PRELIMINARY NOTES ON SOME PACIFIC NORTHWEST COAST PHARYNGEALS*

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0.0 Introduction

The contrastive use of pharyngeal articulation in known languages of the world is relatively rare. Whereas segments involving labial, coronal or dorsal gestures are virtually ubiquitous, appearing in almost every language, pharyngeal consonants occur in a mere 7% of the 693 languages sampled by Ruhlen (1975) and 4% of those sampled by Maddieson (1984). The best known cases of pharyngeal articulation come from the Semitic languages, many of which contrast /ʕ, ħ/. While /ħ/ in Semitic is generally described as a voiceless fricative, /ʕ/ is reported to have a number of allophones: creak, voiceless stop and voiced approximant among them (see Butcher and Ahmad (1987) for a survey and investigation of the manner characteristics of Semitic /ʕ, ħ/). Many Caucasian languages maintain the same contrast between what are assumed to be voiced and voiceless pharyngeal fricatives, /ʕ, ħ/.[1] Within the Americas, Ruhlen's database includes /ħ/ but not /ʕ/ in Capanahua and Achumawi ; /ʢ, ʢ', ʢʷ, ʢ'ʷ/ in Okanagan (Interior Salish); / ħ, ħʷ, ʕ, ʕ', ʕʷ, ʕ'ʷ / in Moses-Columbian (Interior Salish) and /ʢ, ħ/ in Nootka (Wakashan). The dialect of Haida included in Ruhlen's database is that spoken on the Queen Charlotte Islands which, unlike the Northern dialects, contains no pharyngeal phonemes.

The existence of pharyngeal articulation in languages of the Pacific Northwest has been known for some time, at least since 1911 in the case of Nootka (Sapir 1911), though later in the case of Haida and Salish. While there is a long and extensive history of articulatory description and latterly, experimental investigation, of the Semitic pharyngeals, very little instrumental work has been done on the Caucasian data and virtually none at all on the Pacific Northwest data. It is my purpose here to address this lacunae by documenting some of the acoustic properites of pharyngeal articulation in Pacific Northwest Coast languages, namely Interior Salish, Hydaburg Haida and Ahousaht Nootka. It is hoped that the data reported here will contribute in a general sense to what is known about the phonetic properties of speech sounds made in the pharynx, and in so doing provide information of typological, phonetic, and ultimately, phonological use. The data under consideration here are of particular interest since Hydaburg Haida is reported to have a pharyngeal affricate, Nootka has some kind of pharyngeal stop or pharyngealized glottal stop and Salish has pharyngeal resonants. Despite this wealth of phonetic manner distinctions among pharyngeal segments, the International Phonetic

* I am indebted to William Seaburg for recordings of Lillian Pettvei speaking Hydaburg Haida and Thomas Hess for recordings of George Louie speaking Ahousaht (Nootka). The Salish data are taken from my own field recordings, and I thank the speakers involved: Agatha Bart, Lawrence Nicodemus and Charlie Quintasket. Clearly, this investigation could not have been undertaken without the generosity and assistance of all those concerned.

1Some Caucasian languages, such as the Burkikhan dialect of Agul, contrast /ʕ, ħ/ with /H, ʕ, ʔ/. /H, ʕ / are epiglottal fricatives, / ʔ / an epiglottal stop (Catford 1983). The exact details of the articulation of these sounds remain unclear, but their existence suggests that there may be a place of articulation distinction among pharyngeals.

Association (1989) provides symbols for only a voiced and voiceless pharyngeal fricative. However, in terms of both place and manner of articulation it is quite unclear whether the Haida and Nootka segments are phonetic variants on a more general pharyngeal theme that includes the Semitic and Salish types, whether we are dealing with epiglottal segments of the sort found in some Caucasian languages, or whether the glottis is used to effect the stop component of these articulations and the segments are therefore contour or complex in the sense of Sagey (1986).

This paper deals first with pharyngeal articulation in Interior Salish, providing spectrograms of each pharyngeal phoneme (section 1). Sections 2 and 3 investigate data from Hydaburg Haida and Ahousaht Nootka respectively, remarking in particular on manner attributes and place of articulation estimates. The data discussed here are all naturally occurring items recorded from native speakers in citation form, with two or three repetitions of each form. Recordings were digitized at 12,000 Hz and analyzed using *waves+* .

1.0 Interior Salish Pharyngeals

All of the Interior Salish languages present inventories that contrast /ʕ, ʕ', ʕʷ, ʕ'ʷ/. It has been mentioned that other languages have some kind of voiced pharyngeal segment symbolized /ʕ/, but Interior Salish /ʕ', ʕ'ʷ/ are unique.[2] Phonetically, Interior Salish pharyngeals are best described as resonants.[3] They are voiced sounds produced with very little articulatory friction.[4] Their formant structure shows high first formant (F1) values regardless of following vowel context. An intrinsically low second formant (F2) shows up quite clearly in the context of adjacent high front articulations. Comparison of the range of F1 and F2 values of Interior Salish pharyngeals (from Moses-Columbian, Spokane, Kalispel, Colville, Shuswap and Nɬeʔkepmxcin) with those of Arabic languages indicates that Salish pharyngeals share a number of acoustic (and presumably articulatory) properties with Arabic pharyngeals (Bessell 1992). Short of X-ray, electro-magnetic resonance or electromyographic data, it is impossible to say what the *exact* place of articulation of the Interior Salish pharyngeals might be. However, acoustic data support what has been known from impressionistic observation, which is that /ʕ, ʕ', ʕʷ, ʕ'ʷ/ are made with pharyngeal rather than oral constriction and produce a sound of particularly low and often quite back quality. There are no clear cases in the current database, which includes data from ten speakers and six of the Interior Salish languages, of a stop component in pharyngeal articulation such as found in some Semitic data, or the Nootka and Haida data discussed in following sections.[5]

The findings summarized above are illustrated in Figure 1 with an example from Colville. Succeeding figures exemplify the remaining types of pharyngeal phonemes in Interior Salish, including voiceless /ħ, ħʷ/, which occur only in Moses-Columbian Salish and are a recent

2Colarusso (1988) reports /ʕʷ, ħʷ/ in a number of Abkhaz and Abaza dialects.
3This is true of their phonological behaviour also (see Bessell 1992 and references therein).
4Although in some positions in some of the Interior Salish languages, /ʕ/ tends to devoice (Bessell 1992).
5 It is worth remarking, though, that the Interior Salish database concentrates quite deliberately on older speakers, and it may be that younger speakers articulate pharyngeals a little differently.

innovation.[6] A more extensive discussion of Interior Salish pharyngeal articulation and its similarites with Arabic can be found in Bessell (1992).

Figure 1: /ʕ/: ɬáʕlaʔ 'raspberry' (Colville: CQ)

This figure shows clearly the resonant manifestation of /ʕ/, it being indistinguishable from the preceding vowel.

The glottalized pharyngeal is often realized with creaky voice, but frequently involves some period of laryngeal closure that may be accompanied with aspirated, voiceless release, as can be seen in Figure 2.

Figure 2: /ʕ'/: (k'l) niʕ'áp 'forever'

Rounding on /ʕʷ/ lowers all formants, producing slightly lower F-values than found with /ʕ/.

Figure 3: /ʕʷ/ ʕʷəl' 'bright' (Moses-Columbian: AB)

The fomant-lowering induced by rounding is more visible in Figure 4. The offglide of /ʕ'ʷ/ shows a lowered F2 especially, and F1 values for rounded pharyngeals are consistently lower than those for unrounded ones. Here too, glottalization is realized as a period of slightly aspirated closure followed by some creak on the rounded release.

Figure 4: /ʕ'ʷ/ mɛʕ'ʷns 'he broke it' (Coeur d'Alene: LN)

As noted, /ħ/ is an innovation restricted to Moses-Columbian Salish. The form in Figure 5 shows clearly the high F1 and relatively low F2 of pharyngeal articulation and both formants shift noticeably as the vocal tract reconfigures for the high front /i/ vowel. The waveform of /ħ/ shows a strong aperiodic component. The spectrogram shows a clear formant structure starting at 1000 Hz and extending to 5000 Hz. /ħ/ for the speaker whose data are represented here has an average duration of just over 200 Hz (14 tokens).

Figure 5: /ħ/ ħimt 'angry' (Moses-Columbian: AB)

/ħʷ/ is found in only one (onomatopoeic) morpheme in Moses-Columbian, but it behaves regularly in reduplication.

Figure 6: /ħʷ/ ʔəħwaʔ 'cough' (Moses-Columbian: AB)

[6]Okanagan may have some instances of voiceless [ħ], but the data are not entirely clear.

2.0 Hydaburg Haida

There are two basic dialects of Haida[7]: Nothern Haida (spoken by the Alaskan and Massett people) and Southern Haida. There is evidence that the Northern Haida pharyngeals are historically derived from uvulars. Krauss (1979) reports that uvular /ɢ, χ/ have become pharyngeals in Northern Haida, but with some dialect-dependent variation. In Massett, *χ has become a voiceless pharyngeal like Semitic /ħ/ but in Hydaburg, Krauss describes the sound as a 'hoarse pharyngeal trill'. Massett *ɢ has become a pharyngeal much like Semitic /ʕ/, but in Hydaburg the *ɢ has become 'an affricate, glottal stop followed by a hoarse pharyngeal trill' (p. 840). In Skidigate (Southern Haida) this phoneme alternates between a voiced uvular stop and a voiced uvular fricative (Krauss and Leer 1981). If [ɢ, χ] turn up at all in Northern Haida, they can be traced to borrowings from Southern Haida. Very little is known about the phonology of these sounds.

Impressionistically, the Hydaburg pharyngeals are quite unlike the Salish ones, as the descriptions noted above would indicate. While the Salish /ʕ/ is an unambiguous resonant, Hydaburg /ʕ/ absolutely is not. Furthermore, given the historical origin of Haida ʕ < ɢ, one might expect the phoneme to be voiced and to retain some stop quality. Given descriptions of pharyngeal rather than uvular articulation in the Hydaburg dialect under consideration here, one might expect formant transitions to reflect a constriction very low in the vocal tract (hence high F1 especially), but not so low as to be purely glottal and so impose no formant structure on adjacent segments.

2.1 Manner of articulation

As mentioned, the most noticeable distinction between Salish /ʕ/ and Hydaburg /ʕ/ is manner of articulation: the Hydaburg pharyngeal is not a phonetic resonant, whereas Salish /ʕ/ is. The acoustic characteristics of Hydaburg /ʕ/ indicate a noisy, fricative-like sound whose affricate quality (i.e. the stop component) is more readily observable when it is not initial. Some tokens of initial /ʕ/ in the current database indicate a stop gesture followed by a fricative gesture but the stop component is most clear when /ʕ/ is not initial because of the absence of a consistent burst. With respect to the anticipated voice component in /ʕ/ given its origin in /ɢ/, those tokens in which /ʕ/ is preceded by a consonant show evidence of a periodic component prior to the silence that indicates closure.

The findings discussed above are best illustrated by direct examination of spectrograms and waveforms. Figure 7, provided for comparative purposes, is of word-initial /ʔ/. The glottal gesture manifests itself in some forms as one or two initial glottal pulses, which is some cases might be interpretable as a release gesture on a par with that found with other stop consonants. There is no indication of voicing and there is no fricative portion. The formant shift in the initial vowel in Figure 7 reflects the movement of the tongue towards the front articulation required for /d/.

Figure 7: /ʔ/: ʔadíci 'back yonder' (Hydaburg Haida: LP)

[7]Haida is a language isolate spoken on the Queen Charlotte Islands in British Columbia and Ketchikan and Hydaburg in Alaska.

In contrast to /ʔ/, initial /ʕ/(Figure 8) while showing some release feature (which may be glottal in origin and better interpreted as creak) is largely an aperiodic, noisy sound with its major concentrations of energy in the regions of 1000Hz and 2500 Hz. Average duration of the frication is 183 ms (measured over 27 tokens).

Figure 8: /ʕ/: ʕæl 'mussel' (Hydaburg Haida: LP)

The frequency characteristics of observable resonances in the fricative spectrum are to some extent dependent on the following vowel. Figure 9, ʕIliya 'ugly' shows an energy concentration at 500Hz, and an amplitude dip in the spectrum until 4400 Hz.

Figure 9: /ʕ/: ʕIliya 'ugly' (Hydaburg Haida: LP)

This formant instability deserves comment since it is usually glottal articulation which is considered so susceptible to the influence of adjacent (vocalic) articulation. The data under consideration here suggest that Hydaburg /ʕ/ has some similar susceptibility. This is of phoentic interest, since it indicates that whatever the articulatory gesture for /ʕ/, it has some independence from the upper vocal tract activity involved in adjacent gestures. If Hydaburg /ʕ/ has laryngeal fricative release, then the relationship between the formant structure of /ʕ/ and that of adjacent vowels is explained by the fact that the constriction site (larynx) is independent of supra-laryngeal activity. If the release is pharyngeal, then the gesture which produces it, like that which produces /h/, shares this relative independence from upper vocal tract activity. This is not an unreasonable assumption if the constriction is very low and close to the glottis and the musculature employed minimizes interference with the position of the body of the tongue. The matter is complicated since despite some influence from adjacent articulations, Hydaburg pharyngeals still retain some intrinsic formant structure (see Section 2.2). The issue is unlikely to be resolved without articulatory data.

Of further interest in Figure 9 is evidence of periodicity in the beginning of the waveform. This is presumably related to the appearance of glottal pulses is many tokens but also indicates some phonetic voicing. This aspect of /ʕ/ is absolutely consistent in all -Cʕ- sequences in the current database. It deserves further investigation in other contexts. Figure 10, sʕIt^{h} 'red', illustrates this periodic component more clearly.

Figure 10: /ʕ/: sʕIt^{h} 'red' (Hydaburg Haida: LP)

The question of whether /ʕ/ involves a stop component is not clearly resolved by examination of word-initial tokens given the difficulty of differentiating between what may be a laryngeal pulse or pulses and whatever pharyngeal or epiglottal release may look like as well as the absence of a release gesture in some tokens. In non-initial position the question is easier to resolve, since the *timing* of /ʕ/ indicates clearly that it has a period of closure followed by a period of frication (see Figure 10). Measurements of the closure period over 11 tokens average 142 ms (range 107-171 ms), with a

fricative duration of 117ms (range 61-149 ms). The average duration of the phonetic affricate is thus 259 ms (range 186-320ms).

Haida /ħ/ is a voiceless fricative with average duration of 174 ms (13 tokens, range 114-236 ms). As with /ʕ/, the formant structure of the fricative portion is sensitive to adjacent segments. Figure 11 illustrates this with two 50ms spectra taken at the temporal midpoint of /ħ/ followed by /i/ and /u/. The shape of the spectrum above 500 Hz bears a relation to the following vowel, and the F1 of ~550Hz is appropriate for a relatively high vowel such as /i/ or /u/ in the context of a low articulation.

Figure 11: /ħ/ spectra (Hydaburg Haida:LP)

/ħ/ lacks any indication of the stop component found with /ʕ/ and presumably is differentiated from /ʕ/ by this manner characteristic. This manner difference is most easily observed in medial position where /ʕ/ has the timing of a stop, /ħ/ that of a fricative. Figure 12, of medial /ħ/, may be compared with Figure 10, of medial /ʕ/, to illustrate this point.

Figure 12: /ħ/: ʧ^{h}iaħæw 'rain water' (Hydaburg Haida: LP).

2.2 Formant transitions

In the absence of a rigorous acoustic investigation of Hydaburg vowel and consonantal quality there are limitations on the interpretation of the findings reported here with respect to estimates of place of articulation. I present here what indications there are of the formant characteristics of Haida pharyngeals and leave a full investigation of Hydaburg vowel quality and its interaction with consonantal quality for future research.

At pharyngeal-vowel boundaries, the highest F1 readings are found at the boundary between a pharyngeal and a low vowel, the lowest between a pharyngeal and a high vowel. This is to be expected, and is paralleled in both Semitic and Salish data. While the data do not exist to compare these formant values with those found between labials, coronals, velars and uvulars, the database does contain some glottal stop-low vowel sequences. In such cases F1, while high, does not reach the extreme values found with pharyngeals. This again is consistent with what is known about Salish and Arabic pharyngeals. What remains to be seen is whether F1 for Hydaburg pharyngeals is higher than that found with uvulars, thus indicating a lower constriction site in the vocal tract. The matter is of some interest, given the historical derivation of Hydaburg pharyngeals from uvulars.

Figure 13 shows /ħ/ conditioning a much lowered F2 at the onset of the /I/ vowel (1144 Hz). F1 is 447Hz at the same point. Midpoint readings for this vowel are F1 513Hz and F2 1354Hz. This can be compared with Figure 10, sʕIt^{h} 'red', in which F2 undergoes a rapid and very steep transition from the offset of /ʕ/ to the following high front vowel.

Figure 13: ħIl 'neck' (Hydaburg Haida: LP)

3.0 Ahousaht (Nootka) pharyngeals

Dialects of the Wakashan language Nootka include phonemic pharyngeals. Jacobsen (1969) argues that Nootka /ʕ/ is derived from /q', q'ʷ/; /ħ/ from /χ, χʷ/. According to Jacobsen, this is a very recent innovation which does not go back to Proto-Wakashan or Proto-Nootkan.

All descriptions of the Nootkan sounds reflect a strong laryngeal element. Sapir and Swadesh (1939, quoted by Jacobsen 1969) describe the Nootka /ʕ/ as a 'glottal stop pronounced with the pharyngeal passage narrowed by the retraction of the back of the tongue toward the back of the pharyngeal wall', while /ħ/ is described as '/h/ pronounced with the pharyngeal passage thus constricted'. The sense of a glottal element is so strong that Sapir and Swadesh (1939) label the sounds as 'laryngealized glottals'. Sapir (1911) earlier had described Nootka /ʕ/ as "a peculiarly harsh and choky glottal stop resembling Arabic 'ain' "; in a later article he described /ʕ/ as 'a peculiar glottal stop of strangulated articulation and velar resonance'; Swadesh (1939) referred to /ʕ/ as a 'glottal stop with pharyngeal constriction'. [8] Nootkan /ħ/ also is likened to Semitic /ħ/ by Sapir (1911). Rose (1981:14-15) describes pharyngeals in the Kyoquot dialect of Nootka as follows:

> The ħ is like a fricative in being composed of aperiodic noise, but it is like a resonant in having large formant transitions which are perceived as offglides and onglides in adjacent vowels. The ʕ consists of a pharyngealized glottal closure which, like the ħ, is accompanied by a raised larynx and a retracted tongue root. ʕ is like a resonant in having no burst (*i.e.* a stop release). However, associated laryngealization, perceived as a series of 'cracks', gives the impression of a series of stop bursts. Impressionistically, the Nootka ʕ sounds much more stop-like and crisp than the Salish sound written with the same symbol.

The lowering effect of both pharyngeals on high vowels is noted in early descriptions (see Jacobsen 1969) and the low /a/ vowel tends to be realized as [aˤ] in the context of pharyngeals. Rose (1981) transcribes local vowel alternation which is very similar to the allophony described for both Salish and Semitic.

3.1 Manner of articulation

Ahousaht /ʕ/has the timing characteristics of a voiceless stop, i.e., it has a period of closure during which there is no energy in the spectrum and no indication of voicing.[9] Some tokens have what might be interpreted as a release gesture, manifested as a spike in the spectrogram. Figure 14

[8]The glottal aspect of Nootkan /ʕ/ is reflected in several phonological processes. For example, some inflectional suffixes in Nootka cause glottalization of a preceding stop, affricate or resonant. /q, qʷ/ surface as [ʕ] in these cases, suggesting that [ʕ] is both uvular and laryngeal. Under the same conditions a fricative is changed to a homorganic glide. /ħ/ alternates with [w'] in these cases, reflecting its historical origin in /χʷ/. Furthermore, Rose (1981) states that ejectives and 'other glottals such as /h, ʔ, ʕ/' do not occur morpheme-finally, and that vowels are retracted when adjacent to labialized or pharyngealized consonants and are laryngealized adjacent to ejectives, glottalized resonants, ʕ and ʔ.

9The voicelessness of both /ʕ, ħ/ is predicted by the total absence of contrastive voicing in the Nootkan inventory.

illustrates this, including the fact that the frequency range of this spike seems to be dependent on the following articulation. While the gesture which produces this spike *may* be wholly laryngeal in origin, it must be remembered that we lack a complete understanding of lower pharyngeal articulation, and the gesture may involve epiglottal or even ventricular closure and release. Furthermore, this spike is not present in all forms, in which case it is only when /ʕ/ is in non-initial position that its stop character is readily observable as a period of acoustic silence. There is no fricative release for Ahousaht /ʕ/ (as opposed to Haida /ʕ/).

Figure 14: ʕaʕiči 'eyebrow' (Ahousaht: GL)

Ahousaht /ħ/ is a voiceless fricative with average duration of 161 ms. (21 tokens, range 65-260 ms.[10]), Figure 15. /ħ/ has a clear formant structure with energy in the 1000 - 5000Hz region.

Figure 15: /ħ/: ʕaħmis 'a class of sea mammals' (Ahousaht: GL)

3.2 F-transitions

Whatever the musculature and speech organs involved in implementing the stop characteristics of Ahousaht /ʕ/, there is clear evidence that low pharyngeal constriction is also involved. Both /ʕ/ and /ħ/ condition lowering of F2 and raising of F1 when adjacent to a high front vowel. Since the gesture for /i/ is diametrically opposed to that for /ʕ, ħ/, it is in this context that the intrinsic formant characteristics of /ʕ, ħ/ are revealed most dramatically.

Figure 16 illustrates the consequences of pharyngeal articulation, in this case of /ħ/, by contrast with /ʔ/. The latter conditions no formant movement at all, as is expected of a purely laryngeal articulation, whereas /ħ/ lowers F2 and raises F1 at /i/-onset, just as is predicted of pharyngeal articulation.

Figure 16: ʔi:ħtu:p 'class of whales' (Ahousaht: GL)

Similar facts are illustrated for /ʕ/ in Figure 17, where again, lowering of F2 and raising of F1 is conditioned by the transition from the pharyngeal. This figure also provides a contrast between uvular articulation (/q/) and pharyngeal (/ʕ/). Of interest is that /q/ conditions less F2 lowering and F1 raising than /ʕ/, as predicted by its higher place of articulation in the vocal tract.

Figure 17: ʕiʕičqi 'blue whale (found way off shore)' (Ahousaht: GL)

10Ahousaht /ħ/ is shorter in initial position than in medial position, hence the large range in the duration measurements.

4.0 Conclusions

While the findings for Salish are based on a fairly large database with a number of speakers from several different languages, this is not true for the Ahousaht and Hydaburg database used here. There is a real need for a much broader investigation of the phonetics of Nootka and Haida, not only for the purposes of explicating the dimensions of pharyngeal articulation, but to place a phonetic investigation such as the one undertaken here in its full inter- and intra-language context. It is also important to assess the range of speaker-dependent variation.

Even with these limitations, there seems little doubt that the phonetics of pharyngeal articulation as manifested in the Pacific Northwest languages examined here is quite varied. This paper has confirmed impressionistic transcriptions of a pharyngeal resonant (Salish), a pharyngeal affricate (Haida) and a pharyngeal stop (Ahousaht). /ħ/ appears to have a more consistent phonetic profile across the three languages. It is hoped that the data presented here can be used comparatively when the large and extremely interesting pharyngeal and laryngeal inventories of Caucasian languages are examined phonetically.

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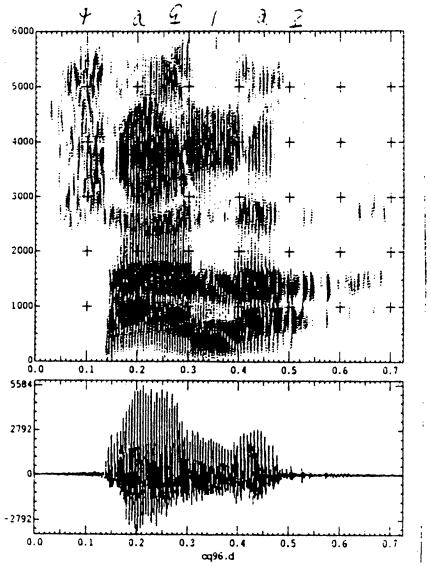


Figure 1: /ʕ/: ɬáʕlaʔ 'raspberry' (Colville: CQ)

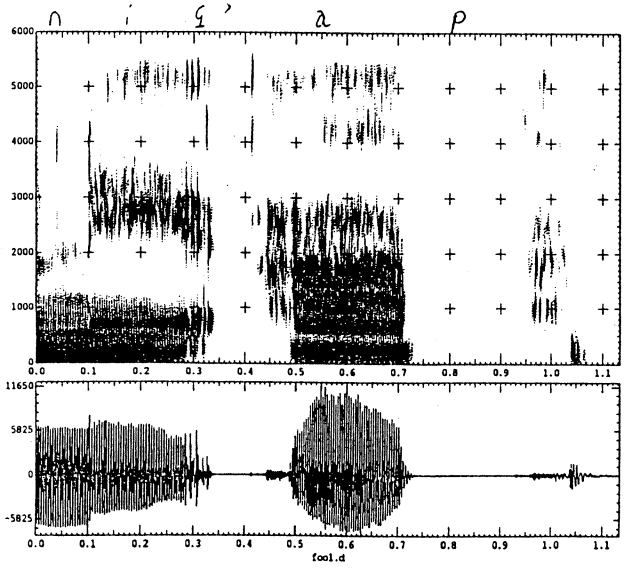


Figure 2: /ʕ'/: (k'l) niʕ'áp 'forever'

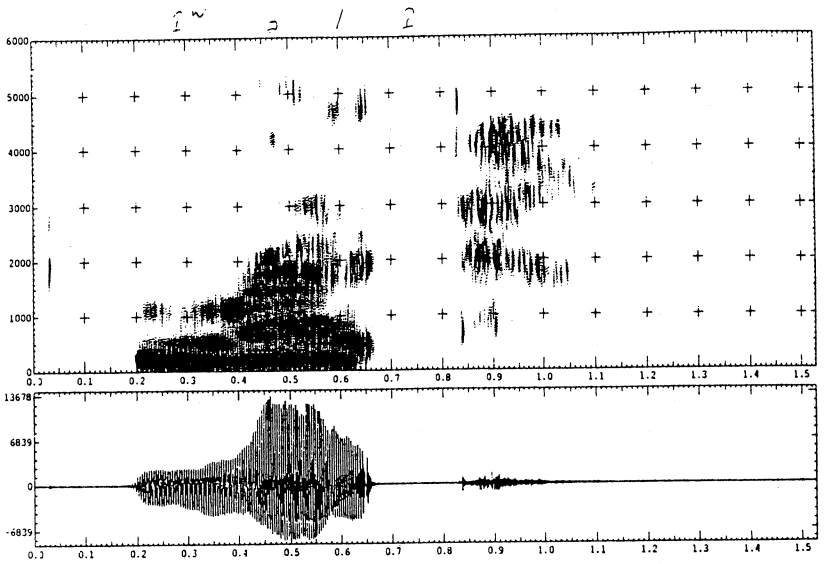
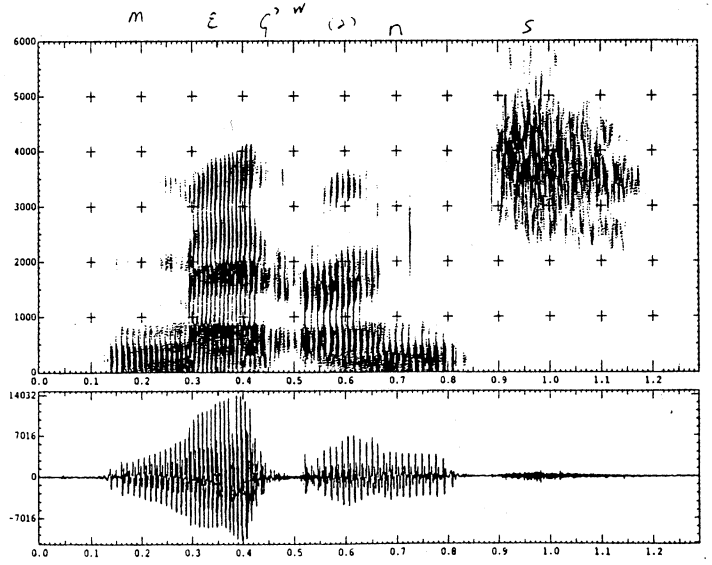


Figure 3: /ʕʷ/ ʕʷəl' 'bright' (Moses-Columbian: AB)



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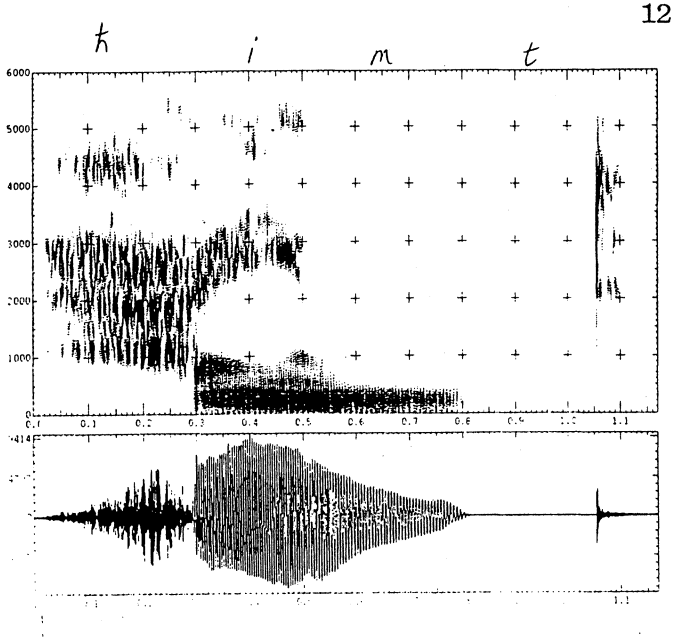

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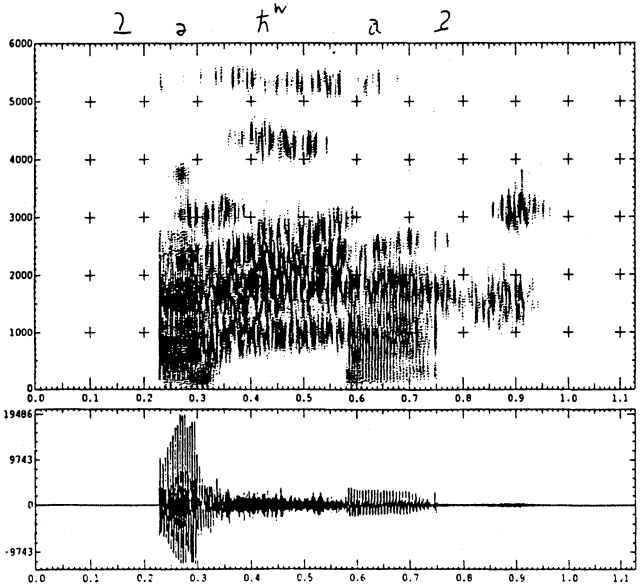

Figure 6: /ħʷ/ ʔəħwaʔ 'cough' (Moses-Columbian: AB)

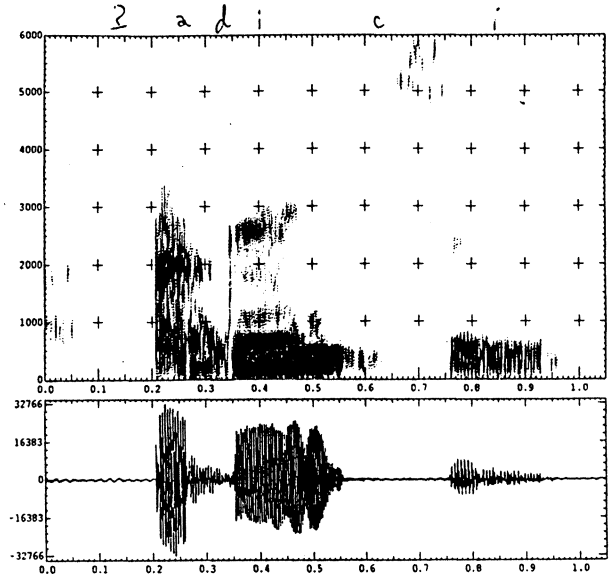

Figure 7: /ʔ/: ʔadíci 'back yonder' (Hydaburg Haida: LP)

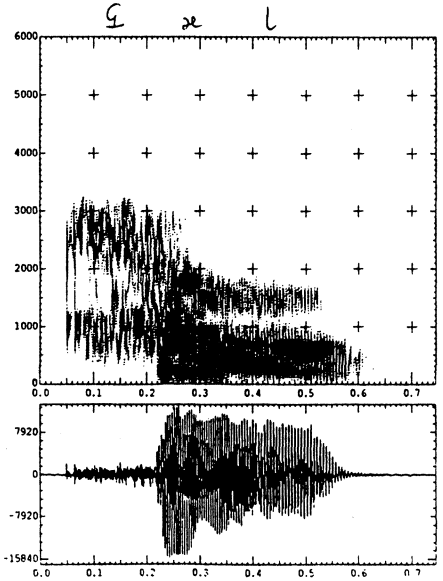

Figure 8: /ʕ/: ʕæl 'mussel' (Hydaburg Haida: LP)

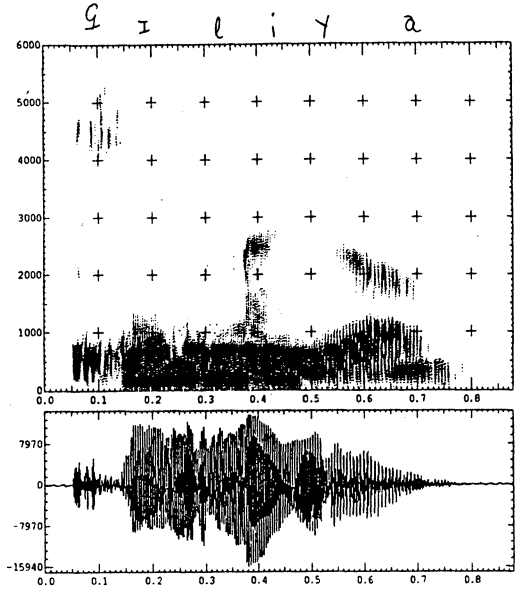

Figure 9: /ʕ/: ʕIliya 'ugly' (Hydaburg Haida: LP)

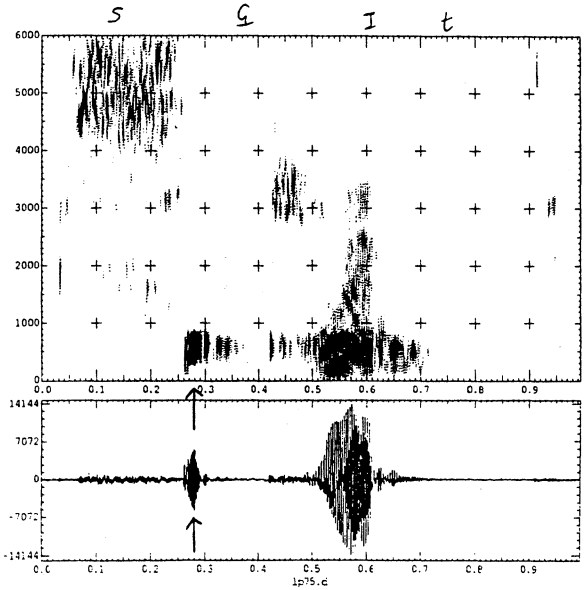

Figure 10: /ʕ/: sʕIt^{h} 'red' (Hydaburg Haida: LP)

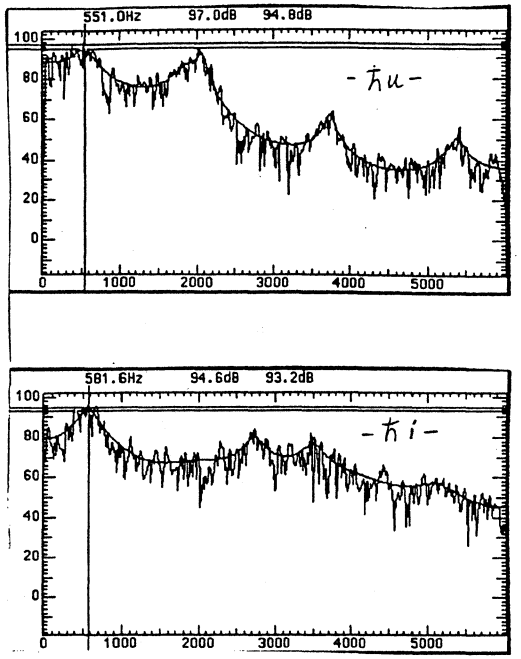

Figure 11: /ħ/ spectra (Hydaburg Haida:LP)

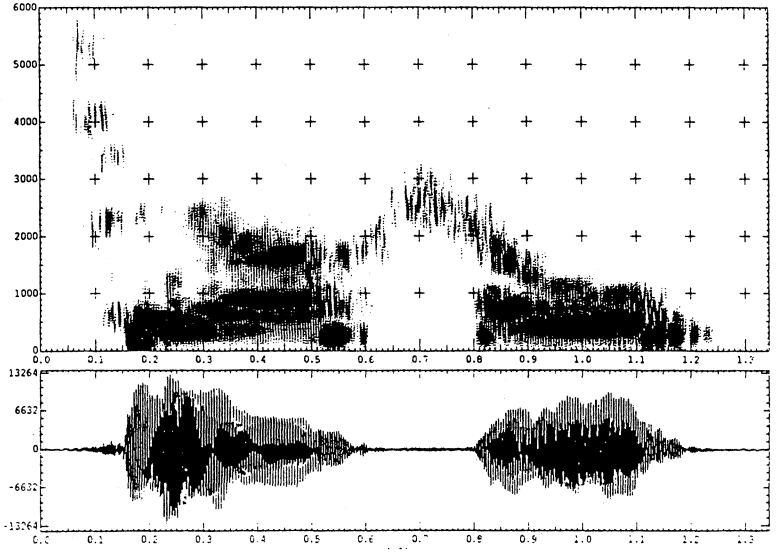

Figure 12: /ħ/: ʧ^{h}iahæw 'rain water' (Hydaburg Haida: LP).

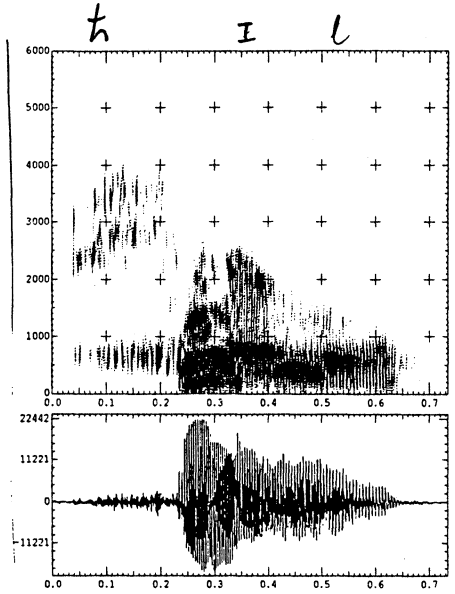

Figure 13: ħIl 'neck' (Hydaburg Haida: LP)

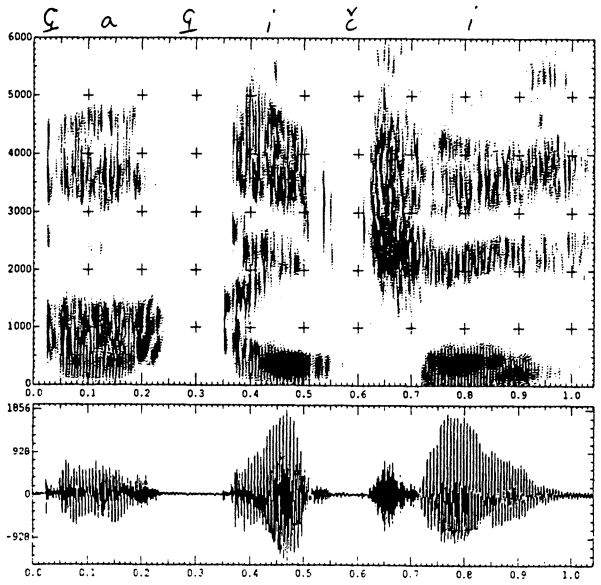

Figure 14: ʕaʕiči 'eyebrow' (Ahousaht: GL)

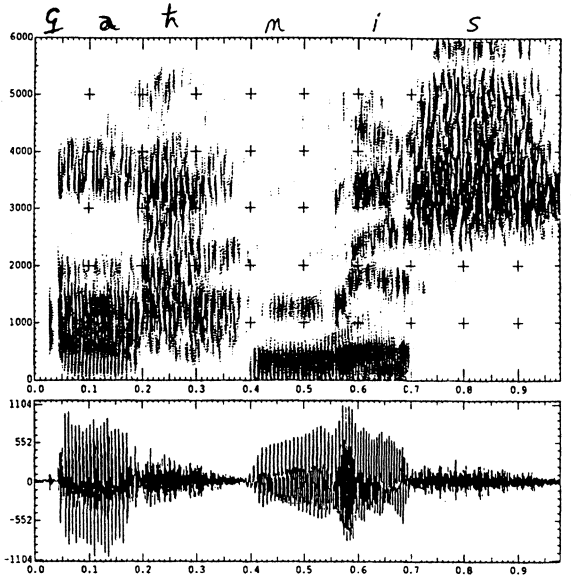

Figure 15: /ħ/: ʕaħmis 'a class of sea mammals' (Ahousaht: GL)

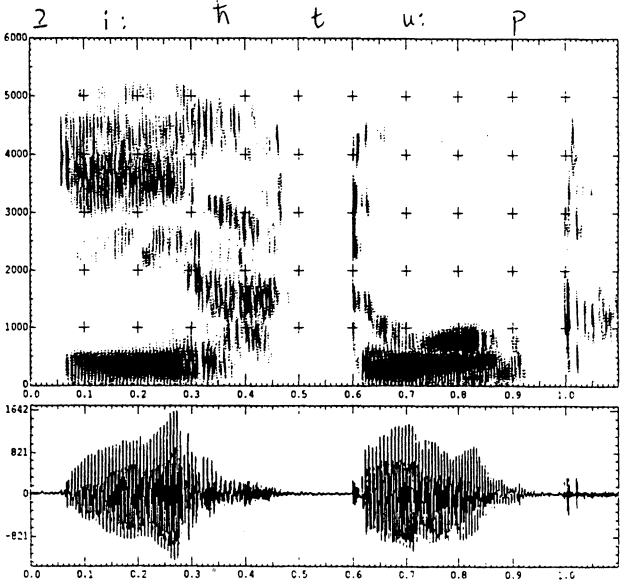

Figure 16: ʔi:ħtu:p 'class of whales' (Ahousaht: GL)

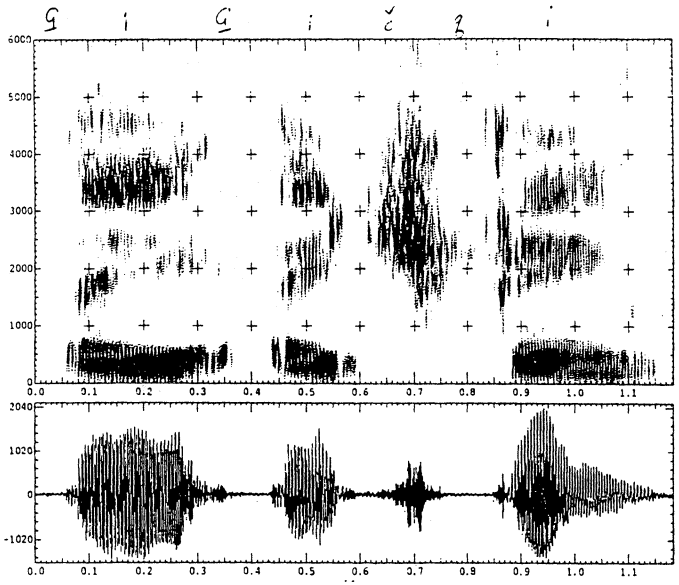

Figure 17: ʕiʕičqi 'blue whale (found way off shore)' (Ahousaht: GL)