Title
Using accelerometer "smart collars" to identify wolf behavioral states and energetic costs

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Using accelerometer “smart collars” to identify wolf behavioral states and energetic costs

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Background

- Wolves are apex predators and cursorial hunters
- Locomotion is energetically costly
- Wolves directly impact prey and indirectly affect many other species by initiating a trophic cascade
- As large carnivores, wolves require substantial prey populations for survival
- If available prey are insufficient, negative energy balance leads to wolf population decline
- Quantifying the energetic demands of wild animals is difficult
- A novel approach is needed to assess the hunting costs of free-ranging wolves in order to predict (and avoid) wolf-livestock conflict

Questions

- To what extent will wolves be able to modulate their locomotive performance (and hence energetic requirements) to cope with the stressors of ecosystem change?
- Can quantifying the energetic costs of locomotion in these animals help inform researchers of predatory events resulting from an animal’s caloric deficiency, thereby giving predictive power for impending human-wildlife conflict or population decline?

Abstract

Habitat loss and fragmentation are the primary threats to most wildlife populations1,4. Additionally, anthropogenic climate change is disrupting predator-prey interactions as interactors often respond differently to ongoing change3. Increasingly degraded landscapes and declining prey populations have magnified these effects on apex predators such as grey wolves (Canis lupus) which must maintain large territories to accommodate their large nutritional demands5. Consequently, wolves may cope with climate change by altering foraging patterns6, resulting in elevated daily energetic costs to track shifting or diminishing prey populations2 as well as increased conflict with humans and livestock8. Wild canids in general (e.g. African wild dogs, coyotes, foxes) and wolves in particular may be especially sensitive to increased energetic demands because they operate at the upper limits of mammalian aerobic metabolism9, exhibiting maximum aerobic performance over three times greater than most placental mammals10. This research will develop the technology necessary to quantify these additional movement costs and generate models for predicting wolf locomotive responses to ongoing environmental perturbation.

Methods

1. Collar Calibration
   Accelerometer collars
   Time-matched video recordings

2. Determination of Energetic Costs
   Open-flow respirometry

3. Model Construction & Validation
   Dynamic state variable model
   1. Incorporate caloric costs of locomotion
   2. Predict foraging movements in wild wolves
   Field Validation
   1. Ground-truth accelerometer technique with captive wolves
   2. Investigate field metabolic rate on free-ranging wolves

Collaborations

<table>
<thead>
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<th>Canid</th>
<th>Sample Size</th>
<th>Collaborator</th>
<th>Location</th>
<th>Status</th>
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</thead>
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<tr>
<td>Dog</td>
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<td>Santa Cruz, CA</td>
<td>Ongoing</td>
</tr>
<tr>
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<td>Wolf</td>
<td>5</td>
<td>Wildwolve Wolf Project</td>
<td>Yellowstone NP</td>
<td>Pending</td>
</tr>
</tbody>
</table>

Implications

For wolves:
- Assess how wolves partition their energy into various behaviors
- Gain insights into ecosystem consequences of elevated canid metabolisms
- Develop validated models from free-ranging wolves for predicting foraging activities and predatory events

For other species:
- Develop a more physiological, mechanistic understanding of how the metabolic costs of transport for individual animals translate into community-wide effects
- Promote animal-borne accelerometer technology for assessing field metabolic rate of various rare and/or elusive species
- E.g. “smart collars” currently being deployed by collaborators on mountain lions (Puma concolor) and mule deer (Odocoileus hemionus) in CA & CO

Conclusions

- Calibrated accelerometer collars may provide a critical link between movement ecology, behavior, energetics and environmental characteristics in wild animals
- Species that are rare, elusive or of particular conservation concern are ideal “smart collar” candidates because the collars measure how hard animals must work to survive, which is predicted to change with environmental circumstances

Literature Cited

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