# “Reconstructing the Traditional Koyukon Athabascan Calendar”

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**S0. Abstract**.

The traditional luni-solar calendar of the Koyukon Athabascan native people of Alaska can be largely reconstructed from a careful correlation of temporal references in the “Koyukon Athabaskan Dictionary”. The calendar is typical of Native American calendars generally, but offers greater flexibility for intercalation. It is speculated that calendric flexibility may be a high-latitude adaptation to the greater difficulty of winter solstice observation and the importance of accurately timing fishing efforts during the summer months.

**S1. Introduction**.

The traditional calendars of the Native peoples of Alaska have received little attention in the literature. The omission is particularly notable in the area of technical chronology and structural analysis of calendric systems. The literature that does exist has tended to focus on material such as linguistics and mythology that are peripheral to technical structural analysis of the calendars (e.g., [Jetté and Jones 2000], [Axlerod 1993]).

This omission is unfortunate, since the calendar is the conceptual framework that organizes religious ceremony and ritual activity and connects external events to cosmology and religious belief. As the budding field of archaeoastronomy has demonstrated over the past several decades, calendric information strongly influences the structure of monumental architecture, cities, and public works of art in many societies. Wars, regnal successions and other political events are also regulated by calendric structure in some traditional societies.

The Native peoples of Alaska possessed traditional calendars before the arrival of Europeans, and retained them with varying degrees of success in the following centuries. Knowledge of the traditional calendars has almost entirely disappeared among Alaskan Native peoples, for two primary reasons: (a) aggressive proselytizing and conversion by Christian missionaries of various persuasions and (b) massive death tolls from introduced diseases that negatively impacted the social fabric of many Native societies (e.g., [Barry 2004]).

Fortunately for the purposes of scholarship and the recovery of the structure of the traditional calendar, in the case of the Koyukon Athabascan peoples a valuable resource exists in the form of the “Koyukon Athabaskan Dictionary” [Jetté and Jones 2000], a careful compilation by Eliza Jones based on the seven-volume manuscript notes of French Canadian Father Jules Jetté S.J. (1864-1927). Jetté worked in Alaska from 1898 until his death, making copious notes and sketches. His work thus spans a time when Alaskan Native peoples had already been exposed to European cultural influences for well over a century, but still retained much of the traditional language and social structure. Traditional calendars, however, were everywhere recognized by Christian missionaries as key supports of traditional life styles; Jetté’s work spans a period when Alaskan Native traditional calendars were being systematically and aggressively eliminated and replaced by European calendars.

A careful reading of the Dictionary (as we refer to [Jetté and Jones 2000] hereafter) reveals that a number of the entries are related to temporal entities and relationships. The entries concerning months and additional auxiliary information about the relations between months can be extracted from the work and collated in chronological order. Using computer software specifically written for the purpose, it is then possible to demonstrate how the traditional calendar functioned under the rules defined.

## S2. Calendric background.

This section briefly discusses the need for calendric information within nomadic hunter / gatherer societies, and supplies basic background information for luni-solar calendars.

### S2.1. Calendric information in nomadic societies.

An oft-accepted model for the origins of calendric knowledge is the 'hieratic city-state' (e.g., [Campbell 1969]), which assumes the existence of agriculture and geographically fixed communities as a necessary prerequisite to the evolutionary development of calendars.

Such a model entirely ignores the fact that nomadic hunting and gathering societies have a great need to know about the rhythms of prey-animal behavior, the annual returns of migratory fowl, and the seasonal availability of fish, berries, eggs, nuts and other food resources. Hunters must know the time of year with accuracy in order to plan long-range hunts, and to avoid being trapped by winter storms. If anything, hunter/gatherer societies have an even greater need for calendrically related information, since their food resources vary significantly over the course of the year, with many having an availability period measured in days.

### S2.2. Luni-solar calendars.

Calendric systems are commonly divided into a number of categories. One of the most common categories is the **luni-solar** calendar, which makes use of both apparent lunar and solar motion to define a calendar. Luni-solar calendars are obvious choices for dividing time into months by the moon and into years by the sun, using the two most obvious and visible celestial bodies. Not surprisingly, such calendars are a frequent choice among small-scale societies.

Use of these natural celestial markers comes at a price, however. The length of the solar year is not a simple integer multiple of the length of the lunar month, with the inevitable consequence that a year composed of lunar months is either too short or too long, compared to the year measured by the sun. Some scheme for 'balancing the books' is required, since virtually all societies must know the relative time of year in order to conduct many essential activities.

In this discussion, specific values will be used for the length of the solar year (SY) and the **synodic lunar period** SLP), which is the amount of time that the moon, viewed by an observer at a location on earth, requires to return to the same phase. The SLP is the length of the lunar month, for calendric purposes.

The length of the solar year has different values according to the definition employed, and the event used to mark the length. This discussion uses the common value of 365.2422 days, which is the current average length of the year as measured from one vernal equinox to the next. The average length of the synodic lunar period is known to be 29.530588 days. Both of these values are known to change slowly over the course of centuries.

Thus, one has the following lengths for solar year and lunar month:

SY = 365.2422 days
SLP = 29.530588 days

One immediate consequence of these values is that a year of twelve lunar months has an average length of:

LY = 12 * 29.530588 = 354.3671 days

leaving a lunar year short of a solar year by approximately:

SY – LY = 365.2422 – 354.3671 = 10.8751 days.

This discussion uses the notation ‘lunar-solar difference’ (LSD) to signify the shortfall and its sign, by calculating:

LSD = (LY – SY) = (- 10.88 days)

Every year of operation of a luni-solar calendar thus accumulates an LSD; in the first year, the shortfall is roughly 11 days, in the second year, roughly 22 days, in the third year roughly 32 and a half days, and so on. Clearly, if one both wishes to use lunar months and to plan events in the solar year, the LSD must be known and accounted for. Every society that uses a luni-solar calendar encounters this same situation.

Historically, a number of schemes have been developed to “balance the books” between lunar months and solar years. A common and generally workable method involves observation of solstice dates, and the tallying of the LSD as a discrepancy in days. When the LSD exceeds the length of a month, commonly taken as thirty days, a month is intercalated. Owing to the mathematics of apparent lunar and solar motion, such a scheme can easily evolve into an octennial schematic pattern known as the octaëteris or ogdoas. Arithmetic schemes such as those used in Babylon by the fourth century B.C. can lead to the use of longer periods, such as the “Metonic” cycle that equates 19 solar years with 235 lunar months, a “Kallippic” cycle of 76 years, and so on. Luni-solar calendars such as the Jewish and Chinese calendars, that are retained and developed over a period of centuries, typically become rather complex in structure and operation.

The Koyukon appear to have elected a different course, well adapted to their particular environmental circumstances.

**S3. Traditional month names and order**.

Several different names were typically in use for each month. Some differences are due to the existence of different dialects in various areas, while others may be attributable to the introduction by Europeans of the Orthodox (Julian) calendar and later, the Gregorian calendar.

The information gathered in the Dictionary concerning traditional month names is presented in Table 1 below. Note that, for simplicity, diacritical marks are not used with the month names. Page numbers, unless otherwise noted, refer to the Dictionary in the table and following text.

Table 1.

| Traditional Month Number | Dictionary Page Number | Traditional Month Name |
|---|---|---|
| 1 | 470 | Benenh Nots’eghededeyhlee |
| | 502 | Benenh Taah K’enet’oye |
| | | Benenh Taah Hool’one |
| | | Benenh Tahh Hulege |
| 2 | 27 | Menenh Tleeteey Hehl’eey |
| | 164 | Benenh Neelkk’aadzaanhyedelaayee |
| | | Benenh Neelts’aanodzaanhdelaayee |
| | | Neelkk’aa Nodzaanh’eelkegee |
| 3 | 416 | Tele Zo’u |
| | 671 | Elts’eeyh Zo’u (obsolete) |

| | | |
|---|---|---|
| 4 | 353 | Kk’olkk’eey Zo’u |
| 5 | 198 | Ggaagge Zo’u |
| | 510 | Hutenh Zo’u |
| | 664 | Dets’en Zo’u |
| 6 | 113 | Benenh Loo Tedaaghee |
| | 401 | Menenh Tohudelegee |
| | 470 | Benenh Loo Tedaaghee |
| 7 | 658 | Benenh Tots’eeyhleyaayee |
| 8 | 470 | Benenh K’et’on’ Nelyaaghee |
| | | Menenh K’et’on’ Nelyaayee |
| | 1 | Benenh K’et’on’ Nelyaaghee |
| | | Menenh K’et’on’ Nelyaayee |
| 9 | 199 | Ggaal Zo’u |
| | | Ggaal Noghe’ |
| 10 | 381 | Noolaaghe Noghe’ |
| | | Noolaaghe Zo’u |
| 11 | 381 | Saanlaagh Noghe’ |
| | | Saanlaagh Zo’u |
| 12 | 381 | Noldlaagh Noghe’ |
| | | Noldlaagh Zo’u |
| 13 | 420 | Huyts’en’ Lookk’e Noghe’ |
| 14 | 511 | Benenh Dedeteeyee |
| | 596 | Benenh Totl’eetl-‘edeghee |
| 15 | 378 | Benenh K’ets’ooneelaa’ee |
| | 467 | Menenh Yoonle Sedeyhdle |
| | 746 | Sooge Zo’ |
| 16 | 280 | Benenh Haal Rtl’ok’eghelyaaghee |

**S4. Calendar structure according to the entries.**

The structure of the traditional calendar, as revealed by the entries, can be analyzed by information category.

**S4.1. Number of months.**

Several of the entries attributed to Jetté describe the traditional calendar as having sixteen months in a “cycle” (page 378) or “Ten’a series” (page 664). The term “Ten’a” is synonymous with “Koyukon”.

**S4.2. Definition of months.**

The traditional months are repeatedly described as “lunar”, implying that lunar phase is the basis for the definition of a month. Such a definition is entirely consistent with Native American practice.

No single entry defines a lunar month, but an entry by Jetté on page 658 strongly implies that the Koyukon Athabascan peoples followed the traditionally accepted practice of Native American peoples by defining a lunar month as the period between two new moons. In that entry, Jetté notes:

**"But when a new moon occurs between the breaking of the river and the launching of the canoes, both the 6th and 7th month are used."**

The statement clearly indicates that a sixth month is intercalated, if a new moon occurs between the time of the breakup of the Yukon River and the time, normally about two weeks later, that canoes are first launched onto the river. An intercalated month therefore begins with the intervening new moon, and since intercalary months do not otherwise differ from common months, one may conclude with almost complete certainty that all months are defined as beginning with a new moon. Such a practice is, again, entirely consistent with Native American practice generally.

### S4.3. Intercalation.

Of the sixteen months, the second, sixth, eleventh and sixteenth of the series are described by Jetté as "embolismal", meaning "embolismic" or "intercalary". The term distinguishes those months that can be intercalated in some years, according to need or schematic arrangement, from "common" or "ordinary" months that are recognized and counted in every year.

The Koyukon Athabascan peoples thus possessed an interesting scheme for intercalation that permitted the insertion of an intercalary month at four specific points during the year, conferring an unusual degree of flexibility in adjusting the calendar to external events.

### S4.4. Definition of the day.

No entry in the Dictionary appears to indicate the basis for a definition of the day. The fact, however, that the new moon almost certainly defines the beginning of a month implies that the visibility of the first lunar crescent was used to define the start of a new month.

It is relatively certain also that the traditional calendar was observational, not schematic. That is, the counting of days of the calendar month depended upon the actual physical observation of the first crescent, and not upon the inference of a beginning date based upon calculation of average month length. Such practice is, again, generally consistent with Native American practice.

Since the best time of day to view the first crescent is early evening at sunset, virtually all societies that define lunar months by first visibility of the lunar crescent also then define the day as ending at sunset, and thus start the following day at sunset.

It should be emphasized that such a conclusion is speculative. Other schemes are possible. One confidently may eliminate arrangements that depend upon the retention and use of observational records over long periods of time as inconsistent with the requirements of a mobile population. Native peoples at high latitudes, however, are known to make use of knowledge of stellar positions to determine both time of year and time of day (**vide**, e.g. [MacDonald 2000]). Definition of the day does not, in any event, critically affect conclusions concerning the traditional Koyukon calendar.

### S4.5. Month order and calendar structure.

Several entries by Jetté indicate that the first month of the year was defined as the month that contains the winter solstice. This definition is also consistent with Native American practice generally.

Since it is possible to calculate accurately the times of new moons and winter solstices, this last clue from Jetté completes the necessary set of information required to produce an outline structure of the traditional calendar that indicates the dates of the first month, the dates of all subsequent months, and the total number of months in the year. Thus, this information is sufficient to indicate whether a given year should contain an intercalary month, and thus whether the year is common or embolismic.

This information is not, however, sufficient to definitively identify the embolismic month that is intercalated in a given year requiring intercalation. For that purpose, knowledge of the set of rules governing the intercalation of months is required.

### S4.6. Role and significance of intercalary months.

Common practice with luni-solar calendars is to add a "second" named month, typically in the same relative position; with the consequence that intercalation always occurs at the same relative point in the annual cycle. Koyukon Athabascan practice, however, differs by defining four separate points at which intercalation can occur.

The Dictionary entries unfortunately describe only the intercalation rule for the sixth month, leaving the rules for months two, eleven and sixteen unattested. The auxiliary information supplied by Jetté, however, coupled with knowledge of general calendric practice and logical deduction, permits an understanding of the rules that were probably in operation.

#### S4.6.1. Months two and sixteen.

For month two, Jetté notes that the natives remained in winter quarters for a period of time after the winter solstice, and then resumed outdoor activities. Specifically, he notes about the second month (page 27) that,

**"Month of the return to outdoor life. Second in the cycle, and embolismal … After the midwinter celebrations [during solstice], the natives linger in their winter villages for a short time, and resume their nomadic existence. This is done or begun, during the latter part of January and the beginning of February."**

On page 164 of the Dictionary, one finds a more detailed discussion of the significance of the month name, which literally means "the month in which the days are separated". Jetté provides a short discussion of the possible meaning of the name. He concludes that the original meaning is "parted", and that the second month is "the month containing the dividing point between shortening and lengthening days". Clearly, however, that conclusion is incorrect since the winter solstice falls in the first month, not the second. One is left to conclude that either the second month was the month containing the solstice at some point in the past, or that some other "parting" is intended. Jetté's description of the month indicates that the days in the second month are separated from those of the first month by the resumption of outdoor activity, which may be the separation of days intended.

The single entry for the sixteenth month contains the short note by Jetté (page 280) stating, "Month of the interruption in trapping. Embolismal, 16$^{th}$ and last in the series … Natives claim that during this moon the marten does not take the bait: it comes to the trap, walks around it, dungs there, but does not go into it." No rule for intercalation is given.

Since the year begins with the month containing the winter solstice, proper calendric function clearly requires that the first month be defined correctly. Since the sun may not be easily visible at the time of the winter solstice at high latitudes, a correct definition of the first month is more problematic than it is in more temperate climes. It is important to note that two of the four embolismic months bracket the critical first month, where they are ideal for introducing an adjustment into the calendar to align the first month with the winter solstice. One cannot state with certainty that the positioning of months two and sixteen as

embolismic months is due solely to this consideration, but these two months are situated exactly where they need to be, bracketing the first month, in order to solve a calendric problem introduced by high latitude.

### S4.6.2. Month six.

The Koyukon Athabascan traditional calendar has many of the features described for an "ecological" calendar (e.g., [Aveni 2002]); i.e., one that depends upon certain environmental features for certain of its rules of operation. In common with North American Native practice generally, the Koyukon Athabascan calendar months are named for activities or animals that are important to the survival of the society. Food items are a typical primary concern in that respect, and Koyukon practice is consistent with that pattern.

A major food source for the Koyukon traditional culture is fish. Much of the year's activities revolve around access to fish, preparation for fishing, fishing, and the preparation of dried fish for consumption during the winter. Thus, signal events in the Koyukon year are the breakup of ice on the Yukon River, and the sequence of fish, primarily salmon, that are available during the months of summer and early autumn. These months are each named for a specific variety of fish that is available during the month.

The Dictionary entry for the seventh month includes the following commentary by Jetté, defining the intercalation rule for the sixth month:

**"The seventh month of the cycle. The name, as far as its significance goes, could be applied to the Menenh Tohudelegee, because of the thawing, the breaking of the river, and the launching of canoes follow closely upon each other. When they actually take place during the same moon, this is called Benenh Tots'eeyhleyaayee and the embolismal 6th is omitted. But when a new moon occurs between the breaking of the river and the launching of the canoes, both the 6th and 7th month are used."**

The intercalation rule for the sixth month is therefore stated quite simply. Breakup of the Yukon River, which usually occurs between 7 May and 27 May (Gregorian, e.g., page 470), is one event, and the launching of the canoes for the first time for the year is another. If the two events occur within the same lunar month, then that month is accounted as the seventh month, and the sixth month is omitted. If a new moon should occur between the two events, however, then the month containing breakup is accounted as the sixth month, and the month containing the canoe launching is taken as the seventh month, thereby introducing the sixth month as an intercalary month.

Thus the third of the intercalary months to be discussed is positioned at another critical point, the start of the all-important fishing season, making possible the proper synchronization of the named fishing months with the expected catch in each month. Clearly, however, this intercalation could only occur in years that contain thirteen months; this intercalation cannot have been performed using only the stated rule, without risking subsequent incorrect operation of the calendar.

### S4.6.3. Month eleven.

Of the eleventh month, Jetté merely notes, "Eleventh in the series of 16: it is embolismal and only used when an intercalary month is needed during the summer season." No rule is given for the intercalation.

One may surmise, however, that a perceived need for intercalation would have arisen if the named months were obviously not synchronized with the predominant fish catch during the named months. Since intercalation requires an insertion, intercalation of an eleventh month could only have had a positive calendric effect if the named months were running behind the catch, and the most likely immediate cause for such a situation would be an "early" new moon in May, causing the sixth month not to be intercalated.

The eleventh month is thus positioned nearer to the end of the critical fishing season.

**S4.6.4. Conclusions about intercalary months.**

Together, the sixth and eleventh months bracket the critical fishing season, just as the sixteenth and second months bracket the calendrically critical period around the winter solstice. The strong suggestion is that the Koyukon Athabascan calendar possesses "ecological" features that are designed to support the goal of human survival by adjusting the calendar to synchronize named months with the associated critical activities.

In effect, the intercalation scheme adopted reduces the risk of a damagingly incorrect calendar by providing multiple possible intercalation points, thus reducing the probability of damage caused by an incorrect assignment. The Koyukon culture appears therefore to demand both flexibility and accuracy from its calendar, and this demand is met by providing multiple correction points. Intercalation is introduced as a possibility precisely at the two times during the year when error is either most likely to occur (around the winter solstice), or is least acceptable in terms of its consequences (fishing season).

**S5. General correspondence of Koyukon and Gregorian calendars.**

It should be clear that lunar months do not respect solar seasons; no constraint operates to closely match a lunar month to a given Gregorian month, which is merely a named section of the solar year. Any synchronization between the two types of month is therefore very rough, and can easily vary by more than twenty days. An observation of correspondence in one year will almost certainly not apply in the following year. If one considers multiple years and determines an average behavior, however, then it is possible to establish some approximate correlations.

The following table summarizes the Dictionary entries that concern the Gregorian equivalents of Koyukon lunar months.

Table 2.

| Traditional Month Number | Dictionary Page Number | Equivalent Period in Gregorian Calendar |
|---|---|---|
| 1 | 470 | "includes the winter solstice" |
| | 502 | around December |
| 2 | 27 | around January-February |
| | | "latter part of January and the beginning of February" |
| 3 | 416 | February in the modern calendar |
| | 671 | "about late January through February" |
| | | "the moon which begins after the winter solstice, and partly to January" |
| 4 | 353 | March in the modern calendar |
| 5 | 198 | April in the modern calendar |
| | | "this month does not reach as far as April 28th" |
| | 510 | April in the modern calendar |
| | 664 | April in the modern calendar |
| 6 | 113 | around May |
| | 401 | around mid-May |
| | 470 | around May |
| 7 | 658 | May in the modern calendar |

| | | |
|---|---|---|
| 8 | 470 | late May, June |
| 9 | 199 | June in the modern calendar<br>"king salmon month" |
| 10 | 381 | July in the modern calendar<br>"dog salmon month" |
| 11 | 381 | August in the modern calendar<br>"month of the silver salmon" |
| 12 | 381 | September in the modern calendar<br>"fall salmon month"<br>"begins in our August, and ends in September" |
| 13 | 420 | September in the modern calendar<br>"fall fish (whitefish) month" |
| 14 | 511 | October in the modern calendar<br>"nearly corresponds to October"<br>contains freezing of Yukon River (12 Oct – 12 Nov) |
| | 596 | October in the modern calendar |
| 15 | 378 | around November<br>"corresponding nearly to November" |
| | 467 | "late-November-early-December" |
| | 746 | November in the modern calendar<br>"generally corresponds to the latter part of October<br>… and the greater part of November" |
| 16 | 280 | "early December" |

Table 2 illustrates the difficulty of attempting a close correlation between the Koyukon and Gregorian calendars that is a reflection of the difficulty of attempting a correlation of months in a luni-solar calendar with the months of a solar calendar in general.

One observation worthy of note from the table is some evident confusion regarding the position of month 2. The only reason that a second month might be intercalated would be the occurrence of a winter solstice very late in month 1, causing the new year to "start short". In such a case, however, an intercalated month 2 would necessarily include the latter part of December and the first part of January.

**S5.1. Additional evidence for intercalation.**

Additional evidence, if any were needed, that the Koyukon calendar operated with intercalation at different points is provided by several auxiliary notes for entries.

Regarding month five, Jones comments (page 199) that, "Ggaagge Zo' is one of the months Jetté has attributed to more than one position in the Koyukon calendar. In some instances he mentioned that Ggaagge Zo' / Dets'en' Zo' were the 4$^{th}$ month, instead of the 5$^{th}$ month."

Clearly, if the second month were intercalary, then month five can be either the fourth month of an ordinary year, or the fifth month of an embolismic year in which the second month is intercalated. Month five can also be the fourth month of an embolismic year in which intercalation occurs after month five, i.e., in which month six, eleven or sixteen is intercalated. There is no necessity to assume an error or inconsistency in the account of Jetté, or in the Dictionary.

**S5.2. Lack of close calendric synchronization**.

Review of Table 2 confirms that correspondence between lunar and Gregorian months is only general. Month five, for example, does not extend to the time of the return of migratory fowl to Alaska, and can thus include early May. Months six and seven are both listed as corresponding to May, while month eight is also listed as including "late May". Thus, no fewer than four lunar months are associated with the month of May in the Gregorian calendar.

A similar situation is observed for the latter part of the year. Two months are described as "September", while "August" is associated with a month that is intercalary and thus used only occasionally. Month fifteen is described in separate entries as both October-November and November-December.

These seeming vagaries are not the consequence of careless scholarship, but are simply the consequence of attempting month matching between two calendars that operate by completely different rules. It is important, therefore, to resist the temptation to employ the Gregorian calendar as a temporal organizer for a calendar that does not obey a related rule set.

**S6. Sample operation of the Koyukon calendar.**

In this section, the operation of the traditional Koyukon calendar is demonstrated for modern dates.

The starting point for this section is a list of dates for new moons. In this discussion, a time period from the end of A.D. 1999 to the end of A.D. 2005 is used, with new moon dates calculated by software [Latham 1998] that essentially reproduces the lunar phase calculations of [Goldstine 1973]. Dates and times are given in terms of Universal Coordinated Time (UTC), and are not adjusted for the longitude of Alaska. The calculations simply supply a source of **bona fide** new moon dates in the Gregorian calendar that illustrates the operation of the Koyukon calendar for a series of new moon dates. Any legitimate series of lunar phase dates would serve as well for the purpose.

In the following table, the following conventions are employed:

(a) intercalary months are denoted by an asterisk (*).
(b) the winter solstice is denoted by 'WS'.

Table 3.

| New Moon Date (Year-Month-Day) | Koyukon Traditional Lunar Month Number Ends | Begins | Comments |
|---|---|---|---|
| 1999-12-07 | <15 or 16> | 1 | <- WS in this month |
| 2000-01-06 | 1 | 3 | |
| 2000-02-05 | 3 | 4 | |
| 2000-03-06 | 4 | 5 | |
| 2000-04-04 | 5 | 7 | |
| 2000-05-04 | 7 | 8 | |
| 2000-06-02 | 8 | 9 | |
| 2000-07-01 | 9 | 10 | |
| 2000-07-31 | 10 | 12 | |
| 2000-08-29 | 12 | 13 | |
| 2000-09-27 | 13 | 14 | |
| 2000-10-27 | 14 | 15 | |
| 2000-11-25 | 15 | 1 | <- WS late in this month |
| 2000-12-25 | 1 | 2 * | <- due to early start of month 1 |
| 2001-01-24 | 2 | 3 | |
| 2001-02-23 | 3 | 4 | |
| 2001-03-25 | 4 | 5 | |
| 2001-04-23 | 5 | 7 | |
| 2001-05-23 | 7 | 8 | |
| 2001-06-21 | 8 | 9 | |
| 2001-07-20 | 9 | 10 | |

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2001-08-19           10          12
2001-09-17           12          13
2001-10-16           13          14
2001-11-15           14          15
2001-12-14           15           1   <- WS in this month
2002-01-13            1           3
2002-02-12            3           4
2002-03-14            4           5
2002-04-12            5           7
2002-05-12            7           8
2002-06-10            8           9
2002-07-10            9          10
2002-08-08           10          12
2002-09-07           12          13
2002-10-06           13          14
2002-11-04           14          15
2002-12-04           15           1   <- WS in this month
2003-01-02            1           3
2003-02-01            3           4
2003-03-03            4           5
2003-04-01            5           7
2003-05-01            7           8
2003-05-31            8           9
2003-06-29            9          10
2003-07-29           10          12
2003-08-27           12          13
2003-09-26           13          14
2003-10-25           14          15
2003-11-23           15           1   <- WS late in this month
2003-12-23            1           2 * <- due to early start of month 1
2004-01-21            2           3
2004-02-20            3           4
2004-03-20            4           5
2004-04-19            5           7
2004-05-19            7           8
2004-06-17            8           9
2004-07-17            9          10
2004-08-16           10          12
2004-09-14           12          13
2004-10-14           13          14
2004-11-12           14          15
2004-12-12           15           1   <- WS in this month
2005-01-10            1           3
2005-02-08            3           4
2005-03-10            4           5
2005-04-08            5           7
2005-05-08            7           8
2005-06-06            8           9
2005-07-06            9          10
2005-08-05           10          12
2005-09-03           12          13
2005-10-03           13          14
2005-11-02           14          15
2005-12-01           15           1   <- WS in this month
2005-12-31            1        <2 or 3>
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**S7. Conclusions.**

Table 3 is a construction that illustrates how the traditional Koyukon calendar might have operated over a typical sample period of six years. This reconstruction should be viewed with some caution, for three reasons.

(a) the intercalation rules are not given in most cases, but must be inferred by deduction from known calendric principles, and the application of logic,

(b) the calendar is known to incorporate environmental factors, and is designed to explicitly permit adjustment,

(c) the reconstruction does not exercise all of the intercalation rules.

With these caveats, however, one may draw certain conclusions regarding the calendar and the proposed reconstruction.

First, the operation of the calendar is predictably smooth and does not require constant tampering to ensure operation. In the six year period shown, two intercalations are required, yielding the expected average of one intercalation every three years. The intercalations are, moreover, structural in nature and easily made on the basis of observation.

Second, the calendar generally satisfies the objectives that are claimed for it, which are the proper start of the year at the winter solstice and the correlation of named months during the fishing season. For every year in Table 3, for example, the ninth month includes a large portion of the month of June and the fourteenth month includes a large portion of the period between the stated dates (12 October to 12 November) for the freezing of the Yukon River.

Third, as noted previously, the statement that the eleventh month corresponds to August and is "silver salmon month" is anomalous. The eleventh month is intercalary, and thus cannot occur in every year. It is possible that additional "ecological" rules were in place that permitted finer adjustments during the summer months, but the Dictionary does not appear to contain a record of them. Recovery of additional calendric information from Native informants may be possible, once the importance of analysis of calendric structure is understood.

Fourth, the reconstruction and the associated methodology demonstrate that technical chronology can play a role in recovering knowledge that may have been considered irretrievably lost, even for calendars that are not schematic and that are unsupported by written evidence from the originating culture itself.

**S8. References.**


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