USGS
science for a changing world

# UPDATE ON SCIENCE AND TOOLS AVAILABLE FOR ADDRESSING RAVEN ABUNDANCE AND REDUCING THEIR IMPACTS ON GREATER SAGE-GROUSE IN NEVADA

**Nevada Sagebrush Ecosystem Council**
**2 November, 2023**

**Peter S. Coates Ph.D.**
**U.S. Geological Survey**
**Western Ecological Research Center**

# Special Issue: Raven Management

22 peer-reviewed papers on raven science and management


Topics include:

- Population growth of ravens
- Synthesis of anthropogenic effects on raven demographics
- Synthesis of predation by ravens to sensitive avian species
- Expanding abundance of ravens in sage-grouse habitats
- Occupancy and density mapping
- Raven adverse impacts to snowy plovers
- Efficacy of lethal and non-lethal techniques
- Estimating raven take
- Population management strategies with software
- Rapid survey assessment
- Science-based Management of Ravens Tool (SMaRT)

All articles will be published by end of year 2022

# Overview

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## Problem

Expansion of raven distribution and abundance

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Anthropogenic resource subsidies

↓

Predation effects on sensitive species

## Solution

Science-based tiered framework

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Decision support tools - SMaRT

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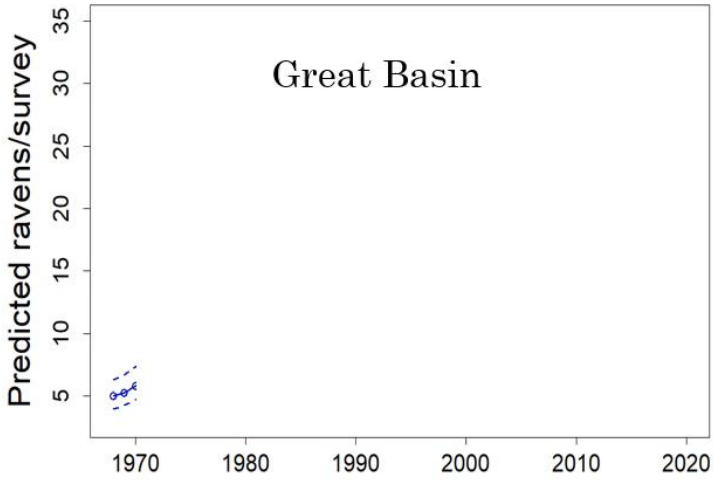
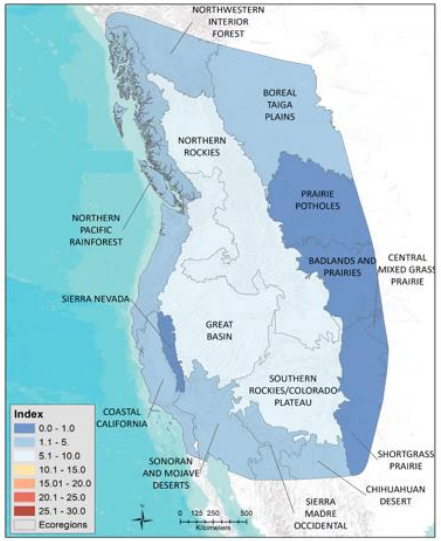
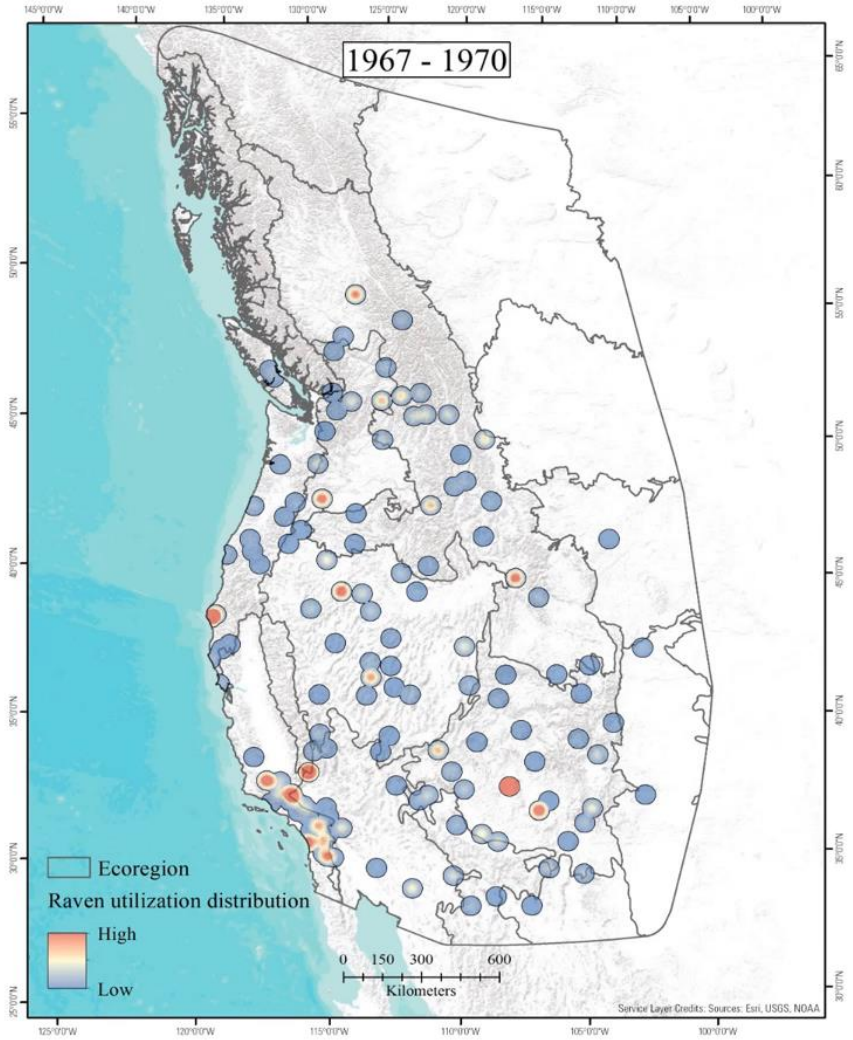
## Raven expansion in the Great Basin region of the western U.S.

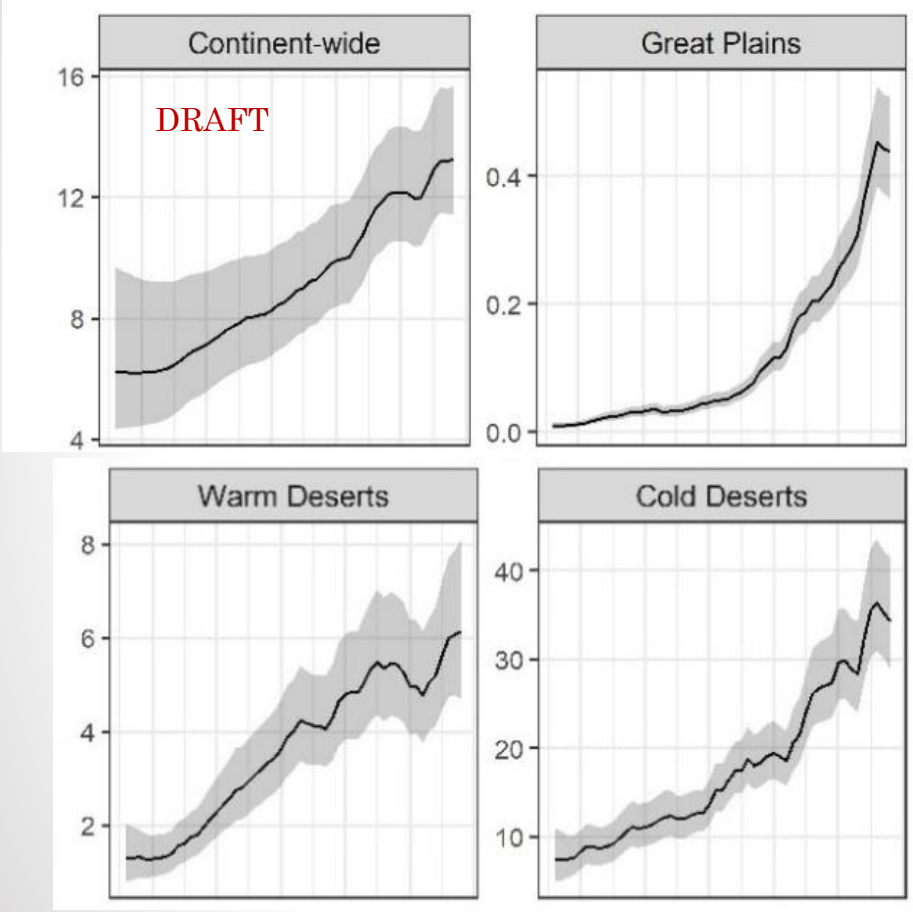


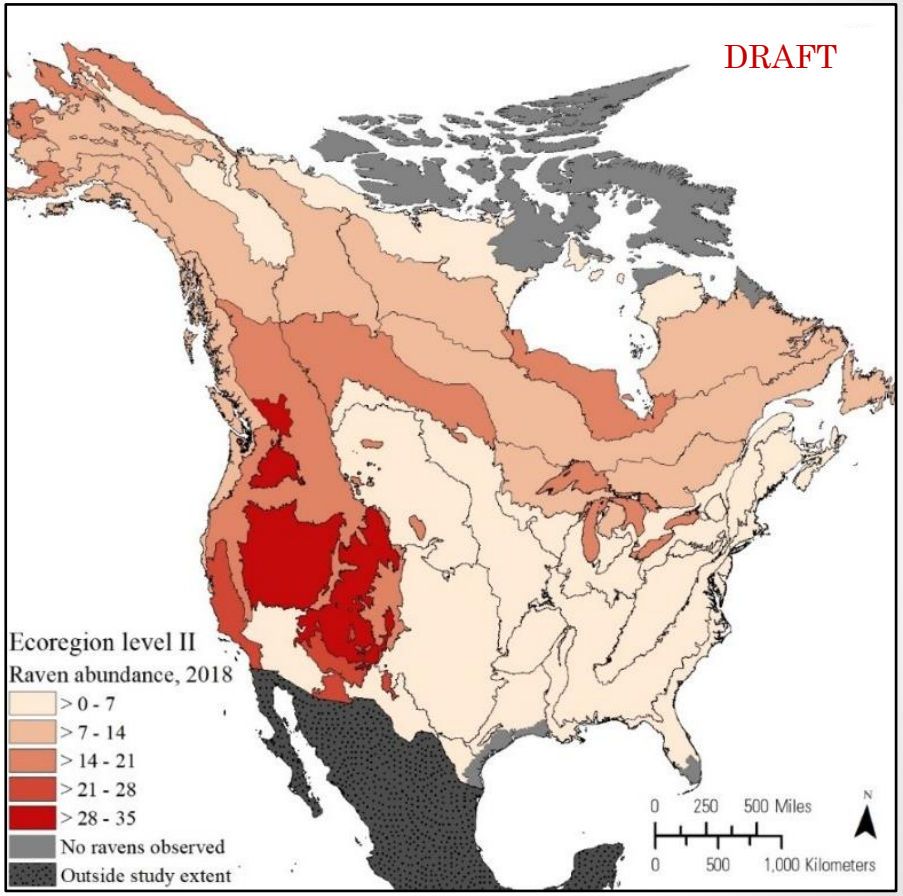




Harju, S.M., et al. (2021). Estimating trends of common raven populations in North America 1966 – 2018. *Human-Wildlife Interactions 15:5.*

# Raven numbers have increased 4.6 times since 1966 in Cold Deserts




Harju, SM; Coates, PS; Dinkins, JB; Jackson, P; Chenaille, MP. *In press*. Estimating trends of common raven populations in North America, 1988 – 2018. *Human-Wildlife Interactions*.

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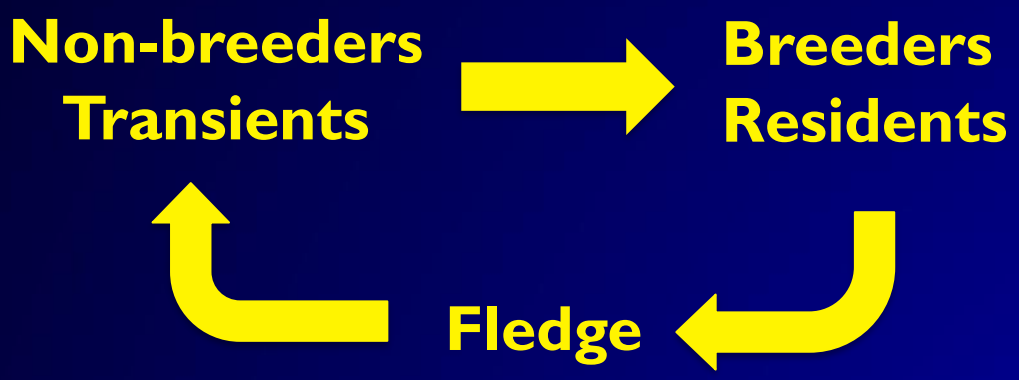
# Conceptual Model



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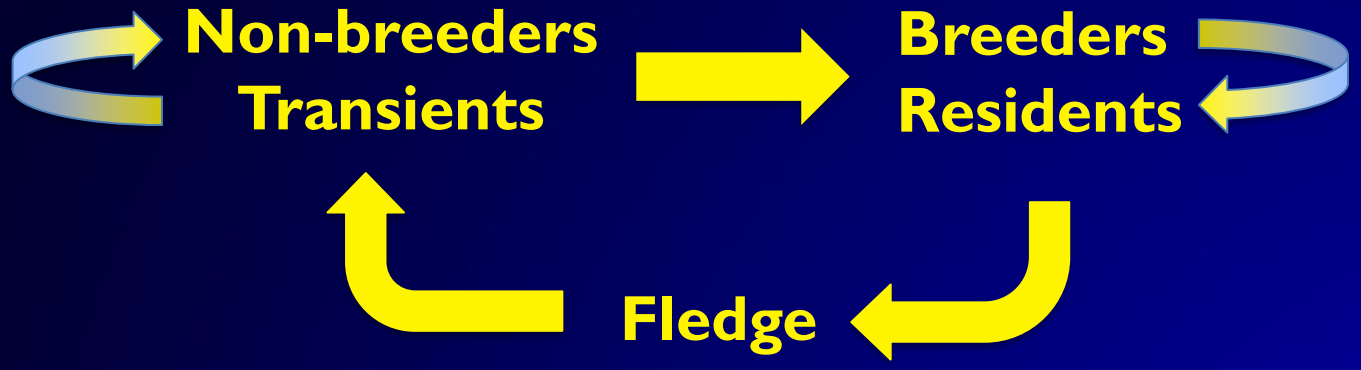

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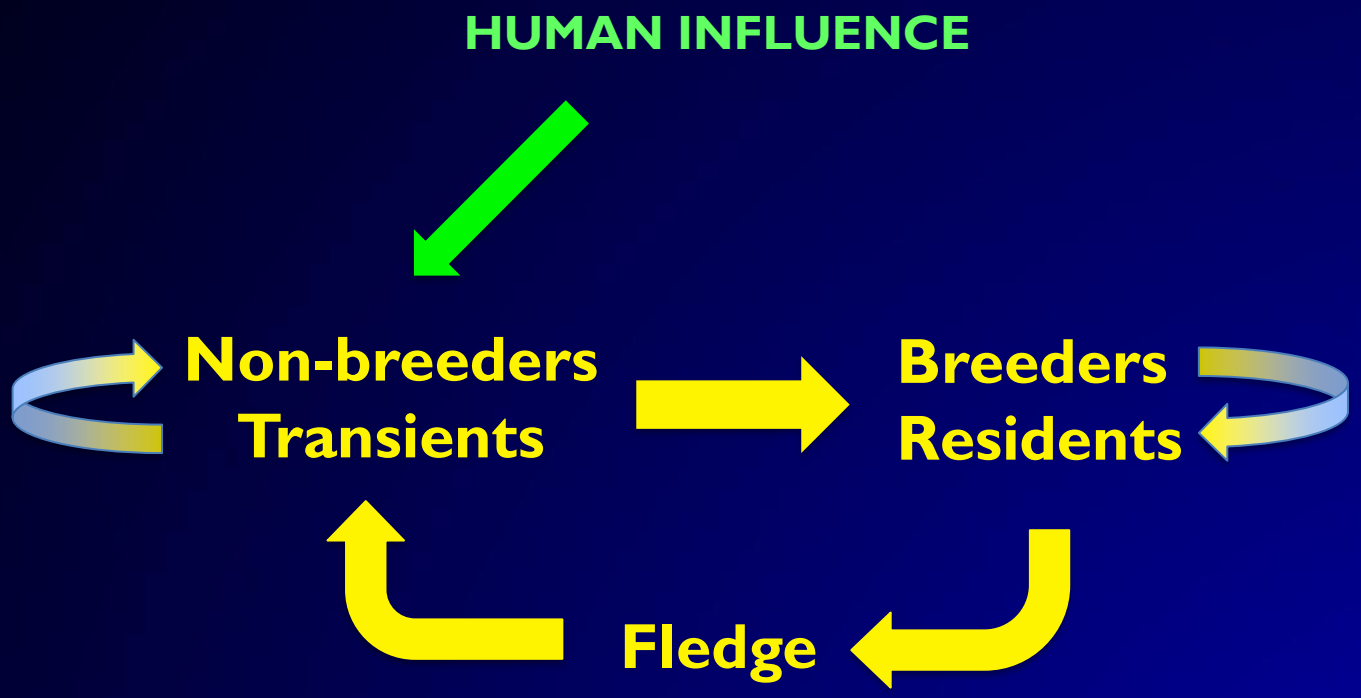
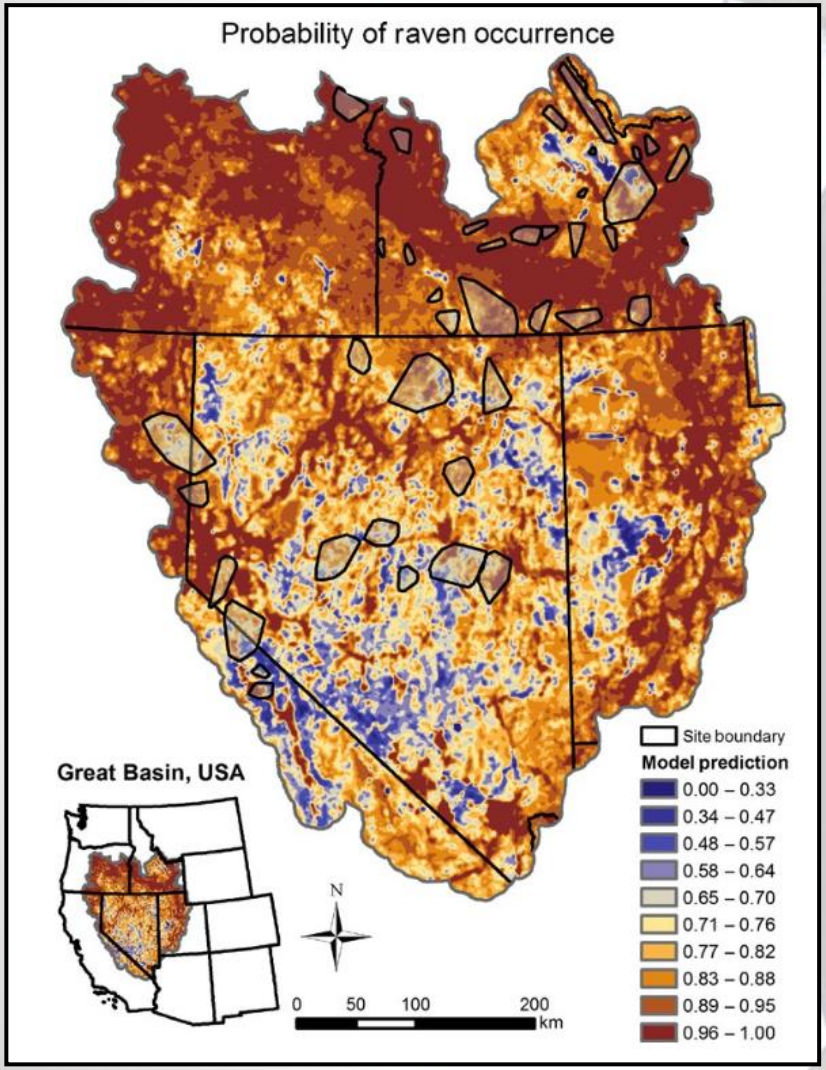


# Anthropogenic subsides impact occupancy



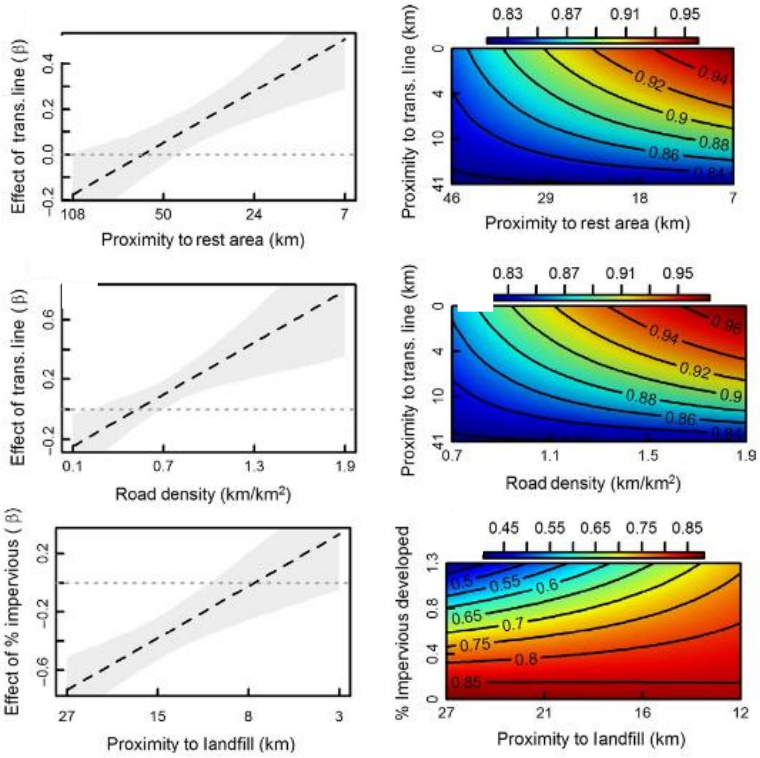

RESEARCH ARTICLE

Journal of Applied Ecology

## Broad-scale occurrence of a subsidized avian predator: Reducing impacts of ravens on sage-grouse and other sensitive prey


Shawn T. O'Neil[1] | Peter S. Coates[1] | Brianne E. Brussee[1] | Pat J. Jackson[2] | Kristy B. Howe[3] | Ann M. Moser[4] | Lee J. Foster[5] | David J. Delehanty[6]

[1]U.S. Geological Survey, Western Ecological Research Center, Dixon, California; [2]Nevada Department of Wildlife, Reno, Nevada; [3]Nevada Natural Heritage Program, Carson City, Nevada; [4]Idaho Department of Fish and Game, Boise, Idaho; [5]Oregon Department of Fish and Wildlife, Hines, Oregon and [6]Department of Biological Sciences, Idaho State University, Pocatello, Idaho

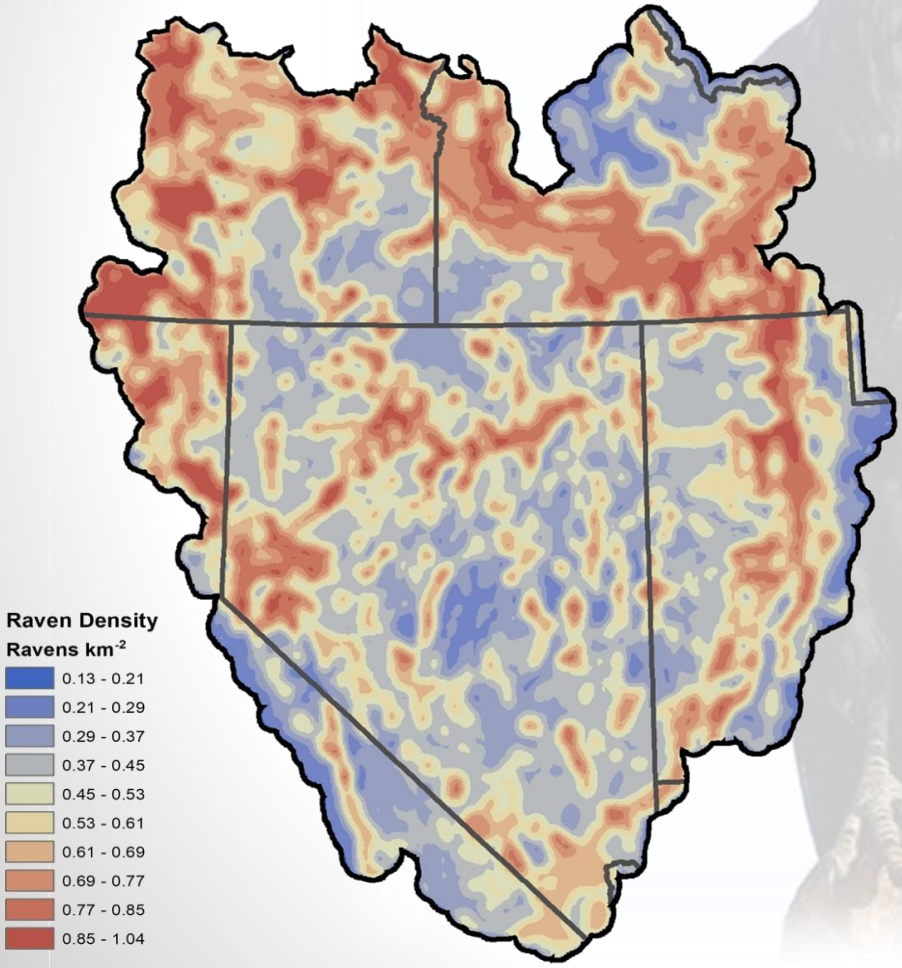
# Raven Density Effects on Sage-Grouse Nest Survival

**Average raven density**

**0.54 ravens km$^{-2}$** (95% CI = 0.42–0.70)

**Total abundance sagebrush in Great Basin**

165,186 (136,874–201,581)

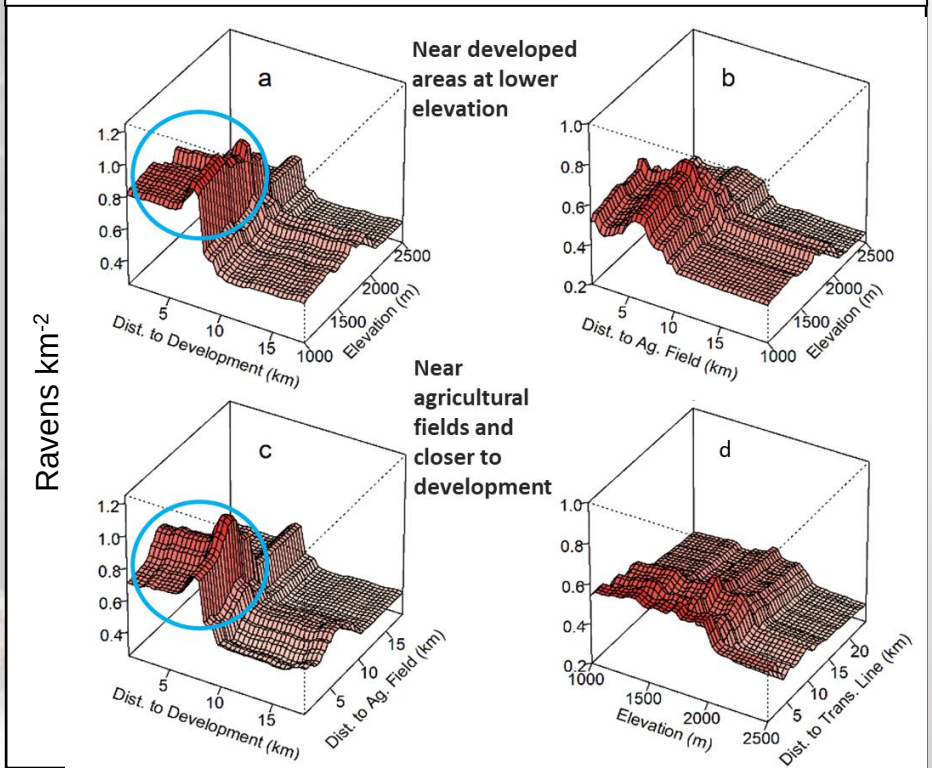



ELSEVIER

Biological Conservation
Volume 243, March 2020, 108409

## Broad-scale impacts of an invasive native predator on a sensitive native prey species within the shifting avian community of the North American Great Basin

Peter S. Coates [a], Shawn T. O'Neil [a], Brianne E. Brussee [a], Mark A. Ricca [a], Pat J. Jackson [b], Jonathan B. Dinkins [c], Kristy B. Howe [d], Ann M. Moser [e], Lee J. Foster [f], David J. Delehanty [g]



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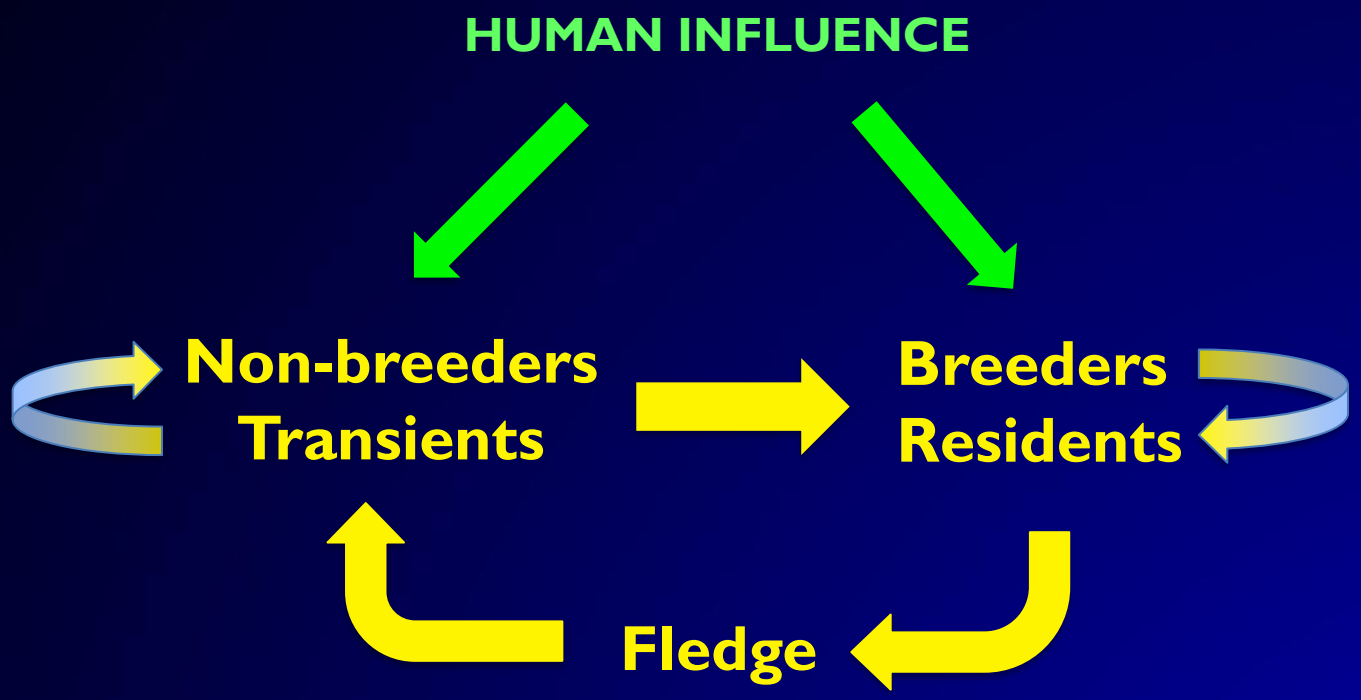
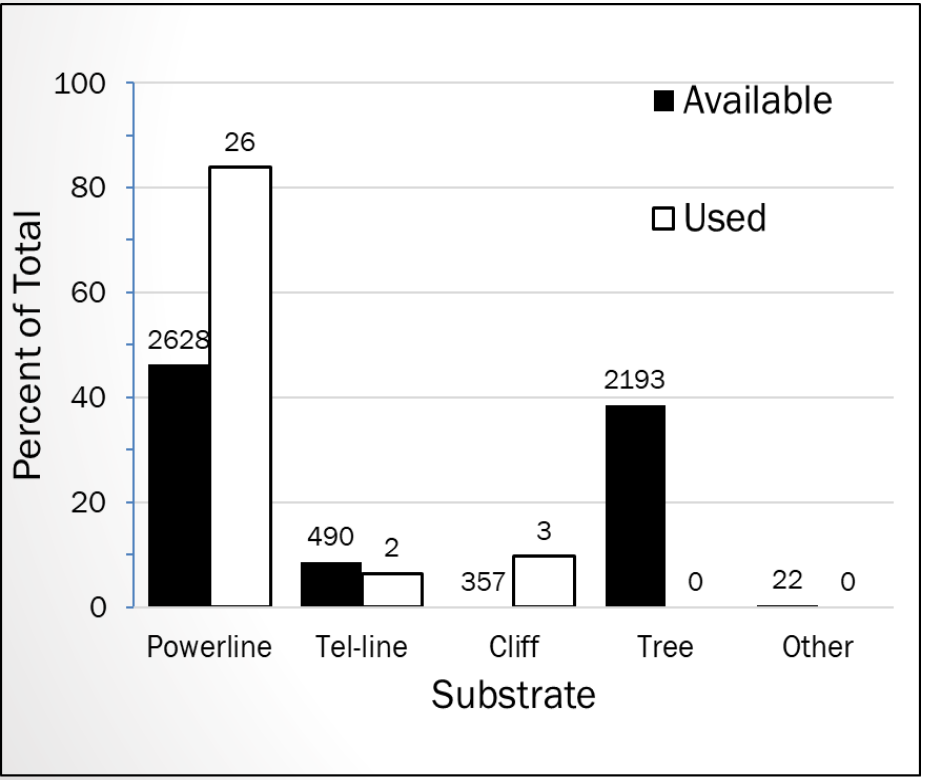
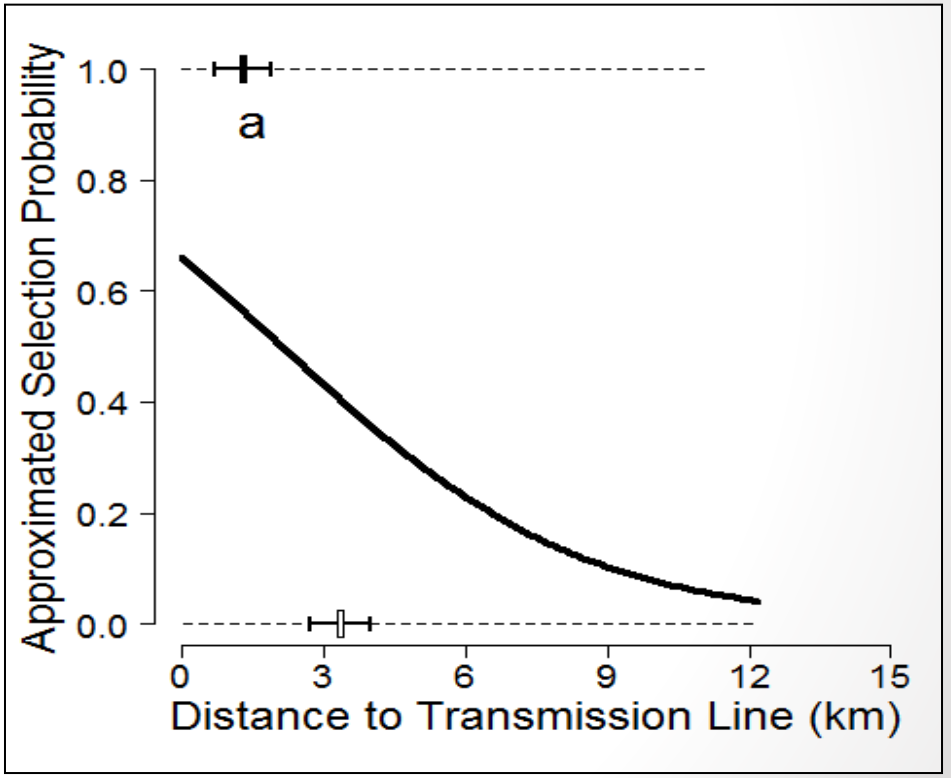


# Nesting ravens select powerlines

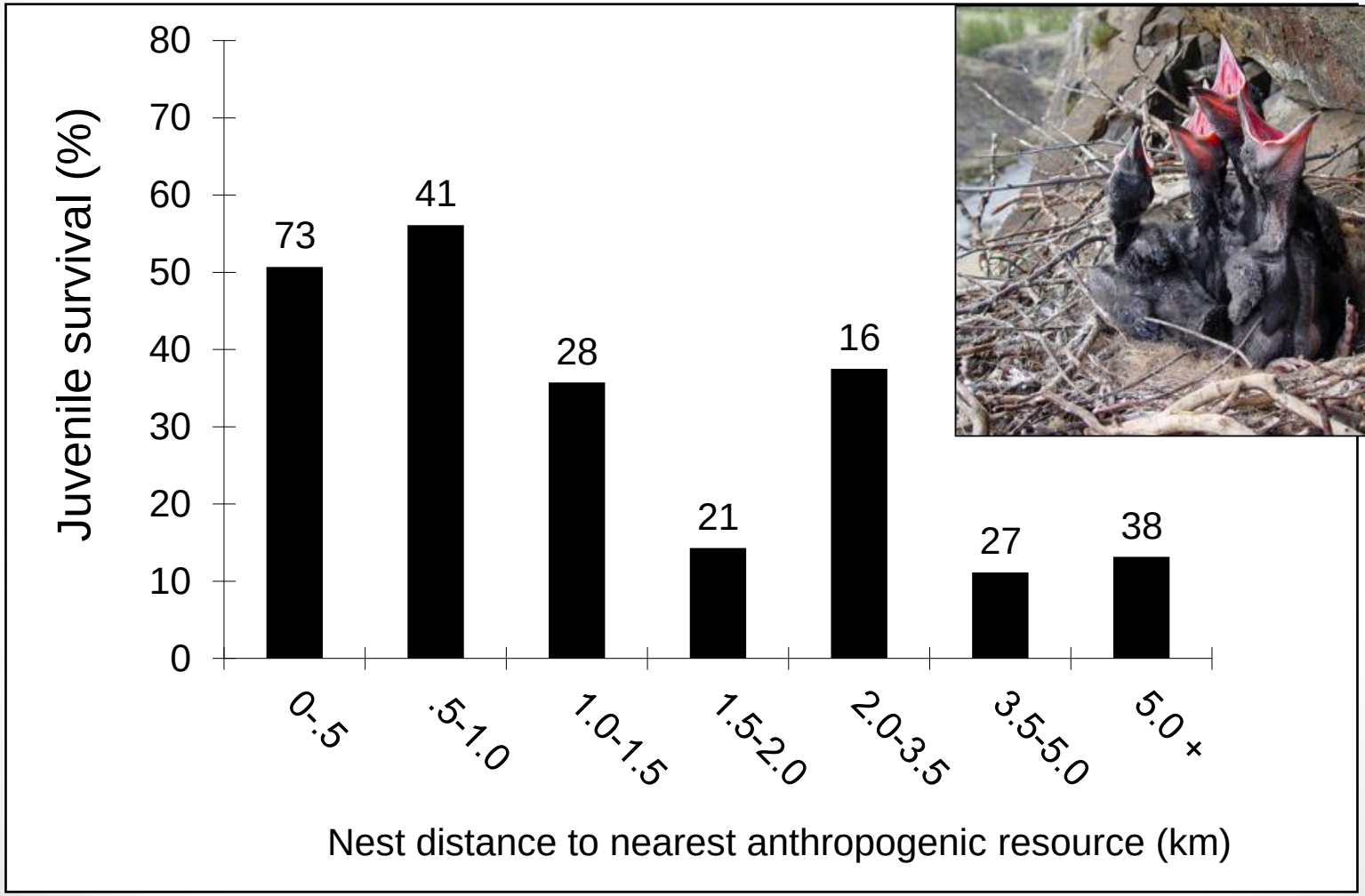



Knight and Kawashima. 1993. Responses of raven and red-tailed hawks to linear right-of-ways. *Journal of Wildlife Management* 57(2):266-271




Howe et al. 2014. Selection of anthropogenic features and vegetation characteristics be nesting common ravens in the sagebrush ecosystem. *The Condor: Ornithological Applications* 116:35-49

# Benefits of anthropogenic resources






*Webb et al. 2004 Condor 106:517-528*

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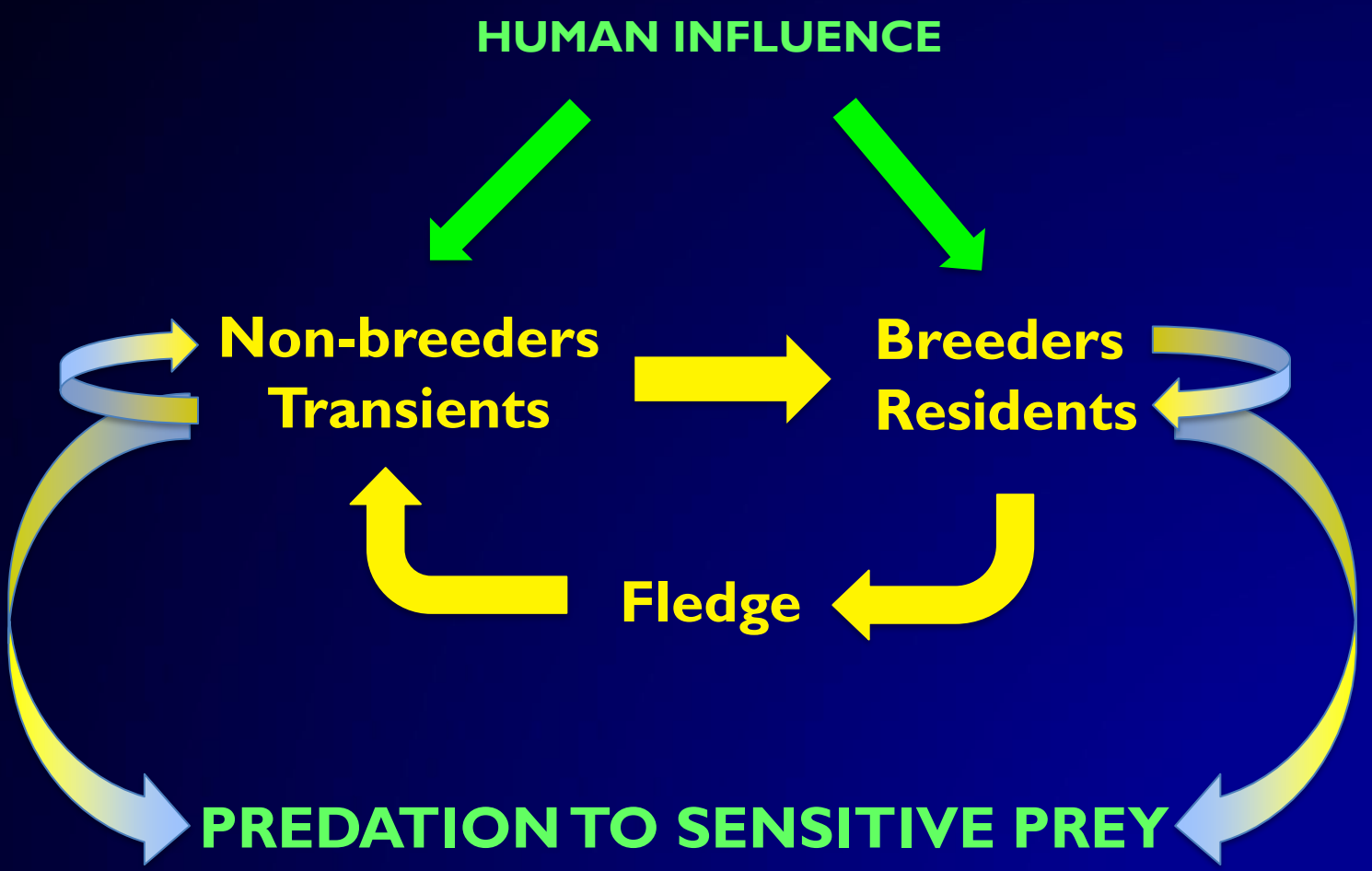
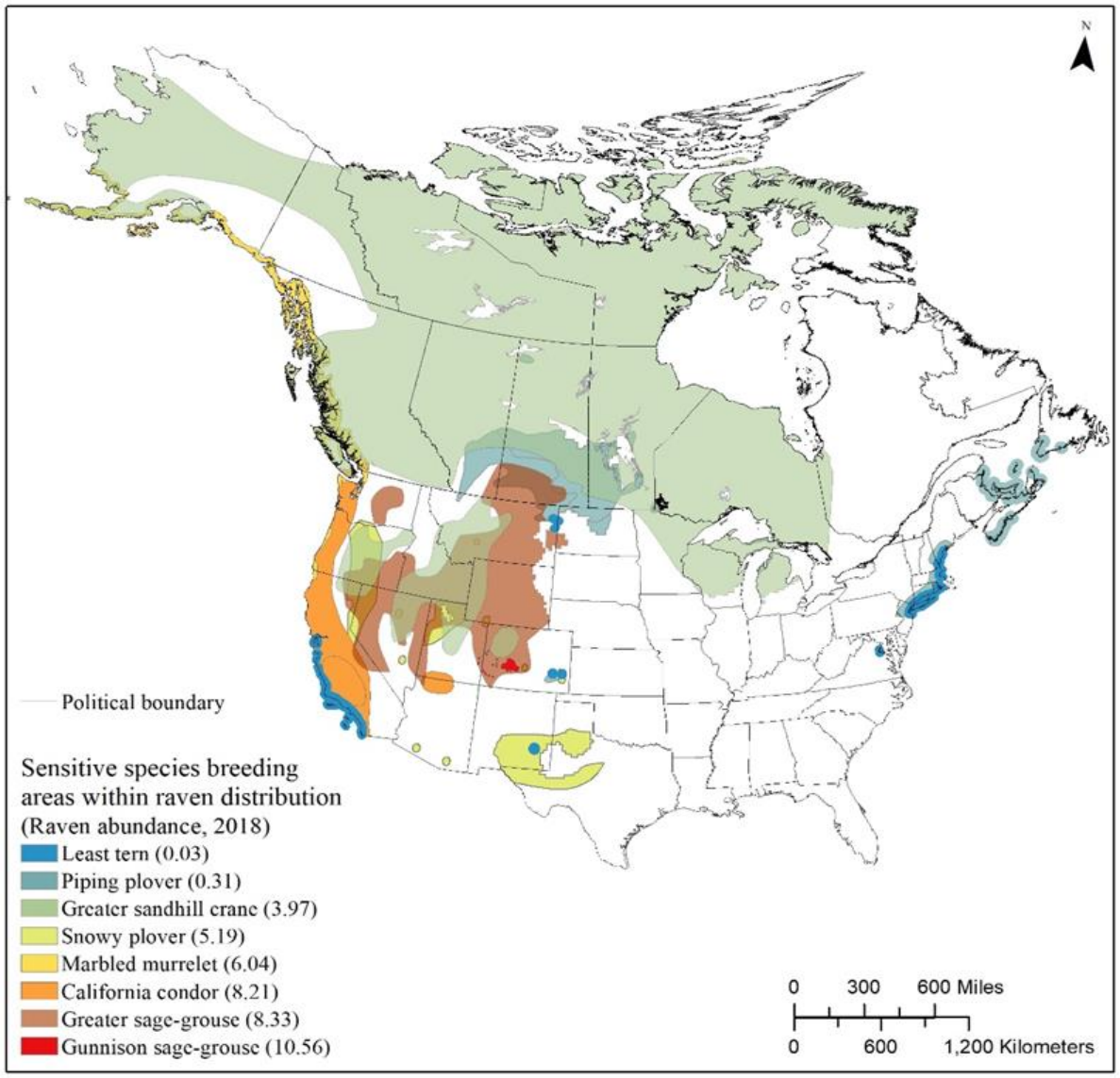


# Ecological Consequences

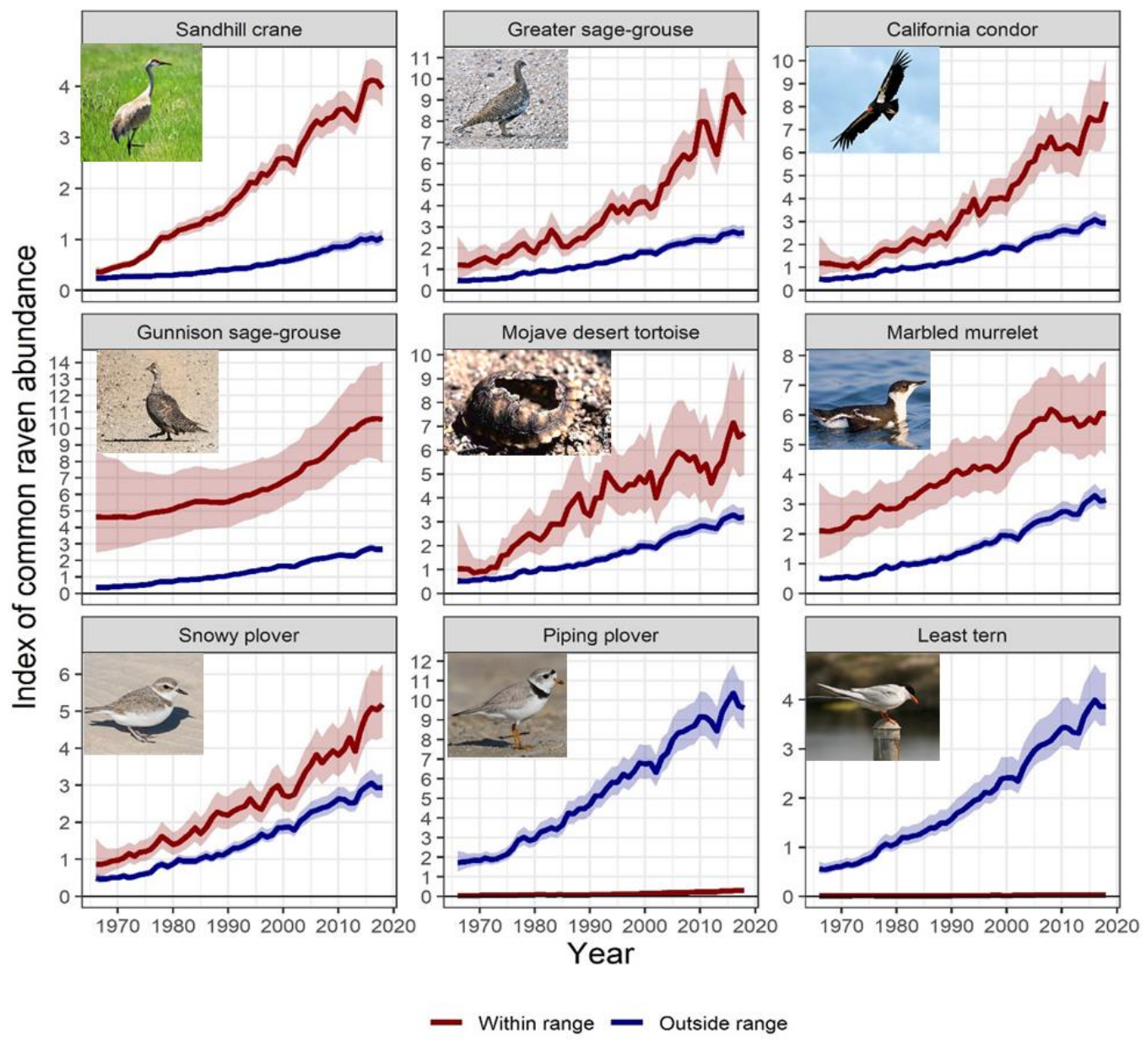
- Hyperpredation
- Spillover predation

# Ravens impact sensitive avian populations




Coates et al. *In press*. Synthesis of nest predation impacts of common ravens on sensitive avian species. *Human-Wildlife Interactions*.

# Ravens impact sensitive avian populations




*Harju et al. In Press. Human-Wildlife Interactions*

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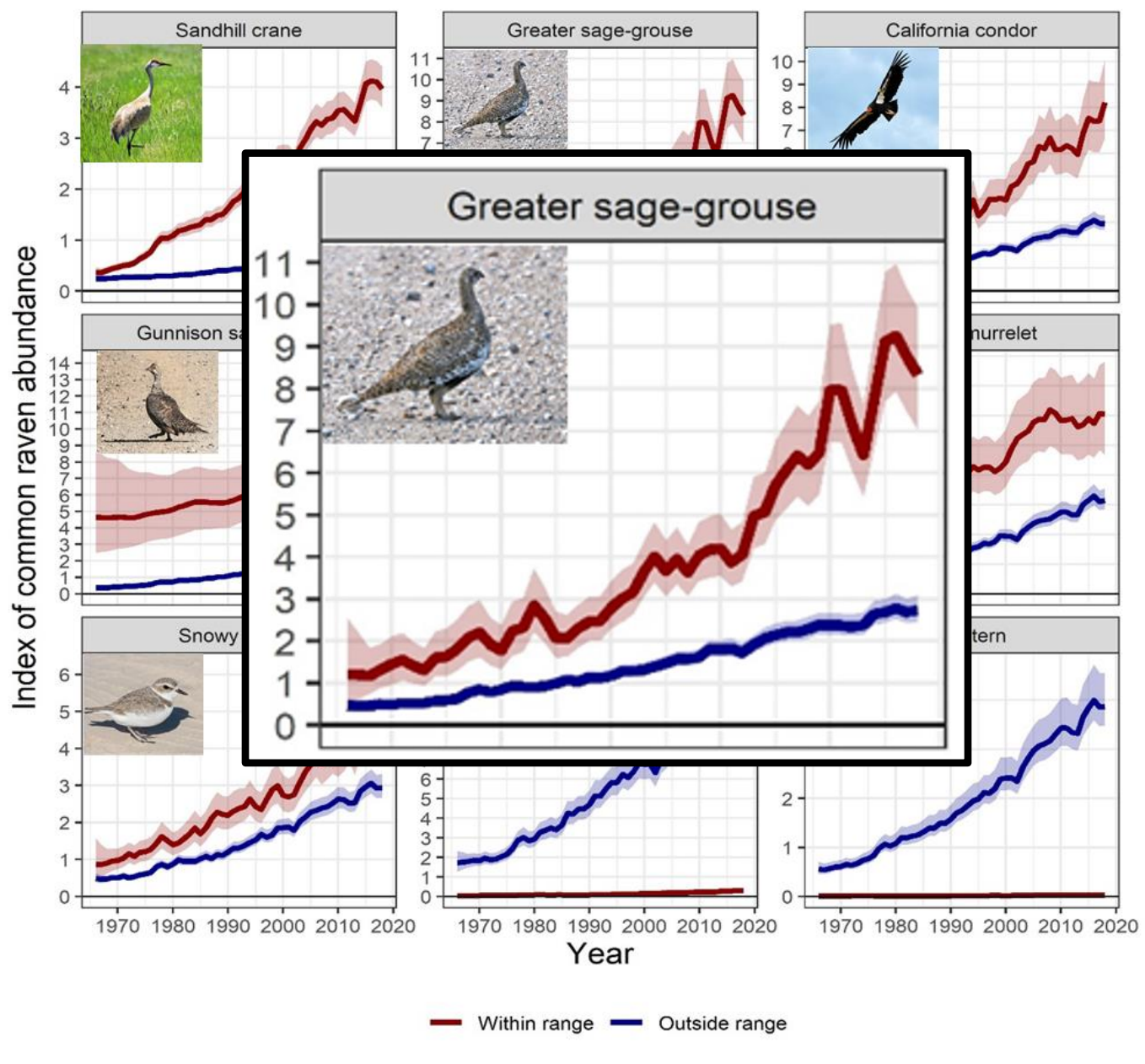
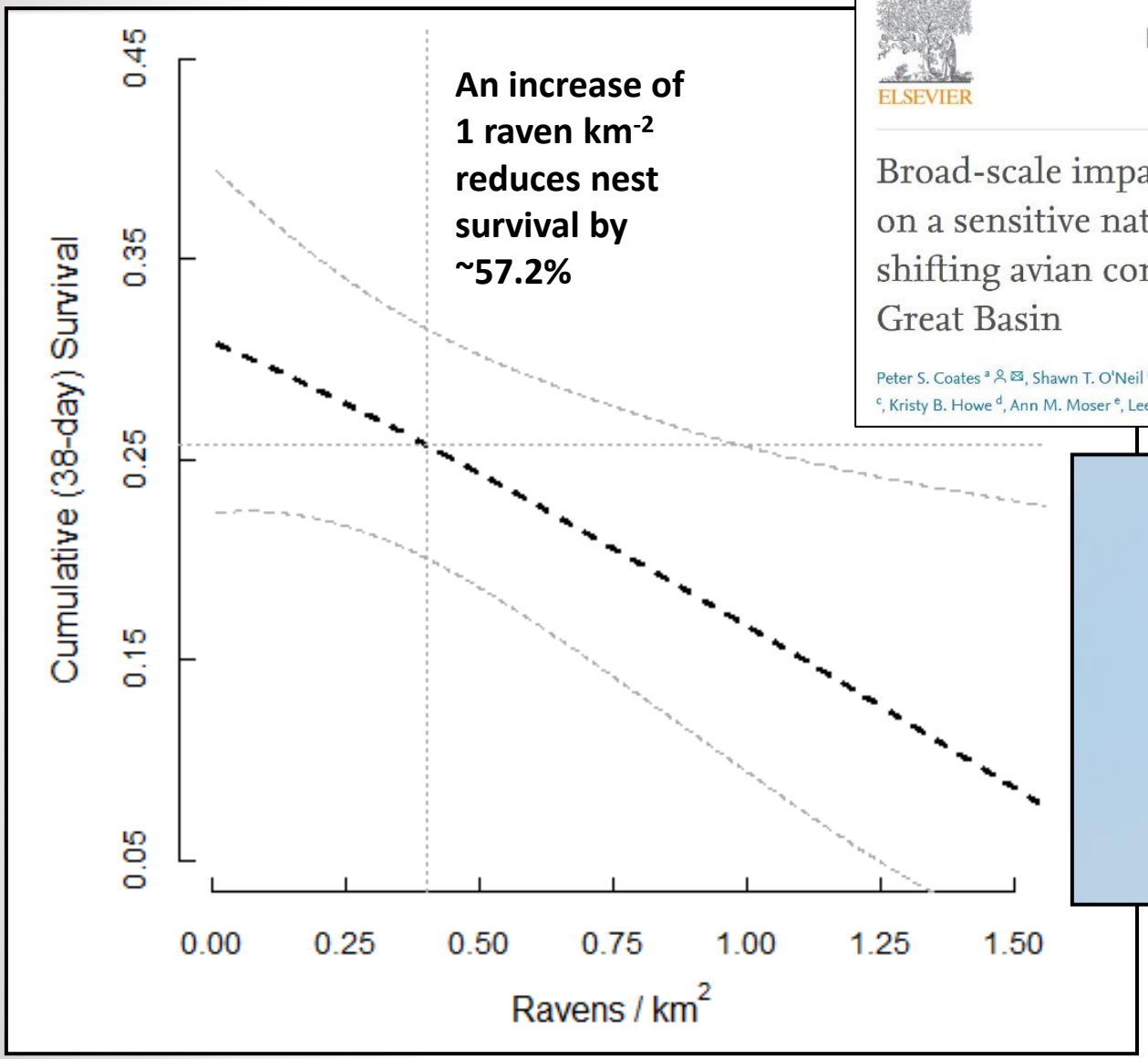



*Harju et al. In Press. Human-Wildlife Interactions*

# Raven density influences nest survival

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Broad-scale impacts of an invasive native predator on a sensitive native prey species within the shifting avian community of the North American Great Basin

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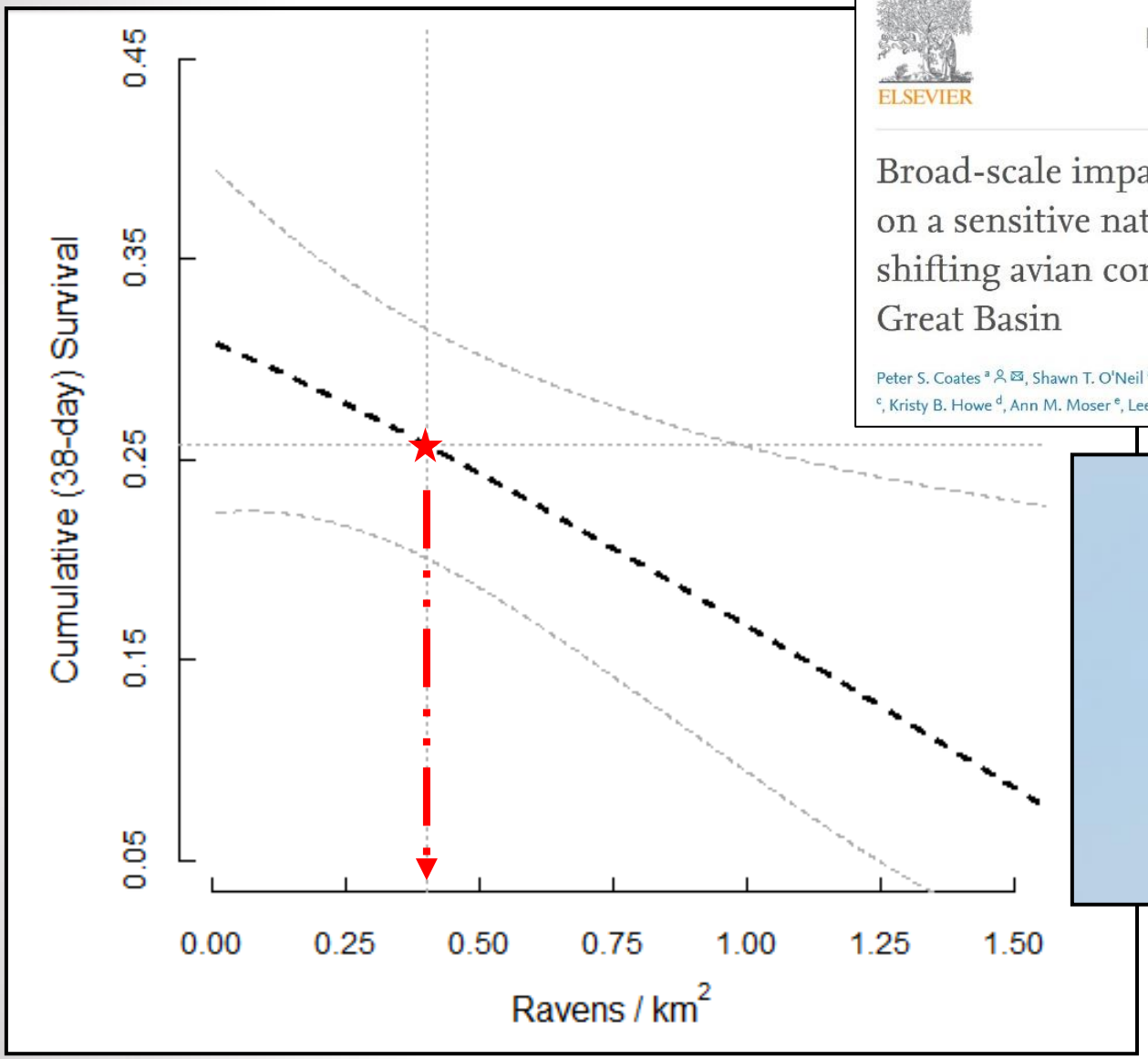
# Ecological threshold of 0.4 ravens km$^{-2}$

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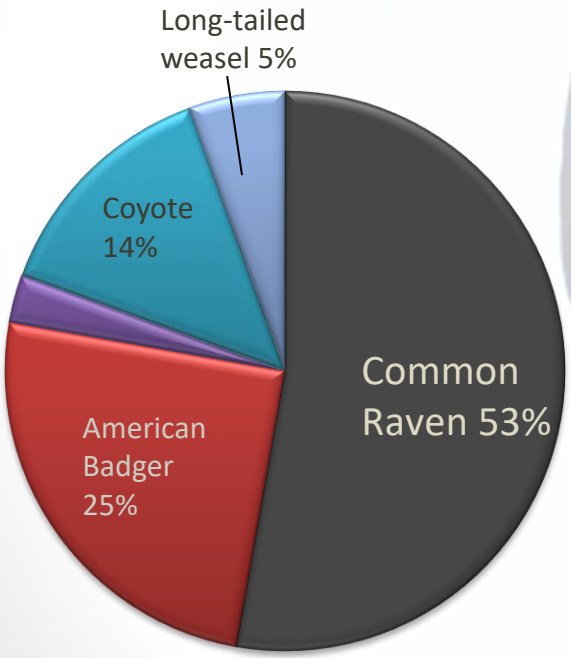
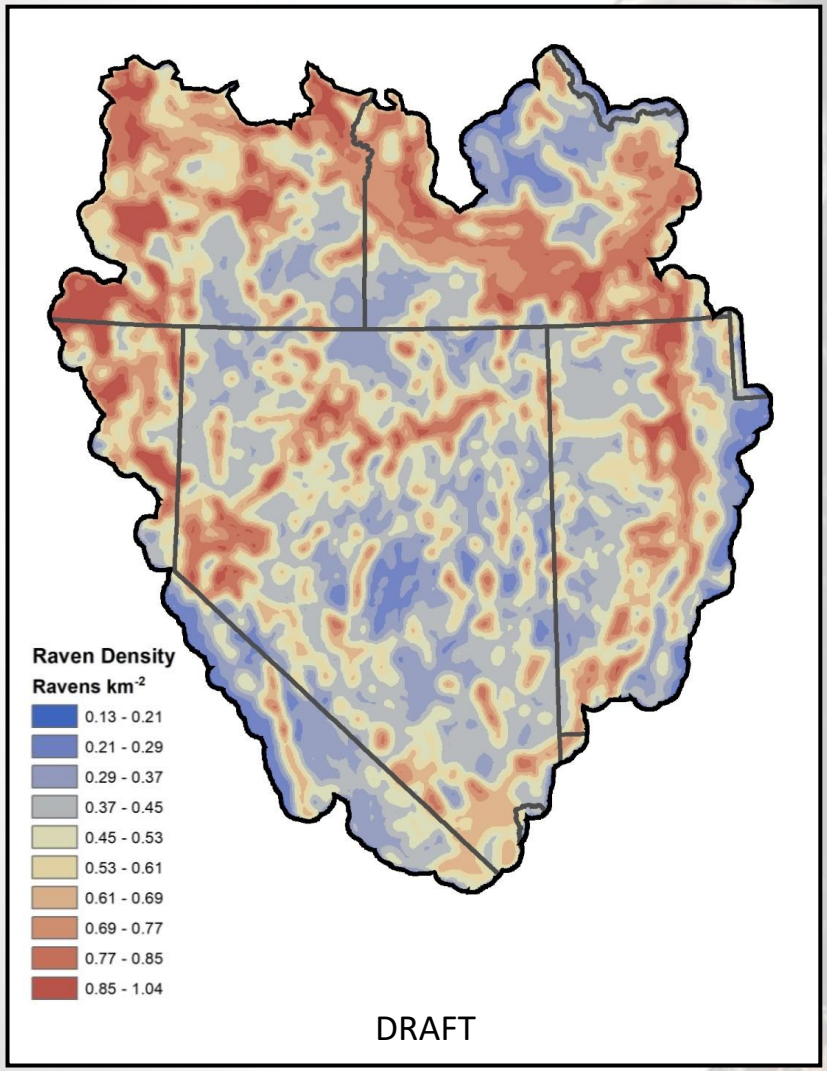
# Ravens as effective sage-grouse egg predator

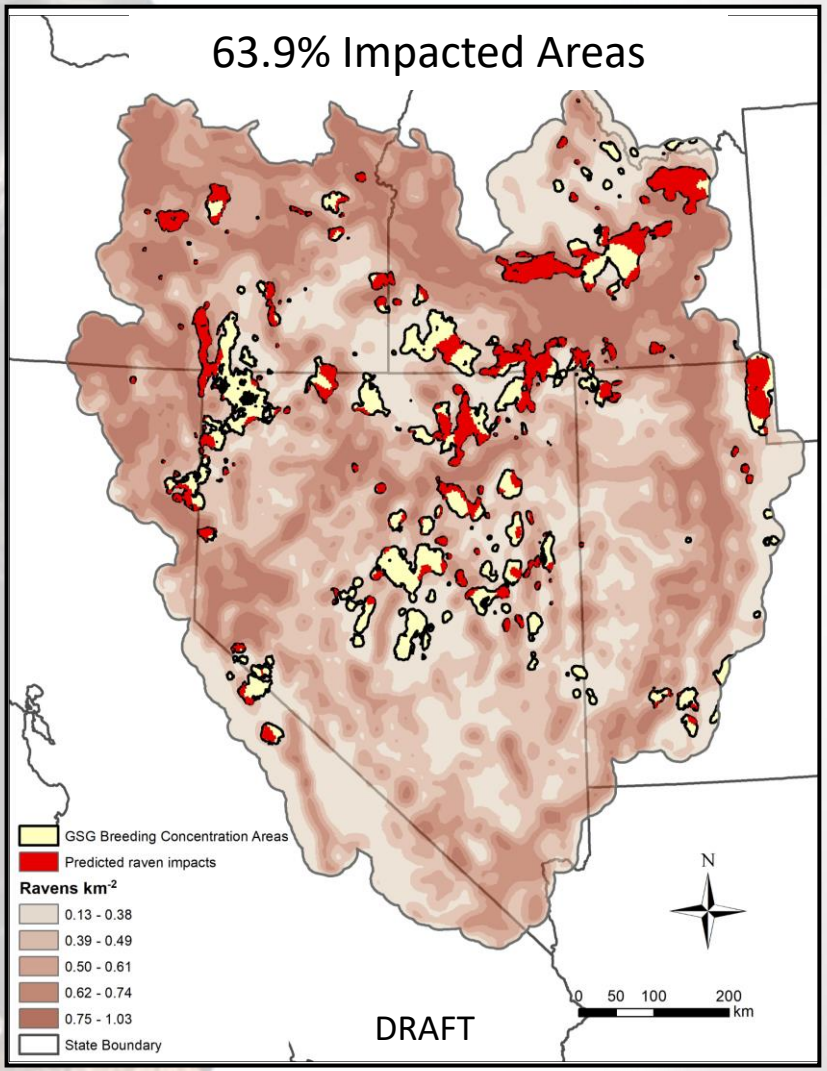



Predation on sage-grouse nests (9 years of video data; Idaho State University)

*Coates and Delehanty (2010). Journal of Wildlife Management 74:240–248.*

# Broad scale impacts of ravens on sage-grouse nest success




*Coates, O'Neil, Brussee et al. 2020. Biological Conservation*

Photo: BLM

# Loss of Habitat

Photo: Matt Lavin

# Shrub cover influences predation by ravens

Journal of Wildlife Management 74(2):240–248; 2010; DOI: 10.2193/2009-047

*Management and Conservation Article*

## Nest Predation of Greater Sage-Grouse in Relation to Microhabitat Factors and Predators

PETER S. COATES,[1] *Department of Biological Sciences, Idaho State University, Pocatello, ID 83209-8007, USA*
DAVID J. DELEHANTY, *Department of Biological Sciences, Idaho State University, Pocatello, ID 83209-8007, USA*

| Resp. | Covariate | Estimate | 95% CI lower | 95% CI upper |
|---|---|---|---|---|
| Raven | raven | 0.23 | 0.11 | 0.41* |
| | shrub cover | -0.08 | -0.15 | -0.02* |
| | grass | 0.17 | -0.63 | 0.41 |
| | forb | 0.16 | -0.40 | 0.70 |
| | understory | 0.02 | -0.04 | 0.08 |
| | shrub height | 0.00 | -0.06 | 0.06 |
| Badger | understory | 0.10 | 0.03 | 0.12* |
| | forb | 0.70 | 0.13 | 1.43* |
| | grass | 0.23 | -0.02 | 0.49 |
| | shrub cover | 0.02 | -0.02 | 0.06 |
| | shrub height | 0.01 | -0.01 | 0.42 |


**1% decrease in shrub cover increased the odds of raven predation by 7.5%**

**20–30% sagebrush cover and >40% total shrub cover**

Received: 20 December 2022 | Revised: 5 April 2023 | Accepted: 11 April 2023

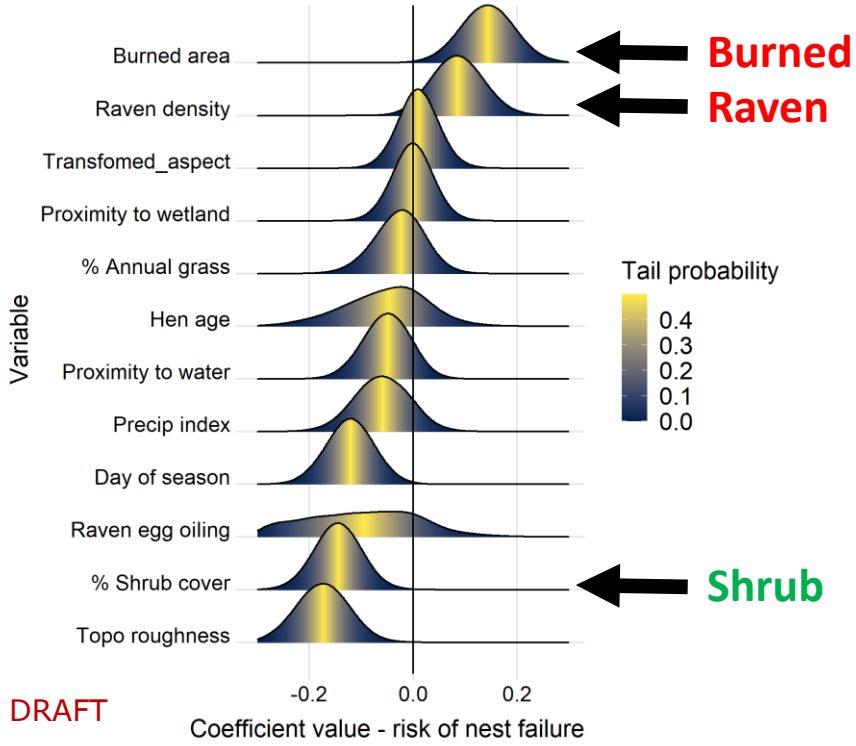
DOI: 10.1002/ecs2.4618

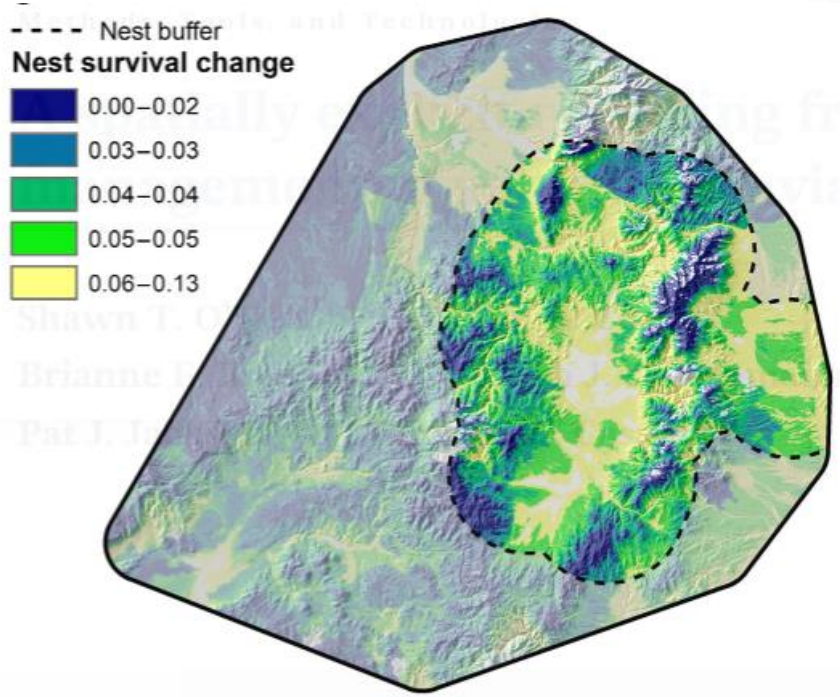
ECOSPHERE
AN ESA OPEN ACCESS JOURNAL

ARTICLE
Methods, Tools, and Technologies

# A spatially explicit modeling framework to guide management of subsidized avian predator densities

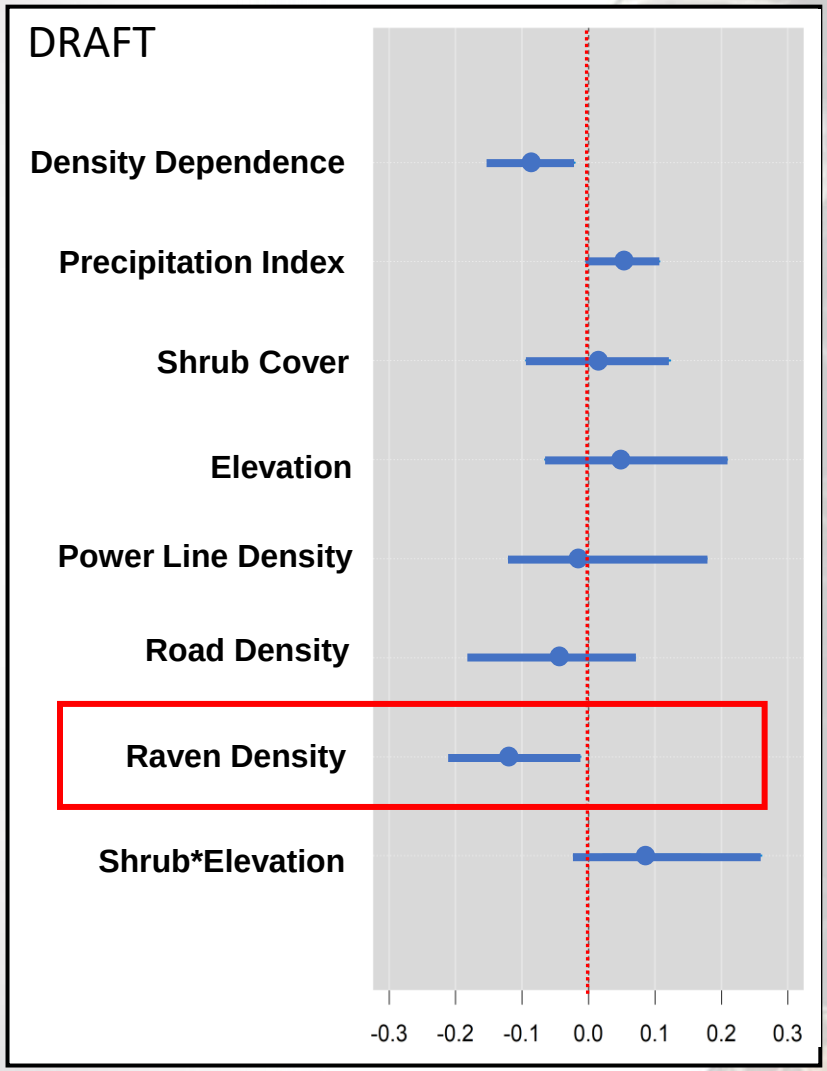
Shawn T. O'Neil[1] | Peter S. Coates[1] | Sarah C. Webster[2] | Brianne E. Brussee[1] | Seth J. Dettenmaier[2] | John C. Tull[3] | Pat J. Jackson[4] | Michael L. Casazza[1] | Shawn P. Espinosa[4]

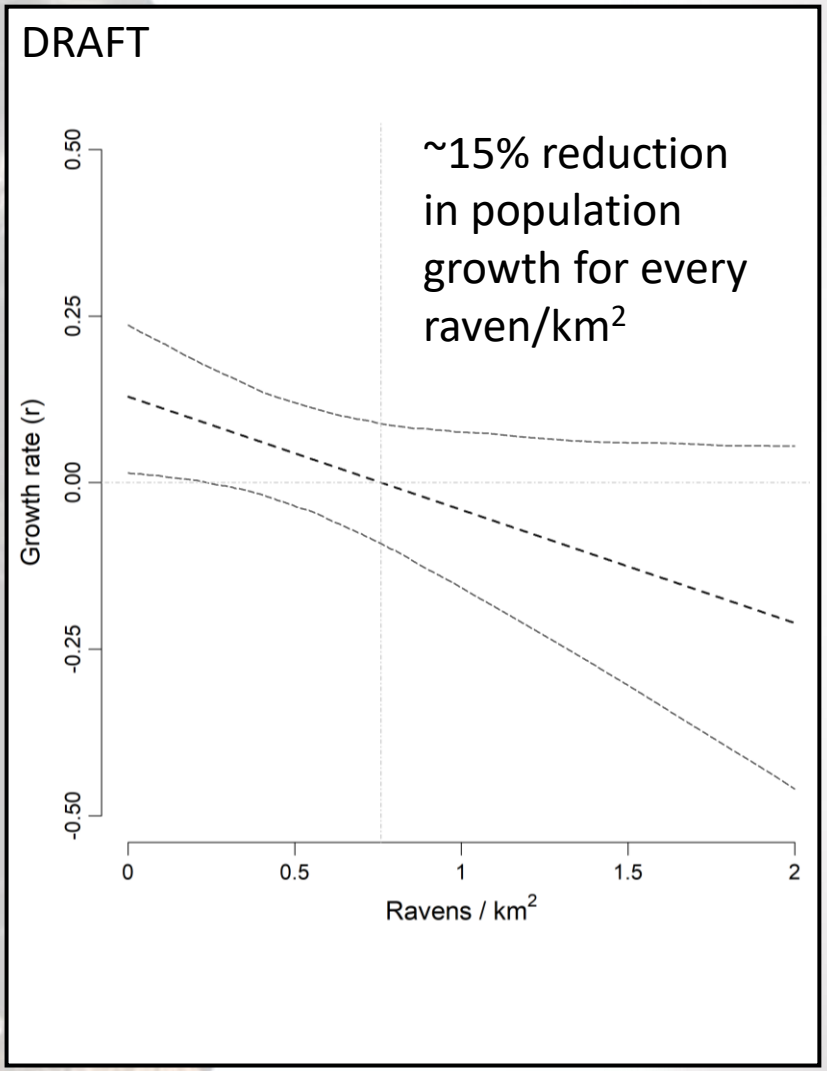



DRAFT

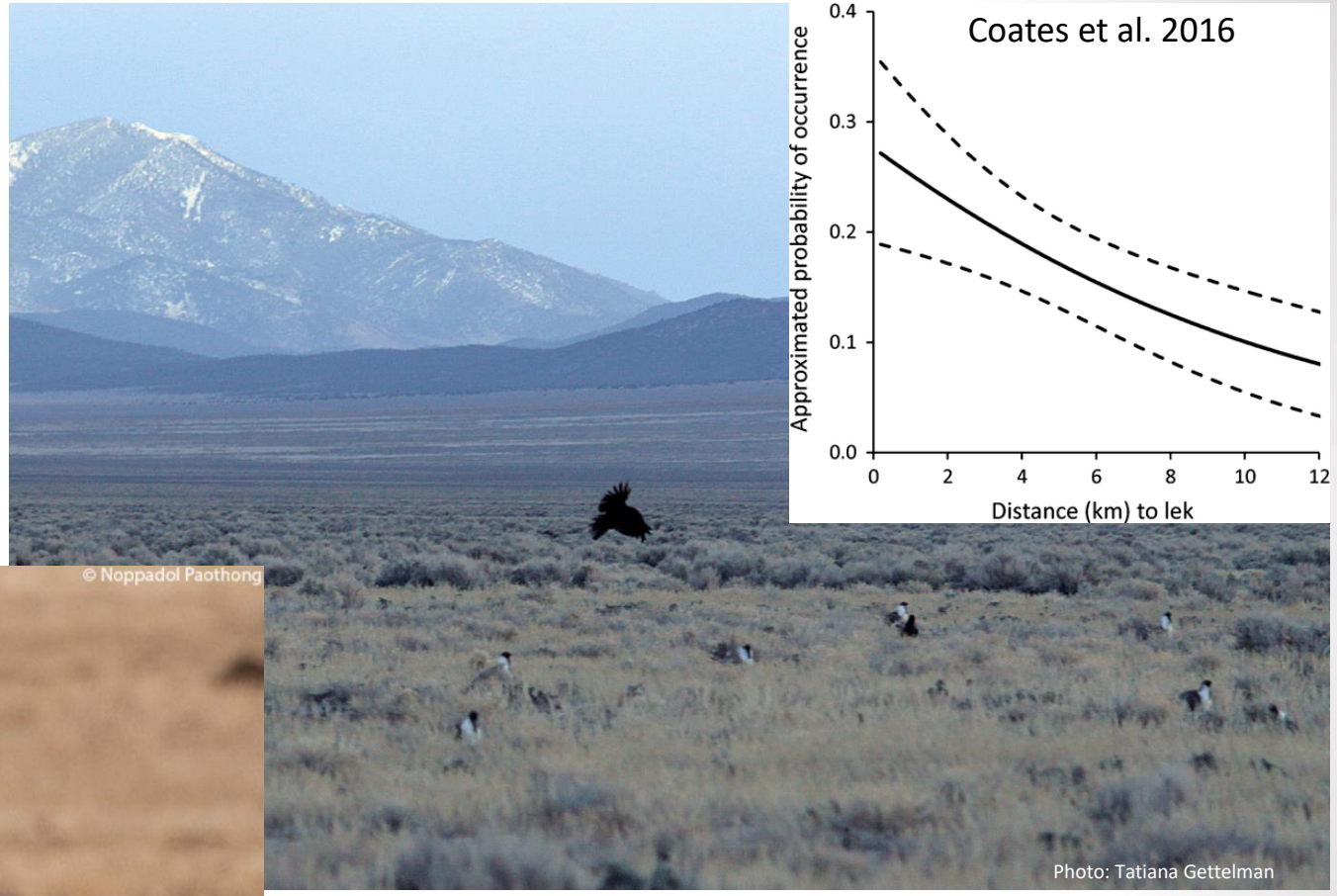
# Impacts on population growth



# Attraction to leks and harassment

Raven attacks greater sage-grouse (NV)








Raven attacks Gunnison sage-grouse (CO)

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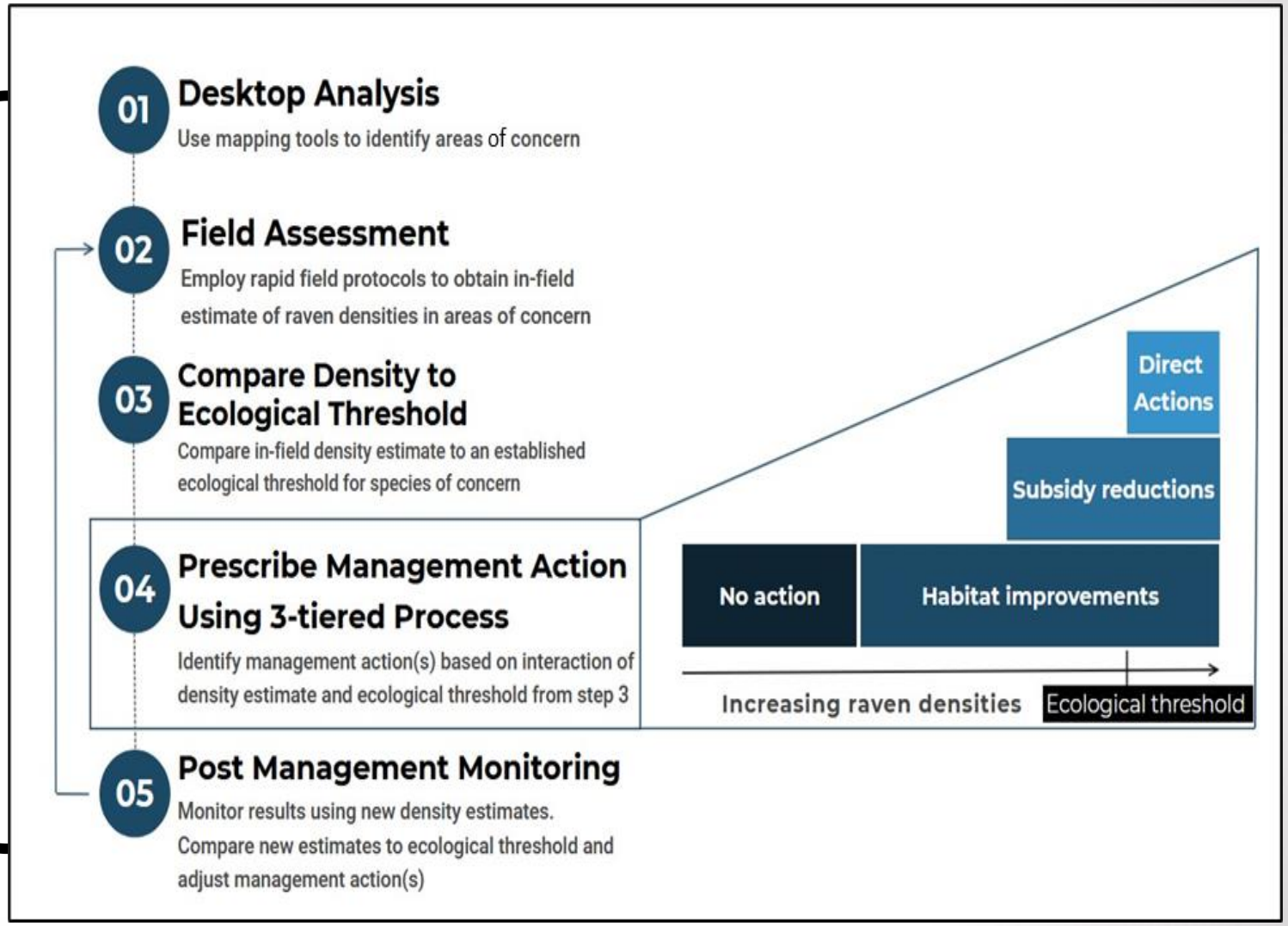
**Adaptive Management Approach (3-tiered system)**

**Science-based Management for Ravens Application (SMaRT)**

# Science-based framework – Raven Core Team

SMaRT




*Dettenmaier et al. In Press. Human Wildlife Interactions.*

# SMaRT – Science-based Management of Ravens Tool

# Acknowledgments


- Nevada Department of Wildlife
- Nevada Wildlife Commissioners
- Nevada Governor’s Sagebrush Ecosystem Council
- U.S. Fish and Wildlife Service
- USDA-APHIS
- Bureau of Land Management
- Great Basin Bird Observatory
- Idaho State University
- Idaho Department of Fish and Game
- Private industry partners (ORMAT, GRP, LS Power)