Bald eagle nest-site selection along the Upper Mississippi River, 1990-2012

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INTRODUCTION:

- Bald eagles (*Haliaeetus leucocephalus*) serve as important predators in the systems they occupy
- Bald eagles populations declined severely in the early 1900's due to habitat destruction, illegal shooting, and the overuse of DDT
- Numbers have rebounded in the lower 48 after legal protections and banning of DDT
- Upper Mississippi River bald eagle population is considered recovered and eagles are expanding into marginal habitat, such as those located further inland, away from the main channel
- This expansion period in their recovery, then suitable nesting locations are becoming saturated, is an excellent time to assess how bald eagles are utilizing this habitat

OBJECTIVE:

To determine how individuals of the Upper Mississippi River bald eagle population are selecting nest sites

STUDY AREA:

Upper Mississippi River National Wildlife and Fish Refuge

- Owned and managed by the U.S. Fish and Wildlife Service
- 4 Districts: Winona, La Crosse, McGregor, and Savanna
- 240,000 acres in MN, WI, IA, and IL
- 420-km stretch of Mississippi River in navigation pools 4-14
- Heterogenous landscape of backwater channels, a main navigation channel, and thousands of scattered islands
- Several sources of disturbance (e.g., barges, recreationalists)

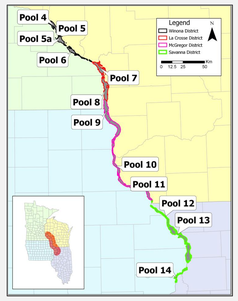

Fig 1. Map of UMRNWFR, USFWS. Created by Benjamin Tjepkes, 2018.

Fig 2. Typical vegetation community and bank structure along Upper Mississippi R.

Fig 3. Landscape view of backwaters and main channel along Upper Mississippi R.

RESULTS:

Table 1. Preliminary model output containing all distance metrics and land cover proportions within 100m buffer. Mean and standard deviation values for both nest and random. Distances are displayed in meters and proportions in percent of total land cover.

			Nest		Random	
Covariate	**Coefficient**	**Std. Error**	**Mean**	**SD**	**Mean**	**SD**
Distance to Active Nest *	0.34	0.07	2512.13	4311.07	3173.58	6934.03
Distance to Channel *	-0.29	0.04	1239.30	970.20	1727.17	1371.30
Distance to Open Water *	-1.38	0.11	54.81	55.37	108.72	186.03
Distance to Rail *	0.39	0.04	1131.25	625.05	959.00	796.89
Distance to Road (High)	-0.02	0.07	1801.54	1469.11	2049.50	3201.45
Distance to Road (Med) *	-0.54	0.10	969.32	499.66	1166.90	2740.51
Distance to Road (Low) *	-0.15	0.04	17514.74	12296	18496.77	13397.07
% Sedge / Grass *	0.13	0.05	1.78	3.79	3.73	5.93
% Lacustrine *	0.86	0.04	5.33	6.34	5.79	6.00
% Palustrine *	0.66	0.04	4.44	5.69	6.22	7.58
% Woody	-0.07	0.04	8.98	7.27	17.19	10.22
% Developed Upland *	-9.50	0.38	0.33	1.62	17.32	14.22
% Undeveloped Upland *	-0.54	0.10	0.16	1.29	1.97	5.76

** Indicates significant values*

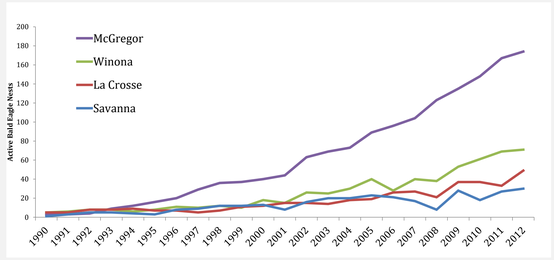

Fig 4. Number of active bald eagle nests per district per year in the UMRNWRFR, 1990-2012.

Summary

- Total # of nests = 561
- Total # of records = 2321
- Total # of random points = 11,363
- All predictor variables were not correlated (i.e., <0.40)

METHODS:

(1) Field Data Collection

- Bald eagle nests monitored by USFWS staff and volunteers
- 1990 – 2012 (23 years)
- 2 Sampling Phases
  - Phase 1 Checks = Activity (i.e., presence of adult)
  - Phase 2 Checks = Productivity (i.e., presence of young)
- Surveys conducted via vehicle, on-foot, and boat
- Observers were aided by the use of binoculars and spotting scopes
- Opportunistic sampling

(2) Data Cleaning and QC

- Monitoring database acquired from USFWS biologists
- Quality control check of 5% of entire dataset
- Removed entries with ambiguous coordinates

(3) Covariate Extraction

- Both habitat-related and disturbance-related
- All spatial analyses conducted in ArcGIS Pro

(4) Model Building

- Mixed-effects resource selection function (GLMER in lme4 package in Program R)
- Use-availability design
- All distance and area metrics scaled and centered (z-transformed)
- Random Effect = Year
- Tested for collinearity

We modeled the probability of a location containing an active eagle nest using a mixed effects logistic regression model:

$$ln\left[\frac{\pi(x)}{1-\pi(x)}\right] = \beta_0 + \mathbf{\beta_n X_n} + \gamma_i$$

Where $\pi(x)$ is the conditional mean of Y, β_0 is the mean intercept, $\mathbf{\beta_n X_n}$ is a vector of fixed effects coefficients for our habitat covariates, and γ_i is a random intercept term for survey year.

Habitat Covariates

- Distance to open water
- Distance to nearest active nest
- Located on island or mainland
  - Area:Perimeter ratio, if on island
- Cover type immediately surrounding point
- % cover type within buffer distance
  - 100m buffer = local scale
  - 500m buffer = intermediate scale
  - 1 km buffer = landscape scale

Data Sources

- Land cover data were acquired from the Upper Midwest Environmental Science Center
- Road and railway were acquired from TIGER/Line® Files

Disturbance Covariates

- Distance to nearest road
  - High – Paved, >50 mph
  - Med – Paved, <50 mph
  - Low – Unpaved
- Distance to railway
- Distance to main river channel

Land Cover Classes

- 15 classes were merged into 6 to simplify modeling intensity
  - (1) Sedge/Grass Wetland
  - (2) Lacustrine Wetland
  - (3) Palustrine Wetland
  - (4) Woody Wetland
  - (5) Developed Upland
  - (6) Undeveloped Upland

DISCUSSION:

Bald Eagle Nest-site Selection

- Greater distances from other active bald eagle nests and railways
- Closer to open water (foraging) and roads (especially medium level roads)
- Avoiding developed and undeveloped uplands

Implications

- These results will be used by Refuge biologists to inform management actions along the river, such as protecting certain areas to promote bald eagle colonization

Further Modeling

- Additional buffer distances (i.e., 500m, 1km) and covariates (e.g., island vs. mainland)
- Fix model convergence issues with nest code as a random effect
- Limit model extent to reduce potential biases related to sampling from roads and main channel

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