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COUNTING IN THE ADMIRALTY ISLANDS

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ABSTRACT

The languages of the Admiralty Islands in Papua New Guinea are remarkable for their extensive use of subtraction as an arithmetical operation in the generation of numeral systems. While subtractive numerals are found in some other Austronesian languages, as Yapese of western Micronesia, where they are synchronically overt, and the Malayo-Chamic languages of western Indonesia-Malaysia and mainland Southeast Asia, where they are synchronically covert, nowhere are they so ubiquitous as in the eastern Admiralties, where nearly every language shares this feature. Other observers have noted this typological trait, but have given an oversimplified picture which suggests far more uniformity than actually exists. Close attention to the data shows that while subtractives usually are limited to 7-9, 70-90 and 700-900, some languages extend this to 6-9, 60-90, and 600-900. In addition, the shape of the subtractive morpheme not only varies across languages, but may also vary across numerical values within the same language, at least one language apparently has reinterpreted subtractive morphology as additive morphology (rather than simply innovating a quinary system of the form 5 + 1, 5 + 2, etc.), the primary numerals used as independent words sometimes differ in shape from the same numeral as part of a larger subtractive numeral, and there are exceptionally frequent deviations from pattern regularity in the postclitic forms for 'hundred'. Overall, the numeral systems of Admiralty Island languages exhibit a typological trait that has been noted for other languages in the New Guinea area, namely, that pattern-breaking is nearly as common as pattern formation.

1. INTRODUCTION

Counting is an activity that seems intuitively straightforward. Even young children in most cultures quickly learn how to display the number of fingers that are needed to express a given quantity. This suggests that somewhere along the path of human evolution, after the origin of language, people began to pay attention to the number of digits on their hands, and use these as a basis for representing quantities external to the body. This gave rise to quinary and decimal counting systems, and once the feet were included, to the occasional vigesimal or quasi-vigesimal system of numeration.

Of the four basic operations of arithmetic, addition, multiplication, subtraction and division, only the first two are commonly used in counting systems of the world. In many ways this seems to be motivated by pragmatic considerations: in collecting quantities of anything, one normally adds new members to the set, rather than discarding some that are already in one's possession, and

[1] Many thanks to Peter C. Lincoln for providing the valuable map (Fig. 1) that should help many readers locate various of these languages in space, to Joel Bradshaw for comments and observations that led to substantial improvements in an earlier version of this paper, and to Eugene Chan for drawing my attention to Lean (1991), and Bender and Beller (2012). The usual disclaimers apply.

counting is therefore typically a summing up, rather than a revision of a previous count. In other words, addition and multiplication can be seen as positive mechanisms of numeration, whereas subtraction and division are their negative equivalents.

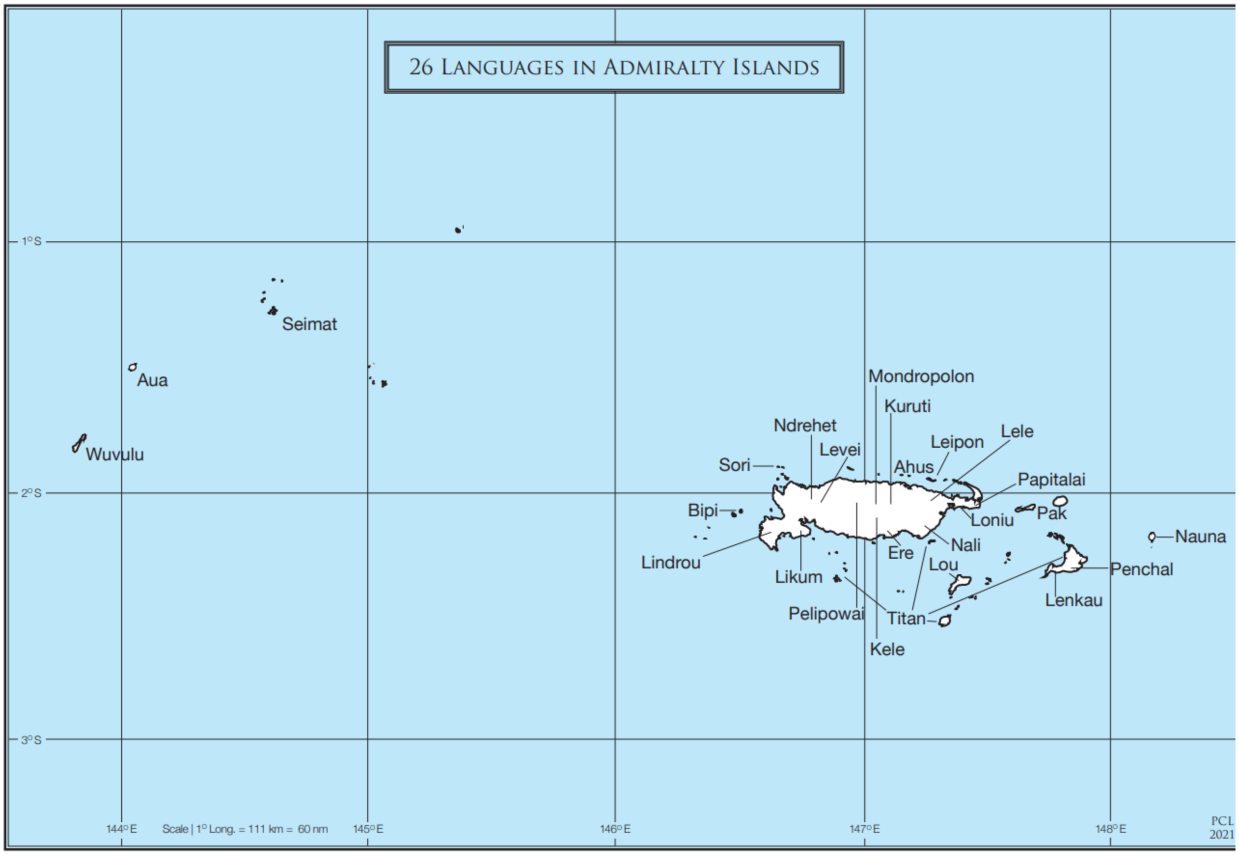

Fig. 1. Map courtesy of Piet Lincoln linc@hawaii.rr.com

The most fundamental arithmetical operation in counting is surely addition, but in counting larger quantities this becomes tedious or cumbersome, so that at some point after humans had begun counting solely by addition, multiplication was added as a second operation, giving rise to the expression of higher numerals, whether these were multiples of five, or of ten. By contrast, subtraction is rarely used in counting systems around the world and, so far as I have been able to determine, division does not occur at all as a primary operation in determining quantities.[2]

These general properties of counting systems around the world make the languages of the Admiralty Islands in Papua New Guinea particularly interesting, since many of them use subtraction to form numerals between 5 and 10. This has been noted in past publications as a general property of languages of the eastern Admiralty Islands, but without going into detail. Ross (1988:342), for example, holds that in languages of the 'Eastern Admiralties Family' "POC numerals from seven to nine are replaced by a system based on subtraction from ten." More specific remarks appear in Carrier (1981), in Patricia Hamel's grammar of Loniu (Hamel 1994),

[2] For a comprehensive overview and typology of counting systems with specific reference to finger-counting, cf. Bender and Beller (2012).

and in Claire Bowern's retrospective grammar of Titan (Bowern 2011), but to date no one has provided a broad comparative picture of the range of variation in counting systems used in these languages. The closest thing to such a study undoubtedly is the massive ethnomathematical survey of Lean (1991), for languages of Papua New Guinea and other parts of the Pacific, which includes the Admiralties as one of its seventeen volumes. Despite the groundbreaking nature of Lean's work, where he discusses counting systems of what he calls the "Manus type", he does not enter into the level of detail that I have been able to explore in this paper, no doubt because the considerably greater scope of his study meant that a certain amount of detail had to be sacrificed in some geographical regions. In particular, although Lean attempted to collect data for every language community in the Admiralty Islands, he missed Ndrehet, which has what is surely the theoretically most challenging system in the entire archipelago. In addition, while his focus was almost entirely on the structural properties of these counting systems, my focus has included both their structural properties and their linguistic forms, which sometimes show puzzling transformations within the same counting system (e.g. '3' as a free numeral and the same form as the substractive element in '7' may differ unpredictably in shape even though they are the same morpheme, and the common element in multiples of '100' often shows vowel variation that cannot be explained from the phonetic environment). Some discussions of Lean's work also misrepresent certain details in the evolution of AN numeral systems, as the claim by Owens (2001:63) that "proto-Oceanic systems use the word for *hand* for the number 5 (*lima*)", as though this was an innovation based on finger tallying, when in fact Proto-Austronesian had *lima '5' and *qalima 'hand' (Blust and Trussel 2020).

The primary aim of this paper is to draw on field data for 26 languages of the Admiralty group, extending from Wuvulu and Aua in the west to Nauna in the east -- hence, the entire span of this archipelago -- in order to show the surprisingly rich variation in counting systems that have developed from what we must assume was a single ancestral language with a single system of numeration. It contains complete accounts of the primary numerals 1-10 in all of these languages, nearly complete accounts of multiples of ten, somewhat less complete accounts of multiples of one hundred, and more fragmentary accounts of systems of numeral classifiers, which number in the dozens in some of these languages, but are apparently absent in others.[3]

[3] Data was collected from February-May, 1975, during a linguistic survey of the Admiralties. In earlier publications (Blust 1978, 1996a, 1996b, 1998a, 1998b, 1998c, 2004, 2005, 2007, 2008, 2017, 2018, n.d.), I have addressed other issues relating to these languages, but I have not previously discussed the wide variability in counting systems. Thanks go to Wes Rooney, headmaster at Manus High School (now Manus Secondary School) in Lorengau, who assisted me both with accommodations and contacts with the speakers, most of whom were students aged 13 to 18 when we met, but are now in their late 50s and early 60s: Bipi, Bipi village (Anthony Sipos, Manuel Joseph, Luke Sihamou), Lindrou, Nyada village (Bonin Boyap, Boluhe Soson), Sori, Sori village #1 (Gaspar Francis), Ndrehet, Ndrehet village (Oscar Ma-ang), Levei, Levei village (Michael Siamoli), Likum, Likum village (Benjamin Harry), Mondropolon, Saha village (Pihon Kuwe), Pelipowai (aka Tulu-Bohuai), Pelipowai village (Saleu Muisu), Kuruti, Liap village (Ken Soeu, Wateh Namun, Arai Pula), Kele, Ndroia village (Weyon Kehii, Kupe Polon), Titan, Timoenai village (Kisokau Powaseu, Kanawi Chakumai, Kiapin Tawali), Ahus, Hus village (Balthasar Kipit), Lele (Leslie Yohang, Ndranou village, Pokela Papahalou, Bowat village), Leipon, Ndrel village (Wules Kamui), Nali, Lahan village (Russell Kitau, Jim Ngangai, Paulus Kambou), Loniu, Loniu village (Sioni Papi, Lihieu Elisha), Papitalai, Naringel village (Pousai Sei, Chapapeu Mespal), Lou, Rei village (Lester Aussell, Kevin Korup), Pak, Mulireu village (Apollos Sangkei, Jack Jonah, Set Kerenkul), Lenkau, Lenkau village (Nineh Dumoil), Penchal, Penchal village (Ananche Kepui, Moal Lapeap), Nauna, Paramoh village (Puliokai Kiendaman). Needless to say, my heartfelt thanks go out to these many (then) young people who were willing to teach a curious stranger something of their fascinating languages. I also wish to thank Pokanas Popat, my onetime neighbor from Lahan village, then 35-40 years of age, who taught me some Nali when he wasn't trying to coax a large *wariy* (monitor lizard) out of my bathroom, to Pompiran Kuyei, then a 20-

Briefly, there are some 25-30 languages in the Admiralty Islands, depending on how one distinguishes language from dialect. All of these are members of the Oceanic subgroup of the Austronesian language family, and they fall into two primary genetic divisions:

I. The Western Islands (Wuvulu, Aua, Seimat, two extinct languages of the Kaniet Islands; cf. Blust 1996b).

II. Eastern Admiralty (the rest). The Eastern Admiralty group in turn divides into:

IIa. The languages of Manus and its immediate satellites, and

IIb. The languages of the Southeastern Islands (Pak-Tong, Lou, Baluan, Lenkau, Penchal, Nauna).

The linguistic situation in IIa. consists largely of one or more dialect chains that stretch the length of the main island. Ross (1988:317) divides them usefully into 1.The West Manus Network, and 2. the East Manus Network, although with details that I do not accept (e.g. Loniu being treated as an independent branch of the Manus Network, rather than part of the East Manus Network).

2. THE PROTO-OCEANIC BASELINE

To begin, it must be clearly understood that Proto-Oceanic, immediately ancestral to the languages of the Admiralties and most other Austronesian (AN) languages of the Pacific, used a decimal system of counting that was inherited from Proto-Austronesian, spoken 2,000 years earlier in Taiwan (Blust 2013:278-300), as seen in Table 1:

TABLE 1: THE PRIMARY NUMERALS OF PROTO-OCEANIC

*tasa	one
*rua	two
*tolu	three
*pa/pati	four
*lima	five
*onom	six
*pitu	seven
*walu	eight
*siwa	nine
*sa-ŋapuluq	ten

year old teacher at MGSS, who helped me with Ere (mother’s village = Loi, father’s village = Kisih), to Sovo Kanik, then aged 42, for advanced help with Lou, to Harry Lopes from Aunna village, then of the Malaria Control Service, for teaching me some Wuvulu, to Omana, from Pa’arufu village, the child of a German father and Aua mother, who probably was then in his 70s, for providing help with Aua, and to Vincent Tonam from Awin village, then aged 21, whose vivid recollections about growing up as a Seimat speaker close to the sea are with me still.

Although the original decimal system has been retained in most of the 1,200+ languages in this family, it has been relatively unstable in Melanesia, almost certainly in part as a result of contact with speakers of Papuan languages. The most common innovation affecting the counting systems of Austronesian languages in Melanesia is the replacement of *onom, *pitu, *walu and *siwa with numerals that are additive, together with a word for 'ten' that is additive, multiplicative, or retained as a non-derived base, hence:

1) 1-5, 5+1, 5+2, 5+3, 5+4, 5+5 (Anejom and Lenakel in southern Vanuatu)
2) 1-5, 5+1, 5+2, 5+3, 5+4, 2x5 (Takia, Yabem, Kaulong, SE Ambrym, Lamen, Iaai)
3) 1-5, 5+1, 5+2, 5+3, 5+4, 10 (Sobei, Kairiru, Manam, Arop-Lokep, Kilivila, Tigak, Bali-Vitu, Sakao, Vinmavis, Port Sandwich, Pije, Cèmuhî, Xârâcùù)

Both of the latter types of innovative systems are found in the Admiralties, Type 2 in Seimat, and Type 3 in Nauna. However, by far the most striking innovation in these languages is the use of subtraction in forming some or all of the numerals between 5 and 10. Subtractive numerals are found in other members of the large and typologically diverse AN language family, but they are quite rare. In particular, Yapese of western Micronesia has a system of the form 1-6, 10-3, 10-2, 10-1, 10, and a few other languages use subtraction only to form the number '9', as Saisiyat of northwest Taiwan, Lio, of central Flores, and Buruese and Soboyo of the central Moluccas in eastern Indonesia (Blust 2013:283).[4] In addition, the Malayo-Chamic languages of western Indonesia-Malaysia and mainland Southeast Asia, and Sundanese of western Java, have systems that are synchronically opaque, but in which the numerals 8 and 9 are historically 10-2 and 10-1 respectively (e.g. Malay *dəlapan* '8' < *dua-alap-an, where *alap is a word for 'to fetch' that has now been lost from the language, and *səmbilan* '9' < *sa-ambil-an, where *ambil* is the current word for 'to fetch').

What makes the Admiralties unique is that a whole range of languages of varying degrees of relationship make use of subtraction in their numeral systems, providing an opportunity for comparative observations about variation on a common theme. In addition to structural variation in terms of the set of numerals formed by subtraction, there is often phonological variation in the same numeral as it occurs in different values. Most counting systems have enough predictability after the primary set of numerals has been learned that the learner can form higher numerals without having to memorize more than a few particular forms. However, as will be seen, irregularities in word-formation relating to numerals abound in these languages, imposing a far higher burden on memorization than is true of languages like English.

3. INNOVATIVE NUMERALS IN THE ADMIRALTIES: SERIAL COUNTING

Although my linguistic survey of the Admiralty Islands covered 26 languages in just three months, with data for many of these being collected in 10 contact hours or less, I focussed early on the counting system, and in most cases I pursued it until I felt I was able to correctly predict the shape of higher numerals before letting the matter rest. As a result, I have fairly detailed accounts of

[4] An anonymous reader points out that Engdewu, spoken on Santa Cruz Island in the Solomon Islands, also "has a subtractive numeral system" . See Vaa: (2013:279).

serial counting for all of these languages, even though there are some gaps with regard to higher numerals, as well as other features of grammar, due to lack of time in the field (Blust n.d.).

3.1. The primary numerals. The most disciplined way to treat this body of data is perhaps to begin with the primary numerals 1-10, then treat multiples of ten, and multiples of one hundred in separate sections, and finally to examine numeral classifiers. Table 2 presents the primary numerals for all 26 languages for which I have data, listed in approximate geographical order from west to east. Because I found it difficult to collect this type of data from the sole Wuvulu speaker with whom I worked, I have drawn on Hafford (2014) for this language, which he has studied for many years. As can be seen, the data that I was able to elicit from two Aua speakers agrees closely with Hafford's Wuvulu material for 5-8 and 10, but differs for 1-4 and 9: [5]

TABLE 2: THE PRIMARY NUMERALS OF 26 LANGUAGES
IN THE ADMIRALTY ISLANDS

	Wuvulu	Aua	Seimat	Bipi	Lindrou	Sori
1.	e-palo	eai	tehu	sih	arí	sip
2.	rua-palo	eruai	hũõhu	xuoh	laʔúh	huop
3.	ʔolu-manu	ʔoduai	toluhu	taloh	talóh	tarop
4.	obao	ʔunaroa	hinalo	hah	háhuw	papuw
5.	aipani	aipan	te-panim	limeh	límeh	limep
6.	ʔoloroa	ʔodaroa	t. tehu	wonoh	ónoh	gonop
7.	ʔolorompalo	ʔodaroamefua	t. hũõhu	adritaloh	drotalóh	ehetarop
8.	fainaroa	fainaroa	t. toluhu	adroxuoh	drolaʔúh	anuhuop
9.	faimpalo	ʔudeawe	t. hinalo	adrosih	droarí	anusip
10.	efua	efua	hũõ-panim	saŋon	rónoh	saŋop

	Ndrehet[6]	Levei	Likum	Mondropolon	Pelipowai
1.	eri	eri	esi	ari	ri
2.	lueh	lueh	rueh	lupuh	lueh
3.	tuloh	toloh	taloh	taloh	toloh
4.	hahup	hahup	hahu	hahuw	hahuw
5.	limeh	limeh	limeh	limeh	limeh
6.	kʰoeri	cohahup	cohahu	onah	onah
7.	kʰolueh	cotoloh	cotaloh	cotaloh	cotoloh
8.	kʰotuloh	colueh	corueh	colupuh	colueh
9.	kʰohahup	coeri	coesi	cuari	curi

[5] Lean (1991:58-60) has a somewhat different set of forms for the primary numerals 1-9 in Wuvulu, namely 1. *aiai*, 2. *guai*, 3. *oduai*, 4. *guineroa*, 5. *aipan*, 6. *oderoa*, 7. *oderomiai*, 8. *vaineroa*, and 9. *vaineromiai*, which he analyzes respectively as 1. 'one-one', 2. 'two ones', 3. 'three ones', 4. 'two by two', 5. 'one hand', 6. 'three-twos', 7. 'three twos and one', 8. four by two', and 9. 'four by two and one'. Needless to say, these are closer to the forms that I collected for Aua than they are to Hafford's Wuvulu forms.

[6] /dr/ is a prenasalized alveolar trill throughout the Admiralties. Since prenasalization is predictable, I do not write it in lexical items that contain it, but I do write *Ndr-* in the name of the language and village names, where speakers may be more accustomed to see the word in written form.

10.	runoh	ronoh	senoh	runuh	runwah

	Kuruti	Kele	Titan	Ahus	Lele
1.	sih	sih	e-si	si	sih
2.	rueh	rueh	e-luo	luoh	luoh
3.	toloh	teloh	e-talo	taloh	toyoh
4.	hahuw	hahuw	e-a	hahu	hahuw
5.	limweh	limweh	e-lima	limeh	imah
6.	onoh	enoh	e-wono	onoh	onoh
7.	odrotoloh	droteloh	adratalo	horaloh	odrotoyoh
8.	odrorueh	drorueh	adraluo	holuoh	odroluoh
9.	odrosih	drosih	adrasi	hosi	odrosih
10.	suŋoh	suŋah	e-akow	seŋoh	suŋuy

	Leipon	Ere	Nali	Loniu	Papitalai
1.	tih	sih	si(h)	sih	tih
2.	marweh	ruoh	maluo(h)	maʔuoh	moruah
3.	maculoh	tulah	maroyo(h)	macoloh	mwatalah
4.	mahah	hahuw	mahahew	mahah	mohahuw
5.	malmeh	limoh	mayima(h)	malimeh	mwalimeh
6.	mawnoh	onah	manono(h)	mawonoh	mawonoh
7.	madeculoh	drotulah	madritoyo(h)	maʔarucoloh	madrotalah
8.	madurweh	droruoh	madriluo(h)	maʔaruʔuoh	madroruah
9.	madutih	droasih	madrosi(h)	maʔarusih	madrotih
10.	masuŋol	saŋul	masoŋuy	masoŋon	masaŋol

	Lou	Pak	Lenkau	Penchal	Nauna
1.	sip	dih	sip	səw	səw
2.	ruep	huoh	huep	lup	ruh
3.	telɪp	duluh	trilip	tulup	tuluh
4.	tolɔt	dalor	trolotr	talət	talət
5.	ŋuran	nuron	ŋuran	rurən	tutən
6.	ŋiniop	wonoh	enep	unup	tutən a səw
7.	ŋaniselɪp	darluh	ŋaritrilip	karutulup	tutən a ruh
8.	ŋaniruep	darhuoh	ŋarihuep	karulup	tutən a tuluh
9.	ŋanisip	dardih	ŋarisip	karusəw	tutən a talət
10.	saŋaul	soŋoh	saŋahul	saŋahul	saŋahul

In looking at this data one almost has to ask “Where do we start?”. The Wuvulu and Aua systems seem to defy any kind of explanation for recurrent elements, and while there is a basic structural and etymological similarity in all languages of the Eastern Admiralties, it is overlaid by a bewildering diversity of detail.

To start with languages of the Western Islands, which represent a primary branch of the Admiralty group, what is the Wuvulu element *palo*, which shows up in '1', '2', '7', and '9'? Hafford (2014:73) holds that *palo* means 'thing', so that *e-palo* is 'one (thing)', *rua palo* is 'two (things)', *ʔolorompalo* is underlying *iʔolo-roa-ma-e-palo*, hence 3x2 +1 = 'seven (things)', and *faimpalo* is underlying *fai-na-roa-ma-e-palo*, hence 4x2 +1 = 'nine (things)'. While this seems to shed some light on the components of a numeral system that otherwise shows a remarkable structural opacity, it leaves several questions unanswered. First, why would *palo* appear only in these four numerals? Second, what is the second element in *ʔolu-manu* 'three', which seems completely unnecessary, since the first element regularly reflects POC *tolu? Third, Hafford's analysis implies that *e* = 'one' and *rua* = 'two'. This works fine for Wuvulu *rua*, which is a transparent reflex of POC *rua 'two', as seen in Table 1, but the only other occurrence of *e* is in *efua*, which Hafford suggests is *e* 'one' + *fua* 'fruit', although there is no obvious reason why the word for 'fruit' would represent the number 'ten' (elsewhere in the Admiralties reflexes of POC *puaq 'fruit' are suffixed to the primary numerals as a fossilized numeral classifier, which is widely attested in the AN language family, whereas its use to represent a specific numerical value is otherwise unknown). Alternatively, *efua* could mean 'one group of ten', but that is not supported by *ʔenu paʔaniana* '20', which we would expect to be **rua fua. Moreover, if the proper analysis of 'seven' is *iʔolo-roa-ma-e-palo* = 3x2 + 1, one must ask why *rua* has become *roa* here, and why the first part of *ʔolu-manu* 'three', which regularly reflects POC *tolu, is altered to *ʔolo* in *ʔoloroa* 'six' (= 3x2), and *ʔolorompalo* 'seven' (= 3x2 + 1). Finally, although the Wuvulu words for '8' and '9' may be multiplicatives, plus addition in the latter case (4x2, 4x2 + 1), they could equally well be seen as subtractives (10-2, 10-1).

Aua is generally regarded as a dialect of the same language as Wuvulu, but it lacks *palo* in the numeral system, and has *e-* not only in *eai* 'one' and *efua* 'ten', but also in *eruai* 'two', which --- if it is the same morpheme --- spoils the interpretation that it could mean 'one'. Moreover, '1', '2' and '3' all end with *-ai*, suggesting a common element to which no obvious meaning can be assigned (pace Lean 1991), and the common element *-roa* in '4', '6' and '8' suggests that these are 2x2, 3x2 and 4x2, but the first element each case (*ʔuna-, ʔoda-, ʔude-*) is otherwise unsupported in the meanings 'two', 'three', or 'four' (although *ʔoda-* resembles *ʔodu-* in *ʔoduai* 'three'). In short, there is no escaping the conclusion that the Wuvulu-Aua system of numeration is a product of extensive innovations that are, at best, very poorly understood.

Thankfully, the Seimat system of numeration is transparently quinary (1-5, 5+1, 5+2, 5+3, 5+5, 2x5), and so presents none of the conceptual problems of Wuvulu-Aua counting. The one morpheme relevant to counting which is shared by all three languages is Wuvulu, Aua *pani-* 'hand', which does not figure in the numeral system, but which is cognate with Seimat *te-panim* 'five', *hũõ panim* 'ten', oddly carrying the 2sg. possessive suffix, as though it still means 'hand' rather than 'five'. The other thing to note about the Seimat numerals that distinguishes them from Wuvulu-Aua, but links them to languages in the Eastern Admiralties, is that 1-3 contain a reflex of the fossilized numeral classifier *-pu.

This brings us to the Eastern Admiralty (EADM) subgroup, which contains the great majority of languages in the Admiralties, including nearly all of those that make unambiguous use of subtraction for some or all of the numerals between 5 and 10. The first thing to note, as observed by Ross (1988:342), is that subtraction is used to form the primary numerals 7-9 in these languages.

However, as seen in Table 2, Ross's remark is overly general, since Ndrehet, Levei and Likum in western Manus, and apparently Lou in the Southeast Admiralties extend the use of subtraction as a numeral-forming device to 'six', and Nauna has an imperfect decimal system of the form 1-5, 5+1, 5+2, 5+3, 5+4, 10.

The second thing to note is that each of these languages uses a morpheme meaning 'take away' or 'subtract' that was recorded only in the numeral system, and which is extremely variable, as shown in Table 3:

TABLE 3: THE SUBTRACTIVE MORPHEME IN THE PRIMARY NUMERALS FOR 26 LANGUAGES IN THE ADMIRALTY ISLANDS

Bipi	Lindrou	Sori	Ndrehet	Levei	Likum
adri/adro-	*dro-*	*ehe/anu-*	*k^ho-*	*co-*	*co-*
Mondropolon	Pelipowai	Kuruti	Kele	Titan	Ahus
co/cu-	*co/cu-*	*odro-*	*dro-*	*adra-*	*ho-*
Lele	Leipon	Ere	Nali	Loniu	Papitalai
odro-	*made/madu-*	*dro-*	*madri/madro*	*maʔaru-*	*madro-*
Lou	Pak	Lenkau	Penchal	Nauna	
ŋini/ŋani-	*dar-*	*ŋari-*	*karu-*	-----	

Based only on this data, a PEADM reconstruction for the subtractive morpheme used with primary numerals cannot be achieved, although a Proto-Manus form based on cognates from languages in both the Western Manus and Eastern Manus Networks, is possible. The most promising candidate is Lindrou, Kele *dro-*, Ndrehet *k^ho-*, Levei, Likum, Mondropolon, Pelipowai *co-*, Ahus *ho-*, Ere *dro-* which, with possibly bimorphemic *adro-* (Bipi), *odro* (Kuruti), and *madro-* (Nali, Papitalai), point to Proto-Manus *dro-.[7] However, a higher-level reconstruction is not justified by this evidence, and one is left with the impression --- both from the variability of the subtractive morpheme, and from the extension of subtraction to replace reflexes of POC *onom, PADM *onopu 'six' in some, but not most languages of Manus ---, that this change began in a single language community, and gained enough influence to spread to ,all parts of the Eastern Admiralties, except Nauna in the easternmost extremity of the archipelago.

The one piece of evidence that stands in the way of this interpretation is data for one or more of the extinct languages of the Kaniet Islands, as reported by Thilenius (1903) and Dempwolff (1905), both of whom recorded a system with the structure 1, 2, 3, 4, 5, 6, 10-3, 10-2, 10-1, 10 (Thilenius: 1. *tef*, 2. *ua*. 3. *tohu*, 4. *faf*, 5. *mia*, 6. *tohiniet*, 7. *kodohu*, 8. *kouehu*, 9. *kodef*, 10. *hemidin*, Dempwolff: 1. *texu*, 2. *uafu*, 3. *tohu*, 4. *fafu*, 5. *himiab*, 6. *tohinias* (?), 7. *go tsoho* (*go tohu*), 8. *go uo* (*go-u*), 9. *go tsen* (*to-texu*), 10. *himisen, himiden*). Taken at face value, this distribution suggests

[7] For reasons that are unclear to me, Ross (1988:344) proposes Proto-Eastern Admiralty *(a)nto-, even though all available evidence points to *dro-, with a possible initial vowel of indeterminate shape, and no reflexes of this form are known from any of the Southeastern languages. The surprising change *dr > k^h in Ndrehet is documented in some detail in Blust (2005:246-48).

that subtractive forms for 7-9 probably were present in Proto-Admiralty, and since there is evidence for the change *dr > *k* in at least the variety of Kaniet described by Thilenius (2003), it appears that a Proto-Admiralty subtractive marker *dro- can be posited with some confidence, forcing us to the conclusion that Wuvulu-Aua and Seimat have replaced an earlier system of the form 1, 2, 3, 4, 5, 6, 10-3, 10-2, 10-1, 10, with a system of the form 1, 2, 3, 4, 5, 5+1, 5+2, 5+3, 5+4, 2x5 in Seimat, and a system of rather more opaque structure in Wuvulu-Aua. [8]

As can be seen from Table 3, another feature of the subtractive morpheme that is puzzling is its variation within a single language, as in (1):

(1)

	six	seven	eight	nine
Bipi		adri-	adro-	adro-
Sori		ehe-	anu-	anu-
Mondropolon		co-	co-	cu-
Pelipowai		co-	co-	cu-
Leipon		made-	madu-	madu-
Nali		madri-	madri-	madro-
Lou	ŋini-	ŋani-	ŋani-	ŋani-

The data in (1) represent variation in the shape of the subtractive morpheme over seven languages for the primary numerals only. Because deviations from pattern regularity are even more extensive than this when we include the subtractive numerals for multiples of ten and of one hundred, the entire set of language-internal variable subtractive markers will be displayed later in the paper, once data for the higher numerals has been introduced.

Probably the most striking anomaly in the data I recorded is seen in the Ndrehet numerals for 6-9, which are logically reversed, so that 6 = 10-1, 7 = 10-2, 8 = 10-3, and 9 = 10 -4. It is natural to assume that the speaker simply became confused, and gave me faulty data, but it is hard to see how this could happen unless he had *learned* them in the cited order. The most likely explanation for this departure from an otherwise general pattern in all surrounding languages, is that the subtractive marker *k^ho*- was reinterpreted as an additive marker at some time in the history of Ndrehet. In other words, *structurally*, the Ndrehet system of primary numerals is identical to that of Nauna, since both are imperfect decimal systems of the form 1-5, 5 + 1, 5+ 2, 5 + 3, 5+ 4, 10. However, etymologically they are quite different, since the Nauna numerals 6-9 are transparently additive (cf. /a/ 'and'), while the corresponding Ndrehet numerals are historically subtractives, where *k^ho*- reflects Proto-Manus *dro-. Since this reinterpretation has not happened in the closely related Levei or Likum, it must have taken place after the separation of Ndrehet from all other language communtities in Manus for which data is available. [9]

[8] Support for this statement can be found in Blust (1996b:41-45), particularly with reference to the words for 'bone', 'blood', 'ear' and '(fresh) water'.
[9] Simons and Fettig (2020) regard Ndrehet and Levei as dialects of the same language, which they call 'Khehek' (= the Ndrehet pronunciation of Ndrehet). However, the reality is that much of Manus consists of dialect chains forming what Ross (1988:317) called the 'West Manus' and 'East Manus' Networks.

Undoubtedly the most vexing question is *why* such a change would occur. *A priori* one might see some motivation for it if the innovative language were surrounded by others that use addition on a quinary base to form the numerals 6-9. However, that is decidedly not the case here, as the nearest languages that have a 5 + 1, 5 +2, 5 +3, 5 + 4 structure for the numerals 6-9 are Seimat in the Western Islands, and Nauna in the extreme east of the Admiralty chain, and all neighboring languages use the cognate prefix as a subtractive marker, hence providing no obvious motivation for this innovation as a product of contact. In considering the global distribution of patterns of formation for compound numerals between 5 and 10, it seems clear that addition is far more common than subtraction, so this odd change in Ndrehet might be considered an unmarking of a highly marked structure. However, this is more a label than an explanation, since the same considerations would apply to all languages of the eastern Admiralties that make use of subtractive numeral systems. [10]

The next irregularity to note is that in several languages the lower numeral that is subtracted from ten to yield those from 6-9, differs in some unpredictable way from the same lower numeral in isolation, as in Ere *dro-asih* 'nine', but *sih* 'one', Lou *ŋani-selɪp* 'seven', but *telɪp* 'three', or Pak *dar-luh* 'seven', but *duluh* 'three' (by contrast, Ahus *taloh* 'three', but *ho-raloh* 'seven', and Nali *royo(h)* 'three', but *madri-toyo(h)* 'seven' are examples of general allomorphy, due to phonological alternation or free variation). Also deserving of comment is the numeral prefix *e-* in Titan, which is absent in the subtractive numerals, but present elsewhere. It is not entirely clear what function this morpheme has in counting, but it is widespread in the Pacific region in both Oceanic and non-Oceanic languages, as with Hawaiian *e kahi* '1', *e lua* '2', *e kolu* '3', *e hā* '4', *e lima* '5' (serial counting), or Palauan *taŋ* '1', *e ruŋ* '2', *e dey* '3', *e waŋ* '4', *e yim* '5' (in counting units of time).

The only other observations of note with regard to Table 2 are the sporadic change *m > *mw* in POC *lima > Kuruti, Kele *limweh* 'five', and the replacement of POC *sa-ŋapuluq with the lexical innovation *e-akow* in Titan, but neither of these has any relevance to the counting system.

For the numerals 11-19, 21-29, etc., all languages appear to use a simple additive strategy (10 + 1, 10 +2, 20 + 1, 20 + 2, etc.), making the shape of these words fully predictable as combinations of the primary numerals that have already been recorded. The only difference observed is between languages that use a conjunction to link the numerals that are combined (*N-conj-n*) vs. those that use simple juxtaposition (*N-n*), as seen in (2):

[10] In a perceptive study of counting practices in the languages of Bougainville, near the western end of the Solomons chain, Lincoln (2010:230) has pointed out that the internal logic of counting systems in some of the languages of Melanesia cannot be understood without taking into account the manner in which counting is done through the use of the two hands in coordination with one another. In Banoni of Bougainville, for example, serial counting begins with the right index finger touching the little finger of the left hand, proceeding through to the thumb, and then 'crossing over' by switching to the left index finger touching the little finger of the right hand' and proceeding through to the thumb. The number 'six' is therefore 'cross over', and 'seven' is 'second cross over' (NOT 6 + 2!). A similar logic of hand-based counting systems may be relevant in the present case, but it would be odd if Ndrehet had a system of finger counting that differs from all other ethnolinguistic groups in the eastern Admiralties, and in any event, it is difficult to see how a system of finger counting could turn subtraction into addition when there is no other indication that the system has changed from base ten to base five.

(2)

	eleven	twelve
N-conj-n	(10 + 1)	(10 + 2)
Wuvulu	efua ma epalo	efua ma ruapalo
Aua	efua me eai	efua me eruai
Sori	saŋop e sip	saŋop e huop
Bipi	saŋon e sih	saŋon e xuoh
Levei	ronoh e eri	ronoh e lueh
Pelipowai	runwah e ri	runwah e lueh
Kuruti	suŋoh pe sih	suŋoh pe rueh
Kele	suŋah pe sih	suŋah pe rueh
Titan	eakow pe si	eakow pe luo
Ahus	seŋoh me sih	seŋoh me luoh
Lele	suŋuy e sih	suŋuy e luoh
Leipon	suŋol e tih	suŋol e rueh
Ere	saŋul pe sih	saŋul pe ruoh
Nali	soŋuy pe si	soŋuy pe luoh
Loniu	masoŋon e sih	masoŋon e uoh
Papitalai	masaŋol e tih	masaŋol e ruah
Lou	saŋaul a sip	saŋaul a ruep
Pak	soŋoh a dih	soŋoh a huoh
Lenkau	saŋahul a sip	saŋahul a huep
Penchal	saŋahul a səw	saŋahul a lup
Nauna	saŋahul a səw	saŋahul a ruh
N-n	(10, 1)	(10, 2)
Seimat	hũõpanim tehu	hũõpanim hũõhu
Lindrou	rónoh arí	rónoh laʔúh
Ndrehet	runoh eri	runoh lueh
Likum	senoh esi	senoh rueh
Mondropolon	runuh ari	runuh lupuh

This dataset shows clearly that the 'N-conj-n' pattern is dominant (21 of 26 languages), and that the 'N-n' pattern is largely areal (western Manus and the Ninigo lagoon). The Wuvulu conjunction /ma/ reflects POC *ma 'and', which implies that all other variants are innovations. However, some of these show a puzzling distribution, with Aua and Ahus sharing /me/, and a number of languages in the West Manus Network and East Manus Network (Ross 1988:317) sharing /e/. While these variants have contradictory subgrouping implications, the use of /a/ in Lou, Pak, Lenkau, Penchal and Nauna very likely was an innovation in Proto-Southeast Admiralty (Blust n.d.).

3.2. Multiples of ten. The second set of numerals that were recorded in languages of the Admiralties are multiples of ten. As seen already, most languages of the eastern Admiralties reflect POC *sa-ŋapuluq 'ten'. In some languages this form has undergone extreme sound changes, but in every language except Kele the form itself is preserved. However, multiples of ten show numerous innovations, and great variation. Unlike the primary numerals, which have complete sets in all languages, there are a few gaps for multiples of ten and one hundred. In particular, the only higher numerals recorded for Papitalai, a language for which I had less than four hours of collection time, were ‘20’ and ‘100’, and for Lenkau the speaker, a shy 13-year old girl at the time of collection, provided ‘20-50’ and ‘100’, but was unsure about the intervening multiples of ten, and offered no multiples of ‘100’. In the interest of continuity, the numeral ‘ten’, which appears at the end of each language in Table 2, is repeated at the beginning here:

TABLE 4: MULTIPLES OF ‘TEN’ IN 26 LANGUAGES OF THE ADMIRALTY ISLANDS

	Wuvulu	Aua	Seimat
10	efua	efua	hũõ-panim
20	ʔenu paʔaniana	ʔenu	seilon tel
30	ʔolufua paʔaniana	ʔolufua	seilon tolu
40	runaroa paʔaniana	xunaroa e fua e ana	seilon hinalo
50	aipani paʔaniana	aipan e fua	seilon tepanim
60	olora paʔaniana	odaroa e fua	seilon tepanim tel
70	oloramfua paʔaniana	odaroa me fua	seilon tepanim hũhũa
80	fainaroa paʔaniana	fainaroa me fua	seilon tepanim tolu
90	faimfua paʔaniana	udeawe me fua	seilon tepanim hinalo
100	efua puʔu	efua puʔu-na	patei tel

	Bipi	Lindrou	Sori	Drehet
10	saŋon	rónoh	saŋop	runoh
20	xuŋon	lúnoh	huŋop	lunoh
30	tuluŋon	tónnoh	tuluŋop	cunuh
40	haŋon	hánoh	paŋop	hanoh
50	limeŋon	lomonoh	lipiŋop	lemenoh
60	wonoŋon	drohánoh	gonoŋop	lemenoh eri
70	adrotuluŋon	dro-tónnoh	ehetuluŋop	lemenoh lueh
80	adroxuŋon	dru-lúnoh	anuhuŋop	lemenoh tuloh
90	adrosaŋon	dró-ronoh	anusaŋop	lemenoh hahup
100	saŋak	rinék	saŋa	rinak

	Levei	Likum	Mondropolon	Pelipowai	Kuruti
10	ronoh	senoh	runuh	runwah	suŋoh
20	lunoh	runoh	lunah	lunwah	ruŋeh
30	sunuh	tunueh	tunuh	cunuh	tuluŋeh
40	hanoh	haanoh	hanuh	haanwah	haŋoh
50	lomonoh	lemenoh	lemenuh	lemenwah	limŋeh
60	cohanoh	cohanoh	unonuh	ononwah	onŋoh

70	cosunuh	cotunueh	cocunuh	cucunuh	drotuluŋeh
80	colunoh	corunoh	colunuh	coalunwah	droruŋeh
90	coronoh	cosenoh	corunuh	corunwah	odrsuŋoh
100	ranak	sinak	ranak	ranak	saŋat

	Kele	Titan	Ahus	Lele	Leipon
10	suŋah	e-akow	seŋoh	suŋuy	masuŋol
20	ruŋeh	lukow	luŋuh	maluŋuy	maroŋol
30	tuluŋeh	tuluŋol	tuluŋuh	matiŋuy	macolŋol
40	haŋoh	aŋol	haŋuh	mahaŋuy	mahaŋol
50	limiŋeh	topwal	limiŋuh	mayimuy	malmeŋol
60	enŋwah	wonoŋal	onoŋuh	manonoŋuy	mawnoŋol
70	drotuluŋeh	adra tuluŋol	horaluŋuh	manodrtiŋuy	madecoloŋol
80	droruŋeh	adra lukow	horuluŋuh	manodrluŋuy	madoroŋol
90	drosuŋah	adra akow	hoseŋuh	manodrsuŋuy	madosuŋol
100	epow	e saŋat	saŋat	masaŋat[11]	masŋet

	Ere	Nali	Loniu	Papitalai	Lou
10	saŋul	masoŋuy	masoŋon	masaŋol	saŋaul
20	ruŋul	maluŋuy	maʔuŋon	ruŋol	ruŋoul
30	tuluŋul	matiŋuy	maculuŋon	-----	tuluŋoul
40	haŋul	mahaŋuy	mahaŋon	-----	awɪ
50	limŋul	mayimiŋuy	malimeŋon	-----	topol
60	anŋul	manoŋuy	mawonoŋon	-----	onoŋoul
70	drotuluŋul	madritiŋuy	maʔaruculuŋon	-----	ŋanisuluŋoul
80	droruŋul	madriluŋuy	maʔaruʔuŋon	-----	ŋaniruŋoul
90	adrisaŋul	madrisoŋuy	maʔarusoŋon	-----	ŋanisaŋaul
100	siŋat	masaŋat	masaŋat	saŋat	soŋot

	Pak	Lenkau	Penchal	Nauna
10	soŋoh	saŋahul	saŋahul	saŋahul
20	kotæn dih	huŋhul	tiŋihul	ruŋohul
30	kotæn dih æ soŋoh	truluŋuhul	liŋihul	tuluŋohul
40	kotæn huoh	hawey	hawiy	hawiy
50	kotæn huoh æ soŋoh	tropol	topol	topəl
60.	kotæn duluh	-----	topol a saŋahul	topəl a saŋahul
70	kotæn duluh æ soŋoh	-----	topol a tiŋihul	topəl a ruŋohul
80	kotæn dalor	-----	topol a liŋihul	topəl a tuluŋohul
90	kotæn dalor æ soŋoh	-----	topol a hawiy	topəl a hawiy
100	saŋar	soŋotr	saŋət	saŋət

[11] The speakers with whom I worked said that *masaŋat* is used in Ndranou village, and *masaŋit* in Bowat.

The first thing that stands out in reading Table 4 is how strikingly different the numeral systems of the Western Islands languages are from those of the eastern Admiralties. Whereas the latter almost invariably repeat the last -CVC, or some variant of it, in multiples of the numeral '10', this does not happen at all in Wuvulu-Aua, where the numeral '10' does not appear again until the word for 'one hundred', which is structurally 10 x *puʔu*, implying that *puʔu* is another word for '10', but one that does not otherwise appear in the numeral system. At the same time, the structure of the counting system implies that *paʔaniana* is yet another term for '10' that occurs only in the numerals '20-90', and is conspicuously absent in the corresponding Aua forms.

If anything, the structure of the Aua system for multiples of ten is even more baffling than that of Wuvulu. I was given exactly the same form for both '7' and '70' (*ʔodaroa me fua*), which is clearly an error, and since both '80' and '90' contain *me fua* ('and ten'), it seems certain that the word that I was given for 'seven' applies only to '70', and that the proper word for 'seven' probably is *ʔodaroa me eai* (cf. Hambruch 1908:43-44 for confirmation). Even with this likely correction, however, the Aua system, like that of Wuvulu, diverges sharply from all other counting systems in the Admiralties in being structurally impenetrable. If *efua* is 'one group of ten' then *ʔolufua* is 3x10, and we are off to a good start, but this good start is almost immediately thrown out of alignment by the *fua* that appears in the numerals 40-90. If '40' is *xuna* (gloss?) x 2, what is the rest of this word? And if *aipan* is 'one hand', as Hafford (2014:73) suggests for Wuvulu *aipani*, then *e fua* presumably means 'times ten', rather than 'one group of ten', so that *ʔodaroa e fua* is 'six times ten'. This seems to work, as does *ʔodaroa me fua*, if this is taken to be short for *ʔodaroa e fua me fua* (6x10 + 10). However, it then throws the structure of '40' into even greater turmoil. The word that was given to me for '80' presumably should be *fainaroa e fua* rather than the one cited, and the form for '90' suggests without further support that *ʔudeawe* is another word for '80. All-in-all, the Wuvulu-Aua system of numeration is in critical need of further study, if it has not already been totally abandoned in favor of Tok Pisin.

Uniquely in languages of the Admiralties, Seimat uses the word for 'person, human being' for '20', clearly a collective representation for all the digits on the hands and feet (note that Wozna and Wilson 2005:22 gloss *tel seilon* as 'one person', where *tel* functions as a numeral classifier, and *seilon tel* as '20', where *tel* functions as the number 'one'). The only other AN languages known to use 'one person' to mean 'twenty' are a number of languages in New Guinea, and Iaai, spoken on the island of Uvea in the Loyalty islands of southern Melanesia.[12] Since 'one person' is commonly used in Papuan languages as a word for 'twenty', one is tempted to see the Seimat innovation as reflecting a Papuan substrate. However, the Ninigo lagoon can be reached only with sophisticated sailing technology, and that is not something that has been observed within the ethnographic present for Papuan speaking peoples. While Manus has an archaeological signature that indicates a pre-AN population (Fredericksen et al. 1993), all languages on Manus today are AN, and none have this feature, or show clear evidence of Papuan contact features in their phonology or grammatical structure, leaving the source of the Seimat innovation for 'twenty' something of a mystery.

[12] Joel Bradshaw (p.c.) has reminded me that this counting feature is not uncommon in the AN languages of New Guinea, as with Numbami *tamota-te* 'person-one' = '20', and that this is only one of a number of structural features that almost certainly are a product of Papuan contact influence.

The Bipi system for multiples of ten shows only two small departures from regularity: whereas the pattern seen in *hah* '4' : *haŋon* '40', *limeh* '5' : *limeŋon* '50', and *wonoh* 'six' : *wonoŋon* '60' suggests that *taloh* 'three' should be **taloŋon when multiplied by ten, the word for '30' is actually *tuluŋon* with both vowels differing, and while Bipi *adritaloh* 'seven' should match **adrituluŋon '70', the word for '70' actually is *adrotuluŋon.* Lindrou shows even greater irregularity in matching the forms of the primary numerals with their forms when multiplied by ten. To save space the full range of these irregularities in all languages cited in Tables 2 and 4 is given in Table 5:

TABLE 5: IRREGULARITIES IN THE SHAPE OF THE PRIMARY NUMERALS WHEN MULTIPLIED BY TEN

	2/20	3/30	5/50	6/60
Bipi		taloh/tulu-ŋon		
Lindrou	laʔúh/lú-noh	talóh/tó-nnoh	limeh/lomo-noh	
Sori		tarop/tulu-ŋop	limep/lipi-ŋop	
Drehet	eri/ru-noh	tuloh/cu-nuh	limeh/leme-noh	
Levei	eri/ro-noh	toloh/su-nuh	limeh/lomo-noh	
Likum		taloh/tu-nueh	limeh/leme-noh	
Mondropolon	rueh/lu-nah	taloh/tu-nuh	limeh/leme-nuh	onah/uno-nuh
Pelipowai		toloh/cu-nuh	limeh/leme-nwah	onah/ono-nwah
Kuruti		toloh/tulu-ŋeh		
Kele		teloh/tulu-ŋeh		
Titan		talo/tulu-ŋol		
Ahus		taloh/tulu-ŋuh	limeh/limi-ŋuh	
Lele		toyoh/ma-ti-ŋuy		
Leipon		ma-culoh/ma-col-ŋol		
Ere		tulah/tulu-ŋul		onah/an-ŋul
Nali		ma-royoh/ma-ti-ŋuy	ma-yima(h)/ma-yimi-ŋuy	
Loniu		ma-coloh/ma-culu-ŋon		
Lou		telɪp/tulu-ŋoul		
Lenkau		trilip/trulu-ŋuhul		

As with the subtractive primary numerals, where the lower numeral that is removed sometimes differs in shape from the same numeral used independently, a similar discrepant pattern is seen in some multiples of ten, as with Mondropolon *lunah* '20', but *co-lunuh* '80', *tunuh* '30', but *co-cunuh* '70', or Lou *tuluŋoul* '30', but *ŋanisuluŋoul* '70'. The Ahus system is particularly rife with irregularity. Given *seŋoh* '10', it is clear that *hoseŋuh* '90' contains a subtractive prefix *ho-* (with irregular variation of the last vowel), and given *luŋuh* '20', we must assume that *horuluŋuh* '80' contains a variant of the subtractive prefix *horu-*. What, then, do we do with *horaluŋuh* '70'? Clearly the analysis cannot be *hora-luŋuh*, since it is '30' that is subtracted from one hundred to form this numeral, not twenty. The only alternative left is to assume *ho-raluŋuh*, with a substantially distorted form of *tuluŋuh* '30'.

In addition to the frequent mismatches in shape between various of the primary numerals when they are multiplied by ten, it is noteworthy that Ndrehet shows the same reversal in the order of subtraction for 60-90 as has already been pointed out for 6-9. On the one hand, this confirms that the numerals 6-9 were recorded correctly, and were not an idiosyncrasy of the speaker with whom I worked, but on the other hand it raises even more difficult questions about how such a historical change could happen. While such a reversal in the primary numerals might be due to reinterpretation of the subtractive marker as an additive marker, in multiples of ten it is mathematically incoherent to interpret it in this way, unless the numbers 1-4 are implicitly regarded as 10-40, despite their values in the primary set. Moreover, since *runoh eri* was given for '11', and *runoh lueh* for '12', *lemenoh eri* might well be interpreted as '51' rather than '60'; since additive forms beyond '11' and '12' were not collected in the field, I can only speculate that a conjunction must be used to separate *lemenoh* and *eri* in the meaning '51'.

Other analytic issues that arise in looking at multiples of ten are as follows. First, the Ahus forms for '70' and '80' are both quadrisyllables that in their segmental phonology differ only in a single vowel, which could easily lead to them being confounded. Evidently to prevent this from happening, the stress pattern differs, but this difference is in the secondary stress, not the primary stress: [hóralùŋuh] '70', [hórùluŋuh] '80'. Second, Pak is unique in having a vigesimal marker *kotæn* in the numerals 20-90 (20 x 1, 20 x 1 + 10, 20 x 2, 20 x 2 + 10, 20 x 3, 20 x 3 + 10, 20 x 4, 20 x 4 + 10). Third, in Penchal the numerals '20' and '30' are multiples of bases that do not occur as the primary numerals '2' and '3': *lup* '2', but *tiŋi-hul* '20', *tulup* '3', but *liŋihul* '30'. Fourth, although the Penchal primary numeral system is decimal, with subtractives for 7-9 (*karu-tulup, karu-lup, karu-səw*), the system for multiples of ten is quinary, with an innovative term *topol* for '50', and an additive strategy for 60-90 (50 + 10, 50 + 20, 50 + 30, 50 + 40). Nauna has a similar system. However, in Nauna the system for multiples of ten is consistent with the system for primary numerals, while for Penchal it is not. This strongly suggests that language contact, with both structural borrowing, and borrowing of content, has played an important role in the shapes of numeral systems throughout the eastern Admiralties.

Another indication that numerals have been borrowed is the distribution of the innovative form Titan *topwal*, Lou *topol*, Lenkau *tropol*, Penchal *topol*, Nauna *topəl* '50', which includes one language in the East Manus Network (Titan), and four in the Southeast Admiralty group. If this was an innovation in Proto-Southeast Admiralty (which seems likely), it must have been borrowed into Titan, even though Titan speakers were the pre-eminent traders of the Admiralties (the 'Manus tru' of Mead 1930). Alternatively, if it was an innovation in Titan that was spread into the Southeast Admiralty languages through trade contacts, it is surprising that it was not borrowed by other language communities on Manus itself.

Finally, with regard to multiples of ten, the suffixal marker of multiplication varies unpredictably in shape in some languages, as follows:

(3)

	ten	twenty	thirty	forty	fifty
Drehet	-noh	-noh	-nuh	-noh	-noh
Levei	-noh	-noh	-nuh	-noh	-noh

Likum	-noh	-noh	-nueh	-noh	-noh
Mondropolon	-nuh	-nah	-nuh	-noh	-noh
Pelipowai	-nwah	-noh	-nwah	-nwah	-nwah
Kuruti	-ŋoh	-ŋeh	-ŋeh	-ŋoh	-ŋeh
Kele	-ŋah	-ŋeh	-ŋeh	-ŋoh	-ŋeh
Ahus	-ŋoh	-ŋuh	-ŋuh	-ŋuh	-ŋuh
Lou	-ŋaul	-ŋoul	-ŋoul	N/A	N/A

Since all of these variants appear to reflect POC *-ŋapuluq, it would be theoretically reassuring if this variation could be predicted from context, with forms containing the vowel /u/ occurring immediately after stems that end in the same vowel, as with Ndrehet *cu-nuh* '30', next to *ha-noh* '40'. However, this does not work, given, e.g. Ndrehet *ru-noh* '10', *lu-noh* '20', Mondropolon *ru-nuh* '10', *lu-nah* '20', *tu-nuh* '30', or Kele *su-ŋah* '10', *ru-ŋeh* '20', *tulu-ŋeh* '30', *haŋeh* '40', etc., where the 'maverick' allomorphs appear to be quite randomly distributed.

3.3. Multiples of one hundred. The third set of numerals recorded in Admiralty languages is multiples of one hundred. As seen with reflexes of POC *sa-ŋapuluq '10', *rua-ŋapuluq '20', *tolu-ŋapuluq '30', and other multiples of ten, most languages of the eastern Admiralties are conservative in reflecting POC *sa-ŋaRatus '100', *rua-ŋaRatus '200', *tolu-ŋaRatus '300', etc., although sometimes with extreme sound change. Apart from the languages of the Western Islands, which have replaced the POC words for both 'ten', and 'one hundred', only one language of the eastern Admiralties (Kele) has replaced the inherited word for 'one hundred'.

As will be seen, the higher the numeric values are, the more gaps occur in my data. Whereas there are no gaps in the primary numerals, multiples of ten are missing for four of the ten values in Lenkau, and seven in Papitalai, and for multiples of one hundred, the recorded numerals are defective in seven of the 26 languages, with one gap in Aua, nine in Seimat, nine in Papitalai, five in Lou, four in Pak, and eight in both Lenkau and Penchal. Seimat presents special problems. I recorded nothing beyond *patei tel* '100' (= one group of one hundred'), and therefore considered citing data from Wozna and Wilson (2005:20-21), who list '100', '101', '110', '200', '300', '400' and '500'. The first problem with doing this, as noted in Blust (n.d.) is that I worked with a speaker of the Awin (Western) dialect, which differs in a number of particulars from the Eastern dialect which served as the basis of the Wozna and Wilson grammar. For my *patei tel* '100', for example, Wozna and Wilson (2005:21) give *seilon tepanim* (lit. 'five people' who, if their bodies are intact, would display exactly one hundred fingers and toes). The rest of the multiples of one hundred (they stop at '500'), follow the same conceptual model: *seilon hũõpanim* '200' ('ten people'), *seilon hũõpanim tepanim* '300' ('fifteen people'), *seilon hinalopanim* '400' ('twenty people'), and *seilon hinalopanim tepanim* '500' ('twenty-five people'). Since my Seimat data is taken from the Awin dialect, I would be following the inadvisable procedure of mixing dialect materials if I were to use the Wozna and Wilson data for these higher numerals. The second reason for avoiding them is that Wozna and Wilson themselves have added a question mark before every numeral that they cite above '100', suggesting that there was some uncertainty, or disagreement among the speakers with whom they worked. I therefore cite only *patei tel* '100' for Seimat.

Multiples of this base for all languages are shown in Table 6:

TABLE 6: MULTIPLES OF 'HUNDRED' IN 26 LANGUAGES OF THE ADMIRALTY ISLANDS

	Wuvulu	Aua	Seimat
100	efua puʔu	efua puʔuna	patei tel
200	ʔenu puʔu	ʔenu puʔuna	-----
300	ʔolufua puʔu	ʔolufua puʔuna	-----
400	runaroa puʔu	xunaroa puʔuna	-----
500	aipani puʔu	aipan puʔuna	-----
600	olora puʔu	odaroa puʔuna	-----
700	oloramfua puʔu	odaroa me fua puʔuna	-----
800	fainaroa puʔu	fainaroa puʔuna	-----
900	faimfua puʔu	udeawe puʔuna	-----
1000	efua pufabaʔa	-----	

	Bipi	Lindrou	Sori	Drehet
100	saŋak	rinék	saŋa	rinak
200	xuŋek	lúnek	huŋe	lunak
300	tuluŋek	tónnek	turuŋe	cinik
400	haŋak	háanek	paŋa	hanak
500	limeŋak	lémenek	limiŋa	lemenak
600	wonoŋak	droháanek	gonoŋa	lemenak eri
700	adrotuluŋak	drotónnek	eheturuŋa	lemenak lueh
800	adroxuŋek	drulúnek	anuhuŋa	lemenak tuloh
900	adrosaŋak	drórinek	anusaŋa	lemenak hahup
1000	sapwaw	rawá	sabaw	ko eri

	Levei	Likum	Mondropolon	Pelipowai	Kuruti
100	ranak	sinak	ranak	ranak	saŋat
200	lunak	runak	lunak	lunak	ruŋet
300	sinik	tulunek	cunak	ciniək	tuluŋet
400	hanak	haanek	hanak	haanak	haŋat
500	lamanak	lemenek	limnak	lemenak	limŋet
600	cohanak	cohaanek	onnak	ononak	anŋat
700	cosinik	cotulunek	cocinik	cociniək	drotulŋet
800	colunak	corunek	colunak	coalunak	droruŋet
900	coranak	cosinak	coranak	coaranak	ansaŋat
1000	ropop	rawa	rua	roa	sede

	Kele	Titan	Ahus	Lele	Leipon
100	epow	e saŋat	saŋat	masaŋat	masŋet
200	rupow	luŋat	luŋat	malŋet	maruŋat

300	tulupow	tuluŋat	tuluŋat	matiŋat	maculŋat
400	hapow	haŋat	haŋat	mahaŋat	mahaŋat
500	lipow	limaŋat	limiŋat	mayimŋat	malmeŋat
600	enpow	wonoŋat	onoŋat	manonŋat	mawnoŋat
700	drotulupow	adratuluŋat	horaluluŋat	manodrtiŋat	madeculŋat
800	drorupow	adraluŋat	holuluŋat	manodrluŋet	madoruŋat
900	dre epow	adrasaŋat	hosaŋat	manodrsaŋat	madosuŋat
1000	ponhapow	pwesi	pwesi	masopuw	matupaw

	Ere	Nali	Loniu	Papitalai	Lou
100	siŋat	masaŋat	masaŋat	saŋat	soŋot
200	ruŋet	maluŋat	maʔuŋet	-----	ruŋot
300	tulŋet	matiŋat	maculuŋat	-----	tuluŋot
400	haaŋat	mahaŋat	mahaŋat	-----	aŋot
500	limŋet	maimiŋat	malimeŋat	-----	-----
600	anŋat	manonoŋat	mawonoŋat	-----	-----
700	drotulŋet	madritiŋat	maʔaruculuŋat	-----	-----
800	drorŋet	madriluŋat	maʔaruʔuŋet	-----	-----
900	adrisiŋat	madrisaŋat	maʔarusaŋat	-----	-----
1000	hapwaw	mapwesi	mapun sih	-----	mwasun sip

	Pak	Lenkau	Penchal	Nauna
100	saŋar	soŋotr	saŋət	saŋət
200	huŋor	huŋotr	luŋət	ruŋət
300	duŋor	-----	-----	mocon tuluh
400	daŋar	-----	-----	mocon talət
500	-----	-----	-----	mocon tutən
600	hoŋor	-----	-----	mocon tutən a səw
700	-----	-----	-----	mocon tutən a ruh
800	-----	-----	-----	mocon tutən a tuluh
900	-----	-----	-----	mocon tutən a talət
1000	lalsan dih	-----	-----	mocon saŋahul

To begin with Wuvulu, since *efua* is '10', *efua puʔu* '100' implies that *puʔu* is another word for 'ten', and *ʔenu puʔu* '200' implies that *ʔenu* is '20, which it is in Aua, but that again raises questions about the function of *paʔaniana* in all the Wuvulu numerals from '20' – '90'. Unlike the primary numerals, where Aua differs from Wuvulu in at least '1', '2', '3', '4' and '9', multiples of both 'ten' and 'one hundred' are essentially the same except for '90' and '900', and the addition of a suffix -*na*, of unknown function, in Aua, but not Wuvulu.

The Bipi multiples of one hundred parallel the multiples of ten in this language, with one exception: the suffixal element meaning 'ten' is invariably -*ŋon*, while that for 'hundred' is -*ŋek* for '200' and '300', but -*ŋak* for all other numerals in this set except '800'. While this is to be expected for '800', since the subtractive element is '200', it is also to be expected for '700', where the subtractive element is ‘300’, but surprisingly, that is not the case. Since the preceding vowel is /u/ in both ‘200’ and ‘300’, it may be that these allomorphs are conditioned, but the pattern is too limited to provide assurance of this, the phonetic basis for the conditioning would be obscure, and the contradictory specifications for ‘300’ as numeral, and ‘300’ as subtractive element in ‘700’ further muddy the waters.

In Lindrou the suffixal element meaning ‘hundred’ is invariant, but the subtractive prefix, which is invariably *dro-* in the primary numerals, is *dru-* in both ‘80’ (*dru-lúnoh*), and ‘800’ (*drulúnek*). Since this prefix precedes the vowel /u/ in the latter two cases, but not the first, a more plausible argument can be advanced here than in Bipi that this variation is phonetically conditioned.

The Sori pattern of allomorphy for the suffix meaning ‘hundred’ is similar to that for Bipi in that this form is *-ŋe* for ‘200’ and ‘300’, but *-ŋa* for other numbers. The difference is that Bipi is consistent in using *-ŋe* for ‘200’, and ‘800’, but is inconsistent with the allomorph in ‘700’, while Sori is inconsistent with the allomorph in both ‘700’ and ‘800’. These were recorded carefully, so it is unlikely that I simply misheard the vowel in those cases that break the expected pattern. What appears more probable is that the vowel of the suffix is phonetically conditioned in ‘200’ and ‘300’, but that pattern pressure overrides this in ‘700’ and ‘800’ after three consecutive numerals ending with *-ŋa*, given the rhythmic character of serial counting, both for primary numerals and multiples of ‘ten’ and ‘one hundred’.

The Ndrehet multiples of ‘one hundred’ parallel those for multiples of ‘ten’ in following the word ‘500’ with the primary numerals ‘1-4’, rather than the mathematically appropriate numerals ‘100-400’. As was already discussed with determining how ‘51’ might be distinguished from ‘60’, this leaves open the question how ‘501’ would be distinguished from ‘600’. One other feature of the ‘hundreds’ set for Ndrehet is the deviation of *cinik* from the expected form **cunak or **tunak.

The Levei multiples of ‘one hundred’ closely parallel those for Ndrehet except in having *ranak* for expected **rinak for ‘100’. The Levei word for ‘300’ is similarly aberrant in being *sinik* rather than the expected **sunak or **tonak.

The Likum suffixal allomorphs for this set of numerals include *-nak* for ‘100’ and ‘200’, and *-nek* for ‘300-500’, but again there is an anomaly, as ‘800’ is *corunek*, as against *runak* ‘200’. Once more, the explanation for this anomaly is likely to be pattern pressure, since the preceding five numerals in sequence end with *-nek*. Although the details differ, this is reminiscent of ‘onset runs’ in many of the world’s languages --- once a rhythmic or repetitive pattern is established, it tends to persist over extended domains (Matisoff 1995). What is left unexplained is why ‘900’ does not participate in this overextended pattern.

The Mondropolon system is internally consistent except for ‘700’, where the subtractive form *cocinik* contains a variant of ‘300’ (*cunak*). This irregularity may be due to borrowing from Ndrehet, where ‘300’ is *cinik*, but borrowing for its use in a subtractive numeral, rather than borrowing of the form in its basic sense is not something that one would normally expect.

Multiples of ‘one hundred’ in Pelipowai appear to be very similar to the system in Mondropolon, with the exception that the last vowel in the word for ‘300’ is phonetically offglided, and the subtractive marker is *co*- in '700', but *coa*- in '800' and '900'.

The Kuruti pattern of vowel variation for the suffix marking hundreds is unlike anything up to this point (*a, e, e, a, e, a*), and shows a structural anomaly in that the subtractive marker is *dro*- in '700' and '800', but *an*- in '900'.

Lexically Kele differs from all other languages cited here with respect to the form of the suffix marking hundreds, having *-pow* in all non-subtractive numerals. Structurally it shows unexplained variation in the subtractive marker, with *dro*- for '700' and '800', and *dre*- for '900', possibly an assimilation to the initial vowel of *epow* '100'.

Ahus shows the same irregularity in '500' as it shows in '50', which is the use of *limi*- as an allomorph of *limeh* '5'. In addition, the subtractive morpheme is quite variable, being *hora*- in '700', with an additional irregular alternation of /t/ with /l/ (hence *horaluluŋat* for expected **horatuluŋat), but *holu*- in '800', and *ho*- in '900'. Phonetically, the stress pattern for '700' and '800' also differs, with primary stress on the initial syllable of [hóraluluŋat], but on the second syllable of [holúluŋat], and the final syllable of [hosaŋát].

The Lele multiples of 'one hundred' are internally consistent except that the word for '200' (*malŋet*) shows syncope of the vowel of *lu*- 'two', while the vowel reappears in the substractive form *manodrluŋet* '800'.

The Leipon pattern of vowel variation in the morpheme for 'hundred' is unique (*e, a, a, a, a, a*). In addition, it shows irregular variation in the subtractive morpheme, which is *made*- in '700', but *mado*- in '800' and '900'.

Apart from the ubiquitous pattern of unpredictable vowel variation in the morpheme marking hundreds that has already been seen in other languages, Ere shows two further structural anomalies. First, the subtractive morpheme is *dro*- for '700' and '800, but *adri*- for '900'. Second, the vowel in the morpheme for 'two' in *ruŋet* '200' syncopates in the subtractive form *drorŋet* '800' (exactly the opposite of the allomorphic variation in Lele).

The Nali and Loniu multiples of 'one hundred' are internally consistent, and too little was recorded of the Papitalai, Lou, Lenkau and Penchal systems to venture any statement about pattern regularity or deviations from it.

The Pak system shows a unique pattern of vowel variation in the morpheme for 'one hundred', but the data I collected is too fragmentary to generalize beyond the numerals recorded.

Finally, the Nauna system shows innovative features that were not recorded anywhere else. While '100' and '200' follow a pattern familiar from most other languages of the eastern Admiralties, reflecting Proto-Eastern Admiralty *sa-ŋatu and *ru-ŋatu, the morpheme *mocon*, which must be glossed 'one hundred' is introduced for the remaining members of this set. What is structurally unusual about this system is that the primary numeral that is multiplied by one hundred follows *mocon* rather than preceding it, and consists of the independent set of primary numerals 3-10, rather than clitic forms of these morphemes.

Table 7 provides a compact overview of the patterns of vowel variation in the suffix marking hundreds across the 23 languages of the Eastern Admiralties (this does not apply to languages of the Western Islands). Languages with a blank under '600' use a subtractive pattern that repeats the number '400'. A dashed line (---) indicates that a suffix marking hundreds is not found for the values so marked, and a question mark indicates missing data in my fieldnotes.

TABLE 7: ALLOMORPHIC VOWEL VARIATION FOR THE SUFFIX MARKING HUNDREDS

	100	200	300	400	500	600
Bipi	a	e	e	a	a	a
Lindrou	e	e	e	e	e	
Sori	a	e	e	a	a	a
Drehet	a	a	i	a	a	
Levei	a	a	i	a	a	
Likum	a	a	e	e	e	
Mondropolon	a	a	a	a	a	a
Pelipowai	a	a	i	a	a	a
Kuruti	a	e	e	a	e	a
Kele	---	---	---	---	---	---
Titan	a	a	a	a	a	a
Ahus	a	a	a	a	a	a
Lele	a	e	a	a	a	a
Leipon	e	a	a	a	a	a
Ere	a	e	e	a	e	a
Nali	a	a	a	a	a	a
Loniu	a	e	a	a	a	a
Papitalai	a	?	?	?	?	?
Lou	o	o	o	o	?	?
Pak	a	o	o	a	?	o
Lenkau	o	o	?	?	?	?
Penchal	ə	ə	?	?	?	?
Nauna	ə	ə	---	---	---	

Finally, as promised in connection with dataset (1), the full range of variation for the subtractive marker within a single language, covering the primary numerals, multiples of ten and multiples of one hundred, is given in Table 8. As can be seen, as more numeral sets are included, more pattern-breaking is found. Thus, while Bipi has internal pattern-breaking in the form of the subtractive numeral for the primary numerals, but none for the higher sets, Lindrou, Kuruti, Kele, Ahus, and Ere have none for the primary set, but show unexplained variation in the multiples of ten and one hundred, and while Pelipowai shows *cu-* for expected *co-* in the number '9', the same departure from expectation in the higher numerals appears with '70' and '700', rather than with the expected '90' and '900':

TABLE 8: THE SUBTRACTIVE MORPHEME IN THE NUMERALS 6-9, 60-90 AND 600-900 FOR 26 LANGUAGES IN THE ADMIRALTY ISLANDS

	Bipi	Lindrou	Sori	Drehet	Levei
6	-----	-----	-----	k^ho-	co-
7	adri-	dro-	**ehe-**	k^ho-	co-
8	adro-	dro-	anu-	k^ho-	co-
9	adro-	dro-	anu-	k^ho-	co-
60	-----	-----	-----	Ø-	co-
70	adro-	dro-	**ehe-**	Ø-	co-
80	adro-	**dru-**	anu-	Ø-	co-
90	adro-	dro-	anu-	Ø-	co-
600	-----	-----	-----	Ø-	co-
700	adro-	dro-	**ehe-**	Ø-	co-
800	adro-	**dru-**	anu-	Ø-	co-
900	adro-	dro-	anu-	Ø-	co-

	Likum	Mondropolon	Pelipowai	Kuruti	Kele
6	co-	-----	-----	-----	-----
7	co-	co-	co-	odro-	dro-
8	co-	co-	co-	odro-	dro-
9	co-	**cu-**	**cu-**	odro-	dro-
60	co-	-----	-----	-----	-----
70	co-	co-	**cu-**	**dro-**	dro-
80	co-	co-	co-	**dro-**	dro-
90	co-	co-	co-	**odr-**	dro-
600	co-	-----	-----	-----	-----
700	co-	co-	**cu-**	**dro-**	dro-
800	co-	co-	co-	**dro-**	dro-
900	co-	co-	co-	**an-**	**dre-**

	Titan	Ahus	Lele	Leipon	Ere
6	-----	-----	-----	-----	-----
7	adra-	ho-	odro-	made-	dro-
8	adra-	ho-	odro-	madu-	dro-
9	adra-	ho-	odro-	madu-	dro-
60	-----	-----	-----	-----	-----
70	adra-	ho-	**manodr-**	made-	dro-
80	adra-	**horu-**	**manodr-**	**mado-**	dro-
90	adra-	ho-	**manodr-**	**mado-**	**adri-**
600	-----	-----	-----	-----	-----
700	adra-	**hora-**	**manodr-**	made-	dro-

800	adra-	**holu-**	**manodr-**	**mado-**	dro-
900	adra-	ho-	**manodr-**	**mado-**	**adri-**

	Nali	Loniu	Papitalai	Lou	Pak
6	-----	-----	-----	ŋini-	-----
7	madri-	maʔaru-	madro-	ŋani-	dar-
8	madri-	maʔaru-	madro-	ŋani-	dar-
9	madro-	maʔaru-	madro-	ŋani-	dar-
60	-----	-----	-----	-----	-----
70	madri-	maʔaru-	?	ŋani-	-----
80	madri-	maʔaru-	?	ŋani-	-----
90	madri-	maʔaru-	?	ŋani-	-----
600	-----	-----	-----	?	?
700	madri-	maʔaru-	?	?	?
800	madri-	maʔaru-	?	?	?
900	madri-	maʔaru-	?	?	?

	Lenkau	Penchal	Nauna
6	-----	-----	-----
7	ŋari-	karu-	-----
8	ŋari-	karu-	-----
9	ŋari-	karu-	-----
60	?	-----	-----
70	?	-----	-----
80	?	-----	-----
90	?	-----	-----
600	?	?	-----
700	?	?	-----
800	?	?	-----
900	?	?	-----

4. NUMERAL CLASSIFIERS

In addition to numerals used for serial counting (i.e. without reference to a specific object), many Admiralty languages use distinct systems in counting different classes of objects. It will be difficult to display all of these in a single table, so I have adopted the strategy of illustrating noun classes one language at a time. Since I recorded numeral classifiers only with the primary numerals, this has proven manageable.

Before presenting the data, it is important to note that in the AN languages of insular Southeast Asia, numeral classifiers and the numerals they occur with are almost always free morphemes that are related through their syntactic properties, as with Malay *se-orang guru* (one-person.cl teacher) ‘a teacher’, *dua ékor babi* (two tail.cl pig) ‘two pigs’, *tiga buah rumah* (three fruit.cl house) ‘three houses’. In this type of system only the number ‘one’ occurs in a clitic form that fuses with the classifier as a single phonological word (cp. *satu* 'one', *dua* 'two', *tiga* 'three'). In Oceanic languages, by contrast, numeral classifiers are generally bound morphemes, either preceding or following the associated numeral. [13]

In the Admiralties all numerals have generally become fused with the classifier into a single phonological unit in the order num + CL + N. To facilitate comparison with the numerals used in serial counting, I repeat the latter here. But first, in the interest of saving space, I will briefly summarize the description of numeral classifiers for those languages that already have published descriptions. These are Wuvulu, as described by Hafford (2014), Seimat, as described by Wozna and Wilson (2005), Kele, as described by Ross (2002), Titan, as described by Bowern (2011), and Loniu, as described by Hamel (1994). The reader is asked to consult those works for full details; all data is written in the orthography of the sources:

Wuvulu: For Wuvulu, Hafford (2014:75-76) lists six numeral classifiers, as follows: 1. Flat things (num + *papa* + N), 2. Long things (num + *tui* + N), 3. Round things (num + *wiʔi* + N), 4. Long edibles (num + *nono* + N), 5. Bisected things (num + *waru* + N), 6. Not known (num + *wilo* + N). He does not explain 'Not known', which presumably means that the class of referents that are counted with *wilo* as a classifier is unknown.

Seimat: For Seimat, Wozna and Wilson (2005:13-15) list sixteen numeral classifiers, as follows, using the number 'one' in each case: 1. Humans (*tel* + N; *tel seilon* 'one person', *tel hehin* 'one woman', *tel akaik* 'ond child', etc.), 2. Animals (*tok* + N; *tok sinen* 'one dog', *tok xixi* 'one fish', etc.), 3. Long objects (*tea* + N; tree, canoe, knife, etc.), 4. General (*tehu*; house, stone, spear, night), 5. Pieces, amounts of larger objects (*teik*; pieces of wood, amount of food or sugar), 6. Body parts (*tepaun*; eye, ear, hand, etc.), 7. Branches[14] (*tewasa*; bananas, betel nuts), 8. Leaves (*teka*; of tree, banana plant, cassava, etc.), 9. Places and groups of things (*tesol*; garden, workplace, place to play; group of children, group of gardens, etc.), 10. Palms, roofs and planks (*tepap*; coconut palm, piece of copper roof, plank of wood, etc.), 11. Fingers and branches (*tengax*; finger; tree branch; branch of coral, etc.), 12. Coconuts, eggs (*temot*; coconut, egg), 13. Fire (*tehot*; fire), 14. Island (*texux*; island), 15. Undetermined (*tenen*; story, song, custom, etc.), 16. Undetermined (*tewau*; window, village, hole, etc.). They note some exceptions to the general noun class structure, as with *man* 'banana', which takes *tok*, like animals, and *lih* 'sail', which takes *teik*, like pieces of larger objects, or amounts of larger quantities.

Kele: Ross (1992:129-132) summarizes the use of numeral classifiers in Kele, noting over 30 morphemes that are suffixed to the numerals 1-6: 1. *-dá* 'utterances', 2. *-daŋ* 'watercourses', 3. *-dah* 'heaps, piles', 4. *-hat* 'containers', 5. *-kah* 'sheets of a substance', 6. *-kai* 'limbs', 7. *-kap* 'flat natural objects', 8. *-kuhat* 'fires', 9. *-m^{w}at* 'spears', 10. *-buŋ* 'small groups of natural objects', 11. *-bul* 'longitudinal halves', 12. *-bus* 'packets', 13. *-dek* 'quarters', 14. *-hir* 'districts', 15. *-ker* 'fathoms', 16. *-kiw* 'slitgongs', 17. *-kor* 'villages', 18. *-kow* 'bundles', 19. *-luk* 'halves', 20. *-mir* 'large groups of animate beings', 21. *-mow* 'animate beings', 22. *-pow* 'taros', 23. *-p^{w}il* 'pools of

[13] I am indebted to an anonymous reader, who noted that numeral classifiers are free morphemes in Yapese, Lihir , and Halia, but are prenumeral bound morphemes in a number of languages of the Louisiade Archipelago and New Caledonia, and are postnumeral bound moprhemes in most Nuclear Micronesian languages (including Nauruan), Samoan, Mussau, and languages of the Admiralties.

[14] This is the term used by Wozna and Wilson, although 'bunches' seems more appropriate.

water', 24. *-pʷo* 'thousands', 25. *-sep* 'families', 26. *-sow* 'artifacts', 27. *-til* 'axe-marks', 28 *-i* (after '1' and '9', but zero elsewhere) 'days and parts of days', 29. *–(h)Vh* 'round objects', 30. *-pʷim* 'buildings' (varying between use with '1' and use with 2-6), 31. *-wey* 'long objects (also varying between use with '1' and use with 2-6), and 32. *-psik* 'small pieces'.

In addition, he lists the following in a column reserved for 'classifiers', but includes no hyphen to indicate that they are attached to numerals as classifiers, are bound numerals, or are simply free bases: 1. *ŋai* 'holes', 2. *ŋat* 'hundreds', 3. *ŋʷah* 'tens', 4. *pay* 'leaf midribs', 5. *pal* 'cutting and slicing implements', 6. *pat* 'sugarcane plants', 7. *sal* 'paths'. In several cases there is reason to question whether these should be included in the enumeration of numeral classifiers. The form *ŋʷah*, for example, is simply one of the allomorphs for multiples of ten (*suŋah* '10', *ruŋeh* '20', *tuluŋeh* '30', *haŋoh* '40', *limiŋeh* '50', *enŋwah* '60'), and *ŋat* in most languages of the Admiralties is one of the allomorphs for multiples of one hundred, although in Kele there has been an innovation producing *epow* '100', *rupow* '200', *tulupow* '300', *hapow* '400', *lipow* '500', *enpow* '600', *drotulupow* '700', *drorupow* '800', and *dre epow* '900', so *-ŋat* may have survived, and been adapted to some other function. To be certain of the status of any of these seven words as numeral classifiers one would need to see them in composition with nouns that are counted, which we do not see in this brief treatment.

Titan: Bowern (2011:66-68), drawing on previously unpublished colonial-era material from the German missionary P. Josef Meier, lists four numeral classifiers, as follows: 1. Human, animal (*amo, rumo, tulumo*, etc.), 2. Trees, canoes, villages (*sei, ruei, tuluei*, etc.), 3. Houses (*sem, ruem, tuluem*, etc.), and 4. Plants (*amo(at), rumoat, tulumoat*, etc.). She adds (2011:67) "There are a great many numeral forms in the texts, and I suspect that there are many more classifiers than Meier has identified," noting textual examples of *akap* 'one' and *arukap* 'two', used with trees, leaves, and bird wings. Bowern provides no information about the syntax of such words, but in my data the numeral classifier follows the noun that is counted, as with *um asem* 'a house', *pow a e amoʔ* 'one pig', *key a tuluwei* 'three trees', *bue a abuŋ* 'four bunches of betel nuts', *limaakap laun key* 'five leaves', or *niw a wono* 'six coconuts'.

Loniu: Hamel (1994:57-66) lists the following numeral classifiers for Loniu: 1. Roads, paths, boundaries; large group of men (*-can*), 2. Set of wooden drums (*-čɔw*), 3. Wrapping material or packets (*-čumʷay*), 4. Waterholes, liquid in containers (*-kah/kahan*), 5. Leaves, except palm fronds (*-kap/kapan*), 6. Strings of valued objects such as beads, dogs' teeth, tambu shells, or fish (*-kew/kewan*), 7. Lands, villages, and winds (*-kɔ(w)/kɔhɔnan/kɔʔɔn*), 8. Individual spears (*-kɔʔɔt*), 9. Sips of liquid, small amounts of liquid taken from larger quantity (*-kum/ɛrɛ*), 10. Humans, loose dogs' teeth (not on a string), individual feathers, and fish (*-mɔw*), 11. Fish nets, fishhooks, fish traps (*-mʷat/mʷɛtin*), 12. Fathoms (*-ŋah/ŋahan*), 13. Holes, caves (*-ŋay/ŋɛyɛn*), 14. *Kupʷen* fish net (*-pan/lɛmin*), 15. Tubers, taro stems for planting; one litter of pigs (*-pat/patan*), 16. Palm fronds, wings, money, paper (*-pay/pɛyɛn*), 17. Piles of firewood (*-pot/kahat/muhun*), 18. Clusters of fruit growing on a single branch, as betel nuts, coconuts, Malay apples (*puŋ/wan/an*), 19. Things broken from a larger whole, as pieces of bread, firewood, baked puddings, dried sago (*-put/čupun*), 20. Strings or ropes of dogs' teeth when not on display (*-pwan/kɛwan*), 21. Speech, in all forms (*-ay/ɛn*), 22. Plates or trays of food (*-ɛ/ɛn*), 23. General, for counting things not otherwise classified (*-h*), [15] 24. Woven fiber objects such as mats, baskets and carrying bags (*-hat/tap*^{w}*an*), 25. Half, or part of something; other side (*-hi/pi/muhun*), 26. Houses when completely built (*-(w)ɛm/lɛmin*), 27. Trees, canoes, bunches of bananas (*-wey/yey/ey/patan*), 28. Certain fish, possibly referring to pairs or halves (*salaha* 'one', *sih* 'two', *sih ɛ salaha* 'three', *maʔawoh* 'four', *maʔawoh ɛ salaha* 'five', *mačɔlɔh* 'six', *mačɔlɔh ɛ salaha* 'seven', *mahah* 'eight', *mahah ɛ salaha* 'nine', *malimɛh* 'ten'),[16] 29. Days or occasions (*pɛʔɛ(n)*), 30. Parrot fish (*-p*^{w}*in*), 31. Mature sago palm (*sahay*?).

The following are the additional languages for which I have field data relating to the use of numeral classifiers. Languages for which I have no data on this topic include Lindrou, Mondropolon, Pelipowai, Kuruti, Lele, Leipon, Papitalai, Pak, Lenkau, and Penchal.

4.1. Bipi. In my data, counted nouns in Bipi show no difference in the form of the numeral, indicating the absence of a system of numeral classifiers: *wum sih* 'one house', *niw sih* 'one coconut', *drapunah sih* 'one child', *ki sih* 'one tree', *ni sih* 'one fish', *wum xuoh* 'two houses', *niw xuoh* 'two coconuts', etc.

4.2. Sori. As in Bipi, nouns in Sori are counted with the numerals used in serial counting and no presence of a classifier: *gum sip* 'one house', *naʔoʔoy sip* 'one child', *ni sip* 'one fish', *gum huop* 'two houses', *naʔoʔoy huop* 'two children', etc.

4.3. Ndrehet. Although only minimal relevant data was collected, it is clear that Ndrehet uses distinct numeral classifiers for houses as against animals and humans, as follows:

SERIAL	CLASS I pigs (*pup*)	CLASS II houses (*asap*)
1. eri	pup rumop	asap reʔiŋ
2. lueh	pup nolowip	asap luʔiŋ
3. tuloh	pup culumup	asap ciliʔiŋ
4. hahup	pup hamop	asap haʔiŋ
5. limeh	pup limup	asap k^horeʔiŋ
6. k^hoeri	pup limuprumop	asap k^holuʔiŋ
7. k^holueh	pup limupnolowip	asap k^hociliʔiŋ
8. k^hotuloh	pup limupculumup	asap k^hohaʔiŋ
9. k^hohahup	pup limuphamop	asap k^hoeri
10. runoh	pup runoh	asap runoh

Children (or other humans) reportedly are counted like pigs (or other animals), hence *nah rumop* 'one child', *nah nolowip* 'two children', *nah culumup* 'three children', etc.

[15] This is the fossilized general numeral classifier PADM *-pu, POC *-puaq that is found in nearly all languages of the Admiralties.
[16] Note that the numerals 2, 4, 6, 8 and 10 here are the forms 1, 2, 3, 4, 5 in serial counting, hence Hamel's suggestion that this system of counting fish may be by pairs (or possibly halves).

It has already been noted that Ndrehet stands out from other languages of the eastern Admiralties in having apparently reinterpreted the subtractive marker *k^{h}o-* as an additive marker, since 10-1 = '6', 10-2 = '7', 10 – 3 = '8', and 10 – 4 = '9' is mathematically unsound, forcing us to interpret these as 5 + 1, 5 + 2, 5 + 3 and 5 + 4, despite the clear comparative evidence that *k^{h}o-* reflects Proto-Manus *dro- 'subtractive marker for numerals'. In addition to this, other arithmetical peculiarities appear in the use of numeral classifiers. The system in use for animate beings (including minimally pigs and children) is transparently quinary, such that 6 = 5 + 1, 7 = 5 +2, etc. It is thus structured like the system of serial counting, with the difference that Ndrehet serial counting has evolved from the reinterpretation of a subtractive marker as an additive marker, while the system for counting animate beings is based on straightforward addition to 'five'. What is most confounding about the available data is the Class II system for counting referents, which mimics the system of serial counting in using the historical subtractive marker as an innovative additive marker, but one that is quaternary, hence based on 'four', rather than 'five', so in counting houses from one to ten the structure is 1, 2, 3, 4, 4 +1, 4 + 2, 4 + 3, 4 + 4, and then --- one must say astonishingly --- concluding with *k^{h}o* being used once again as a subtractive marker, hence 10 -1, and then 10. To cap what must be considered one of the most bizarre counting systems ever recorded, both '5' and '9' are expressed as 10-1, but where the first of these numerals uses the historical subtractive marker as an innovative additive marker in an innovative quaternary counting system, the second uses uses the historical subtractive marker without change, so that *k^{h}o-* marks addition for 5-8, but subtraction for '9', and the only way that '5' and '9' can be distinguished on the surface is through the use of a numeral classifier for '5' but a numeral drawn from serial counting for '9'.

For ease of reference, Table 9 summarizes these strikingly different mathematical structures in serial counting, and counting Class I and Class II referents in Ndrehet:

TABLE 9: THREE SYSTEMS OF ARITHMETIC IN NDREHET COUNTING SYSTEMS

SERIAL COUNTING	CLASS I	CLASS II
1	1	1
2	2	2
3	3	3
4	4	4
5	5	10-1 (= 4 + 1) = 5
10-1 (= 5 + 1) = 6	5 + 1 = 6	10-2 (= 4 + 2) = 6
10-2 (= 5 + 2) = 7	5 + 2 = 7	10-3 (= 4 + 3) = 7
10-3 (= 5 + 3) = 8	5 + 3 = 8	10-4 (= 4 + 4) = 8
10-4 (= 5 + 4) = 9	5 + 4 = 9	10-1 = 9
10	10	10

How such a convoluted system of numeration could have evolved from a straightforward decimal system in POC is a question that I suspect will not be answered soon. Needless to say, given the multiple questions raised by this clearly fragmentary set of data, the task of recording the entire system of numeral classifiers in Ndrehet, if that is still possible, must be considered one of the highest priorities in Admiralty Island linguistics.

4.4. Levei. Levei data was collected for six different noun classes: 1. children, pigs, fish, and ropes, 2. houses, 3. trees, 4. leaves, 5. bunches of things, and 6. coconuts. In the first five of these the numeral is fused with a counting classifier, but coconuts are counted with the common numerals used in serial counting. While the order N + num + cl. was said to be preferable, I was told that num + cl. + N is also used (N-final order was initially given for counting children, pigs, fish, ropes, and houses, but N-initial order was given for trees, leaves, and coconuts; the numerals given for counting bunches had no noun associated with them, leaving the preferred order of constituents an open question). I cite all forms here as they were recorded, leaving other ordering options as implied alternatives:

SERIAL	CLASS I fish (*ni*)	CLASS II houses (*isop*)	CLASS III trees (*kep*)
1. eri	romop ni	reʔiŋ isop	kep reʔep
2. lueh	nolowip ni	luʔiŋ isop	kep luʔep
3. toloh	sulumup ni	siliʔiŋ isop	kep siliʔep
4. hahup	hamop ni	haʔiŋ isop	kep haʔep
5. limeh	limup ni	lemiʔiŋ isop	kep lemeʔep
6. cohahup	cohamop ni	cohaʔiŋ isop	kep cohaʔep
7. cotoloh	cosulumop ni	cosiliʔiŋ isop	kep cosiliʔep
8. colueh	conolowip ni	coluʔiŋ isop	kep coluʔep
9. coeri	coromop ni	coreʔiŋ isop	kep coreʔep
10. ronoh	ronoh ni	ronoh isop	kep ronoh

CLASS IV leaves (*luʔu kep*)	CLASS V bunches	CLASS VI coconuts (*cikilip*)
1. luʔu kep rotoh	rop^{w}iŋ	eri
2. luʔu kep lutoh	lup^{w}iŋ	lueh
3. luʔu kep sulutoh	sulup^{w}iŋ	toloh
4. luʔu kep hatoh	hap^{w}iŋ	hahup
5. luʔu kep lomutoh	lemep^{w}iŋ	limeh
6. luʔu kep cohatoh	cohap^{w}iŋ	cohahup
7. luʔu kep cosulutoh	cosulup^{w}iŋ	cotoloh
8. luʔu kep colutoh	colup^{w}iŋ	colueh
9. luʔu kep corotoh	corop^{w}iŋ	coeri
10. luʔu kep ronoh	ronoh	ronoh

As stated above, Class I also applies to children (*ñoh*), pigs (*pup*), and ropes (*rukep*). It should be noted that although *ñoh* was used for 'child' with counting classifiers (*romop ñoh 'one child', nolowip ñoh* 'two children', etc.), the singular possessive forms recorded for the same meaning were *nesu-k, nise-ŋ, nesu-ŋ* 'my/your/his or her child'.

4.5. Likum. Likum data was collected for five different noun classes: 1. children, pigs, fish and leaves, 2. houses, 3. trees, 4. bunches of things, as coconut, and 5. coconuts.

SERIAL	CLASS I pigs (*pow*)	CLASS II houses (*esew*)
1. esi	pow samo	esew selem
2. rueh	pow rumow	esew rulem
3. taloh	pow tulumow	esew tululem
4. hahu	pow haamo	esew haalem
5. limeh	pow lim^{w}ew	esew lemelem
6. cohahu	pow cohaamo	esew cohaalem
7. cotaloh	pow cotulumow	esew cotululem
8. corueh	pow corumow	esew corulem
9. coesi	pow cosamo	esew coselem
10. senoh	pow senoh	esew senoh

CLASS III trees (*kay*)	CLASS IV bunches (*cikiley*)	CLASS V coconut (*cikiley*)
1. kay saʔay	cikiley sikam	cikiley esi
2. kay ruʔay	cikiley rukam	cikiley rueh
3. kay tuluʔey	cikiley tulukam	cikiley taloh
4. kay haʔay	cikiley haakam	cikiley hahu
5. kay lemeʔay	cikiley lemekam	cikiley limeh
6. kay cohaʔay	cikiley cohaakam	cikiley cohahu
7. kay cotuluʔey	cikiley cotulukam	cikiley cotaloh
8. kay coruʔay	cikiley corukam	cikiley corueh
9. kay cosaʔay	cikiley cosikam	cikiley coesi
10. kay senoh	cikiley senoh?	cikiley senoh?

As noted above, Class I also includes children (*nah*), fish (*ni*), and leaves (*leʔun*). The classifier for pigs, children, fish, and leaves was consistently recorded as -/mo/ ([moʔ]) in the numbers 1 and 4, and their subtractive forms in 6 and 9, but as /mow/ ([mow]) in the numbers 2 and 3, and their subtractive forms in 7 and 8, and the distinction between classes IV and V is between bunches of coconuts (Class IV) vs. individual coconuts (Class V). It will be noted that *cikiley senoh* was recorded as both '10 bunches of coconuts', and '10 coconuts', but this surely indicates an error that was not caught in the field.

4.6. Ahus. In my data, Ahus shows no difference between numerals used in serial counting and in counting specific referents, indicating the absence of a system of numeral classifiers: *pu si* 'one pig', *pu luoh* 'two pigs', *um si* 'one house', *um luoh* 'two houses', *kay si* 'one tree', *kay luoh* 'two trees', etc.

4.7. Ere. Ere data was collected for six different noun classes: 1. children and pigs, 2. houses, 3. trees, 4. leaves, 5. bunches (as of betel nuts), and 6. coconuts.

SERIAL	CLASS I child (*nat*)	CLASS II house (*esew*)	CLASS III tree (*key*)
1. sih	nat hamow	esew siʔim	key haʔey
2. ruoh	nat rumuw	esew ruʔim	key ruʔiy
3. tulah	nat turumuw	esew tulʔim	key tulʔiy
4. hahuw	nat haamow	esew haʔim	key haaʔey
5. limoh	nat limuw	esew limʔim	key limʔey
6. onah	nat anmow	esew aniʔim	key aney
7. drotulah	nat droturumuw	esew drotulʔim	key drotulʔiy
8. droruoh	nat drorumuw	esew droruʔim	key drorʔey
9. droasih	nat adrisamow	esew adrisaʔim	key adrisaʔey
10. saŋul	nat saŋul	esew saŋul	key saŋul

CLASS IV leaves (*drudroʔan key*)	CLASS V bunches (*nukʷan*)	CLASS VI coconuts (*padris*)
1. drudroʔan key hakap	nukʷan pame hambuŋ	padris sih
2. drudroʔan key rukep	nukʷan pame rumbuŋ	padris ruoh
3. drudroʔan key tulkep	nukʷan pame tulumbuŋ	padris tulah
4. drudroʔan key haakap	nukʷan pame haambuŋ	padris hahuw
5. drudroʔan key limkep	nukʷan pame limbuŋ	padris limoh
6. drudroʔan key ankap	nukʷan pame anbuŋ	padris onah
7. drudroʔan key drotulkep	nukʷan pame drutulumbuŋ	padris drotulah
8. drudroʔan key drorukep	nukʷan pame drorumbuŋ	padris droruoh
9. drudroʔan key adrisikap	nukʷan pame adrisambuŋ	padris droasih
10. drudroʔan key saŋul	nukʷan pame saŋol	padris saŋul

Based on this data, notable features of the Ere system of counting classifiers include a vowel length contrast used to distinguish ‘one’ from ‘four’ in Classes I, III, IV and V (no length distinction was recorded for *hahuw* or *haʔim*), and variation in the subtractive marker between *dro-* for ‘7’ and ‘8’ and *adri-* for ‘9’. With regard to the latter, it is noteworthy that in *serial* counting a comparable variation is found only in multiples of ten and one hundred, but not in the primary numerals, which have invariant *dro-*. Further evidence of pattern-breaking is seen in the non-matching forms for ‘one’ as independent numeral and as subtractive component of ‘9’; in serial counting this is realized as *sih* : *asih*, but in Class I as *hamow* : *-samow*, in Class II as *siʔim* : *-saʔim*, in Class III as *haʔey* : *-saʔey*, in Class IV as *hakap* : *-sikap*, and in Class V as *hambuŋ* : *-sambuŋ*. In addition, Class III shows variation between *ruʔiy* and *-rʔey*. Finally, the structure of Class V is more complex than that of the others, as it contains a noun meaning ‘bunches’, plus a second noun specifying the type of bunch (*pame* ‘betel nuts’), and then the classifier at the end specifying bunches again.

4.8. Nali. For Nali I recorded numeral classifiers for seven noun classes: 1. children, pigs, fish, 2. houses, 3. trees, 4. leaves, 5. ropes, 6. bunches (two patterns), and 7. coconuts. However, my data for this language presents special problems. Nali was the first language I began to work on after arriving in Manus, and as a result, when recording it I did not yet appreciate the ubiquity of pattern-breaking in the numeral systems of Admiralty languages. As a result, I recorded 1-10 only for 'houses'. For all other noun classes I recorded the numeral classifiers for 1-3, followed by 'etc.', suggesting that the rest can be predicted based on the pattern seen with 'houses'. In hindsight, I see this as a mistake, given the frequency of pattern-breaking for counting with numeral classifiers in other languages, and I hesitate to speculate about the shapes of forms that were not actually recorded. As a result, I list only 1-3, and 10 without qualification for all noun classes except Class II. I would normally add 7-9 to this, since they typically incorporate 1-3, but given the atypical form for '9' in Class II, I do this only for '7' and '8', which I give with a question mark. It should be added that although all numerals from 2-10 in serial counting were recorded with the prefix *ma*-, and a similar pattern was recorded for Class II, other noun classes were recorded without this element, which apparently is optional for 2-9 (but obligatory for 10):

SERIAL	CLASS I children (*bunah*)	CLASS II houses (*sew*)
1. si(h)	bunah hamow	sew hawum
2. maluo(h)	bunah malumow	sew maluwum
3. maroyo(h)	bunah matimow	sew matiwum
4. mahahew	?	sew mahawum
5. mayima(h)	?	sew mayiwum
6. manono(h)	?	sew manonowum
7. madritoyo(h)	bunah madritimow?	sew madritiwum
8. madriluo(h)	bunah madrilumow?	sew madriluwum
9. madrosi(h)	?	sew madrotiwum
10. masoŋuy	bunah masoŋuy	sew masoŋuy

CLASS III trees (*key*)	CLASS IV leaves (*yow key*)	CLASS V ropes (*malkey*)
1. key hakow	yow key hakap	malkey hakiw
2. key malukow	yow key malukap	malkey malukiw
3. key matikow	yow key matikap	malkey matikiw
4. ?	?	?
5. ?	?	?
6. ?	?	?
7. key madritikow?	yow key madritikap?	malkey madritikiw?
8. key madrilukow?	yow key madrilukap?	malkey madrilukiw?
9. ?	?	?
10. key masoŋuy	yow key masoŋuy	malkey masoŋuy

CLASS VIa betel nuts (*bue*)	CLASS VIb betel nuts (*bue*)	CLASS VII coconuts (*niw*)
1. bue hambuŋ	bue hanam	niw si(h)
2. bue malumbuŋ	bue lunam	niw luo(h)
3. bue timbuŋ	bue tinam	niw toyo(h)

4. ?	?	niw hahew
5. ?	?	niw yima(h)
6. ?	?	niw nono(h)
7. bue madritimbuŋ?	bue madritinam?	niw madritoyo(h)
8. bue madrilumbuŋ?	bue madrilunam?	niw madriluo(h)
9. ?	?	niw madrosi(h)
10. bue masoŋuy	bue masoŋuy	niw masoŋuy

4.9. Lou. Lou data was collected for four different noun classes, as follows: 1. children, pigs, fish, leaves, ropes, 2. trees, sticks, 3. houses, coconuts, 4. Bunches (of coconuts, betel nuts). Data for Class IV includes only numbers 1-3:

SERIAL	CLASS I children (*not*)	CLASS II trees (*ke*)	CLASS III houses (*um*)
1. sip	not som	ke se	um sip
2. ruʔep	not rumo	ke rue	um ruʔep
3. telɪp	not tulumo	ke tulue	um telɪp
4. tolot	not amo	ke parantolot	um tolot
5. ŋuran	not ŋuran	ke paranŋuran	um ŋuran
6. ŋiniop	not ŋiniop	ke paranŋiniup	um ŋiniop
7. ŋaniselɪp	not ŋaniselɪp	ke paranŋaniselɪp	um ŋaniselɪp
8. ŋaniruʔep	not ŋanirumo	ke paranŋaniruʔip	um ŋaniruʔep
9. ŋanisip	not ŋanisom	ke ŋanisip	um ŋanisip
10. saŋaul	not saŋaul	ke saŋaul	um saŋaul

CLASS IV
coconuts (*puol*)

1. puol su
2. puol ru
3. puol tulu

As noted above, Class I also includes pigs (*puo*), fish (*nik*), leaves (*rein ke*), and ropes (*tel*), Class II also includes sticks (also *ke*), and Class III also includes coconuts (*puol*). Coconuts (and presumably betel nuts) therefore occur as members of both Class III (where *puol sip* is 'one coconut'), and Class IV (where *puol su* is 'one bunch of coconuts').

4.10. Nauna. In my data, Nauna shows no difference between numerals used in serial counting and in counting specific referents, indicating the absence of a system of numeral classifiers: *puw səw* 'one pig', *puw ruh* 'two pigs', *puw tuluh* 'three pigs', *yum siw* 'one house', *yum ruh* 'two houses', *yum tuluh* 'three houses', etc.

5. CONCLUSIONS.

The languages of the Admiralty Islands are of considerable typological interest in being among the few languages in the world that are known to use subtraction as a recurrent process for deriving numerals in ordinary counting. Beyond this, they are noteworthy, as well, for the frequency with which a pattern, once established, is then broken unpredictably. The result is that learning to count with any of these systems requires a greater burden on memory than is found in most other languages, where established patterns typically allow reliable extrapolation.

The data collected here is fragmentary, with complete sets of primary numerals used in serial counting for all 26 languages, but some gaps for multiples of ten, more gaps for multiples of one hundred, and considerably more gaps for the use of numeral classifiers (which were recorded only for the primary numerals 1-10). A great deal remains to be done in determining the full enumerative potential of all of these languages, but particular attention should be paid to Ndrehet, which exhibits changes of a highly unusual type, including the reinterpretation of the historical subtractive marker as an additive marker in serial counting, the use of both quinary and quaternary principles of counting in the two noun classes for which classifiers were recorded, and the bizarre use of the same prefix k^h*o*- as an additive marker for 4 + 1 = 5, 4 + 2 = 6, 4 + 3 = 7, and 4 + 4 = 8, but a subtractive marker for 10 -1 = 9 in Class II nouns, a category of currently unknown extent that minimally includes houses.

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