


Anuran Courtship & Mating



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Goal of the Lecture

**To familiarize students with anuran courtship
and mating strategies**

Reading Assignments:

1) See Website

Lecture Structure

1. Migration & Orientation
2. Vocalizations
 - A. Type of Calls
 - B. Call Mechanics
 - C. Types of Vocal Sacs
 - D. Factors Influencing Calls
 - E. Call Strategies
 - F. Calls and Fitness
3. Predators
4. Other Communication Methods
5. Courtship
 - A. Sexual Dimorphism
 - B. Amplexus
 - C. Oviposition

Migration

- Can begin in the fall
 - Overwinter near breeding areas
- Must cross barriers

Conservation Implications?



USDOT

Where's the Garmin?

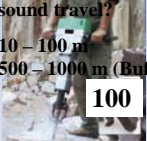
- Auditory Cues
- How loud?
 - 120 decibels



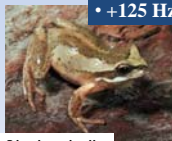
Eleutherodactylus coqui

How far can the sound travel?

- 10 – 100 m
- 500 – 1000 m (Bufonids, Spadefoots)



100



+125 Hz

Litoria ewingii

Conservation Implications?


Where's the Garmin?

- Geotactic or Hygrotactic
 - Migrate downhill and toward moisture
 - Non-random dispersal to and from wetland
- Olfactory Cues
 - Breeding site odors (algae blooms)




Where's the Garmin?

- Visual Cues
 - Celestial Bodies
 - Circadian Clock
 - Fixed Visual Landmarks



Conservation Implications?



- Fewer calls
- More frequent movements
- Orientation?



(Baker and Richardson 2006)

Types of Anuran Calls

- Advertisement Calls
 - Courtship
 - Territory
 - Encounter
 - Compound Advertisement
- Courtship
 - Attract female for mating
 - Once female is close lengthen call and/or increase calling rate

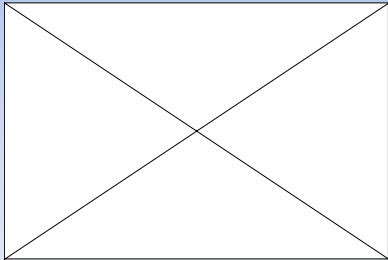
Types of Anuran Calls

Modifications of advertisement call

- Territory – Aggressive (long-range)
 - Produced in response to another male advertisement call
- Encounter – Aggressive (short-range)
 - Produced in response to a close encounter with another male
- Graded Aggressive Call – calls become longer as the distance between males decreases


Types of Anuran Calls

- Compound Advertisement
 - “Co” – Territory
 - “qui” – Courtship





Types of Anuran Calls

- Reciprocation Call
 - Female response
 - Discoglossidae, Pelodytidae
- Release Call
 - Response to unwelcomed amplexus
- Distress Call
 - Loud – often due to predators

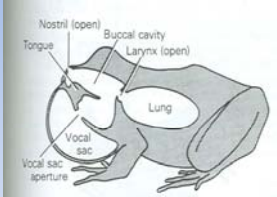


Alytes cisternasii

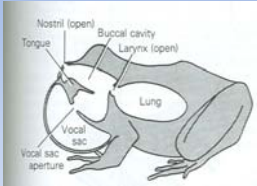


Mechanics of the Typical Anuran Call

- 1) Inhale Lungs
- 2) Close Nares
- 3) Contract Trunk Muscles
 - External & Internal Oblique Muscles
 - Muscle contraction determine call
 - Short calls –single contraction
 - Long call – series of short contractions (pulses)



Mechanics of the Typical Anuran Call



5) Buccal Cavity

6) Vocal Slits
• Connects BC to VS

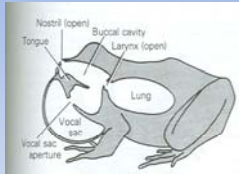
4) Larynx (vocal cords)

• Mass and Tension → Frequency

1 Hz = 1 per second

Mass ↑ Frequency ?

Mechanics of the Typical Anuran Call



7) Vocal Sac

• Resonates sound
• Not efficient

8) Nares Open



• Tympanum can provide additional resonance

Types of Vocal Sacs

• Internal
Thick-walled
Usually lower frequency
Call from the water




• External
Thin-walled
Often small frogs
Call from the air




Types of Vocal Sacs


- **Median Subgular**
Single sac in throat
Most common
- **Paired Subgular**
Two sacs in throat
Partial or completely separated
- **Paired Lateral**
Behind & below the jaw



External



Pternohyala fodiens
External or Internal



Internal

Advertisement Call Strategies

- 1) **Simultaneous vs. Synchronous Callers**
 - **Simultaneous:** Explosive Breeders (BS < 2 weeks)
 - **Synchronous:** Prolonged Breeders (BS > 1 month)
 - Males alternate calls to minimize overlap
 - Call only when females are present
 - Unison bout calling
- 2) **Change in Call Rate**
 - Increase call rate when female is detected
 - 10-20 sec call once per several minutes
 - 5 second interval between calls when females approaches



Advertisement Call Strategies

- 3) **Long Calls and Fast Rates**
Females prefer longer calls @ faster rates
Often correlated with body size
- 4) **Chorus Leaders**
Females attracted to speaker that initiated chorus
Often most dominant imitates the chorus

Long, Slow
over
Fast, Short



Advertisement Call Strategies

5) Satellite Males

- Often Smaller Males
- Intercept Females

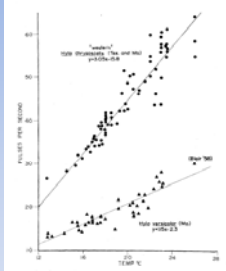


Rana clamitans

Factors Influencing Advertisement Calls

1) Temperature

- Linear relation with call and pulse rates
- Relation decouples toward end of BS
- **Temperature Coupling**
Females are attracted to calls produced at temperatures similar to their body temp



Gerhardt 1978

2) Vegetation

- Grasslands: 500-1000 m
- Longer, continuous calls @ lower freq
- Forests: <100 m
- Shorter calls @ higher frequency
- Similar tone w/ gradual modulation

Factors Influencing Advertisement Calls

3) Soil

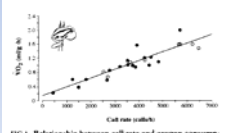
- Lower frequency (<1000 Hz, opercular)

4) Rivers

- Short calls @ higher frequency
- Centrolenids and Dendrobatids

5) Food Resources

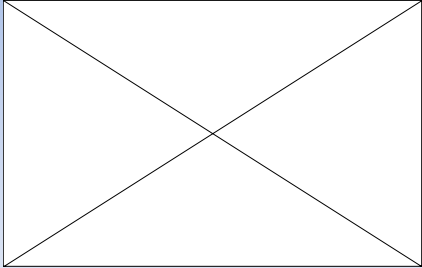
- Call rates of unfed males are lower
- Unfed males 2X lipids as fed males
- Unfed males sustain 15 nights of calling on stored lipids alone



Grafé 1996




Who Else is Listening?

- Tropical Bats



Who Else is Listening?

- Dr. Mike Ryan (UT-Austin)




Physalaemus pustulosus

- 2 Call Types
 - Simple (Whines)
 - Complex (Whines)




Who Else is Listening?

Blood-sucking flies
(*Corethrella*)



- More attracted to complex calls



Who Else is Listening?

- Mammals 
- Reptiles 
100 – 200 Hz
- Other Amphibians
- *Rana catesbiana*
- *Bufo marinus* 


Visual Methods to Attract Females & Defend Territories

- Physical aggression
D. pumilio wrestling 
- Waving 
Atelopus zeteki

Fast moving streams can be loud


Sexual Dimorphism

1. Females are usually larger




Sexual Dimorphism

2. Presence of vocal sac





3. Eggs



4. Tympanum

- In most Anurans - Female larger (exception Ranids)





♂

♀

Sexual Dimorphism


5. Nuptial Excrescences

- Spiked Epithelia Swelling
- Assists in grasping and ovulation



6. Others


- Toe pad shape
- Glands
- Tusks or spines
- Hair-like projections









Trichobatrachus robustus

Anuran Courtship




- Advertisement Calls
 - Males call until nudged
 - Female positions for amplexus
 - Preamplectic rituals
- Conspecific Recognition
 - Size - Bufo
 - Skin textures



Types of Amplexus


- Inguinal
 - Ancestral
 - Vents not juxtaposed
- Axillary
 - Most common
- Cephalic

Types of Amplexus

- Glued
 - Breviceps*
- Straddle
 - Manidactylus liber*
- Independent
 - Dendrobates granuliferus*



Aquatic Oviposition

- Usually large numbers of eggs >100
- Female arches ventrally
- Male arches dorsally ?
- Male releases sperm and egg are deposited



Aquatic Oviposition

- Explosive Breeders



Arboreal Oviposition

- Typically small clutches <50
- Eggs are hydrated
- Often parental care

