial codas. Table 10 contains examples from each correspondence set with discussion afterward.[3]

The almost universal frontness of reflexes in these correspondence sets suggests that the reconstructed vowel was front as well, but a lack of fronting in Gaai *gutan* 'eye' and in Mei Lan and Woq Helaq *ləhəq̰ʔ* 'blood' indicates that the fronted reflexes may have arisen in parallel innovations. Most reflexes of PSM *a: still remain long in the daughter languages, even if only phonetically so. For example, in Mei Lan and Woq Helaq, /əa̰/ is a long vowel with a schwa nucleus and a lowered off-glide, /ea̰/ is phonetically long in all languages where it appears, and in Kelai /æ/ is longer than /a/.

Correspondence sets 1–4 are in complementary distribution that points to the same proto-phoneme. PSM *a: may have been pronounced [æ:] where it appeared before glottal codas, and either *[æ] or *[ea̰] before others. Fronting of *a to *e*, especially before velar consonants, is common in Borneo and has occurred in Uma Juman Kayan (Blust 1977), Kajang language of the upper Rejang and Punan Bah (Smith 2017a), Merap (Smith 2017b), and others.

4.4 CORRESPONDENCE SETS 5, 6, AND 7. Correspondence sets 5–7, shown in table 11, are reflexes of PKAY *a after labialized onsets and are further conditioned by the quality of the coda; set 5 is found before alveolar codas, set 6 before velars, and set 7 before glottal codas. The vowels are almost universally high, back, and rounded, with schwa-like off-glides conditioned by the coda. In some cases, however, Wahau maintains the low-vowel nucleus with a high-front in-glide (see reflexes of PKAY *niwaŋ 'skinny' and of PSM *ŋ-kʷa:h 'to sell'). This is taken as evidence that the modern vowel quality was conditioned by the onset, and that PSM probably had a central vowel as the nucleus.

3. In table 10, Gaai *gutan* is a fusion of *guə̰ŋ mətan*, or 'hole of the eye'. Throughout Segai-Modang facial features are compounded with the word 'hole': PSM *gʷa:ŋ məta:n 'hole of the eye', *gʷa:ŋ ba:ʔ 'hole of the mouth', *gʷa:ŋ lᵘuŋ 'hole of the nose'. In many cases the compounds are maintained. In others, like Gaai *gutan*, they have fused together.

TABLE 10. EVIDENCE FOR CORRESPONDENCE SETS 1–4

Set	PKAY	PSM	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
1	*mata-n	*məta:n	mtæn	gutan	mtæn	məteə̯n	məteə̯n	mətiə̯n	‘eye’
2	*daha?	*ləha:?	ləhæ?	alhay?	lhæ?	ləhəə̯?	ləhəə̯?	ləhe?	‘blood’
3	*m-asak	*sa:k	seə̯k	seə̯k	sæk	sayk	sayk	siə̯k	‘ripe’
4	*kəlarap	*kəla:p	–	kleə̯p	–	kəleə̯p	kəleə̯p	kəlip	‘sleep walk’
	*ga?am	*gə?a:m	gə?æm	–	–	gə?eə̯m	gə?eə̯m	gə?im	‘molar’

Set 5 has a consistent pronunciation as a high, back, rounded vowel, except in Long Gelat where the alveolar coda conditions a fronted vowel üə̯ (pronounced as [yɪ̯] and [ʉɪ̯]). Very little separates sets 5 and 6 that are equivalent except for Mei Lan and Woq Helaq, both with schwa off-glides in 6 but not 5, and by Long Gelat which fronts the vowel in 5 but not 6. Set 7 lacks a schwa off-glide in most languages. All correspondence sets, however, remain conditioned by the coda, and the differences in pronunciation are not phonemic.

4.5 CORRESPONDENCE SETS 8–11. It is generally more difficult to find reflexes of *a: in final syllables following a palatal onset. The correspondence sets in this section, found in table 12, are thus less robustly supported but remain consistent with the patterns observed so far. The place of articulation of the coda conditions reflexes in the modern languages, giving rise to four distinct correspondence sets. Set 8 appears before alveolar codas, set 9 before glottals, set 10 before labials, and set 11 before velar codas.

Set 8 is the most well-supported set in this section and appears after a palatalized onset and before an alveolar coda. In set 8, *a: is reflected as a high-front vowel, often with a schwa-like off-glide except for Mei Lan and Woq Helaq that invariably reflect a monophthong. This parallels reflexes of *a: after labialized onsets and before alveolar codas (correspondence set 5) where only Mei Lan and Woq Helaq reflect a monophthong before alveolar codas.

Correspondence set 9 is evidenced by a single word, PSM *dʸa:ʔ ‘under’. Note, however, that the pattern in set 9 parallels that found in reflexes of *a: in the environment C^w _ [ʔ, h]# in set 7 from table 11. Gaai, Kelai, and Long Gelat

TABLE 11. EVIDENCE FOR CORRESPONDENCE SETS 5–7

Set	PKAY	PSM	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
5	*kulat	*kəlʷa:t	kluə̯t	kluə̯t	kluə̯t	kəlut	kəlut	kəlüɻ̯t	‘mushroom’
6	*niwaŋ	*ŋʷa:ŋ	ŋwaŋ	–	məŋuŋ	əŋŋuə̯ŋ	məŋuə̯ŋ	haŋuə̯ŋ	‘skinny’
	*udaŋ	*lʷa:ŋ	–	yuə̯ŋ	yuə̯ŋ	luə̯ŋ	luə̯ŋ	luə̯ŋ	‘shrimp’
7	*uta?	*tʷa:?	ntuə̯?	tu?	tu?	əntuə̯?	əntuə̯?	əntu?	‘vomit’
	–	*ŋ-kʷa:h	ŋkwah	kuh	kuh	əŋkuə̯h	əŋkuə̯h	əŋkuh	‘to sell’

TABLE 12. EVIDENCE FOR CORRESPONDENCE SET 8

Set	PKAY	PSM	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
8	*ucan	*ca:n	cɪə̯n	ciə̯n	ciə̯n	sin	sin	sün̰	‘rain’
9	*indaq	*dʸa:ʔ	dɪə̯ʔ	diʔ	diʔ	diə̯ʔ	diə̯ʔ	duʔ	‘under’
10	*siap	*ja:p	jɪə̯p	jip	jip	jip	jip	jup	‘chicken’
11	*biraŋ	*wəlʸa:ŋ	wlɪə̯ŋ	walheə̯ŋ	walheə̯ŋ	wəliə̯ŋ	wəliə̯ŋ	uluə̯ŋ	‘ant’

have a monophthong, while Wahau, Mei Lan, and Woq Helaq have an off-glide. This lends credibility to the set.

AQ12 Set 10 is characterized by a lack of off-gliding in all languages except Wahau. Set 11 is evidenced by only two example sets, reflexes of PKAY *kabiraŋ ‘ant’ and *ihaŋ ‘between’. Like correspondence set 6, schwa-like off-glides are universal before velar consonants, and parallels similar sound changes in other language groups in Borneo.

4.6 CORRESPONDENCE SET 12–16. PSM *a: contrasted with *a only in closed syllables. Historically, there were two sources for *a. The first is from PKAY *a where it occurred in open final syllables after a neutral onset. The open syllable was closed with glottal stop and *a remained short. The second source is PKAY *ə where it occurred in closed final syllables with a neutral onset. In PSM, both had merged as *a, so they are listed together in set 12, shown in table 13.

Sets 13 and 14 both reflect a central vowel, most likely a phonetic schwa as evidenced directly by Wahau, and indirectly in the other languages, where *a is reflected as a mid-vowel (except in Mei Lan, Woq Helaq, and Long Gelat where it is reflected as *aw*, but that is assumed to have gone through an earlier stage, *o). Set 14 is identical to set 13 apart from Kelai where the quality of the reflex is dependent on the quality of the final-syllable onset. In set 13*Cʸ conditioned an *ɛ* reflex but in set 14 *Cʷ conditioned an *o* reflex in Kelai. Although there is only one example in the table, individual reflexes in Kelai demonstrate this condition, including Kelai *sgoʔ* ‘sheath for a parang’ that reflects *sawa ‘spouse’ (*sawa > *səgʷəʔ > *sgoʔ*) and Kelai *doʔ* ‘to meet’ that has no PMP reconstruction

TABLE 13. EVIDENCE FOR CORREPONDENCE SET 12

Set	PKAY	PSM	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
12	*dəŋən	*dəŋan	ləŋan	alŋan	l̥ŋan	ləŋan	ləŋan	dəŋan	‘otter’
	*dəpa	*paʔ	paʔ	paʔ	–	paʔ	paʔ	paʔ	‘fathom’
	*baha	*wəhaʔ	wəhaʔ	–	uhaʔ	wəhaʔ	wəhaʔ	–	‘ember’
13	*limaʔ	*mʸaʔ	məʔ	moʔ	mɛʔ	mawʔ	mawʔ	mawʔ	‘five’
14	*duaʔ	*ləgʷaʔ	ləgəʔ	agoʔ	agoʔ	əŋgawʔ	əŋgawʔ	əŋgawʔ	‘two’
15	*uləŋ	*əlʷaŋ	ələŋ	əloŋ	ləwŋ	əlawŋ	əlawŋ	əlaŋ	‘thorn’
16	*uləd	*lʷal	ləl	lol	lal	lon	lawn	loə̯n	‘maggot’

but belongs to the same correspondence set: Wahau *dəʔ*, Woq Helaq *dawʔ*, Long Gelat *dawʔ*, PSM *dʷəʔ*.[4]

Sets 12–16 are in complementary distribution and indicate that PKAY *ə (in closed final syllables) and *a (in final syllables that were historically open, but were eventually closed with glottal stop) had merged as a single phoneme.

4.7 RECONSTRUCTION AND THE PHONETIC SHAPE OF PSM CENTRAL VOWELS. So far I have argued that PSM had three phonemic central vowels with *aː, *a, and *ə, but only *aː and *a were found in the final syllable, evidenced by cognate sets 1–11 and 12–16, respectively. This discussion focuses only on the phonetic shape of final-syllable vowels. The long vowel *aː has a fronted reflex in all cognate sets. As seen in sets 1–4, it is realized either as [æ], [a], [əa̯], [ea̯], [ia̯], or [i] in modern languages, which supports reconstructing a phonetically front vowel *[æ]. Every language in this study, however, also has in at least one correspondence set a front-vowel reflex with a schwa off-glide, either [ea̯] or [ia̯]. This suggests that there may have been variation in pronunciation or a condition that remains unclear. The true phonetic form of PSM *aː is uncertain because of this, and we may reconstruct *[æː]/*[ea̯] for what was phonemically *[aː].

In PSM there was no distinctive contrast between *[a] and *[ə] in the final syllable; *[a] was found after neutral onsets and *[ə] after palatalized or labialized onsets, as evidenced by correspondence sets 12–16. Neither appeared in open syllables; [ə] because of a restriction inherited from PAn and [a] because these words were closed with glottal stop. There are two mutually incompatible solutions regarding the reconstruction of a single phoneme to represent both allophones: we may reconstruct *a, with a conditioned variant [ə] appearing after palatalized and labialized onsets or we may reconstruct *ə, with [a] appearing after neutral onsets. In this study, *a is preferred because it belongs to the only correspondence set (12) with complete regularity across languages; that is, every language reflects *a as *a after a neutral onset, with no variation between languages. Where *[ə] is reconstructed after palatalized and labialized onsets it has complex and variable pronunciations in the modern languages that in some cases include [a] as a variable pronunciation.

This reconstruction means that schwa, as a phoneme, was restricted to prefinal syllables and only appeared in word-final syllables as a conditioned allophone. This is a typical restriction for sesquisyllabic languages and one that is found in, to name only a few examples, Lamkang (Tibeto-Burman, see Thounaojam and Chelliah 2007; Khular 2010); Burmese (Green 2005; Hill 2012); and modern

4. As a side note, reflexes of *duha are somewhat opaque, but nevertheless regular. In Modang languages *l is reflected as a nasal wherever it appears in coda position. With reflexes of PMP *duha (PKAY *dua), *d first became *l in PSM and the transition glide between *u and *a hardened, producing PSM *ləgʷaʔ. Later, the penultimate vowel deleted in Modang and a support vowel was innovated in word-initial position to avoid a banned word-initial cluster, Proto-Modang *əlgʷaʔ. *l, from PMP *d, became a nasal due to its coda position, and assimilated to the place of the following onset producing the modern form *əŋgawʔ*. As a result, *d became *ŋ in reflexes of *duha in these languages.

Segai-Modang languages including Mei Lan, Woq Helaq, Kelai, and Gaai that allow schwa only in prefinal syllables (Smith 2017a) among others.

5. SEGAI-MODANG REFLEXES OF PKAY HIGH VOWELS. PSM high vowels, like the central vowels, have diverse reflexes conditioned by the quality of both final-syllable onsets and final-syllable codas. At the PSM level, we can reconstruct conditioned allophony for both high vowels; *i was realized as *[i], *[e], *[əy], and *[ay] and *u as *[u], *[o], *[əw], and *[aw] depending on various conditioning factors, discussed at the end of the section.

5.1 REFLEXES OF PKAY *U. PKAY *u is reflected by conditioned variants that were dependent on both the presence, absence, and quality of the coda, and the quality of onsets. Because these conditions can be reconstructed to PSM, however, the various phonetic realizations are reconstructed as allophones of *u. There are several correspondence sets, numbered 17 through 25 in table 14.

5.1.1 CORRESPONDENCE SETS 17–25. As seen in table 15, sets 17–21 reflect *u after a neutral onset with further variations conditioned by coda quality. It is generally reflected in the modern languages as either *ɒ* in Wahau, Gaai, and Kelai or *o* in Mei Lan, Woq Helaq, and Long Gelat, with additional conditioned allophones discussed in more detail later. Gaai has an additional back-rounded off-glide, which provides evidence favoring a *[o] phonetic reconstruction. A feature of these sets is that they appear either before glottal consonants or the nasal series at various places of articulation. Before the voiceless stops, *u belongs to a separate set, discussed further in section 4.2.3.

Correspondence set 17 occurs preceding glottal consonants (*ʔ or *h). Set 18 is nearly identical to 17, but is differentiated by the Long Gelat reflex, which developed an off-glide before a velar coda. Set 19 unfortunately lacks Mei Lan data, but nevertheless forms a phonemic set with 17 and 18. Woq Helaq reflects a triphthong /əo̯w/ with the off-glide /w/ being triggered by the labial coda, and Long Gelat reflects a monophthong, /a/.

TABLE 14. BACK-VOWEL CORRESPONDENCE SETS

Set	PSM	Phonetic	Condition	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat
17	*u	*[o]	C_[ʔ, h]	ɒ	ɒw	ɒ	o	o	o
18	*u	*[o]	C_ŋ	ɒ	ɒw	ɒ	o	o	o̯
19	*u	*[o]	C_m	ɒ	ɒw	ɒ	–	əa̯w	a
20	*u	*[o]	C_[n, l]	ɒ	ɒ̯/o̯	o̯	o̯	o̯	u̯
21	*u	*[aw]	C_#	aw	aw	aw	a̯	a	a
22	*u	*[u]	C_t; $C^{y/w}$_[alv]	u	o̯	o̯/u	əw	əw	ə
23	*u	*[u]	C_[p, k]; $C^{y/w}$_[vel]	u	əw	u/o	əw	əw	ə
24	*u	*[u]	$C^{y/w}$_[ʔ, h]	u	əw	əw	əw	əw	əw
25	*u	*[əw]	$C^{y/w}$_#	əw	aw	aw	o	o	o̯

TABLE 15. EVIDENCE FOR CORREPONDENCE SETS 17–21

Set	PKAY	PSM	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
17	*təluh	*təluh	tlɒh	klɒw	klɒh	kəloh	kəloh	təloh	‘egg’
18	*ləsuŋ	*suŋ	sɒŋ	sɒwŋ	sɒŋ	soŋ	soŋ	soə̯ŋ	‘mortar’
19	–	*bəlum	blɒm	blɒwm	blɒm	–	bələə̯wm	bəlam	‘alive’
20	*taʔun	*təʔun	təʔɒn	təʔoə̯n	təʔoə̯n	təʔoə̯n	təʔoə̯n	təʔuə̯n	‘year’
21	*batu	*wətu	əltaw	utaw	utaw	wətaə̯	wəta	uta	‘stone’

Set 20 occurs only before alveolar codas. In this environment most languages reflect an off-glide, except for Wahau that maintains a monophthong. The Gaai and Kelai reflexes are somewhat irregular and vary between /ɒə̯/ and /oə̯/. Finally, where PKAY *u appeared in an open final syllable with a neutral onset, as in set 21, it is reflected as /aw/ in Wahau, Gaai, and Kelai and as either /aə̯/ in Mei Lan (reported as /aɐ̯/ in Smith 2017a, from a different speaker) or /a/ in Woq Helaq and Long Gelat.

5.1.2 CORRESPONDENCE SETS 22–25. Palatalized and labialized onsets affected PSM high vowels as well, preventing lowering and vowel breaking in the proto-language. This results in universally higher reflexes of the high vowels after palatalized and labialized onsets than after neutral onsets. Unlike *a, however, reflexes of *u and *i were affected identically by both labialized and palatalized onsets, as seen in table 16.

In set 22 where PKAY *u appeared before an alveolar coda and after palatalized or labialized consonants, it was retained as *[u] in PSM. It is reflected unchanged in Wahau, but lowered to *oə̯* in both Gaai and Kelai. In Mei Lan and Woq Helaq the nucleus lowered to schwa creating *əw*, and Long Gelat reflects the vowel as *ə*. The Long Gelat form is assumed to have gone through an intermediate stage, *əw, which underwent further monophthongization. Like correspondence set 22, set 23 is characterized by the change *u > *ə* in Long Gelat. It is differentiated from set 20 by in-gliding rather than out-gliding in Gaai, and a prevalence of monophthongal realizations in Kelai.

Set 24, which occurs before word final glottal stop and after a palatalized or labialized consonant, is a distinct correspondence set: *u is reflected unchanged as *u* in Wahau but as *əw* in the other languages, including Long Gelat. Set 25, where PKAY *u followed a palatalized or labialized consonant in an open syllable, became PSM *əw. Wahau maintains *əw*, Gaai and Kelai both lowered the

AQ15

TABLE 16. EVIDENCE FOR CORREPONDENCE SETS 22–25

Set	PKAY	PSM	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
22	*pulut	*pəlʷut	plut	ploə̯t	ploə̯t	pələwt	pələwt	pələt	‘sap’
23	*uruŋ	*lʷuŋ	luŋ	ləwŋ	yuŋ	ləwŋ	ləwŋ	ləŋ	‘nose’
24	*buluʔ	*lʷuʔ	luʔ	ləwʔ	ləwʔ	ləwʔ	ləwʔ	ləwʔ	‘bamboo’
25	*kutu	*tʷu	təw	taw	ptaw	to	to	toə̯	‘louse’

nucleus to *aw*, Mei Lan and Woq Helaq monophthongized *əw as *o,* and Long Gelat has the diphthong *oə̯*. The preferred reconstruction is *əw because it forms a parallel set with reflexes of *-i in the same environment, which is straightforwardly reconstructed as *əy (section 4.3).

Closer inspection of the languages reveals several apparent exceptions where sets 21 and 22 appear in environments that follow neutral onsets. These exceptions, however, reveal an additional coda condition on the development of *u. Where *u normally gave rise to correspondence sets 17–20 following a neutral onset, if the coda was a voiceless orally articulated stop (which excludes glottal stop and h), it instead follows correspondence sets 21 or 22. Several examples demonstrate this:

(6) **Set 22 after regular onsets:**
PKAY *ŋaput/kaput 'tie' > PSM *ŋəput/kəput
Wahau *ŋəput*, Woq Helaq *ŋəpəwt*, Long Gelat *ŋəpət/kəpət*
PKAY *takut 'afraid'> PSM *təkut
Wahau *kut*, Gaai *tkoə̯t*, Kelai *tkut*, Woq Helaq, *təkoə̯t*, Long Gelat *təkət.*

(7) **Set 23 after regular onsets**
PKAY *haruk 'canoe' > PSM həluk
Gaai *haləwk*, Kelai *halok*, Mei Lan *hələwk*, Woq Helaq *hələwk*, Long Gelat *hələk.*
PKAY *manuk 'bird' > PSM *mənuk
Gaai *mnəwk*, Kelai *mnok*, Mei Lan *mənəwk*, Woq Helaq *mənəwk*, Long Gelat *mənək*
PKAY *pəlanuk 'mouse deer' > PSM *pələnuk
Wahau *pəlnuk*, Gaai *palnəwk*, Kelai *palnəwk*, Mei Lan *pənnəwk*, Woq Helaq *pənnəwk*, Long Gelat *pənnək.*
PKAY *tiup 'to blow' > PSM *jup
Gaai *jəwp*, Kelai *jəwp*, Woq Helaq *ñəwp*, Long Gelat *ñəp*.

5.2 SEGAI-MODANG REFLEXES OF PKAY *i. As seen in table 17, there are multiple reflexes of *i in final syllables that, like reflexes of *u, are conditioned by the quality of both the onset and coda. Where palatalized or labialized consonants were found in the onset, reflexes are higher than after regular onsets. Some of these sets, particularly those involving the lax vowel ɛ, show more variation than is typically seen in Segai-Modang. The irregularity and variation of pronunciation between [ɛ], [e], and [eə̯] remains an issue that needs special attention.

5.2.1 CORRESPONDENCE SETS 26–29, REFLEXES OF *i AFTER NEUTRAL ONSTES. Table 18 contains evidence for the correspondence sets 26–29, which occur after neutral onsets. Reflexes in these sets universally contain lowered nuclei and have almost completely merged as /ay/ in the Modang languages, with the exception of an /e/ reflex before alveolar codas in Mei Lan. Wahau, Gaai, and Kelai reflexes are more diverse, although the

TABLE 17. FRONT-VOWEL CORRESPONDENCE SETS (26–35)

Set	PSM	Phonetic	Condition	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat
26	*i	[ay]	C_#	ɒy	ay	ay	ay	ay	ay
27	*i	[e]	C_[alv]	e	eə̯	ɛ/eə̯	e	ay	ay
28	*i	[e]	C_ŋ	e	ay	e(ə̯)	ay	ay	ay
29	*i	[e]	C_[ʔ, h]	e	ay	ɛ/eə̯	ay	ay	ay
30	*i	[əy]	$C^{y/w}$_#	əy	ay/oy	ay	oy	oy	oy
31	*i	[i]	$C^{y/w}$_n	i	eə̯	e	ey	ey	ey
32	*i	[i]	$C^{y/w}$_[t, s]	i	ɛ/ey	ɪ	ey	ey	ey
33	*i	[i]	$C^{y/w}$_ŋ	i	ey	iə̯	ey	ey	ey
34	*i	[i]	$C^{y/w}$_h	i	e	e/i	ey	ey	e
35	*i	[i]	$C^{y/w}$_ʔ	i	–	e/i	ey	ey	ey

general trend is toward lowering the nucleus while maintaining a high-front off-glide.

Where *i appeared in an open final syllable following a regular onset, as in set 26, it became PSM *[ay], a conditioned allophone of *i. In most languages it has changed little. In Gaai and Kelai it is pronounced *ay*, and in Modang varieties it is pronounced [aə̯], although [aə̯] is not distinctive and is simply written as *ay.* Wahau has backed and merged the nucleus as *ɒ*, but keeps the front off-glide as *ə̯*, giving modern Wahau *ɒə̯*.

Set 27 occurs after a neutral onset and before an alveolar coda. In this environment *i is reflected as a mid-vowel in most languages but as a diphthong in Woq Helaq and Long Gelat. PSM *s, which is retained in most languages, is reflected as *-h* in Woq Helaq and Long Gelat, but the vowel still patterns with the alveolars (PKAY *məmis ‘sweet’ > PSM *mis, Wahau *mes*, Gaai *meə̯s*, Kelai *mɛs*, Mei Lan *mes*, Woq Helaq *mayh*, and Long Gelat *mayh*)

Set 28 occurs after a neutral onset and before *-ŋ (and possibly before all velar consonants, but a paucity of data prevents further analysis). In this set *i is reflected as a diphthong in all languages except Wahau where it is *e*. Finally, set 29 appears after a neutral onset and before the glottal consonants *ʔ and *h, where *i is reflected as a diphthong again in most languages, as a monophthong in Wahau, and as either the lax vowel *ɛ* or the diphthong *eə̯* in Kelai.

TABLE 18. EVIDENCE FOR CORREPONDENCE SET 26

Set	PKAY	PSM	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
26	*tali	*təli	–	tlay	tlay	–	–	təlay	‘rope’
	*kami	*mi	mɒy	–	may	may	may	–	‘we (excl)’
28	*sin	*sin	sen	seə̯n	sɛn	sen	sayn	sayn	‘flesh’
29	*mahiŋ	*məhiŋ	məheŋ	–	ŋəlheŋ	məhayŋ	məhayŋ	məhayŋ	‘hard’
	–	*pədiŋ	pədeŋ	dayŋ	deə̯ŋ	–	pədayŋ	pədayŋ	‘cousin’
30	*siʔ	*siʔ	seʔ	sayʔ	seə̯ʔ	sayʔ	sayʔ	sayʔ	‘snail’

5.2.2 CORRESPONDENCE SETS 30–35, *i IN CLOSED SYLLABLES AFTER PALATALIZED AND LABIALIZED ONSETS. After palatalized and labialized onsets reflexes of PSM *i are higher across the board. Some example sets are presented below in table 19.

Set 30 occurs in open syllables with a palatalized or labialized onset. In this environment *i became PSM *i (phonetically [əy]). Wahau retains this reflex as *əy*, and Kelai has lowered the nucleus to *ay.* In Gaai there are two conflicting reflexes, *ay* in the reflex of PKAY *puti 'banana' but *oy* elsewhere. Mei Lan, Woq Helaq, and Long Gelat all have *oe̯*.

In set 31, *i is reflected as *i* before *-n* in Wahau, as *ey* in Mei Lan, Woq Helaq, and Long Gelat, and as *ea̯* and *e* in Gaai and Kelai, respectively. This change is exemplified by reflexes of *huadi 'sibling' in table 19, which needs some explanation. First, the reflexes contain an inalienable possessor suffix *-n*, which appears fused on many body part and kinship words. Second, Wahau, Mei Lan, Woq Helaq, and Long Gelat all point to a scenario where *u was de-syllabified and incorporated into the onset of the initial sesquisyllable (*hua- > *ua- > *wa- > *wə-). Gaai and Kelai, in this scenario, later deleted schwa and re-syllabified *w- to *u*, presumably to avoid a banned initial cluster. A search of the data reveals that there are no cases of a *w*-initial consonant cluster in either Gaai or Kelai, which supports the present analysis. Long Gelat also lacks any examples of an initial sesquisyllable of the shape *wə-*. We can compare Long Gelat *ukit* with Woq Helaq and Mei Lan *wəkea̯t* 'roots', which demonstrates the regularity of the comparison.

In set 32, after palatalized and labialized onsets and before voiceless alveolars, *i is reflected as *i* in Wahau, as *ey* in Mei Lan, Woq Helaq, and Long Gelat, and as ɪ in Kelai, although this is not contrastive and is considered an allophone of /e/. The Gaai reflexes are variable, and it is not possible to accurately describe with the available data.

In set 33, before *ŋ and after palatalized and labialized onsets *i is again reflected as *ey* in most languages and *i* in Wahau. The set is differentiated from the others by Kelai, which has a schwa off-glide, *ia̯*.

In set 34, before *h, *i is reflected with more monophthongs than before other consonants. At some point in pre-PSM *i and *u from PKAY *ikuR 'tail' must have undergone an irregular metathesis, *ikuR > *ukiR > PSM > *kʷih, as reflexes fall into the correspondence set associated with final-syllable *i. This

TABLE 19. EVIDENCE FOR CORRESPONDENCE SET 31

Set	PKAY	PSM	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
30	*puti	*pətʷi	təy	ptay	ptay	pətoy	pətoy	pətoy	'banana'
31	*huadi	*wəli-n	wlin	uleə̯n	uyen	wəleyn	wəleyn	uleyn	'sibling'
32	*isit	*sʸit	sit	sɛt	sɪt	seyt	seyt	seyt	'spider hunter'
33	*diŋdiŋ	*dʸiŋ	diŋ	deyŋ	dia̯ŋ	deyŋ	deyŋ	deyŋ	'wall'
34	*kulih	*kəlʷih	kəlih	kleh	kleh	kəleyh	kəleyh	kəleh	'clouded leopard'
35	*biniʔ	*ñiʔ	ñiʔ	–	n-ñeʔ	ñeyʔ	ñeyʔ	ñeyʔ	'seed rice'

irregular metathesis could form an additional piece of evidence for Segai-Modang as a subgroup. Note that Kayan-Murik languages do not reflect this metathesis, for example, Balui Liko (Kayan) *ikoh* and Ngorek (Murik) *ekoh*.

Finally, correspondence set 35 contains reflexes of *i after palatalized and labialized onsets before glottal stop. Due to lexical replacement, there is a complete lack of Gaai data, so it is not possible to state the entire set. The available data suggest that, like many of the other correspondence sets, the glottals are treated as a unit. Sets 34 and 35 are identical, apart from the missing Gaai data, so subsequent research may combine the two.

5.3 RAISED VOWEL REFLEXES AND PSM HIGH-VOWEL ALLOPHONY. The modern Segai-Modang forms are conditioned by the presence or absence of palatalized and labialized onsets, but because the nature of raised vowel reflexes is language-specific, we cannot reconstruct raised vowel reflexes all the way to PSM. In PSM, there was allophony conditioned by the presence or absence of palatalization and labialization, but this allophony had not yet phonemicized. The distinct reflexes must have emerged after the proto-language began to diversify. Because of this, much of the modern vowel complexity is reconstructed in the onsets, simplifying the reconstructed vowel inventory.

The reconstruction proposed in this study recognizes that there was considerable vowel allophony in the proto-language. The high vowels *u/*i had the following allophones conditioned by four environments, [u], [o], [aw], [əw], and [i], [e], [ay], [əy]. The conditions are represented in table 20. Condition 1 acted upon word-final high-vowels after neutral onsets. Evidence is from correspondence sets 20 and 25. Condition 2 acted upon high vowels in closed word-final syllables after neutral onsets, except where *u preceded a voiceless coda, in which case reflexes align with condition 3. Evidence is from correspondence sets 16–19 and 26–29. Condition 3 acted upon high vowels in closed word-final syllables after palatalized or labialized onsets, or in the case of *u, before voiceless codas after neutral onsets. Evidence is from correspondence sets 21–23 and 30–34. Finally, condition 4 acted upon word-final high-vowels after palatalized or labialized onsets. Evidence is from correspondence sets 24 and 26.

The conditions 1–4 were present in PSM, which implies that despite diversity in its daughter languages, PSM had a constrained vowel inventory with allophonic variation that occurred in predictable environments. There were only two high vowels, *i and *u, that gave rise to at least 19 correspondence sets in modern Segai-Modang.

6. SEGAI-MODANG REFLEXES OF PKAY FINAL DIPHTHONGS *A:Y, *A:W, *OY, *IW. Like all the vowels, diphthongs have unique reflexes following palatalized and labialized onsets. Six correspondence sets have been

TABLE 20. ALLOPHONES OF HIGH VOWELS IN PSM AND CONDITIONING ENVIRONMENTS

Condition number	Phonemic form	Phonetic form	Notes
1	*/Cu/	*[Caw]	
	*/Ci/	*[Cay]	
2	*/CuC/	*[CoC]	If the coda is [+voi], otherwise [CuC]
	*/CiC/	*[CɛC]	
3	*/C$^{y/w}$uC/	*[C$^{j/w}$uC]	
	*/C$^{y/w}$iC/	*[C$^{j/w}$iC]	
4	*/C$^{y/w}$u/	*[C$^{j/w}$əw]	
	*/C$^{y/w}$i/	*[C$^{j/w}$əy]	

identified, including a single merger that is regular across all languages and therefore reconstructable to PSM. Diphthongs that begin with *a, PMP *aw and *ay, are reconstructed as PSM *aːw and *aːy because of phonetically long reflexes in Gaai and Kelai and because the reflexes all show the same tendency for fronting that reflexes of *aː do. Word-final diphthongs underwent fewer changes because of the lack of coda-conditioned allophony that is present in reflexes of the regular vowels. Nevertheless, word-final diphthongs were influenced by the quality of the onset, and four reconstructed PKAY word-final diphthongs diversified into at least six separate correspondence sets in modern Segai-Modang. Table 21 contains the correspondence sets, and table 22 contains example words from each set demonstrating their validity.

Reflexes of *aːy are found in set 36 and are reflected as front vowels in Mei Lan, Woq Helaq, and Long Gelat. The Kelai and Gaai reflexes are phonetically long and in both languages, reflexes of *-aːy remain distinct from reflexes of *-i, even where the latter diphthongized. For example, in Gaai *-ay became /-ɒy/, and *-i became /-ay/ after neutral onsets.

Reflexes of PSM *-aːw are also phonetically long and are reflected with a front-vowel nucleus across the board. In most languages the *w off-glide has lost its labiality and is reflected as a simple schwa off-glide. The only exceptions are Gaai and Kelai.

TABLE 21. WORD-FINAL DIPHTHONG CORRESPONDENCE SETS (36–41)

Set	PSM	Phonetic	Condition	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat
36	*-aːy	[æːy]	C_	ay	ɑy	aɐ̯	ey	ɐy	ey/ɛy
37	*-aːw	[æːw]	C_	eə̯	eə̯w	æw	eə̯	eə̯	iə̯
38	*-oy	[oy]	C_	əy/ɒy	oy	oy	oy	oy	oy
39	*-iw/aːw	[iw]	C_; C^{y}_	iə̯/iə̯w	eə̯w/iw	iw/ew	iw	i	u
40	*-aːy	[aːy]	C^{w}_	uɐ̯y	uy	uy	uy	uy	uy
41	*-aːw	[aːw]	C^{w}_	uə̯	-	iw	iw	i	u

TABLE 22. EVIDENCE FOR CORRESPONDENCE SET 36

Set	PKAY	PSM	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
36	*pajay	*pəla:y	play	pɑy	plaę	pəley	pəley	pəley	‘rice plant’
37	*sapaw	*səpa:w	səpeǫ	speǫw	spæw	səpeǫ	səpeǫ	səpiǫ	‘roof’
38	*apuy	*əpoy	əpɒy	poy	əpoy	poy	poy	poy	‘fire’
39	*payaw	*pəjiw	bjiǫw	bjiw	bjiw	pəjiw	pəji	pəju	‘deer’
	*saliw	*ñəliw	nliǫw	nleǫw	nlew	ñəliw	ñəli	ñəlu	‘to buy’
40	*uay	*gʷa:y	guęy	guy	guy	guy	guy	guy	‘rattan’
41	–	*kʷa:w	kuǫ	–	kiw	kiw	ki	ku	‘tooth’
	*ŋ-uab	*ŋʷa:w	ŋuǫ	–	ŋiw	–	–	ŋu	‘yawn’

In set 38, PKAY *uy became PSM *oy and is reflected as such in nearly all languages, except in Gaai where the nucleus has lowered.

The final three sets, 39, 40, and 41, are the diphthongs after labialized and palatalized onsets. Although there are four possible combinations of palatal and labial onsets with inherited diphthongs (Cʸaw, Cʸay, Cʷaw, Cʷay), only three, Cʸaw, Cʷaw, and Cʷay, are attested in the data. Also, *-a:w merged with *-iw as PSM *-iw wherever it appeared after a palatal consonant, represented by set 39.

Set 40 demonstrates that after a labialized onset all languages reflect *a:y as *uy*, except Wahau which has the triphthong *uey*. PSM *-Cʷaw also has a distinct correspondence set, number 41, although interestingly the only hint that PSM maintained the labiality of the onset comes from Wahau. All other Segai-Modang languages for which data are available have merged *Cʷaw, *-Ciw, and *Cʸaw as *Ciw* (or any of the language specific reflexes of *iw).

7. CONCLUSION: PROTO-SEGAI-MODANG VOWEL SYSTEM. Segai-Modang languages present a complex but nevertheless manageable series of correspondence sets that derive a modern mainland Southeast Asian phonological typology from the more Austronesian typology of PKAY. Tables 23 and 24 present the reconstructed vowels of PSM, as argued for throughout this paper. Table 23 contains the reflexes of PMP monophthongs, and table 24 contains reflexes of PMP word-final diphthongs. Allophones are indicated in square brackets.

The available linguistic evidence suggests that PSM was sesquisyllabic. The basic word-shape was CəCV(C). Only schwa was allowed in the penultimate syllable, and *i, *u, *a, and *a: were restricted to the final syllable. It follows from the sesquisyllabic word-shape and regular word-final stress of the modern languages that PSM stress was also word-final. Although the modern languages have higher-than-average vowel inventories, it was also shown that PSM had not yet phonemicized many of the innovative vowel qualities and instead has a more constrained vowel system. Modern vowel

TABLE 23. PROTO-SEGAI-MODANG VOWELS

	Front	Central	Back
high	*i [i, e, ay, əy]		*u [u, o, aw, əw]
mid		*ə	
low		*a [a, ə] *a: [æ/eə̯]	

diversity is derived from distinctly palatalized and labialized final-syllable onsets. Most consonants had regular, palatal, and labial varieties in this position, except for the palatal series, which was inherently palatal, as well as *w, *n, *ŋ (which only had a labialized counterpart), and *b (which did not occur in final-syllable onsets).

Although palatalized and labialized consonants are often derivable from the reconstructed qualities of PKAY penultimate vowels, it was also shown that penultimate-vowel quality alone cannot explain all the observed palatalized and labialized reflexes. These cases provide evidence that the PSM penultimate vowel was indeed schwa, and that PKAY penultimate vowel qualities had been transferred to the final-syllable onset sometime during pre-PSM and continued to the final-syllable vowel in a process of rightward, iterative feature spreading.

Segai-Modang is a low-level subgroup. It contains perhaps one to two dozen isolects spoken in communities in East Kalimantan, and is part of the Kayanic subgroup, itself descended from Proto-Greater North Borneo and further from Proto-Western Indonesian (Blust 2010; Smith 2017a). As is the case with several other languages of Borneo with notable historical phonologies, the changes that have taken place are relatively recent, suggesting that stress shift, a defining feature of phonologically innovative languages in Borneo, was immediately followed by a period of rapid sound change. Comparative linguistics does not offer exact timescales, but because Segai-Modang is so far down the family tree we can assume that these changes took place in the recent past. Segai-Modang thus provides yet another example, to quote Blust (2007), of Borneo as a "hot spot" for linguistic change.

TABLE 24. PROTO-SEGAI-MODANG DIPHTHONGS

	Front	Central	Back
high	*iw		
mid			*oy
low		*a:y, *a:w	

APPENDIX: REFLEXES OF FINAL-SYLLABLE VOWELS ORGANIZED BY COGNATE SET

AQ17

Set	PKAY	PSM	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
1	*a	*a:	æ	a	æ	eə̯	eə̯	iə̯	
	*mata	*məta:n	mtæn	gutan	mtæn	məteə̯n	məteə̯n	mətiə̯n	‘eye’
	*jaʔa	*cəʔa:n	səʔæn	tʔan	cəʔæn	səʔeə̯n	səʔeə̯n	səʔiə̯n	‘chin’
	*palad	*pəla:l	maʔplæl	plal	miplæl	pəleə̯n	pəleə̯n	pəliə̯n	‘palm’
	*jalan	*la:n	læn	gulan	gulæn	leə̯n	leə̯n	liə̯n	‘road’
	–	*wəʔa:n	wəʔæn	uʔan	wuʔæn	wəʔeə̯n	wəʔeə̯n	uʔiə̯n	‘cut’
2	*a	*a:	æ	ay	æ	əə̯	əə̯	e	
	*dahaʔ	*ləha:ʔ	ləhæʔ	alhayʔ	l̥hæʔ	ləhəə̯ʔ	ləhəə̯ʔ	ləheʔ	‘blood’
	*qataʔ	*məta:ʔ	mtæʔ	mtaʔ	mtæʔ	mətəə̯ʔ	mətəə̯ʔ	məteʔ	‘raw; unripe’
	*jəlaʔ	*təla:ʔ	tlæʔ	klayʔ	klæʔ	tələə̯ʔ	tələə̯ʔ	təleʔ	‘tongue’
	*salah	*səla:h	slæh	slayh	slæh	sələə̯h	sələə̯h	səleh	‘nest’
	*babaʔ	*wa:ʔ	wæʔ	guayʔ	wæʔ	wəə̯ʔ	wəə̯ʔ	weʔ	‘mouth’
	*tanaʔ	*təna:ʔ	næʔ	tnayʔ	tnæʔ	tənəə̯ʔ	tənəə̯ʔ	təneʔ	‘land’
3	*a	*a:	eə̯	eə̯	æ	ay	ay	iə̯	
	–	*təʔa:k	–	tʔeə̯k	–	nəʔayk	n/təʔayk	təʔiə̯k	‘drop’
	*C-alaŋ	*əla:ŋ	əleə̯ŋ	əleə̯ŋ	əlæŋ	əlayŋ	–	ʔaliə̯ŋ	‘bridge’
	*m-asak	*sa:k	seə̯k	seə̯k	sæk	sayk	sayk	siə̯k	‘ripe’
	–	*ŋəwa:k	–	ŋweə̯k	–	ŋəwayk	ŋəwayk	–	‘shout’
4	*a	*a:	æ	eə̯	–	eə̯	eə̯	i	
	–	*kəla:p	klæp	leə̯p	–	kəleə̯p	kəleə̯p	–	‘scale’
	*ŋəlarap	*kəla:p	–	kleə̯p	–	kəleə̯p	ŋ/kəleə̯p	kəlip	‘sleep walk’
	*gaʔam	*gəʔa:m	gəʔæm	–	–	gəʔeə̯m	gəʔeə̯m	gəʔim	‘molar’
5	*a	*a:	uə̯/uə̯	uə̯	uə̯	u	u	üɪ̯	
	*kulat	*kəlʷa:t	kluə̯t	kluə̯t	kluə̯t	kəlut	kəlut	kəlüɪ̯t	‘mushroom’
	*bulan	*wəlʷa:n	wluə̯n	uluə̯n	uluə̯n	wəlun	wəlun	ulüɪ̯n	‘moon’
	*kuman	*mʷa:n	muə̯n	muə̯n	muə̯n	mun	mun	müɪ̯n	‘to eat’
6	*a	*a:	uə̯/wa	uə̯	uə̯/u	uə̯	uə̯	uə̯	
	*bəhuaŋ	*wəhgʷa:ŋ	wəhguə̯ŋ	wahguə̯ŋ	–	wahguə̯ŋ	wahguə̯ŋ	wahguə̯ŋ	‘bear’
	*niwaŋ	*ŋʷa:ŋ	ŋwaŋ	–	məŋuŋ	əŋŋuə̯ŋ	məŋuə̯ŋ	haŋuə̯ŋ	‘skinny’
	*udaŋ	*lʷa:ŋ	–	yuə̯ŋ	yuə̯ŋ	luə̯ŋ	luə̯ŋ	luə̯ŋ	‘shrimp’
7	*a	*a:	uə̯/wa	u	u	uə̯	uə̯	u	
	*luraʔ	*lʷa:ʔ	nəpluə̯ʔ	napplu ʔ	mñuʔ	ənluə̯ʔ	ənluə̯ʔ	ənluʔ	‘spit’
	*utaʔ	*tʷa:ʔ	ntuə̯ʔ	tuʔ	tuʔ	əntuə̯ʔ	əntuə̯ʔ	əntuʔ	‘vomit’
	*kuraʔ	*kəlʷa:ʔ	kluə̯ʔ	kuʔ	kuʔ	kəluə̯ʔ	kəluə̯ʔ	kəluʔ	‘how many’
	–	*ŋ-kʷa:h	ŋkwah	kuh	kuh	əŋkuə̯h	əŋkuə̯h	əŋkuh	‘sell’
8	*a	*a:	ɪə̯	i/(iə̯)	i/(iə̯)	i	i	üɪ̯	
	*ucan	*ca:n	cɪə̯n	ciə̯n	ciə̯n	sin	sin	süɪ̯n	‘rain’
	*kitan	*kətʸa:n	–	tiə̯n	ktin	kətin	kətin	kətüɪ̯n	‘binturong’
	*sipan	*jələpʸa:n	ñəmpɪə̯n	jəlpin	jəlpin	ñəmpin	ñəmpin	ñəmpüɪ̯n	‘centipede’
	*pitan	*jəpətʸa:n	səptɪə̯n	japtin	jəptin	səptin	səptin	səptüɪ̯n	‘nine’
9	*a	*a:	ɪə̯	i	i	iə̯	iə̯	u	
	*indaq	*dʸa:ʔ	dɪə̯ʔ	diʔ	diʔ	diə̯ʔ	diə̯ʔ	duʔ	‘under’
10	*a	*a:	*ɪə̯	i	i	i	i	u	
	*siap	*ja:p	jɪə̯p	jip	jip	jip	jip	jup	‘chicken’
	*qayam	*ja:m	jɪə̯m	jim	jiə̯m	jim	jim	jum	‘domestic animal’
11	*a	*a:	ɪə̯	eə̯	eə̯/iə̯	iə̯	iə̯	uə̯	
	*kabiraŋ	*wəlʸa:ŋ	wlɪə̯ŋ	walheə̯ŋ	walheə̯ŋ	wəliə̯ŋ	wəliə̯ŋ	uluə̯ŋ	‘ant’
	*ihaŋ	*hʸa:ŋ	hɪə̯ŋ	–	hiə̯ŋ	hiə̯ŋ	hiə̯ŋ	huə̯ŋ	‘between’

Set	PKAY	PSM	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
12	*ə	*a	a	a	a	a	a	a	
	*dəŋən	*dəŋan	ləŋan	alŋan	lŋan	ləŋan	ləŋan	dəŋan	‘otter’
	*qahəm	*ham	ham	ham	ham	ham	ham	ham	‘pangolin’
	*dəpa	*paʔ	paʔ	paʔ	–	paʔ	paʔ	paʔ	‘fathom’
	*baha	*wəhaʔ	wəhaʔ	–	uhaʔ	wəhaʔ	wəhaʔ	–	‘ember’
	*paha	*pəhaʔ	pəhaʔ	–	phaʔ	pəhaʔ	pəhaʔ	–	‘storage rack’
13	*a	*a [ə]	ə	o	ɛ	aw	aw	aw	
	*bəʔayaʔ	*wahjaʔ	wəjəʔ	wahjoʔ	wajɛʔ	wahjawʔ	wahjawʔ	wahəjawʔ	‘crocodile’
	*limaʔ	*mʸaʔ	məʔ	moʔ	mɛʔ	mawʔ	mawʔ	mawʔ	‘five’
	*ñipaʔ	*pʸaʔ	pəʔ	poʔ	pɛʔ	pawʔ	pawʔ	pawʔ	‘snake’
	*ləʔiaʔ	*ləjaʔ	jəʔ	aljoʔ	jɛʔ	ləjawʔ	ləjawʔ	ləjawʔ	‘ginger’
14	*a	*a [ə]	ə	o	o	aw	aw	aw	
	*duaʔ	*ləgʷaʔ	ləgəʔ	agoʔ	agoʔ	əŋgawʔ	əŋgawʔ	əŋgawʔ	‘two’
15	*ə	*a [ə]	ə	o	əw	aw	aw	a	
	*uləŋ	*əlʷaŋ	ələŋ	əloŋ	ləwŋ	əlawŋ	əlawŋ	əlaŋ	‘thorn’
	*irək	*lʸak	lək	lok	–	lawk	lawk	lak	‘snot’
	*hinəŋ	*ñaŋ	–	noŋ	nəwŋ	ñawŋ	ñawŋ	ñaŋ	‘face’
	*hutək	*tʷak	–	tok	təwk	tawk	tawk	tak	‘brain’
16	*ə	*a [ə]	*ə	*o	*a	*o	*aw	*oꞑ	
	–	*dʷat	ndət	dot	–	əndot	əndawt	əndoꞑt	‘sting’
	*uləd	*lʷal	ləl	lol	lal	lon	lawn	loꞑn	‘maggot’
17	*u	*u [o]	ɒ	ɒw	ɒ	o	o	o	
	*təluh	*təluh	tlɒh	klɒw	klɒh	kəloh	kəloh	təloh	‘egg’
	*bəsuh	*pəsuh	psɒh	psɒwh	psɒh	pəsoh	pəsoh	pəsoh	‘satiated’
	*pənuʔ	*nuʔ	mnɒʔ	nɒwʔ	nɒʔ	noʔ	noʔ	noʔ	‘full’
18	*u	*u [o]	ɒ	ɒw	ɒ	o	o	oꞑ	
	*ləsuŋ	*suŋ	sɒŋ	sɒwŋ	sɒŋ	soŋ	soŋ	soꞑŋ	‘mortar’
	*tahtuŋ	*tahtuŋ	–	tahtɒwŋ	təhtɒŋ	toŋ	toŋ	toꞑŋ	‘porcupine’
	*luŋ	*luŋ	lɒŋ	lɒwŋ	lɒŋ	loŋ	loŋ	loꞑŋ	‘estuary’
19	*u	*u [o]	ɒ	ɒw	ɒ	–	əaw	a	
	–	*bələum	blɒm	blɒwm	blɒm	–	bələawm	bələam	‘alive’
	–	*ləhum	məlhɒm	mahɒwm	ŋalhɒm	–	mənhəawm	mənham	‘green; blue’
20	*u	*u [o]	ɒ	ɒꞑ/oꞑ	oꞑ	oꞑ	oꞑ	uꞑ	
	*talun	*təlun	tlɒn	–	–	təloꞑn	təloꞑn	–	‘rope’
	*məsun	*məsun	nsɒn	sɒꞑn	soꞑn	məsoꞑn	–	məsuꞑn	‘grandchild’
	*sun	*sun	sɒn	–	soꞑn	soꞑn	soꞑn	–	‘smoke’
	*ʔol	*ʔul	–	ɒꞑl	mʔɒꞑl	məʔoꞑn	məʔoꞑn	məʔuꞑn	‘wake up’
	*taʔun	*taʔun	təʔɒn	təʔoꞑn	təʔoꞑn	təʔoꞑn	təʔoꞑn	təʔuꞑn	‘year’
21	*u	*u [aw]	aw	aw	aw	aꞑ	a	a	
	*batu	*wətu	əltaw	utaw	utaw	wətaꞑ	wəta	uta	‘stone’
	*paku	*pəku	(p)kaw	pkaw	pkaw	pəkaꞑ	pəka	pəka	‘fern’
	*təlu	*təlu	tlaw	klaw	aklaw	ətla	ətla	ətla	‘three’
	*qahəlu	*əlu	əlaw	alaw	alaw	əlaꞑ	əla	ala	‘pestle’
	*katu	*kətu	–	ŋtaw	–	ŋətaꞑ	ŋəta	ŋəta	‘to send’
22	*u	*u [u]	u	oꞑ	oꞑ/u	əw	əw	ə	
	*pulut	*pəlʷut	plut	ploꞑt	ploꞑt	pələwt	pələwt	pələt	‘sap’
	*silu	*səlʰun	həlun	sloꞑn	sloꞑn	hələwn	hələwn	hələn	‘finger nail’
	*bulu	*bəlʷun	blun	bloꞑn	bloꞑn	bələwn	bələwn	bələn	‘body hair’
	*lumut	*ləmʷut	ləmut	almoꞑt	lmut	ləməwt	ləməwt	ləmət	‘moss’
23	*u	*u [u]	u	əw	u/əw	əw	əw	ə	
	*tutuŋ	*pətʷuŋ	–	ptəwŋ	ptəwŋ	təwŋ	təwŋ	təŋ	‘aflame’
	*uruŋ	*lʷuŋ	luŋ	ləwŋ	yuŋ	ləwŋ	ləwŋ	ləŋ	‘nose’
	*tukuŋ	*təkʷuŋ	təkuŋ	kəwŋ	kuŋ	təkəwŋ	təkəwŋ	təkəŋ	‘helmeted hornbill’
	–	*sətʷuŋ	stuŋ	stəwŋ	stəwŋ	sətəwŋ	sətəwŋ	sətəŋ	‘raft’

Set	PKAY	PSM	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
24	*u	*u [u]	u	əw	əw	əw	əw	əw	
	*buluʔ	*lʷuʔ	luʔ	ləwʔ	ləwʔ	ləwʔ	ləwʔ	ləwʔ	‘bamboo’
	*puluʔ	*pəlʷuʔ	pluʔ	pləwʔ	pləwʔ	pələwʔ	pələwʔ	pələwʔ	‘multiple of ten’
	*pusuʔ	*pəsʷuʔ	suʔ	psəwʔ	psəwʔ	pəsəwʔ	pəsəwʔ	pəsəwʔ	‘heart’
	*tuju ʔ	*təcʸuʔ	tcuʔ	tcəwʔ	tcuʔ	səwʔ	səwʔ	səwʔ	‘seven’
	*lunduʔ	*ndʷuʔ	nduʔ	dəwʔ	dəwʔ	əndəwʔ	əndəwʔ	ndəwʔ	‘to sleep’
25	*u	*u [əw]	əw	aw	aw	o	o	oə̲	
	*kutu	*tʷu	təw	taw	ptaw	to	to	toə̲	‘louse’
	*tuyu	*jʸu	jəw	–	jaw	jo	jo	joə̲	‘crab’
	*kayu	*kəjʸu	kəjəw	gjaw	kjaw	kəjo	kəjo	–	‘wood; tree’
	*ŋəbahu	*ŋəhʷu	ŋəhəw	ŋhaw	pakhaw	ŋəho	–	ŋəhoə̲	‘jealous’
26	*i	*i [ay]	ɒy	ay	ay	ay	ay	ay	
	*tali	*təli	–	tlay	tlay	–	–	telay	‘rope’
	*kami	*mi	mɒy	–	may	may	may	–	‘we (excl)’
	*laki	*ləki	elkɒy	mangkay	mangkay	lekay	lekay	lekay	‘man’
	*pasi	*pəsi	psɒy	–	–	pesay	pesay	mesay	‘fishing line’
27	*i	*i [əy]	əy	ay/oy	ay	oy	oy	oy	
	*puti	*pətʷi	təy	ptay	ptay	pətoy	pətoy	pətoy	‘banana’
	*ubi	*gʷi	gəy	goy	gay	goy	goy	–	‘yam’
	*wahñi	*wəhñi	wəhnəy	wahñoy	wuñay	wəñoy	wəñoy	–	‘bee’
	*jihi	*jəhʸi	jəhəy	–	–	jəhoy	jəhoy	jəhoy	‘house post’
	*i-ni	*nʸi	–	nay	–	noy	noy	noy	‘this’
28	*i	*i [e]	e	eə̲	ɛ/eə̲	e	ay	ay	
	*səŋit	*səŋit	həŋet	ŋeə̲t	ŋeə̲t	həŋet	həŋayt	həŋayt	‘urine’
	*bin	*bin	ben	beə̲n	beə̲n	ben	bayn	bayn	‘carry on the back’
	*sin	*sin	sen	seə̲n	sɛn	sen	sayn	sayn	‘flesh’
	*məmis	*mis	mes	meə̲s	mɛs	mes	mayh	mayh	‘sweet’
	*taŋis	*təŋis	ŋes	nŋeə̲s	nŋeə̲s	nəŋes	nəŋayh	nəŋayh	‘to cry’
	*daqih-n	*ləʔin	ləʔen	–	ləʔɛn	ləʔen	ləʔayn	ləʔayn	‘forehead’
29	*i	*i [e]	E	ay	e(ə̲)	Ay	ay	ay	
	*mahiŋ	*məhiŋ	məheŋ	–	ŋəlheŋ	məhayŋ	məhayŋ	məhayŋ	‘hard’
	–	*pədiŋ	pədeŋ	Dayŋ	deə̲ŋ	–	pədayŋ	pədayŋ	‘cousin’
30	*i	*i [e]	E	ay	ɛ/eə̲	Ay	ay	ay	
	*siʔ	*siʔ	seʔ	sayʔ	sɛə̲ʔ	sayʔ	sayʔ	sayʔ	‘snail’
	*ləbiʔ	*ləwiʔ	–	malwayʔ	dalaweʔ	ləwayʔ	ləwayʔ	luayʔ	‘evening’
	*hiʔ	*hiʔ	heʔ	hayʔ	hɛʔ	hayʔ	hayʔ	hãyʔ	‘who?’
	*səʔih	*səʔih	sʔeh	sʔayh	səʔeə̲h	–	səʔayh	səʔayh	‘shy’
	*bəlih	*bəlih	bleh	–	blɛh	bəlayh	bəlayh	bəlayh	‘tasteless’
31	*i	*i [i]	i	eə̲	e	ey	ey	ey	
	*huadi	*wəli-n	wlin	uleə̲n	uyen	wəleyn	wəleyn	uleyn	‘sibling’
	*hipun	pʸin	pin	peə̲n	pen	peyn	peyn	peyn	‘have; own’
	*nupi	*(m)pʷin	təmpin	ŋəmpeə̲n	ŋeə̲mpen	əmpeyn	əmpeyn	əmpeyn	‘to dream’
32	*i	*i [i]	i	ɛ/ey	ɪ	ey	ey	ey	
	*isit	*sʸit	sit	sɛt	sɪt	seyt	seyt	seyt	‘spider hunter’
	*tipis	*pʸis	pis	peys	pɪs		peyh	peh	‘thin’
33	*i	*i [i]	i	ey	iə̲	ey	ey	ey	
	*diŋdiŋ	*dʸiŋ	diŋ	deyŋ	diə̲ŋ	deyŋ	deyŋ	deyŋ	‘wall’
	*mahiriŋ	*mahəlʸiŋ	məhliŋ	məhleyŋ	məlhiə̲ŋ	–	mahleyŋ	mahəleyŋ	‘new’
	–	*bəliŋ	bliŋ	bleŋ	bliŋ	bəleyŋ	bəleyŋ	bəleyŋ	‘spiraling shape’

Set	PKAY	PSM	Wahau	Gaai	Kelai	Mei Lan	Woq Helaq	Long Gelat	
	*ikiŋ	*səkʸiŋ	səkiŋ	–	–	səkeyŋ	səkeyŋ		‘pinky’
34	*i	*i [i]	i	e	e/i	ey	ey	e	
	*kulih	*kəlʷih	kəlih	kleh	kleh	kəleyh	kəleyh	kəleh	‘clouded leopard’
	*ikuh	*kʷih	kih	keh	kih	keyh	keyh	keh	‘tail’
35	*i	*i [i]	i	–	e/i	ey	ey	ey	
	*biniʔ	*ñiʔ	ñiʔ	–	n-ñeʔ	ñeyʔ	ñeyʔ	ñeyʔ	‘seed rice’
	*piliʔ	*lʸiʔ	ŋə-liʔ	–	–	ŋə-leyʔ	ŋə-leyʔ	ŋə-leyʔ	‘choose’
	–	*nəlʸiʔ	nniʔ	–	–	ñəleyʔ	ñəleyʔ	ñəleyʔ	‘to see’
	*bəliti ʔ	*bələtʸiʔ	bəlti ʔ	–	bəlti ʔ	bələteyʔ	bələteyʔ	bələteyʔ	‘rambutan’
36	*-ay	*a:y	ay	ɑy	ae̯	ey	ey	ey/ɛy	
	*pajay	*pəla:y	play	pɑy	plae̯	pəley	pəley	pəley	‘rice plant’
	*patay	*pəta:y	ntay	ptɑy	ptae̯	mətey	mətey	mətey	‘death’
	*qatay	*(h)əta:y	tay	tɑy	atae̯	tey	hətey	tɛy	‘liver’
	*sakay	*səka:y	səkay	–	–	–	səkey	səkɛy	‘stranger’
	*bəRsay	*pəsa:y	–	psɑy	psae̯	pəsey	pəsey	pəsɛy	‘paddle’
37	*-aw	*a:w	eə̯	eə̯w	æw	eə̯	eə̯	iə̯	
	*sapaw	*səpa:w	səpeə̯	speə̯w	spæw	səpeə̯	səpeə̯	səpiə̯	‘roof’
	*kasaw	*kəsa:w	kəseə̯	kseə̯w	ksæw	kəseə̯	kəseə̯	kəsiə̯	‘rafter’
	*ləpaw	*pa:w	peə̯	peə̯w	–	peə̯	peə̯	piə̯	‘granary’
	*balabaw	*əwa:w	əweə̯	aweə̯w	awæw	əweə̯	əweə̯	əwiə̯	‘rat’
	*qaləjaw	*da:w	–	deə̯w	dæw	deə̯	deə̯	diə̯	‘day’
38	*-uy	*oy	əy/ɒy	oy	oy	oy	oy	oy	
	*apuy	*əpoy	əpəy/əpɒy	poy	əpoy	poy	poy	poy	‘fire’
	*babuy	*əwoy	–	–	awoy	əwoy	əwoy	awoy	‘wild boar’
39	*-aw/-iw	*-iw	iə̯w	eə̯w/iw	iw/ew	iw	i	u	
	*kayaw	*ŋəñiw	–	ŋñeə̯w	ññiw	əññiw	ənñi	ŋəñu	‘headhunt’
	*payaw	*pəjiw	bjiə̯w	bjiw	bjiw	pəjiw	pəji	pəju	‘deer’
	*saliw	*ñəliw	nliə̯w	nleə̯w	nlew	ñəliw	ñəli	ñəlu	‘to buy’
40	*-ay	*a:y	ueɣ	uy	uy	uy	uy	uy	
	*luhay	*ləhʷa:y	ləhueɣ	alhuy	ləhuy	–	ləhuy	luhuy	‘easy’
	*uay	*gʷa:y	gueɣ	guy	guy	guy	guy	guy	‘rattan’
	*suŋay	*səŋʷa:y	–	ŋuy	ŋuy	həŋuy	həŋuy	həŋuy	‘river’
41	*-aw	*a:w	uə̯	–	iw	iw	i	u	
	–	*kʷa:w	kuə̯	–	kiw	kiw	ki	ku	‘tooth’
	*ŋ-uab	*ŋʷa:w	ŋuə̯	–	ŋiw	–	–	ŋu	‘to yawn’

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QUERIES

AQ1: Au: There are two Smith (2017) references, denoted as 2017a and 2017b. Please clarify which one you are referring here.

AQ2: Au: Tables 2, 3, 6, 12, 13, 15 and 16 are not cited in the text. Please cite them.

AQ3: Au: You have mentioned the insertion of tables 2 and 3 but the corresponding intext citations for these tables are missing. Can we add Tables 2 and 3 citations in parentheses at the end of these two paragraphs? Please clarify.

AQ4: Au: Please confirm if edit made is OK.

AQ5: Au: Please provide other sources here. Also confirm if deletion made is OK.

AQ6: Au: Please check if edit made to the sentence "In an iterative feature spreading . . . " is OK.

AQ7: Au: Please verify the changes to match consistency with tables.

AQ8: Au: Please provide in-text citation for Table 9.

AQ9: Au: Please clarify if the added item (3) is correct here?

AQ10: Au: I have hyphenated "off-glide" for consistency.

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