Relationships among prescribed grassland management, vegetative structure, and grassland birds on military airfields in the northeastern U.S. -- *Preliminary Results*

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Introduction

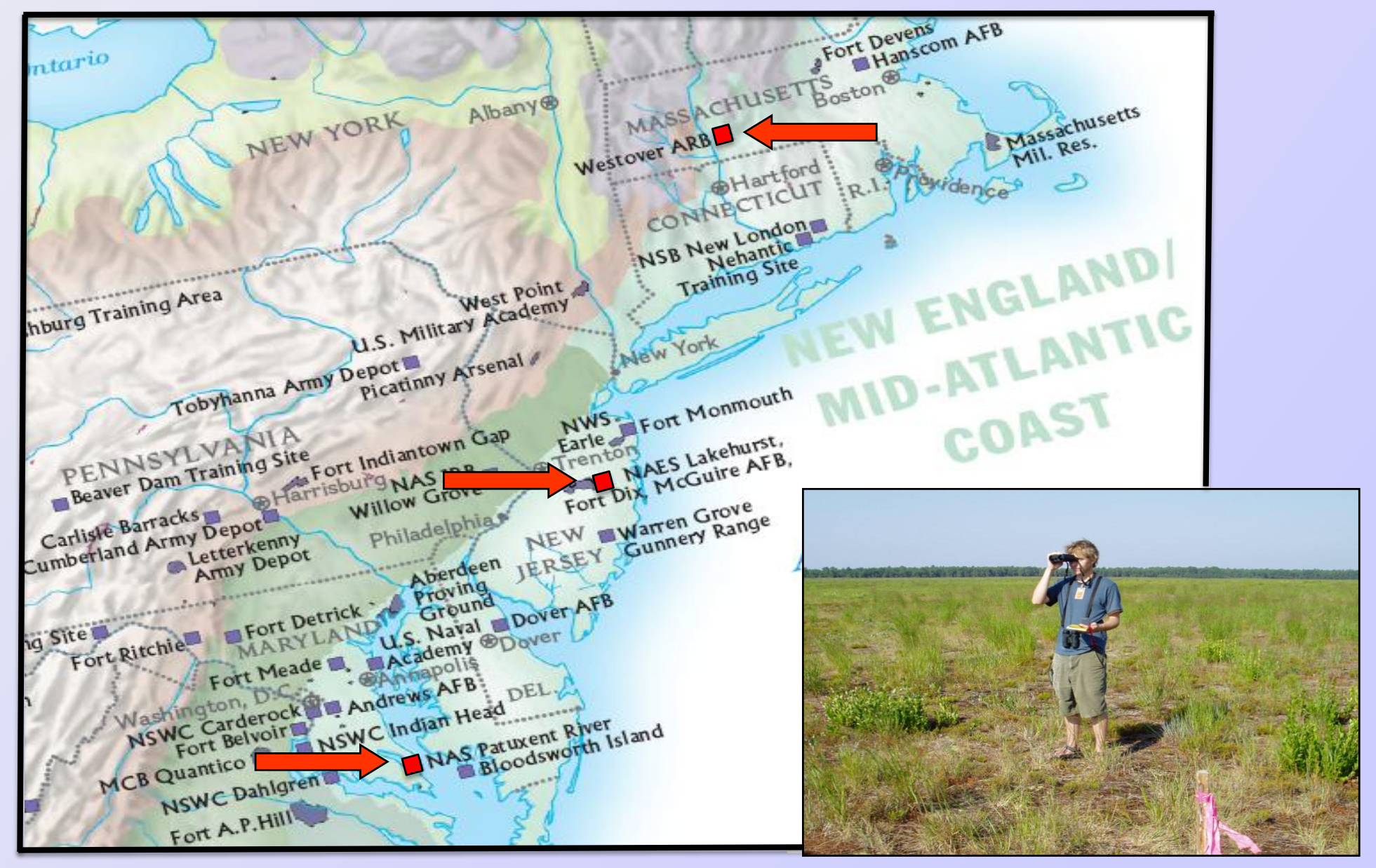
Benefits from proper management of vegetation proximal to airfields may be twofold; 1) a reduction in risk of bird-aircraft collisions and 2) habitat enhancement for grassland species of conservation concern. Several studies suggest that airports in general, if properly managed, can be important for maintaining stable breeding populations of grassland birds (Askins 1993, Kershner and Bollinger 1996), and military airfields have been specifically identified as key components in the conservation of rare and threatened grassland birds (Osborne and Peterson 1984). At the same time, high collision-risk species such as laughing gull (*Larus atricilla*), Canada goose (*Branta canadensis*), red-winged blackbird (*Agelaius phoeniceus*) and European starling (*Sturnus vulgaris*) respond to specific grassland management regimes, although the extent to which these responses occur is unclear (Fitzpatrick 2003). How management of airfield groundcover can best minimize high-risk bird activity is a controversial subject in North America, and current recommendations are based primarily on European studies from the 1960s and 1970s (Cleary and Dolbeer 2005). Although "tall-grass" (i.e., 7-14 inch) management has been identified as the best practice for deterring problem species, few data are available to support the probability that such management is preferable to maintaining grass at shorter or taller thresholds in the eastern United States.

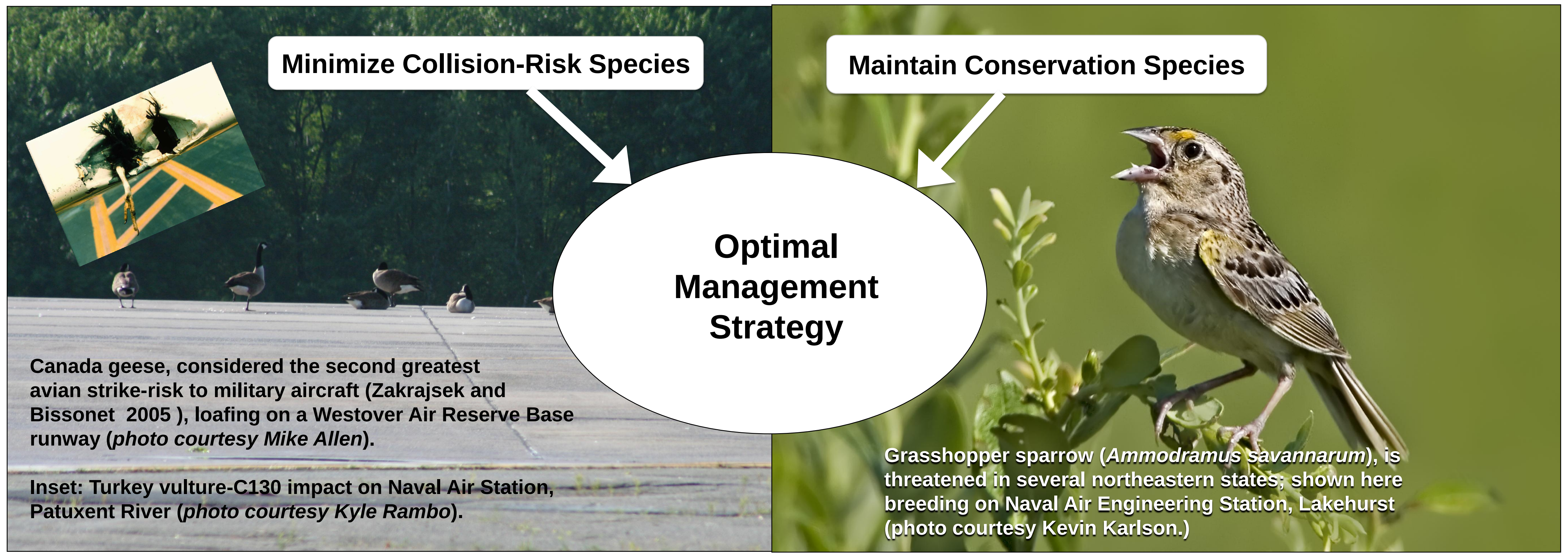
In the first year of the current study (Fall 2007 – Summer 2008), we set out determine how current management practices affect avian use of airfields. The study included intensive monitoring of avian airfield use throughout the annual cycle, tracking mowing schedules, and measuring vegetative structure .

Methods and Study Sites

- A line-distance sampling method was used within 44 plots to account for imperfect detection rates and obtain unbiased avian density estimates (n=615 samples). Detection probability functions were determined using program Distance 5.0 v.2 (Thomas et al. 2006).
- Surveys were conducted bi-monthly during fall migration, spring migration, and breeding seasons to gain a broad temporal view of avian habitat use at airfields.
- Vegetation surveys were taken contemporaneously with each avian survey.
- Management practices employed at each site were recorded daily through cooperative agreements with mowing crews.
- Study took place at 3 military airfields: Naval Air Engineering Station, Lakehurst (LNAES), Westover Air Reserve Base (WARB), and Naval Air Station, Patuxent River (PRNAS) [**Figure 1**].
- Prior to analysis, birds were assigned "Conservation Value" and "Collision-Risk" scores based on relevant conservation plan priority ratings and Hazard Indices (HI_S, Zakrajsek and Bissonette 2005). Higher risk or conservation scores (relativized to 1-5 range) reflect greater risk and conservation status, respectively.
- Inferences about the relationships among vegetation structure, management history and avian densities were derived from an information-theoretic approach (Burnham and Anderson 2000). Akaike's Information Criterion (AIC) was used to determine the best Generalized Linear Model (GLM) for predicting avian density on airfields.

Figure 1. Three DoD installations where avian monitoring was conducted, 2007-2008: WARB, MA; LNAES, NJ; PRNAS, MD.





Minimize Collision-Risk Species

Maintain Conservation Species

Optimal Management Strategy

Canada geese, considered the second greatest avian strike-risk to military aircraft (Zakrajsek and Bissonet 2005), loafing on a Westover Air Reserve Base runway (*photo courtesy Mike Allen*).

Inset: Turkey vulture-C130 impact on Naval Air Station, Patuxent River (*photo courtesy Kyle Rambo*).

Grasshopper sparrow (*Ammodramus savannarum*), is threatened in several northeastern states, shown here breeding on Naval Air Engineering Station, Lakehurst (photo courtesy Kevin Karlson.)

Results – *Total Bird Density*

The best performing model for predicting total bird density included several vegetation structure parameters as well as a vegetation height x site interaction (**Table 1**). Model fit was fair, with R^2 values ranging from 0.14 to 0.18. Models incorporating management history alone were weaker than those incorporating vegetation parameters and did not produce clear results.

Avian density estimates were affected by site (i.e., military installation) and season. Closer examination of the seasonal effect indicated that densities were higher during breeding and fall migration than during spring migration, a relationship that was driven by patterns at LNAES and WARB, as PRNAS experienced highest avian densities during spring migration. More birds were present, overall, on PRNAS than on LNAES and WARB. Overall bird density was also positively associated with shrub and forb cover, and negatively associated with vegetation density.

Total avian density increased with grass height but was also significantly influenced by a site x grass height interaction, indicating different response patterns at the three study sites. LNAES and WARB densities were positively related to vegetation height, whereas PRNAS densities were negatively related to vegetation height (**Figure 2**).

Figure 2. Relationship between predicted avian density and mean vegetation height, as determined by AIC best-performing model.

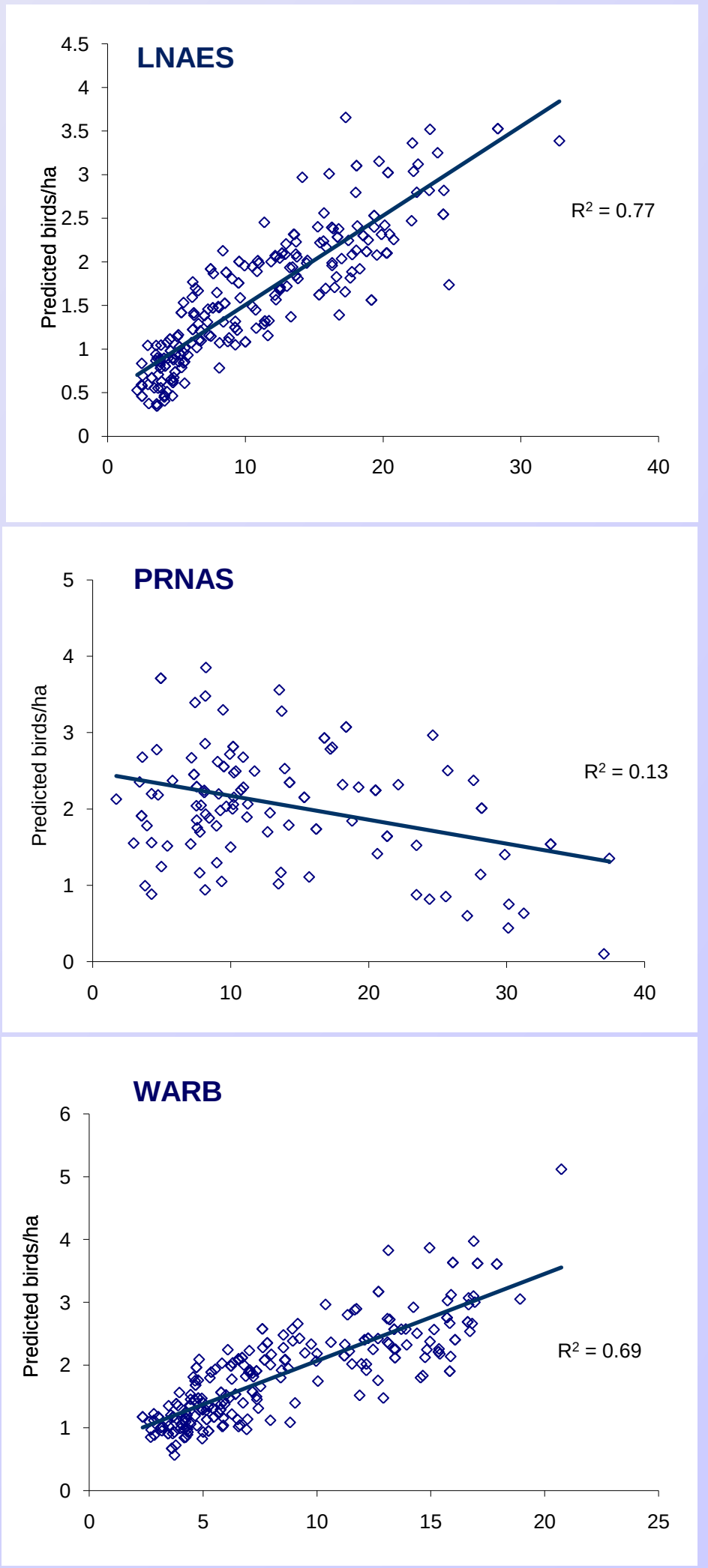


Table 1. Parameters related to avian density on airfields, as determined by AIC best-performing model.

Model Parameters	Estimate	P	Lower CI	Upper CI
Site		<.0001		
Season		0.0003		
% Shrub Cover	0.49	0.004	0.16	0.82
% Grass Cover	-0.29	0.08	-0.61	0.03
% Forb Cover	0.39	0.03	0.04	0.73
Vegetation Density	-0.03	0.02	-0.05	0.00
Vegetation Height (linear)	0.07	<0.0001	0.03	0.11
Vegetation Height (quadratic)	0.00	0.08	-0.002	0.0002
Vegetation Height x Site Interaction		0.002		

Results – *Top Collision-risk and Conservation –value Species*

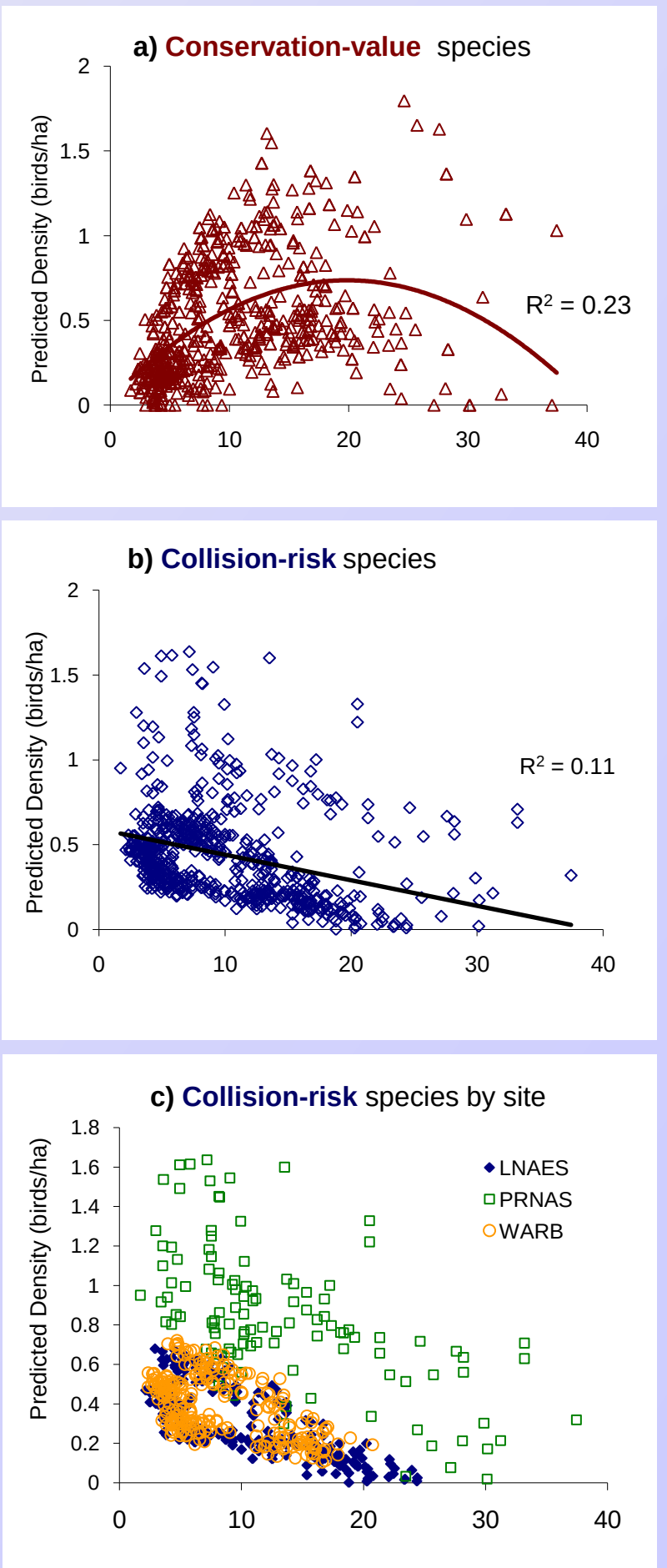
To better understand the dynamics between habitat structure and management on targeted avian species, we generated two subsets of the transect density data for closer examination. The first subset, or "conservation value" dataset, represented only those species with a conservation concern score $\geq$ 3, which accounted for the top-rated 16 species. Similarly, a "collision-risk" dataset included only species with risk scores $\geq$ 1.06, representing the highest 10 risk-rated species groups (Zakrajsek and Bissonett 2005).

The best models for conservation value species densities included several vegetation. parameters and a vegetation height x season interaction. The best model for collision-risk species included vegetation parameters and a vegetation height x site interaction. Model fit ranged from R^2=0.19-0.23.

Conservation species density varied by site and season, was positively related to shrub cover and was negatively related to grass cover. Conservation species were also associated with vegetation height, with both the linear and quadratic components of the relationship emerging as significant (**Figure 3a**). LNAES contained fewer birds of conservation concern, overall, than did PRNAS or WARB. Seasonal effects varied by site.

Collision-risk species density also varied by site and season, and was positively associated with shrub cover. Risk species were recorded most frequently in shorter vegetation (**Figure 3b**), and although a site interaction was noted, this negative relationship was apparent at all three bases (**Figure 3c**). Risk species densities were highest on PRNAS, and densities were higher during fall migration and breeding than during spring migration. No interaction between site and season was detected.

Figure 3. Relationships between top collision-risk and conservation species densities and mean vegetation height, as determined by AIC best-performing models.



Discussion

Our preliminary results indicate that conservation-value and collision-risk species may demonstrate markedly different response patterns to airfield vegetation-height management. Species with conservation value tended to increase in numbers as vegetation height increased, to approximately 20 inches, after which numbers decreased. Alternatively, collision-risk species were most prominent in shorter vegetation. These patterns held true for all three installations.

Although the potential for conflict among airfield management objectives remains, our results indicate that management actions to benefit conservation species and reduce strike-risk species may not necessarily be incompatible. We suggest that with an increased understanding of avian-airfield dynamics, DoD can simultaneously work towards both goals and that an optimal management solution may be reached through collaborative process (**Figure 4**). Because of the complexity of the issue, we suggest that it would be in the best interest of DoD managers to take advantage of the large set of decision-support tools available (Lyons et al. 2008), some of which allow for the weighting and evaluation of potentially conflicting management criteria (Mendoza and Martins 2006). Airfield safety is clearly the primary goal and would thus receive a substantial weighting factor in any multi-criteria decision analysis. However, the DoD as a federal agency also has responsibility to protect migratory birds of conservation concern, to the extent that such actions do not interfere with military readiness (e.g., Migratory Bird Treaty Act, Sikes Act, Executive Order 13186, National Defense Authorization Act). We are currently completing the second year of this study, the results of which will be incorporated into predictive models to help guide management strategies for DoD airfields in the Northeast.

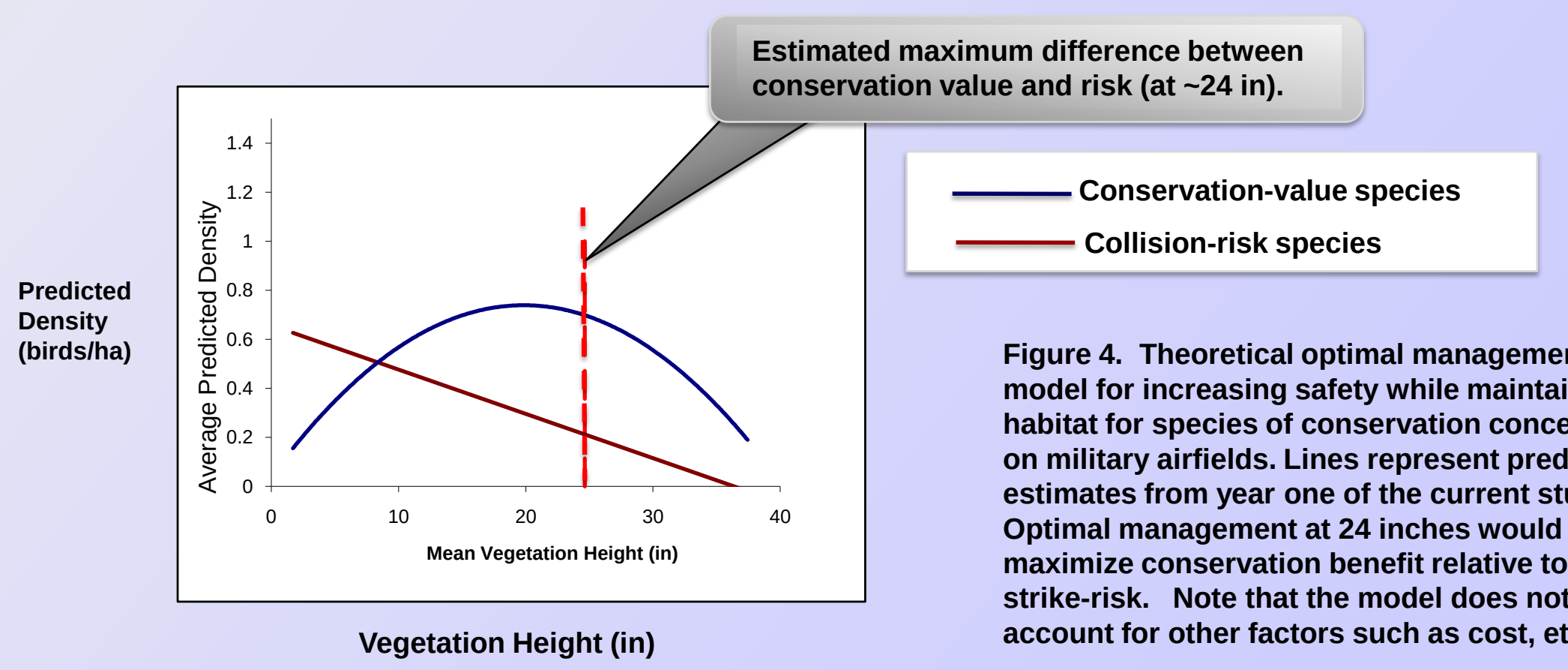


Figure 4. Theoretical optimal management model for increasing safety while maintaining habitat for species of conservation concern on military airfields. Lines represent predicted estimates from year one of the current study. Optimal management at 24 inches would maximize conservation benefit relative to strike-risk. Note that the model does not account for other factors such as cost, etc.

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