



Application of a tiered management framework for raven management in Nevada

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US Geological Survey¹ – Nevada Department of Wildlife² – USDA-APHIS-Wildlife Services³

Problem

Raven predation on sage-grouse



Where are there enough ravens to warrant direct removal



What treatment areas would benefit sage-grouse most

Solution

Science-based tiered framework



Decision support tools - SMaRT



USGS raven and sage-grouse products

1. Identify priority areas
2. Estimate site-level raven densities
3. Compare estimate to ecological threshold
4. Provide management options
5. (Re)assess management action(s)



SMaRT



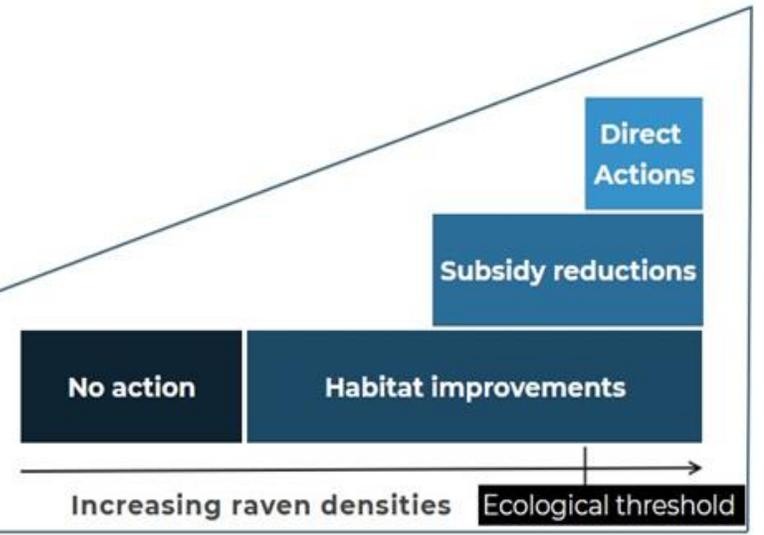
01 Desktop Analysis
Use mapping tools to identify areas of concern

02 Field Assessment
Employ rapid field protocols to obtain in-field estimate of raven densities in areas of concern

03 Compare Density to Ecological Threshold
Compare in-field density estimate to an established ecological threshold for species of concern

04 Prescribe Management Action Using 3-tiered Process
Identify management action(s) based on interaction of density estimate and ecological threshold from step 3

05 Post Management Monitoring
Monitor results using new density estimates. Compare new estimates to ecological threshold and adjust management action(s)



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

Raven Decision Support Software

A suite of decision support tools for adaptive raven management

Link to USGS. gov

SMaRT tool menu

Additional resources and information

DOI related links in footer

USGS science for a changing world

- Home
- Management Tools
 - SMaRT
 - Design Management Site
 - Get Management Tier
- Documentation
 - Tool Guides
 - Citation
 - Resources
 - Partners

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Step 1. Identify Management Areas

USGS
science for a changing world

Home
Management Tools
• SMART (beta)
 o Design Management Site
 o Get Management Tier
Documentation

Select a site design option:

Upload

Design survey sites across CONUS

Option 1: upload
Upload your pre-defined survey site shapefile

Navigate to shapefile
Browse .dbf + .prj + .shp + .shx

Clear Map

To clear drawn shapes, use the draw toolbar. See the [user guide](#) for instructions

Please define survey site using one of the available options

Customize the map (optional):

Define high raven density:
Only available within the Great Basin

minimum density to consider
0

Set Density **Clip site by density**

Upload your own guide layer

Navigate to guide shapefile
Browse .dbf + .prj + .shp + .shx

GIS data info

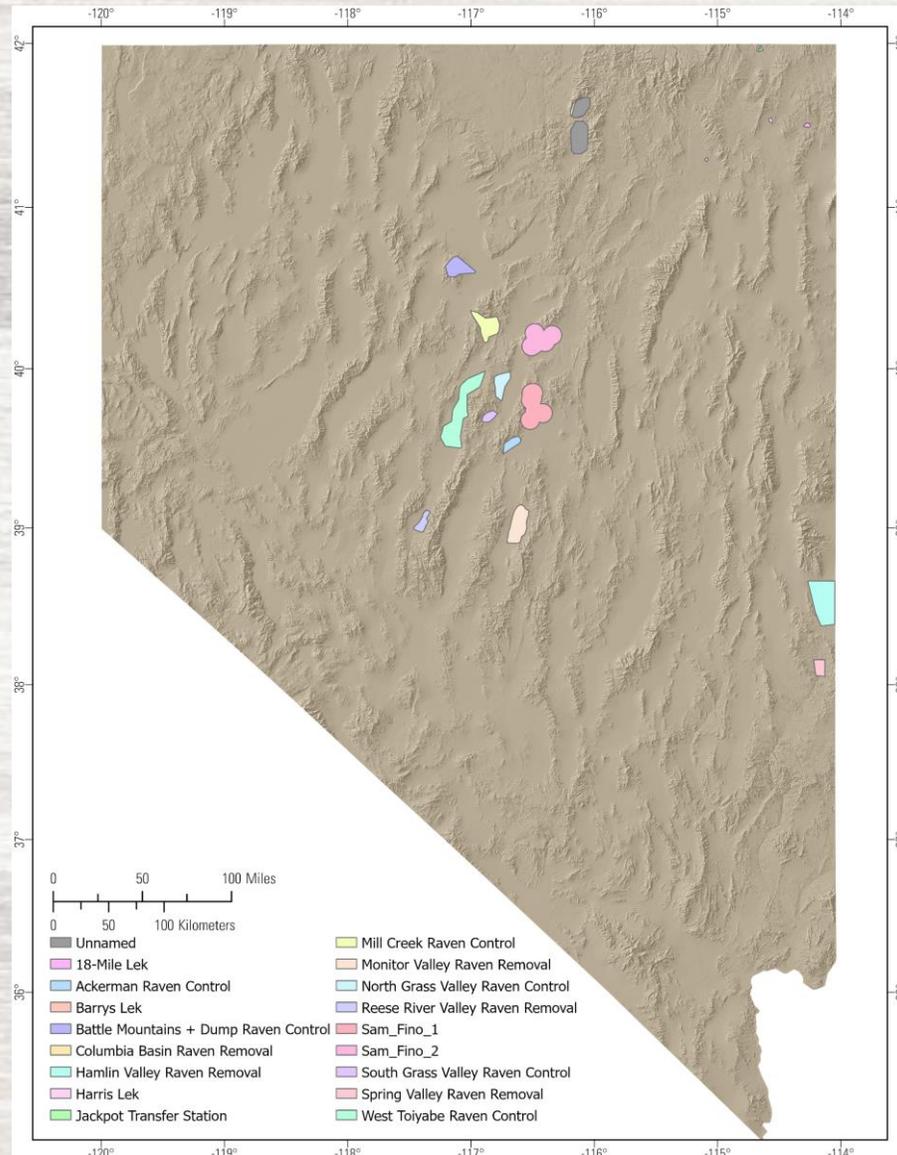
United States

Ottawa
New York
Washington

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Step 1. Identify Management Areas

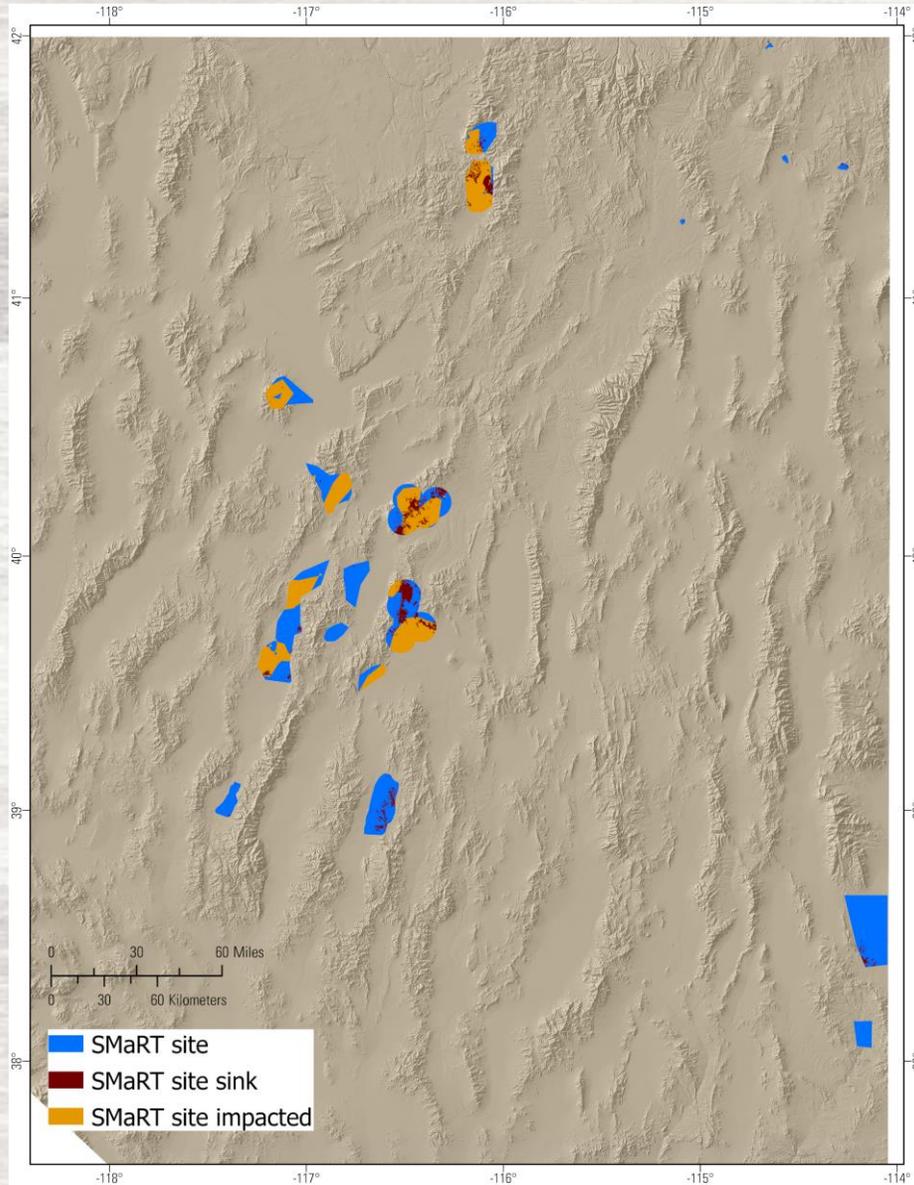


NDOW candidate treatment areas:

- Polygons provided by NDOW Biologists based on lek locations and observed ravens

Data and processes for polygon development were conducted by the Nevada Department of Wildlife.

Step 1. Identify Management Areas



NDOW candidate treatment areas

USGS provided maps of:

- Nest sink areas
- Sage-grouse concentration areas
- High density areas (>0.4 ravens/km²)

Polygon revisions were conducted by the Nevada Department of Wildlife.

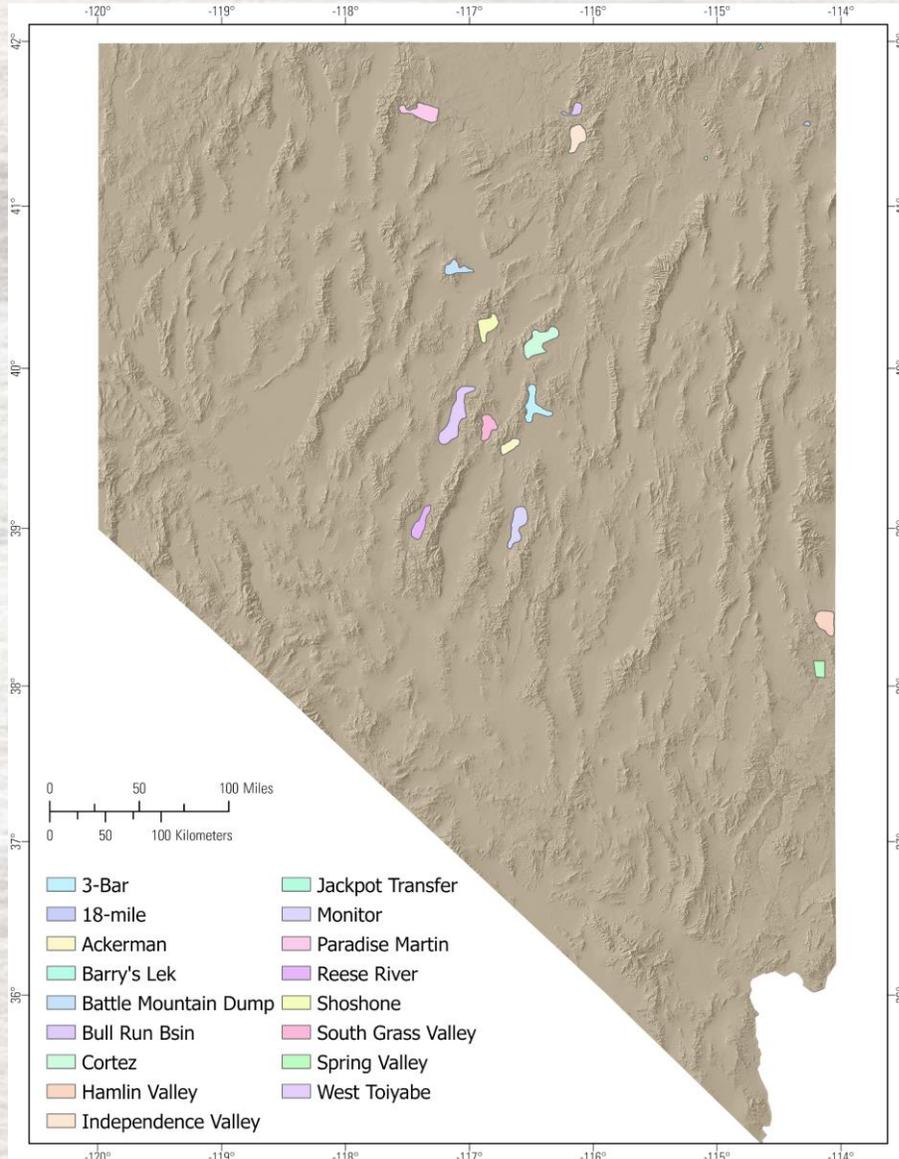
Step 1. Identify Management Areas



The screenshot shows the USGS SMArT web application interface. On the left is a dark navigation sidebar with the USGS logo and menu items: Home, Management Tools, SMArT (expanded to show Design Management Site and Get Management Tier), and Documentation. The main content area is divided into two panels. The left panel, titled 'Select a site design option:', features a dropdown menu set to 'Upload' and a section for 'Design survey sites across CONUS'. It lists 'Option 1: upload' with instructions to upload a pre-defined survey site shapefile. Below this is a 'Navigate to shapefile' section with a 'Browse' button and a file type filter for '.dbf + .prj + .shp + .shx'. A 'Clear Map' button is highlighted with a red box. A note at the bottom of this panel states: 'To clear drawn shapes, use the draw toolbar. See the user guide for instructions. Please define survey site using one of the available options'. The right panel, titled 'Customize the map (optional):', includes a 'Define high raven density' section with a note 'Only available within the Great Basin' and a 'minimum density to consider' input field set to '0'. It contains 'Set Density' and 'Clip site by density' buttons. Below is an 'Upload your own guide layer' section with a 'Navigate to guide shapefile' section and a 'Browse' button with the same file type filter. At the bottom of the interface is a map of the United States with a red-shaded area in the western region. A legend on the right side of the map shows a color scale from -0.2 (light red) to -1.0 (dark red). A 'GIS data info' button is located in the top right corner of the map area.

Polygon revisions were directed by the Nevada Department of Wildlife.

Step 1. Identify Management Areas



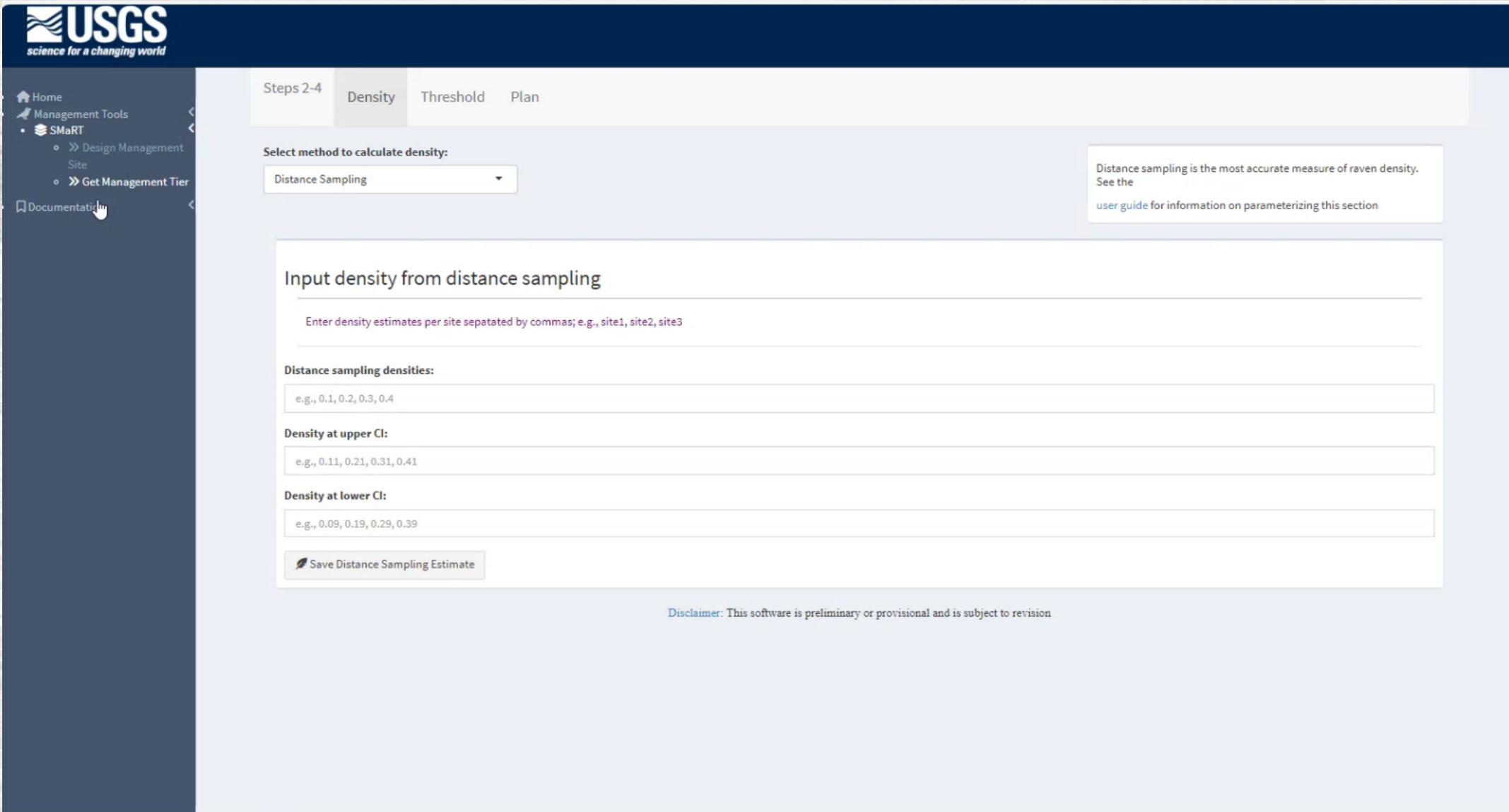
NDOW candidate treatment areas

NDOW revised polygons to:

- better match where the sink habitat is located
- reduce the size of the polygon where there was low selection
- better cover lek locations

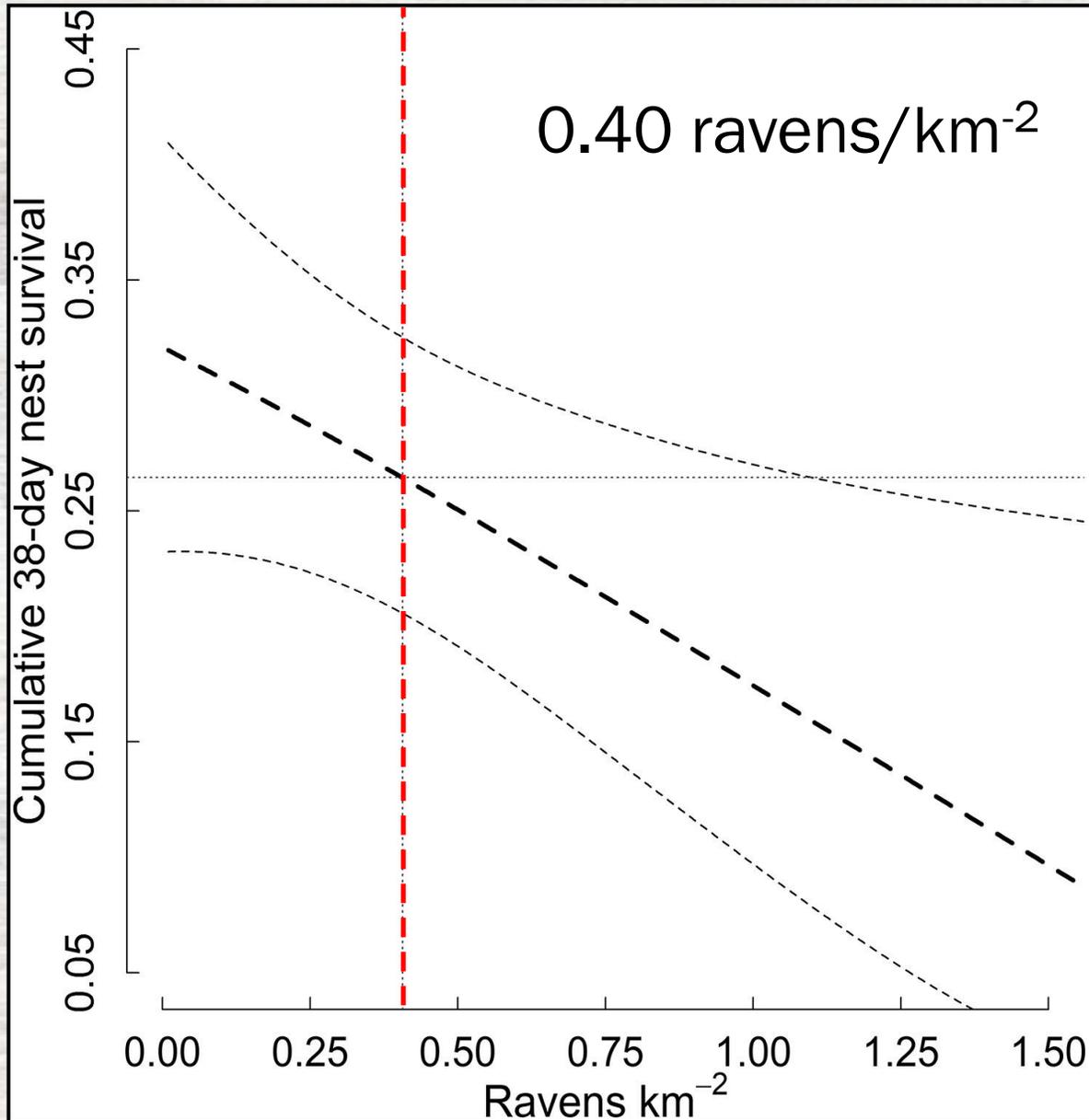
Polygon revisions were conducted by the Nevada Department of Wildlife.

Step 2. Estimate Raven Density



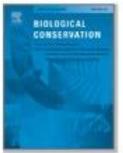
The screenshot shows the USGS SMaRT web interface. The top navigation bar includes 'Steps 2-4', 'Density', 'Threshold', and 'Plan'. The 'Density' tab is active. On the left, a sidebar menu contains 'Home', 'Management Tools', 'SMaRT', 'Design Management Site', 'Get Management Tier', and 'Documentation'. The main content area is titled 'Input density from distance sampling'. It features a dropdown menu set to 'Distance Sampling'. A text box prompts the user to 'Enter density estimates per site separated by commas; e.g., site1, site2, site3'. Below this are three input fields: 'Distance sampling densities' (e.g., 0.1, 0.2, 0.3, 0.4), 'Density at upper CI' (e.g., 0.11, 0.21, 0.31, 0.41), and 'Density at lower CI' (e.g., 0.09, 0.19, 0.29, 0.39). A 'Save Distance Sampling Estimate' button is at the bottom. A disclaimer at the bottom center states: 'Disclaimer: This software is preliminary or provisional and is subject to revision'. A callout box on the right notes: 'Distance sampling is the most accurate measure of raven density. See the user guide for information on parameterizing this section'.

Step 3. Compare density estimate to threshold



Biological Conservation

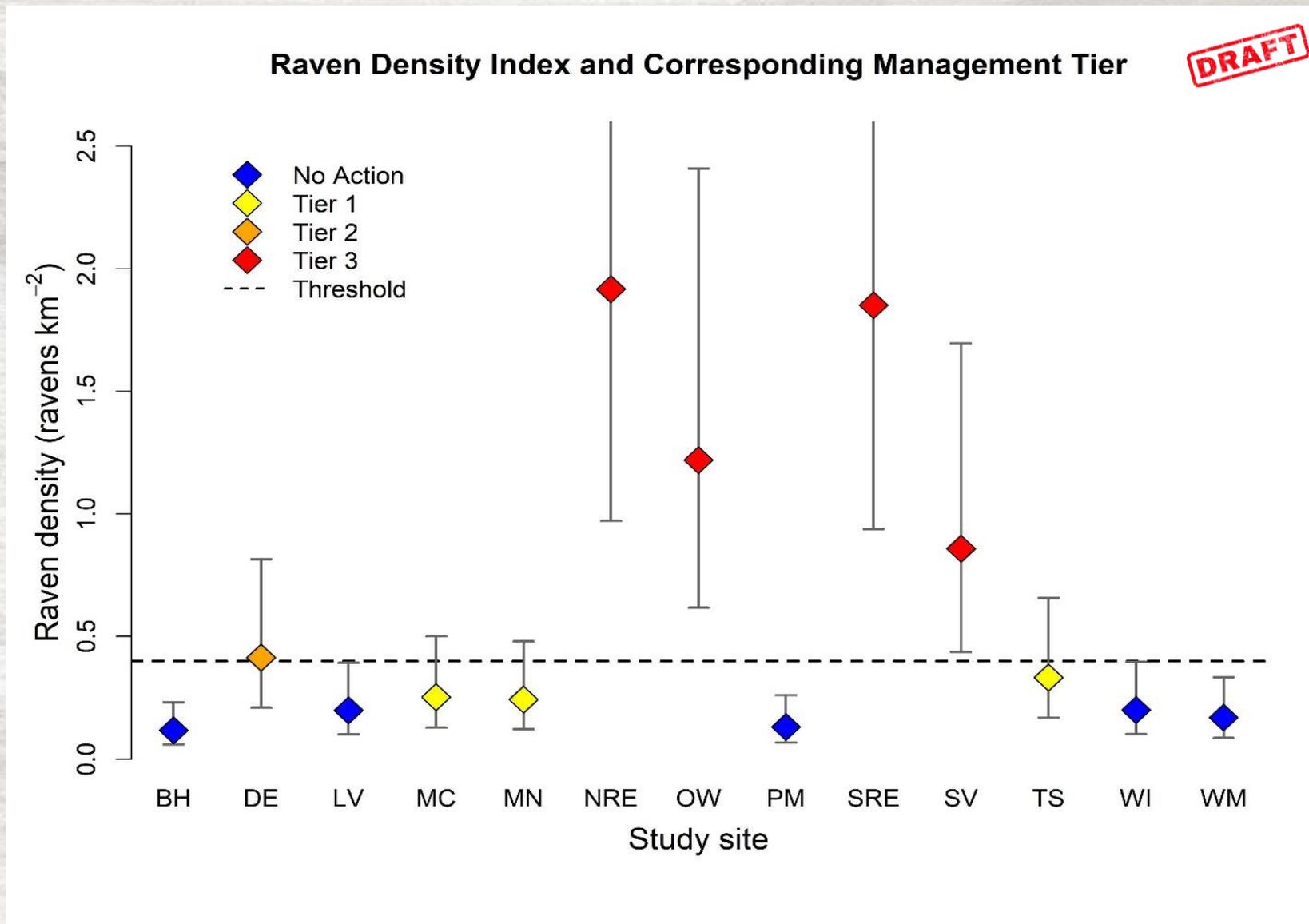
Volume 243, March 2020, 108409



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

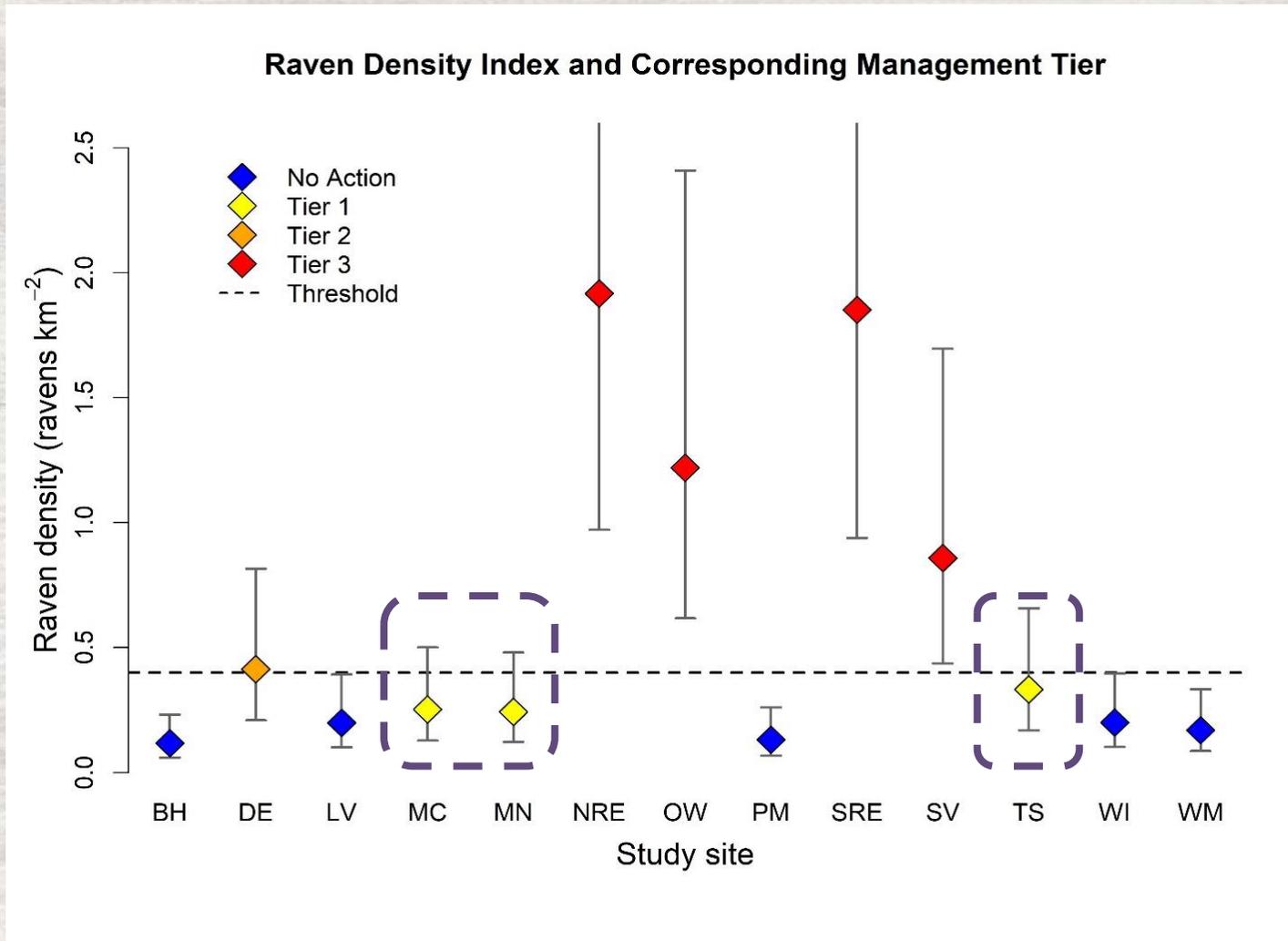
Peter S. Coates ^a ✉, Shawn T. O'Neil ^a, Brianne E. Brussee ^a, Mark A. Ricca ^a, Pat J. Jackson ^b, Jonathan B. Dinkins ^c, Kristy B. Howe ^d, Ann M. Moser ^e, Lee J. Foster ^f, David J. Delehanty ^g

Step 3. Compare density estimate to threshold



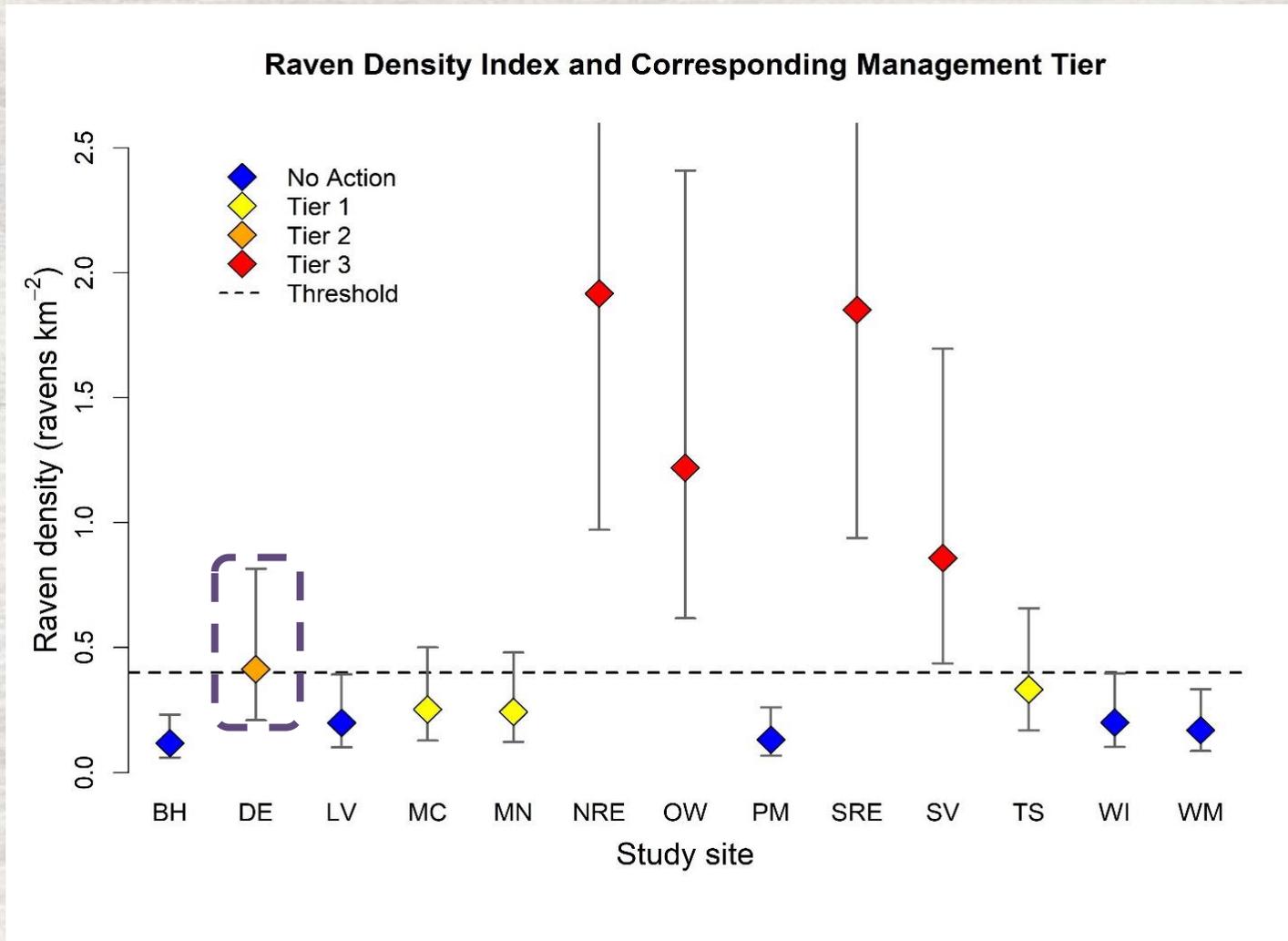
Step 3. Compare density estimate to threshold

Tier 1 Density estimate – below threshold
95% CI – overlaps threshold



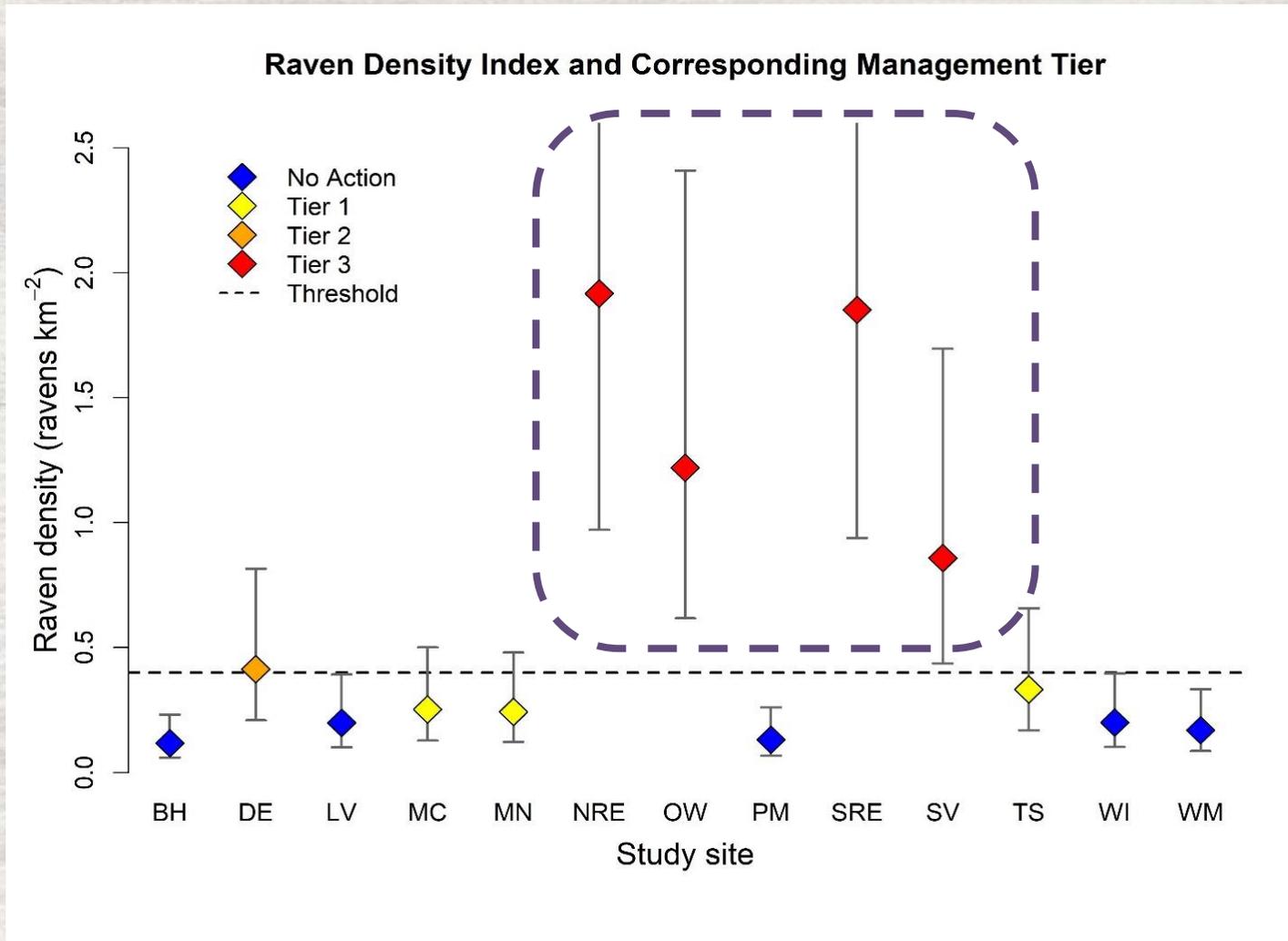
Step 3. Compare density estimate to threshold

Tier 2 Density estimate – above threshold
95% CI – overlaps threshold



Step 3. Compare density estimate to threshold

Tier 3 Density estimate – above threshold
95% CI – exceeds threshold



Step 3. Compare density estimate to threshold

USGS science for a changing world

Steps 2-4 Density **Threshold** Plan

Identify ecological threshold

Select known threshold:

sage-grouse

0.4
ravens/km²

Coates et al. 2020

Save threshold

Raven Density

Density

Site_1 Site_2 Site_3

Tiers

- Tier 0
- Tier 1
- Tier 2

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Step 3. Compare density estimate to threshold

Steps 2-4

Density

Threshold

Plan

Select method to calculate density:

Density Surface



DENSITY ADDED

Use density surface when you don't have survey data. See the [user guide](#) for information on parameterizing this section

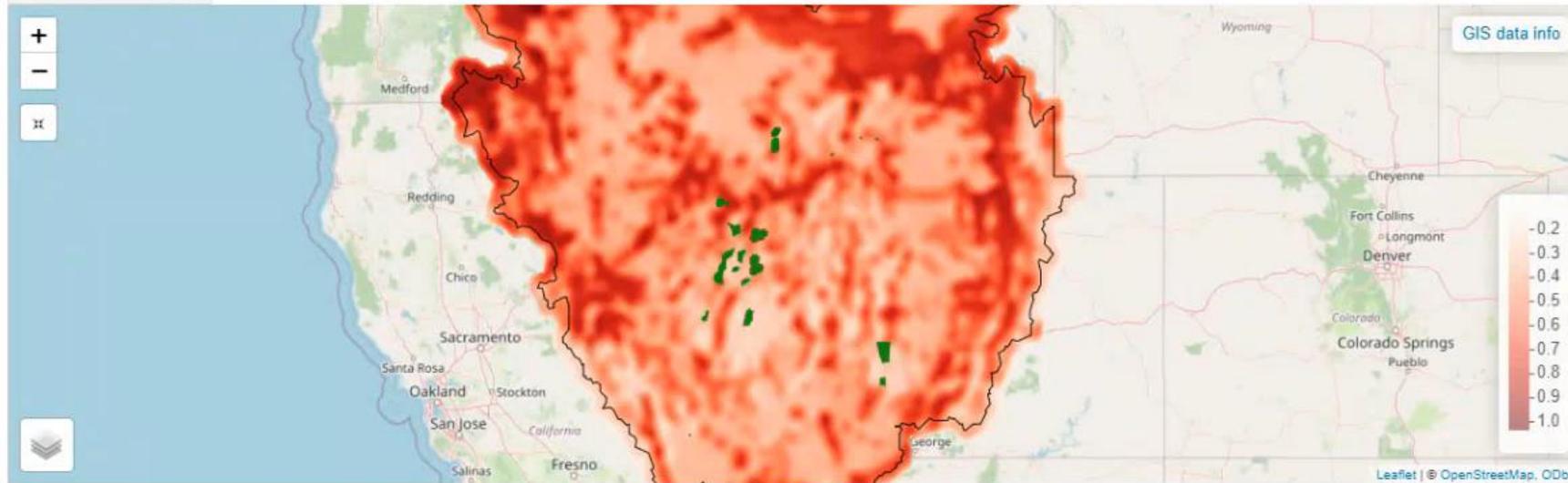
Calculate density with density surface

shapefile path

Browse 4 files

Upload complete

Calculate Site Density



Disclaimer: This software is preliminary or provisional and is subject to revision

The 3 Tiers

Tier	Trigger	Management Options
Tier 3	Density estimate – exceeds threshold 95% CI – exceeds threshold	Direct Actions
Tier 2	Density estimate – exceeds threshold 95% CI – overlaps threshold	Reduce Access to Anthropogenic Subsidies
Tier 1	Density estimate – below threshold 95% CI – overlaps threshold	Habitat Improvement Actions
No Action	Density estimate - below threshold 95% CI – below threshold	

Step 4. Identify management options

Steps 2-4 Density **Threshold** Plan

Identify ecological threshold

Select known threshold:

sage-grouse

0.4
ravens/km²

Coates et al. 2020

THRESHOLD SET

Save threshold

Raven Density

Site	Density	Tier
Site_1	0.56	Tier 3
Site_10	0.39	Tier 0
Site_11	0.46	Tier 3
Site_12	0.88	Tier 3
Site_13	0.29	Tier 0
Site_14	0.36	Tier 0
Site_15	0.41	Tier 3
Site_16	0.45	Tier 3
Site_17	0.34	Tier 0
Site_18	0.54	Tier 3
Site_19	0.39	Tier 0
Site_2	0.52	Tier 3
Site_3	0.43	Tier 3
Site_4	0.35	Tier 0
Site_5	0.45	Tier 3
Site_6	0.40	Tier 3
Site_7	0.37	Tier 0
Site_8	0.62	Tier 3
Site_9	0.40	Tier 3

Disclaimer: This software is preliminary or provisional and is subject to revision

Step 4. Identify management options

OPTIONAL: Target Known Subsidies

Known Subsidies

- Roads
- Sewage Ponds
- Landfills
- Communication Towers
- Residential/Commercial Areas
- Transmission Lines
- Telephone Poles
- Agriculture
- Livestock Burial Pits
- Livestock Feedlots
- Livestock Troughs
- Buildings/Structures
- Fences

Save Selected Subsidies

OPTIONAL: Identify subsidies from GIS

import surveyed sites shapefile

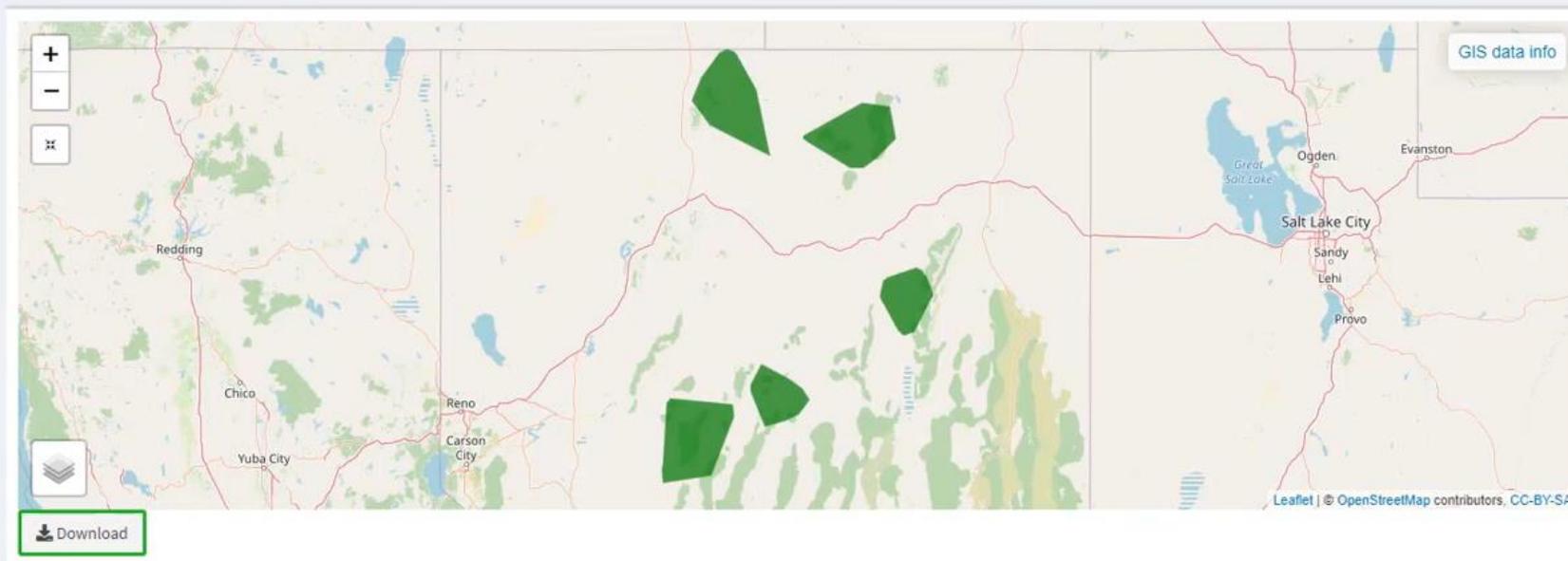
shapefile path

Browse 8 files

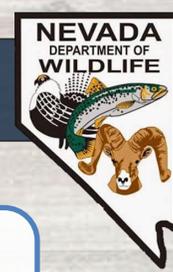
Upload complete

Analyze Raven Subsidies

Map Raven Subsidies



Prioritize Management Actions



Density

- Density < 0.4 (with CI) = 0
- Density > 0.4 (with CI) = 0.5
- Density > 0.4 (without CI) = 1

Impacted by
ravens?

- No = 0
- Yes = 1

Concentration
Area?

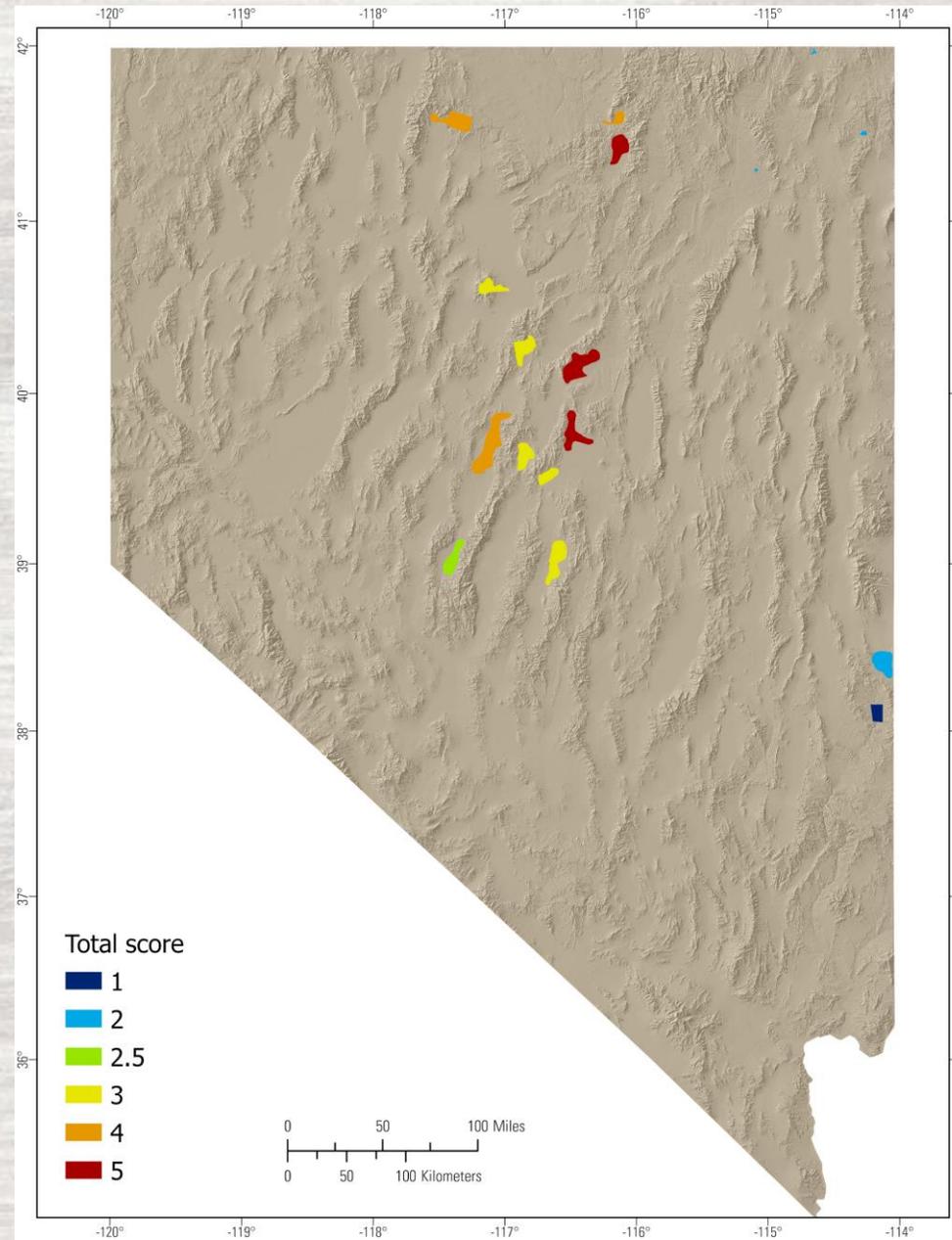
- No = 0
- Yes = 1

Habitat
Quality

- Low = 0
- Moderate = 1
- High = 2

Polygon prioritization was determined by the Nevada Department of Wildlife.

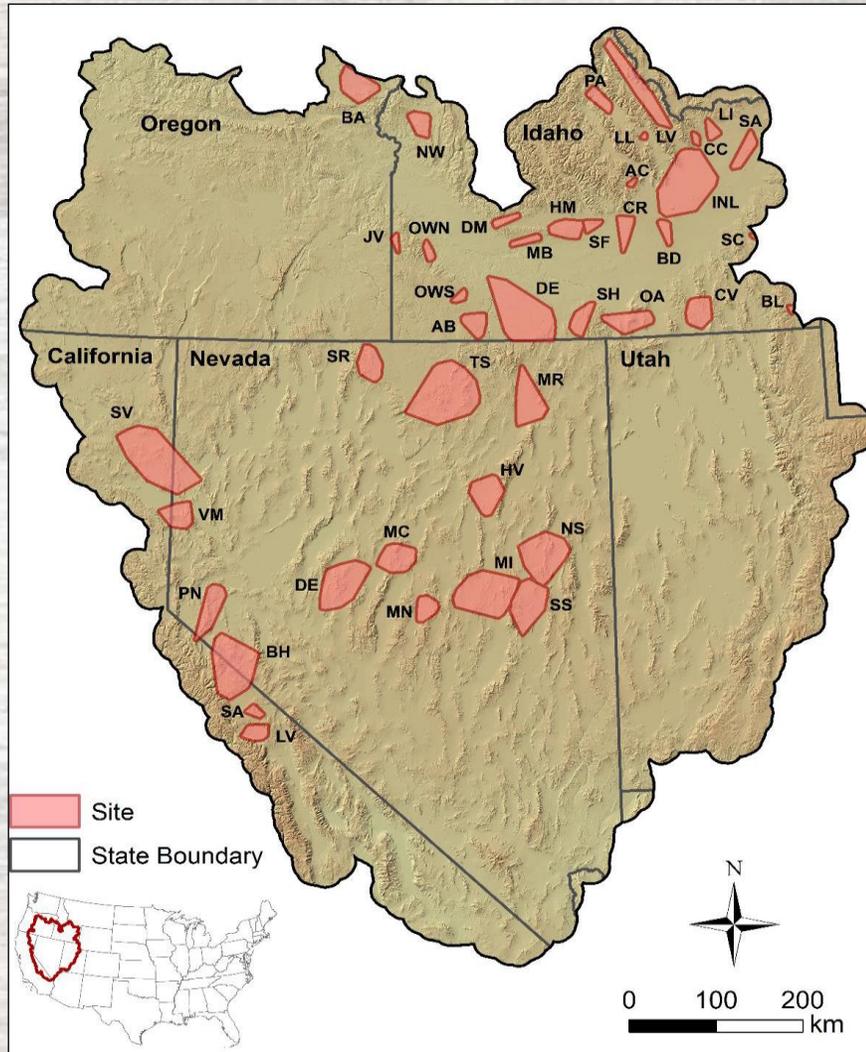
Additional Prioritization by NDOW



Polygon prioritization was determined by the Nevada Department of Wildlife.

Step 5. Post-action Monitoring

Methods – Raven surveys and data collection



Raven point counts

- California, Nevada, Idaho, Oregon
- 2007 – 2021 (>30,000 surveys)
- 43 sites, >145 site-year combinations
- April – July

Step 5. Post-action Monitoring



Raven point counts

- 10 minute survey, 360°
- Binocular, rangefinder, GPS, compass
- Estimate distance to raptor/raven
- Surveys in conjunction with sage-grouse monitoring
 - Random locations
 - Lek locations
 - Nest locations
 - Brood locations
 - Treatment locations

Step 5. Post-action Monitoring

Methods – Raven surveys and data collection

Generate random RRHL locations within sites

- 50 locations per site
 - 40 within 50-100 m of roads
 - 10 > 100 m from roads
- Surveys on same day must be 2 km apart

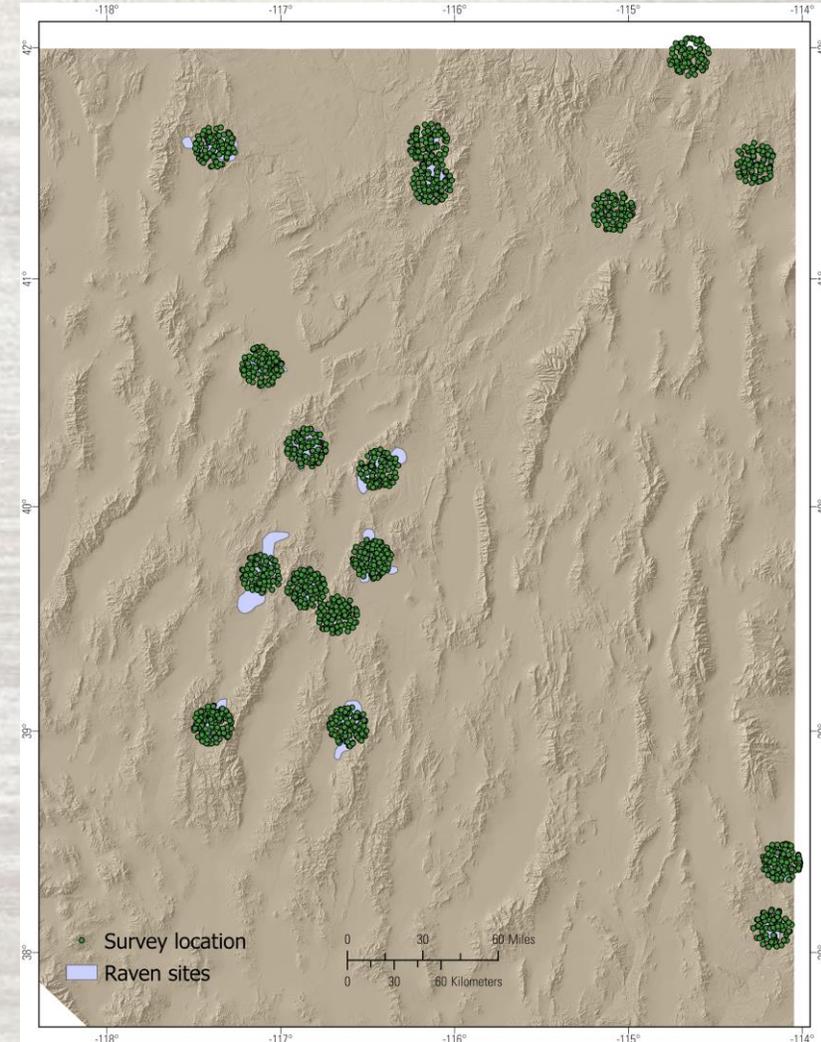


Step 5. Post-action Monitoring

Methods – Raven surveys and data collection

Goals:

- Survey 30-50 locations per site
- Survey pre and post treatment
- Analyze density with rapid assessment function
- Analyze density with distance sampling methods



Preliminary information, subject to revision. Not for citation or distribution.

Challenges for adaptive management

- Goal to use the Rapid Assessment Function (RAF), to estimate density with data with < 50 individual observations
- Time and Effort needed to sufficiently survey ravens
- Flexibility in survey location selection process for field logistics
- Improvements needed for navigating to survey locations

Questions?

