

# IGBC Science Subcommittee

## 2026 IGBC YES Fall Meeting

Photo: J. Davis

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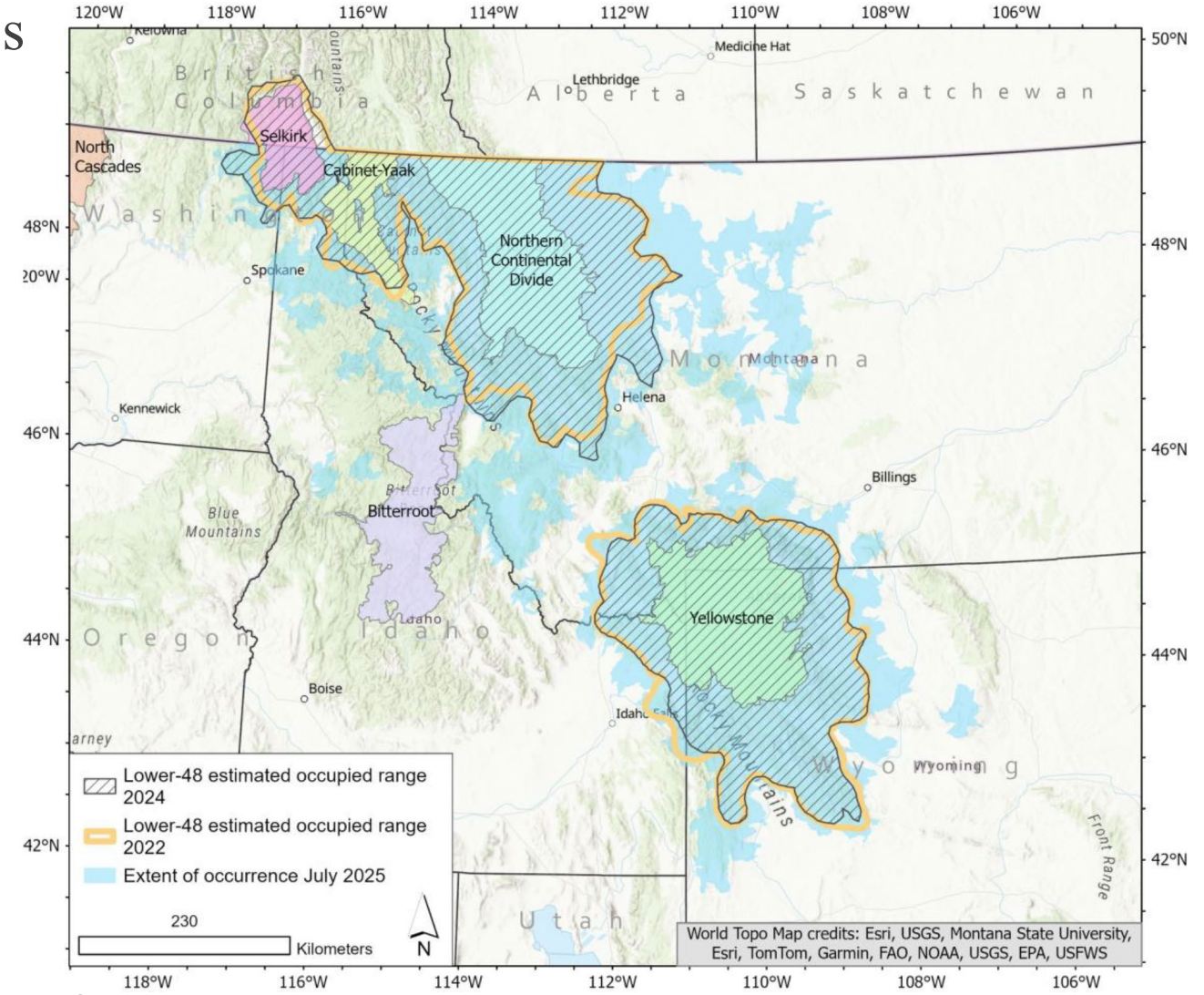
Interagency Grizzly Bear Committee

# Science Subcommittee roles and responsibilities

- Coordinate research across ecosystems
- Conduct cross-ecosystem science as needed, contingent on funding and/or logistical support
- Inform the Executive Committee of ongoing research efforts on an annual basis
- Respond to requests for cross-ecosystem science from the Executive Committee.
- Ecosystem science leads, USFWS, USFS, and Canadian trans-boundary scientist




Costello et al. (2025)

# Big picture summary: estimated abundance

- Cabinet-Yaak Ecosystem
  - 58 bears (2023) Kasworm et al. (2024a)
- Selkirk Ecosystem (US portion)
  - 57 bears (2023) Kasworm et al. (2024b)
- Northern Continental Divide Ecosystem
  - 1,047 bears (2018, new pending) NCDE Subcommittee (2021)
- Greater Yellowstone Ecosystem
  - 1,055 bears (DMA, 2025)


Photo: IGBST

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 Not for citation or distribution.

# Ongoing research: GYE, NCDE, SCYE, and Multi-ecosystem

Demographics: Selkirk BC and US population estimate; density estimation using cameras in YNP (with MSU); spatially explicit survival (with Univ. Trento); estimating time to reach BE targets under EIS alternatives; close-kin mark-recapture to estimate population size

Habitat and connectivity: habitat modeling and connectivity areas (with UI); effects of forest management and wildfire disturbance on habitat selection and movements (with UM); denning habitat (with UM); evaluation of illegal motorized access; review paper on secure habitat and road density; GTNP road crossings, huckleberry habitat modeling

Bear ecology: natal dispersal; use of army cutworm moths; complete blood count reference panel (with Polish Academy of Sciences); denning chronology (with UM)

Genetics: genome project (with UC-Riverside, UC-Santa Cruz, WSU)

Activity: accelerometer data to predict behaviors (with WSU, fRi)

Human-bear interactions and conflict: responses to residential human-bear conflicts (); use of grain bins; spatiotemporal patterns of livestock depredation (UC-Berkeley); techniques to reduce livestock depredation; decadal growth of traffic volume on US Highway 2 and its influence on crossing behavior

Social science:

Recreation: responses to recreational activities in YNP (with MSU); predicting trail crossings and use in YNP and GTNP; responses to recreational activities in GNP (with UM)

Landscape change: YNP bear foods and demographics (with MSU); decision tools for NPS managers (with MSU)

# Research to highlight

- USFS collaboration
  - Evaluation of illegal motorized access (NCDE and SCYE)
  - Review paper on secure habitat and road density (multi-ecosystem)

- IGBST update to GYE spatially explicit survival

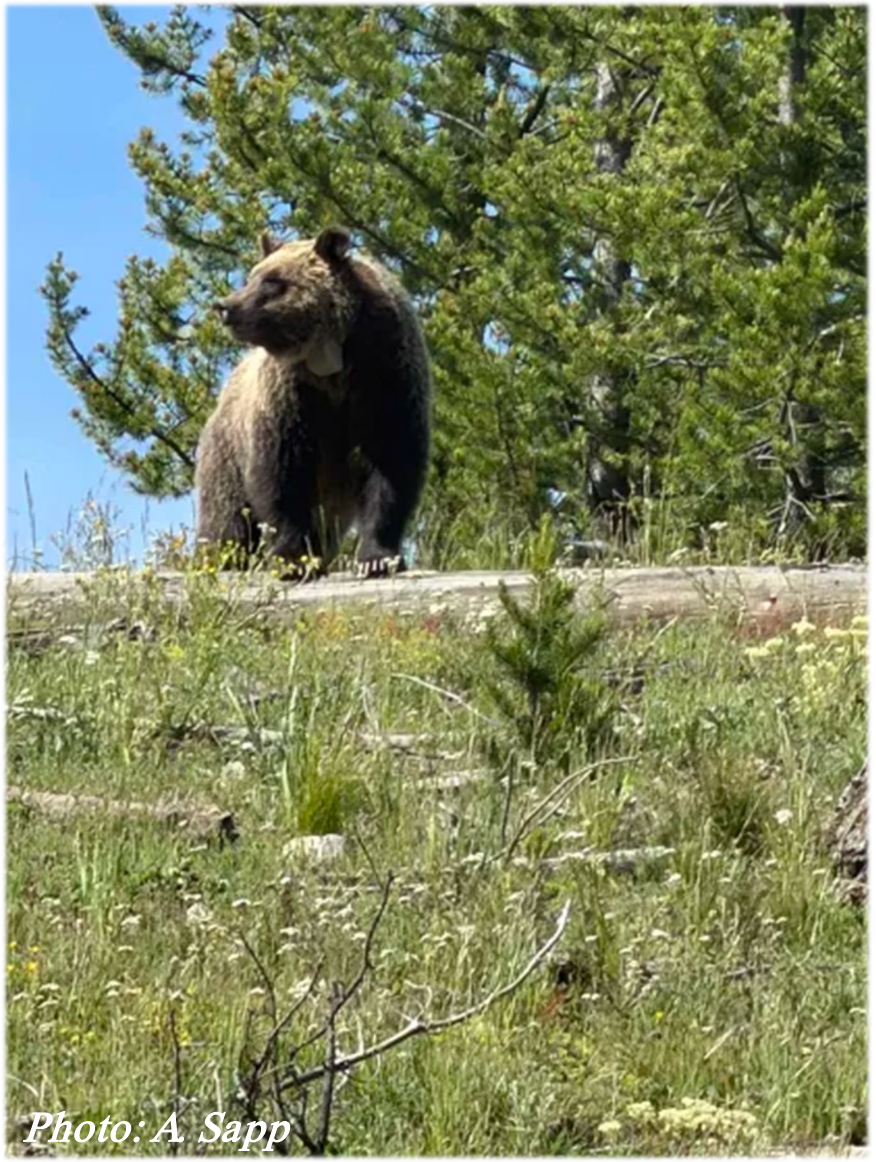
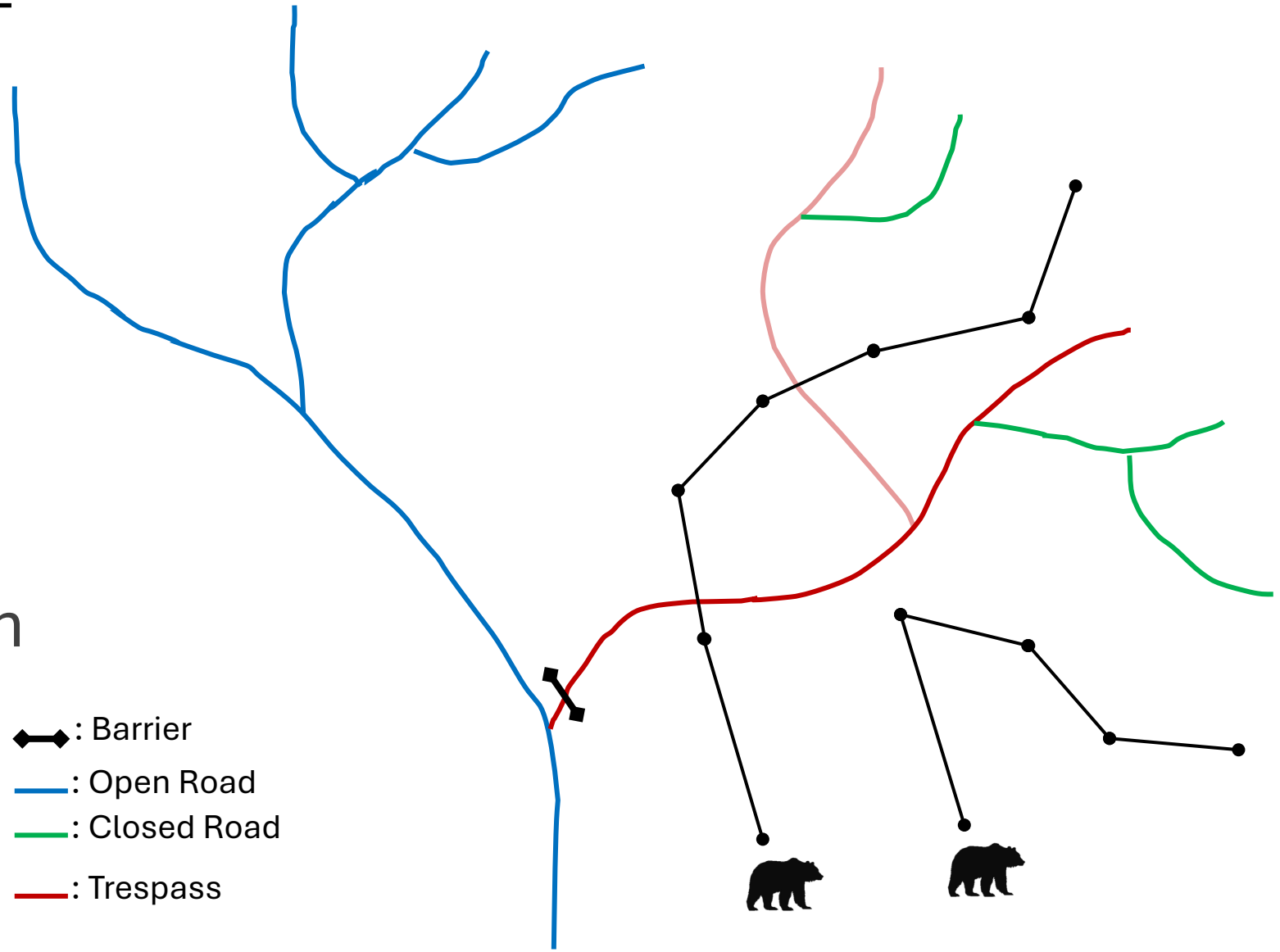


*Photo: A. Sapp*

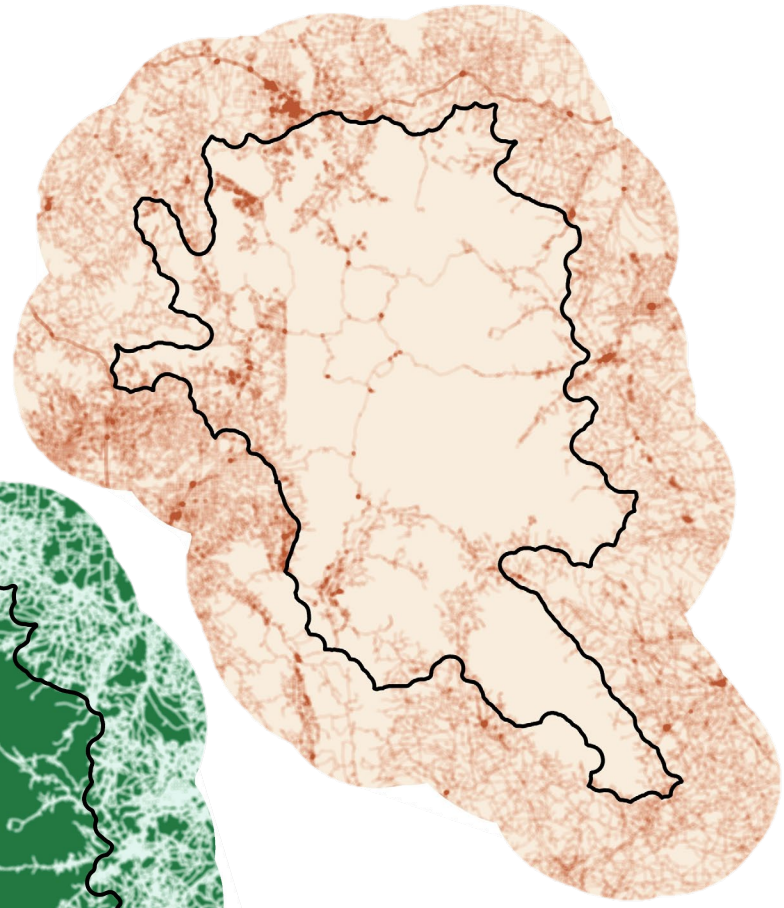
# Illegal motorized use

- Can we detect and quantify illegal motorized use using cell phone data?
- If trespass occurs, can we detect an impact on bear movements or habitat use?

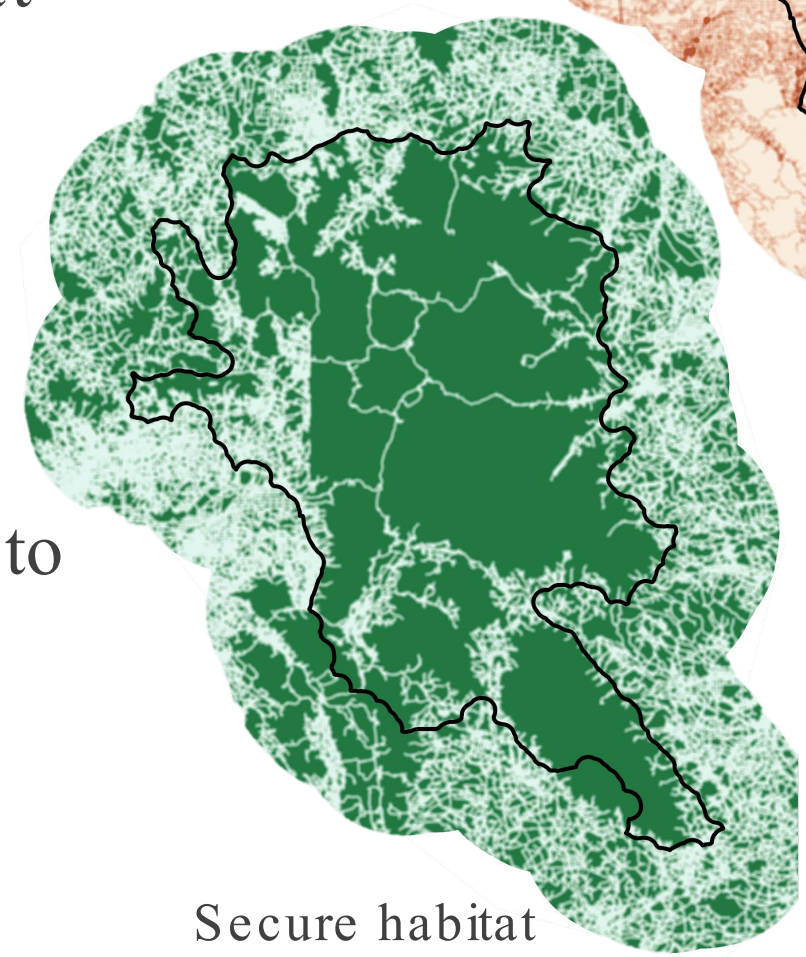


# Secure habitat and road density

- Review paper summarizing the scientific literature on secure habitat and road density
- Clarify patch size differences and intentions among ecosystem Conservation Strategies.
- Provide science-based information to support future conservation and management decisions.



Road density



Secure habitat

# Spatially explicit survival

Journal of Wildlife Management 74(4):654–667; 2010; DOI: 10.2193/2009-206

*Management and Conservation Article*

## Hazards Affecting Grizzly Bear Survival in the Greater Yellowstone Ecosystem

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**ABSTRACT** During the past 2 decades, the grizzly bear (*Ursus arctos*) population in the Greater Yellowstone Ecosystem (GYE) has increased in numbers and expanded its range. Early efforts to model grizzly bear mortality were principally focused within the United States Fish and Wildlife Service Grizzly Bear Recovery Zone, which currently represents only about 61% of known bear distribution in the GYE. A more recent analysis that explored one spatial covariate that encompassed the entire GYE suggested that grizzly bear survival was highest in Yellowstone National Park, followed by areas in the grizzly bear Recovery Zone outside the park, and lowest outside the Recovery Zone. Although management differences within these areas partially explained differences in grizzly bear survival, these simple spatial covariates did not capture site-specific reasons why bears die at higher rates outside the Recovery Zone. Here, we model annual survival of grizzly bears in the GYE to 1) identify landscape features (i.e., foods, land management policies, or human disturbances factors) that best describe spatial heterogeneity among bear mortalities, 2) spatially depict the differences in grizzly bear survival across the GYE, and 3) demonstrate how our spatially explicit model of survival can be linked with demographic parameters to identify source and sink habitats. We used recent data from radiomarked bears to estimate survival (1983–2003) using the known-fate data type in Program MARK. Our top models suggested that survival of independent (age ≥2 yr) grizzly bears was best explained by the level of human development of the landscape within the home ranges of bears. Survival improved as secure habitat and elevation increased but declined as road density, number of homes, and site developments increased. Bears living in areas open to fall ungulate hunting suffered higher rates of mortality than bears living in areas closed to hunting. Our top model strongly supported previous research that identified roads and developed sites as hazards to grizzly bear survival. We also demonstrated that rural homes and ungulate hunting negatively affected survival, both new findings. We illustrate how our survival model, when linked with estimates of reproduction and survival of dependent young, can be used to identify demographically the source and sink habitats in the GYE. Finally, we discuss how this demographic model constitutes one component of a habitat-based framework for grizzly bear conservation. Such a framework can spatially depict the areas of risk in otherwise good habitat, providing a focus for resource management in the GYE.

**KEY WORDS** Demography, Greater Yellowstone Ecosystem, grizzly bear, hazard models, known-fate analysis, road density, secure habitat, source–sink dynamics, survival, *Ursus arctos*.

The Greater Yellowstone Ecosystem (GYE) grizzly bear (*Ursus arctos*), listed as a threatened species in 1975, was formally delisted by the United States Fish and Wildlife Service (USFWS) in 2007 (USFWS 2007). The bear was relisted by court order in November 2009. Today, this population of grizzly bears lives in close proximity to humans and is what Scott et al. (2005:384) refer to as a "conservation-reliant species," that is, a species that is at risk from threats so persistent that it requires continuous management to maintain population levels.

Humans are the primary agent of death in grizzly bears. Indeed, rates of human-caused mortality determine the trajectories of most grizzly bear populations (Eberhardt et al. 1994, McLellan et al. 1999, Harris et al. 2006). Accordingly, understanding bear–human relationships and modeling the mortality risk in human-dominated landscapes have received recent attention, leading to development of increasingly comprehensive, spatially explicit hazard models. For example, building on early studies that emphasized the effects of roads on grizzly bear survival (Archibald et al. 1987, McLellan and Shackleton 1988, Mattson and Knight 1991, Mace et al. 1996, Mace and Waller 1997), recent hazard models also consider differences in land management policy, proximity to humans and human developments, terrain features, and vegetation cover, as well as sex, age, and management history of individual bears (Boyce et al. 2001, Merrill and Mattson 2003, Johnson et al. 2004, Nielsen et al. 2004, Haroldson et al. 2006). Moreover, these models have the potential to provide managers with spatially explicit assessments of risks, thereby focusing management activities (Nielsen et al. 2006).

Risk assessments are typically constructed using data from histories of radiomarked individuals or the locations of dead bears (Boyce et al. 2001, Merrill and Mattson 2003, Johnson et al. 2004, Nielsen et al. 2004, Haroldson et al. 2006). Methods to model survival from marked individuals are well established, allow for direct comparisons among habitats where bears survive and where they die, and constitute one component necessary to parameterize demographic models (White and Garrott 1990, White and Burnham 1999). Models using known mortality locations allow for an alternative approach when telemetry data are unavailable. These models compare mortality sites to random or telemetry locations but require assumptions about reporting rates and the spatial accuracy of the death sites (Merrill and Mattson 2003, Nielsen et al. 2004).

Despite progress in modeling grizzly bear mortality risk, important challenges remain. Most notably, in the GYE, a

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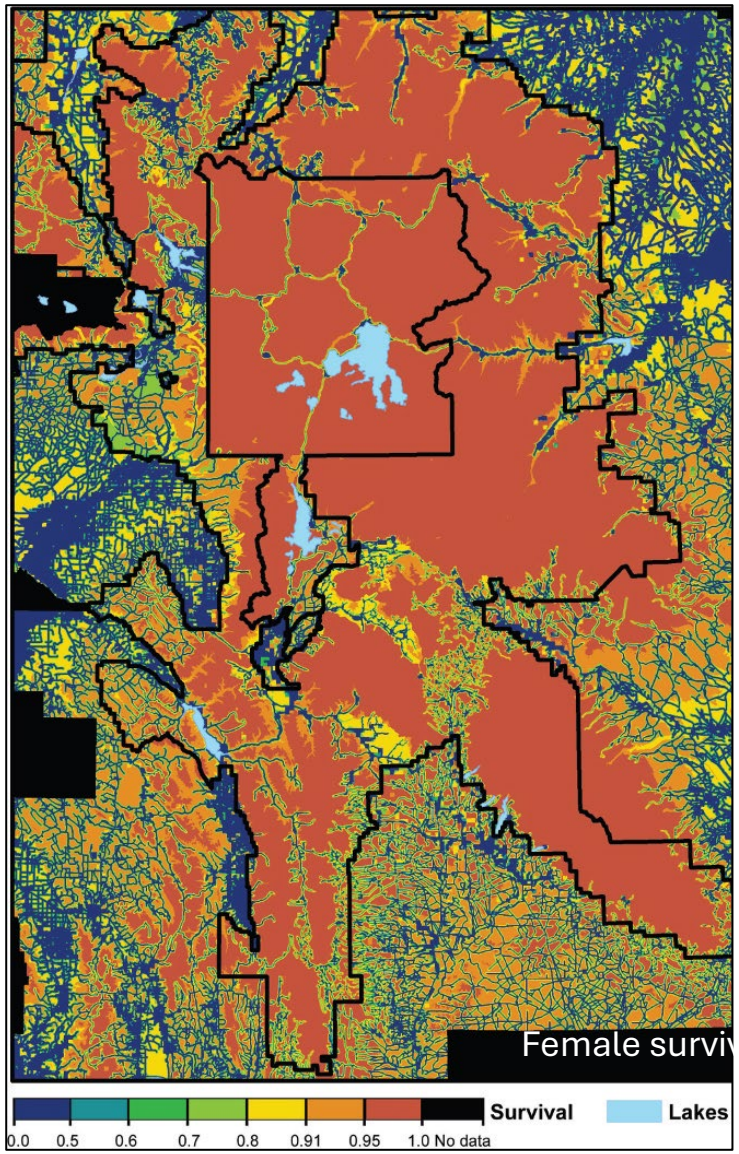


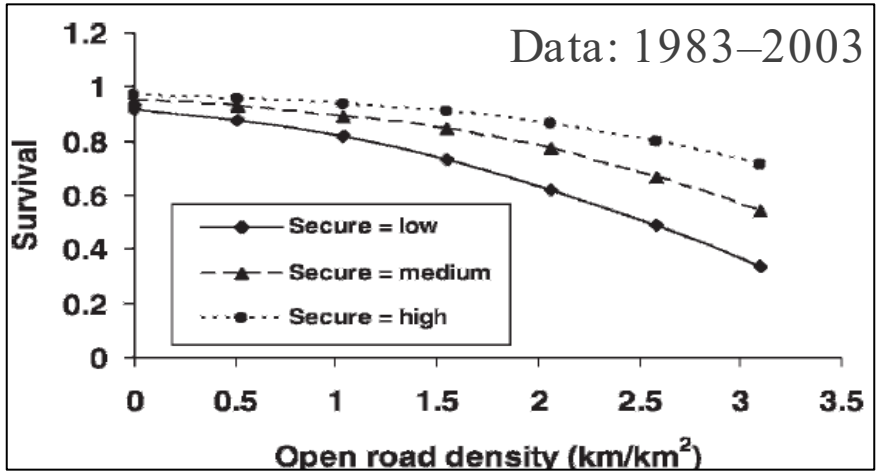

# Connectivity modeling

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## Predicted connectivity pathways between grizzly bear ecosystems in Western Montana

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ABSTRACT

Habitat and corridor mapping are key components of many conservation programs. Grizzly bear populations in the continental US are fragmented and connectivity among federal recovery areas is a conservation goal. Building on recent work, we modeled movements to predict areas of connectivity, using integrated step selection functions (iSSFs) developed from GPS-collared grizzly bears (F = 46, M = 19) in the Northern Continental Divide Ecosystem (NCDE). We applied iSSFs in a >300,000 km$^2$ area including the NCDE, Cabinet–Yaak (CYE), Bitterroot (BE), and Greater Yellowstone (GYE) Ecosystems. First, we simulated directed movements (randomized shortest paths with 3 levels of exploration) between start and end nodes across populations. Second, we simulated undirected movements from start nodes in the NCDE, CYE, or GYE (no predetermined end nodes). We summarized and binned results as classes 1 (lowest relative predicted use) – 10 (highest relative predicted use) and evaluated predictions using 127 outlier grizzly bear locations. Connectivity pathways were primarily associated with mountainous areas and secondarily with river and stream courses in open valleys. Values at outlier locations indicated good model fit and mean classes at outlier locations (≥7.4) and Spearman rank correlations (≥0.87) were highest for undirected simulations and directed simulations with the highest level of exploration. Our resulting predictive maps can facilitate on-the-ground application of this research for prioritizing habitat conservation, human-bear conflict mitigation, and transportation planning. Additionally, our overall modeling approach has utility for myriad species and conservation applications.

### 1. Introduction

Connectivity among wildlife populations is of pressing concern given ongoing and accelerating habitat loss to human development, which fragments remaining habitats and isolates populations (Crooks et al., 2017, 2011; Fahrig et al., 2021). Connected landscapes are those that facilitate movements of animals between patches (Fahrig et al., 2021; Taylor et al., 1993). Loss of connectivity among populations may reduce their genetic variation and ability to respond to and recover from environmental perturbations. Theory and empirical precedent have shown that island populations face greater risks of extinction, especially when small (MacArthur and Wilson, 1967). Isolation of populations may accordingly accelerate irreversible losses of species.

Today, grizzly bears (*Ursus arctos*) represent an example of a species threatened by habitat loss and population fragmentation. Worldwide, brown bear populations have become extirpated or fragmented, particularly on the southern edge of their distribution (McLellan et al., 2017). In the conterminous United States, an estimated 50,000 grizzly bears were likely present 200 years ago (USFWS, 2022). The arrival of Europeans brought heavy persecution, habitat loss, and rapid decline. By 1975, when grizzly bears were listed as a threatened species under the Endangered Species Act, only six remnant populations were thought to remain in the conterminous US. These were found in large tracts of mostly public land, such as National Parks and National Forests, representing just 2 % of the species' former range (USFWS, 1993). Later evidence indicated that two of these populations had also become extirpated.

Establishment of recovery zones within each grizzly bear ecosystem (Fig. 1; USFWS, 1993) and collaborative efforts among state and federal agencies, tribes, landowners, and the public have facilitated slow increases in grizzly bear numbers and range extent. As of 2021, population estimates exceeded 1000 animals each in the Northern Continental

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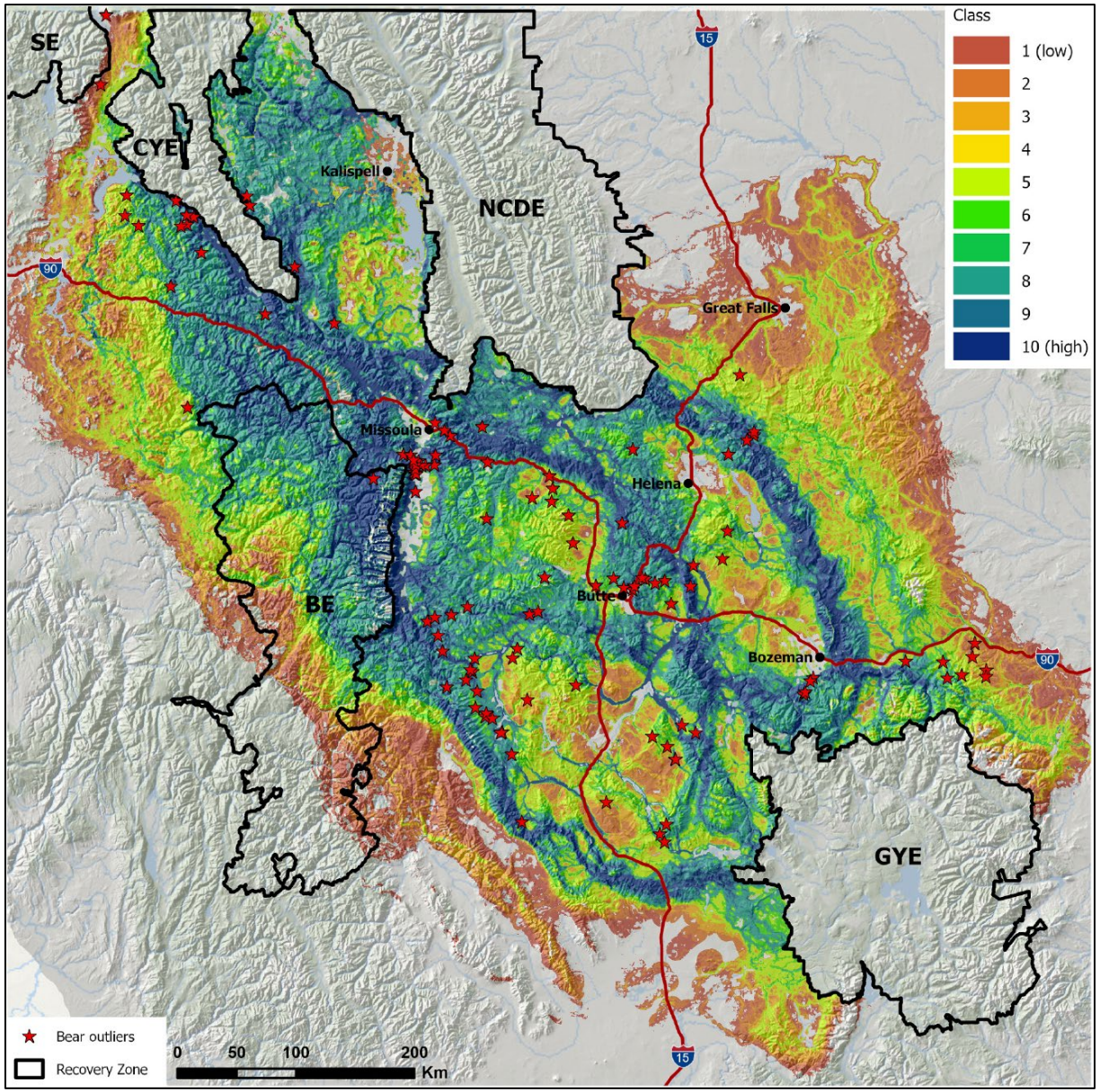



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Photo: J. Davis