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Department of Defense Legacy III Initiative and Bat Conservation in Utah

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Legacy III (09-346): Protocol Implementation

This final phase is crucial to ensuring that the extensive efforts and achievements realized through the first two phases becomes integrated into an established state-wide bat management effort that will remain self-sustaining across agencies long after this project concludes. The three main objectives of this phase were to: 1) write a DoD specific Risk Assessment for bat and military mission interaction, 2) create species-specific habitat models, and 3) implement the Utah Bat Monitoring Protocol state-wide. These actions directly ensure that the WAP, INRMPs, and the Utah Bat Conservation Plan goals and objectives are implemented throughout the state.

Joel Diamond

DoD Risk Assessment

Introduction

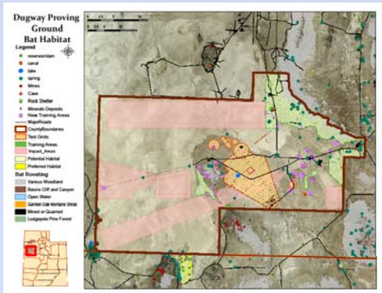
- Consolidate, understand, and apply data and knowledge gained from the Legacy project to military mission activity and land management.
- The plan includes bat monitoring on all 5 DoD facilities.
- Land use will include bat use and military testing and training activities and will ensure an extensive look at bat and military mission interaction.

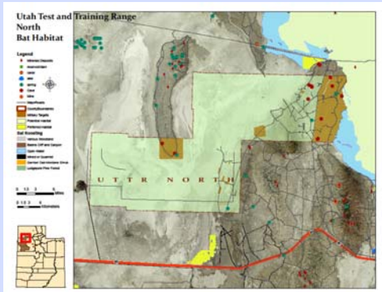
Methods

- Actionable management guidelines for each base will be outlined for improvement and/or sustainment of bat populations and mitigation for bat habitat loss due to critical mission use areas.
- Surrounding lands will be assessed for potential improvement or protection of habitat to ensure that military testing and training capabilities throughout Utah remain sustainable and unrestricted.
- Mitigation measures (if needed) can be implemented at little to no cost to DoD facilities because of the extensive work put into interagency cooperation through this Legacy initiative.

Results/Discussion

Fig 28. Bat habitat and range use on U.S. Army Dugway Proving Ground and U.S. Air Force Utah Test and Training Range North.





DoD facilities provide a wide array of bat habitat including roosting, foraging, watering, and migration corridors. These types allow for continued stability of bat populations and communities within the area.

Bat roosting habitat was found across Utah DoD installations. These actual and potential roosts provide critical bat habitat and should be managed for stability.

Bats were also observed foraging across DoD facilities. Foraging densities were highest above or near open water. Because bats require daily water these sites should be managed for continued use.

While no documented bat migration corridors occur on DoD facilities, actual and potential migration habitat exists within mines, caves, buildings, trees, and foliage. Migration roosts can be protected for potential use.

Species Specific Habitat Models

Introduction

- Species specific models have been created for DoD lands and the state of Utah based on occurrence and habitat needs.
- Habitat models are coveted components of impact analyses and assessments completed by state and federal agencies.
- Species models will be integrated quickly into existing impact analysis infrastructure. Models will be incorporated into the standardized sampling framework to prioritize future survey efforts and balance the needs and desires of partner agencies.

Methods

- Assign each species data point to a spatially explicit 3 km area (Legacy I BatBase data set).
- Each species was evaluated as "present" within every area they were detected.
- "Pseudo-absence" was estimated in every area a species was not found. A site could not be selected as a pseudo-absence site unless the bat species in question had not been capture/observed during at least nine sampling events.
- The associated land form, land cover, geology, and climate (135 total variables) were then used to create a presence/pseudo-absence framework within R® statistical software.
- Data were analyzed using the Random Forest package within R statistical software. Ten random forest models were run. Each model consisted of 250 iterations. The outputs were averaged to create a percent fit of each model.

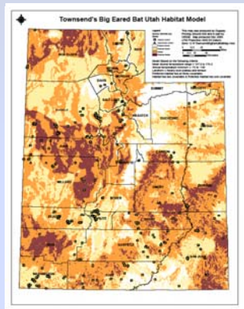


Fig 29. Random forest analysis model results mapped using ArcGIS 9.2. Actual bat captures are overlaid to illustrate model fit. Map courtesy of Teresa Langley, GIS Specialist, DPG.

Results

- 200 classification trees were run to compile a random forest analysis for Utah's 6 sensitive bat species.
- This analysis was then used to calculate a model error rate.

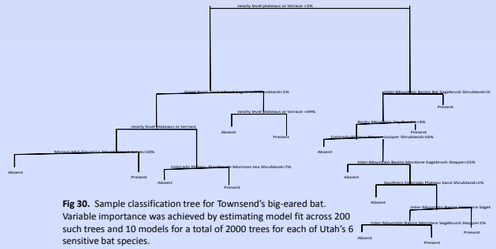


Fig 30. Sample classification tree for Townsend's big-eared bat. Variable importance was achieved by estimating model fit across 200 such trees and 10 models for a total of 2000 trees for each of Utah's 6 sensitive bat species.

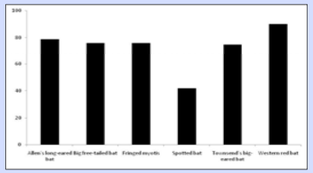


Fig 31. Percent model fit for Utah's 6 bat species of concern.

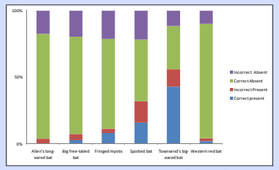


Fig 32. Percent correct and incorrect classification of species presence and absence across Utah's 6 species of concern.

- The Allen's big-eared bat model correctly categorized presence/absence in 79% of model iterations. The model was poor at predicting presence, while excelling in predicting absence.
- The big free-tailed bat model correctly categorized presence/absence in 76% of model iterations. This model correctly predicted presence in 50% of iterations and absence in 79% of iterations.
- The fringed myotis model correctly categorize presence/absence in 76% of model iterations. The model correctly predicted 71% of present and 77% of absent iterations.
- The spotted bat model only correctly categorized presence/absence in 42% of model iterations. This model correctly predicted presence in 50% and absence in 68% of iterations.
- The Townsend's big-eared bat model correctly predicted presence/absence events in 75% of iterations. This model correctly predicted presence in 77% of iterations.
- The western red bat model correctly categorized presence/absence in 90% of model iterations. This model correctly predicted presence in 50% and absence in 90% of iterations.

Discussion

Overall the presence/absence models preformed well within context. Of the 6 models, 5 performed at or above 70% accuracy. In complex ecological systems such as bat communities, a model prediction rate above 50% is often the norm. The models consistently performed better at absence prediction than presence with the exception of Townsend's big-eared bat and fringed myotis. Both of these species are strongly associated with geologic cover types that are characterized by natural caves and abandoned mines making model predictions for absence more accurate. This association of Townsend's big-eared bat and the fringed myotis with cavern habitat is well documented.

Utah Bat Monitoring Protocol Implementation

Results

Overall

Table 2. Summary of Utah bat species Akaike's Information Criterion (AIC) weights used in monitoring protocol. Observed occupancy is based on the number of occupied cells divided by the total number of cells sampled. Estimated occupancy is based on the occupancy estimate calculated within the software package MARK. Detection probability was also estimated within program MARK.

Species	Species code	Observed Occupancy	Estimated Occupancy (ψ)	SE (ψ)	Detection probability (p)	SE (p)
Pallid Bat	ANPA	0.292	0.337	0.060	0.569	0.102
Big brown bat	EPFU	0.375	0.400	0.060	0.351	0.103
Hoary bat	LACI	0.203	0.236	0.063	0.222	0.140
Silver-haired bat	LANO	0.406	0.442	0.069	0.565	0.101
California myotis	MYCA	0.219	0.278	0.079	0.375	0.133
Western small-footed myotis	MYCI	0.328	0.436	0.099	0.359	0.109
Long-eared myotis	MYEV	0.406	0.496	0.087	0.420	0.100
Little brown bat	MYLU	0.344	0.593	0.173	0.250	0.097
Fringed myotis	MYTH	0.188	0.329	0.140	0.241	0.130
Long-legged myotis	MYVO	0.453	0.546	0.082	0.473	0.203
Yuma myotis	MYYU	0.281	0.440	0.129	0.284	0.111
Western pipistrelle	PIHE	0.297	0.311	0.061	0.636	0.113

Species Specific

Table 3. Covariate relationships for the 12 Utah bat species with an observed occupancy of >18%. Each AIC model is based on the relationship between occupancy and covariates. The top 3 to 4 models for each species are displayed here.

Pallid Bat

Model	K	AIC	ΔAIC
Ecoregion, UTMN, Elevation, Wstype	4	138.786	0
Ecoregion, UTMN, Elevation, Wstype, Canopy	5	139.115	0.329
Ecoregion, Elevation, Wstype	3	140.837	2.051
Elevation	1	164.097	25.311

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California Myotis

Model	K	AIC	ΔAIC
Ecoregion UTMN Elevation WSPerimeter	4	160.779	0.000
UTMN Elevation WSPerimeter	3	161.572	0.793
Ecoregion UTMN Elevation	3	162.134	1.355
UTMN	1	163.167	2.388

Silver-haired bat

Model	K	AIC	ΔAIC
UTME Elevation NetArea WSWidth	4	207.15	0.000
Elevation NetArea WSWidth	3	210.53	3.38
UTME Elevation NetArea	3	215.74	8.59
Elevation	1	219.798	12.648

Western Small-footed Myotis

Model	K	AIC	ΔAIC
Ecoregion WSWidth Moonphase WSType	4	167.613	0.000
Ecoregion Elevation WSWidth Moonphase WSType	5	167.892	0.279
Ecoregion Moonphase WSType	3	168.129	0.516
MoonPhase	1	170.933	3.320

Long-eared Myotis

Model	K	AIC	ΔAIC
UTMN Elevation WSPerimeter	3	198.96	0.000
Elevation WSPerimeter	2	198.977	0.017
Ecoregion UTMN Elevation WSPerimeter	4	200.096	1.136
Elevation	1	204.531	5.571

Fringed Myotis

Model	K	AIC	ΔAIC
UTMN WSType	2	113.512	0.000
UTMN Elevation WSType	3	114.269	0.757
Ecoregion UTMN Elevation WSType	4	115.133	1.621
WSType	1	116.033	2.521

Little Brown Bat

Model	K	AIC	ΔAIC
UTMN WSWIDTH	2	162.341	0.000
UTMN	1	163.097	0.756
UTMN NetArea WSWidth	3	163.356	1.015
Ecoregion UTMN NetArea WSWidth	4	165.077	2.736

Yuma Myotis

Model	K	AIC	ΔAIC
Ecoregion UTMN Understory	3	130.428	0.000
Ecoregion UTMN Elevation Understory	4	131.872	1.444
Ecoregion UTMN	2	132.858	2.43
Ecoregion	1	133.674	3.246

Long-legged Myotis

Model	K	AIC	ΔAIC
Elevation	1	204.481	0.000
Elevation UTME	2	206.201	1.72
UTME	1	221.765	17.284

Western Pipistrelle

Model	K	AIC	ΔAIC
Ecoregion UTMN Elevation WSType Canopy Understory	6	111.168	0.000
Ecoregion UTMN Elevation WSType Canopy	5	112.899	1.731
UTMN Elevation WSType Canopy	4	112.947	1.779
Elevation	1	159.088	47.920

Discussion

These findings can be used to better allocate resources to monitor bat taxa on a landscape scale. By calculating the detectability of these 12 bat species, the sampling intensity required to create a complete picture of biodiversity at a sampling site can be estimated. By estimating occupancy, the distribution of bat species in relationship to the landscape and site characteristics in Utah can be better understood. Repeating these surveys every three years will produce a population stability estimate; are they stable, increasing, or decreasing?

This protocol was only able to determine occupancy and detectability (and ultimately measure population changes over time) for 12 of the 18 bat species in Utah. This is a result of low capture and/or detection rates for rare species. The protocol will need to be modified to increase detection of rare species (e.g. through targeted surveys or increased roost surveys). Specifically a cavern and cliff roosting site survey is needed to increase detectability of Townsend's big-eared bat and the big free-tailed bat, two of Utah's rare species. As expected, this protocol was not capable of creating occupancy estimates for Utah's three rarest species; Allen's big-eared bat, spotted bat, and western red bat have only been recorded 166, 120, and 19 times across 103 years in Utah.

In summary, this protocol was capable of estimating occupancy for 12 bat species and with small adjustments may be capable of providing estimates for three more bat species. The Utah Bat Conservation Cooperative is in the process of evaluating the use of this method for future management.

Acknowledgments