

Physics 1240: Sound and Music

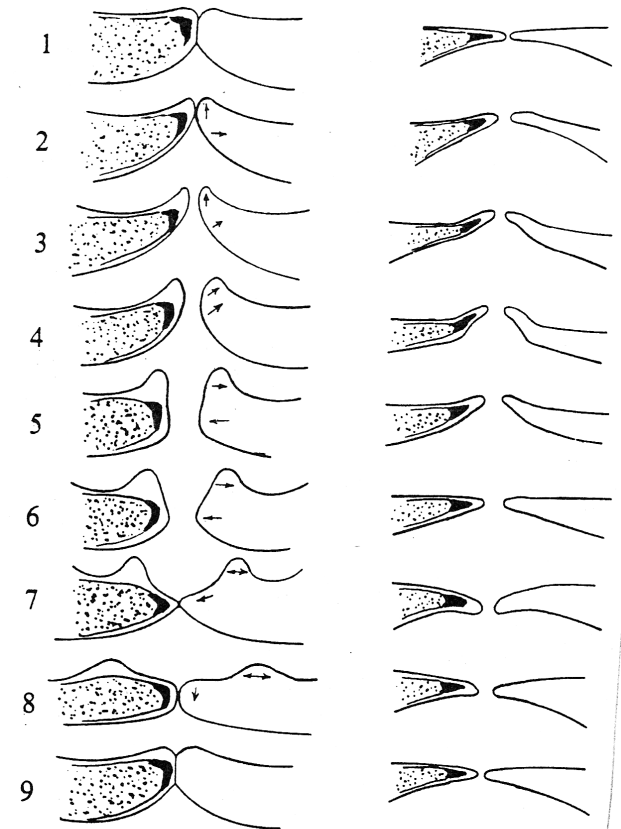
Today (8/1/19): Language, Animal Sound Production

Next time: Auditorium and Room Acoustics



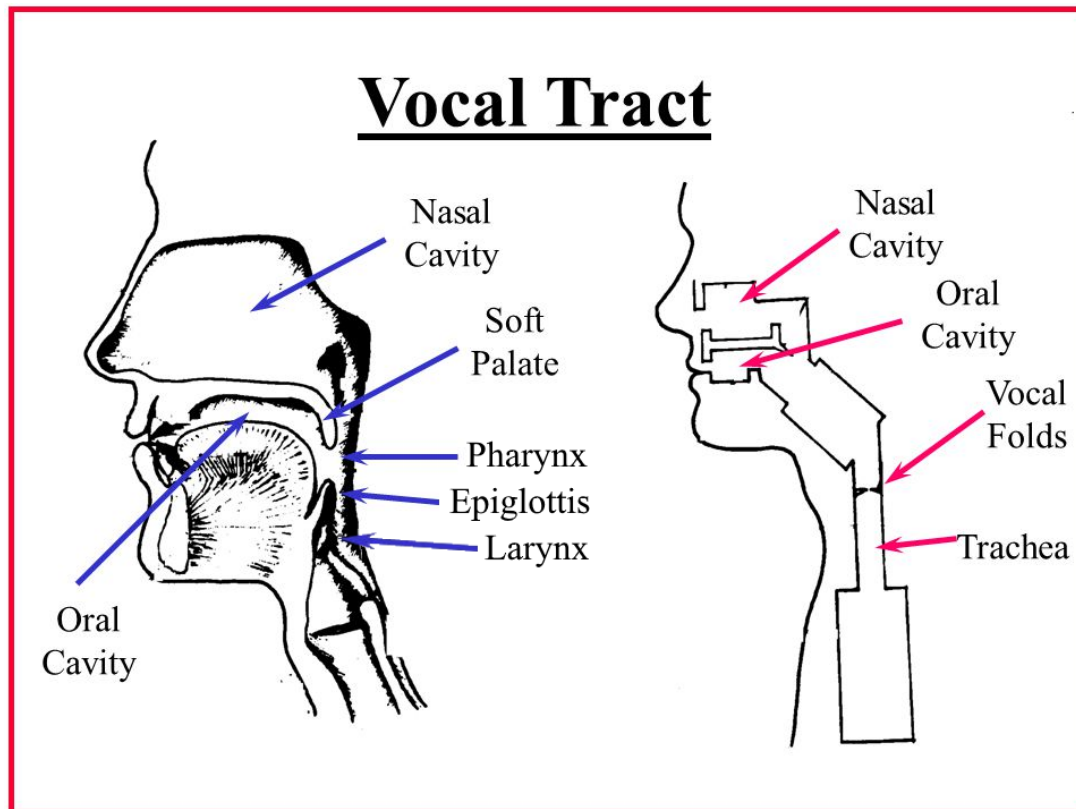
Review

- Vocal cords: produce sound by the Bernoulli effect
- Determines pitch of a sound



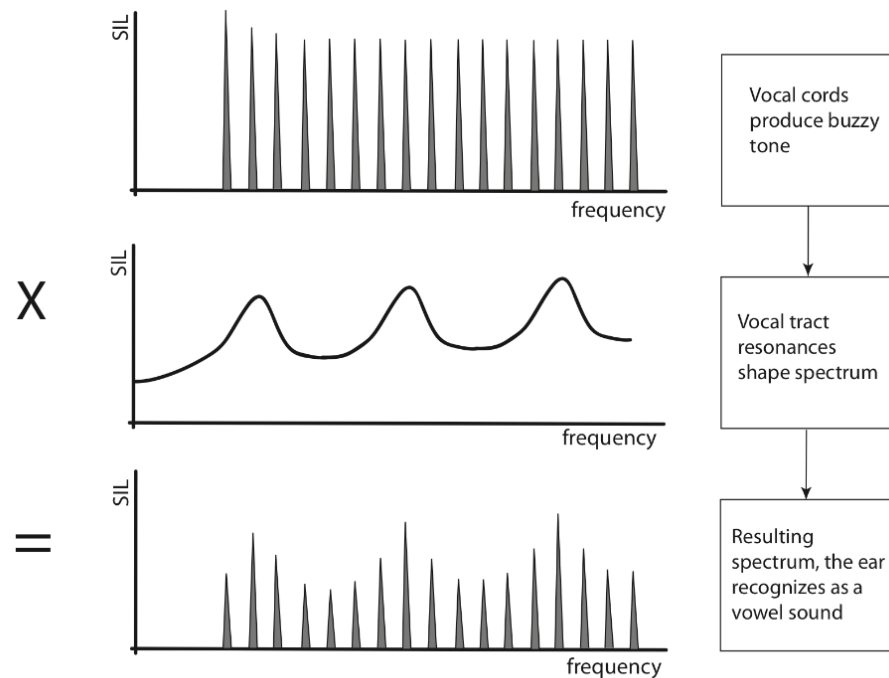
Review

- Vocal tract: can be modelled as tube closed on one end, 14-17 cm long
- Determines timbre of a sound



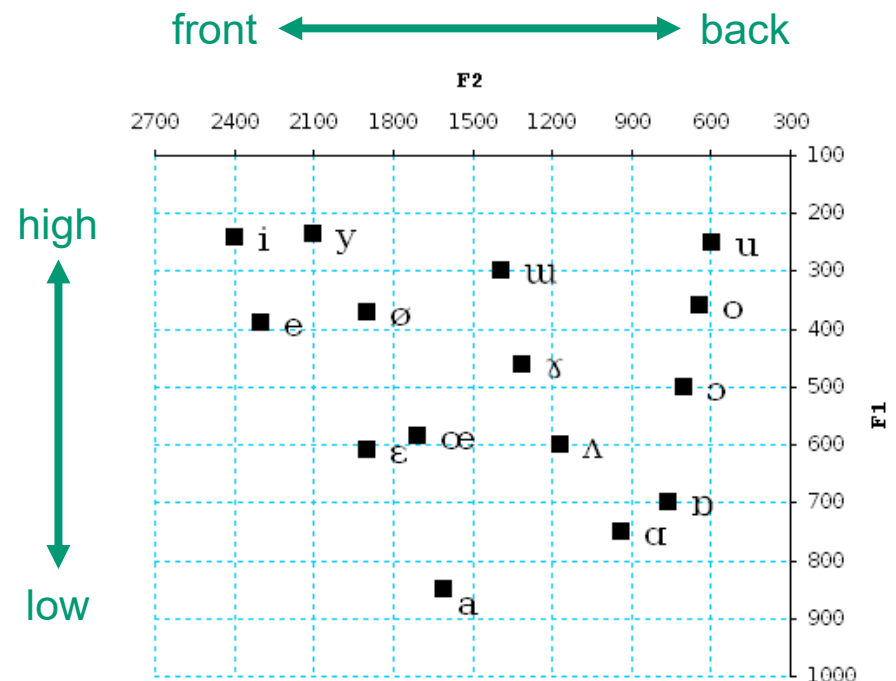
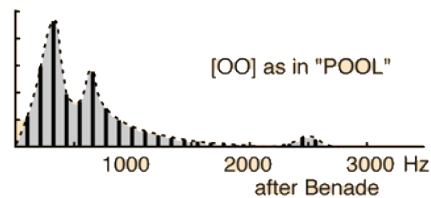
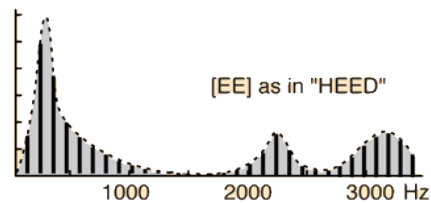
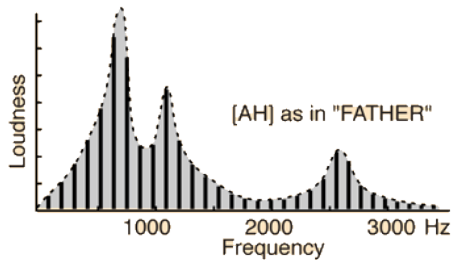
Review

- Formant: band of enhanced frequencies corresponding to a resonant frequency in the vocal tract



- What different sounds are we able to make with our vocal tract?

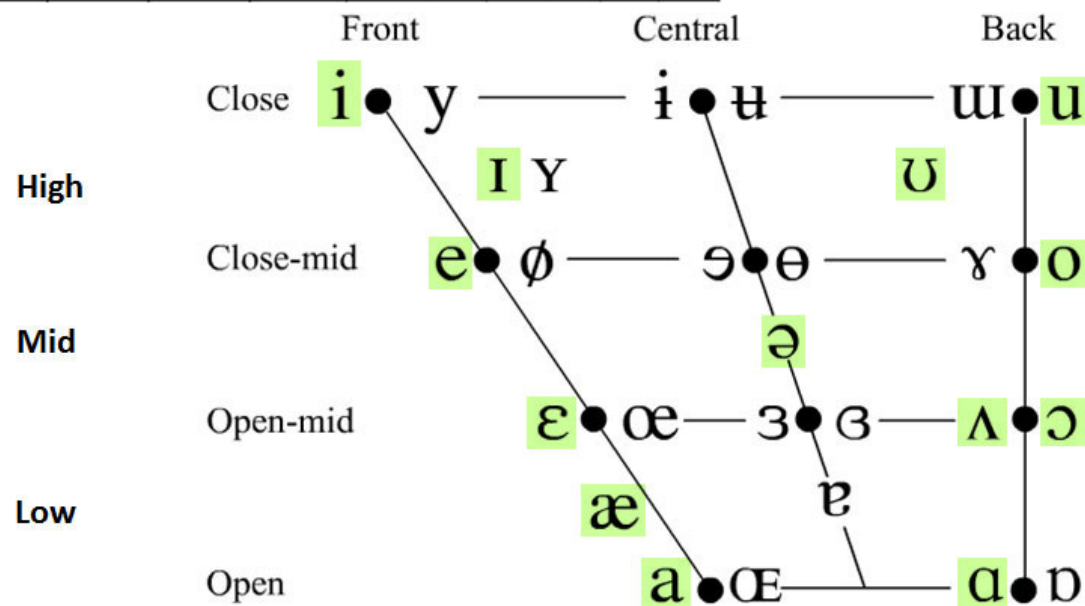
- F1 and F2 determine different vowels



- Phonemes: smallest units of sound
 - Vowels (vocal tract completely open)
 - Plosives (burst of air through initially closed vocal cords)
 - Fricatives (forcing air through turbulent passageways)
 - Other (Approximants (l, r, w, y), Nasals (m, n, ng))
- Voiced (vocal cords set to vibrate) vs unvoiced (whispering)
- Places of articulation: lips, teeth, alveolar ridge, hard palate, soft palate, uvula, pharynx (throat), epiglottis, glottis
- Diphthongs: two vowel sounds merged together (e.g. coin, loud, side)

International Phonetic Alphabet

	Bilabial	Labio-dental	Dental	Alveolar	Post-Alveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Epi-glottal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k ɡ	q ɢ		ʔ	ʔ
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ	ħ	h ɦ
Approximant	w*	ʋ		ɹ		ɻ	j	ɰ			ç	h ɦ
Trill	ʙ			r					ʀ			
Tap, Flap		ɹ̥		ɾ		ɽ						
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ			
Lateral fricative				ɬ ɮ								
Lateral approximant				l		ɭ	ʎ	ʟ				
Lateral flap				ɭ								



North American English Sounds



Clicker Question 17.1

The pitch of a vowel sound can be changed by...

- A) Changing the frequency of the first formant
- B) Changing the shape of the vocal tract
- C) Changing the tension of the vocal folds
- D) Both A and B



Clicker Question 17.1

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- C) Changing the tension of the vocal folds**
- D) Both A and B



Clicker Question 17.2

The type of vowel sound produced can be changed by...

- A) Changing the frequency of the first formant
- B) Changing the shape of the vocal tract
- C) Changing the tension of the vocal folds
- D) Both A and B



Clicker Question 17.2

The type of vowel sound produced can be changed by...

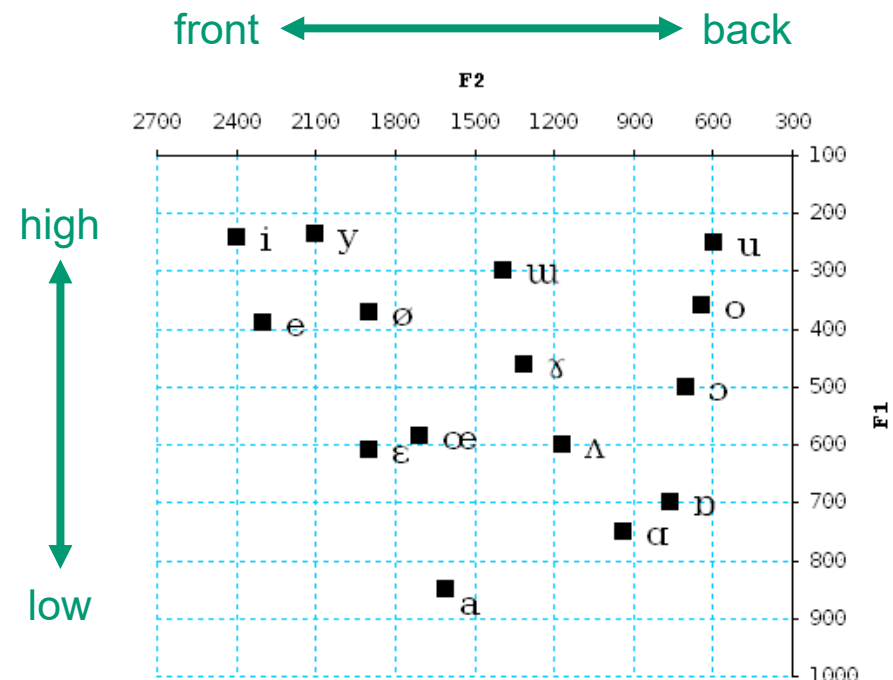
- A) Changing the frequency of the first formant
- B) Changing the shape of the vocal tract
- C) Changing the tension of the vocal folds
- D) **Both A and B**



Clicker Question 17.3

Approximately what are the first two formant frequencies for the “u” sound in the word “chute”?

- A) 100 Hz and 1000 Hz
- B) 250 Hz and 700 Hz
- C) 350 Hz and 700 Hz
- D) 250 Hz and 2400 Hz

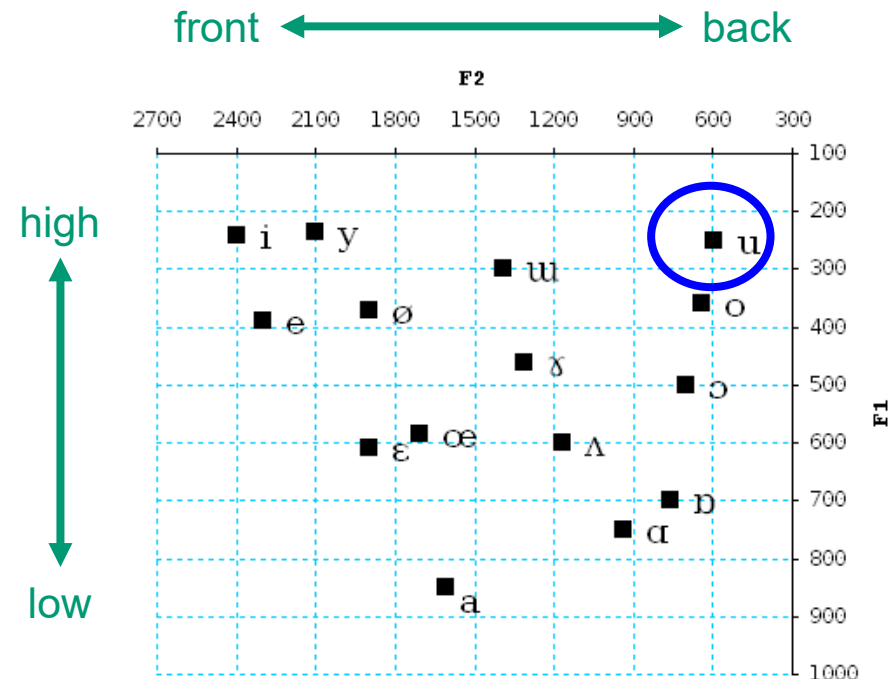




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BA

Clicker Question 17.4

How many vowel sounds are present in the phrase “iced tea”?

- A) 2
- B) 3
- C) 4
- D) 5
- E) 6



BA

Clicker Question 17.4

How many vowel sounds are present in the phrase “iced tea”?

A) 2

B) 3

aist.ti

C) 4

D) 5

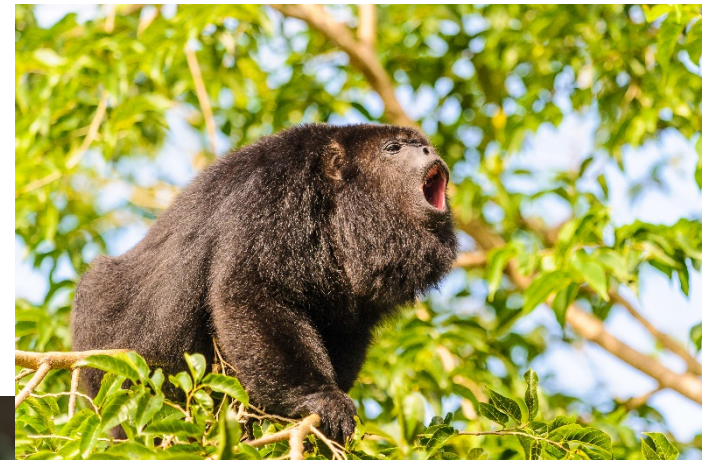
E) 6

- Other animals also produce sound!
- Common mechanisms:
 1. Air flow (humans, other mammals, frogs, birds)
 2. File and scraper (crickets, grasshoppers, crabs)
 3. Vibrating membrane (cicadas)
 4. Can you think of others?



Air Flow in Animals

- Mammals can produce a wide variety of sounds
 - Larynx, resonating chamber





Air Flow in Animals

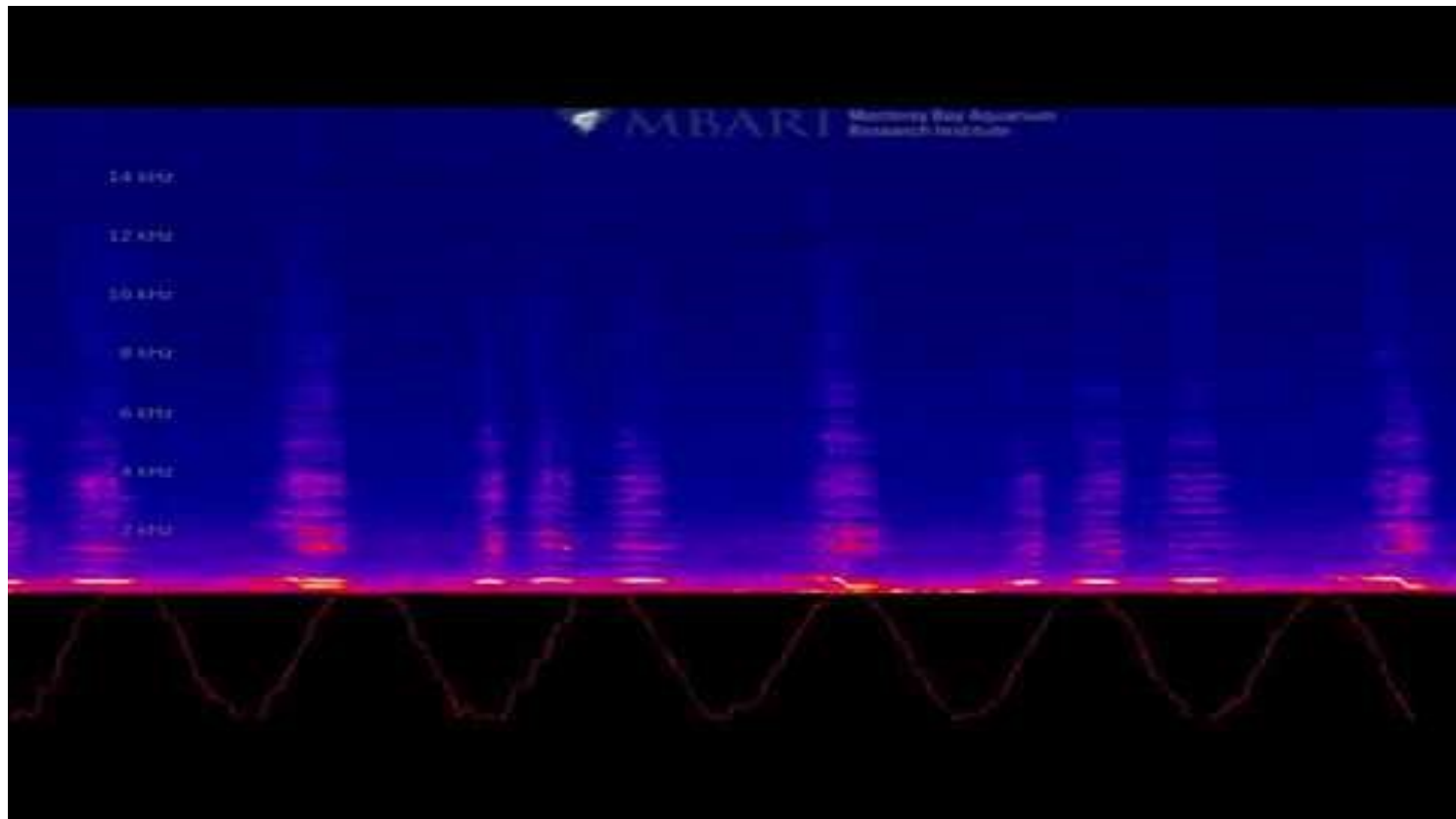
- Frogs





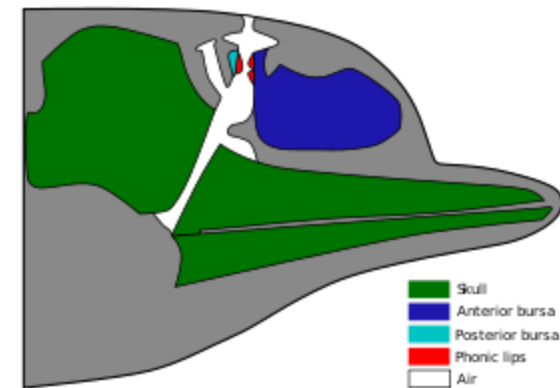
Air Flow in Animals

- Baleen whales
 - Larynx but no vocal cords; don't need to exhale to vocalize



Air Flow in Animals

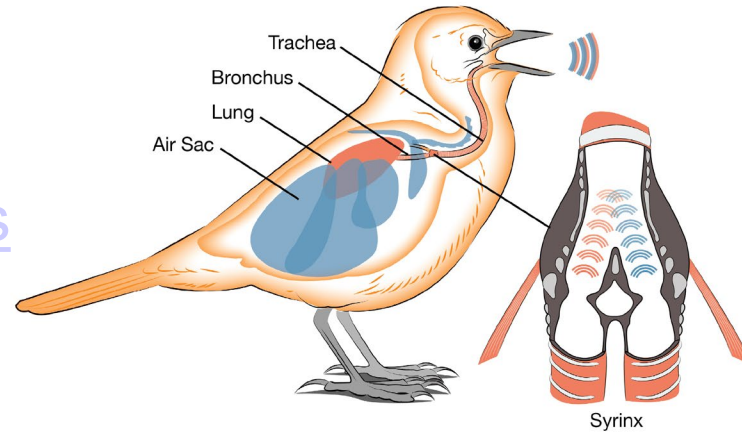
- Toothed whales
 - No larynx; phonic lips on forehead
 - Echolocation



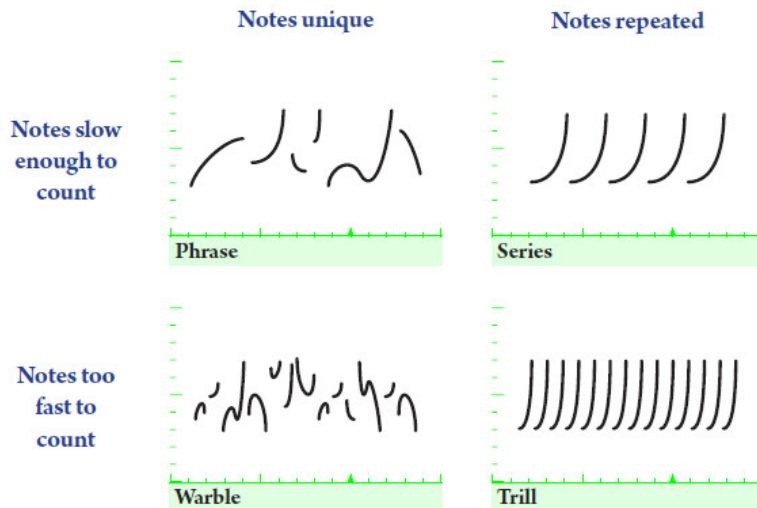
Air Flow in Animals

- Birds: syrinx

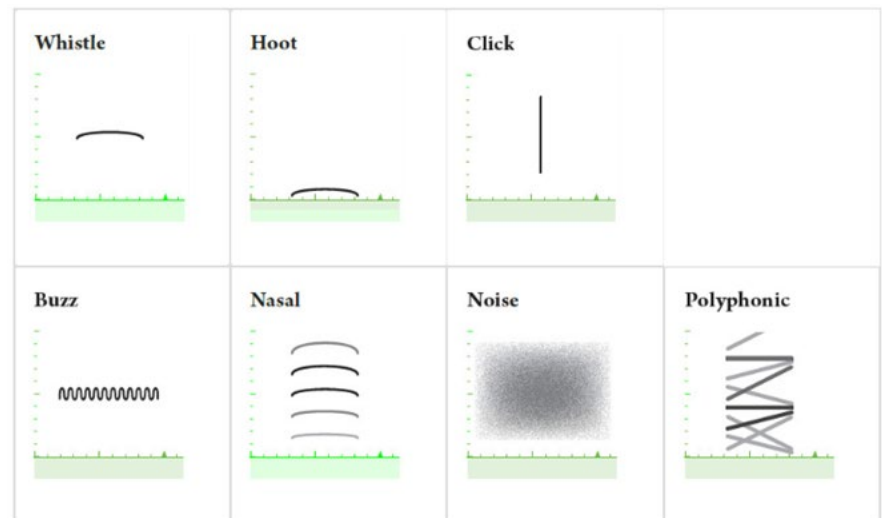
<https://academy.allaboutbirds.org/features/birdsong/how-birds-sing>

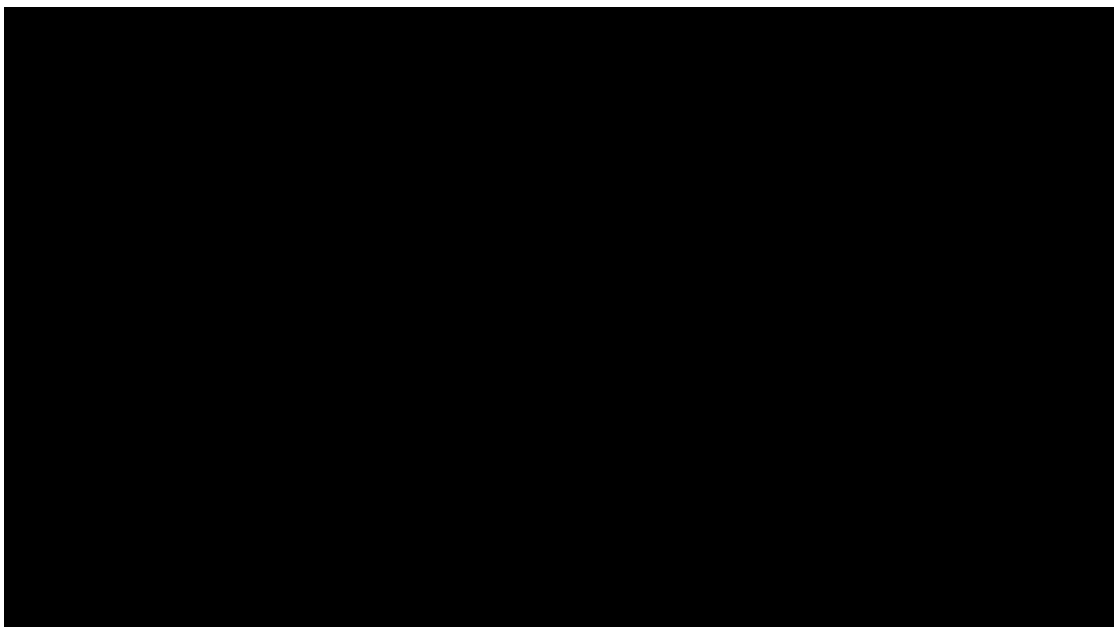
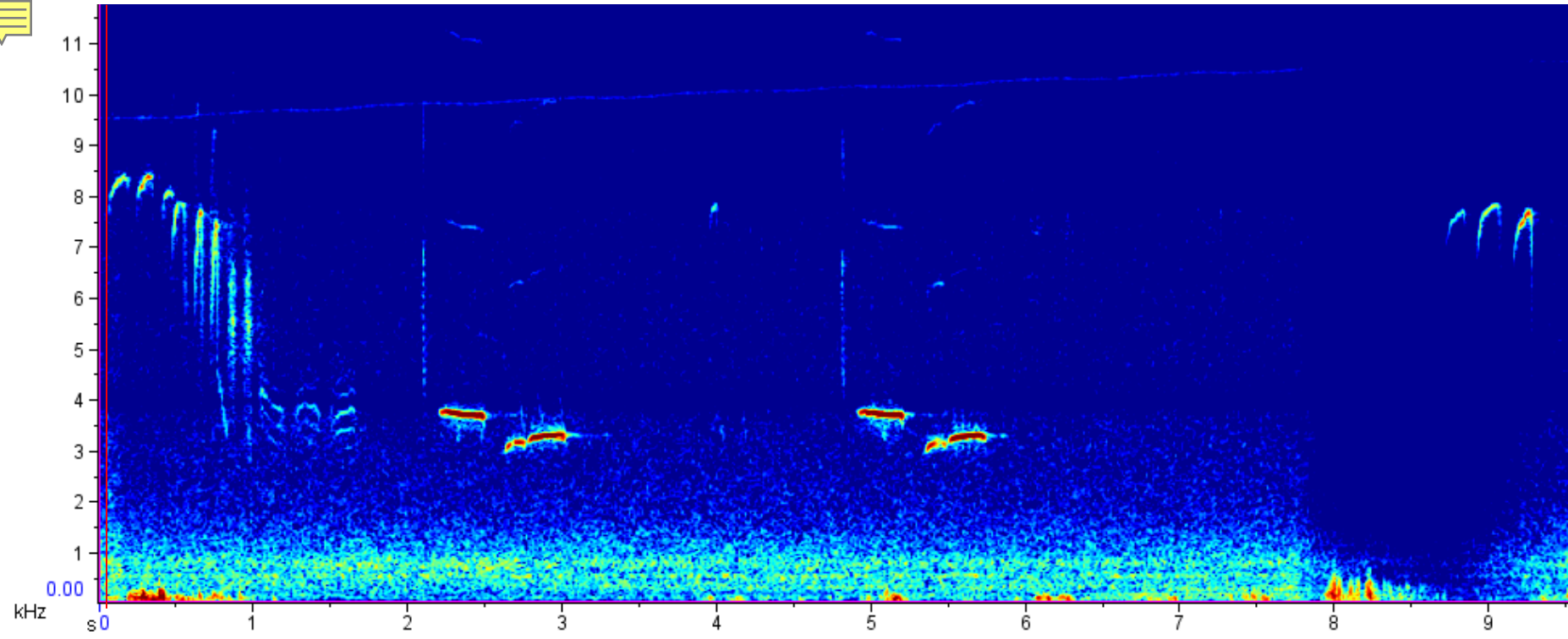


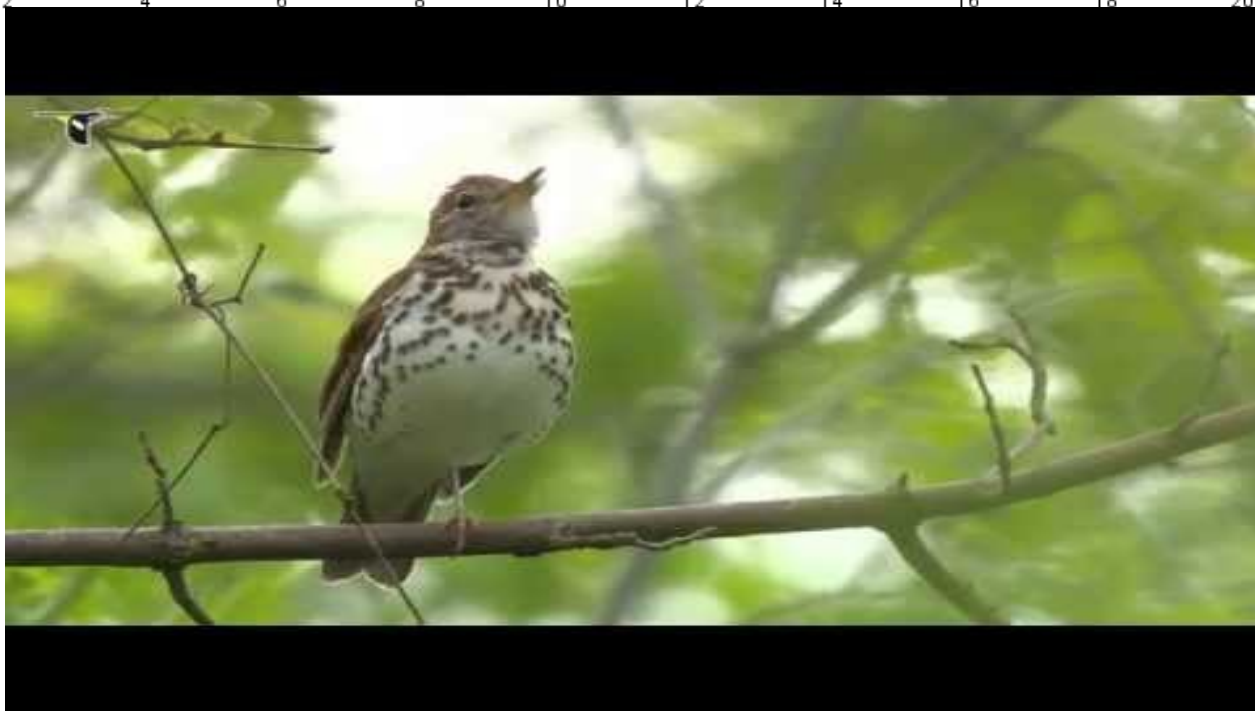
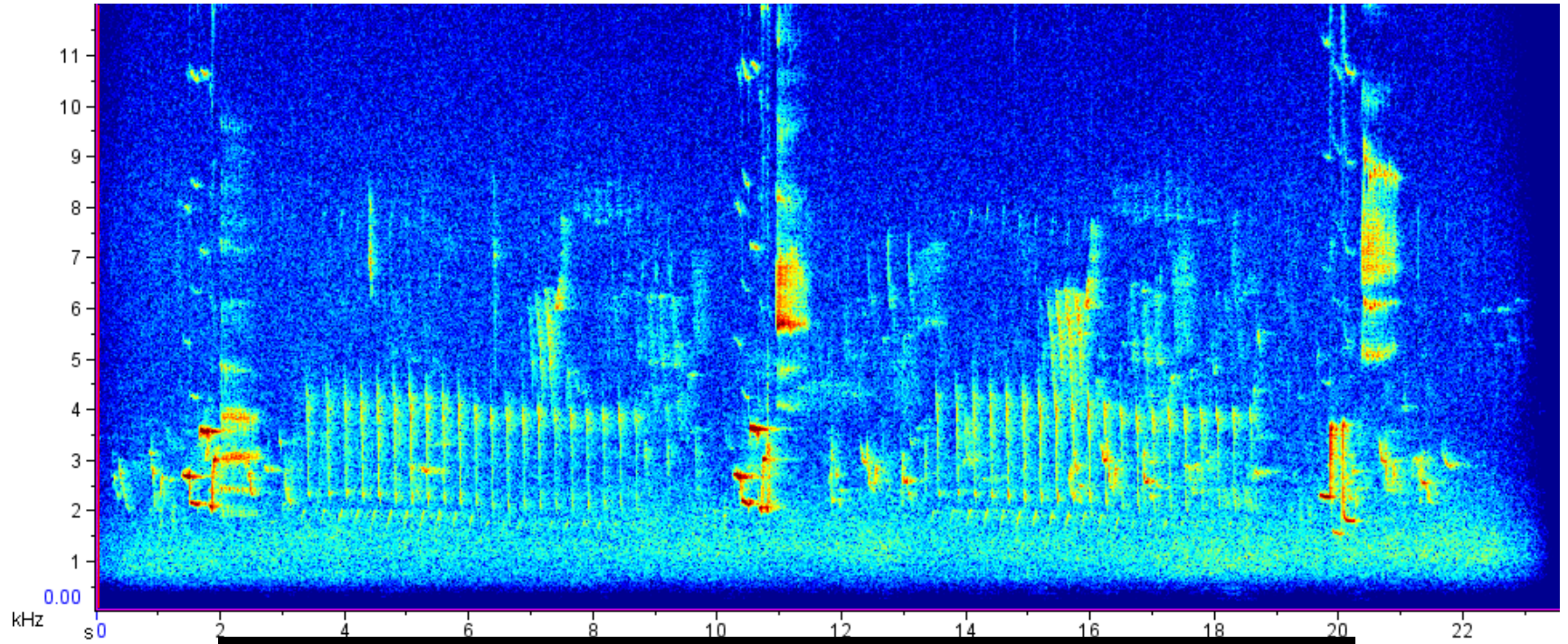
Song patterns

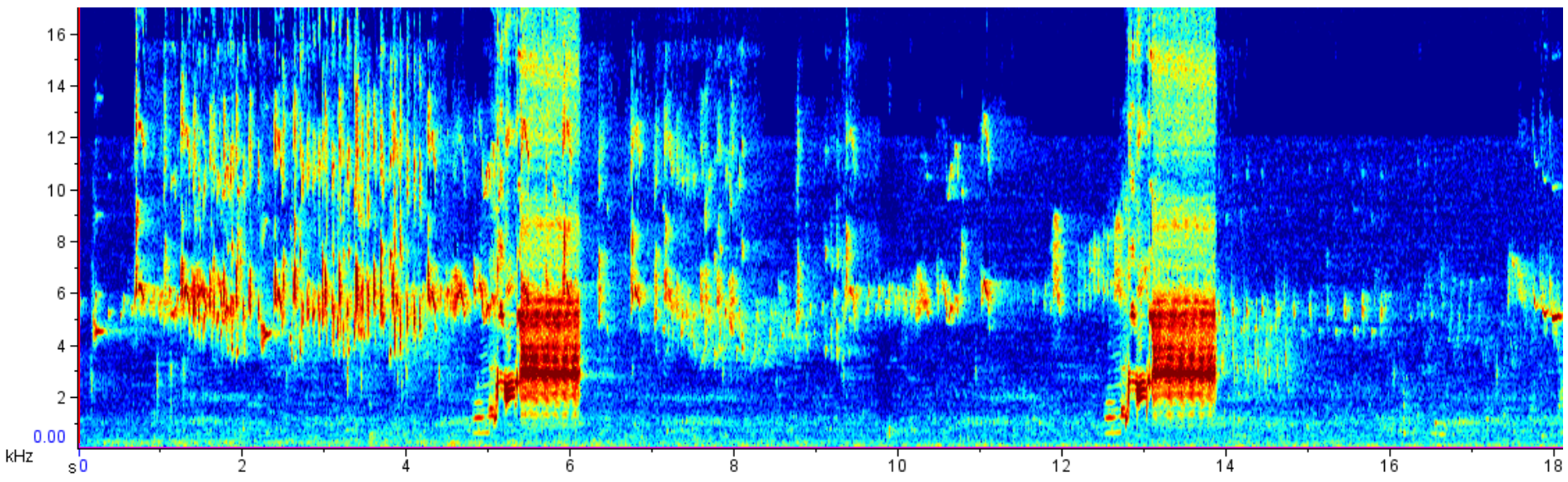


Timbres











Air Flow in Animals

- Lyrebird



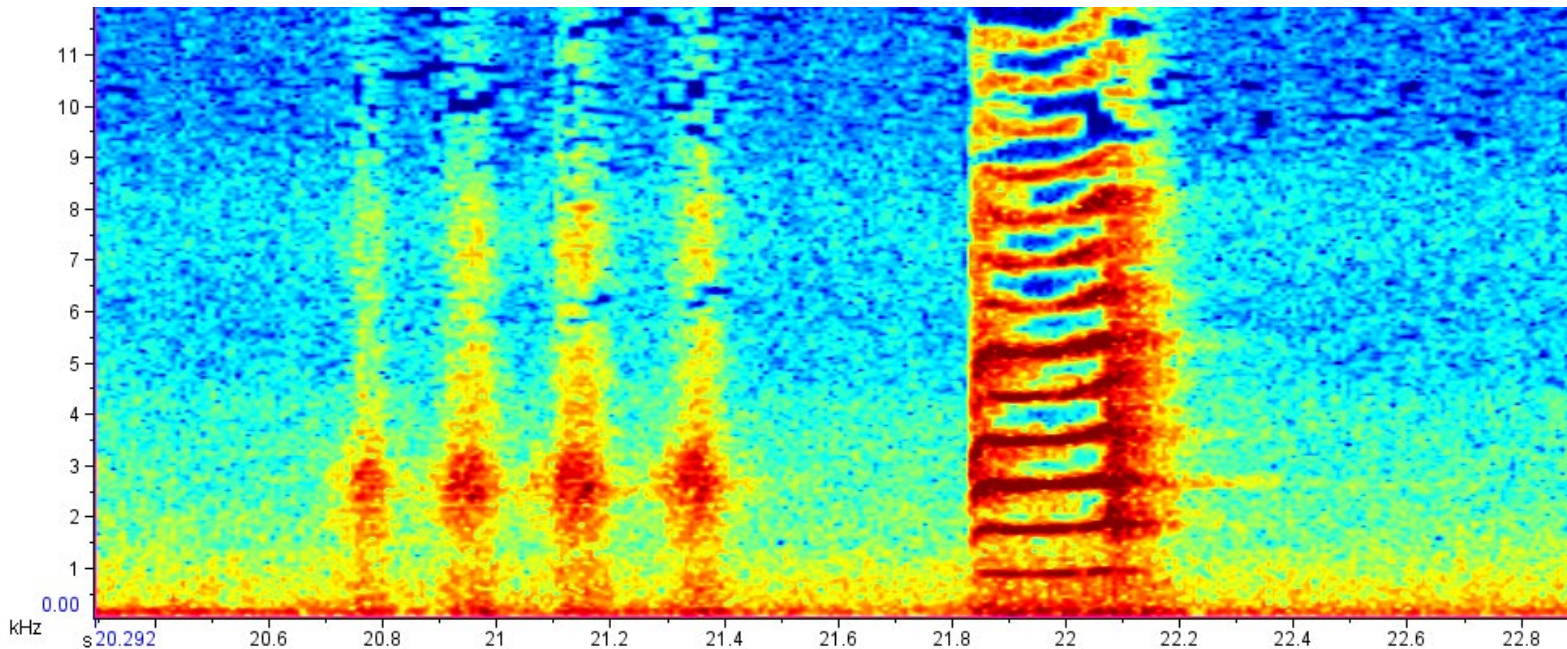


BA

Clicker Question 17.5

What best describes the timbre of the following bird call?

- A) Noise followed by nasal sound
- B) Whistle followed by noise
- C) Noise followed by buzz
- D) Nose followed by whistle



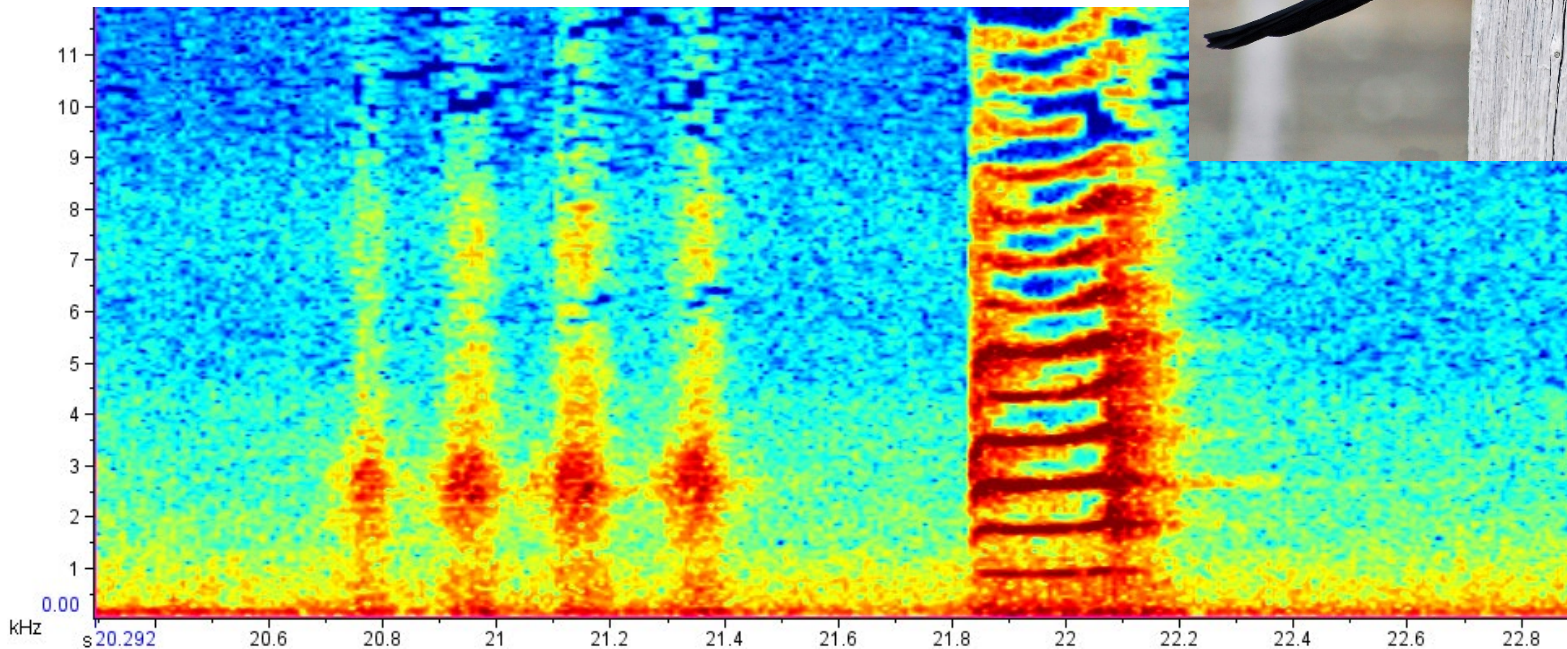


BA

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Air Flow in Animals

- Dinosaurs

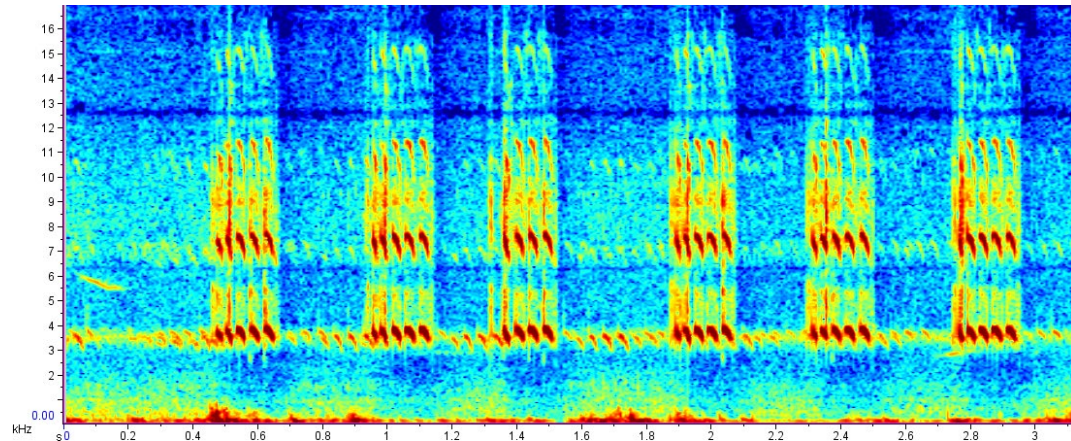


Insect Sounds

- Stridulation: rubbing two body parts together (file and scraper)
 - Leg-wing (grasshoppers)
 - Wing-wing (crickets, katydids)
- Cricket as thermometer: Cold-blooded (more heat means more energy, faster vibrations)

$$T[{}^{\circ}\text{F}] = 40 + N_{15}$$

chirps in 15 seconds





Insect Sounds

- Tymbal: vibrating membrane in insects like cicadas

