

Passive Acoustic Monitoring for Welfare and Conservation

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Basic Format

- Describe a project
- What we know
- Acoustic "tools" and knowledge we have currently
- What acoustic monitoring tools we need

Monitoring Welfare in Captivity

- Signs of stress
- Conflict
- Level of excitement
- Psychological development
- Cycles of behavior
- Assessing reaction to & control with sound (as a management tool)

Captive/Domestic monitoring

Chickens

- evaluating the effects of induced molting on chicken well-being

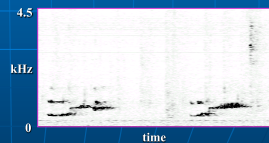
Rhesus Macaques

- managing conflict in captive troops
- prevent wounding from aggression

Induced Molting in Chickens

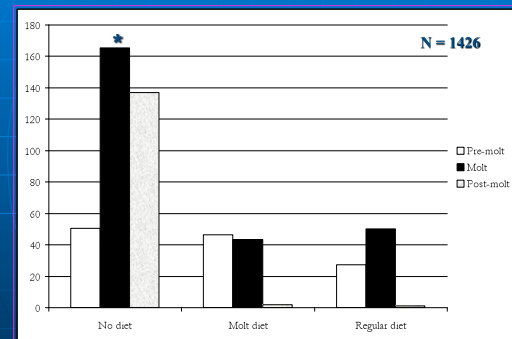


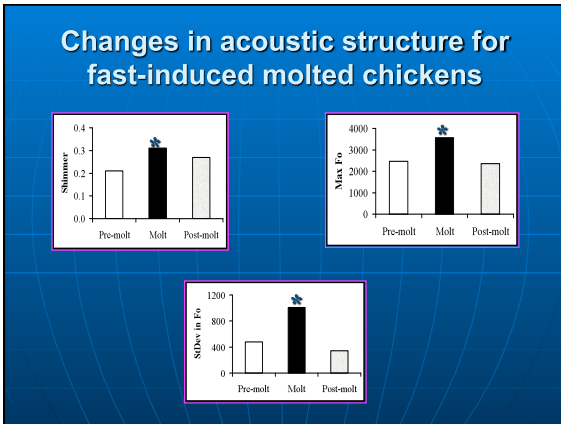
- Better egg production after molting
 - molting induced by fasting or low nutrition
- Chickens generally regarded as "stoic"



- "Gakel call" - associated with frustration

Rate of gakel calling





Knowledge and Tools

- A vocalization that is an indicator of well-being
- Demonstrated differences in Gakel production under different circumstances

Changes in rate and acoustic structure of gakels may be important for helping to assess well-being in chickens

Applicable to a number of welfare issues in chickens

- ### What We Need
- Automated monitoring systems that identifies:
 - rates of calling
 - significant acoustic variation for monitoring types of acoustic activities
 - Design a "filter" that attends to salient acoustic features
 - fine-tune sensitivity of monitoring system

- ### Rhesus Macaques
-
- Despotic dominance style
 - High rates of conflict with wounding
 - Cage wars

- ### Costs & Benefits of Large Group Social Housing
-
- Higher risk of aggression-based morbidity and mortality
 - Breed better in social groups
 - Permits species-typical social behavior & organization
 - Promotes higher amounts of activity in a more naturalistic environmental setting

shrill bark (alarm call)

noisy scream

threat bark

tonal scream

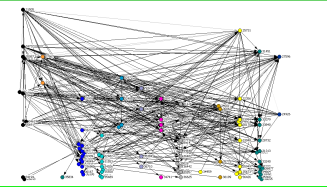
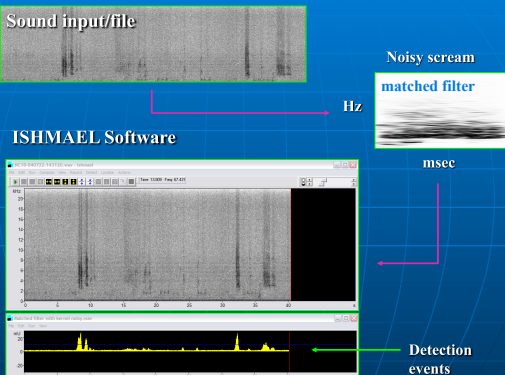
pulsed scream

coo

- We know vocalizations associated with conflict and contact aggression

Tools and Knowledge

- Established a limited methodology for monitoring behavior and vocalizations
- Some idea of individual roles in managing interactions (Flack et al. 2006)
- Social networks

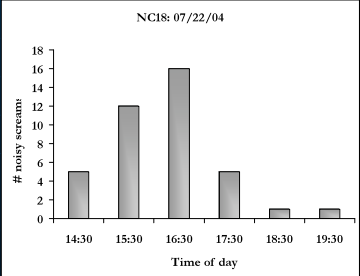
Sound input/file

Noisy scream matched filter

ISHMAEL Software

Detection events

Detection of Events

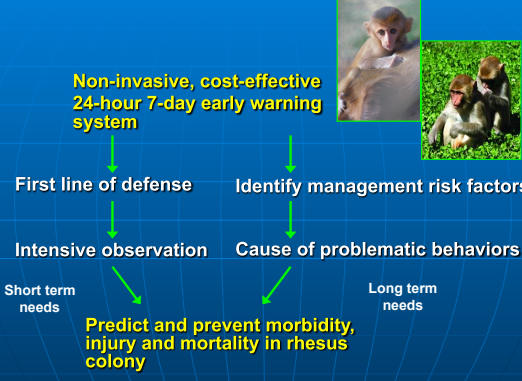


NCI8: 07/22/04

Time of day	# noisy scream
14:30	5
15:30	12
16:30	16
17:30	5
18:30	1
19:30	1

Aggression rises after staff depart at 15:00

Non-invasive, cost-effective 24-hour 7-day early warning system



First line of defense

Identify management risk factors

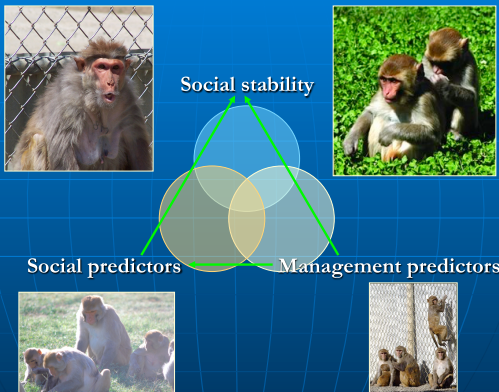
Intensive observation

Cause of problematic behaviors

Short term needs

Long term needs

Predict and prevent morbidity, injury and mortality in rhesus colony



Social stability

Social predictors

Management predictors

What We Need

- An automated monitoring system
 - short term alerting system (call attendant to avert/stop conflict)
 - long-term prediction of patterns to head off large-scale conflict
- Target known vocalizations
- Rates of vocalization ratios changing over time
 - set a threshold
 - what screams associated with what behaviors
 - we look for threats and screams together right now

Monitoring in the Wild

- Characterizing communication repertoires
- Identifying
 - species / censusing biodiversity
 - demographic groups (sex, age, social rank, etc.)
 - behaviors
 - individuals
- Censusing populations / examining population structure
- Estimate genetic diversity
- Tracking individuals
- Monitoring reintroduction efforts
- Assessing reaction to & control with sound

Acoustic Monitoring Solves Problems

- ▶ **Nocturnal**
- ▶ **Subterranean**
- ▶ **Arboreal**
- ▶ **Aquatic**

Visually inaccessible
Use of acoustic or seismic

- ▶ **Endangered**

Non-invasive
Monitoring of reintroduction efforts

Wildlife Monitoring

Ground squirrels

- metapopulation structure
- effects of anthropogenic noise

Mexican spotted owls


- identifying age and sex classes
- monitoring presence of an endangered species on military land

Wildlife Monitoring (cont.)


Humpback whales

- identifying individuals
- effects of anthropogenic noise
- monitoring movements
- identify specific foraging behavior
- spatial arrangement
- understand relationship between winter and summer behavior


Ground Squirrels

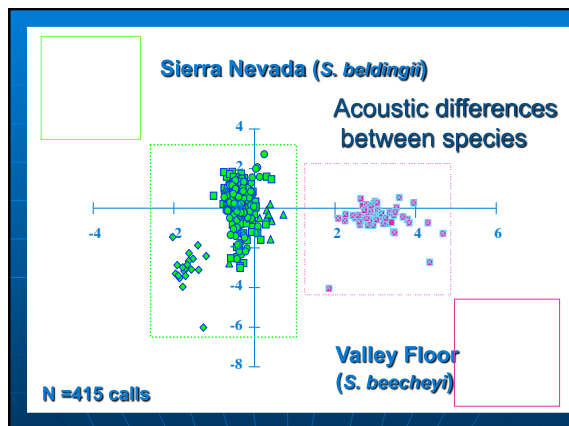


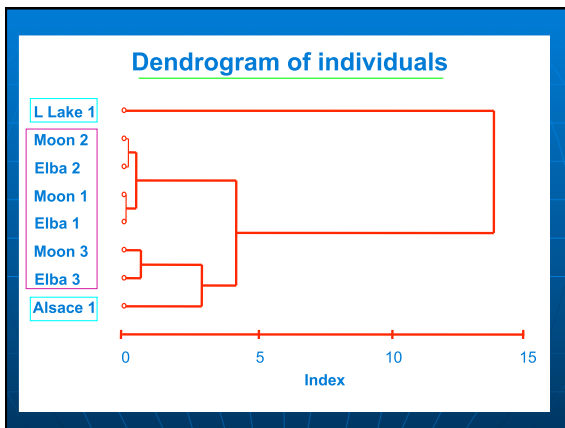
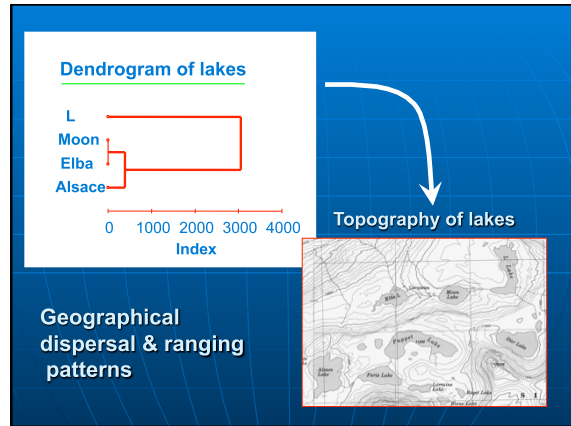
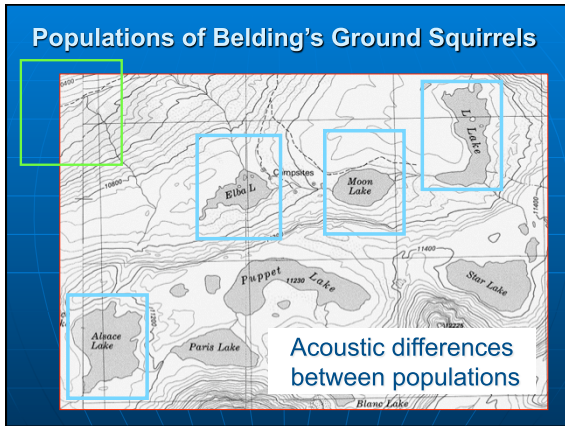
Tonic alarm



Acute alarm







Can acoustic diversity estimate genetic diversity?

- Collection of fecal/hair samples from individuals in multiple populations
- Extract and characterize genetic information
- Correlation of genetic data with acoustic measures in a population

Placement of corridors
Translocate & reintroduce individuals

Conservation Issues Affected by Acoustics

- Effects of vehicular traffic noise on ground squirrel alarm calls
- Placement of corridors
- Translocation & reintroduction of individuals

What we need

- a robust monitoring system
- increased sample sizes
- automated monitoring and extraction
 - filters!

Mexican Spotted Owls





- Listed as endangered
- Cryptic
- Nocturnal
- Arboreal
- Live in difficult topography
- Rough terrain
- Found on military installations in Southwest


Current Habitat for the Mexican Spotted Owl
(Data courtesy of USGS)




Vocalizations Differ Between the Sexes



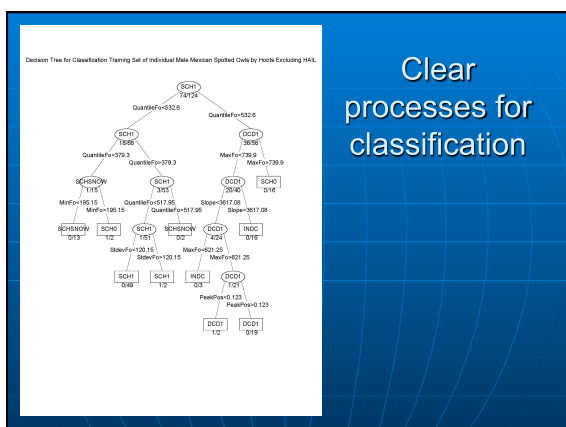
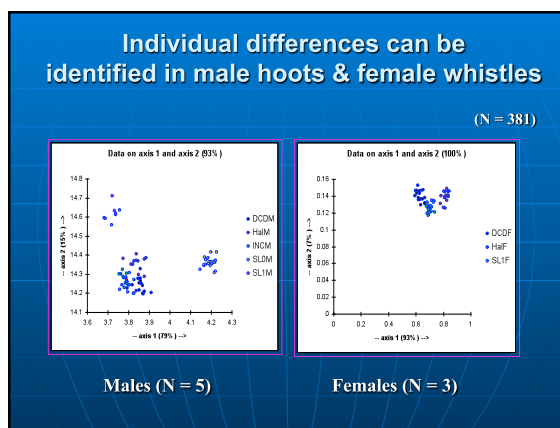
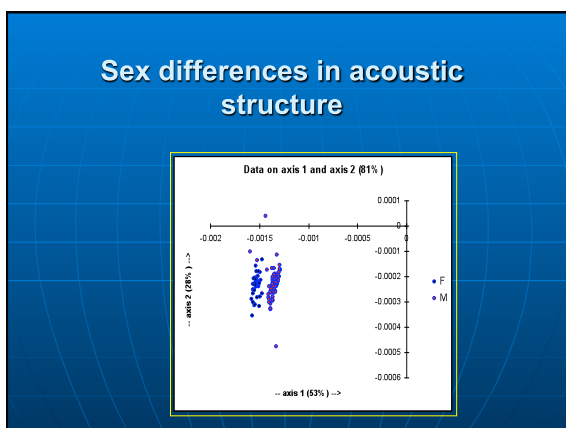
Female Whistle



Male Hoot



Freq (Hz) 0 2,400
Time (Sec) 0 4



- ## Proposed an array with the following characteristics
- Capability of localizing individuals
 - 3 or more elements distributed in a triangle centered on an activity center
 - Additional individual elements placed in areas not known to be occupied by owls
 - Collect data continuously at night for four month period
 - Software must be developed to detect calls, localize callers, and estimate range

What We Need

- A tidy package/system
- Need to track
 - demographic change
 - reproductive success
 - individual without disturbance

Humpback Whales

Alaska Whale Foundation
Research · Conservation · Education

SEI Institute
Research · Conservation · Education

UCDAVIS



- Cosmopolitan species
- Polynesian population breeds in Hawaii and feeds in along Alaskan bight
- Endangered species

Bubble Net Feeding

- Feeding on schooling herring
- Only a small portion of the population participates
 - not kin
- Long term associations documented between pairs of whales


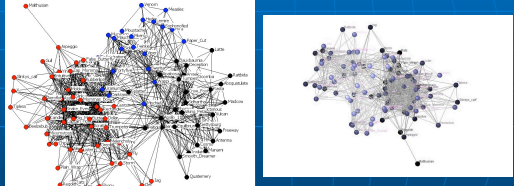


Photo by Thomas Wilkinson

Networks of Social Foraging Whales



Bubble Net Feeding

- Within social foraging groups there is task specialization
 - vocalizer (9 to 15 individuals in field site)
 - bubble blower ???



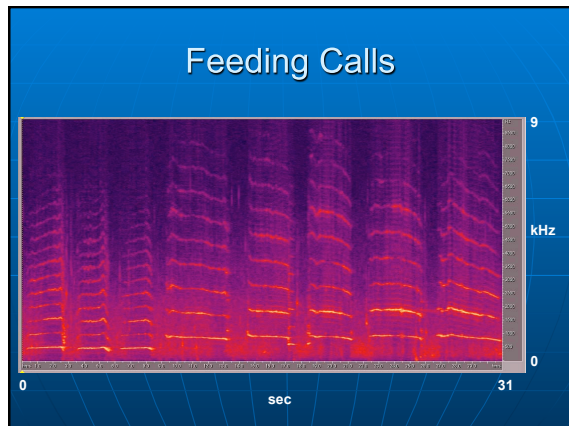
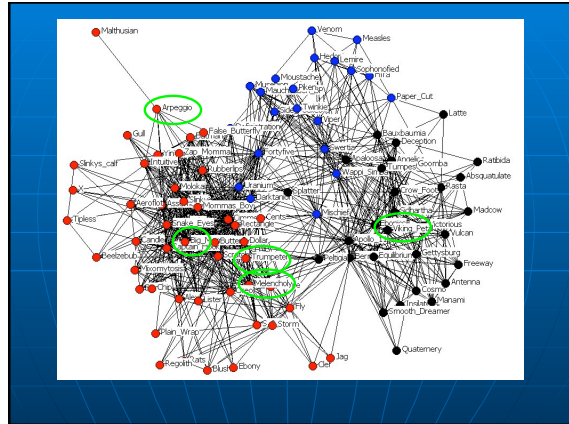



Image by Duncan Murrell





Tools and Knowledge

Image by Duncan Marrell

- Long term data
- CART for recognizing individual feed callers
- Know a little about how they response to noise
- Have protocol for assessing channel capacity and noise effects

- ### Whales what we need:
- Localize individuals
 - Monitoring systems that attach to animals
 - Monitoring stations/network
 - Monitoring animals 24/7
 - Metadata analysis

What does this mean for Hawaii?

- ### The Overall Needs
- Biological information married to engineering
 - Automated
 - track behavior for welfare – aggression, etc.
 - feature extraction
 - run features through a filter
 - Run remotely
 - Filter design
 - Environmentally robust
 - Data storage and sending
 - Crunching data/formatted
 - Replace ourselves
 - LONG TERM FUNDING!!!
 - The nexus between welfare and conservation
 - not all individuals are created equal

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