Using Stable Isotopes to Assess Longitudinal Diet Patterns of American Black Bears in Great Smoky Mountains National Park

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National Park System/Service
- Established 1872
- No regulations prohibiting feeding wildlife
- National Park Service established 1916

Great Smoky Mountains National Park
- Established 1934
- Human visitation increase
- Black bear populations increase
- Currently most visited National Park
NPS Mission
“...Preserve historic wildlife and provide opportunities for the public to view the natural system of the park…”

GSMNP Nuisance Bear Management Goal
Minimize bear-human conflicts while allowing wild bears to live naturally

Reactive Management
- 1970s – 1990s
- Relocation of nuisance bears

Proactive Management
- Prevention of nuisance activity
- Behavior modification
Justification

- High visitor density
- High bear density
- Variable natural food crops

Longitudinal Data Set

Hypotheses

1) Use of human food sources by black bears increases with increasing density of black bears.

2) Use of human food sources by black bears increases following poor hard mast production.

3) Use of human food sources by black bears decreases following a change in management strategies by the National Park Service during the early 1990s.

4) Because of larger home ranges, adult male black bears are more likely than other sex and age groups to have access to human food sources.
Study Area (328 km²)

Feeding Ecology

- High energy foods
- Previous nutritional studies on scat
- Digestive efficiency range
  - 30% plant matter
  - 90% meat
Methods
1,835 hair samples collected from 1975 – 2008
Stratified random sampling 1980 – 2002
Stable carbon and nitrogen isotope analysis
Multivariate analysis of variance (MANOVA)

Stable Isotopes – What are they?
δX = [(R_{sample} – R_{standard}) / R_{standard}] x 1000
where R is $^{13}$C/$^{12}$C or $^{15}$N/$^{14}$N

Stable Isotopes – Carbon Fractionation
- Stable carbon isotope analysis
- Fractionation within photosynthetic pathways
  - $C_4$ plants $^{13}$C depleted
  - $C_3$ plants $^{13}$C enriched
    - Native GSMNP vegetation $C_4$ plants
Stable Isotopes – Nitrogen Fractionation

- Stable nitrogen isotope analysis
- Fractionation within metabolic pathways
  - $^{14}$N removed from digestive tract
  - $^{15}$N is assimilated into tissues (enrichment)
    - High trophic level = enriched $^{15}$N

Mass Spectrometry

- Identical swing every stroke

Which Bears ...?

- Young females and sub-adult males - front country
- Older males - back country

Hatch and van Manen 2007

Stiver 1999
**Expected Outcome/Implications**

- Can examine effectiveness of past management strategies and base future management strategies on results.
- Can examine effect of poor mast year production and exploitation of anthropogenic food sources, enabling park personnel to better prepare for potential nuisance bear activity.

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