Identifying and predicting stopping behavior of off-highway vehicle (OHV) recreationists using a presence-only model from ecology

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BACKGROUND

- Off-highway vehicle (OHV) recreation is a valued ecosystem service in the United States, especially in the west where the abundance of public lands provides many opportunities to participate (Shilling et al. 2012).
- Between 1999 and 2007, national number of OHV participation days increased by 56% and is predicted to increase an additional 58% by 2060 (Bowker et al. 2012).
- Land managers are challenged with a dual mandate of providing recreational opportunities while still maintaining healthy habitat for wildlife.
- OHV use can negatively impact wildlife by decreasing nesting and reproductive success, disturbing natural behaviors such as foraging, and minimizing the area of suitable habitat (Boyle and Samson 1985).
- Recreation types influence the disturbance response of wildlife. Wildlife have been shown to be more sensitive to pedestrian than vehicle traffic (Wolf and Croft 2010). Predictable human behavior, such as staying on frequently used trails and constant homogenous movement, has been shown to invoke less of a reaction from wildlife than unpredictable behavior including off-trail approaches or heterogeneous movements (i.e., stop and go; Taylor and Knight 2003).
- Stopping locations of recreationists in sensitive habitats can increase disturbance potential to wildlife. Knowledge of highly suitable stopping locations within these sensitive areas can help manage human-wildlife conflicts.

OBJECTIVES

- Identify stopping locations of OHV recreationists.
- Use a presence-only model from ecology to examine habitat suitability for stopping locations of OHV recreationists
- Identify landscape variables that predict stopping locations by OHV recreationists

CONNECTIONS WITH GOLDEN EAGLE RESEARCH

- OHV recreation within golden eagle nesting habitats has been shown to adversely affect reproductive success (Steenhof et al. 2014, Spaul 2015).
- Flushing a bird from its nest or territory is indicative of wildlife disturbance. In collaborative research, flushing behavior commonly occurred when OHV riders either stopped and became pedestrians or abruptly changed their direction of travel (Spaul 2015).
- Research is needed to understand how OHV recreationists use the landscape.
- Additional ongoing research is determining if characteristics of OHV users such as past experience, knowledge of the area, motivations for recreating, and group characteristics influence their spatial and temporal patterns within a complex trail network.

CONNECTIONS WITH POPULATION INCREASE

- The three most populous cities (Boise, Nampa, Meridian) in Idaho are in counties (Ada and Canyon) adjacent to the Murphy Subregion and its 1350 km complex trail system (Fig. 1).
- Ada and Canyon counties 2000 - 2010 population growth rate (25.6%) much higher compared to national average (9.7%)
- Greater pressures placed on peri-urban landscapes for recreational use.
- Ongoing research examining the mechanisms which attract people to become OHV recreationists, providing information on the effects of population growth under alternate future scenarios.
- Finding a balance between landscape use and landscape protection in the context of projected population increases is necessary to ensure the coexistence of healthy natural areas and fulfilling recreational opportunities.

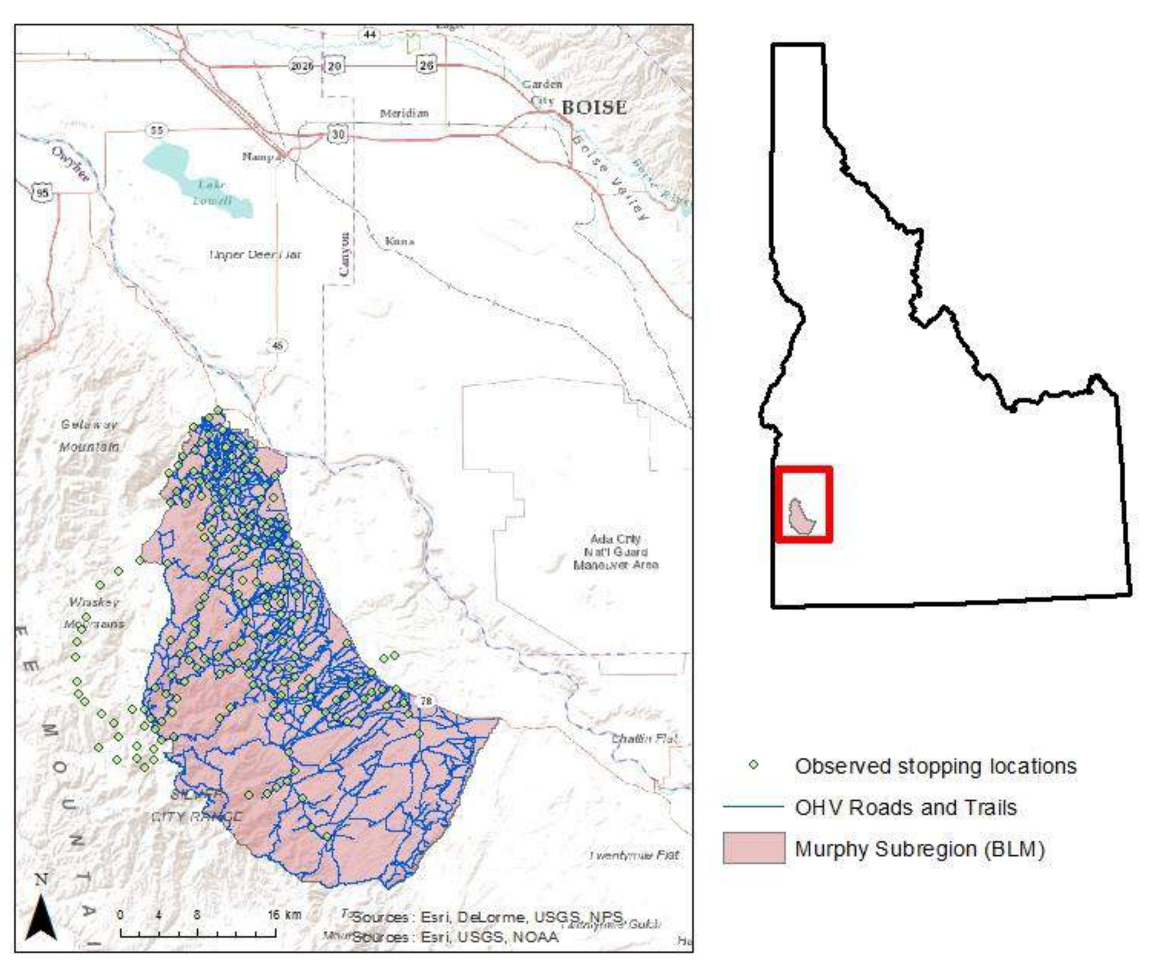

Fig. 1. Murphy Subregion of the Owyhee Front Management Area (BLM).

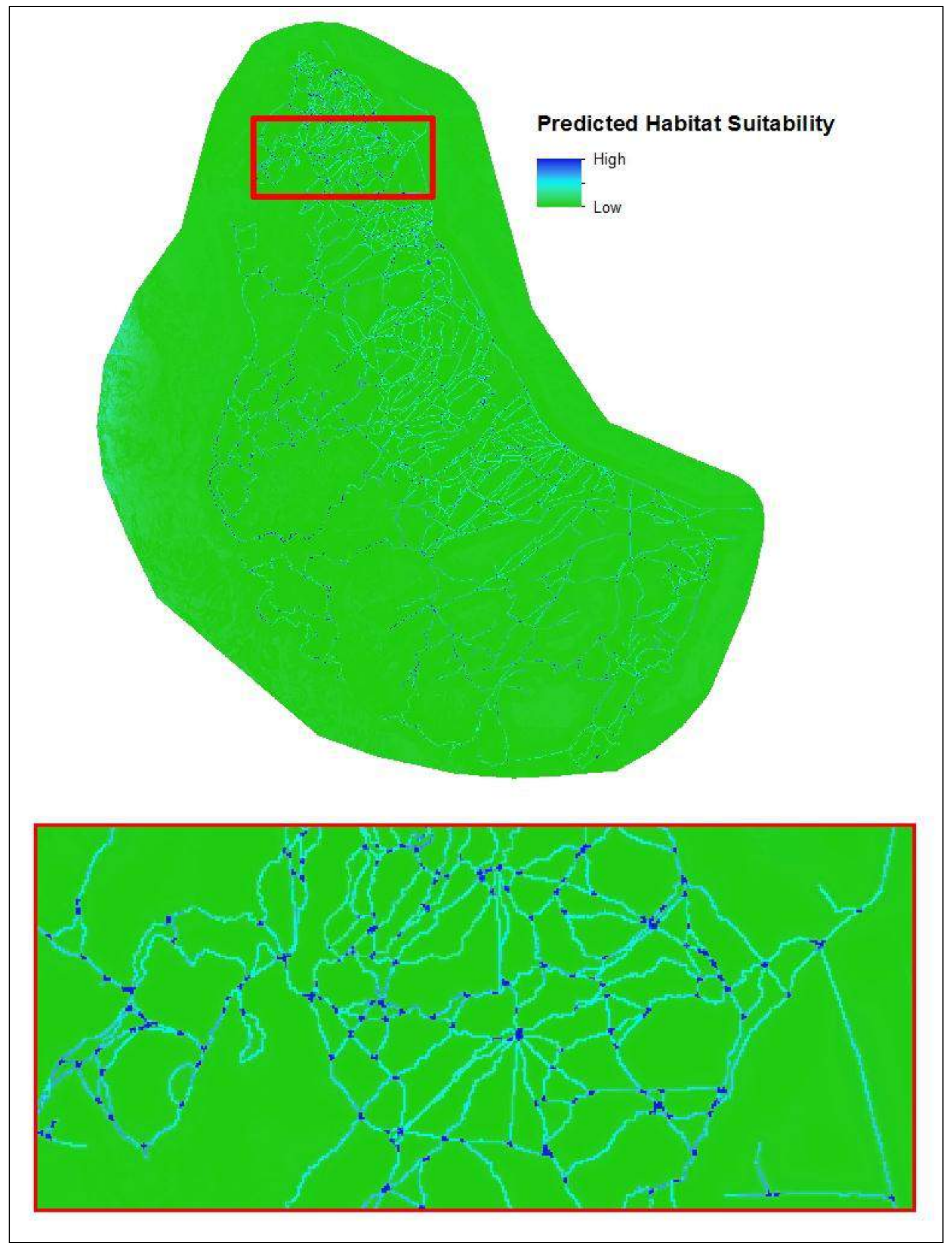

Fig. 3. Predicted suitability map for stopping locations of OHV riders in the Murphy Subregion (Owyhee Front Management Area, BLM). Dark blue represents high suitability areas while green represents low suitability.

Fig. 2. Attaching GPS receiver to OHV.

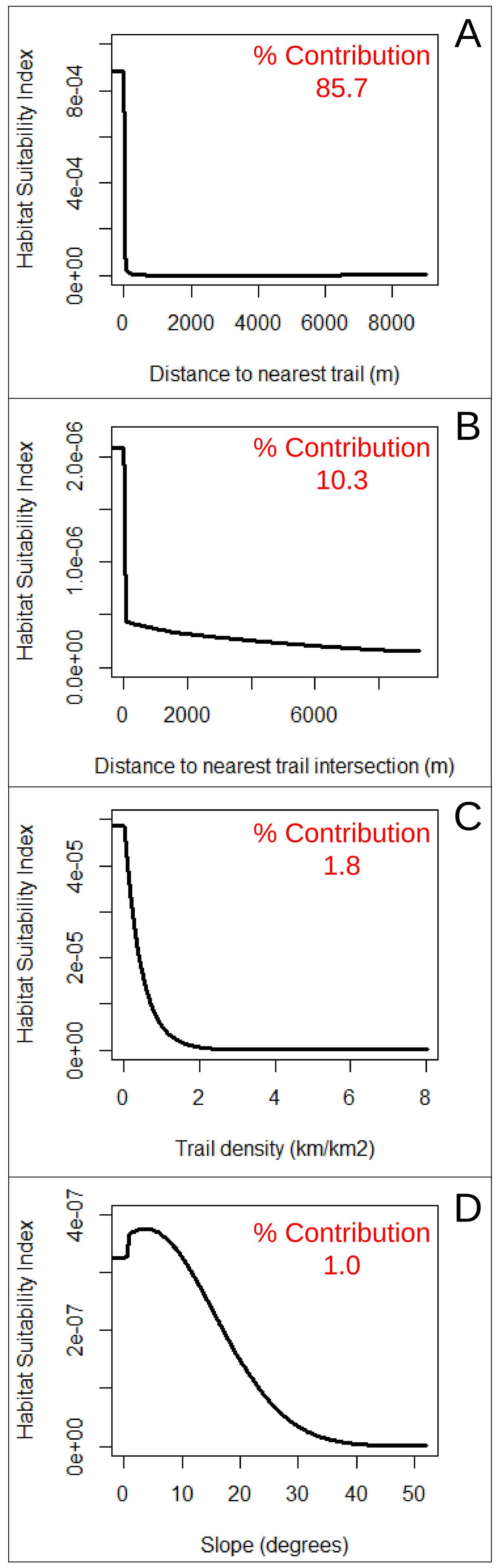

Fig. 4. Predicted habitat suitability for stopping locations as a function of the relationships between (A) distance to trail, (B) distance to intersection, (C) trail density, and (D) slope.

METHODS

Stopping Locations

- GPS receivers attached to participant's vehicles (Fig. 2).
- Recorded position, time, speed, and altitude at a five second interval.
- Speeds ≤ 0.1 kph were considered a stopping event.
- Points within a 5 m threshold combined.
- Points filtered (1 km buffer) to reduce spatial autocorrelation.

MaxEnt

- MaxEnt is a presence-only modeling technique used to determine habitat suitability and environmental predictors for a focal species (Elith et al. 2011)
- Presence-only models have been used to examine human distributions relating to outdoor recreationists (Pauli et al. *in review*) and to identify human-wildlife conflict areas (Vanausdall et al. *in review*).

Environmental variables

- Variables chosen to examine influence of both natural landscape and trail/infrastructure characteristics.
- Natural landscape variables were elevation, slope, relative topographic position, visibility index, and land cover.
- Infrastructure variables were distance to nearest trail, distance to nearest trailhead, distance to nearest trail intersection, distance to nearest trail dead end, and trail density.

Analysis

- Stopping locations and environmental variables were modeled in MaxEnt. Suitability of locations for stopping was predicted for the study area (Fig. 3)
- Area under the curve (AUC) measured how well the model discriminated between stopping locations and random locations.
- AUC values of 1 indicate perfect discrimination while an AUC value of 0.5 indicates differentiation at a random level (Fielding and Bell 1997).
- AUC of the model was compared to AUCs of 500 generated null models to determine if it significantly contributed to predicting stopping locations.

RESULTS

- 206 of 2,101 stopping locations retained for analysis after filtering (Fig. 1).
- 145 location points (70%) were used for model training while remaining 61 points (30%) were used for model evaluation.
- Training AUC = 0.941 and test AUC = 0.894 (SD = 0.024). Both AUC values significantly higher than AUC values of the 500 null models ($p < 0.002$).
- **Distance to trail, distance to intersection, and trail density contributed most to the predictive power of the model (Fig. 4).** The most influential non-infrastructure variable was slope, contributing 1.0% predictive power.

DISCUSSION AND MANAGEMENT IMPLICATIONS

- Recreational use of natural landscapes can be predicted by the combination of natural and infrastructural characteristics.
- Landscape variables that best predicted stopping locations were infrastructure based, giving land managers opportunities to manipulate the current trail network with the goal of influencing stopping behaviors and thus minimizing human-wildlife conflict.
- Additional research will examine if there are differences in landscape qualities between areas where short stopping events occur compared to areas where longer stops are observed.

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ACKNOWLEDGEMENTS

This research is supported by the Idaho NSF EPSCoR MILES program. Additional thanks to Grant Furtado, Denell LeTourneau, Rob Spaul, Eli Frazier, Michelle Kinney, BLM Owyhee Front Office, BSU Raptor Research Center, Dr. Jeffrey Hallo (Clemson University), and to all recreationists who participated.