Summer 2011

A Landscape-Scale Approach for Modeling Habitat Suitability for the Louisiana Black Bear (Ursus americanus luteolus) in East Texas

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Remotely Wild
Newsletter of the Spatial Ecology & Telemetry Working Group

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By the beginning of the twentieth century, the Louisiana black bear had become rare in east Texas and by the 1940's was considered extirpated from the state. Beginning in the late 1970s, reliable black bear sightings have been recorded in east Texas with increasing occurrence. In 1973 restrictions were placed on black bear hunting with the eventual statewide prohibition and a listing of the black bear to the Texas endangered species list in 1987. In January of 1992, with mounting concerns that the Louisiana black bear population was approaching the minimum viable threshold due to human-related mortality and increased habitat destruction, the U.S. Fish and Wildlife Service classified the Louisiana black bear as a threatened species under the Endangered Species Act of 1973.

Much of the current research within the historic range of the Louisiana black bear focuses on identifying and quantitatively describing potential or occupied habitats and current habitat use. Reports indicated that east Texas contains some of the largest blocks of forested habitat suitable for but currently unoccupied by black bears in the southeast. Research in the 1990s confirmed that suitable black bear habitat exists in portions of east Texas. However, despite reliable bear sightings over the past 30 years and the existence of suitable habitat, stable breeding populations apparently do not exist.

In 2009, in an effort to meet the recovery goals set forth by state and federal Louisiana black bear recovery plans, Stephen F. Austin State University in partnership with the Texas Parks and Wildlife Department, the Black Bear Conservation Coalition, and the East Texas Black Bear Task Force (ETBBTF), began a 3- year study researching the current occupancy and suitability of habitats for the Louisiana black bear in east Texas.

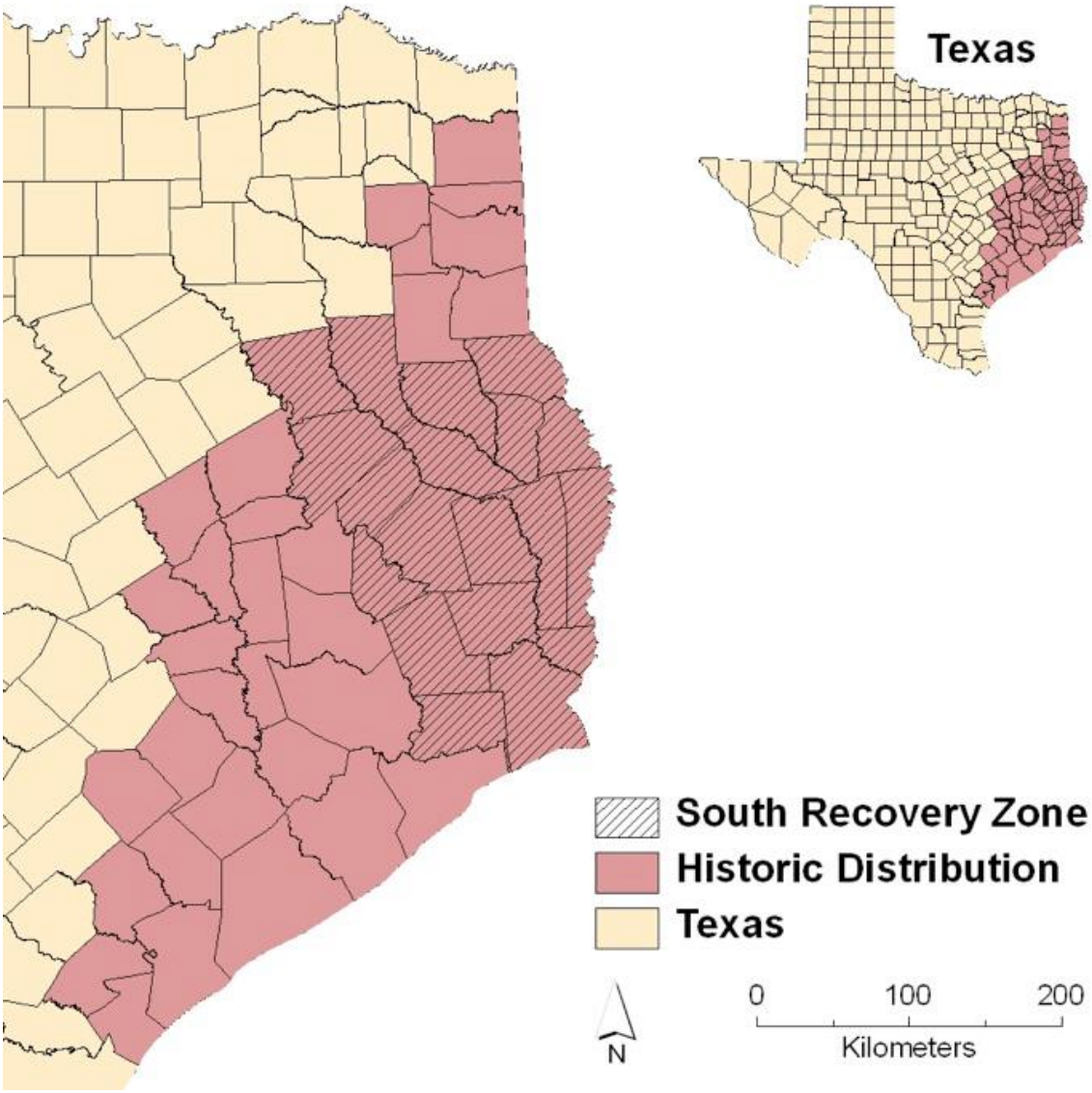

Figure 1. *Historic distribution for the Louisiana black bear in east Texas and south recovery zone of the East Texas Black Bear Task Force recovery plan.*

Previous research in Texas utilized established habitat suitability index (HSI) models to quantify habitats for specific political or administrative boundaries. However, in order to assess the suitability of habitat for the entire south recovery zone of the ETBBTF recovery plan (Figure 1), we incorporated components from three established HSI models to develop a landscape-scale HSI model for 19 counties of the Pineywoods ecoregion in east Texas.

Habitat suitability index models have been used since the early 1980s to quantify wildlife habitat based on known life requisite variables and habitat requirements. Habitat variables (e.g. fall food

production) are evaluated on a suitability index (SI) scale from 0 (unsuitable habitat) to 1 (optimum suitability). Final HIS scores are typically the weighted mean of the multiple SI scores calculated according to the hypothesized relationship between variables. Because of the coarseness of most GIS data, HSI models are well suited for habitat generalists and species with large spatial requirements such as black bears.

In the past most HSI models were used to develop a single habitat suitability score for distinct political or administrative boundaries such as a national forest. Because of the large spatial requirements for, and increasing confirmed reports of, black bears throughout east Texas, our objective was to develop a landscape scale HSI model that could be used to evaluate year-round habitat requirements and direct conservation efforts region-wide. Research suggests that more simple black bear models consisting of food and cover components reflect habitat selection better at a population level and that resource availability is more important to black bear habitat quality than abiotic components such as slope and aspect. Our model thus incorporates food, cover, and human impact components.

Using the 2009 Texas Vegetation Classification Project land classification model (TVCP; a product of remote sensing of LandSat satellite imagery, aerial photo interpretation, digital soil surveys, and digital elevation models consisting of 119 ecological classifications at 10 meter resolution), TVCP interpretive booklet, existing HSI model equations (Van Manen 1991, Mitchell 2002), and literature review from previous habitat studies in east Texas and surrounding region, we assigned SI scores for summer food availability, fall food availability, fall food diversity, fall food productivity, protection cover, and tree den availability to 98 habitat classifications and calculated food and cover component indices in ArcGIS 9.3.1(Figure 2 and 3).

Roads affect habitat quality at a relatively large spatial scale. Research has shown that bears avoided areas <1600 meters from gravel roads when establishing summer and fall home ranges and males and females avoided areas <800 meters during the summer and fall respectively. We incorporated a distance to road variable and buffered all state and county roads and assigned SI scores according to the equation developed by Mitchell (2002; x = distance to roads; when $0 < x < 1.6$ km, $SIR = 0.156x + 0.195x2 = 0.25$; when $x > 1.6$ km, $SIR = 1.0$).

Since the TVCP model includes low and high density urban classes, we incorporated a human-bear conflict zone variable (Bowman 1999). We buffered low (1.1 km) and high (3.9 km) density urban areas based on the home range size for female Louisiana black bears and assigned SI scores (within urban buffer zones SIHD = 0; outside urban buffer zone SIHD = 1). We combined the distance to roads and human-bear conflict zone variables and calculated a human impact component index (Figure 4).

We combined food, cover, and human-impact components to calculate overall a priori HSI scores (HSI = [[CIFOOD] x 2 + CICOVER + CIHUMAN IMPACT] / 4). Rather than apply HSI scores to compartment boundaries, we calculated HSI scores per pixel to develop a landscape-scale HSI model (Figure 5). Currently, we are conducting detailed vegetation analysis per habitat class of the TVCP in order to develop SI scores per class and evaluate the accuracy of our model. By evaluating our a priori model using independent habitat analysis, we can provide a level of

precision that could not otherwise be attained using field data that was incorporated into the development of the TVCP. We will readjust our SI scores accordingly to develop a final model consistent with the results of detailed vegetation survey and measurement.

References:

Bowman, J. L. 1999. An assessment of habitat suitability and human attitudes for black bear restoration in Mississippi. Mississippi State University, Mississippi State.

Mitchell, M. S., J. W. Zimmerman, and R. A. Powell. 2002. Test of a habitat suitability index for black bears in the southern Appalachians. Wildlife Society Bulletin 30:794-808.

Van Manen, F. T. 1991. A feasibility study for the potential reintroduction of black bears into the Big South Fork Area of Kentucky and Tennessee. Tennessee Wildlife Resources Agency

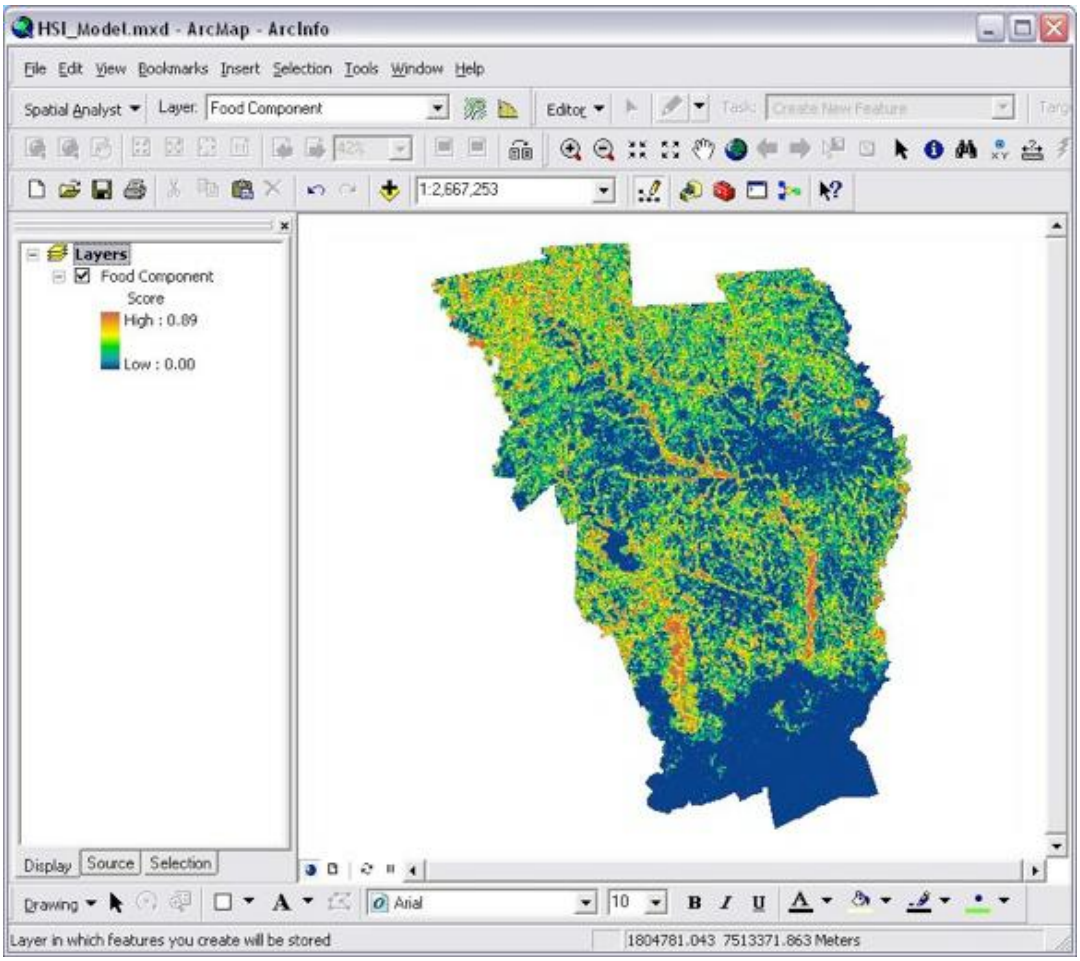

Figure 2. *Food component with suitability index scores ranging from unsuitable (SI = 0.00; blue) to high suitability (SI = 0.89; red*

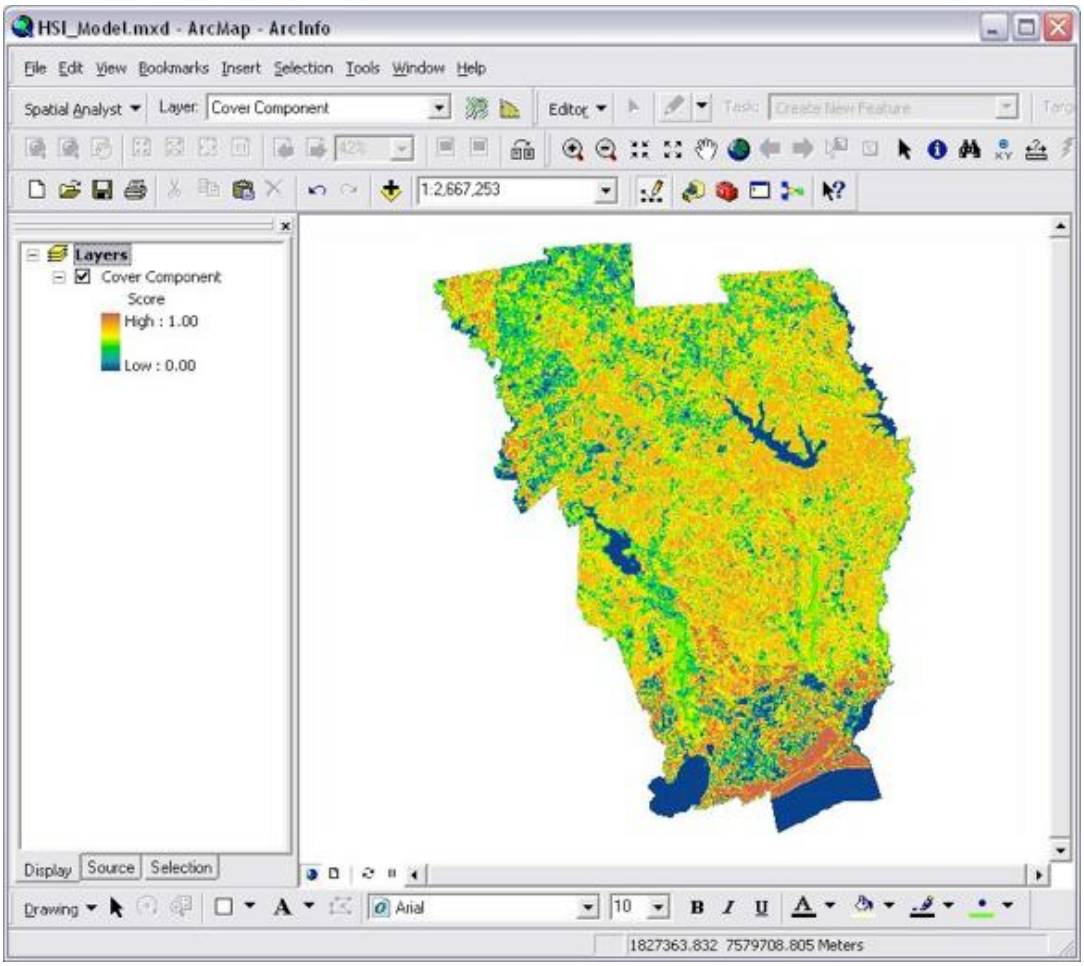

Figure 3. *Cover component with suitability index scores ranging from unsuitable (SI = 0.00; blue) to high suitability (SI = 1.00; red).*

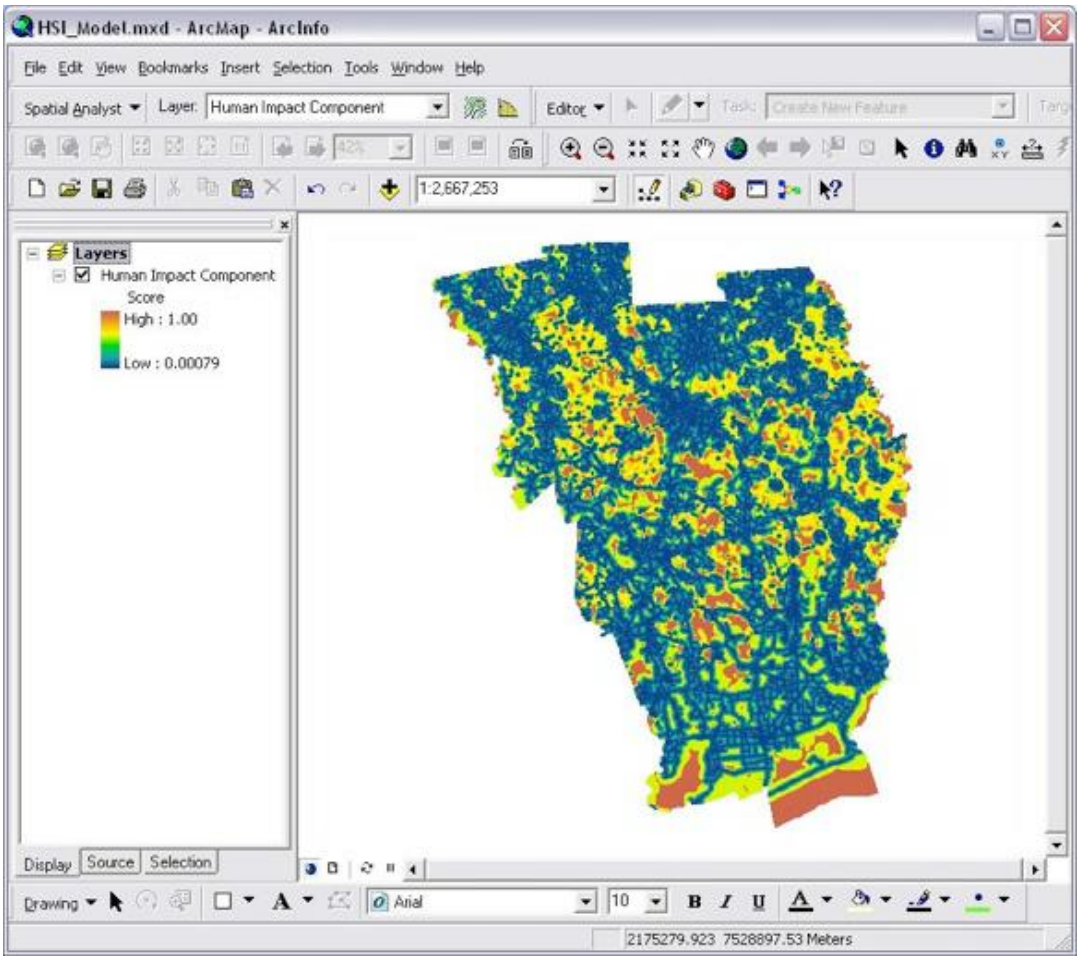

Figure 4. *Human impact component with suitability scores ranging from unsuitable (SI = 0.00079; blue) to high suitability (SI = 1.00; red).*

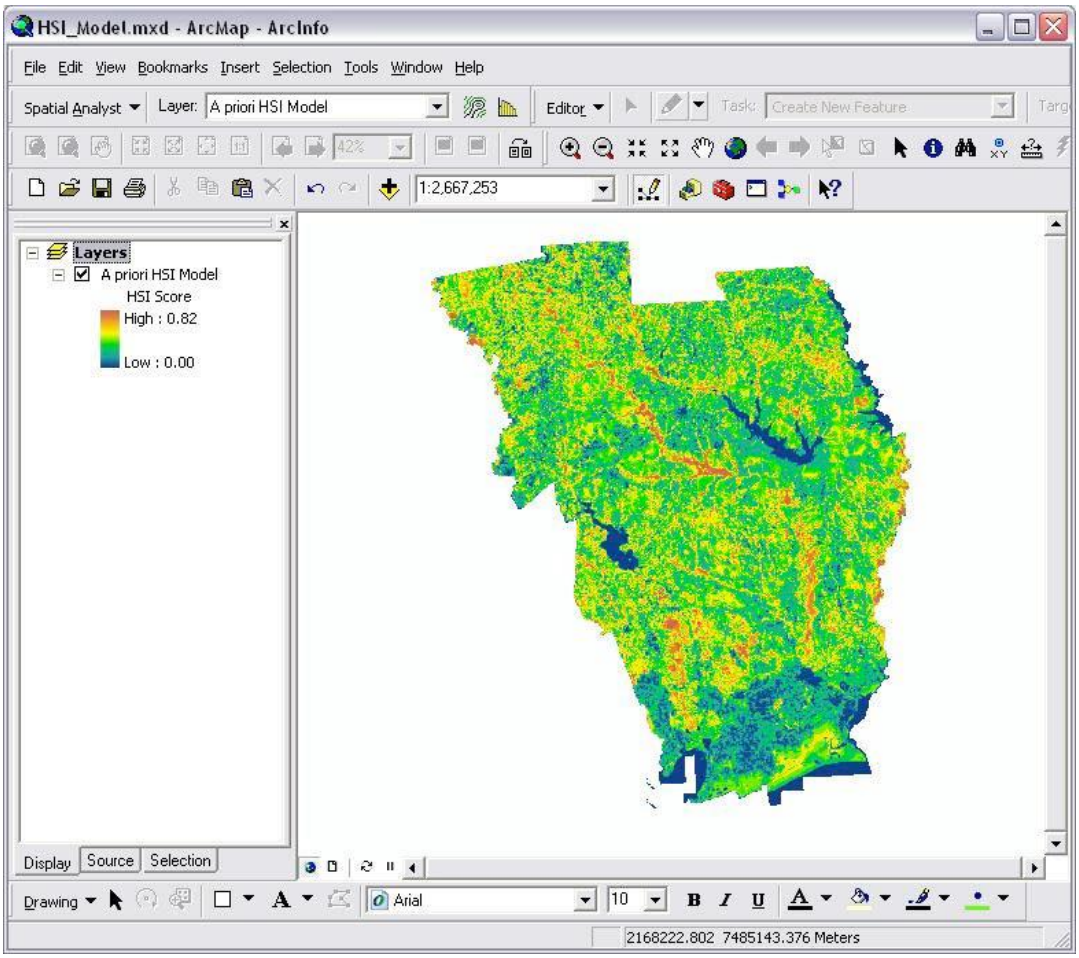

Figure 5. *Landscape-scale a priori habitat suitability index model for the south recovery zone of the East Texas Black Bear Task Force recovery zones. The model was developed at 10 meter resolution for 19 counties in east Texas with HSI scores ranging from 0.00 (unsuitable habitat) to 0.82 (high suitability).*