RAVEN SCIENCE, ECOLOGY, AND MANAGEMENT: TARGETING SOLUTIONS WITH APPLIED SCIENCE

Pete S. Coates[1], Joseph L. Atkinson[1], William I. Boarman[2], Brianne E. Brussee[1], Michael P. Chenaille[1], David J. Delehanty[3], Seth J. Dettenmaier[1], Jonathan B. Dinkins[4], Ian A. Dwight[5], Seth M. Harju[6], Kerry L. Holcomb[7], Pat J. Jackson[8], Shawn T. O'Neil[1], Brian G. Prochazka[1], Mark A. Ricca[1], Timothy Shields[2], John C. Tull[7], William C. Webb[3], Sarah C. Webster[1], Cali L. Wiese[1]

USGS science for a changing world

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[4]Oregon State University | [5]California Department of Fish and Game
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NEVADA DEPARTMENT OF WILDLIFE

Raven Management Special Issue

22 peer-reviewed papers on raven ecology and management

Articles supported by NDOW $3 predator fee:

- Raven population trends
- Occurrence, resource use and demography of ravens
- Density and occurrence modeling within Great Basin
- Nest predation impacts of ravens on sensitive species
- Ravens disrupt lekking sage-grouse
- Tortoise raven viable conflict threshold
- Rapid assessment to estimate raven densities
- Effects of lethal removal of ravens
- Manipulating raven reproduction to conserve prey species
- Science-based framework for management of ravens

Estimating trends of common raven populations in North America, 1966–2018

Seth M. Harju, Heron Ecological, LLC., P.O. Box 235, Kingston, ID 83839, USA *seth@heronecological.com*

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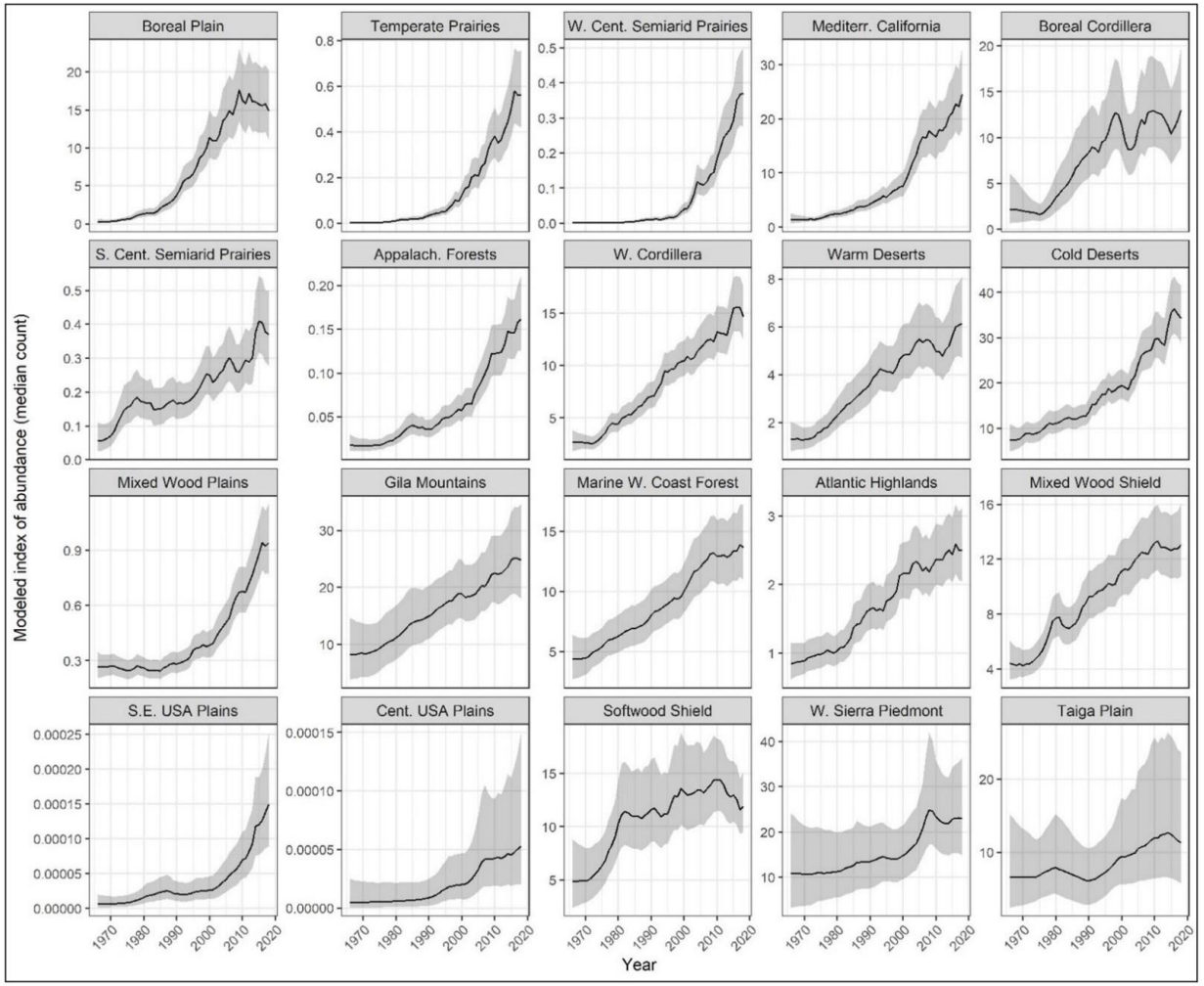
Michael P. Chenaille, U.S. Geological Survey, Western Ecological Research Center, Dixon Field Station, 800 Business Park Drive, Suite D, Dixon, CA 95620, USA



Estimating trends of common raven populations in North America, 1966–2018

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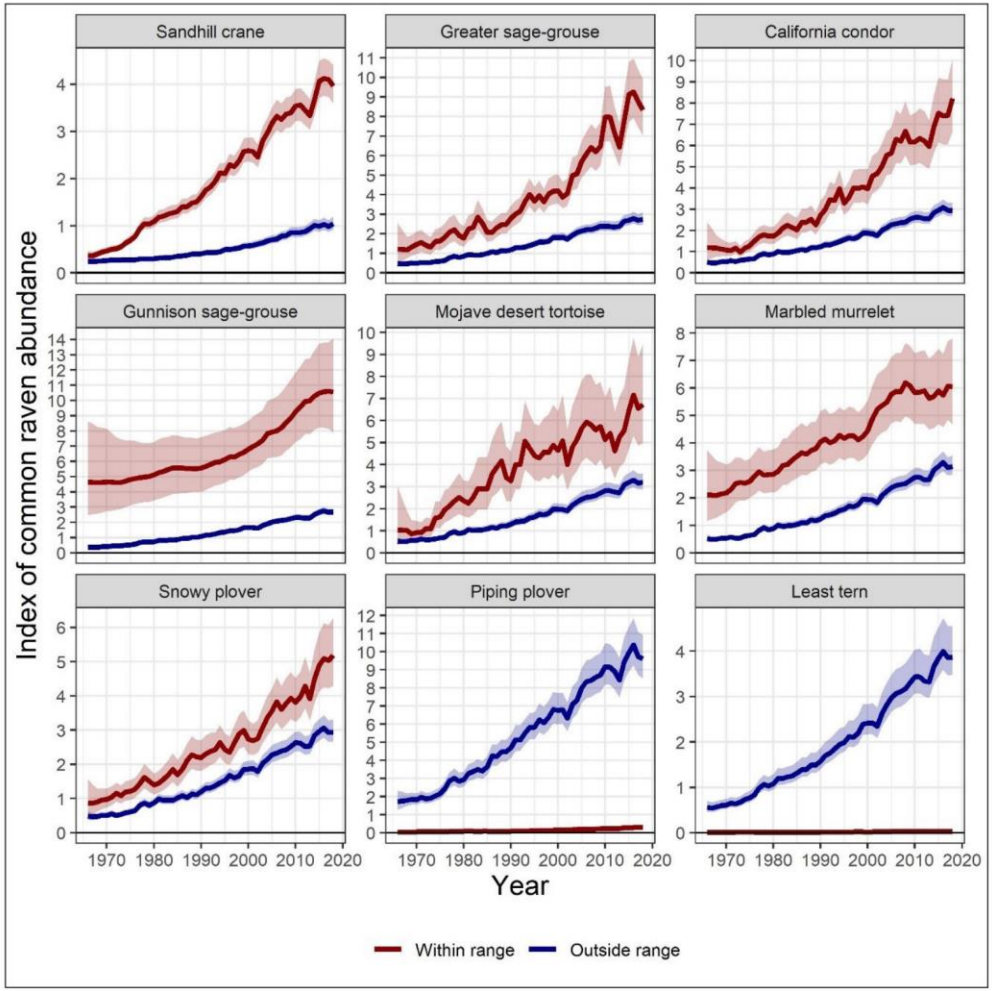

Human–Wildlife Interactions 15(3):433–446, Winter 2021 • digitalcommons.usu.edu/hwi

USGS science for a changing world

Techniques

A rapid assessment function to estimate common raven population densities: implications for targeted management

Brianne E. Brussee, U.S. Geological Survey, Western Ecological Research Center, 800 Business Park Drive, Suite D, Dixon, CA 95620, USA
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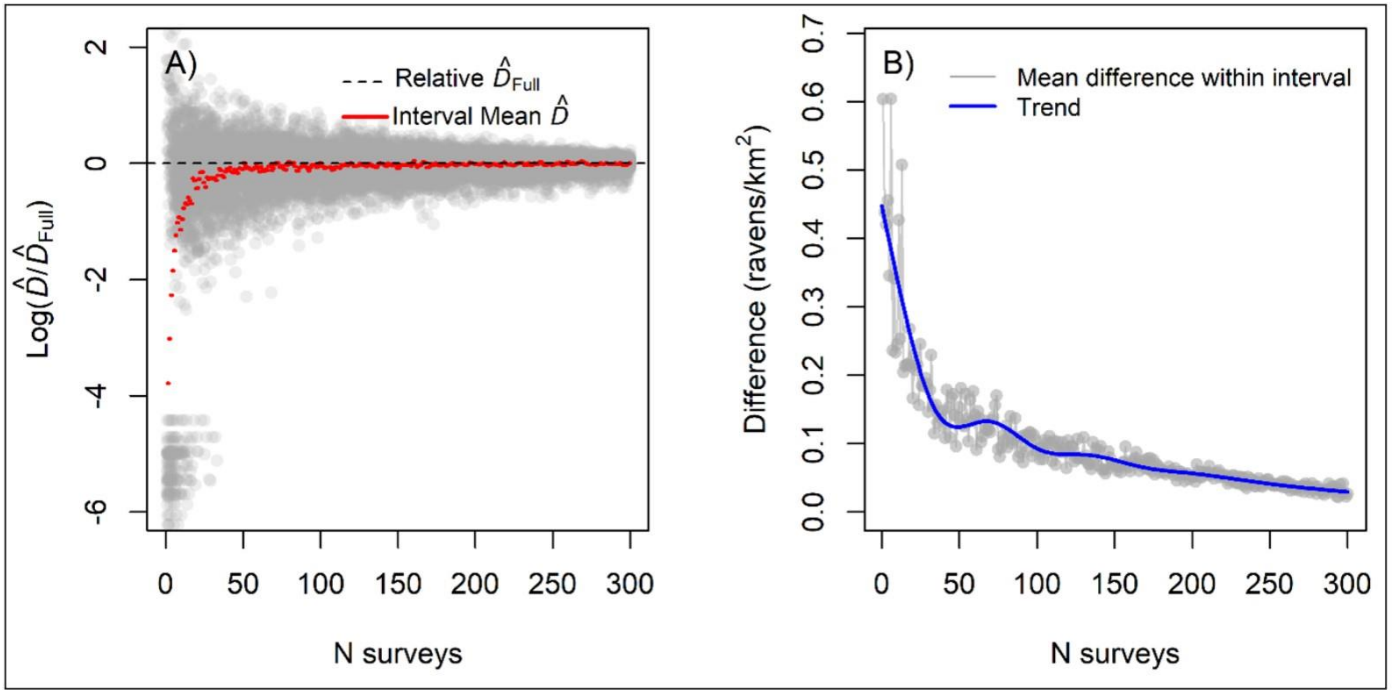
Pat J. Jackson, Nevada Department of Wildlife, Reno, NV 89511, USA
Kristy B. Howe, Nevada Division of Natural Heritage, Carson City, NV 89701, USA
David J. Delehanty, Idaho State University, Department of Biological Sciences, Pocatello, ID 83209, USA



Human–Wildlife Interactions 15(3):575–597, Winter 2021 • digitalcommons.usu.edu/hwi

Case Study

SMaRT: a science-based tiered framework for common ravens

Seth J. Dettenmaier, U.S. Geological Survey, Western Ecological Research Center, Dixon Field Station, 800 Business Park Drive, Suite D, Dixon, CA 95620, USA
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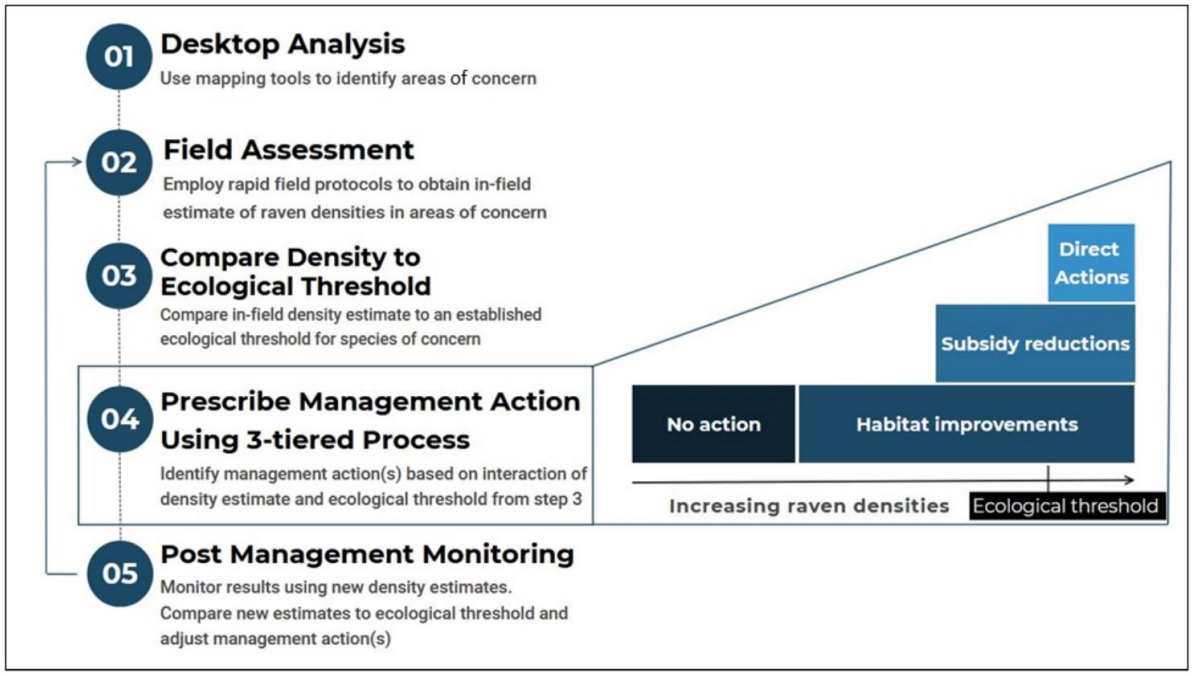

Reviewing the Raven Issue

USGS science for a changing world

Problem

Expansion of raven distribution and abundance

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Anthropogenic resource subsidies

↓

Predation effects on sensitive species

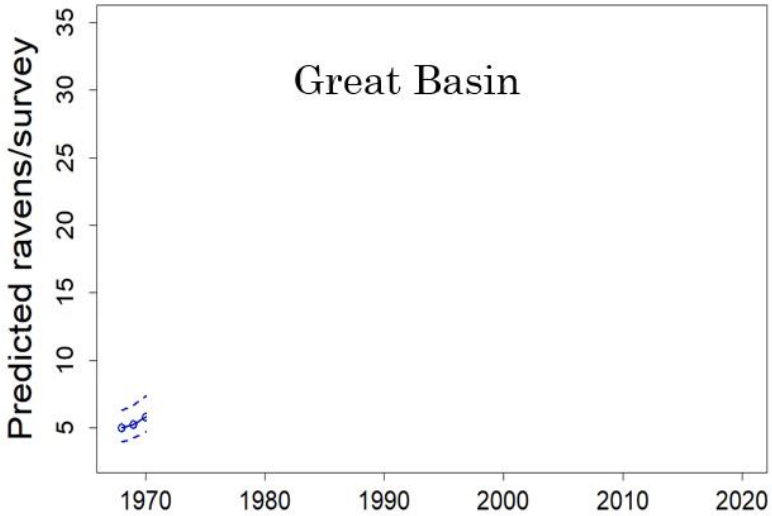
Solution

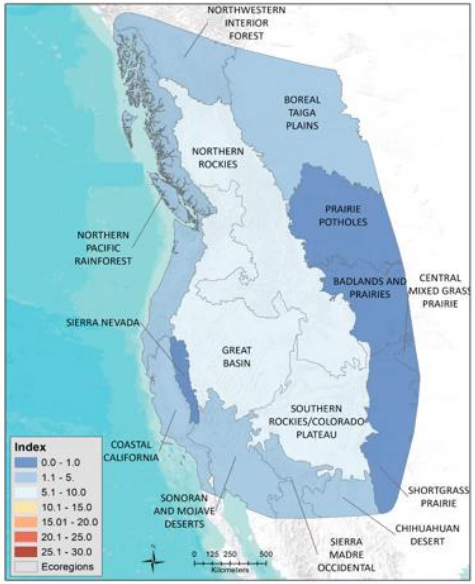
Science-based tiered framework

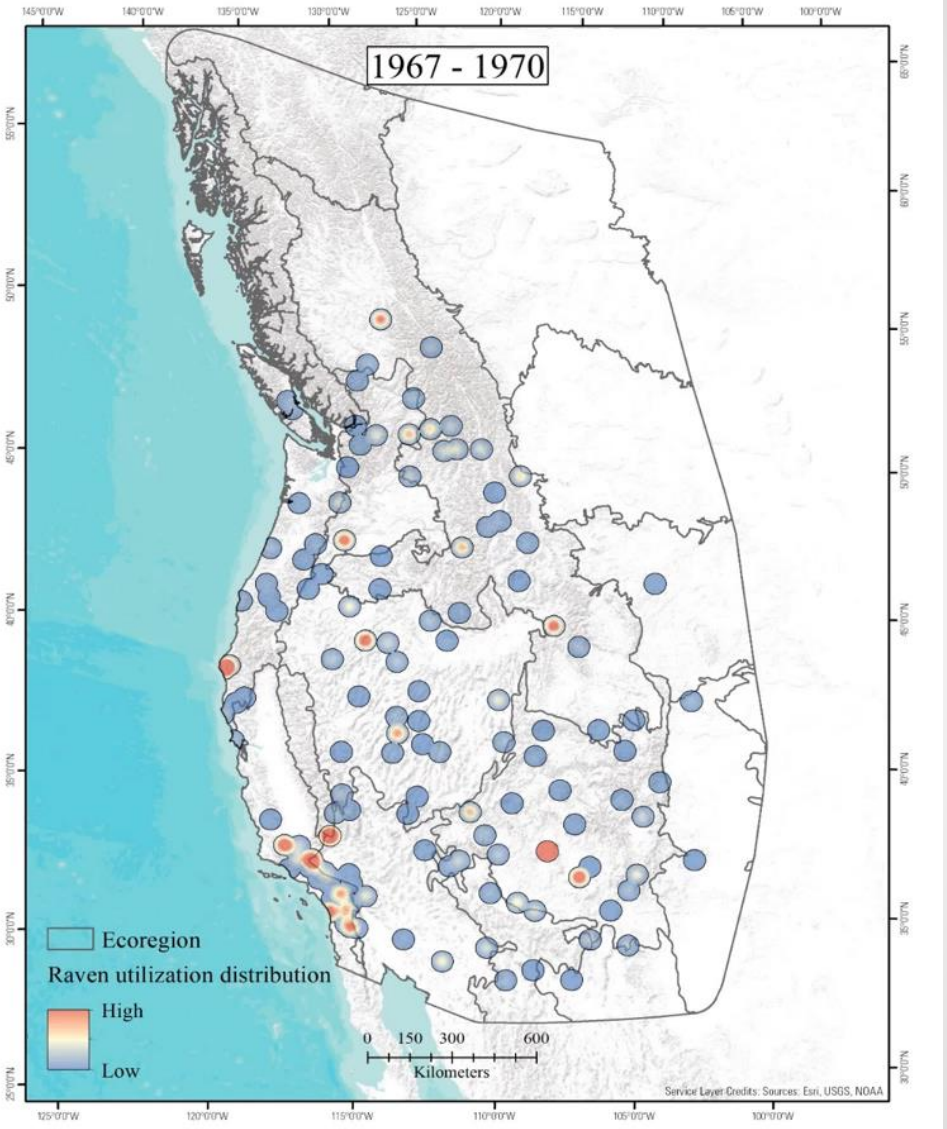
↓

Decision support tools - SMaRT

Raven Populations are Increasing







Harju, S.M., et al. (2021). Estimating trends of common raven populations in North America 1966 – 2018. *Human-Wildlife Interactions 15:3.*

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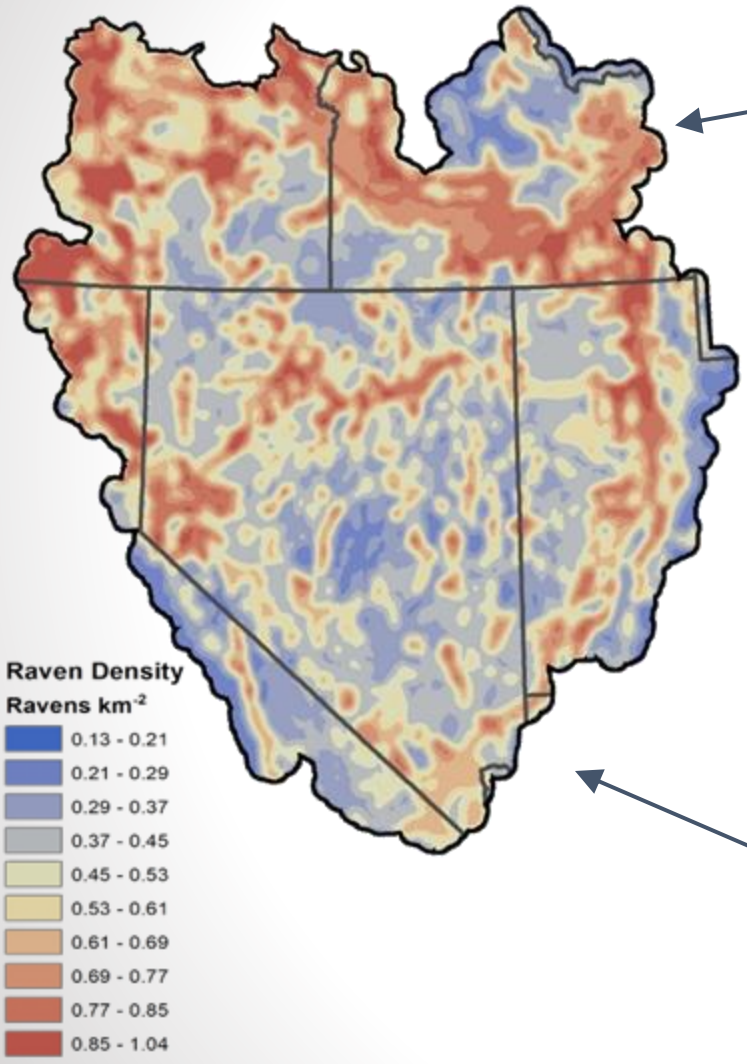
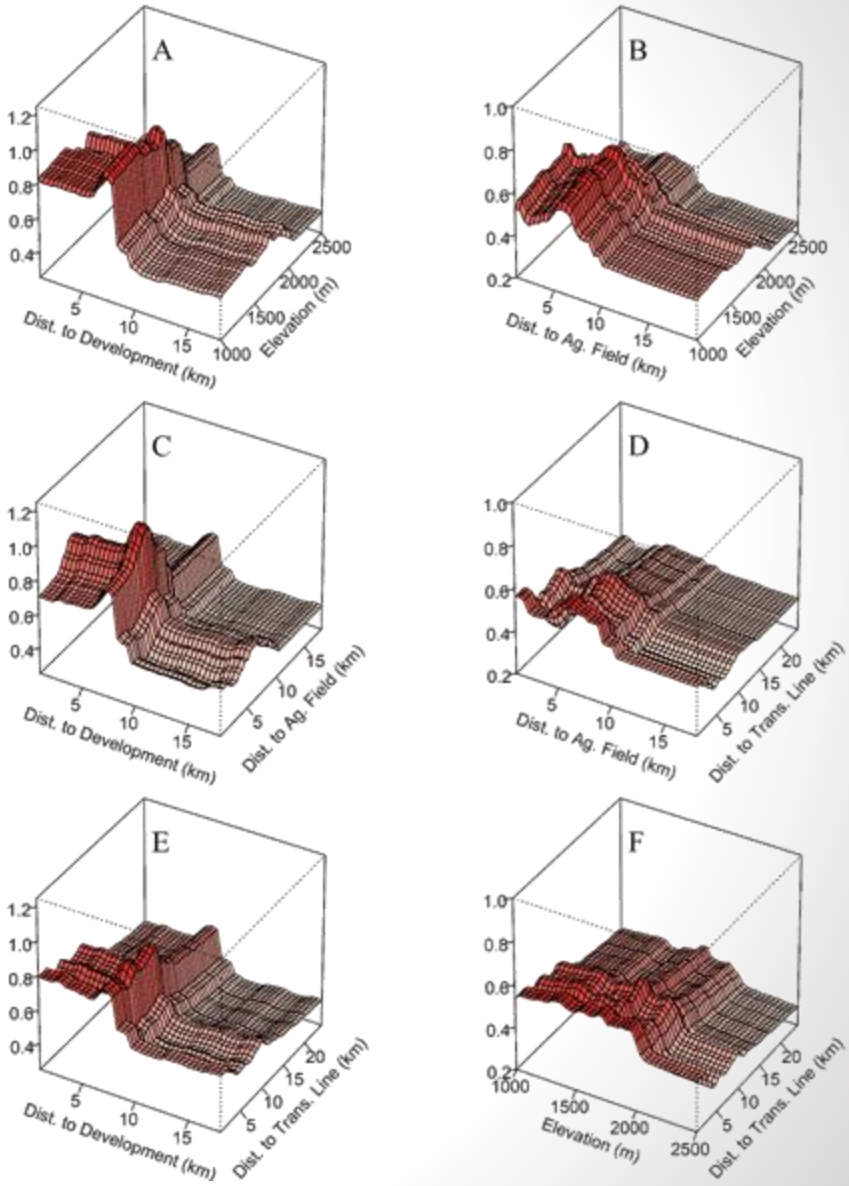
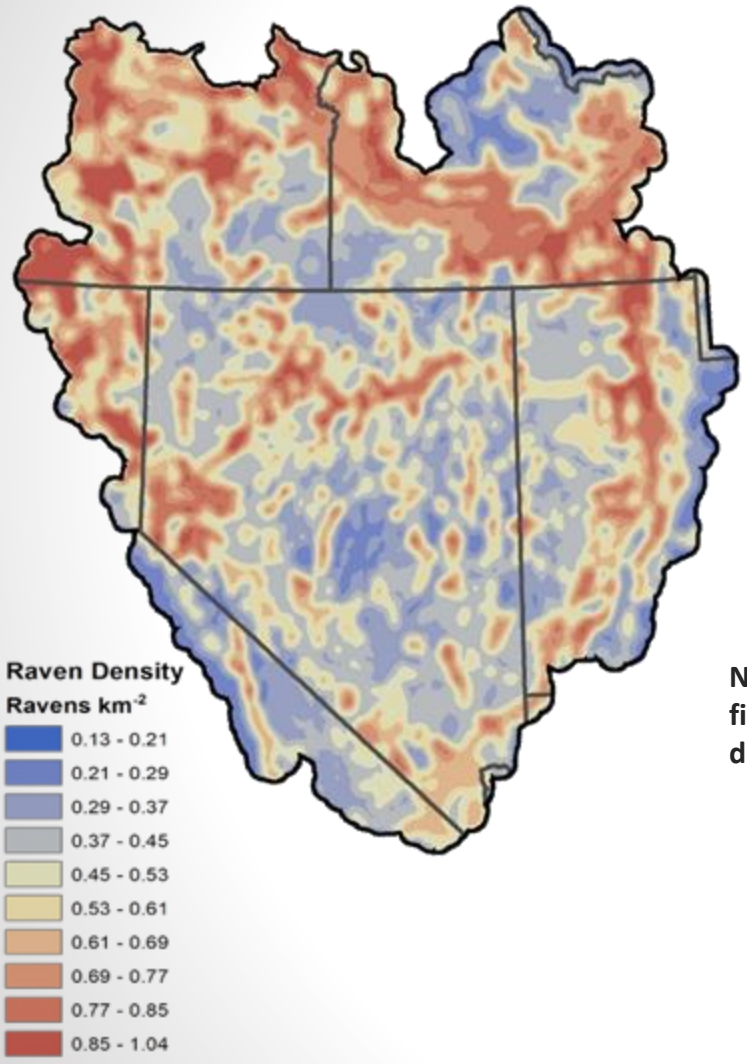
Anthropogenic subsides influence density



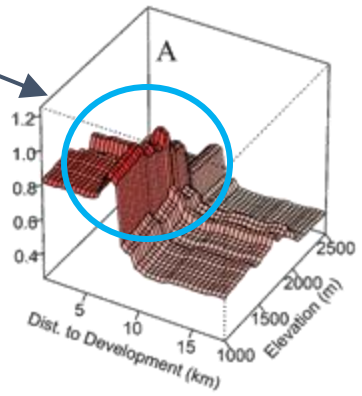


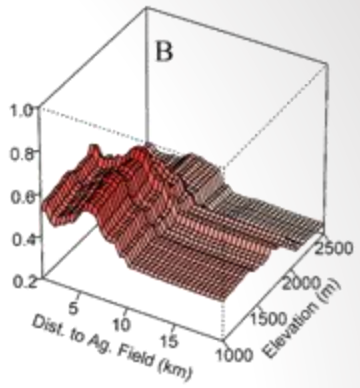
Coates et al. (2020) *Biol. Conservation 242*
https://doi.org/10.1016/j.biocon.2020.108409

Anthropogenic subsides influence density

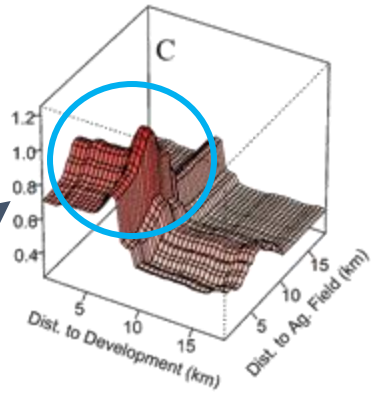


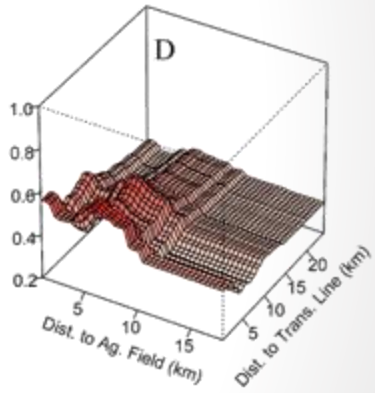
Near developed areas at lower elevation

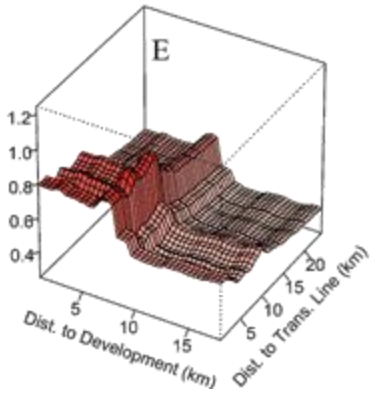


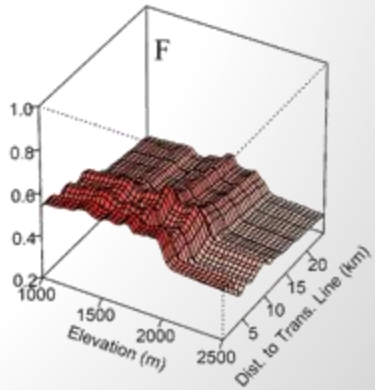


Near agricultural fields and closer to development



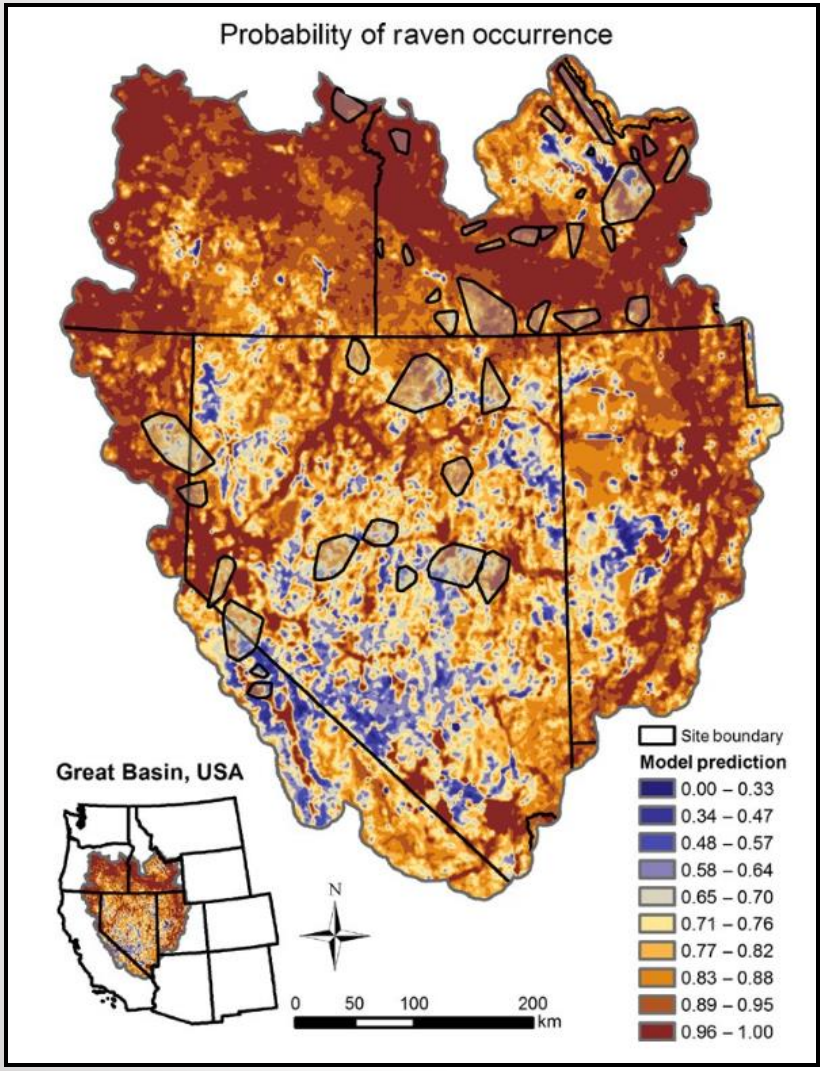






Coates et al. (2020) *Biol. Conservation 242*
https://doi.org/10.1016/j.biocon.2020.108409

Anthropogenic subsides influence occupancy



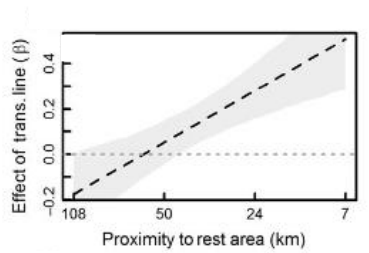
RESEARCH ARTICLE

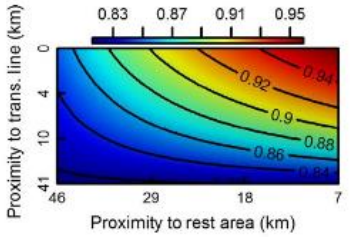
Journal of Applied Ecology

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

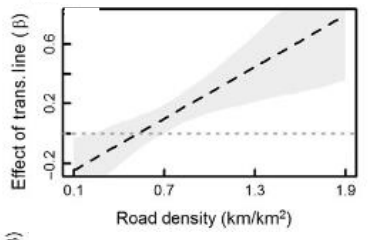
Shawn T. O'Neil[1] | Peter S. Coates[1] | Brianne E. Brussee[1] | Pat J. Jackson[2] | Kristy B. Howe[3] | Ann M. Moser[4] | Lee J. Foster[5] | David J. Delehanty[6]

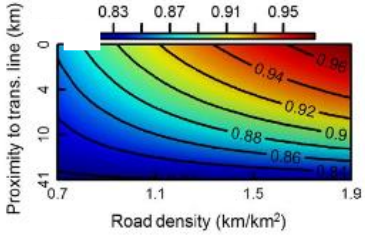
[1]U.S. Geological Survey, Western Ecological Research Center, Dixon, California; [2]Nevada Department of Wildlife, Reno, Nevada; [3]Nevada Natural Heritage Program, Carson City, Nevada; [4]Idaho Department of Fish and Game, Boise, Idaho; [5]Oregon Department of Fish and Wildlife, Hines, Oregon and [6]Department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



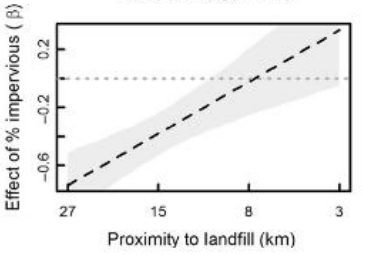


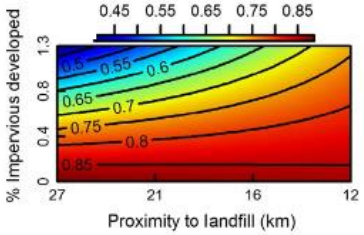
Transmission line
Rest area





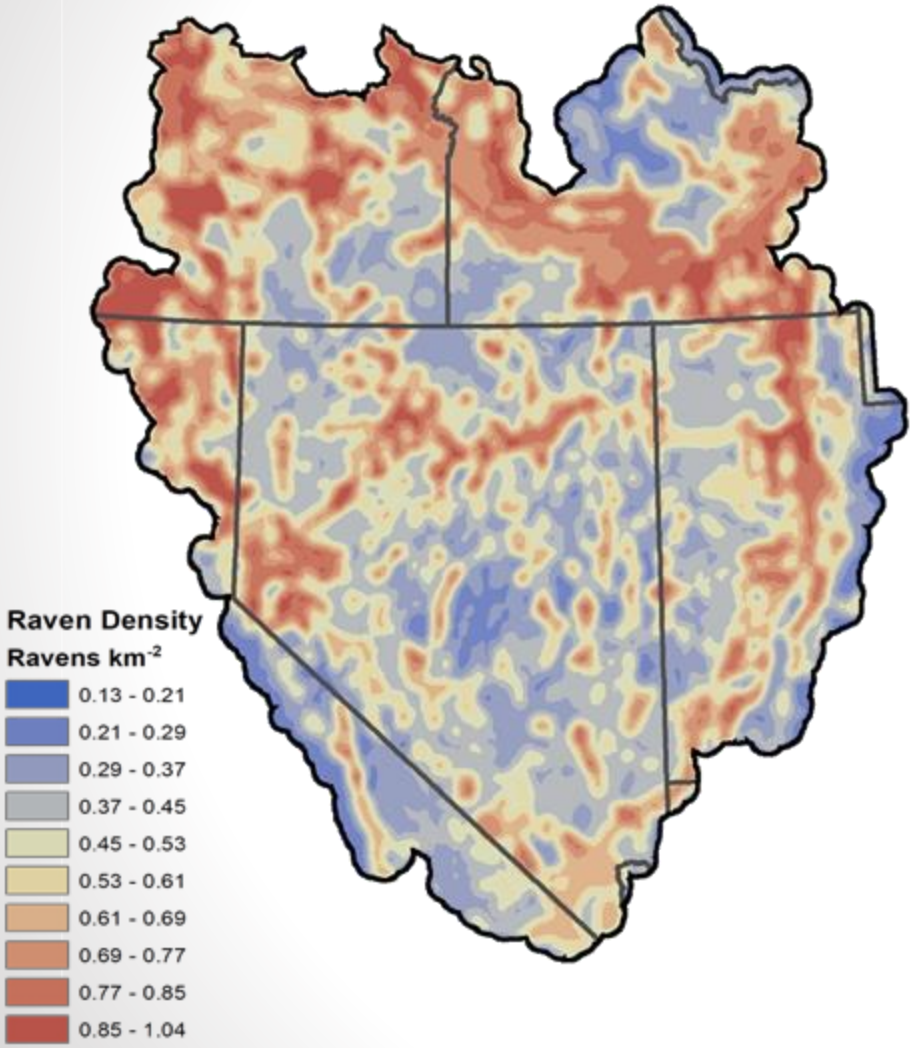
Transmission line
Road density





Imperviousness
Landfills

Great Basin Raven Density and Numbers



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]

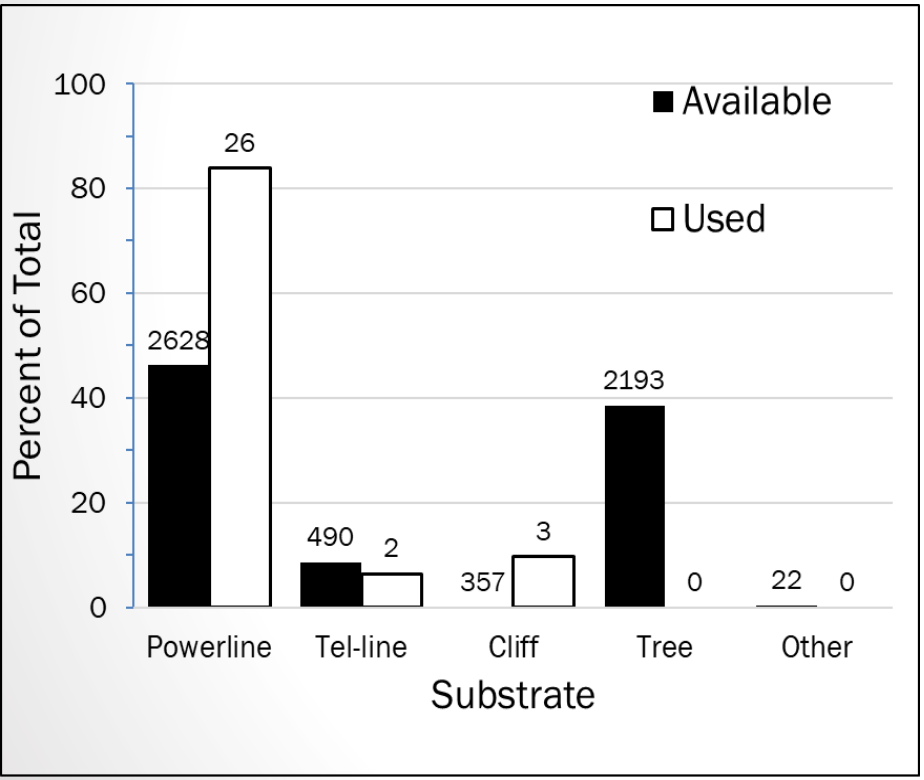
Average raven density

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

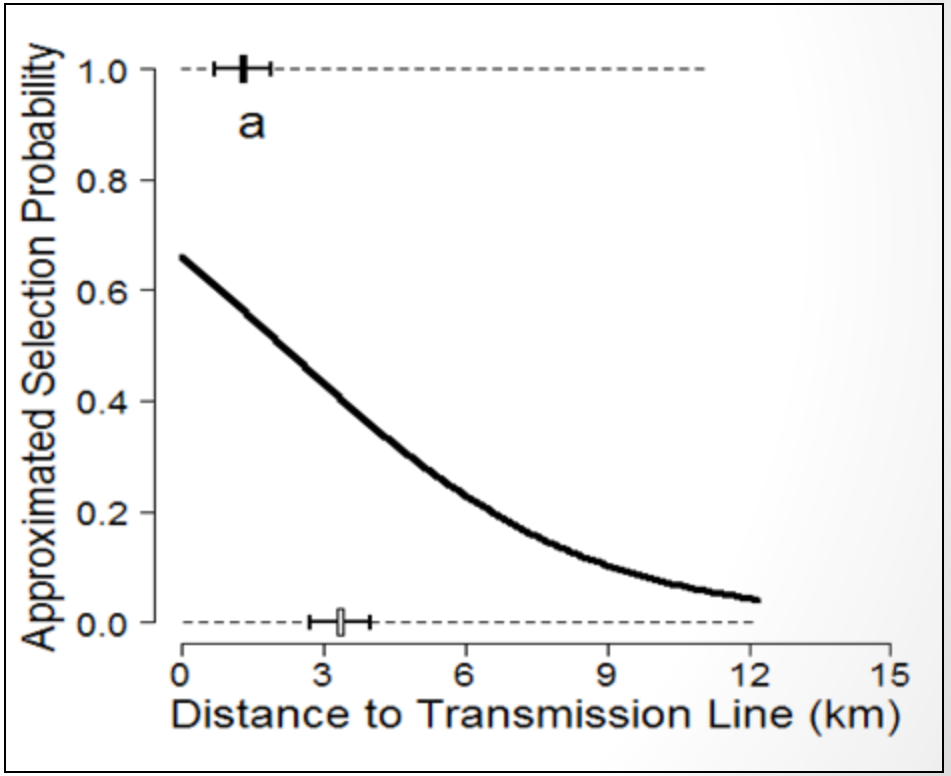
Total abundance Great Basin

403,346 (95% CI = 310,783–522,803)

Raven Nest Selection

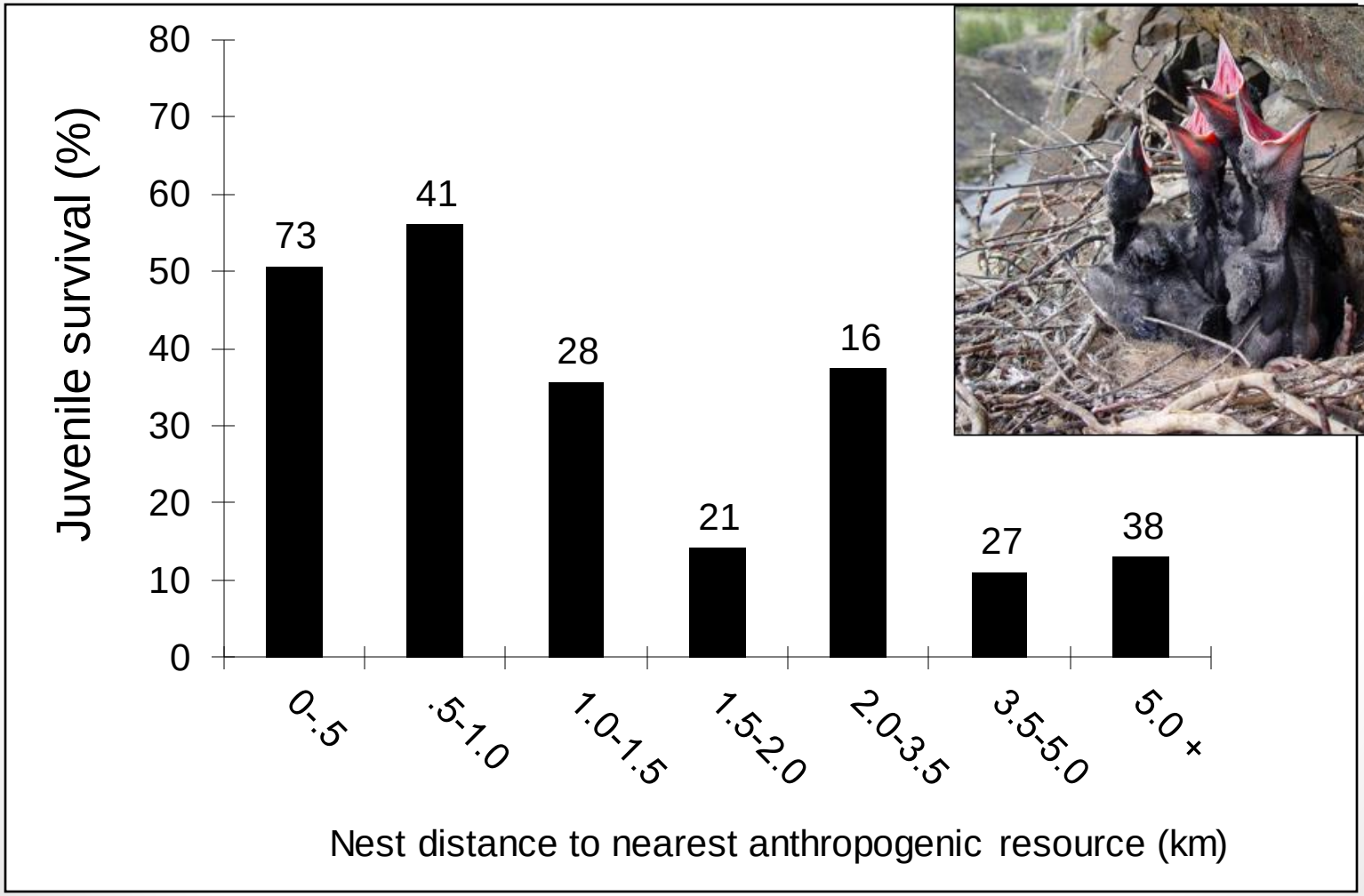


Knight and Kawashima. 1993. Responses of raven and red-tailed hawks to linear right-of-ways. *Journal of Wildlife Management* 57(2):266-271



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

Anthropogenic subsidies Benefit Ravens



Webb et al. 2004 Condor 106:517-528

Overview

USGS science for a changing world

Problem

Expansion of raven distribution and abundance

↓

Anthropogenic resource subsidies

↓

Predation effects on sensitive species

Solution

Science-based tiered framework

↓

Decision support tools - SMaRT

Ecological Consequences

– Hyperpredation

– Spillover predation

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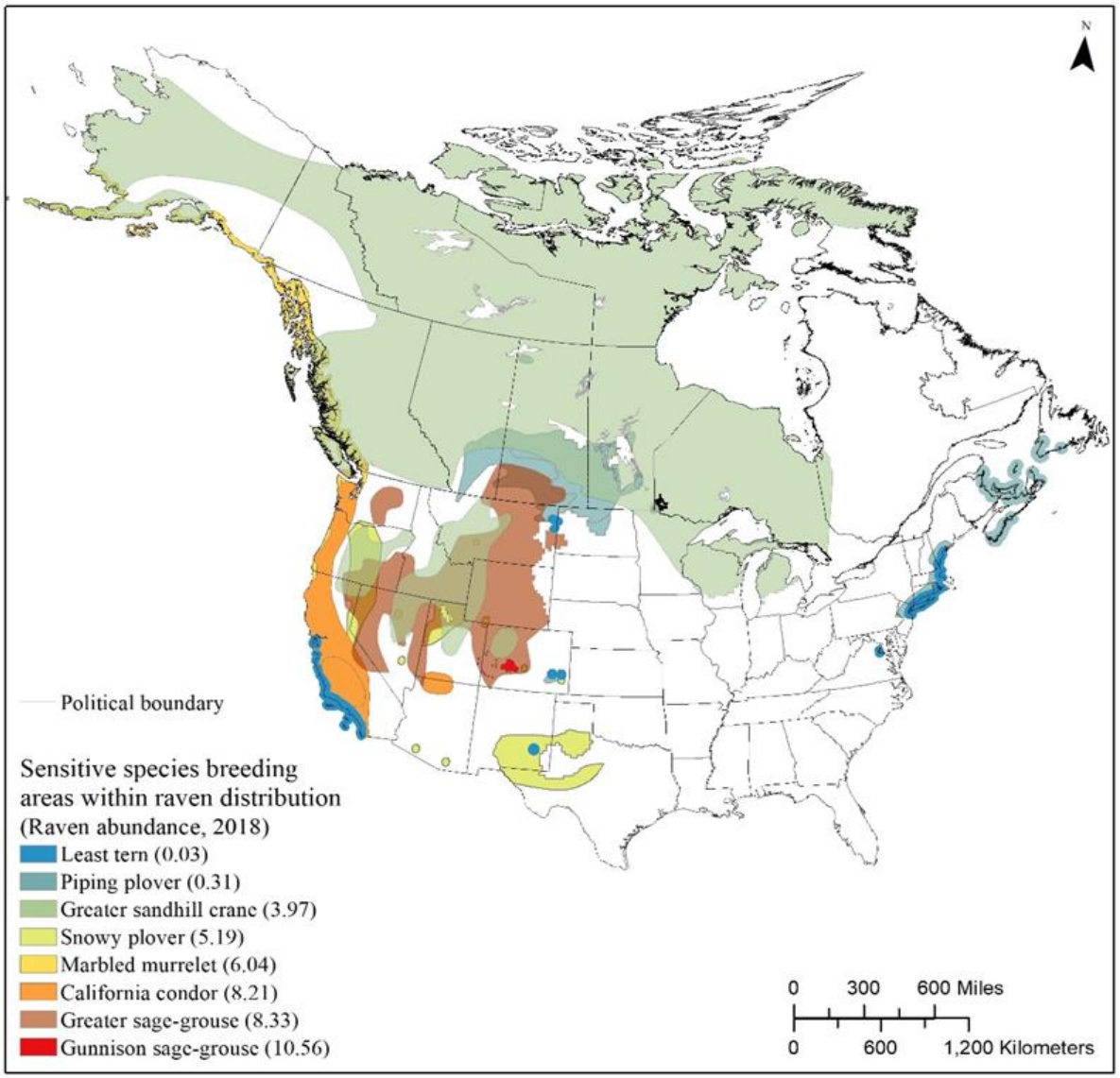
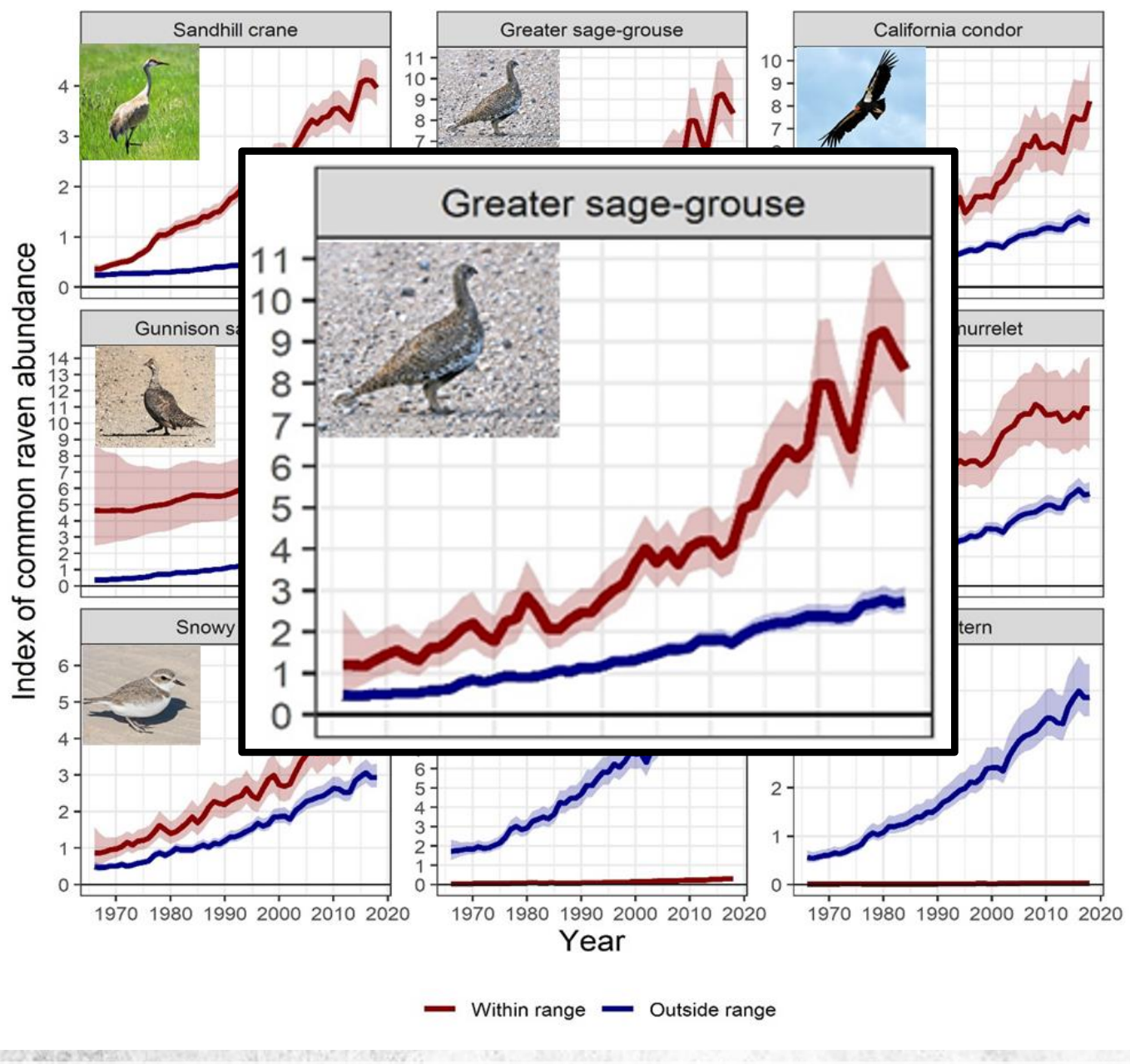
Ravens impact sensitive avian populations



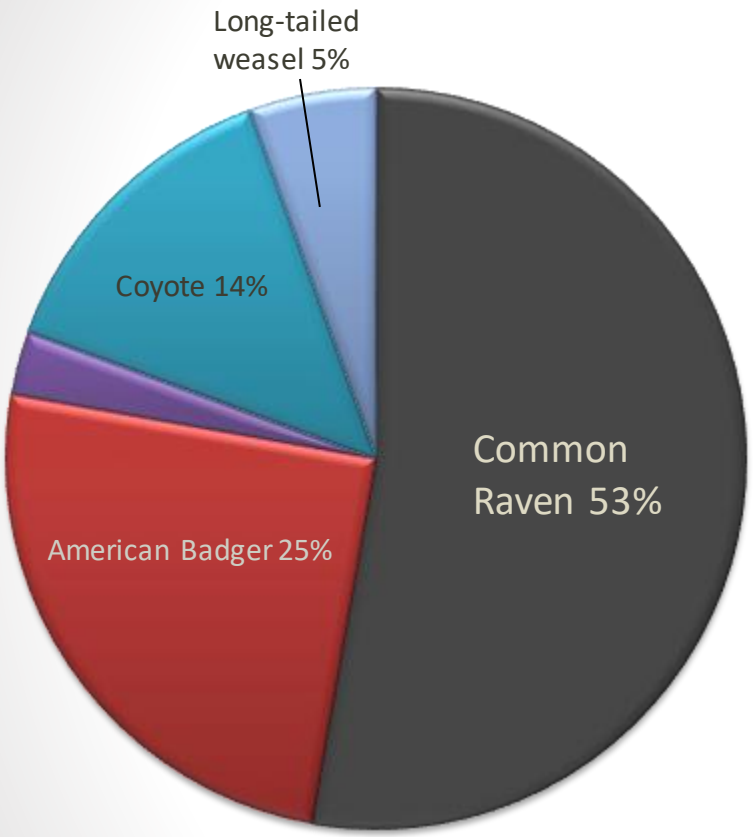
Coates et al. *2021*. Synthesis of nest predation impacts of common ravens on sensitive avian species. *Human-Wildlife Interactions. 15(3)*. https://doi.org/10.26077/962c-56f0

Ravens impact sensitive avian populations



Harju et al. In Press. Human-Wildlife Interactions

Ravens as effective sage-grouse egg predator



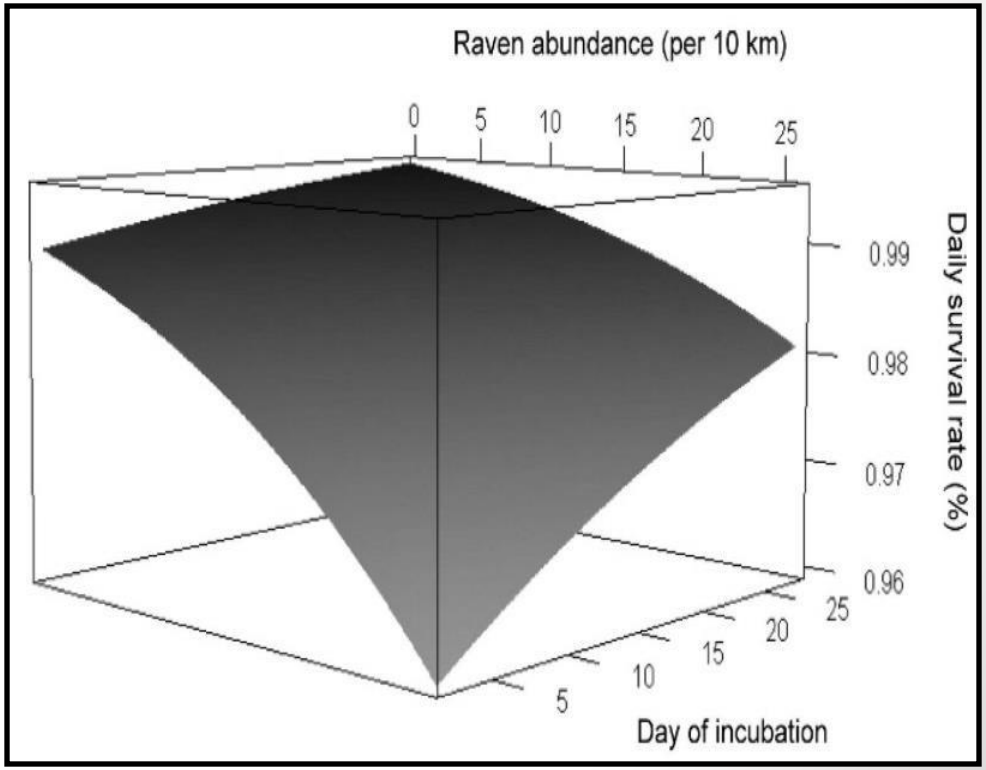
Predation on sage-grouse nests
(9 years of video data; ISU)

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*



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

Shrub cover influences predation by ravens

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

Management and Conservation Article

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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%

Photo: BLM

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Photo: Matt Lavin

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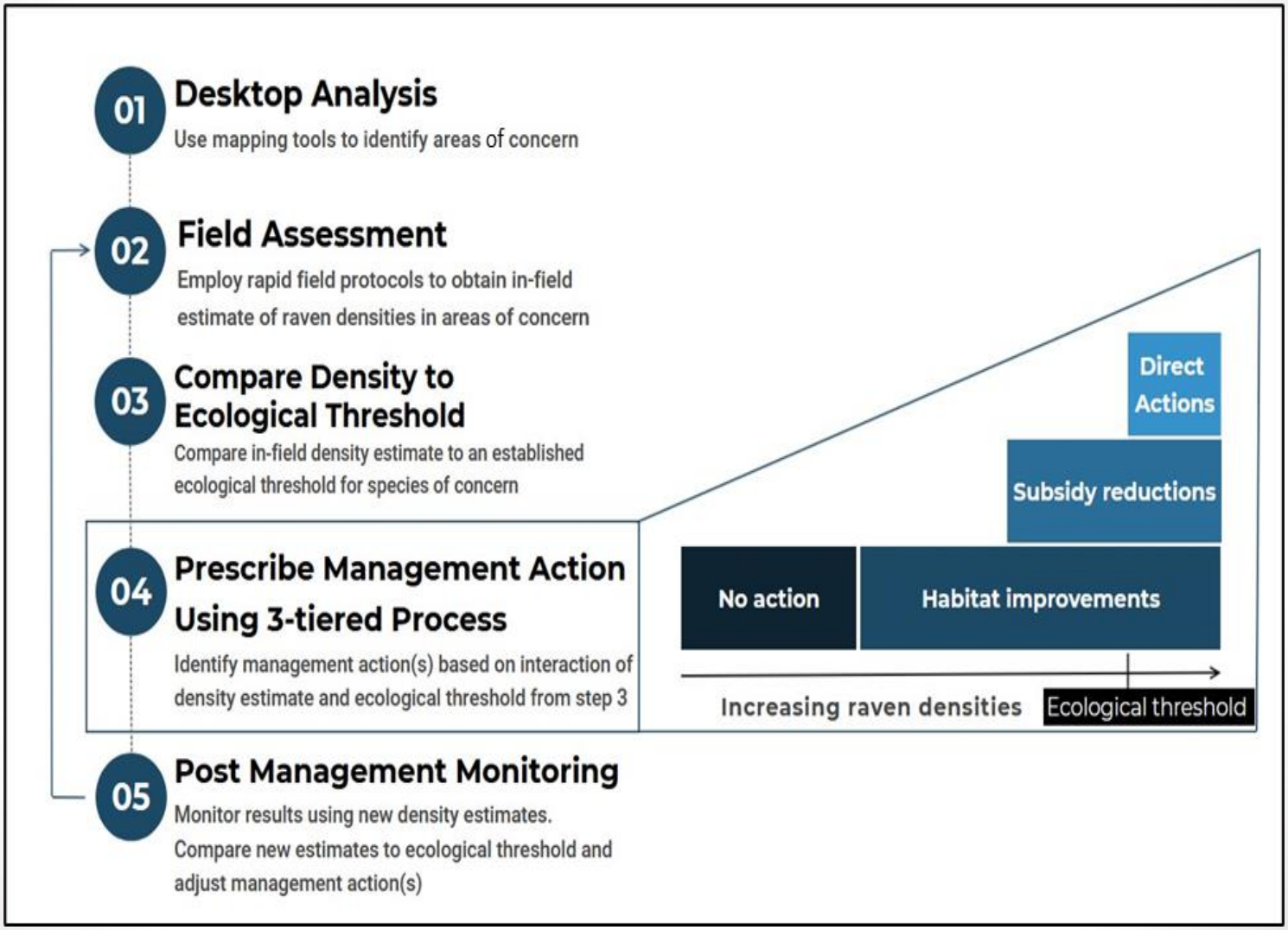
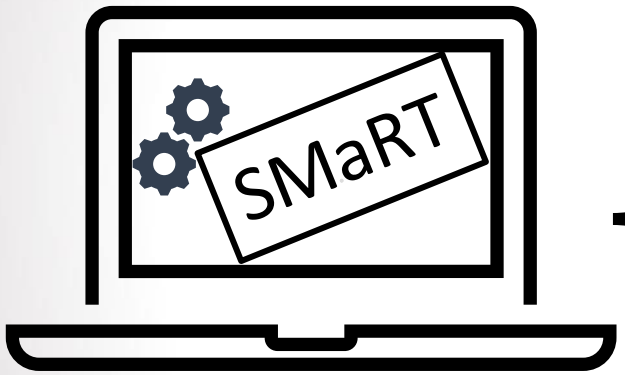
Decision support tools - SMaRT

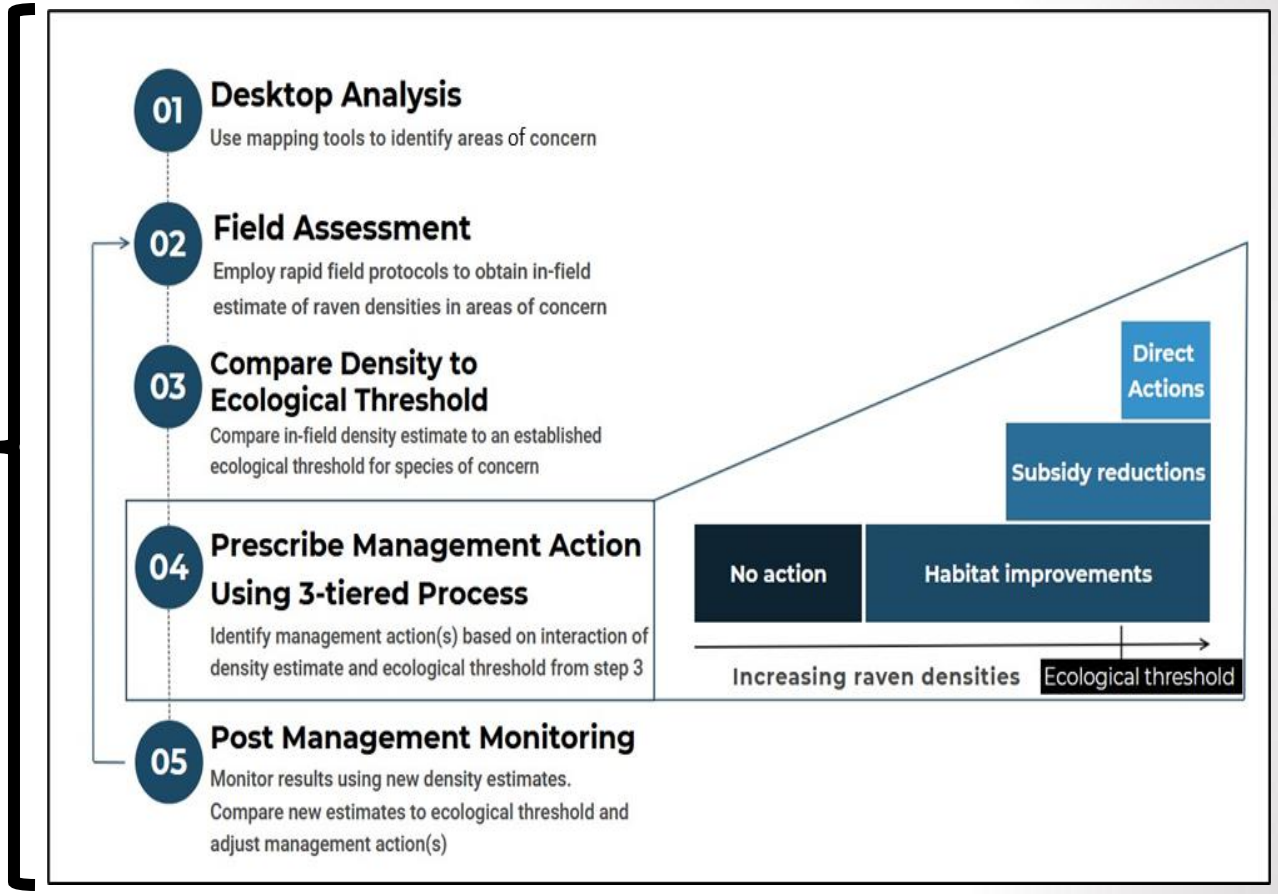
Science-based framework – Raven Core Team



Dettenmaier et al. (2021). Human-Wildlife Interactions: 15(3).

Applied Science-based Framework



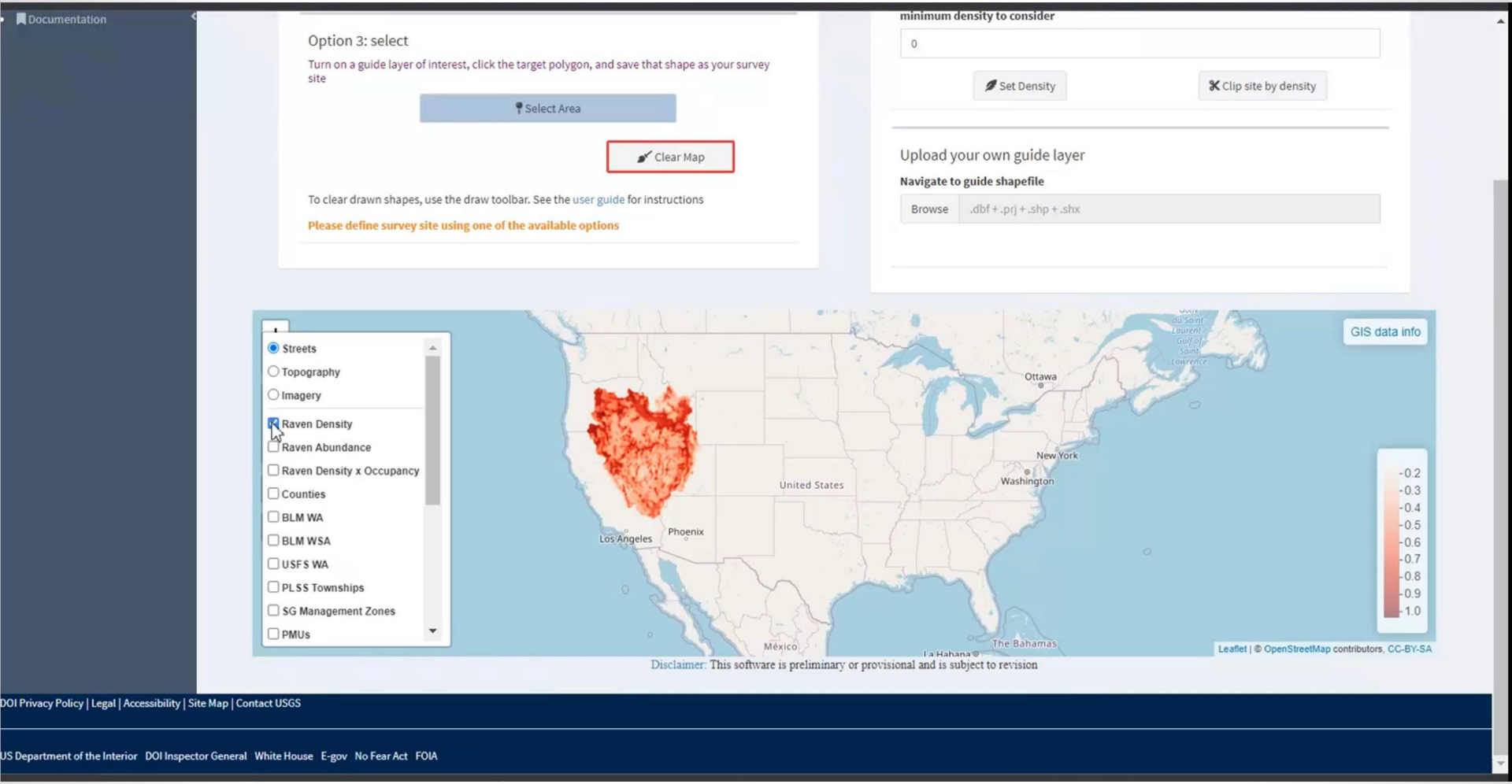


Dettenmaier et al. (2021). Human Wildlife Interactions: 15(3).

SMaRT – Science-based Management of Ravens Tool

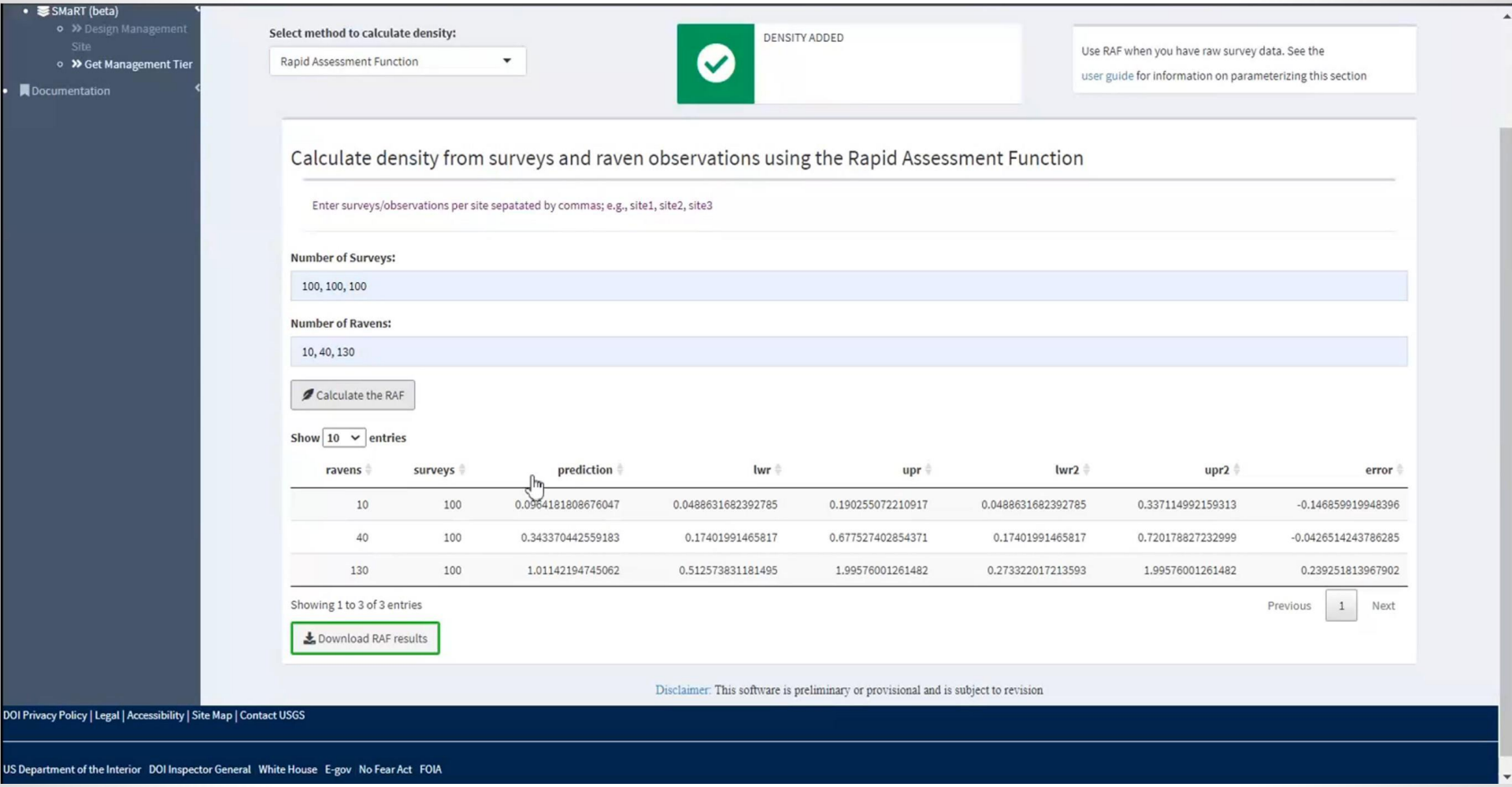
https://rconnect.usgs.gov/smart/

SMaRT – Science-based Management of Ravens Tool



https://rconnect.usgs.gov/smart/

SMaRT – Science-based Management of Ravens Tool



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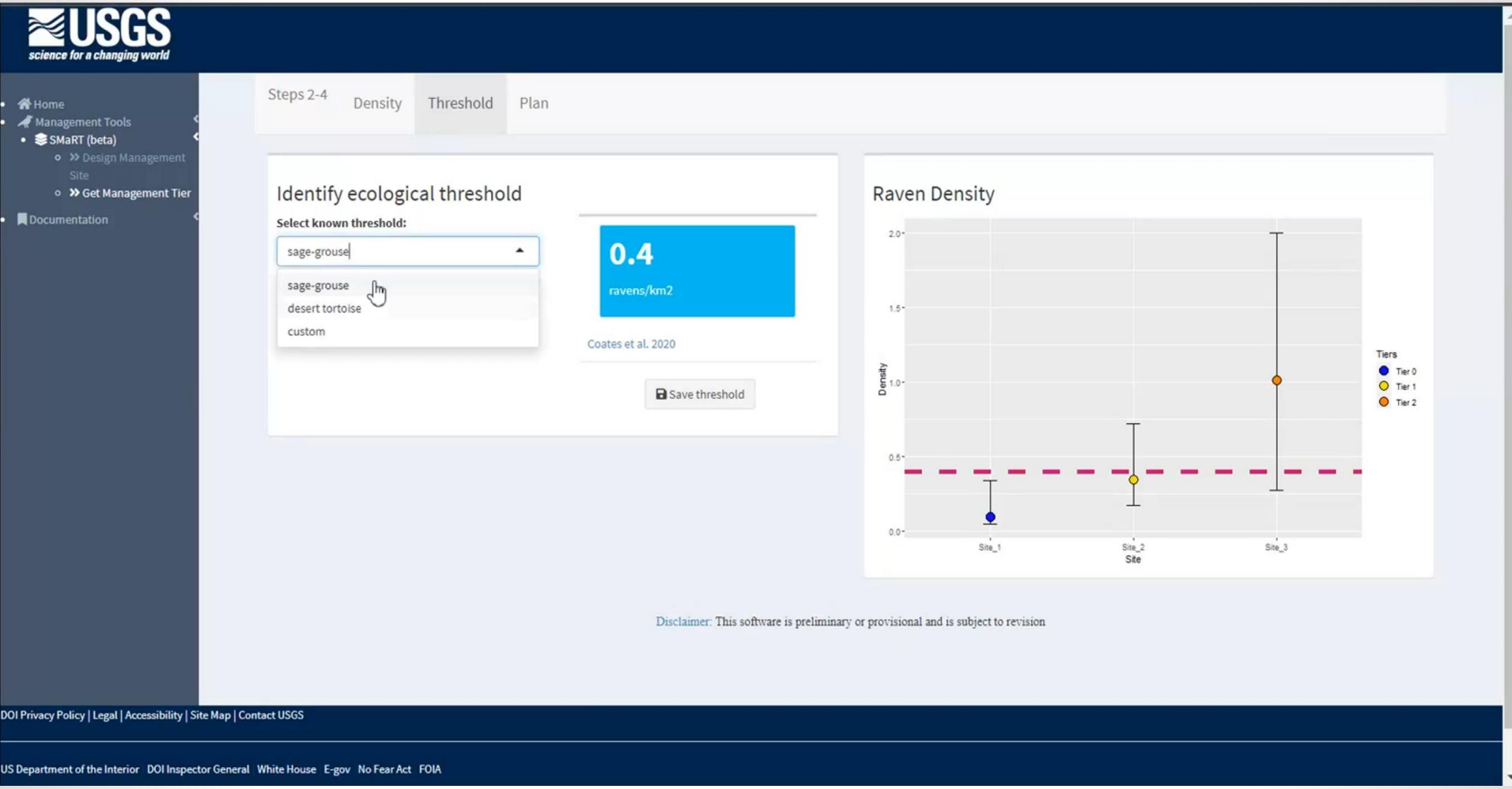
SMaRT – Science-based Management of Ravens Tool



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SMaRT – Science-based Management of Ravens Tool

	Tier	Target.Species	Management.Category	Management.Method	Management.Option	Resource.Type	Target	SOURCE
2	Tier 1 - Habitat Improvements	GRSG	Habitat Restoration	GRSG Recovery	Seed or plant sagebrush/native shrubs	Sage-grouse Habitat	Habitat	Created by user on 2022-01-27 using the USGS SMaRT tool https://doi.org/10.5066/P9B5ANSM
3	Tier 1 - Habitat Improvements	GRSG	Habitat Restoration	GRSG Recovery	Place grazing exclusion around sagebrush/native shrubs	Sage-grouse Habitat	Habitat	Created by user on 2022-01-27 using the USGS SMaRT tool https://doi.org/10.5066/P9B5ANSM
4	Tier 1 - Habitat Improvements	GRSG	Habitat Restoration	GRSG Recovery	Apply herbicide to remove cheatgrass or other invasive plants	Sage-grouse Habitat	Habitat	Created by user on 2022-01-27 using the USGS SMaRT tool https://doi.org/10.5066/P9B5ANSM
5	Tier 1 - Habitat Improvements	GRSG	Habitat Restoration	GRSG Recovery	Remove pinyon and juniper in areas of conifer expansion	Sage-grouse Habitat	Habitat	Created by user on 2022-01-27 using the USGS SMaRT tool https://doi.org/10.5066/P9B5ANSM
6	Tier 1 - Habitat Improvements	GRSG	Habitat Restoration	GRSG Recovery	Seed or plant native forbs an grasses	Sage-grouse Habitat	Habitat	Created by user on 2022-01-27 using the USGS SMaRT tool https://doi.org/10.5066/P9B5ANSM
7	Tier 1 - Habitat Improvements	GRSG	Habitat Restoration	GRSG Recovery	Place grazing exclusion around native forbs and grasses	Sage-grouse Habitat	Habitat	Created by user on 2022-01-27 using the USGS SMaRT tool https://doi.org/10.5066/P9B5ANSM
18	Tier 2 - Subsidy Reductions	CORA	Food Resources	Containment	Bury or cover livestock burial pits	Persistent Point Source	Livestock - Pits	Created by user on 2022-01-27 using the USGS SMaRT tool https://doi.org/10.5066/P9B5ANSM
19	Tier 2 - Subsidy Reductions	CORA	Food Resources	Harassment Devices	Install acoustic hazing devices or effigies around livestock burial pits	Persistent Point Source	Livestock - Pits	Created by user on 2022-01-27 using the USGS SMaRT tool https://doi.org/10.5066/P9B5ANSM
					Apply nonlethal chemical			Created by user on 2022-01-27 using the

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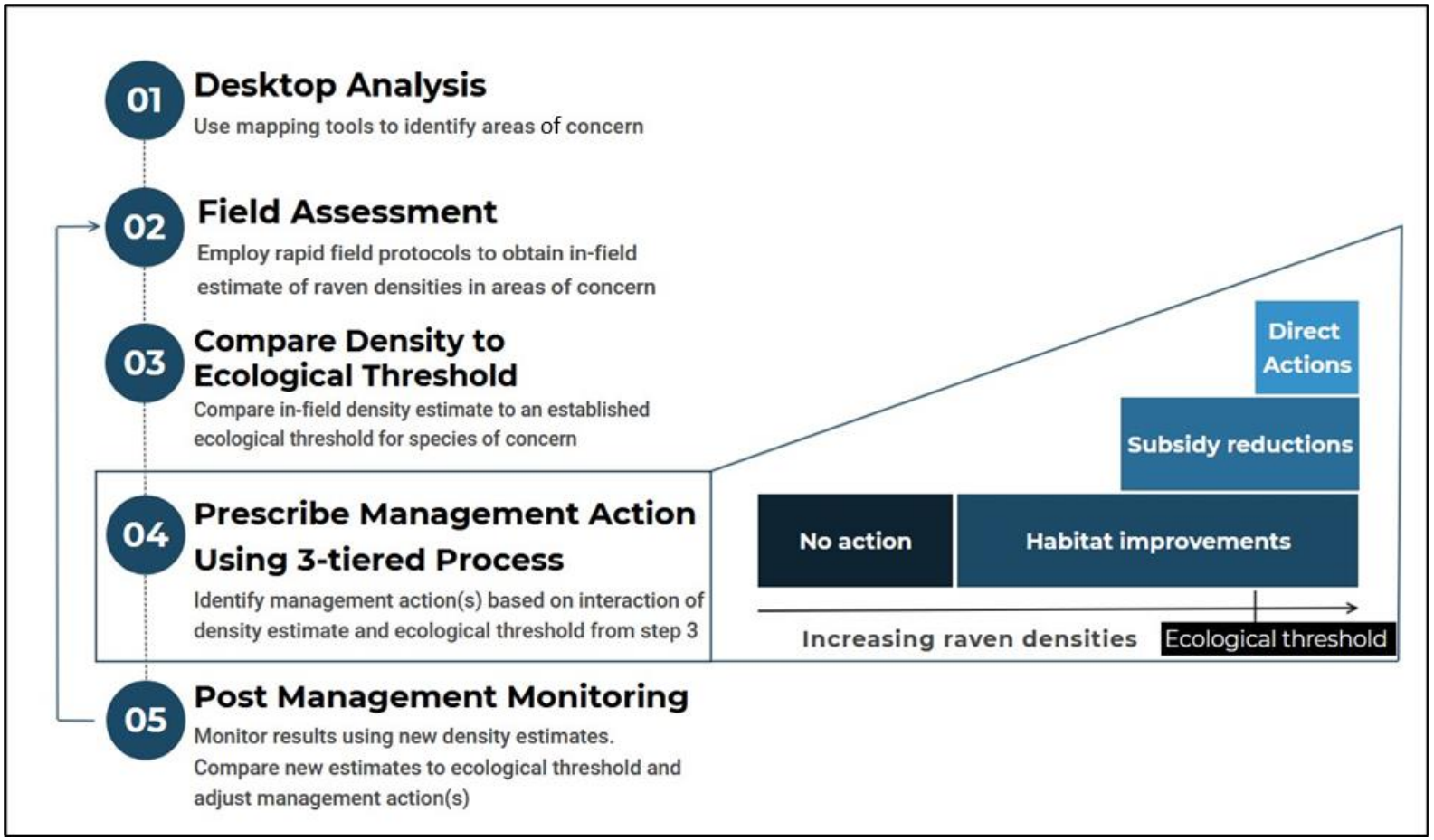
Supporting adaptive management



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How many ravens to remove?

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APHIS

Are management actions effective?

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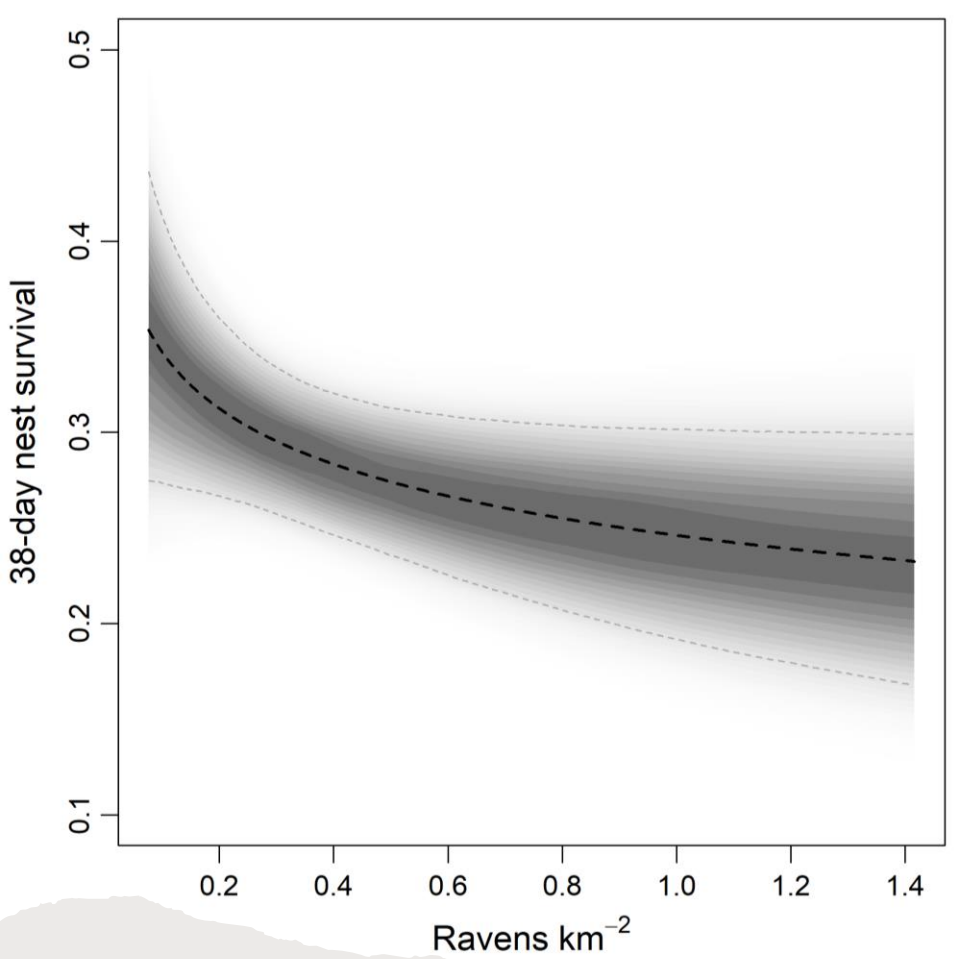

Refining thresholds

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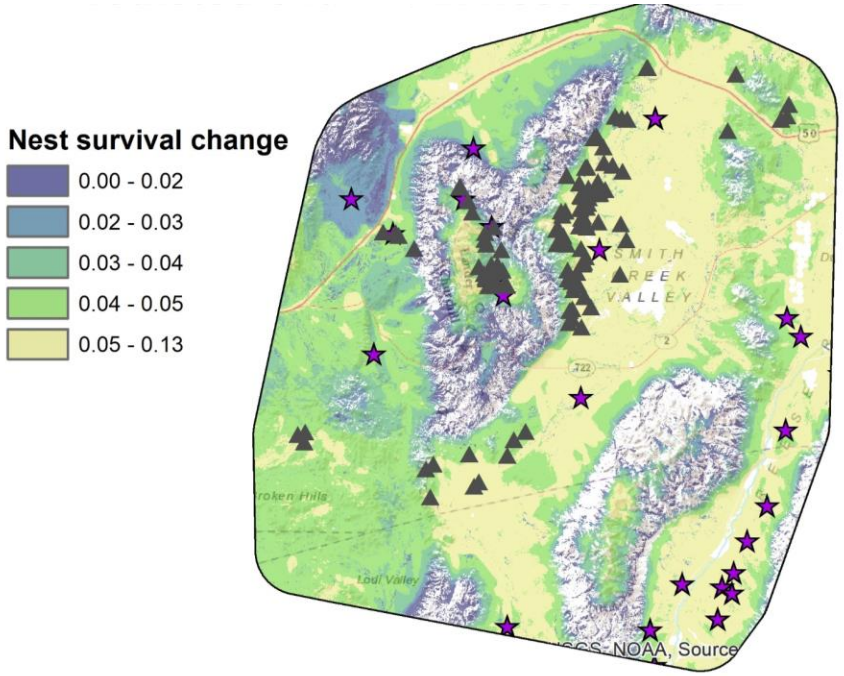
Where to remove?



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Simulated egg-oiling treatment

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Simulated egg-baiting treatment

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Cost/benefit?

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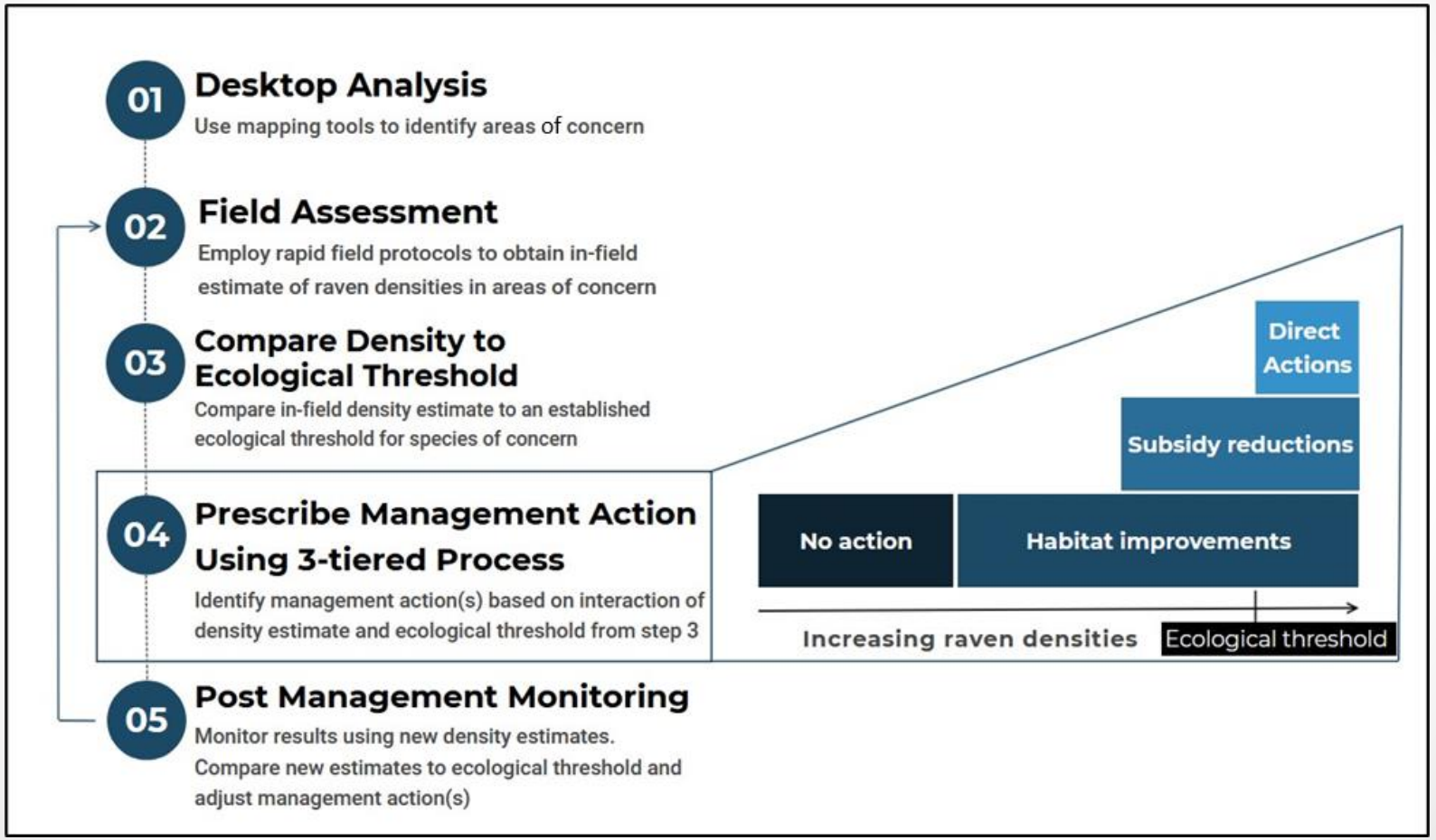

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The Birds (1963). Photo: Mentalfloss.com

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Photo: isoldyou (eBay username)

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Jason Cipriani/CNN Underscored

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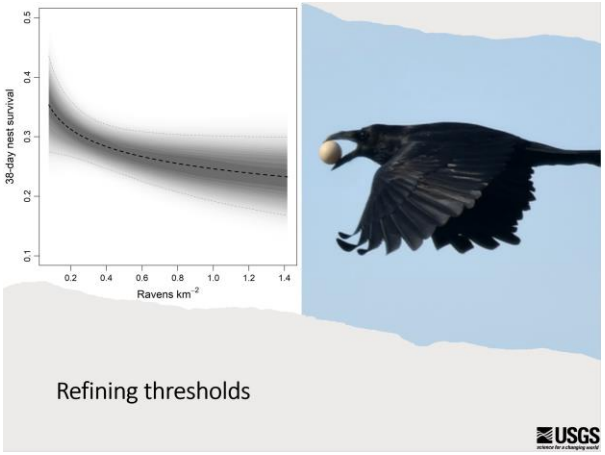
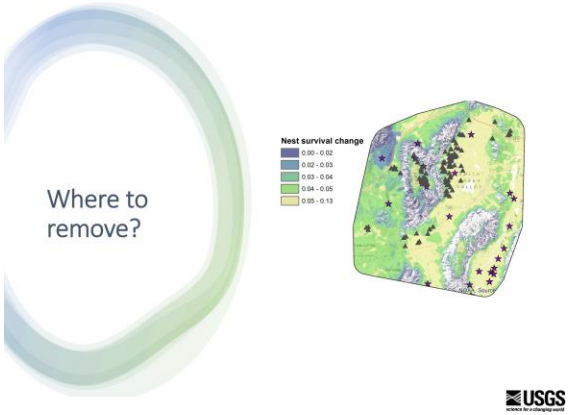

38-day nest survival
Ravens km-2
Refining thresholds
USGS


Where to remove?
Nest survival change
USGS

Questions?