
**Overview**
- Physical characteristics of vocalizations
- How the syrinx produces sounds
- Functional aspects of communication
  - Information content of song
  - Species and individual recognition
  - Advantages of song variety and dialects
- Vocal mimicry
- Learning to sing

**Terminology**
- Song
- Call
- Amplitude
- Frequency
- Oscillograph/gram
- Sonograph/gram
- Glissando
- Harmonic
- Modulation
Song types

- **Whistled songs**
  - Nearly pure sinusoidal waveforms, no harmonics (Blackpoll Warbler)
- **Harmonic songs**
  - Show multiples of fundamental frequency (Black-capped Chickadee)

Sound characteristics

- (A) Contact calls: short duration, broad frequency range are easy to locate.
- (B) Alarm calls: long duration, narrow frequency range are difficult to locate.
- Simple calls penetrate vegetation, common in forest birds (Bellbird, Ovenbird)
- Low frequency sounds are best for long-distance communication (Bittern, Owl)
- Complex calls most effective in open habitats (Meadowlark)

Sound is produced by the syrinx

- Located in the body cavity at the junction of the trachea and the two primary bronchi
- Primary structures are vibrating tympaniform membranes, supporting cartilage, and controlling muscles
- Sound created by vibration of air passing through syrinx
- Movement of the bill is generally not important to sound production

Syringeal musculature

- Syringeal muscles control song production
- 2 – 6 pairs
- Lacking in ratites, storks, and New World vultures

Cassowary
Birds have two voices

- The two halves of the syrinx are independent and can produce two distinct songs simultaneously

Complex modulation = complex song

- Rapid changes (modulation) in frequency and amplitude create complex songs

Whooping it up

http://www.operationmigration.org/

Functions of songs and calls

- Reproductive
  - Define territory boundaries
  - Defend territory against rivals
  - Attract mates
  - Synchronize reproduction
  - Strengthen pair bond

- Social
  - Species identification
  - Warning calls
  - Information about food
  - Flock maintenance
  - Mobbing predators

- Individual
  - Individual recognition
  - Identify mates, offspring, parents, neighbors
  - Define territory boundaries
Songs convey important information about species

- Calls of four individual Least Terns

Songs convey important information about individuals

- Song repertoires and mimicry may represent sexual selection acting on song
  - Chestnut-sided Warblers (Kroodsma) and Swamp Sparrows with longer, more frequent, and more vigorous songs have higher reproductive success (Nowicki).
  - Northern Mockingbirds and Superb Lyrebirds with more diverse repertoires have higher mating and reproductive success

Song repertoires and mimicry

- Songs show variation at different geographic scales
Four stages of song learning

- **Early Development**
  - First 2-3 months, begging calls and simple subsong
- **Silent Period (Fall)**
  - No vocalizations for up to several months
- **Subsong Period (Winter)**
  - Practice period, song is plastic, auditory feedback essential
- **Song Crystallization (Spring)**
  - Syllables dropped, final form of song becomes fixed

Non-vocal sounds

“Peent!”