Cougar movements in a fragmented landscape: effects of behavior, humans, and prey

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Species that can adapt to human activities are those that will persist and drive ecological interactions in the future....
Connectivity defines the universe

• All things are *interconnected* and *interdependent*  
  (F. Capra, Berkeley, CA, 1975)

• The costs of increasing connectivity for ourselves may be borne ecologically, aesthetically, or economically....
Why is connectivity important for conservation of cougars and other wildlife?

• Closed / small populations at risk of inbreeding depression / stochastic extinction;
• Many populations spatially structured (metapopulation concept)
• Dispersal critical for gene flow, recruitment, and recolonization of suitable habitats
• Large area requirements; most individuals likely to interact with humans even at low levels of development
Cougar movements in a fragmented landscape: effects of behavior, humans, and prey

- Habitat loss / fragmentation = major land-use factors driving species endangerment;
- California in vanguard of environmental protection – also human population density, urbanization, and land-use change;
- Q: How can behavior measured in a less-developed state inform land-use and conservation policies in the most populous state?
Questions:

I. Scale 1. How do cougars respond to anthropogenic land uses? (within home range)

II. Scale 2. Are dispersal movements shaped by habitat configuration and permeability? (landscape)

III. What are the implications of cougar movement behavior for connectivity in California?
Capture & marking

Capture and marking

Monitoring

Tracking

Circadian movements

dispersal

GPS

VHF

Ear tags
Oquirrh Mtns (1997-present): fragmented, urban (n = 93 marked; 26 dispersed)

Potential barriers:
- freeways
- urban areas
- agriculture
- water
- desert basins
Monroe Mtn (1996-present): connected, rural (n = 153 marked; 35 dispersed)

Potential corridors:

- forest cover
- riparian zones
- ridges
Study areas represent 2 points along a fragmentation gradient.
Questions:

I. How do cougars respond to anthropogenic land uses?
   I. Scale = home range (30-200 km²);
   II. life stage = resident adults

anthropogenic lands = UWI
urban, agriculture, mining
F44: repeated use of highway underpass
F06: foraging bouts on the UWI

F06: 1/28-2/4/03

Copperton
6:00 PM

Bingham Cemetery
5:00 AM

Copperton
7:00 AM

Bingham Cemetery
9:00 PM

Bingham Cemetery
11:00 PM

3.5 Km
F12: mixed response to roads / underpass
How do cougars respond to anthropogenic land uses?

- UWI generally underused relative to availability;
- High degree of individual variability;
- Sex, age, repro
Sex, age, and reproductive status influence use of anthropogenic landscapes...

- Dental wear with age
- Energetic demands
- "Safe" food
- Attraction to roads

Knopff et al. 2010
Questions:

I. How do cougars respond to anthropogenic land uses?
   I. Scale = home range (30-200 km²);
   II. Life stage = resident adults

II. Scale 2. Are dispersal movements shaped by habitat configuration and permeability?
   I. Scale = landscape (> 1,000 km²);
   II. Life stage = dispersing subadults

III. What are the implications of cougar movement behavior for connectivity in California?
In the absence of barriers, follow familiar habitat....

FS04: subadult
But, in the presence of barriers, keep your eye on the goal....

Great Salt Lake
Salt Lake City: ~ 1 m people
Oquirrh Mtns
Wasatch Mtns

The Sundance Kid
Sundance ski area
1-3 cougars / yr captured and removed from urban settings along the Wasatch Front
Or, improvise as you go...

Capture: 2/9/05

Dispersal of cougar F31 from Oquirrh Mountains, Utah to Meeker, Colorado, 9 February 2005 to 7 February 2006
Fragmented vs. Connected: dispersal directions were NOT random...

Fragmented:
- \( n = 23 \)
- Mean direction: \( \text{SW} \pm 66^\circ \)

Connected:
- \( n = 25 \)
- Mean direction: \( \text{E} \pm 75^\circ \)
Do prey migrations influence connectivity?
How do Behavior and Habitat Fragmentation Affect Cougar Dispersal Patterns?

- Presence of corridors or barriers \([\textit{can}]\) create a \textit{path of least resistance}; highly individualistic
- stronger constraints will result in greater movement predictability; absent barriers, natural drivers such as food or social interactions likely dominate…

Factors Influencing Connectivity

<table>
<thead>
<tr>
<th>Natural</th>
<th>Landscape</th>
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<tbody>
<tr>
<td>social, food</td>
<td>movement constraints</td>
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connected  fragmented

>>> >> >> >> >> >> >> >> >> >> >> >> >> >> >> >> >> >> >>
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Implications for the Golden State:

1. Roads can act as both a deterrent and attractant, depending on the scale and demographic class being considered.
2. Corridors should be considered within a habitat context.
3. Natural factors / Behavioral drivers are important; mitigation of fragmentation should attempt to mimic natural patterns to the extent possible.
Financial and Logistical Support
What is a dispersal corridor?
1,900 km² ~ 47 lions
What does this mean for Connectivity in California?

“Another working day has ended
Only the rush hour hell to face
Packed like lemmings into shiny metal boxes
Contestants in a suicidal race
Daddy grips the wheel and stares alone into the distance
He knows that something somewhere has to break.....”
Cougar use of edge

Figure 14. Cumulative distribution functions for edge density in 3 male and 13 female cougar home ranges compared to density in 1,000 randomly placed home ranges on the Oquirrh Mountains, Utah. The random home ranges were circles with area equal to the mean female cougar home range size on the study site.
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