

The Segmental Sound Patterns of Palauan*

(1) Phonetic description of 19 surface consonants

	Labial			Dental			Dento-alveolar		Alveolar		Velar			Glottal
	+voi	-voi	+asp	+voi	-voi	+asp	+voi	-voi	+voi	-voi	+voi	-voi	+asp	-voi
Stop	[b]	[p]		[d]	[t]	[t ^h]					[g]	[k]	[k ^h]	[ʔ]
Fric				[ð]	[θ]			[s]						
Nas	[m]			[n]							[ŋ]			
Lat									[l]					
Tap							[ɾ]							
Trill							([r]) ¹							
Glides	[w]													

(2) Phonetic description of 6 surface vowels

	Front	Central	Back/ Round
High	[i]		[u]
Mid	[ɛ]	[ə]	[o]
Low		[a]	

(3) Phonetic description of 11 contrastive consonants

	Bilabial	Dental	Dento-alveolar	Alveolar	Velar	Glottal
Stop	[b]~[p]	[t]~[t ^h]			[k]~[k ^h]~[g]	[ʔ]
Fric~stop		[ð]~[θ]~[d]~[t]				
Fric			[s]			
Nas	[m]				[ŋ]~[n]	
Lat				[l]		
Rhot			[ɾ](~[r])			
Glides	[w]					

(4) Phonetic description of 5 contrastive vowels

	Front	Central	Back/ Round
High	[i]~[ə]		[u]~[ə]
Mid	[ɛ]~[ə]		[o]~[ə]
Low		[a]~[ə]	

* Based on the description of Josephs (1975) and Zuraw (2002). Palauan is a Western Malayo-Polynesian language spoken on Palau (Belau) in Micronesia.

¹ The trill has a special status that will be addressed below.

Vowel distribution

The vowels show very little variation. The changes that are found are restricted to prosodically motivated deletion, reduction to schwa, and schwa epenthesis. The contrastive vowel inventory based on the phonological patterns is shown in (5).

(5) Phonetic description of 5 vowel phonemes

	Front	Central	Back/ Round
High	/i/		/u/
Mid	/ε/		/o/
Low		/a/	

Short vowels delete in certain unstressed positions when doing so results in licit syllable structure. (This tells us that all vowel features are subject to prosodically conditioned deletion.)

(6)	<u>plain</u>		<u>suffixed</u>	
	[ðɪŋəs]	~	[θŋəsél]	‘satisfaction’
	[kúðəm]	~	[ktəmél]	‘interval’
	[búŋ]	~	[pŋál]	‘flower’
	[bíð]	~	[pðəŋél]	‘action of swinging’
	[rásəʔ]	~	[rsəʔél]	‘blood’

Short vowels become schwa in unstressed positions when deletion would result in illicit syllable structure. (One has to ask what the feature composition of this minimal reduced vowel is.)

(7)	[psipsə]	<i>bsibs</i> ‘drill’	~	[psəpsɛk ^h]	<i>bsebsek</i> ‘my drill’
	[ʔur]	<i>chur</i> ‘laughter’	~	[ʔɛrik ^h]	<i>cherik</i> ‘my laughter’
	[sɛrs]	<i>sers</i> ‘garden’	~	[sərsɛk ^h]	<i>sersek</i> ‘my garden’
	[ŋor]	<i>ngor</i> ‘mouth’	~	[ŋɛrɛk ^h]	<i>ngerek</i> ‘my mouth’
	[kar]	<i>kar</i> ‘medicine’	~	[kɛruk ^h]	<i>keruk</i> ‘my medicine’

Schwa is epenthesized after some final consonant sequences. (Assuming that epenthesized vowels are featurally minimal (unmarked in the language), one has to ask what its feature composition is.)

(8)	[psipsə]	<i>bsibs</i> ‘drill’
	[ralmə]	<i>ralm</i> ‘water’
	[diallə]	<i>diall</i> ‘ship’
	[ʔomðaswə]	<i>omdasu</i> ‘think’ (reduction?)

(Note that orthographic “u” can sometimes count as a member in a final consonant sequence, and the “long” consonants (“ll” and “rr”) condition epenthesis, therefore are treated here as consonant sequences.)

Schwa is epenthesized between dental and lateral sequences that arise as the result of ‘l’ infixation).

- (9) [təlup] *telub* ‘spat’ ([tup] ‘spit’)
 [ðəlaŋəp] *delangeb* ‘covered’
 [sələsəp] *seleseb* ‘burned’

Compare with non-dentals, which do not condition a schwa.

- (10) [kla] *kla* ‘eaten’
 [ŋlim] *nglim* ‘drunk (up)’
 [bloəs] *bloes* ‘shot’

Schwa is epenthesized between glottal stops and other consonants.

- (11) [ʔəlat^h] *chelat* ‘smoked’

To summarize, short vowels delete in unstressed syllables if syllable structure restrictions allow, otherwise they reduce to schwa. Schwa epenthesis breaks up illicit consonant clusters.

Vowel-vowel combinations

All vowels show co-occurrence restrictions. The following charts provide the distribution of vowels in vowel-vowel sequences. The empty cells are those for which I did not find evidence. An interpretation of the distribution is given after the charts. Note that the shading indicates identical vowels that are disallowed.

(12) V́V sequences

	í	ú	é	ó	á
í	íí	íu			
ú	úi	úu			
é	éí	éu	éí	éo	
ó	ói	óu	óé	óu	
á	ái	áu	áé	áo	--

- A sequence of two low vowels is not allowed.
- A sequence of identical mid vowels is not allowed - the second becomes high.
- The unstressed vowel cannot be more sonorous/lower than the stressed vowel.

(13) VV́ sequences

	í	ú	é	ó	á
í	--	íú	íé	ío	ía
u	uí	--	ué	uó	uá
ε			--	εó	εá
o			?	--	oá
a					--

- A sequence of two identical vowels is not allowed.
- The unstressed vowel cannot be more sonorous/lower than the stressed vowel.

When sequences of vowels are unstressed, one of them deletes and the other remains unreduced. The following data come from Zuraw (2002:5).

(14)	<u>alternation</u>	<u>plain</u>	<u>suffixed</u>	
	[iú] --> [i]	ʔiúkl	ʔiklél	‘good voice’
	[úi] --> [i]	túiʔ	tiʔél	‘torch’
	[ié] --> [i]	babiér	babilɣél	‘paper’
	[éi] gap			
	[iό] --> [i]	ɲiόkl-	ɲiklél	‘cooking starchy food’
	[ói] --> [i]	bóið	biðél	‘chant about travelers’
	[iá] --> [i]	ðiállə	ðillél	‘ship’
	[ái] --> [i]	báis	biséł	‘action of wandering around’
	[éu] --> [ε]	téu	teɣél	‘width’
	[uέ] gap			
	[εό] --> [ε]	oreóməl	oreməléł	‘forest’
	[όε] --> [ε]	bəróel	bərelél	‘spears’
	[εά] --> [ε]	bεáʔəð	bεʔəðél	‘tin’
	[άε] --> [ε]	báεb	bεbél	‘pipe’
	[uό] --> [u]	ʔuóðəl	ʔuðələléł	‘older sister of female’
	[όu] --> [u]	róus-	rusél	‘distribution’
	[uά] --> [u]	tuɣəl	tuɣələléł	‘door’
	[áu] --> [u]	sául	sulél	‘tiredness; trouble’
	[oá] --> [o]	omoáʔəl	omoʔələléł	‘river’
	[áo] --> [o]	táoð	toðél	‘fork’

There is a clear hierarchy of retention preference: i > ε > u > o > a

There are a few patterns not found and/or discussed by Zuraw. These are listed in (15), with the reduction pattern predicted by the data in (14).

(15)	<u>predicted alternation</u>
	[uí] --> [i]??
	[íu] --> [i]??
	[éi] --> [i]?? (Zuraw gap)
	[uέ] --> [ε]?? (Zuraw gap)
	[έo] --> [ε]??
	[oέ] --> [ε]??

Vowel behavior discussed thus far leads to the following conclusions:

- 1) There are three phonological heights.
 - The mid vowels alternate with high vowels, therefore have a high feature.
 - The mid vowels have the same distributional restrictions as the low vowel, therefore has a low vowel feature.
 - The high vowel feature is less susceptible to loss than the low vowel feature.
- 2) Since reduction in unstressed positions usually entails feature simplification, the behavior of vowels in reduced sequences:
 - Supports the conclusion that there are three heights.
 - Leads to the conclusion that the back vowels have a feature that the front vowels lack since the front vowels are retained while the back vowels delete.
- 3) It seems clear that [i] is the preferred minimally specified full short vowels. If we assume a prosodic difference between reduced “short” vowels and reduced “diphthongs”.
- 4) The interpretation of schwa is option to several options. 1) If we assume structure preservation, then the difference between reduced diphthong [i] and reduced short vowel [ə] is not one of features. Since the reduced short vowel /i/ is never in contrast in this position, it need not be phonetically dispersed and surfaces as the articulatorily easiest vowel to produce - schwa. In the reduced diphthong environment, there is a contrast among reduced vowels, so the minimal reduced high vowel /i/ must be phonetically dispersed from neutral position. It surfaces as [i] in this environment. 2) Another possibility, pointed out by Martin Krämer, is that the reduced short vowel, schwa, is an empty root node. If we allow such segments within the theory, then diphthong reduction involves the retention of some vowel features, while simple vowel reduction involves loss of all features. For the sake of simplicity, I will assume the latter option, but accept that there are complications for allowing empty root nodes that need to be explored further (e.g. contrastive schwa?).

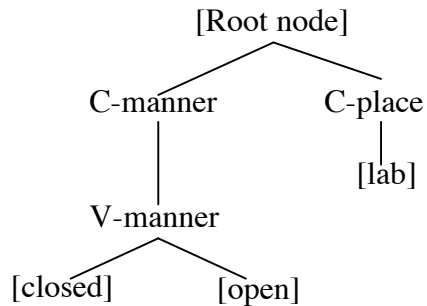
Given the distribution of the vocalic segments, and the tenets of the Parallel Structures Model, the following is a chart of the PSM feature specification for each Palauan vowel. Note that two segments are composed of only a single feature and because there is no difference in place behavior between consonants and vowels (e.g. no vowel place harmony), only C-place features are necessary.

(16) PSM feature chart for Palauan vowels

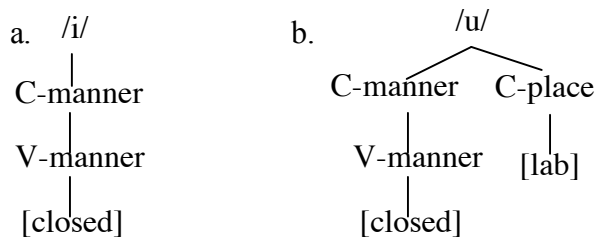
			C-place [lab]	V-manner [closed]	V-manner [open]
Featureless		[ə]			
High	/i/	[i]		✓	
	/u/	[u]	✓	✓	
Mid	/ɛ/	[ɛ]		✓	✓
	/o/	[o]	✓	✓	✓
Low	/a/	[a]			✓

The fully specified representation is given in (16), and the representations of each segment are given in (17) through (19).

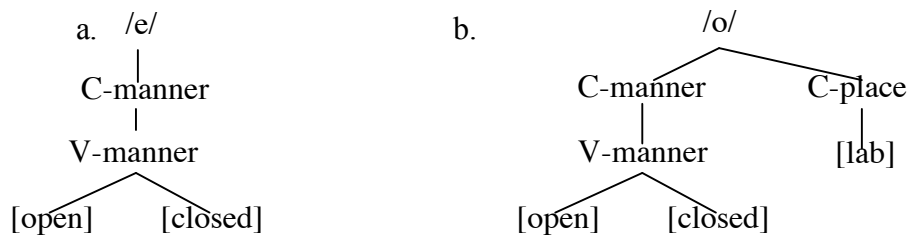
(17) Palauan PSM Vowel Geometry



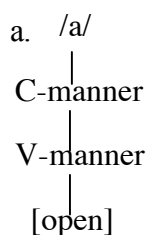
(18) High vowels



(19) Mid vowels



(20) Low vowel



Consonant distribution and features

Recall the set of consonants that seem to alternative.

(21) Phonetic description of 11 contrastive consonants and their alternations

	Bilabial	Dental	Dento-alveolar	Alveolar	Velar	Glottal
Stop	[b]~[p]	[t]~[tʰ]			[k]~[kʰ]~[g]	[ʔ]
Fric~stop		[ð]~[θ]~[d]~[t]				
Fric			[s]			
Nas	[m]				[ŋ]~[n]	
Lat				[l]		
Rhot			[r](~[r])			
Glides	[w]					

Glottal stop

(22) Allophone distribution

	Word-initial			Word-medial			Word-final	
	#__V	#__l	#__C(non-l)	V__V	C__V	V__C	V__#	C__#
/ʔ/	✓	---	---	✓	✓	---	✓	---

- Appears in all environments not involving a consonant sequence. When an underlying sequence of a glottal stop and another consonant would syllabify as a cluster, a schwa is epenthesized between the two.
- Epenthesized before phrase-initial vowels.
 - This leads to one set of words that always begin with glottal stop regardless of the phrasal context and one set of words that have a glottal stop only phrase-initially. Phrase-medially, this second set begins with a vowel.
 - This suggests that the glottal stop is the “default” onset segment.

- (23) [ʔoləs] *oles* ‘knife’ versus [ŋoləs] *Ng oles* ‘It’s a knife’
 [ʔullə] *chull* ‘rain’ versus [ŋʔullə] *Ng chull* ‘It’s raining’

Velar stop

(24) Allophone distribution

	Word-initial			Word-medial			Word-final	
	#__V	#__l	#__C(non-l)	V__V	C__V	V__C	V__#	C__#
/k/	✓	✓	✓		✓	✓		
kʰ							✓ (##)	✓ (##)
g				✓				

The velar stops are in obvious complementary distribution. The aspirated allophone only appears in word-final (probably phrase-final) position, the voiced allophone only occurs in intervocalic position and the plain allophone appears elsewhere.

- (25)
- | | | |
|------------------------|---------------|----------------|
| [kið] | <i>kid</i> | ‘we’ |
| [klou] | <i>klou</i> | ‘big’ |
| [kmarəð] | <i>kmared</i> | ‘light’ |
| [lotkii] | <i>lotkii</i> | ‘remembers it’ |
| [kpokpə] | <i>kbokb</i> | ‘wall’ |
| [prak ^h] | <i>brak</i> | ‘taro’ |
| [ðərumk ^h] | <i>derumk</i> | ‘thunder’ |
| [rəgas] | <i>rekas</i> | ‘mosquito’ |

It seems clear that the phoneme is /k/.

Dental stop

- (26) Allophone distribution

	Word-initial			Word-medial			Word-final	
	#__V	#__l	#__C(non-l)	V__V	C__V	V__C	V__#	C__#
/t/	✓	---	✓	✓	✓	?		
t ^h		---				?	✓(##)	✓(##)

There are two dental stop allophones that are obviously related to one another (there are two others to be discussed below). As was the case with the velar stops, they are found in complementary distribution, with the plain allophone found in the widest distribution. The aspirated allophone is found only in word/phrase-final position.

- (27)
- | | | |
|-----------------------|---------------|-----------------|
| [tuu] | <i>tuu</i> | ‘banana’ |
| [tmuu] | <i>tmuu</i> | ‘enter’ |
| [mətik ^h] | <i>metik</i> | ‘find’ |
| [rəktəl] | <i>rekteł</i> | ‘his sickness’ |
| [ʔəlat ^h] | <i>chelāt</i> | ‘smoked (fish)’ |
| [ðakt ^h] | <i>dakt</i> | ‘fear’ |

Following the logic of the velars, we can assume that the phoneme is /t/.

Labial stop

- (28) Allophone distribution

	Word-initial			Word-medial			Word-final	
	#__V	#__l	#__C(non-l)	V__V	C__V	V__C	V__#	C__#
/p/			✓		✓	✓	✓	?
b	✓	✓		✓				?

The bilabial stops also are in complementary distribution, however, there is no clear surface indication of which corresponds most closely to the phoneme. The plain stop appears in environments where one might expect devoicing, and the voiced stop appears in

environments where one might expect voicing (pre-sonorant position). Given this stalemate, we must find another metric by which to decide among allophones. If we assume that all stops in this language have the same contrastive laryngeal specification, then we must choose the plain bilabial as the phoneme. Also, if there is a markedness relationship between plain and voiced obstruents, then we must assume that the plain stop is the phoneme here. Note that the bilabials do not seem to participate in phrase-final aspiration/release. However, given the soft flesh involved in bilabials, it is more difficult to hear (and articulate) as audible a release than for coronals and velars. Therefore, it is possible that these are, in fact, released. This is an empirical issue worth investigating.

- (29)
- | | | |
|-----------------------|--------------|-------------------|
| [bai] | <i>bai</i> | ‘community house’ |
| [blai] | <i>blai</i> | ‘house’ |
| [rubak ^h] | <i>rubak</i> | ‘old man’ |
| [ptuʔ] | <i>btuch</i> | ‘star’ |
| [tpak ^h] | <i>tbak</i> | ‘my spit’ |
| [tup] | <i>tub</i> | ‘spit’ |

Following the above logic, we can assume that the phoneme is /p/.

Dental fricative

- (30) Allophone distribution

	Word-initial			Word-medial			Word-final	
	#__V	#__l	#__C(non-l)	V__V	C__V	V__C	V__#	C__#
/s/	✓	--	?	✓	?	?	✓	✓

The alveolar voiceless fricative occurs in a variety of environments and does not show variation. Therefore, it is taken as an individual phonemes, /s/.

- (31)
- | | | |
|-------------------------|----------------|--------|
| [sils] | <i>sils</i> | ‘sun’ |
| [məsilək ^h] | <i>mesilek</i> | ‘wash’ |
| [məŋiis] | <i>mengiis</i> | ‘dig’ |

Bilabial nasal

- (32) Allophone distribution

	Word-initial			Word-medial			Word-final	
	#__V	#__l	#__C(non-l)	V__V	C__V	V__C	V__#	C__#
/m/	✓	✓	✓	✓	✓	?	✓	✓

The bilabial nasal occurs in a variety of environments and does not show variation. Therefore, it is taken as an individual phonemes, /m/.

- (33)
- | | | |
|----------------------|----------------|--------------|
| [mað] | <i>mad</i> | ‘die’ |
| [mlai] | <i>mlai</i> | ‘canoe’ |
| [mboəs] | <i>ng boes</i> | ‘it’s a gun’ |
| [ʔoməs] | <i>omes</i> | ‘see’ |
| [tmak ^h] | <i>dmak</i> | ‘together’ |
| [blim] | <i>blim</i> | ‘your house’ |
| [ʔarm] | <i>charm</i> | ‘animal’ |

Non-labial nasal

- (34) Allophone distribution

	Word-initial			Word-medial			Word-final	
	#__V	#__l	#__C(non-l)	V__V	C__V	V__C	V__#	C__#
/ŋ/	✓	✓	✓ (non-dental)	✓	?	✓ (non-dental)	✓	?
n			✓ (dental)			✓ (dental)		

The non-labial nasal allophones are found in complementary distribution, with the dental variant found only when adjacent to a dental (i.e. [t, s, ð, r]). From a feature markedness perspective, this seems a little odd since many theories claim that coronal place is the least marked and as such should take part in distinguishing place contrasts. However, there is also nasal place assimilation of the velar nasal suggesting that it is phonologically placeless.

- (35)
- | | | |
|------------------------|------------------|--------------------|
| [ŋau] | <i>ngau</i> | ‘fire’ |
| [ŋlim] | <i>nglim</i> | ‘drunk (up)’ |
| [ŋʔətik ^h] | <i>ng chetik</i> | ‘I don’t like it’ |
| [iaŋəð] | <i>eanged</i> | ‘sky’ |
| [ðəŋʔoklə] | <i>dengchoki</i> | ‘sit’ |
| [buŋ] | <i>bung</i> | ‘flower’ |
| [səŋsonðə] | <i>sengsongd</i> | ‘stick’ |
| [ntil] | <i>ng til</i> | ‘it’s her purse’ |
| [nriil] | <i>ngriil</i> | ‘place near beach’ |
| [mboəs] | <i>ng boes</i> | ‘it’s a gun’ |

This suggests that the phoneme is /ŋ/.

Short liquids

- (36) Allophone distribution

	Word-initial			Word-medial			Word-final	
	#__V	#__l	#__C(non-l)	V__V	C__V	V__C	V__#	C__#
/l/	✓	✓	✓	✓	✓	?	✓	?
/r/	✓	?	✓	✓	?	?	✓	?

The short liquids are found in a variety of overlapping contexts so are clearly contrastive with one another. They do not show any individual allophony, so we may assume they are /l/ and /r/.

- (37)
- | | | |
|----------|----------------|-----------|
| [lius] | <i>lius</i> | ‘coconut’ |
| [mlai] | <i>mlai</i> | ‘canoe’ |
| [lmaŋəl] | <i>lmangel</i> | ‘cry’ |
| [məlai] | <i>melai</i> | ‘take’ |
| [kallə] | <i>kall</i> | ‘food’ |
- (38)
- | | | |
|------------------------|----------------|------------|
| [rakt ^h] | <i>rakt</i> | ‘sickness’ |
| [rsəʔək ^h] | <i>rsechek</i> | ‘my blood’ |
| [bəras] | <i>beras</i> | ‘rice’ |
| [kar] | <i>kar</i> | ‘medicine’ |

Long liquids

In addition to the short liquids, there are also two long liquids. Because these overlap with their short counterparts in some environments, they have been analyzed as contrastive segments.

However, the fact that they only occur in restricted positions, are they only consonants to appear as long, and condition schwa epenthesis when found word-finally (like other clusters), all combine to suggest that they are not individual segments but sequences of two identical segments.

(39) Allophone distribution

	Word-initial			Word-medial			Word-final	
	#__V	#__l	#__C(non-l)	V__V	C__V	V__C	V__#	C__#
/l/	✓	✓	✓	✓	✓	?	✓	?
ll	✓	---	---	✓	---	---	---	---
/r/	✓	?	✓	✓	?	?	✓	?
rr (r)	✓	---	---	✓	---	---	---	---

Thus, there is only a short lateral phoneme /l/ and a short rhotic phoneme /r/.

- (40)
- | | | |
|------------|----------------|------------|
| [lləl] | <i>llel</i> | ‘its leaf’ |
| [kallə] | <i>kall</i> | ‘food’ |
| [rom] | <i>rrom</i> | ‘liquor’ |
| [kərrəgar] | <i>kerekar</i> | ‘tree’ |

Glides

The phonemic status of the glides is an interesting issue. The alveolar glide is in complementary distribution with the high front vowels, thus can be seen as an allophone of a

vowel phoneme. It occurs when the high front vowel is the unstressed vowel in a sequence of vowels. For this reason, these glides have been transcribed here as [i], not [j].

On the other hand, the bilabial glide is in a similar allophonic relationship with the high round vowels in most environments, but seems to contrast with the high round vowel in final position following a consonant. These final glides trigger consonant cluster schwa epenthesis.

(41) Allophone distribution

	Word-initial			Word-medial			Word-final	
	#__V	#__l	#__C(non-l)	V__V	C__V	V__C	V__#	C__#
/w/	✓/?	?	?	✓/?	✓	✓/?	✓/?	---

(42) [ʔomðaswə] *omdasu* ‘think’

(need to find example of [...Cu], but Josephs says, “In some instances, a word-final *u* preceded by a consonant also results in a schwa release”, suggesting that final [...Cu] is the norm, rather than the exception.)

We can conclude from the word-final cluster context that there is a separate phoneme /w/. Note that this leaves open the question of how to represent bilabial glides that do not participate in alternations. They could be /u/ or /w/.

Dental fricative

The most complex set of allophonic alternations involve [ð, d, θ, t].

(43) Allophone distribution

	Word-initial			Word-medial			Word-final	
	#__V	#__l	#__C(non-l)	V__V	C__V	V__C	V__#	C__#
/ð/	✓ (slow)	---		✓	✓	?	✓	?
d	✓ (fast)	---						
θ		---	✓ (vel) (slow)					
t		---	✓ (lab) or (fast)					

It is clear from the distribution that [ð] has the widest distribution, including non-cluster careful speech, so we may assume the phoneme is /ð/. The voiced stop allophone [d] is only found in word-initial position before a vowel in fast speech. The voiceless allophones [θ, t] occur initially before consonants, where [t] is found at faster speech rates and before labials and [θ] is found at slower speech rates and before velars.

- (44)
- | | | |
|----------------------|----------------|-----------------|
| [ðup] ~ [dup] | <i>dub</i> | ‘dynamite’ |
| [mæðal] | <i>medal</i> | ‘his face’ |
| [mægæalðə] | <i>mekeald</i> | ‘warm’ |
| [tmak ^h] | <i>dmak</i> | ‘together’ |
| [θŋoð] | <i>dngod</i> | ‘tattoo needle’ |

An interesting question regarding the /ð/ phoneme has to do with its laryngeal specification. First, no other segments in the language seem to make use of a laryngeal contrast. Second, if

we assume a laryngeal markedness relationship such that a segment with a contrastive voicing feature presupposes the presence of a segment without that feature, then we might expect a /θ/ phoneme in the language as well. This is clearly not the case and suggests the /ð/ is phonologically unspecified for a voicing feature. The distribution of voiced and unvoiced allophones in this language is then dependent on vocal tract aerodynamics and spontaneous voicing, not phonological features.

Phonological features specification

There are a number of ways one might interpret the phonetics and distribution of the Palauan consonants to propose individual phonological feature specifications. Given the highly restrictive nature of the PSM, we are forced to make particular choices.

Given that there is only one unambiguous fricative in this language, /s/, we might assign this the C-manner[open] feature.

(45) PSM feature chart for Palauan /s/

		C-manner [open]
/s/	[s]	✓

Given the manner variation of /ð/, we might propose that this segment is composed of only C-place[cor].

(46) PSM feature chart for Palauan /ð/

		C-place [cor]
/ð/	[ð,d,t,θ]	✓

Among labial consonants, [w] has the weakest closure and does not seem to form a series with other segments with similar manner of articulation. Therefore, we might assign it C-place[lab].

(47) PSM feature chart for Palauan /w/

		C-place [lab]
/w/	[w]	✓

This would leave /p/ and /t/ as labial and coronal stops, respectively.

(48) PSM feature chart for Palauan /p/ and /t/

		C-place [lab]	C-place [cor]	C-manner [closed]
/p/	[p,b]	✓		✓
/t/	[t,t ^h]		✓	✓

Given the use of C-manner[closed], there must be a segment composed of only this feature. There are two additional segments that have a stop gesture: /ʔ/ and /k/. Since there does not seem to be any independent use for a glottal closure feature (C-laryngeal[closed]) and the

glottal stop does not make use of an oral place of articulation, the starting assumption might be that the placeless stop is /ʔ/. This might also be suggested by the fact that the glottal stop is the epenthetic consonant (at least phrase-initially) in the language, and as such it might be expected to be featurally minimal and as non-sonorous as possible (to make a good onset).

(49) Tentative PSM feature chart for Palauan glottal stop (to be revised)

		C-manner [closed]
/ʔ/	[ʔ]	✓

However, we run into a problem with specifying /k/. The only option left, if we want this segment to be a phonological stop, is to say that it is C-manner[closed]&C-place[dor].

(50) Tentative PSM feature chart for Palauan velar stop (to be revised)

		C-place [dor]	C-manner [closed]
/k/	[k,k ^h ,g]	✓	✓

The problem with this is that there is no evidence of another C-place[dor] segment in this language, and the model predicts that there should be a segment composed of only this place feature if /k/ has both a dorsal feature and a stop feature. In the absence of evidence of such a segment, there are three options. First, we could assume that /k/ is the only C-place[dor] segment in the language and is not a phonological stop. Second, we could assume that C-manner[closed] maps onto an oral stop gesture in this language and that the glottal stop is really C-laryngeal[closed]. This leaves /k/ as the placeless oral stop in this language, as is suggested by the default velar gesture seen in the placeless nasal. This is depicted in (51).

(51) Revised PSM feature chart for Palauan stops (option 1)

		C-place [lab]	C-place [cor]	C-laryn [closed]	C-manner [closed]
/ʔ/	[ʔ]			✓	
/k/	[k,k ^h ,g]				✓
/p/	[p,b]	✓			✓
/t/	[t,t ^h]		✓		✓

The third option, pointed out by Martin Krämer (p.c.), is that the glottal stop is empty of features. This would leave the glottal stop and the schwa as different phonetic realizations of an empty root node. These two realizations would be conditioned by syllable position - schwa in nuclear position and glottal stop in onset position. To keep out phonology as simple as possible, let us assume this last option, acknowledging the consequences still yet to be explored.

(52) Revised PSM feature chart for Palauan stops (option 2)

		C-place [lab]	C-place [cor]	C-manner [closed]
/ /	[ʔ] [ə]			
/k/	[k,k ^h ,g]			✓
/p/	[p,b]	✓		✓
/t/	[t,t ^h]		✓	✓

We are left with having to specify the nasals, lateral and rhotic with features. Let us begin with the nasals. There are two things we might do here. We might simply assume that nasality necessarily implies mapping to a nasal manner feature. This option is given in (53). It is the velar nasal that seems unspecified for place since it varies along the place dimension and the labial nasal does not.

(53) PSM feature chart for Palauan nasal consonants (option 1)

	C-place [lab]	C-manner [nasal]
/ŋ/		✓
/m/	✓	✓

However, this option has the disadvantage of introducing another feature. Another option is to consider other aspects about the articulation of these segments and to “reuse” features used elsewhere in the system. Note that nasal stops involve both stopping the flow of air and having continuous flow of air. In essence, they are phonetically both stops and continuants. Thus, I will assume the following feature specifications.

(54) PSM feature chart for Palauan nasal consonants (option 2)

		C-place [lab]	C-manner	
			[closed]	[open]
Stop+	/ŋ/		✓	✓
Continuant	/m/	✓	✓	✓

Note that this option for the feature specification of nasals may help to explain why nasals in some language behave like stops, but in other languages they do not. In the former language type, they may have a C-manner[closed] feature, but in the latter language type, they may not - perhaps only C-manner[nasal].

For the sake of concreteness and feature economy, I will assume the feature specification in (54).

Given that [i, u, l, r] form the natural class of segments that may appear in identical sequences, and the PSM way of building sonorant consonants from combinations of C-manner and V-manner features, we might propose that the liquids have a V-manner feature. Since [l] and [r] seem to differ in the amount of closure they have and neither contrasts with a similar segment along the place dimension, we might propose that /l/ has an additional C-manner[closed] and /r/ has C-manner[open].

(55) PSM feature chart for Palauan liquids

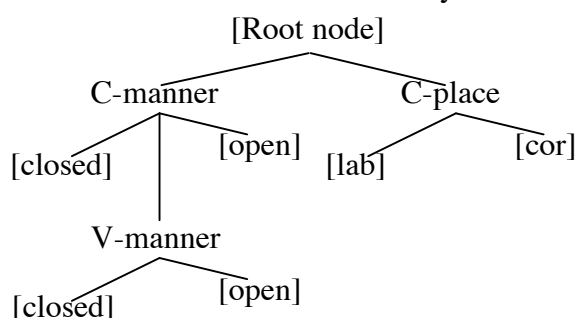
		C-manner [closed]	C-manner [open]	V-manner [closed]
/l/	[l]	✓		✓
/r/	[r]		✓	✓

The full chart of feature specifications for individual Palauan segments is given in (56), the full PSM geometry used in Palauan is given in (57), and the consonant representations given in (58) through (62). Note the economy of feature use, representations and the symmetry across the inventory.

(56) PSM feature chart for Palauan

			C-place		C-manner		V-manner	
			[lab]	[cor]	[closed]	[open]	[closed]	[open]
Featureless	/ /	[ʔ] [ə]						
Mannerless	/w/	[w]	✓					
	/ð/	[ð,d,t,θ]		✓				
Stop	/k/	[k,k ^h ,g]			✓			
	/p/	[p,b]	✓		✓			
	/t/	[t,t ^h]		✓	✓			
Stop+ Continuant	/ŋ/	[ŋ,n]			✓	✓		
	/m/	[m]	✓		✓	✓		
Continuant	/s/	[s]				✓		
Stop+High	/l/	[l]			✓		✓	
Continuant+High	/r/	[r]				✓	✓	
High	/i/	[i]					✓	
	/u/	[u]	✓				✓	
Mid	/ɛ/	[ɛ]					✓	✓
	/o/	[o]	✓				✓	✓
Low	/a/	[a]						✓

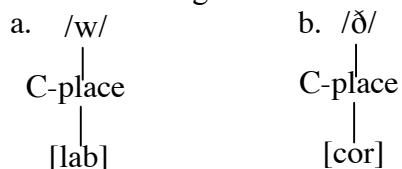
(57) Palauan PSM Feature Geometry



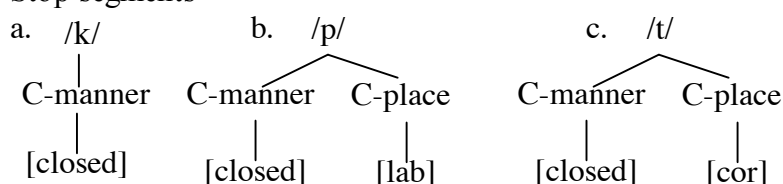
(58) Featureless segment(s)

a. /root/ --> [ʔ] [ə]

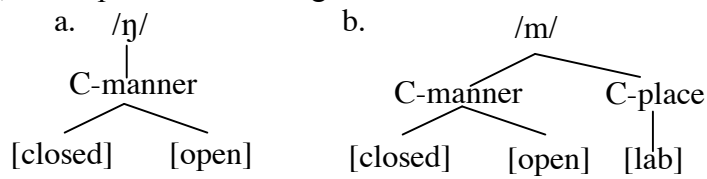
(59) Mannerless segments



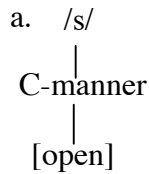
(60) Stop segments



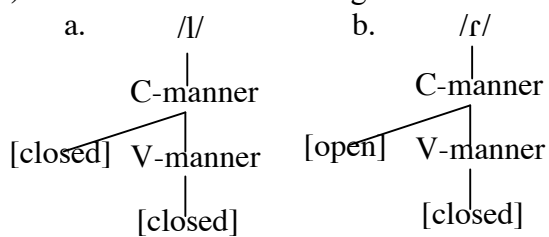
(61) Stop+Continuant segments



(62) Continuant segment



(63) Sonorant consonant segments

**Wish list**

- Nasal assimilation facts
- Description of initial, medial and final clusters - including those that cause epenthesis, those that do not cause epenthesis, and those that simply never appear (if any)
- Fuller description of the phonetic nature of “final w” - see if it is like other (Pacific) languages, i.e. [w~β~v~v]
- OT analysis of the contrasts and distribution

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