A phonetic investigation of Flathead Salish

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LING 410

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1. Introduction

1.1. Overview

The following paper details the findings of a general phonetic investigation of the Flathead Salish language conducted over the course of four months during the 2024 Fall semester. Over 200 audio recordings were collected with our language consultant, a heritage speaker of Flathead Salish, and were organized and analyzed in order to gain insight into the phonetic inventory, suprasegmental features, and other deeper linguistic characteristics of the language. Thus, the topics discussed in this paper include the background of Flathead Salish and a description of our language consultant, characteristics of observed consonants and vowels, a description of one suprasegmental feature, and deeper analyses of obstruent clusters and prosody in Flathead Salish.

1.2. Language background

Flathead Salish (ISO 639 code: [FLA]) is one of approximately 27 languages housed under the umbrella of the Salishan language family, which is a group of Indigenous languages used throughout the Pacific Northwest (Ethnologue, 2024). Flathead Salish is an Interior Salishan language spoken on the Flathead Reservation in what is now known as Northwest Montana, as opposed to Coastal variations of Salish spoken in modern-day Oregon and Washington, or the nuχalk (Bella Coola) variation found in British Columbia, Canada. It is generally agreed that three highly similar variations of Southern Interior Salish are spoken in this area—npoqínišcn (Spokane), qlispé (Kalispel), and séliš (Bitterroot Salish) (Ethnologue, 2024). The specific variation of Salish addressed in this paper is referred to by a number of names, including Kalispel-Pend d'Oreille, Bitterroot Salish, Salish Qlispel, Flathead Salish, Montana

Salish, and more generally, Salish or séliš by its own speakers (ELP, n.d.). Our language consultant described his dialect as a "mix of qlispé and Bitterroot Salish" and recommended the name Flathead Salish to emphasize its connection to the place it is spoken; thus, we will refer to the language focused on in this investigation as Flathead Salish to avoid confusion with the wider language family and other similar but distinct Salishan dialects.

Current and accurate records of the number of fluent speakers of Flathead Salish are difficult to find, but estimates generally range from approximately seven speakers (our language consultant, 2024), to 40 speakers (Flemming et al., 2008), to up to 70 speakers (ELP, n.d.). While the majority of fluent, daily speakers of Flathead Salish are over 60, ongoing revitalization efforts have been made to reconnect younger generations to the language and cultural significance of Flathead Salish, such as through the establishment of the Nk̓ʷusm Salish Language School in Arlee, Montana, in 2002 (Nk̓ʷusm, 2023).

1.3. Consultant background

The language consultant for this project was Snpaqsin Morigeau, a 19-year-old undergraduate student at the University of Hawai‘i at Mānoa and heritage speaker of Flathead Salish. Snpaqsin spent his early years on the Flathead Reservation, and was exposed to Flathead Salish through his interactions with his grandmother, Atél (a fluent speaker), and during his attendance at the Nk̓ʷusm Salish Immersion School from ages two to five. At age five, he moved off the reservation to Missoula, Montana, and lost much of his exposure to Flathead Salish. When he entered high school, he began self-studying the language again, and plans to return to the Flathead Reservation to take Salish language classes at the Salish Kootenai College after he graduates. We met with our consultant weekly over the course of six weeks to record 207 words based on Swadesh (1957), plus a few additional words that contained sounds not well-represented in the original 207 word list.

2. Consonants

		bilabial	alveolar	post alveolar	palatal	velar		uvular		glottal
						plain	labial	plain	labial	
plosive	plain	p	t				kʷ	q	qʷ	ʔ
	ejective	pʼ	tʼ				kʷʼ	qʼ	qʷʼ	
nasal	plain	m	n							
	glottalized	ʔm	ʔn							
fricative			s	ʃ		x	xʷ	χ	χʷ	h
affricate	plain		t͡s	t͡ʃ						
	ejective		t͡sʼ	t͡ʃʼ						
alveolar lateral affricate	ejective		t͡ɬʼ							
lateral fricative			ɬ							
lateral approximant	plain		l							
	glottalized		ʔl							
approximant	plain				j		w			
	glottalized				ʔj		ʔw			

Table 1: Consonant inventory of Flathead Salish. In red: sounds noted in the literature but not observed in our recordings.

Table 1 represents the 34 consonants of Flathead Salish, including 32 consonants observed in our own recordings, along with two additional consonants (marked in red) that are described in other studies concerning Flathead Salish phonetics (see **Section 2.2. Glottalization**), but were not found in our data. This rather large, unwieldy consonant chart is the result of our attempts to visually represent the various possible realizations of the 18 "plain" consonants of Flathead Salish: /p/ /t/ /m/ /n/ /s/ /ʃ/ /t͡ʃ/ /t͡s/ /ɬ/ /l/ /j/ /w/ /x/ /χ/ /h/ /k/ /q/ and /ʔ/. All of these consonants (with the exception of the post-alveolar fricative /ʃ/ and glottal sounds /h/ and /ʔ/) are able to undergo at least one change in their articulation process that results in a new, distinct phoneme—these secondary articulations include labialization ("labial"), glottalization ("glottalized") and change in airstream mechanism ("ejective"), and are described in detail in the sections below.

2.1. Labialization

In Flathead Salish, the voiceless velar stop and fricative /k/ and /x/, along with the voiceless uvular stop and fricative /q/ and /χ/ appear to be able to undergo a secondary articulation process known as labialization, in which the lips become rounded during production. These labialized consonants can be found in word-initial, intervocalic, and final positions, but the word-final /xʷ/ appears to be quite common, occurring in over a dozen words in our recording list. As described by Flemming et al. (2008), "labialized consonants are marked by low F2 at release, resulting in a [w]-like onglide into a following unrounded vowel" (p. 469). This effect was visible in our own recordings containing labialized consonants, such as the upward glide of F2 before the productions of /ɛ/ in **[xʷɛʔxʷɛjutʰ]** 'animal' (see *Fig. 1*), resulting in initial confusion as we attempted to transcribe this effect as /wɛ/, or perhaps as the diphthong /ʊɛ/. Instances of the previously mentioned word-final /xʷ/ also caused confusion as the anticipatory rounding of the lips brought down the F2 of the preceding vowel, resulting in what initially sounded like the diphthong /ɛʊ/ in the word **[t͡ʃɛxʷ]** 'dry' (see *Fig. 2*). The implications of labialization on surrounding vowels is discussed further in **Section 4.2. Diphthongs**.

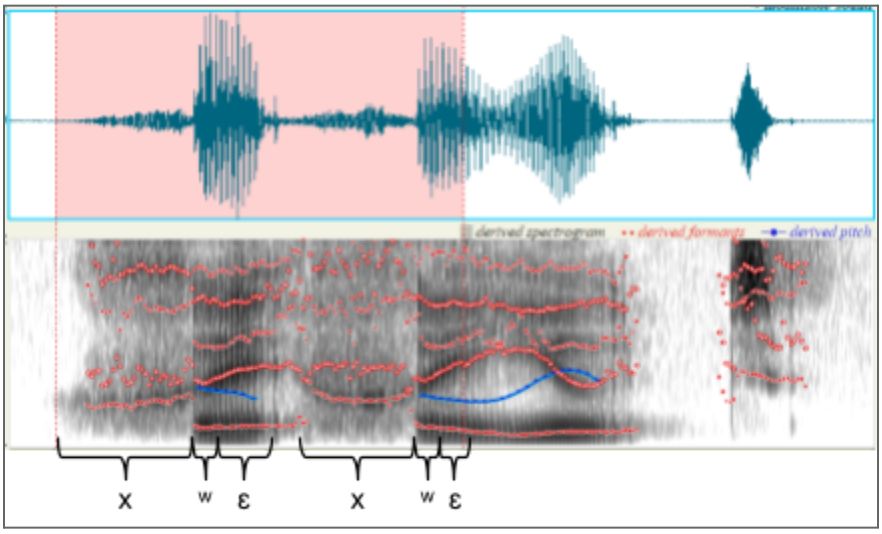

Figure 1: The word [xʷɛʔxʷɛjutʰ] 'animal' visualized in an oscillogram (top) and spectrogram (bottom). Two productions of the labialized /xʷ/, along with its F2 lowering effect on the following unrounded /ɛ/ sound can be seen.

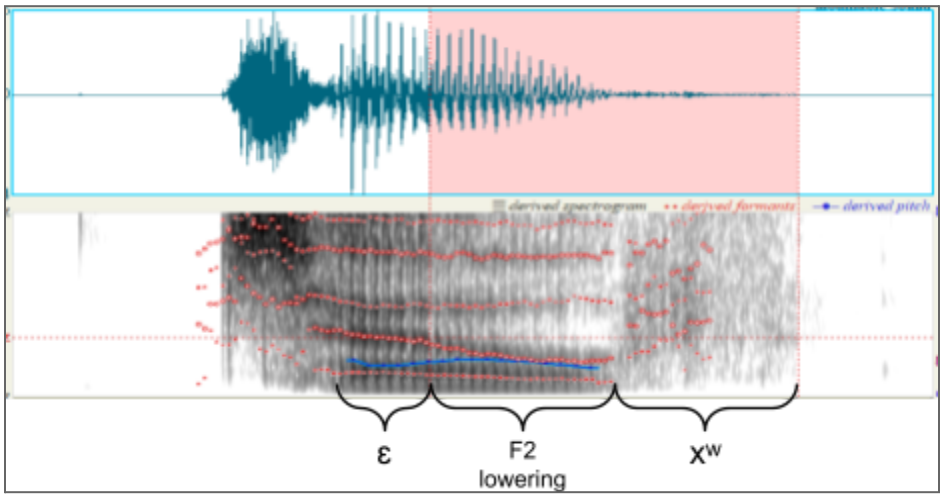

Figure 2: The word [t͡ʃɛxʷ] 'dry' visualized in an oscillogram (top) and spectrogram (bottom). The dramatic F2 lowering effect of the word-final labialized voiceless velar fricative /xʷ/ on the preceding /ɛ/ is visible, resulting in the auditory and visual illusion of the diphthong /ɛʊ/.

2.2. Glottalization

The sonorants of Flathead Salish, /m/ /n/ /l/ /j/ and /w/, appear able to undergo a secondary articulatory process called glottalization, in which the glottis momentarily constricts or closes during the production of a normally modal sound. This glottalization effect was subtle enough that it was initially passed over during our recording sessions, until our language consultant pointed out the difference between plain and "hard" sonorants in both Flathead Salish's written orthography and in pronunciation. Upon a review of the literature, it has become apparent that glottalization in Flathead Salish is most commonly realized as pre-glottalized sonorants, which are listed as /ˀm/ /ˀn/ /ˀl/ /ˀj/ and /ˀw/ in our consonant chart (*Table 1*). Aside from pre-glottalization, glottalized consonants are also known to affect the quality of surrounding vowels, often cutting them short or causing creaky voice as the glottis restricts (Thurgood, 1976). In our recordings, the glottalized approximant /ˀl/ and the glottalized glides /ˀw/ and /ˀj/ were observed and minimal pairs were found, including **[sḭˀl]** 'confused' vs. **[sil]** 'place more than one object upright', **[ʁˀw]** 'to speak' vs. **[ʁw]** 'he speaks', and **[qʰɛˀj]** 'to write' vs. **[qʰɛj]** 'large camp.' Most

commonly, these glottalized consonants were distinguished by a retracted/creaky vowel, shortened glottalized consonant, higher pitch, and louder volume (see *Fig. 3*).

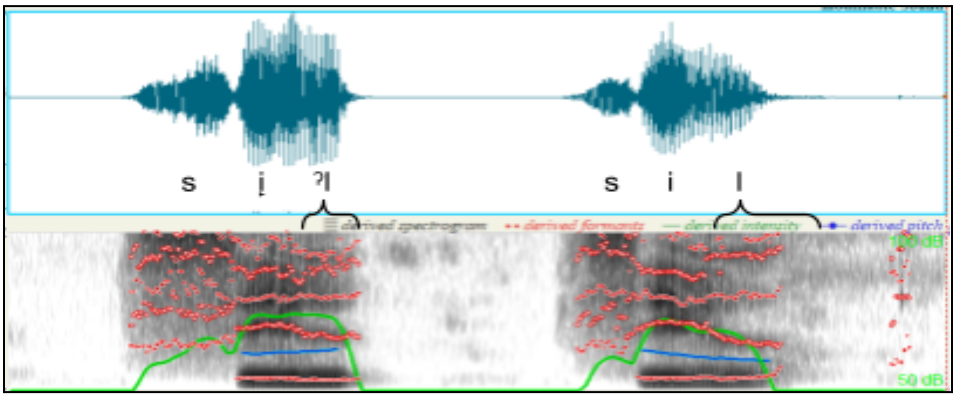

Figure 3: The minimal pair [siʲ̯ʔl] 'confused' and [sil] 'place more than one object upright' visualized in an oscillogram (top) and spectrogram (bottom). Derived formants are labeled in red, pitch in blue, and volume in green. A visibly higher pitch and shortened glottalized consonant can be seen in the first word.

We were unable to find minimal pairs for the glottalized nasals /ˀm/ and /ˀn/, and our language consultant expressed his own uncertainty regarding the acoustic and articulatory differences between the pairs. Thus, even though differences between glottalized and non-glottalized nasals have been recorded in previous literature (see Carlson, 1972; Flemming et al., 2008), clear evidence of these sounds in our own recordings was not found, which we represented as red cells in *Table 1*.

2.3. Ejectives

In Flathead Salish, the consonants /p/ /t/ /t͡ʃ/ /t͡s/ /kʷ/ /q/ and /qʷ/ were observed in a "plain" pulmonic egressive form, as well as a glottalic egressive—or "ejective"—form. Although it was often difficult to distinguish between the plain and ejective sounds produced in our recordings during the transcription phase, many word-final ejectives were easily spotted due to an additional acoustic artifact visible on a spectrogram. In *Fig. 4* below, the word **[ɬmɐq']** 'to burn' shows (A) the production of a word-final plain uvular ejective stop /q'/, which can be seen immediately preceding (B) an additional meaningless glottal sound, which we hypothesize to be the result of the glottis releasing and larynx lowering back to its initial position following the production of the ejective. This artifact was observed

frequently in words containing word-final ejectives, but rarely in cases where word-initial or medial ejective consonants are immediately followed by a vowel or consonant, as this seems to interrupt or obscure the production of this laryngeal sound. Minimal pairs between plain and ejective sounds are known to exist, such as between the colors **/qʷɐj/** ‘blue’ and **/qʷ’ɐj/** ‘black,’ although we were unable to get recordings of this effect with our language consultant.

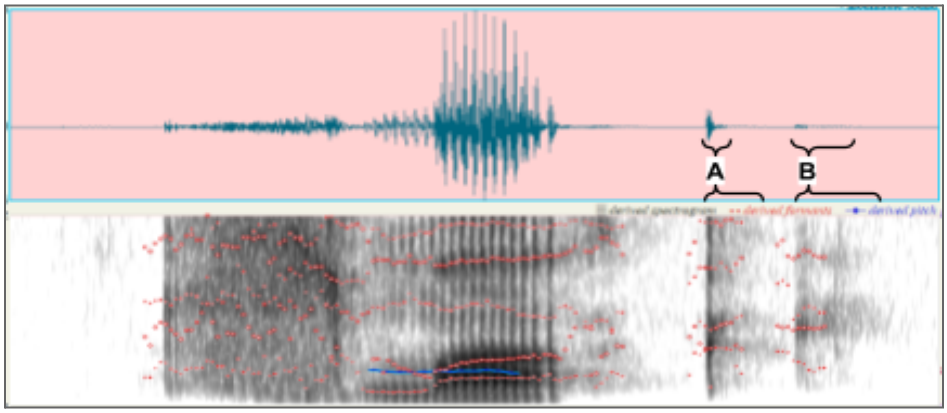

Figure 4: The word [ɬmɐq'] ‘to burn’ visualized in an oscillogram (top) and spectrogram (bottom). The uvular ejective stop /q’/ (marked ‘A’) is immediately followed by a small laryngeal sound (marked ‘B’).

2.4. Aspiration

It appears that our language consultant also had a tendency to sometimes produce aspirated pulmonic stops in the place of the required ejective stops (according to the canon pronunciation indicated in the orthography), especially in the cases of difficult-to-articulate sounds such as the (post)alveolar ejective affricates /t͡ʃ’/ and /t͡s’/, along with the alveolar ejective stop /t’/. In extension, aspirated versions of the plain /p/, /t/, and /q/ were also initially recorded in our data, though upon further research, aspirated stops in general do not appear to be contrastive in Flathead Salish (Flemming et al., 2008, p. 471). Instead, the sporadic appearance of these dramatically aspirated stops can likely be attributed to the individual speech habits of our language consultant, difficulty articulating certain ejective sounds, and some influence from English pronunciation, which tends to favor aspirated stops in word-initial positions (Crowley & Houts-Smith, 2010).

2.5. Alveolar lateral ejective affricate

A notable sound found in a number of our recordings is the alveolar lateral ejective affricate /t͡ɬ’/. This sound was referred to as a “barred lambda” by our language consultant, likely in reference to this sound’s representation in the Flathead Salish orthography as ƛ’, reflecting the symbol preferred for this sound by the North American Phonetic Alphabet (Pete, 2010). This was an unexpected sound to come across during our initial recordings, and it took many sessions of confusion and questioning with our consultant before we were able to gain a better understanding of this sound. As described by our language consultant, the ejective “barred lambda” is produced “like the click sound you do to call horses, but in reverse; you push it out, not in.” In articulatory terms, this affricate sound is the result of the production of the voiceless alveolar stop /t/, followed immediately by a voiceless alveolar lateral fricative /ɬ/. In addition, the airstream mechanism of this sound is glottalic, which seems to add to its uniqueness—of the twelve languages documented on Wikipedia containing this sound, four of them are dialects of the Salishan language family (Wikipedia contributors, 2024). This sound can appear in word-initial, intervocalic, or word-final positions, and as a part of a complex obstruent cluster. We observed the alveolar lateral ejective affricate in nine words in our word list, including **[ɛ̃nɬt͡ɬ’t͡ɬ’ɪmɐ̃qs]** ‘sharp’ (see *Fig. 5*), **[t͡ɬ’lɪl]** ‘to die,’ and **[pʰɐt͡ɬ’]** ‘smooth.’

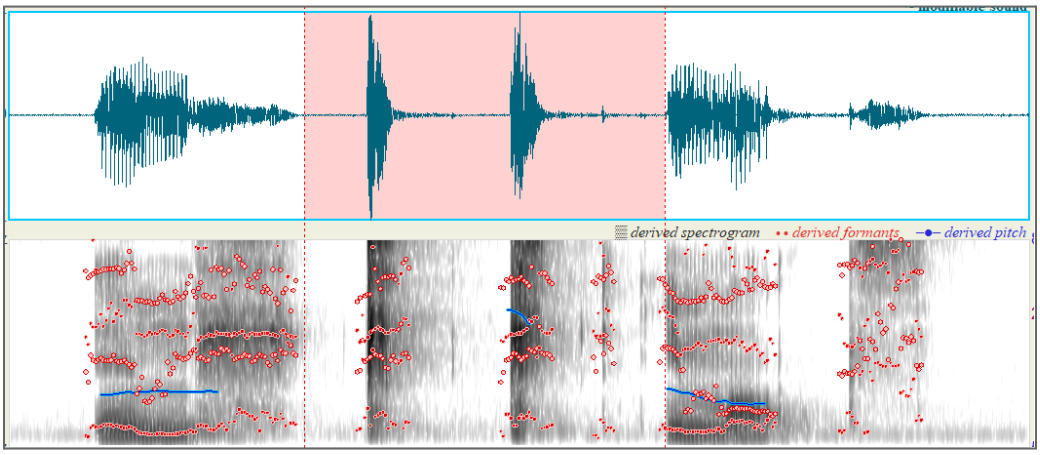

Figure 5: The word [ɛ̃nɬt͡ɬ’t͡ɬ’ɪmɐ̃qs] ‘sharp’ visualized in an oscillogram (top) and spectrogram (bottom). Two occurrences of the alveolar lateral ejective affricate /t͡ɬ’/ (highlighted in red) can be seen.

2.6. Velar and uvular sounds

Another notable characteristic of Flathead Salish's consonant inventory is the apparent lack of plain and ejective voiceless velar stops /k/ and /k'/. We initially had some difficulty distinguishing uvular stops from velar stops, until we were informed by our language consultant that many of the sounds we had first labeled as velar were actually being pronounced "further back" in his throat, indicating that the place of articulation is closer to uvular. This issue was compounded further due to our language consultant's tendency to aspirate many of his stops, which contributed to our initial interpretation of voiceless uvular stops being velar. However, as noted by Flemming et al. (2008), voiceless velar stops are almost always labialized, as the "non-labialized /k/ occurs only in two or three loanwords and there is no non-labialized velar ejective" (p. 469). As seen in *Table 1*, in cases where a non-labialized sound produced anterior to the palate is needed, the plain voiceless uvular stop /q/ and uvular ejective stop /q'/ fulfill these roles.

2.7. Additional notes on consonants

Finally, a few additional notes can be made regarding some apparent gaps in our consonant chart, namely, a lack of voiced obstruents and rhotic sounds. Most varieties of Salish appear to lack a voicing distinction between obstruents, which was reflected in our data, as only voiceless obstruents were recorded in our transcriptions. This effect was made especially apparent through our language consultant's tendency to aspirate word-initial and word-final voiceless stops, but was less clear for medial obstruents, as a lack of aspiration made it difficult to determine if what we were hearing was voiced or voiceless. Because it is possible for languages without a voicing contrast in stops to have intervocalic voicing in certain conditions (see Keating et al., 1983), additional research that engages with a larger number of speakers could be conducted to determine whether this phenomenon occurs in modern Flathead Salish. Lastly, no instances of rhotic sounds were found in our recordings. While not uncommon in the Salishan language, this lack of rhotic sounds helps distinguish Flathead Salish from other Southern Interior Salish dialects, such as Spokane and snchitsu'umshtsn (Coeur d'Alene), which both utilize the plain and glottalized voiced alveolar approximants /ɹ/ and /ˀɹ/ (Carlson, 1972; Doak & Montler, 2006).

Finally, it should be mentioned here that Salishan dialects employ a wide range of extremely complex consonant clusters—a deeper analysis on this phenomenon in Flathead Salish is discussed in **Section 5.1. Obstruent clusters in Flathead Salish**.

3. Vowels

3.1. Monophthongs

The monophthongs we observed in Flathead Salish are relatively simple compared to the consonant inventory described above. Our language consultant mainly produced the vowels /i/, /ɛ/, /ɐ/, /o/, and /u/, as shown in *Chart 1* and *2*. We also noticed the frequent production of a schwa-like vowel in unstressed syllables. Other accounts of vowels in Salishan languages generally concede that the schwa is "not established as a phoneme because it never occurs stressed and seems to be generally predictable" (Carlson, 1972, p. 12), which is also reflected in our data.

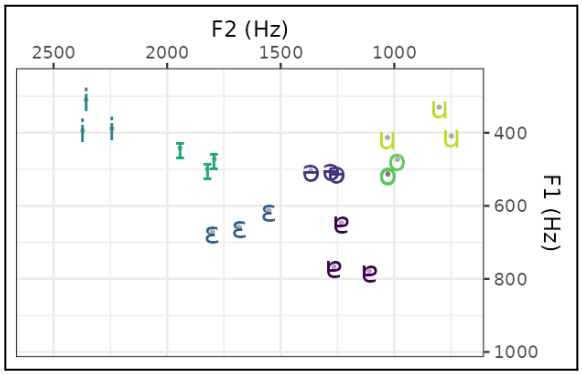

Chart 1: F1 and F2 chart of monophthongs in Flathead Salish.

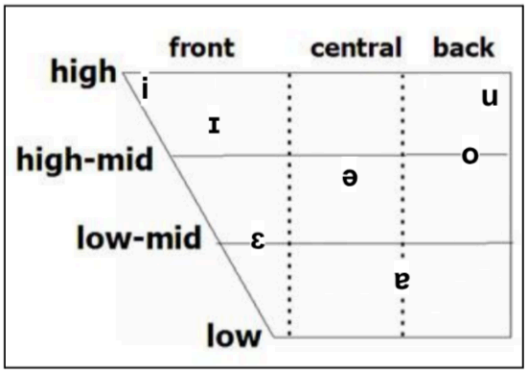

Chart 2: Idealized vowel space of monophthongs in Flathead Salish.

However, many words produced by our language consultant also contained the high-mid near-front unrounded /ɪ/ in both stressed and unstressed positions, a sound that is not accounted for in other studies of Salishan phonetics. Upon further investigation, it appears that these two productions of /ɪ/—one stressed, the other unstressed—are in fact reflective of three distinct processes that result in the

production of a similar sound. Firstly, as shown in the word **[spɪqɐɬtʰ]** 'fruit' (*Fig. 6*), /ɪ/ was frequently recorded as a lax alternative to /i/ when it occurred in an unstressed syllable in a word, thus playing a similar role to the schwa. Secondly, /ɪ/ also emerged in unstressed positions when the canonical pronunciation of a word called for a syllabic nasal stop; thus, our language consultant's production of words like **[wiʃɪn]** 'long' (*Fig. 7*) included the vowel /ɪ/ when other speakers may pronounce the word like **/wiʃn̩/**.

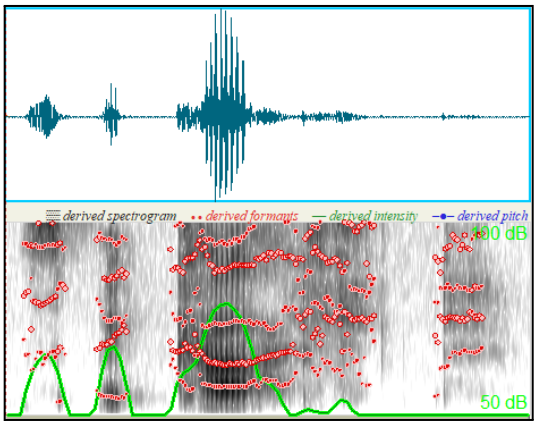

Figure 6: The word [spɪqɐɬtʰ] 'fruit' visualized in an oscillogram (top) and spectrogram (bottom).

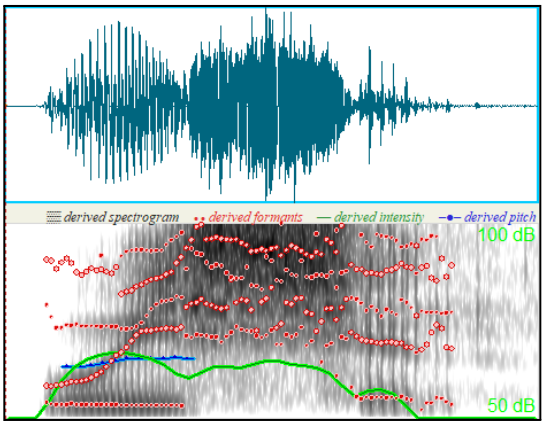

Figure 7: The word [wiʃɪn] 'long' visualized in an oscillogram (top) and spectrogram (bottom).

Finally, in cases where /ɪ/ occurs in stressed syllables, it was found that a voiced lateral approximant /l/ or voiceless alveolar lateral fricative /ɬ/ always immediately followed this vowel, as seen in **[t͡ɬ'lɪl]** 'to die,' and **[qʷl̩xʷɪlɬʰ]** 'to live' (*Fig. 8* and *Fig. 9*). This indicates that for our speaker, /ɪ/ (in stressed positions) may actually be an allophone of /i/ when immediately preceding a lateral coda. Because this phenomenon has not been documented in prior phonological studies of Salishan dialects, we suspect that this phenomenon may be caused by influence from English, given that /ɪ/ is commonly found in similar phonetic environments (like in its reduced form in the unstressed syllable of 'America,' or in its phonemic form in the word 'pill').

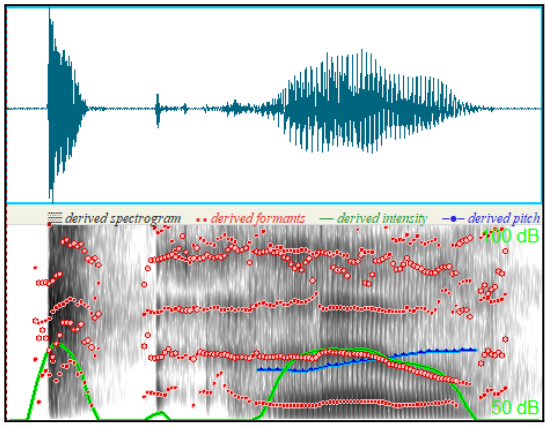

Figure 8: The word [t͡ɬ'ɬɪl] 'to die' visualized in an oscillogram (top) and spectrogram (bottom).

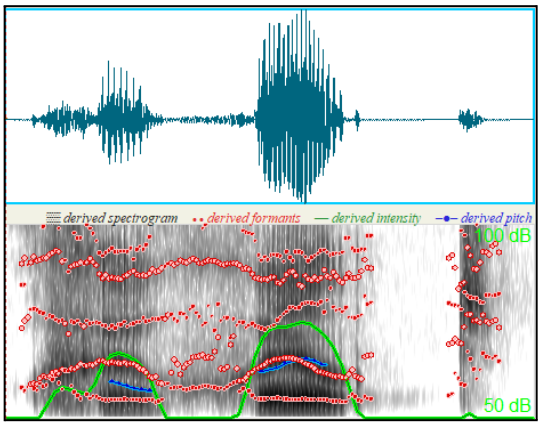

Figure 9: The word [qʷɬxʷɪɬtʰ] 'to live' visualized in an oscillogram (top) and spectrogram (bottom).

A retracted production of /i/ as [i̱] was also observed following all versions of the uvular consonants /q/ and /χ/; this effect is visible in the minimal pair **[sit͡s]** 'new' and **[χʷi̱t͡s]** 'to give' (*Fig. 10* and *Fig. 11*). It appears that these consonants, being pronounced so far back in the mouth, make it difficult to pronounce the extremely fronted /i/, resulting in slightly increased F1 and slightly decreased F2. In modern Salish language instruction, this effect is often emphasized as one way to check if you are pronouncing the uvular consonants correctly (Pete, 2010).

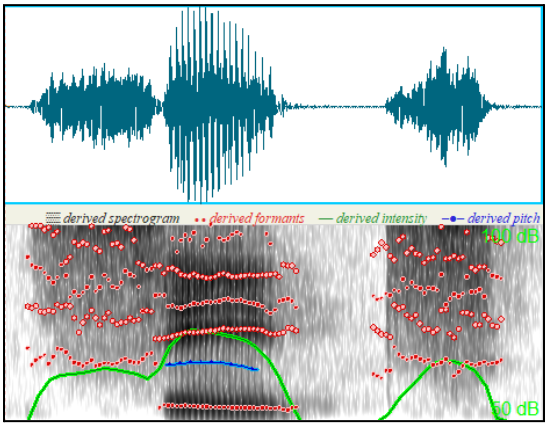

Figure 10: The word [sit͡s] 'new' visualized in an oscillogram (top) and spectrogram (bottom).

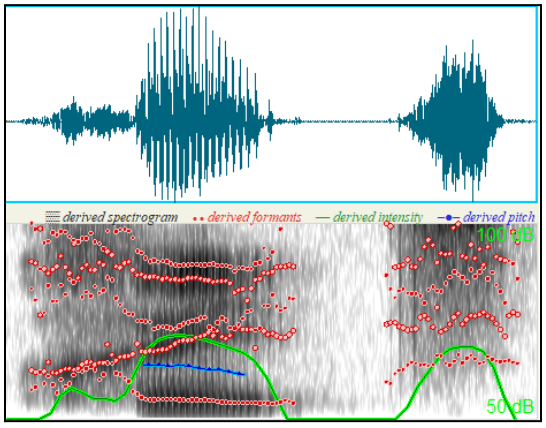

Figure 11: The word [χʷi̱t͡s] 'to give' visualized in an oscillogram (top) and spectrogram (bottom).

3.2. Diphthongs

During our early recording sessions and transcription attempts, diphthongs appeared to be present in a number of words in Flathead Salish. Thus, attempts were made to record and plot the first 25% and last 75% of each apparent diphthong, which can then be turned into acoustic and articulatory vowel charts as shown in *Chart 3* and *Chart 4*. Specifically, the diphthongs /uɪ/ /ɛɪ/ /ɐɛ/ and /ɛu/ were most frequently observed.

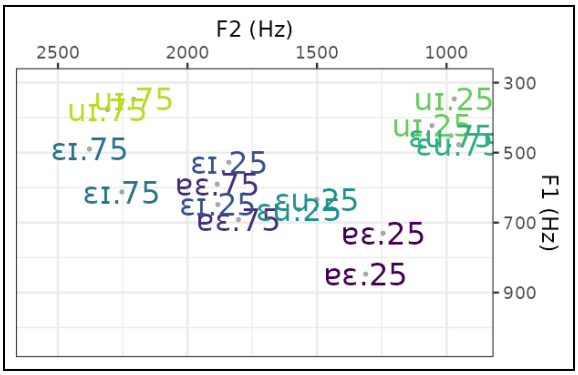

Chart 3: F1 and F2 chart of diphthongs in Flathead Salish.

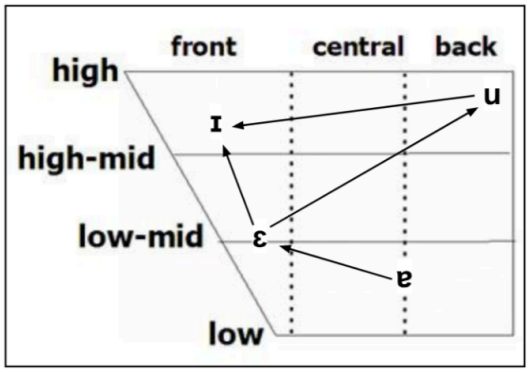

Chart 4: Idealized vowel space of diphthongs in Flathead Salish.

However, further analysis indicates that the sounds illustrated above are not true diphthongs. Instead, we believe that they reflect the effects of coarticulation from certain nearby consonants, given that these diphthongs never occurred outside of a few very specific circumstances. In the case of diphthongs with /ɪ/ or /ɛ/ in its latter half, they are always followed by the voiced palatal approximant /j/, such as in the words **[skʷuj]** 'mother' and **[ɐjxʷtʰi]** 'I am tired' (*Fig. 12* and *Fig. 13*). Comparing words in sequence—where one ends with the voiced palatal approximant and thus exhibits a diphthong-like quality in its vowel, while the other does not—can illustrate this effect quite clearly, such as in the utterance **/t͡ɬ'm̩ ʃɛ l̩ ʃɛj/** 'it used to be there' (although we could not get a recording of this sentence with our language consultant).

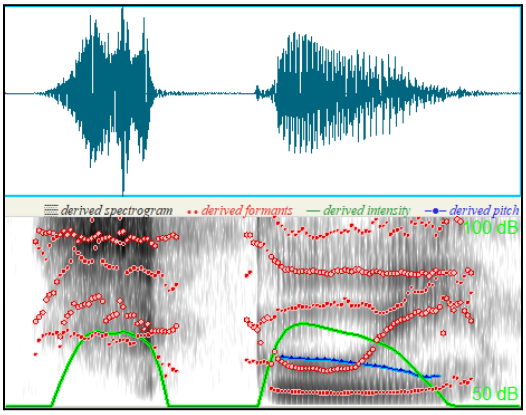

Figure 12: The word [skʷuj] 'mother' visualized in an oscillogram (top) and spectrogram (bottom).

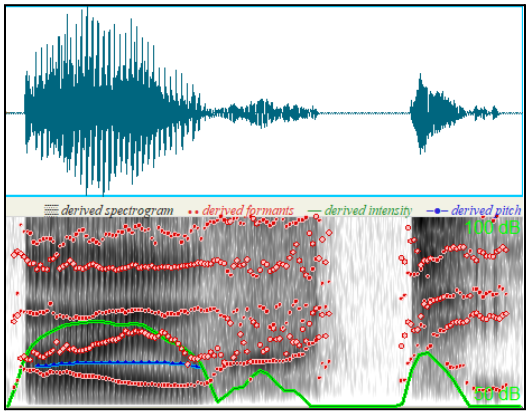

Figure 13: The word [ɐjxʷtʰi] 'I am tired' visualized in an oscillogram (top) and spectrogram (bottom).

For the diphthong /e͡u/, it quickly became clear that this sound only occurs when the open mid-front unrounded vowel /ɛ/ is immediately followed by a labialized stop or fricative (such as /qʷ'/ or /xʷ/), or by the voiced labial-velar approximant /w/. As mentioned in **Section 2.1. Labialization**, /xʷ/ appears to be a common word-final consonant in Flathead Salish, such as in the word **[t͡ʃɛxʷ]** 'dry' (see *Fig. 2* on page 5). Thus, it is not surprising that we ran into this diphthong-like sound frequently in our recordings. Whether or not true diphthongs play a phonemic role in Flathead Salish is still unclear, but we currently suspect that the especially strong diphthong effects illustrated above mainly reflect the individual pronunciation of our language consultant.

4. Suprasegmentals

4.1. Intonation and asking questions in Flathead Salish

Despite its many phonological and morphological complexities, Flathead Salish seems to lack most meaning-contrasting suprasegmental elements. For example, Flathead Salish does not utilize contrastive tones like Thai, or a shift in stress to change a word's meaning like in English. However, some observations made during our recording sessions have provided insight into the role (or lack thereof) of intonation in forming interrogatives. As expected, Flathead Salish generally utilizes falling terminal

intonation, where the last syllable in an utterance drops in pitch to indicate the end of a statement or clause (Carlson, 1972). However, during the recording and research phase of this project, it became clear that unlike languages like English, which uses a high rising intonation to change the meaning of an utterance from the declarative to interrogative mood, the high rising intonation rarely, if ever, occurs at the end of questions in Flathead Salish. This effect can be seen when comparing *Fig. 14* and *Fig. 15*, which display the pitch of the interrogative utterance **[hɐ kʷ qs xʷu͡ɪ t͡ʃʼ ɛsijaʔpʰ↗qɛ↘ʔni]** 'are you going to the powwow?' and the declarative utterance **[unɛxʷ | t͡ʃɪqs xʷu͡ɪ t͡ʃʼ ɛsijn̪ap↗qɛ↘ʔn̪i̪]** 'yes, I'm going to the powwow,' respectively (recordings provided by Thornton Media, 2022). In both cases, a nearly identical global rise in intonation on the penultimate syllable, then a global drop on the last syllable is present, indicating that intonation does not play a role in expressing the interrogative mood. Instead, Salishan languages are known to indicate questions on the lexical and morphological level, such as through the use of question words or the interrogative particle **/ha/** (Pete, 2010).

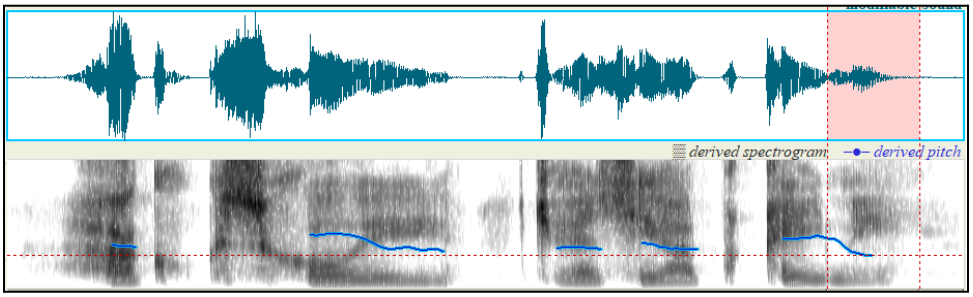

Figure 14: The utterance [hɐ kʷ qs xʷu͡ɪ t͡ʃʼ ɛsijaʔpʰ↗qɛ↘ʔni] 'are you going to the powwow?' visualized in an oscillogram (top) and spectrogram (bottom). Pitch is indicated in blue, and the pitch drop is highlighted in red.

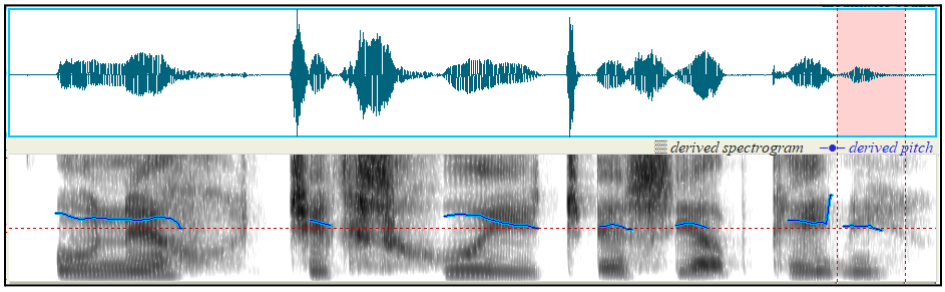

Figure 15: The utterance [unɛxʷ | t͡ʃɪqs xʷu͡ɪ t͡ʃʼ ɛsijn̪ap↗qɛ↘ʔn̪i̪] 'yes, I'm going to the powwow,' visualized in an oscillogram (top) and spectrogram (bottom). Pitch is indicated in blue, and the pitch drop is highlighted in red.

5. Deeper Analysis

5.1. Obstruent clusters in Flathead Salish

Perhaps one of the most famous aspects of the Salishan languages is their frequent use of extremely complex obstruent clusters. These clusters involve the sequential production of varying stops, fricatives, and affricates without any apparent voicing, and they can occur in word-initial, intervocalic, and final positions. Because Flathead Salish utilizes reduplication for a variety of morphological purposes, such as plurals, diminutives and developmentals (Carlson, 1972), it is not surprising that many of the words we recorded contained clusters with up to four consonants in a row. In our own recording, the word **[stʃ͡ts'hɛstʃ͡stʰ]** 'right (direction)' stood out as containing two four-letter obstruent clusters in both the word-initial position and the word-final position—in other words, this word contains eight consonants, and only a single vowel as the nucleus (see *Fig. 16*).

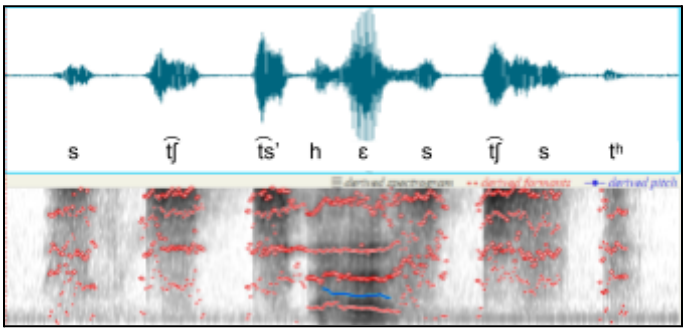

Figure 16: The [stʃ͡ts'hɛstʃ͡stʰ] 'right (direction)' visualized in an oscillogram (top) and spectrogram (bottom).

We also expected to find another impressively complex consonant cluster in the word for 'sea,' which is canonically pronounced as **/stʃ͡ɬpt͡ɬ'mɛt'kʷ/**, with five obstruents at the start of the word. However, as may be visible in *Fig. 16*, our consultant was a bit hesitant in pronouncing long consonant clusters, and often inserted voicing between some consonants—this appears to be what happened in our recording of 'sea,' which he pronounced as **[stʃ͡ɮp't͡ɬ'mɛt'kʷ]**. Flemming et al. (2008) notes that when complex consonant clusters in Flathead Salish start a syllable, they often get treated as one unit without

breaking the sounds into separate parts. In addition, certain combinations of consonants may be more likely to be simplified or reduced in rapid speech, especially in cases of reduplication.

5.2. Rhythm and Prosody in Flathead Salish

This section attempts to dive deeper into the prosodic features of Flathead Salish, providing a look into the role of pitch and duration in the prosody of spoken words and utterances. The following section is based on limited data gathered from observations in our recordings and additional resources. Previous studies of Flathead Salish have shown that pitch acts as the primary cue for lexical accent, while additional phonetic cues in accent such as amplitude and duration also play key roles (Flemming et al., 2008). Besides these scant observations, little information could be found in the literature that details the nature of prosody in Flathead Salish. However, during our own recording sessions, a few suprasegmental elements related to prosody in Flathead Salish became immediately apparent: a) all multisyllable words appeared to have a primary stress and sometimes a secondary stress, b) our language consultant's pitch seemed to rise when stressing syllables, and c) full sentences in Flathead Salish appeared to have a "waltz-like" rhythm when spoken.

Thus, we hypothesize that Flathead Salish may be a stress-timed language, which is defined as a language that has approximately "equal amounts of time between two consecutive stressed syllables" (Conlen, 2016, p.2). Similarly to other stress-timed languages like English or Polish, Flathead Salish appears to utilize pitch and duration as the primary method to produce this rhythmic, waltz-like timing, with increased amplitude in stressed syllables being a nonessential result of unstressed syllables often lacking or losing their vowels in most Salish dialects (Carlson, 1972, p. 24). This effect can be seen in *Fig. 17*, in which the pitch, amplitude, and duration in milliseconds of each accented section of the utterance **[tʰ.sə.ˈlɐq.ˌswɛs.ˈʔi .ɬn.ɬu.ˈt’i͡ɬ.ˌt’ɛ. ʔlə.ˈwɐ̟]** 'mosquitos are what bats eat' are marked (recordings provided by Thornton Media, 2022). As seen below, each "beat" of the utterance is built around a stressed vowel or vowel-like sound (highlighted in yellow) that land on the penultimate or last syllable of each section, resulting in a clear rhythmic prosody in which each chunk lasts approximately 700~900 ms. The assertion that Flathead Salish uses pitch as the primary indicator of stress is supported

by *Table 2*, which shows the average pitch of the stressed and unstressed syllables in each of the four sections. Primary stress was reliably observed as averaging 10~40 Hz higher in pitch compared to the unstressed syllable, and incidents of secondary stress remained comfortably in between the two ends. The only break in this pattern occurs in the final syllable chunk, which shows the secondary stress pitch to be slightly higher than the primary stress pitch. We hypothesize that this may be due to the use of downspeak in terminal intonation, as discussed in **Section 4.1. Intonation and asking questions in Flathead Salish**.

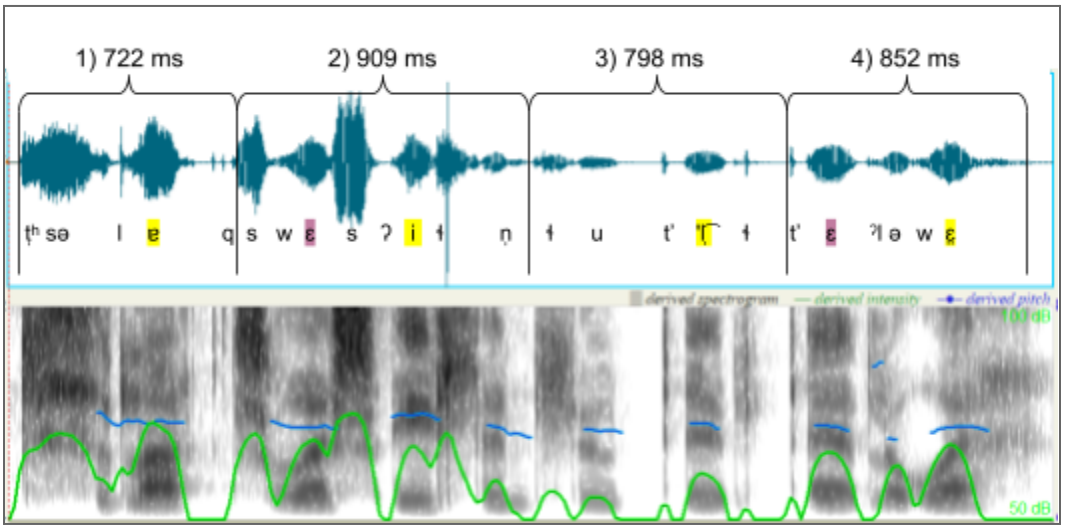

Figure 17: The sentence [tʰ.sə.ˈlɐq.ˌswɛs.ˈʔi.ɬn.ɬu.ˈt't͡ɬ'.ˌt'ɛ.ʔlə.ˈwɐ] 'mosquitos are what bats eat' visualized in an oscillogram (top) and spectrogram (bottom). Pitch is shown in blue, while volume is expressed in green. The stressed syllable of each section is highlighted in yellow, and occurrences of secondary stress are shown in purple.

	Chunk 1	Chunk 2	Chunk 3	Chunk 4
Primary stress pitch	/l**ɐ**q/: 181.4 Hz	/ʔ**i**/: 193.6 Hz	/**t͡ɬ'**/: 174.0 Hz	/w**ʰɛ**/: 165.1 Hz
Secondary stress pitch		/sw**ɛ**s/: 165.3 Hz		/t'**ɛ**/: 167.2 Hz
Unstressed pitch	/s**ə**/: 171.6 Hz	/ɬ**n**/: 157.0 Hz	/ɬ**u**/: 158.5 Hz	/ʔl**ə**/: 141.0 Hz

Table 2: The average pitch of each primarily stressed, secondarily stressed, and unstressed syllable in the sentence [tʰ.sə.ˈlɐq.ˌswɛs.ˈʔi.ɬn.ɬu.t'.ˈt͡ɬ'.ˌt'ɛ.ʔlə.ˈwʰɛ] 'mosquitos are what bats eat'.

As for duration, the observed use of the reduced vowels /ə/ and /ɪ/ (or the deletion of vowels altogether) in primarily unstressed positions indicates that the length of each syllable in a chunk may be shortened or lengthened in order to maintain this stress-timed prosody. This postulation is supported in works examining other dialects of Salish, such as Koch's (2008) observations that "higher pitch, greater amplitude and longer duration are associated with accented syllables" in nłeʔkepmxcín (Thompson River Salish) (p. 35). However, as shown in *Table 2* and *3*, this assertion is challenged by the fact that the stressed syllable with the highest pitch—/ʔi/ in Chunk 2—is perceived auditorily as the most emphasized part of the sentence, and yet it is the second-to-shortest syllable in the utterance at only 138 ms. Thus, an argument can be made that pitch takes priority over duration when delineating stress in Flathead Salish, even though duration may still be used to maintain a rhythmic flow in speech; however, further research that analyses the speech of a wide range of fluent speakers should be conducted to get a clearer picture of the nature of prosody in Flathead Salish.

	Chunk 1			**Chunk 2**			**Chunk 3**		**Chunk 4**		
Syllable	/t̪ʰ/	/sə/	/læq̣/	/swɛs/	/ʔi/	/ɬn̪/	/ɬu/	/t’l̪̂/	/t’ɛ/	/ʔlə/	/wɛ̨/
Duration (ms)	100	252	370	467	138	304	402	396	298	160	394

Table 3: The duration in milliseconds of each syllable in the sentence [t̪ʰ.sə.ˈlæq.ˌswɛs.ˈʔi.ɬn̪.ɬu.t’.ˈl̪̂.ˌt’ɛ.ʔlə.ˈwʰɛ] 'mosquitos are what bats eat'. Primary stress of each chunk is marked in yellow.

6. Conclusion

This project has provided a wonderful introductory opportunity to experience what it is like to uncover and organize the phonetic characteristics of a language like Flathead Salish. Through extensive work with our language consultant, we have attempted to gain insight on Flathead Salish's consonant and vowel inventory, suprasegmental characteristics, and prosodic features. However, we recognize that because this project is built upon the speech of a single heritage speaker, the information provided in this paper is bound to reflect the many idiosyncrasies of our language consultant's unique voice. But despite

these limitations, we hope that these findings will still contribute to an ever-growing understanding of the phonetics of Flathead Salish, and we look forward to future studies and the continued revitalization efforts of this beautiful language.

Lemlmtš to Snpaqsin Morigeau for generously sharing his time, language, history, and knowledge with us. This project, and a semester full of memories, would not have existed without his help.

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Appendices

Appendix A. Selected audio files

Section	File #	Transcription	English gloss
2.1.	44	[xʷɛʔxʷɛjutʰ]	animal
	195	[t͡ʃɛxʷ]	dry
2.2.	1004	[sɨˀl]	confused
	1004	[sil]	to place more than one object upright
	1005	[ɐˀw]	to speak
	1005	[ɐw]	he speaks
	1006	[qʰɛˀj]	to write
	1006	[qʰɛj]	large camp
2.3.	169	[ɬmɐq']	to burn
2.5.	191	[ɛ̃nɬt͡ɬ’t͡ɬ’ɪmɐ̃qs]	sharp
	109	[t͡ɬ’lɪl]	to die
	193	[pʰɐt͡ɬ’]	smooth
3.1.	54	[spɪqɐɬtʰ]	fruit
	28	[wiʃɪn]	long
	109	[t͡ɬ’lɪl]	to die
	108	[qʷɻxʷɪltʰ]	to live
	03	[sit͡s]	new
	04	[χʷɨt͡s]	to give
3.2.	05	[skʷuj]	mother
	06	[ɐjxʷtʰi]	I am tired
	195	[t͡ʃɛxʷ]	dry
4.1.	1001	[hɐ kʷ qs xʷu͡ɪ t͡ʃ˜ ɛsijaʔpʰ↗qɛ↘ˀni]	Are you going to the powwow?

	1002	[unɛxʷ | t͡ʃɪqs xʷuɪ̯ t͡ʃʼ ɛsijaːp↗qɛ↘ʔniː]	Yes, I'm going to the powwow.
5.1.	199	[st͡ʃt͡s'hɛst͡ʃstʰ]	right (direction)
	154	[st͡ʃɪɬp'tɬ'mɛt'kʷ]	sea
5.2.	1003	[tʰ.sə.ˈlɐqˑ.ˌswɛs.ˈʔi .ɬn̩.ɬu.ˈtʼl̩ɬˑ.ˌtʼɛ. ʔlə.ˈwɐ]	Mosquitos are what bats eat.

Appendix B. Formant values for Monophthongs and Diphthongs

Mon. vowel	Transcription	English gloss	F1	F2	F3
i	[mi]	to know	388.56	2242.52	2738.53
i	[iɬɪn]	to eat	309.31	2357.12	3118.59
i	[mit͡ʃʼ]	to cut	394.24	2371.94	3023.47
ɐ	[jɐʔmim]	to gather	766.13	1265.76	2396.62
ɐ	[ʃɐl]	suspended	645.63	1233.38	2455.86
ɐ	[tʰɐ]	not	778.20	1110.38	2608.36
ɛ	[ɛp']	to wipe	658.38	1682.09	2660.51
ɛ	[swɛ]	who	612.97	1552.18	2626.21
ɛ	[stɛm]	what	671.76	1800.77	2834.02
o	[jomim]	hold steady	514.33	1027.80	2603.09
o	[olin]	belly	472.77	986.14	2708.83
o	[soχʷɛp]	root	511.22	1029.15	2815.70
u	[tum]	to suck	412.91	1030.10	2715.63
u	[upʼ]	hair not on head	329.74	802.68	2450.44
u	[mus']	four	409.14	748.67	2604.55
ɪ	[sɪnxʷuɬ]	blood	499.47	1823.01	2859.05
ɪ	[ʃɪl]	to chop	441.36	1943.52	2707.23

ɪ	[sɪmɛ̃m]	woman	471.92	1791.97	2985.96
ə	[łəɬɐqʼ]	thin	504.44	1367.70	2566.70
ə	[qʷʰəmĩn]	horn	500.76	1278.05	2536.87
ə	[spəʔus]	heart	507.47	1253.48	2497.42

Transcription	English Gloss	Diph. vowel	F1	F2	F3
[qʷɐj]	black	ɐɛ 25%	730.40	1244.66	2370.57
		ɐɛ 75%	590.06	1885.39	2502.34
[ɐjxʷtɪ]	(I am) tired	ɐɛ 25%	846.94	1311.99	2434.31
		ɐɛ 75%	691.16	1803.11	2447.66
[qɛjn]	eye	ɛɪ 25%	648.41	1882.88	2380.37
		ɛɪ 75%	612.33	2253.37	2853.11
[stɐ̯pɛjs]	rain	ɛɪ 25%	527.62	1840.10	2712.36
		ɛɪ 75%	489.46	2378.62	2742.53
[skʷuj]	mother	uɪ 25%	346.34	969.84	2768.07
		uɪ 75%	376.68	2308.56	2819.42
[t͡ʃʼuj]	to come	uɪ 25%	422.48	1056.08	2708.26
		uɪ 75%	347.45	2207.26	2754.67
[n̩ɬɪʃulɛxʷ]	worm	ɛu 25%	634.17	1501.44	2743.81
		ɛu 75%	477.24	952.47	2807.91
[ɪlʔɛw]	father	ɛu 25%	662.67	1570.33	2859.87
		ɛu 75%	451.55	983.10	2840.26