Genetic Structure and Diversity in South Texas Bobwhites: Implications for Conservation

Meet the Northern Bobwhite…

- Twenty-two subspecies
- Ground-dwelling upland bird
  - About 200 g
  - Short-lived (1 yr)
  - High reproductive rate
  - Relatively sedentary
Bobwhite population trends

- Range-wide decline
  - Changes in land-use
  - Huntable populations in Texas, Georgia-Florida

Changes in quail density (Peterson et al. 2006)
Bobwhite population trends

- “Boom and bust” population dynamics
  - Winter densities varied 6-fold during 10-yr period (Lehmann 1984)
  - 1.4 to 8.2 ha × quail⁻¹
Precipitation drives populations

Palmer Drought Severity Index

Texas - Division 10: 1895-2005 (Monthly Averages)
Bobwhite population trends

- Cyclic behavior
- Region-wide
  - South Texas
  - Edwards Plateau
  - Rolling Plains
- Five-year periods

Lusk et al. 2007
Bobwhite population dynamics

- Sustaining populations found only in extensive areas of contiguous habitat

- When habitat patches are altered or fragmented to some (presently unknown) threshold level, populations collapse
South Texas quail populations…

• Effects of land-use, dynamics at regional scale
• Management at local scale
• How do local—regional dynamics function?
Population dynamics and structure

- Low dispersal, high turnover
  - Genetic structure high
  - Genetic diversity low or variable

Modified from Harrison & Hastings (1996)
Population dynamics and structure

• Estimate diversity and population structure
  – Large-scale investigation
  – Infer effects of population dynamics, connectivity

Harrison & Hastings 1996
Populations used in genetic analyses
DNA extraction and amplification

- Extracted DNA using a commercial kit
- Sequenced 380bp portion of mtDNA control region
- Amplified 7 microsatellite DNA loci using PCR
Data analysis

• mtDNA data (380 bp)
  – Haplotype diversity
  – AMOVA
  – Minimum spanning network

• Microsatellite data (7 loci)
  – Gene and allelic diversity
  – Pairwise $F_{ST}$, exact test of differentiation
  – AMOVA
  – Spatial autocorrelation
Haplotype diversity

Error bars are +/- 1 SE

Haplotype diversity

21 sites
N = 8 to 12 per site

Site
Minimum spanning network:
Relationships among haplotypes
The 2 most common haplotypes were widely distributed...
AMOVA for mtDNA data

Among populations 4%  
Within populations 96%

21 sites  
N = 190  
$F_{ST} = 0.037$
Microsatellite diversity and population structure

- Sampled 24 sites, 567 individuals
- Observed heterozygosity = 0.58
  - Range: 0.39 to 0.86
- 13 alleles/locus
  - Range: 7 to 19 alleles
- Low structure
  - Fst < 0.01
  - Exact tests non-significant
  - Pairwise Fst non-significant
AMOVA for microsatellite data

Among sites: 1%
Among individuals in site: 16%
Among individuals: 83%

24 sites
N = 567
$F_{ST} < 0.01$
Intercept at \( \sim 50 \) km

Implies sites within 50 km are non-independent

Assume diameter of a local population is 50 km.

Corresponds to an area of 1,964 km\(^2\) or 502,655 ac
Population dynamics, diversity and structure

- Low differentiation, high diversity
  - Importance of dispersal? Role of population turnover?
  - Life history, dispersal, and genetic variation….

Modified from Harrison & Hastings (1996)
Implications for bobwhites

- Theoretical predictions for high-turnover populations: should be good dispersers
  - Otherwise, bottlenecks, stochastic events
  - Dispersal more important than previously realized?
  - Maintain genetic variability, minimize structure

- Do bobwhites fit a metapopulation model?
  - Re-colonization and extinction dynamics
  - Counterbalance local extinctions during boom-bust
Implications for bobwhites

• One of the most studied, managed species
  – Populations continue to decline

• Extant populations occupy intact habitats
  – Large continuous sections of suitable habitat
  – Uninterrupted patterns of dispersal

  – Habitat fragmentation = no re-colonization?
  – Local populations eventually extirpated through stochastic events
Implications for bobwhites

• Most current management is site-specific

• If dispersal is critical to bobwhite populations, small-scale management may be insufficient

• To halt or reverse the Northern Bobwhite decline, a shift to large-scale management of habitat resources that provide usable space may be required (Williams et al. 2004).
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