*Poster Presentation*

# Woody Vegetation Response to Over a Decade of Deer Reduction in Indiana State Parks

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**ABSTRACT:** White-tailed deer (*Odocoileus virginianus*) population sizes increased rapidly throughout Indiana in the latter half of the 20th century due to favorable landscape conditions and regulated hunting. Hunting was historically prohibited in state parks and deer became abundant to the point that vegetation communities were severely degraded from decades of chronic deer herbivory. The Indiana Department of Natural Resources implemented controlled hunts in the 1990s to reduce deer population abundance and allow vegetation communities to recover. In 1996 and 1997, long-term vegetation monitoring plots were established in sixteen state parks and six historically-hunted reference areas for comparison. We resampled the herbaceous and woody vegetation in fifteen of these state parks (85 plots) and five of the reference areas (23 plots) in the summer of 2010 to examine how deer reductions affected vegetation percent cover, woody stem density, and species composition of the forest understory. We measured the total transect distance covered by all plants less than 50 cm tall across three, parallel 10 m line transects. We then calculated the percent cover for each species by dividing it's transect overlap distance by the total plot transect distance (3,000 cm). Plant species were grouped into several functional groups, or growth forms. Total percent cover and the percent cover of each functional group were compared between study periods in pooled state parks and reference areas with a two-way analysis of variance (ANOVA).

In each plot we also tallied woody stems in three height classes: <50 cm in five-1 $m^2$ quadrats, 50-200 cm in a 50 $m^2$ circular plot, and >2 m in a 300 $m^2$ circular plot. In each height class, mean stems/ha in each study period were compared using Wilcoxon signed rank tests for non-normal data. We calculated the relative density (density of a species/total density of all species) of abundant species in both study periods based upon density values pooled across park and reference plots. Species richness (S), evenness (E), and Shannon-Weiner diversity (H□) were calculated and compared between sampling intervals by height class for pooled state parks and reference areas with paired t-tests or Wilcoxon signed rank tests.

Herbaceous-layer cover increased 102% in state parks ($F_{(1, 80)} = 159.7$, $p < 0.001$) and only 30% in reference areas ($F_{(4, 80)} = 3.6$, $p = 0.009$). Increased mean cover was largest among the tree seedling (2% to 13%; $F_{(1, 80)} = 241.7$, $p < 0.001$) and perennial herb (19% to 26%; $F_{(1, 80)} = 25.8$, $p < 0.001$) functional groups in parks. Ferns and graminoids increased (2% to 4%; $F_{(1, 80)} = 18.3$, $p < 0.001$ and 1% to 3%; $F_{(1, 80)} = 56.5$, $p < 0.001$, respectively) and exotics decreased somewhat (2% to 1%; $F_{(1, 80)} = 7.9$, $p = 0.006$). In reference areas, mean cover of trees increased from 4% to 11% ($F_{(1, 19)} = 68.7$, $p < 0.001$) while perennial herb mean cover remained about the same (29% to 25%; $F_{(1, 19)} = 6.9$, $p = 0.017$). Ferns, graminoids, and exotics in reference areas each increased (from 4% to 5%; $F_{(1, 19)} = 3.3$, $p = 0.084$, 1% to 3%; $F_{(1, 19)} = 16.1$, $p < 0.001$, and 1% to 2%; $F_{(1, 19)} = 4.6$, $p = 0.046$, respectively). Mean cover of liliaceous species increased from 1% to 2% in parks ($F_{(1, 80)} = 15.1$, $p < 0.001$) and decreased from 2% to 1% in reference areas ($F_{(1, 19)} = 9.4$, $p = 0.006$). Observed increases in state park herbaceous-layer cover

were not driven by increased cover of fern, graminoid, or exotic functional groups, but primarily by increased cover of tree seedlings and perennial herbs.

Stem density in the <50 cm and 50-200 cm height classes increased significantly in the state parks and in the reference areas ($p < 0.001$ for each), though density increases in the state park 50-200 cm height class were greatest. Relative density of white ash increased in the 50-200 cm height class in state parks and remained high in reference areas. Oak, hickory, and elm species' relative densities also increased somewhat in the 50-200 height class in state parks. The relative density of sugar maple, an abundant species in all height classes across both state parks and reference areas in 1996/97, declined in all height classes by 2010. Less palatable species such as pawpaw and spicebush were abundant in parks in 1996/97 in the 50-200 cm height class, but decreased in relative density in this class by 2010. In state parks, S, E, and H□ increased in the 50-200 cm height class ($p \leq 0.001$, $p = 0.001$, and $p \leq 0.001$). These results indicate that the void in forest understories created by chronic herbivory in Indiana state parks is filling in with a diverse array of species following deer population reductions. Controlled hunting is therefore a viable management strategy in this system that can be used to obtain increased woody regeneration and species diversity as well as and increased herbaceous-layer percent cover and diversity.

**Key Words:** population regulation, white-tailed deer, wood vegetation recovery

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