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Bridging Science with Management to Optimize Habitat Quality for Black Bears

ENVIRONMENTAL ISSUE

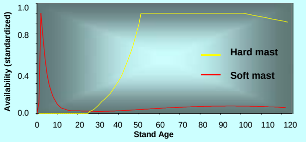
National forests must be managed for multiple uses, including maintaining economic gain, recreation opportunities, and wildlife habitat. Harvesting trees increases economic gain, but it may or may not improve habitat quality for wild black bears. **GOAL 1** was to understand how clearcuts and access roads affect habitat quality for black bears in the southern Appalachian Mountains. **GOAL 2** is to use results from **GOAL 1** to develop optimization models for designing forested landscapes that maximize habitat quality for black bears while simultaneously meeting economic and recreation objectives.

GOAL 1: Effect of clearcuts and roads on habitat quality for black bears

SCIENTIFIC APPROACH

This research is part of a continuing 22-year study on black bears in the Pisgah Bear Sanctuary (PBS) in North Carolina. My first goal was to understand how clearcuts and roads affect habitat quality, which is the capacity of an area to provide ***resources*** important to ***survival*** and ***reproduction***. Foods, den sites, and escape cover are important resources to bears, but foods are most important. In particular, hard mast (acorns and nuts) and soft mast (fleshy fruits) have been shown to affect survival or reproduction of some bear populations. To address **GOAL 1,** I had **3 objectives**:

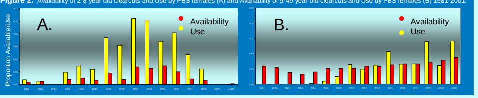
Figure 1. Functional relationships between stand age and soft mast availability and stand age and hard mast availability in southern Appalachian Mountains. The function for hard mast was based on information from Burns and Honkala (1990) and assumes a linear relationship for ages 26-49.



Objective 1: Understand how clearcuts affected temporal availability of soft mast in PBS (temporal dynamics of hard mast are already known; Burns and Honkala 1990). I measured berry plants and production in 100 clearcuts (0-122 years old). Availability of soft mast was highest in 2-8 year old clearcuts, lowest in ~9-49 year old clearcuts, and moderate in 50+ year old clearcuts (Fig. 1). Availability of hard mast was zero in 0-25 year old stands, minimal in ~26-49 year old stands, and highest in 50+ year old stands.

Objective 2: Test how PBS bears responded to changes in temporal availability of hard mast and soft mast in clearcuts. To evaluate demographic response, we trapped bears from 1981-2002, estimated survival, reproduction, and population growth rate for each year 1981-2002, and linked demography with estimates of hard mast and soft mast availability (Reynolds et al. *in progress*). We found the additive effect of hard mast and soft mast limited PBS bears. In addition, soft mast in 2-8 year old clearcuts positively affected reproduction. To evaluate behavioral response, I evaluated resource selection of 98 females from 1981-2001. Females selected 2-8 year old clearcuts (Fig. 2A), avoided 9-49 year old clearcuts (Fig. 2B), and used 50+ year old clearcuts randomly.

Figure 2. Availability of 2-8 year old clearcuts and Use by PBS females (A) and Availability of 9-49 year old clearcuts and Use by PBS females (B) 1981-2001.



Objective 3: Test if spatial configuration of 2-8 year old clearcuts affected habitat quality and if roads affected habitat quality. I found 2-8 year old clearcuts were relatively more clustered within home ranges of reproductively successful females and areas within 250-1600 meters of paved, gravel and gated roads negatively affected survival and reproduction.

DISCUSSION of results from GOAL 1

Clearcuts affected temporal availability of soft mast, which affected habitat quality for Pisgah bears. Because the additive effect of hard mast and soft mast limited Pisgah bears and soft mast was highly available in 2-8 year old clearcuts, this age class positively affected habitat quality. Alternatively, 9-49 year old stands, in which neither soft mast nor hard mast were highly available, negatively affected habitat quality. Older stands (50+), which had moderate levels of soft mast and high levels of hard mast, positively affected habitat quality. Spatial arrangement of clearcuts affected bear reproduction and areas near roads negatively affected bear survival and reproduction.

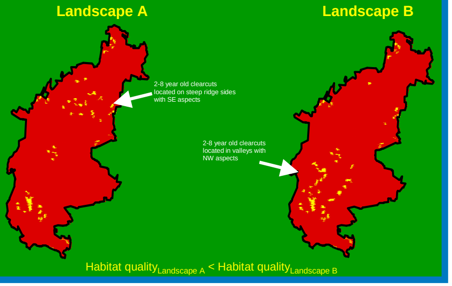
GOAL 2: Develop optimization models

SCIENTIFIC APPROACH and IMPACT

Results from **GOAL 1** showed time and space affected habitat quality in clearcuts and in areas near roads. To address **GOAL 2**, I will use algorithms from Figure 1, vary constraints of economic gain and recreation opportunity, and then quantify how many and which stands (i.e., age classes) should be harvested to maximize habitat quality over 4 durations of time (5, 25, 50, and 100 years), while simultaneously meeting economic and recreation objectives. I will also develop a tool that forest managers can use to optimize habitat quality by manipulating how many stands, which stands, and WHERE stands should be harvested AND where roads should be built on forested landscapes.

Figure 3. Comparison of habitat quality on 2 simulated landscapes for which spatial location of 2-8 year old clearcuts (depicted in yellow) was varied. For illustrative purposes, I estimated habitat quality as only the availability of soft mast for only 1 year.

Habitat quality$_{\text{Landscape A}}$ < Habitat quality$_{\text{Landscape B}}$ because 2-8 year old clearcuts on Landscape B were placed in spatial locations optimal for berry production. **This simple evaluation can be expanded** by defining habitat quality in terms of both soft mast and hard mast and evaluated over longer time periods (e.g. 5, 25, 50, and 100 years). In addition, spatial pattern of 2-8 year old clearcuts (i.e. degree of clustering) and location of roads can be manipulated to maximize habitat quality. Finally, economic and recreation constraints can be varied.



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