Lexware, Dene Band Labels, and Recent Alaska Dene Lexicography Work

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1. Early ANLC Dene Research and the First *Lexware* Dene Language Projects

I began working at Alaska Native Language Center in 1973 as a specialist on Alaska Dene (aka Athabaskan) languages. Our research on Dene at ANLC was comparative in its approach (Krauss 1973, 1986). In the 1970s I was collaborating on distinct Dene languages with colleagues Michael Krauss, Jeff Leer, Chad Thomson, Katherine Peter, Eliza Jones, and Jane McGary. We strived for breadth in documentation. For Dena'ina and Ahtna I was attempting to (a) work with speakers from all dialects; (b) do topical vocabulary research using ethnological and biological sources; (c) collect verb themes (which tend to be cognate across the Dene languages), verb paradigms, and verbal derivations; (d) record and transcribe stories with many strong speakers; (e) prepare learning materials for the fledgling language classes in a few school districts. The decade 1973 to about 1983 or 1984 were exciting times for Alaska Native language work. Cassette tape recorders were increasingly used all over Alaska. The projects were small, with little funding, but much enthusiasm. Many of the foremost speakers of Alaska languages were contributing volumes of information, recorded and written, with a range of people (teachers, agency staff, researchers in various fields).

Until 1978, the primary materials on the languages were handwritten notes or typescripts. The initial stage for a dictionary was a box of 4" x 6" slips of paper, where one can add examples filed by the main stem in a verb theme or a vocabulary item. Some of my early verb paradigm slips for Dena'ina have 50 or more words written on both sides of a slip of paper. The first ANLC publications were typed on an IBM *Selectric* (which had interchangeable type balls including phonetic and Dene).

Two ANLC research papers contributed to the integrated root-morpheme organization for various Dene languages. Citing Alaska Dene data of the 1970s, Leer (1979) defined the basic categories of roots and stems which led to advances in Proto-Dene root reconstructions. Comparing Ahtna and Navajo, Kari (1979) outlined the system of verb theme categories and defined several types of derivational strings that can account for the myriad forms that can be derived for a single verb theme. The verb complexes in the Alaska Dene languages are elaborate, Koyukon having the most positions with thirty-one prefix positions before the root and four suffix positions after the root. Sections with an English-style alphabetization ordered by the root-initial or affix-initial consonants seemed to be optimal.

In 1978-79, not yet using a computer for word processing, I did a 2,000-page handwritten mock-up of a root-morpheme Ahtna dictionary. For Koyukon Eliza Jones, Chad Thompson, Jane McGary and I assembled an elaborate typescript of Koyukon sections in a tentative page format and that included many notes written by the Jesuit scholar Jules Jetté. (See Fig. 1.) Jane McGary typed this on an IBM *Selectric.* Underlining stood for font alternations (plain, bold, italic), anticipating the capabilities of personal computers. Note the headword line, the stem sets, and a notation for the verb theme. We presented this format at a 1980 conference "Lexicography in the New World Context" held at the University of New Mexico LSA Institute. At that conference

Larry Thompson referred us to his colleague at the University of Hawaii, Bob Hsu. Hsu was supporting numerous dictionary projects with his *Lexware* programs and his band label approach to text-based dictionary making.

ZAAK /carve, whittle/ *ǯʷak

dur	zaayh	zaak	zaayh	zaayh
mom, con,	zaayh	zaak	ziyhtł	zaayh
conclu,dist				
prog	ziyhtł			
cust	ziyh	ziyh	ziyh	ziyh

carve O, whittle O — O+G+(ł)+zaak (oper.)

Note that ł appears only in PAS, other derivations have ø classifier.

yagheełzaak he carved on it — dur.

hugheełzaak he carved (a surface) — dur.

ninkohdin'a yokko k'agheełzaaga kk'aant'aa it looks like shavings made by a man

ghalizaaga shavings — nom.

"The ghalizaaga are thin shavings of dried wood, used as primitive torches. One of the children often stands near the mother whilst she is engaged in cooking, during a dark winter evening: he has a handful of ghalizaaga, and burns them, one after another, to shed light on the preparation of the evening meal."

nok'idagheezaak he made some shavings (for fire) — dur., term.

yaghadaalzaak he shaped it by carving — conclu.

oyh laagha ghadaalzaak "he planed sticks into shape for a snowshoe frame" (cf. oyh laagha gheełzaak, 'he carved on sticks for snowshoe frame (not necessarily into shape)', dur.) — conclu.

haayaghadinaalzaak he carved it to a point — 1 mom.

haaghadinaałizaak it is carved to a point — 1 mom., pass.

yiyee ts'aak'ineezaak he carved something out of the inside of it — n mom.

ninok'aghanaalzaak he carved something into a shape, he bevelled it — conclu.-dist. (sg. O)

ninok'aghanoziyhtł he is carving something into a shape — dist.-progr.

hu dok'idee hołeets'a hutł tł'o kk'aats'iyeekk'a ninok'aghanoziyhtł didnee? "Is he who speaks thus able to carve well the bench support of a sled?"

iron (n.)

k'aazaaga' L iron, metal, steel — n.

k'aazaaga' tługha copper ('yellow iron')

fingers, i.e. pointed objects

-nilozaaga fingers, hand, tendons on back of hand — n. poss.

binilozaaga deenaał she has long fingers

knife

saaya, -zaaya' knife, trump in cards — n.

saay lił, saay litł sheath, scabbard ('knife skin')

saay t'usga' table knife ('flat knife')

saay gida' butcher knife, hunting knife ('big knife')

saay kk'o' knife blade, edge

saay kk'o' kkala the knife is dull

Fig. 1 Page-format for Koyukon, typed on IBM Selectric (Kari 1980)

In 1980 Bob Hsu introduced the *Lexware* approach to dictionaries to several of us at ANLC. *Lexware* is a text-based hierarchical database that is similar to XML but that is more readable. The band label conventions allow for unlimited sub-entries that can be creatively ordered. Using drafts of the Ahtna and Koyukon dictionaries, Hsu's initial assignment for me was to design band labels that convey the integrated root-morpheme format: verb themes, prefixes and suffixes, stem sets, the common word categories, along with conventions for marking dialects. In 1980 I began typing the root-initial sections of Ahtna and Koyukon *Lexware* files.

Kari (1990b) is a history of the Ahtna dictionary project, including the first *Terak* computer at ANLC, the band label conventions, the English finder list and the page-format program that Bob Hsu wrote. While computer capacity was limited, the constant elements for twenty years were the flexible system of Dene band labels, and the plain ASCII text format. We used hard characters to represent plain (=), bold (&) and italic (%) fonts. The ASCII substitute characters for Koyukon were \ for ł, | for Ł, and @ for ʉ. Bob pointed out that this would ensure that data entered in the 1980s would be "future proof." For over 35 years the files and text have remained readable and accessible as different operating systems, word processors, and Unicode characters became available.

For years numerous print-outs of unformatted *Lexware* files for Ahtna and Koyukon in the Dene band labels served as scripts for linguistic and ethnological field work on various Alaska Dene languages. For the first version of a Lower Tanana dictionary file (1989-93)I copied verb themes from Ahtna or Koyukon into a starter file for Lower Tanana (LT). Over the years I shared several *Lexware* files with colleagues and students. Sharon Hargus, who was working on Deg Hit'an in Alaska, and Babine-Wetsuwit'en and Sekani in British Columbia; Siri Tuttle, who received versions of the Lower Tanana and Middle Tanana (MT); Olga Lovick, the Upper Tanana file; Gary Holton and Rick Thoman, the file for Tanacross. Numerous *Lexware* files were used on nearly every page of Jeff Leer's 1996 Comparative Athabaskan Lexicon manuscript. Data from *Lexware* files were exchanged with Edward Vajda in 2007-2010 as he was assembling his 2010 article on the Dene-Yeniseian Hypotheses.

The logic and versatility of the Dene band labels and comparability of the integrated root-morpheme format is evident to anyone who has a keen interest in Dene linguistics or ethnology. The two published *Lexware* dictionaries, Ahtna (Kari 1990a) and Koyukon (Jetté and Jones 2000), have not been modified since they were published. A few academics in the 1990s, referring to the *Ahtna Athabaskan Dictionary* or to proofs of the *Koyukon Athabaskan Dictionary* sections, wrote that the ANLC Dene dictionary format was "intimidating" or "impossible for non-linguists to use" (Dementi-Leonard and Gilmore 1999).[1] Such statements may have led some language learners to

[1] "Linguists from the ANLC at the UAF began language work in the referenced areas in the 1960s… Dictionary entries have been organized alphabetically by root and affix (see Kari 1990). The structure of Athabascan is prefix agglutinative, which presents some lexical complexities. Participants frequently addressed their questions and concerns about the accessibility and usefulness of scholarly and linguistic materials that are so highly technical and academic that they are difficult if not impossible for non-linguists to use. Many Athabascan people have attended school and possess English literacy skills. However, materials in stem and other written formats are often intimidating to both speakers and non-speakers of Athabascan, and Athabascan literacy remains uncommon in most regions" (Dementi-Leonard and Gilmore 1999, 52).

simply ignore two excellent reference works. The logic and potential of the Dene band label organization for Ahtna and Koyukon dictionaries remain underappreciated.

Further context. The Alaska Dene languages have excellent grammatical and lexical materials. Several Dene languages have hundreds of pages of accurately written texts. Between 1975 and 2000 very few persons participated in the Ahtna or Koyukon dictionary projects. The lexicography process has never been taught at University of Alaska, Fairbanks (UAF) or in Alaska. During my career at UAF (1973-1997) small classes on Dene linguistics were offered only two or three times. Dene language data/materials remain underutilized both at UAF and in Alaska in general.

I retired from ANLC and UAF in 1997. I have worked on many projects for seven or eight Alaska Dene languages, usually on small contracts. I work at my home office on Dene languages and dialects with few or no speakers. I have developed a large array of methods and filing systems for vocabulary research, verb theme research, audio-text transcription, targeted proofreading, and for maintaining cumulative place names lists.

In a recent paper presented at the May 2018 Language Revitalization Institute at UAF (Kari 2018a), I wrote the following:

> Language work is what I have been doing since 1970. I wrote two articles (Kari 1991 and 2005) where I describe the scope and assumptions of Alaska language work. Language work remains the broadest and most instructive term for discussions about the futures of Alaska's Native languages. I continue to advocate for comprehensive, highly-quality language work in Alaska…For this first language revitalization institute in 2018, it is important to contemplate *futures* for many or even perhaps for all 21 Alaska Native languages. Here are ten inter-related topics that can prompt this discussion….

One way to introduce the Dene band label format and the integrated root-morpheme organization is to page though the pdf file of the *Koyukon Athabaskan Dictionary* (Jetté and Jones 2000; KAD henceforth). For various reasons the KAD is the best single reference work for any Dene language. One feature we added just before publication is a 12-page Table of Headwords (pp. xiv-xxv), illustrated in Figure 2.

The KAD table of headwords is an alphabetical list of all primary elements of this well-documented Dene language. The table is a band sort of the first line of every entry with its page number: [.rt] = a root, [.af] = an affix, and [.lw] = loanword), [pa] after * is a partial reconstruction of Proto-Dene (Athabascan) sounds of the root, and [tag] with brackets is a short gloss (or meaning) for the root or affix. The Koyukon verb complex is displayed on pp. 758-759 of KAD, with 31 prefix positions preceding the root and 4 suffix positions following it. This may be the most elaborate verb complex for a prefixing language anywhere in the world. All Koyukon prefixes and suffixes are entered at least once. The inventory of derivational strings in the KAD is extensive. The overall presentation emulates the elements of the language's stacking templatic word formation.

For those who may still be intimidated by the KAD, I suggest you begin with the Table of Headwords. The material and natural world, the conscious and the subconscious, the lexical and the grammatical are consolidated as an alphabetical outline of Koyukon cosmography. The extensive annotations by Jules Jetté and Eliza Jones can be read for reference or for enjoyment.

The format of the KAD is designed for the Dene languages, so the Koyukon sections in the band label format can be readily compared with other Dene languages.

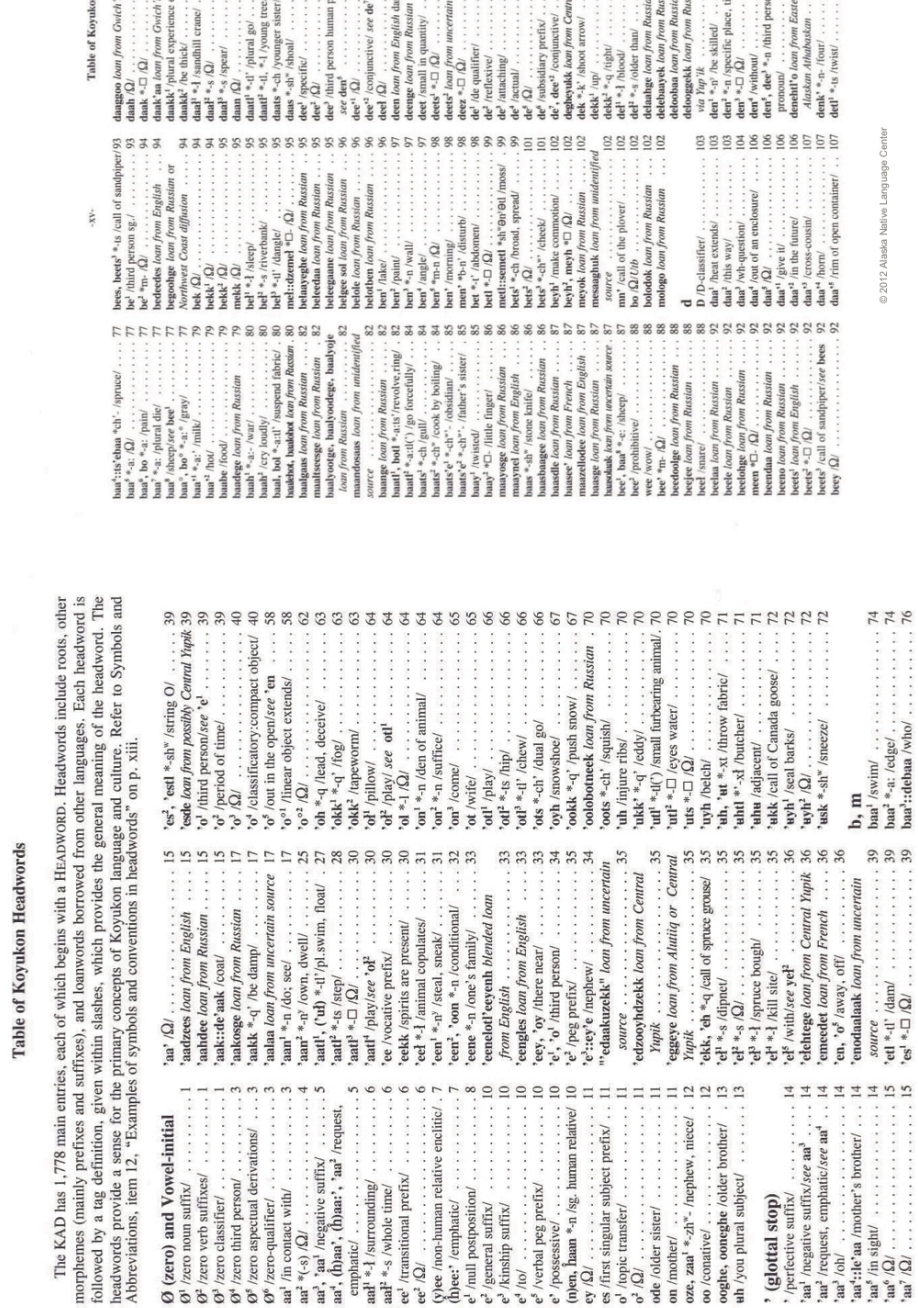

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Table of Koyukon Headwords

The KAD has 1,778 main entries, each of which begins with a HEADWORD. Headwords include roots, other morphemes (mainly prefixes and suffixes), and loanwords borrowed from other languages. Each headword is followed by a tag definition, given within slashes, which provides the general meaning of the headword. The headwords provide a sense for the primary concepts of Koyukon language and culture. Refer to Symbols and Abbreviations, item 12, "Examples of symbols and conventions in headwords" on p. xiii.

Ø (zero) and Vowel-initial

Ø¹ /zero noun suffix/ 1
Ø² /zero verb suffixes/ 1
Ø³ /zero classifier/ 1
Ø⁴ /zero third person/ 3
Ø⁵ /zero aspectual derivations/ . . . 3
Ø⁶ /zero-qualifier/ 3
aa¹ /in contact with/ 3
aa² *-n /dry, see/ 4
aa³ *-n' /town, dwell/ 4
aa⁴ *-n' /own, dwell/ 4
aa⁵, aa¹ /negative suffix/ 5
aa⁶, (h)aa⁶, (h)aa:⁶, ²aa² /request, emphatic/ 5
aal¹ *-Ł /surrounding/ 6
aal² *-s /whole time/ 6
ee¹ /transitional prefix/ 6
ee² /Ω/ 6
(y)ee /non-human relative enclitic/ . 7
(h)ee:⁷ /emphatic/ 7
e¹ /null postposition/ 8
e² /general suffix/ 10
e³ /kinship suffix/ 10
e⁴ /to/ 10
e⁵ /verbal peg prefix/ 10
e⁶ /possessive/ 10
(n)en, ²aan *-n /sg. human relative/ 10
ey /Ω/ 11
es /first singular subject prefix/ . . 11
o¹ /topic transfer/ 11
o² /Ω/ 11
ode /older sister/ 11
on /mother/ 11
oze, zaa¹ *-zh' -/nephew, niece/ . 12
oo /conative/ 12
ooghe, ooneghe /older brother/ . . 13
uh /you plural subject/ 13

' (glottal stop)

' /perfective suffix/ 14
'aa¹ /negative suffix/*see* aa³ . . 14
'aa² /request, emphatic/*see* aa⁶ . 14
'aa³ /oh/ 14
'aa⁴::le'aa /mother's brother/ . . . 14
'aa⁵ /in sight/ 14
'aa⁶ /Ω/ 15
'aa⁷ /Ω/ 15
'aa' /Ω/ 15
'aadzees *loan from English* 15
'aahdee *loan from Russian* 15
'aak::de'aak /coat/ 15
'aakosge *loan from Russian* 17
'aakk *-q' /be damp/ 17
'aalaa *loan from uncertain source* 17
'aan¹ *-n /do, see/ 17
'aan² *-n' /own, dwell/ 17
'aat¹, ('ul) *-tł'/pl.swim, float/ . 27
'aat² *-ts /step/ 28
'aat³ *-□ /Ω/ 30
'aat⁴ /play/*see* 'oł² 30
'ał² /pillow/ 30
'ał³ /play/ *see* oł¹ 30
'ol *-l /Ω/ 30
'ee /vocative prefix/ 30
'eekk /spirits are present/ 30
'eel *-Ł /animal copulates/ 31
'een¹ *-n' /steal, sneak/ 31
'een² *-n /conditional/ 32
'eene *-n /one's family/ 33
'eenelotł'eeyenh *blended loan from English* 33
'eengles *loan from English* 33
'eey, 'oy /there near/ 33
'e¹, 'ó /third person/ 34
'e² /peg prefix/ 34
''e¹::ey'e /nephew/ 34
'e¹::ey'e /nephew/ 34
''edaakuzekk *loan from uncertain source* 35
'edzooyhdzekk *loan from Central Yupik* 35
'eggeye *loan from Aluitiq or Central Yupik* 35
'ekk, 'eh *-q /call of spruce grouse/ 35
'el *-s /dipnet/ 35
'el² *-s /Ω/ 35
'el³ *-Ł /spruce bough/ 35
'el⁴ *-Ł /kill site/ 35
'el⁵ /with/*see* yel² 36
'elehtege *loan from Central Yupik* 36
'emeedet *loan from French* 36
'en, 'ó /away, off/ 36
'enodaalaak *loan from uncertain source* 39
'eł¹ *-łł' /dam/ 39
'eł² *-łł' /Ω/ 39
'es¹, 'estł *-sh' /string O/ 39
'estle *loan from possibly Central Yupik* 39
'e¹ /third person/*see* 'e¹ 39
'e² /period of time/ 39
'e³ /Ω/ 40
'e⁴ /classificatory:compact object/ . 40
'e⁵ /out in the open/*see* 'en . . . 58
'e⁶'¹ /linear object extends/ 58
'e⁶'² /Ω/ 62
'eł¹, ('ul) *-łł'/pl.swim, float/ . 63
'eł² *-ts /step/ 63
'ekk² /tapeworm/ 63
'eł³ /pillow/ 64
'eł⁴ /play/ *see* oł¹ 64
'ol *-l /Ω/ 64
'on¹ *-n /den of animal/ 64
'on² *-n /suffice/ 64
'on³ /come/ 65
'ot /wife/ 65
'otł¹ /play/ 65
'otł² *-ts /hip/ 66
'otł³ *-łł' /chew/ 66
'ots *-ch' /dual go/ 66
'oyh /snowshoe/ 66
'ookk *-q' /push snow/ 67
'oolobotneek *loan from Russian* . . 67
'oots *-ch' /squish/ 67
'uh /injure ribs/ 70
'ukk¹ *-q' /eddy/ 70
'utł¹ *-łł(') /small furbearing animal/ 70
'utł² *-□ /eyes water/ 70
'uts *-□ /Ω/ 70
'uyh /belch/ 70
'uh, 'ut *-xt /throw fabric/ 70
'uhtł *-xł /butcher/ 71
'uhu /adjacent/ 71
'ukk /call of Canada goose/ 71
'uyh¹ /seal barks/ 72
'uyh² /Ω/ 72
'usk *-sh' /sneeze/ 72

b, m

baa¹ /swim/ 74
baa² *-n. /edge/ 74
baa³::debaa /who/ 76
bees, beesł² *-ts /call of sandpiper/ 93
be¹ /third person sg./ 93
be² *m- /Ω/ 94
bedeedes *loan from English* 94
begoolge *loan from Russian* or *Northwest Coast diffusion* 94
bek /Ω/ 94
bekk¹ /Ω/ 94
bekk² /Ω/ 95
mekk /Ω/ 95
bel¹ *-Ł /sleep/ 95
bel² *-s /riverbank/ 95
bel³ *-łł' /dangle/ 95
mel::ozemel *-□- /Ω/ 95
belauyeghe *loan from Russian* . . . 95
beleedaa *loan from Russian* 95
beleegaane *loan from Russian* . . . 95
belgee *loan from Russian* 96
belethen *loan from Russian* 96
ben¹ /lake/ 96
ben² /paint/ 97
ben³ *-n /wall/ 97
ben⁴ /angle/ 97
ben⁵ *m-n /Ω/ 98
ben⁶ /morning/ 98
men⁷ *b-n' /disturb/ 98
bet *-t' /abdomen/ 98
bet¹ *-□ /Ω/ 99
metl::semetł *sh'ØnØł /moss/ . . . 99
betł² *-ch /broad, spread/ 99
betł³ /Ω/ 101
betł⁴ *-ch' /cheek/ 101
beyh¹ /make commotion/ 102
beyh² /meyh *-□ /Ω/ 102
meyok *loan from Russian* 102
mesaghuk *loan from unidentified source* 102
bez¹, baa⁸ *-z' /call of the plover/ . 102
mu² /call of the plover/ 102
bo /Ω/*1/b* 102
bolodok *loan from Russian* 102
mologo *loan from Russian* 102

d

D /D-classifier/ 103
daa¹ /heat extends/ 103
daa² /this way/ 103
daa³ /wh-question/ 104
daa⁴ /out of an enclosure/ 106
daa⁵ /Ω/ 106
daa⁶' /give it/ 106
daa⁷' /in the future/ 106
daa⁸' /cross-cossin/ 107
daa⁹' /horn/ 107
daa¹⁰ /rim of open container/ . . . 107
daagoos *loan from Cowich'in* . . . 108
daah /Ω/ 108
daak *-□ /Ω/ 108
dadee'aa *loan from Cowich'in* . . . 108
daakk¹ /plural experience event/ . . 108
daakk² /be thick/ 115
daał¹ *-Ł /sandhill crane/ 115
daał² *-s /Ω/ 115
daał³ *-s /spear/ 115
daan /Ω/ 115
daatł *-łł' /plural go/ 116
daatł² *-łł, *-Ł /young tree/ 121
daats *-ch /younger sister/ 121
daas *-sh' /shoal/ 121
dee¹ /specific/ 122
dee² /Ω/ 122
dee³ /third person human pronoun/ . 122
dee⁴ /Ω/ 122
dee:⁵ /Ω/ 122
dee:⁶ /conjunctive/ *see* de² 122
deel /Ω/ 122
deen *loan from English* damn . . . 122
deenge *loan from Russian* 123
deet /small in quantity/ 123
deetł *-□ /Ω/ 123
deets² *loan from uncertain source* 124
deez *-□ /Ω/ 124
de² /de qualifier/ 124
de² /reflexive/ 124
de² /attaching/ 125
de² /actual/ 125
de² /Ω/ 126
de² /subsidiary prefix/ 126
de², dee² /conjunctive/ 127
de:⁷ /deep/ 127
dekk¹ *-Ł /shoot arrow/ 127
dekk² *-Ł /right/ 128
dełł¹ *-Ł /blood/ 130
dełł² *-s /older than/ 130
dełaahge *loan from Russian* . . . 131
delebaayek *loan from Russian* . . . 131
dełoobaa *loan from Russian* . . . 131
dełoogękk *loan from Russian via Yup'ik* 131
den¹ *-n' /be skilled/ 131
den² *-n /specific place, time/ . . . 132
den³ *-□ /Ω/ 133
den⁴ /without/ 133
den⁵, dee² *-n /third person human pronoun/ 134
denehtł'o *loan from Eastern Alaskan Athabaskan* 134
denk *-n- /four/ 134
detł *-ts /twist/ 135

Fig. 2. KAD Table of Headwords (Jetté and Jones 2000, xiv-xv)

2. Recent Advances in Dene Band Labels and Comparative Dene Research

In the summer of 2016, I was preparing an NSF proposal for adjacent languages Lower Tanana and Middle Tanana. Bob Hsu's former student and *Lexware* successor Tim Montler agreed to participate in the proposed project. In late 2016 when visiting Alan Boraas' Dena'ina language class at Kenai Peninsula College in Soldotna, some persons at Kenaitze Indian Tribe (KIT) contacted me about joining their new Dena'ina Language and Culture Revitalization Program (DLACRP). The KIT tribal council told me I should work on whatever I considered to be most important for the Dena'ina language.

In January 2017 at Tim's place in Denton, Texas, I obtained software that he recommended: *EditPad Pro, AceText* (Just Great Software, https://www.just-great-software.com), and Tim's Alaska keyboard in *Keyman* (SIL International, https://keyman.com). The substitute characters in several files were converted to Unicode characters. Since then I am able to open and compare the 1990 Ahtna file, the 2000 Koyukon file, a mid-size Lower Tanana file, a smaller file for extinct Middle Tanana, and my massive Dena'ina file that I have worked on sporadically since the 1980s. Note that these five Dene languages are geographically contiguous, which makes tracing the diffusional patterns among the languages highly interesting (e.g., shared vs. innovated terms for plants or birds, rare terms found only in one language).

The Alaska Dene languages inform one another, and the verb themes throughout the large Dene family are strongly cognate. During 2017-2018 my mantra has become "high volume Dene lexicography." In the 1980s, even with small computer capacity, the *Lexware* Dene band labels facilitated rapid placement of a word or a sentence under a proper root and verb theme. With modern computer capacity four or five programs can run concurrently. The pace of building and editing entries is far more efficient than it was in the 1990s. One engaging routine is to *fold the lines* (like the KAD Table of Headwords) to display the first three bands of an entry: headword (root, affix, loanword), tag (short gloss), and root type.

Several new features and policies with the Dene band label system give us new ways to advance analyses or to reconstruct of Proto-Dene roots, affixes, and lexemes both in shape and meaning. Comparing the 1990 Ahtna and 2000 Koyukon folded lines file, and the three active files, I am reducing the root inventories in Dena'ina, MT and LT by 4%-5% by recognizing some derived roots or reanalyzed roots, and by recognizing several Dene root-formation or theme-formation processes. Fig. 3 is a portion the entry for the root *dho*[1] /mouth/ in the band label format.

.rt	dho$1	
pd	*dha·	
tag	mouth	
rtyp	NV-anat	
df	dho, tho, dhot, tho' d√: dhoł, thoł, thola'	< derived forms
rcom	LT does not have the theme, derived verb	
	root &xw+Ø+dhoyh =tell story	
..n	-dho, tho, -dhot	
dial	MNC	
dial	T -lo, -lot	< Toklat dialect
gl	*mouth	
ex	sedho dhetl-'onh	

eng	I have it in my mouth	
...an	-dho dwxts'ena	
gl	*palate, roof of the mouth	
...n	thonkenaya	
gl	*gossip	
lit	mouth-plural-talking	
..drt	dhoł	< derived verb root
gl	yawning	
com	an interesting derived root with mouth, &dho+ł	
..sets		
set	dur dhoł >>	
..th	Ø+dhoł	
tc	op	
gl	to *yawn	
..par dur		
ex	beł yedalonh ts'elo edhoł	
eng	*he is sleepy and is yawning	
..i-n	thoł, -dhola'	
dial	MN	
dial	T łoł, lole'	
gl	*yawn, yawning *power	
ex	thoł t'anh	
eng	he has yawning power	
ex	"xeghoyenighalwxnich, ywgh łol selole'," grandpa belole' medicine ghila'	
eng	"you watch out (for bear); there is yawning about it, my yawning (pow)er,"	
quo he2	"grandpa had his yawning medicine"	< Hester Evan text

Fig 3. Band label entry from *Lower Tanana Dene Dictionary*: *dho* /mouth, yawn/

In the KAD (pp. 404, 414), we had treated ‘mouth,’ ‘yawn’ as separate roots. In Lower Tanana as in Fig. 3 we show that mouth and yawning are related. The *derived verb root* ‘yawn’ is formed by a suffix *ł*. This *ł* is a verb-formation suffix (which is placed as a subentry of the all-important ł-classifier prefix). The derived verb root ‘yawn’ can even become a noun. Yawning power was among the tools used by persons with basic shamanistic skill.

The band labels for lexemes have three levels of indentation (., .., …; adding four-dot entries was found to be impractical. We can catalog rare dialect forms (in Fig. 3 "T" is the Toklat dialect of LT). We can add or rearrange subentries and examples creatively.

The process of building entries is much more interesting than it was twenty years ago. For example, recently the *n* ‘distributive’ entries in Koyukon were copied into Dena’ina. In about 30 minutes I added about 75 lines, discovering a few types of strings with *n* distributive in Dena’ina by searching for a several prefix combinations over this large file (over 80,000 lines).

It is interesting to review and standardize the “tag” band (the general gloss of the root). Tag meanings are often the same across the languages. According to Tim Montler (p.c.), standardizing the tag band can help us to combine various entries into multiple language comparative tables.

Sometimes noticeable innovations can then be identified. In Dena'ina the common verb theme 'to eat' is *O+l+qet'*. The verb root **qət'* is common in Alaska Dene, and we gloss the tag as /slide, be slippery/. This is a noticeable *esoterogenic* (or tabooistic) innovation in Dena'ina (see Kari 2007, xxi-xxii). Currently I am using the symbol ↀ (the Roman numeral 10,000, Unicode U+2182). This tag for Dena'ina might be /slide, slippery; eat ↀ/. However, there are so many types of esoterogenic terms in Dena'ina and its dialects that it is not clear how best to present this in the very large Dena'ina file.

It is worthwhile to see if a standardized *root type* system can be used for these five languages. Some groups of roots are quite distinctive. The nine directional roots that take special prefixes and suffixes are its own root type. A recent survey of the root type "color" between LT and Denai'ina shows differences in roots for some colors (even within Dena'ina dialects) or differences in color hue for some roots. I am noting the most elaborate roots for verb theme development with a triple-prime symbol ‴. The most mega-productive verb in all five languages is PD **ni·g* /move the hand, feel/.

Nine of the twelve Alaska Dene languages have *Lexware* root-morpheme files, making it possible to track sound correspondences, rare or unique archaisms, or unusual innovations. Diffusional patterns in Alaska Dene languages offer many insights into Dene prehistory. Ives Goddard (p.c., August 1980) has made the point that the interdental thibilant series in Northern Dene languages must descend from Proto-Dene. This is counter to the PD consonant system in Krauss and Golla (1981, 72), Krauss and Leer (1981), and Leer (1996a; 1996b) which treat all such sounds as an alveolar affricate sibilant series **c* (or *ts*). Ostensibly, this was because neither Eyak nor Tlingit have thibilants. For Den., MT, and LT I am converting the PD forms used in the Ahtna and Koyukon file to the five PD thibilants: *ddh, tth, tth', dh, th*. This then allows the palatal series, **č* (Krauss & Golla 1981, Krauss & Leer 1981), to be treated as coronals *dz, ts, ts',z, s*.

Here are several supporting arguments. (a) Northern Dene languages are the only languages in the world with five interdental thibilants (Chomsky and Halle 1968, 322). (b) the *tth* series helps us track archaisms. Numerous previously undetected archaisms with *th, tth* etc. are in LT, MT as well as in Tanacross and Upper Tanana. (c) There is an absence of thibilant-triggered strident assimilation effects in LT, MT and Tanacross, as opposed to various progressive-regressive strident assimilation patterns among the *ts* and ch^r series. (d) In Northern Dene we find a wide array of unique five-member sound shifts that more plausibly emanated from the unique *tth-* series rather than a *ts*: Hare *f,* Bear Lake, Dogrib k^w, Mountain *p,* Ak Gwich'in *k*, Koy *tl* (Krauss and Golla 1981, 72). (e) The extensive geographic spread of the Northern Dene languages that have retained *tth* (op. cit.) in 14 languages and in dialects of two others. In sum, the "Great Northern Series shift" posited in Leer (1996a) never happened.

Figs. 4-6 presents some tth-series comparisons, analyses, and reconstructions I have noted in Alaska, Navajo, and Proto-Dene. Fig. 5 recognizes rare types of root formation. **thəth* 'skin' can appear as a noun formation suffix *-th* or a stem-initial *th-*. Or *b-* 'third person sg.' can appear in derived roots such as 'sleep', literally 'his/her instrument'.

gloss	*langs.*	*forms*	*reconstructed PD **
‘stone’	At Den	ts’es ts’es	*tth’əth
‘pit, seed’	At Tc	-ents’ese’ -entth’édh’	*-əntth’ədhəʔ
‘bottom snow’	At LT Tc	sesi theyh theyh	*thəx̯ʸ (‘fine particles’)
‘chum salmon’	MT Den-u Tc Gwi	theyi seyi theyi khyii	*thəyi
‘elbow’	At MT LT-minto LT-chena	-ts’os -ts’ith -ts’es -tth’eth	*ts’əth
‘cheek’	At LT-minto LT-chena	-tl’abets’ -tl’abets -tl’abetth	*tl’abətth’
‘one’	At LT-minto LT-chena	ts’iłk’ey ts’iłk’i tth’iłk’i	*ts’iłq’i
‘ridge’	At LT Den	ses, -yese’ seth, -yeddha' ses, -yits'a	*shəth, -ɣʸi·ddhəʔ ~ -ɣʸəthəʔ

Fig. 4. Theta Series Comparisons: Rare Forms

gloss	*langs.*	*forms*	*reconstructed PD **
‘skin pants’	At LT Gwi	seł theł thał	*thəł <th+ł
‘quiver’	At LT	k’aas k’oth	*q’a·th < q’a+th
‘skin sled’	At LT	bes beth	*bəth <b+th
‘sleep’	LT Koy	beł beł	*bəł <b+ł

Fig. 5. Theta Series Comparisons: Examples of Derived Roots

gloss	*langs.*	*forms*	*reconstructed PD **
‘throat’	At	-zaek’	*dheˑq’
	Den	-zaq’	
	LT	-dhaga	
	Nav	-zéé’ (‘mouth’)	
‘mouth’	At	-zaa	*dhaˑ
	LT	-dho	
	Nav	-zaad (‘language’)	
‘yawn’	LT	Ø+dhoł	*Ø+dhaˑ+ł
	Koy	Ø+loł	
	DH	Ø+dhoł	
‘tell story’	Koy	xw+Ø+loyh	*xw+Ø+dhaˑxʸ
	DH	xw+dhoyh	
‘ancient’ (adj.)	Den	suk	*thaˑ+k+ə
	LT	thoga	
	Koy	tloge	
	DH	thoge	
‘clay vessel’	Den	isuk’	*ʔu+thaˑ+k’
	Koy	oołok	
	DH	ethok	
	Nav	’asaa’	
‘distant’ (space-time)	At	d+ł+zet	*d+Ø+dhaˑt
	LT	d+Ø+dhot	

Fig. 6. Theta Series Comparisons: Abstraction in Roots, Themes with *dh~th*

We see in Fig. 6 how essential the theta-series is for recognizing semantic threads between ‘mouth’ (Fig. 2) and other more sporadic lexemes such as ‘old,’ ‘distant (space-time)’ and even the intriguing terms for ‘clay vessel’ that Sapir 1923 noted was in Navajo ‘pot, vessel’ as well as in Sarcee and Ingalik (Deg Hit’an). Krauss and Leer (p.c.) consider this to be a possible ancient diffusion because intervocalic voiceless fricatives tend to be rare. The ‘clay pot’ was a Dene invention in Western Alaska. It was described as early as 1868 by Dall at Anvik (Jetté and Jones 2000, 413). Based on the Koy, DH and Den. forms I reconstruct this as **ʔu+thaˑ+k’* with the conative prefix to mean ‘old-ish’. The distribution of the word that Sapir noted in 1923 remains remarkable, and its etymology is tied to the set of Proto-Dene roots and derived roots with *dhaˑ* /mouth/.

In the past three years using the *Lexware* band label format it is possible to rearrange roots and derived roots, along with entries and subentries. The root groupings for Lower Tanana are much more abstract than those for Ahtna (Kari 1990a) or Koyukon (Jetté and Jones 2000). Many newly reconstructed PD lexemes are in the draft files for Den., LT, and MT. Edward Vajda is cognizant of the theta-series being in Proto-Dene; several words in Fig. 4 have Yeniseian cognates (Vajda 2019).

3. The Cumulative Root-Morpheme File as the Centerpiece of Dene Language Work

High volume Dene lexicography also refers to the ways that the dictionary-making process can interface with many phases of language work for one language. We emphasize making use of all of an Alaska Native language's written documentation. Audio files must be placed in folders with naming conventions. Text-audio file management is essential. When there is the capacity (as with Gwich'in), a detailed topical dictionary should be maintained in topical chapters.

Two of my favorite subfields of language work are text-audio file development, and place names research. For text work, I have had to do most transcriptions myself for Dena'ina, LT, and MT. In the 1980s I used a Sony transcriber device with cassettes. I used an alternating-line format for texts that mimics the ex/eng (example/English) bands in the *Lexware* dictionaries. In the 1980s-1990s I used the *WordPerfect* transcriber feature with wav files to type drafts of texts and for targeted proofreading with speakers.

In 2018 I discovered *Inqscribe,* a low-cost transcription software for audio transcription of video subtitling (https://www.inqscribe.com/). This has been an advance for my text production system. I can put time codes in a file, go back to segments that require more work, or I can prepare for targeted proofreading. For Middle Tanana and the arcane Bessie Barnabus texts (BB, 1881-1993), I can advance some percentage of her lines. More difficult passages I review with Sally Hale from Tanacross. I can put selected BB sentences into the MT dictionary file without exporting the lines from *Inqscribe*. I recommend *Inqscribe* for persons who do a lot of audio transcription. For LT there are a number of high-priority untranscribed texts. For Dena'ina that number is very large. The techniques for placing sentences from text to dictionary are a measure of the editor's knowledge of the contents of the viable file.

The text files for Gwich'in language need to keep advancing while building the cumulative file. Gwich'in has large amounts of untranscribed audio files with expert speakers and many types of written documents. An overall strategy is required to track archival items. File consolidation and file naming, and text placement into a dictionary file can be coordinated using spreadsheets. Standards in literacy and proofreading are essential.

Lower Tanana and Dena'ina have good place names lists (Kari et al. 2012, Kari 2018b). For Middle Tanana our goal is to have every place name mentioned by Bessie Barnabus, Eva Moffit (EM) or Abraham Luke (AB) on the drainage lists. As we go through the BB, EM and AB recordings, I can mark each mention of a name in an *Access* database. Gerad Smith has been mapping these features since 2015. Some locations may be speculative. In 2018 the MT list grew from c. 300 to c. 340 names. Smith will be putting together a report of MT place names and annotations.

To enter place names into the dictionary files, I make a pass through the *Access* file by drainage order. I can choose certain names that can enhance dictionary entries. During this pass I am able to make corrections in the place name records or make note of location changes. Using the program *AceText* (an open-ended clipboard), one technique is to go through about 50 names, copying some records into *AceText*. The following day, I can open the LT or Dena'ina files and decide where to add new place names. To narrow this down, I can search [..pn] in *EditPad* to see the place names that are already in the viable file.

High volume Dene lexicography also refers to work with expert speakers. Increasingly we cannot find strong speakers who can understand expert-level audio recordings. Some speakers are

very good at hearing different neighboring Dene dialects. In the three active *Lexware* files I put question flags in the files. I also prepare the next set of texts that I can spot-check. With Sally Hale (Tanacross) and Charlie Hubbard (Ahtna) we alternate between text review and dictionary file questions. The faster the pace of the session, the more enjoyable it is. For Charlie and Sally I take notes in an *EditPad* file, writing new words or sentences in their respective languages. This in-person field work requires preparation.

4. The Pedagogical Potential of the *Lexware* Format and Dene Band Labels

With three concurrent projects during 2017-2019 there is an opportunity to reflect on how Alaska Dene lexicography used to be done, and how it might be done. Funding for dictionary work should be cumulative, whereby small funding in one year can make significant improvements in the viable file. I tell people that what matters most is the long-term commitment to the language and its cumulative documentation.

In the past year I have demonstrated the use of *EditPad* and the unformatted Dena'ina or Lower Tanana *Lexware* files to varied groups (language community members, students or colleagues at UAF or Kenai Peninsula College (KPC) in Soldotna. I set up with a double monitor, a projector and screen, an auxiliary keyboard, and a laser pointer. All levels of the languages are on display in the cumulative files. The sessions have led to wide-ranging of questions on the language, the ethnography, or the lexicography process. Seeing pages of data in the band labels prompts both high-level and amateur-level language and computerization discussions. The integrated root-morpheme files show the logic of the band labels. The Dene languages are conservative, especially the verb themes. In principle, we should be able to account for every prefix in every Dena'ina verb form. Verb themes and strings that trigger aspects (like n-momentaneous or gh-momentaneous) are always cognate.

The Alaska Dene languages inform one another. In the current work, utilizing five Alaska Dene dictionaries in nearly identical band label formats, we can improve root groupings or subentries. Using features of *EditPad,* it is engaging to compare or to expand entries in one of the files. The folded-line headword files can be viewed on screens concurrently for three or four languages. Also, these folded lines files can be saved as pdf files, printed out, and compared with one another. These folded line files are useful as contrastive outlines, where policies for root groupings or for glossing the tag bands can be discussed.

As I show people the larger viable files, for example the Dena'ina file with over 80,000 lines, I point out that as the editor I try to monitor the content and style of the entire file. Sometimes I find I had accidently deleted 50 or more lines, perhaps a month ago. These can be retrieved from back-up files. I regularly view screens with 20 to 30 lines. I review all conventions, and the colored lines in *EditPad* are helpful. Spelling of words and word division policy should be accurate; punctuation and style of the Dena'ina and English translations can be consistent. *Lexware* allows for limitless subentries, so the placement of verb examples or lexical items can be continually refined. I try to maintain an efficient pace for editing sessions, whether it is transcribing texts or reviewing one of the dictionary files, often noting that I enjoy cultivating the primary sources on these languages.

The LT and Dena'ina active *Lexware* files are being distributed on a limited basis in two formats, unformatted and formatted. For Dena'ina I have shared versions of my unformatted *Lexware* file since the mid-2000s with various avid learners of the language. Alan Boraas at KPC

has made compilations of verb themes from those files. Advanced language learners benefit from searching through unformatted files and seeing the logic of the band labels. Example sentences can be used as reading practice. Strategies for ordering examples or excluding examples (for a learner's version) can be informative to the Dena'ina learners.

We are at a point where the lexicography process for Dene languages can be engaging and informative for basic-to-advanced learners or for scientific scholarship. There are indications that the Dene band label format offers some new opportunities for starter Dene dictionaries. Entries can be built up gradually based on groups of verb themes, or on vocabulary types such as anatomical terms or the directionals. We can find new ways to build collaborations on dictionaries. Researchers, speakers and learners can find roles that can merge while building the large cumulative dictionary file. A mix of scientific, educational and creative goals are possible. Various fields of study in science and the humanities may be able to benefit from congruent Dene dictionary files: biology, hydrology, ethnogeography, fisheries, archaeology, oral traditions, and more.

The cumulative file for the language in the Dene band label system is the centerpiece of the work for three languages. We have to scale our goals for the various Dene languages. Dena'ina has massive documentation with a growing language effort. Lower Tanana has a mid-size corpus. LT is a conservative language for stem-initial and stem-final consonant contrasts. The Toklat dialect of Lower Tanana is well documented and is being incorporated into the LT file. Middle Tanana is a small language upstream from Fairbanks. There are good sources for the last three speakers and the Salcha and Goodpaster dialects from 1964 to the 1990s. For both LT and MT we can display rare vocabulary and rare dialect forms and we can add example sentences from numerous texts. For MT, there has been no group of language learners, and a real language effort is not possible. LT has a larger potential user group, and it is possible to encourage a few persons who have the potential for advancing the LT language into the future. LT has various high level-texts that have yet to be transcribed.

For Dena'ina there is a growing language effort. This semester with the KIT group we discuss various dictionary entries and features and potential tasks. The challenge for Dena'ina into the future is for the cumulative Dena'ina root-morpheme file to become an increasingly accurate record of the Dena'ina dialects and narratives, while offering options for abridgement for learners. We can exclude many obscure entries and example sentences in a learners' version.

I emphasize efficiency in current dictionary sessions for three languages. However, we have the issue of having little opportunity for rigorous proofreading for any of the dated versions. The files can be expanded and refined, while various kinds of errors have not been attended to. A point of discussion becomes: when should we make a dated version of the dictionary file publicly available?

5. Updating *Lexware a*nd Developing Capacity for Dene Lexicography in Alaska

The current page formatting program is being supported by Tim Montler at the University of North Texas. We are working on congruent bands labels, font alternations, and abbreviations for Dena'ina, Lower Tanana and Middle Tanana. Tim has advised us that Bob Hsu's original conversion program that was written in the Spitbol programming language could be rewritten in a current programming language. Tim summarized his current conversion program in this December 28, 2018 email:

My typesetting program is totally different from the one Bob used for the Koyukon dictionary. Bob wrote ad hoc typesetting programs for over 50 Lexware dictionaries. The way Bob envisioned the use of *Lexware* was that the typesetting would be done once near the end of the project after the dictionary is complete. Intermediate printouts could be done using the LISTGEN or BANDPACK modules.

The way we have been doing it is different. My typesetting program has taken the place of LISTGEN and BANDPACK. A program to typeset a Lexware format dictionary could be written in any programming language. The typesetting could even be done entirely, though more tediously, in *EditPad* with regex search and replace. Because there will continue to be many typeset intermediate versions of your dictionaries, I think it would be good if Cam Webb or anyone else could write a script in some language other than Spitbol to do the typesetting. The reason for this is that there are not many Spitbol programmers around, and every small change you want to make in the band labels or their interpretations requires a change in the program. The base of the program we've been using is one that I have used for Colville-Okanagan, Alabama, Coeur d'Alene, Klallam and Saanich as well as the Dene languages. It has grown and changed over the years and has a lot built into it that is not used for the Dene dictionaries. A program written in some other widely used language, made specifically for your Dene dictionaries, would be simpler and more easily modified by other programmers.

In mid-December Campbell Webb, a botanist at the UAF Museum with extensive experience with text-based programming for botanical databases, came to a talk I gave at ANLC. Webb analyzed my Dene band label format in a short paper. Tim Montler shared the code for his conversion program with Cam and added comments to this paper. Here are some excerpts from Webb and Montler (2018):

Pros of the Lexware system

• Infinitely flexible! You are not limited by the software designer's choices about elements you want to record. You can create a data element simply by minting a new band label. With this flexibility, Jim has customized the generic use of bands (a.k.a. data "fields", or "columns") for Dene languages. The Gwich'in group now has a chance to build on this and add new elements for a Gwich'in dictionary (as we discussed). In addition, with some additional programming work one can invent new analyses and products.

• Also associated with plain-text data is ease of data entry. Once you know how to use an editing program, you can whiz around and edit/add data very fast. Most other dictionary programs would require many clicks to find the right "box" to type into.

• Perhaps the number one reason to use Lexware is *backward compatibility*: you can reuse and compare with Jim's files.

• The option for concurrent editing (see below). I guess that none of the existing desktop dictionary programs (above) permit this. You would have a single data file and have to send a master copy back and forth among collaborators, with the inconvenience and risks of data loss that this entails.

Cons

• Perhaps the number one issue is that there is no built-in validation with a plain-text file. If you misspell a band label or put something in the wrong order, you'll never know until the product comes out looking incomplete. This can be addressed by adding a stand-alone validator to the tool-chain... Tim's SPITBOL converter incorporates a validator.

• Currently the dependence on Tim for producing an output, whether a dictionary or an analysis, is of course a major con. Hopefully, this barrier to use will be lowered soon.

In 2019 we are exploring an update phase for Montler's conversion program with collaboration between ANLC and College of Rural and Community Development (CRCD). Also in May of 2019 I will teach a class "Introduction to Dene Lexicography" at UAF demonstrating features of the Dena'ina and Lower Tanana dictionary files.

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