



Applying Habitat Models to Predict Mexican Spotted Owl Occupancy in the Guadalupe Mountains

The Mexican Spotted Owl (*Stix occidentalis lucida*) is a federally threatened species inhabiting mixed conifer forests and canyon systems throughout the southwestern United States and Mexico. Identifying Mexican Spotted Owl breeding habitat is important for conservation and recovery efforts. In the Guadalupe Mountains of West Texas and Southeast New Mexico, Mexican Spotted Owls have been known to nest and roost in steep canyon systems. Spotted Owls in this region are understudied and the extent of their breeding habitat is largely unknown. The Southwestern Geophysical Habitat Model (GHM) and the Utah-based Habitat Model (UBM) are Geographical Information Systems (GIS)-based models that predict the potential breeding-season habitat of Mexican Spotted Owls. When applied together in the Guadalupe Mountains, these models project overlapping and non-overlapping predictions. Validating these model predictions can improve identification of breeding habitats in this region to provide managers a foundation for recovery efforts.

Methods

The objectives of this study were to:

1. Validate and compare the predicted habitat of the GHM and UBM using historical data of known nest and roost sites (1994 to 2006) in the Guadalupe Mountains.
2. Test the utility of the GHM's and UBM's habitat predictions for estimating site occupancy in the Guadalupe Mountains based on the results of nighttime surveys conducted during the 2007 breeding season (March through August).

I used the GHM and UBM to produce basic predictions of high- and low-quality habitat in the Guadalupe Mountains. I used GIS software to manipulate each model's output according to their suggested intervals of predicted habitat to produce four strata: (1) high-quality habitat predicted by the GHM alone, (2) high-quality habitat predicted by the UBM alone, (3) high-quality habitat predicted by both the GHM and UBM (HQO), and (4) low-quality habitat predicted by both models (Figure 1).

I tested the efficiency of these four strata at predicting known Mexican Spotted Owl nest and roost sites based on historical data from surveys conducted between 1994 and 2006 throughout the Guadalupe Mountains. Additionally, I tested the capability of these four strata at predicting Mexican Spotted Owl site occupancy based on results of nighttime surveys. Surveys were conducted three times throughout the breeding season within 200 ha sample units. I used the statistical program PRESENCE to estimate detection probabilities and



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Mexican Spotted Owl (female).

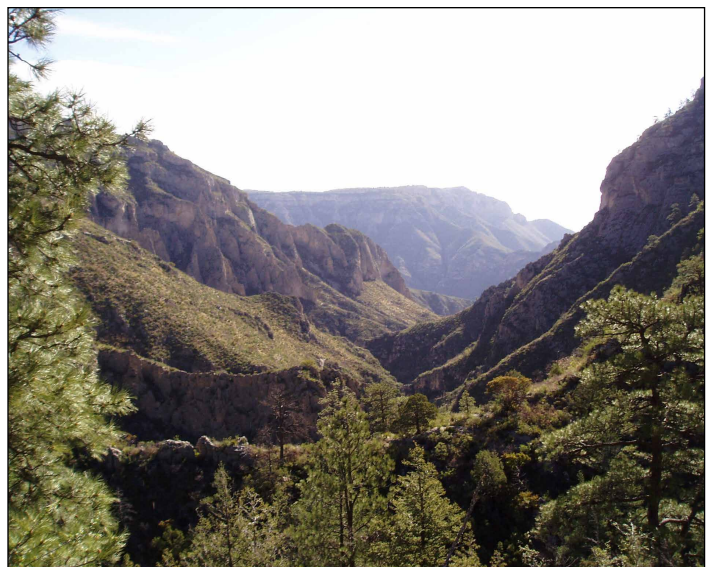
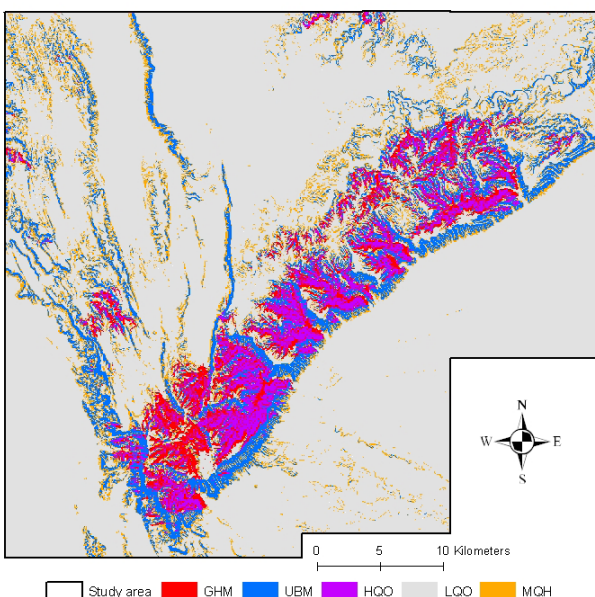
the proportion of area occupied (PAO) by Mexican Spotted Owls.

Results

Model Validation & Comparison Based on Historical Data

A total of 4 nest and 27 roost sites (n=31) were identified as reliable historical daytime records. The high-quality habitat





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Mexican Spotted Owl habitat, Devil's Den in Guadalupe Mountains National Park.

Figure 1. Map of predicted Mexican Spotted Owl breeding season habitat in the Guadalupe Mountains based on the Southwestern Geophysical Habitat Model (GHM), the Utah-based Model (UBM), high-quality overlap model (HQO), low-quality overlap model (LQO), and medium quality habitat model (MQH).

predicted by the GHM identified 81% (n=25) of nest and roost sites. The high-quality habitat predicted by the UBM identified 58% (n=18) of nest and roost sites, while projections of overlapping predicted high-quality habitat (HQO) identified 48% (n=15) of nest and roost sites. Low-quality overlapping habitat projected by both models identified 3% (n=1). When all four strata were compared, the proportion of high-quality

overlapping habitat within 200 m of historical locations had a significantly stronger association with historical nest and roost sites than all other strata (Figure 2).

Occupancy and Detection Probabilities

A total of 142 survey nights were accomplished across three survey periods in 51 days between 11 May and 28 August 2007. Fifty-six percent (n=14) of the 25 high-quality habitat sample units surveyed had one or more detections of Mexican Spotted Owls. Mexican Spotted Owls were not detected within any of the five low-quality habitat sample units.

The probability of detecting Mexican Spotted Owls within sample units was generally higher than 0.5 but less than 1.0.

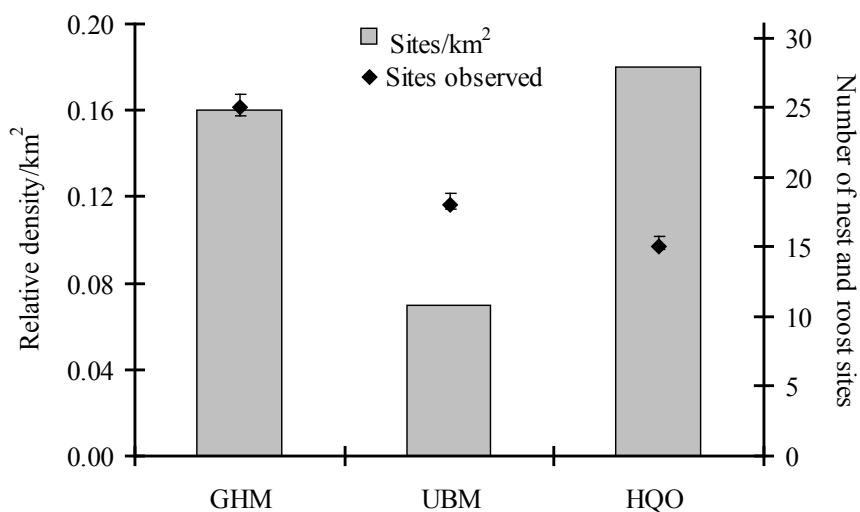


Figure 2. The relative density of historical (1994-2006) Mexican Spotted Owl nest and roost sites (n=31) with 95% confidence limits (represented by black bars) observed within the high-quality habitats predicted by the GHM, UBM, and high-quality overlapping habitat (HQO) in the Guadalupe Mountains.

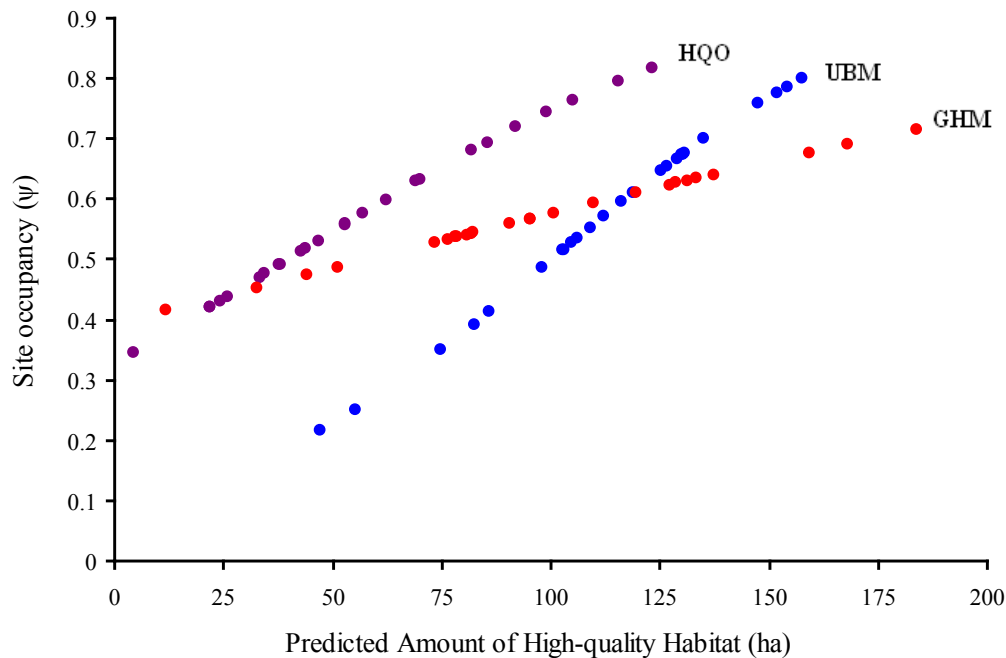


Figure 3. Occupancy estimates for 25 sample units surveyed for Mexican spotted owls in the Guadalupe Mountains compared to the amount of area of high-quality breeding-season habitat predicted by the GHM, UBM, and high-quality overlapping habitat predicted by both models (HQO).

Detection probabilities decreased for all sample units as survey period and individual visitation day approached September. The top-ranking occupancy models were constant occupancy, UBM, and HQO, all with constant detection probabilities. The GHM had the lowest cumulative weight and differed markedly from the top ranking model.

The total area of high-quality habitat across the total number of sample units was 5,305 ha. The proportion of area occupied (PAO) by Mexican Spotted Owls within accessible regions of predicted high-quality habitats in the Guadalupe Mountains did not vary considerably between models. The area of predicted habitat within sample units projected by the GHM and UBM were relatively the same differing only by 363 ha; however, the area of HQO was approximately half that predicted by either model alone. Given the area of predicted habitat and the number of Spotted Owls occupying sample units, high-quality overlapping habitat was the most efficient model for estimating Mexican Spotted Owl occupancy in the Guadalupe Mountains than using both models alone (Figure 3).

Discussion

This study was the first attempt to locate Mexican Spotted Owls and determine their site occupancy in the Guadalupe Mountains using predictions of potential breeding-season habitat generated by GIS-based habitat models. The results of this study show that:

1. The GHM's and UBM's high-quality habitat were effective at locating a proportion of known Mexican Spotted Owl nest and roost sites in the Guadalupe Mountains,

2. Predictive habitat models can be useful tools to inventory this threatened species and estimate its occupancy based on model predictions, and
3. The overlapping predictions of the GHM and UBM provide the most efficient model for predicting Mexican Spotted Owl habitat in the Guadalupe Mountains.

Management Recommendations

Presently, there is no means of isolating the overlapping high-quality habitat; therefore, application of this model still requires the added expense (or benefit) of both the GHM and UBM. It would be advantageous to managers and researchers to isolate the overlapping high-quality habitat to make more efficient use of time and resources when conducting inventory and monitoring programs. I recommend that managers consult the predicted habitat of the GHM, UBM, and overlap as a template for designing fire prescription and suppression plans, additional inventory projects, and implementing recovery efforts in the Guadalupe Mountains.

Reference

Mullet, T. C. 2008. Evaluation of two GIS habitat models and initial characterization of nesting and breeding-season roosting microhabitat for Mexican Spotted Owls in the Guadalupe Mountains. M.S. Thesis, Sul Ross State University, Alpine, TX, USA. 140pp.

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