



Seedlings & Forest Regeneration *Resource Brief*

Importance

Forests are the dominant natural vegetation in the parks of the National Capital Region Network (NCRN). In recent years, there has been increasing concern about forest “regeneration”—the ability of seedlings and saplings to survive and replace large trees that die.

One reason for this concern is the high density of deer in most NCRN parks. A variety of studies have shown that at high densities, white-tailed deer can significantly reduce regeneration. Deer have been shown to reduce the diversity (Tilghman 1989), density (Frelich and Lorimer 1985, McCormick et al. 1993), and average height of seedlings (Marquis 1981, Tilghman 1989, McCormick et al. 1993). Deer densities in NCRN parks are high enough to cause these impacts to forest vegetation (Bates 2009).

Monitoring & Scoring

Regeneration is also a concern for commercial foresters. Before a forest is clear-cut for timber, foresters want to know if there are enough seedlings for a commercially valuable forest to regrow, or if a treatment, such as deer exclusion, fertilization or planting, will be required.

In response to regeneration concerns, scientists at the US Forest Service developed a measure, called a “stocking index,” to determine if regeneration is sufficient (Marquis and Bjorkbom 1982). The information used to develop the index comes from comparing forest stands before and after cutting to determine how many seedlings are required for a forest to recover (Grisez and Peace 1973). The stocking index takes into account three different aspects of forest regeneration: the number of seedlings recorded, the size of the seedlings, and the geographic distribution of the seedlings. Obviously, the more seedlings present the better. The size of the seedlings is important, as taller seedlings are more likely to survive than smaller seedlings. Finally, a forest is more likely to successfully regenerate if the seedlings are spread out than if they are concentrated in only a few places.

To calculate the stocking index, monitoring plots are placed randomly in the forest. At each plot seedlings are counted and the height of each seedling is determined. Depending on the need of the land managers, the index can include



Photo: NPS

Seedlings and saplings in the understory of an NCRN forest vegetation plot at Wolf Trap National Park for the Performing Arts.

all trees or only commercially important species. Based on these measurements each plot is given a score. If the score meets or exceeds a certain threshold value it is considered to be adequately stocked, if it fails to meet that threshold it is inadequately stocked. A higher threshold is used in forests with high deer density to take into account the effects of deer browse on seedling growth and survival. An entire forest is considered to be adequately stocked if 2/3rds of the plots pass the threshold (Marquis 1982, Marquis and Bjorkbom 1982, McWilliams et al. 1995, Stout 1998).

Using NCRN Inventory & Monitoring (I&M) forest vegetation monitoring data (Schmit et al. 2009) we calculated stocking indexes for all NCRN parks. All plots were monitored once between 2008 and 2011. All tree species were included in calculating the stocking index. Seedlings smaller than 15cm tall are not monitored and saplings larger than 2.5cm diameter at breast height are monitored but not used to calculate the stocking index.

Scores used in the stocking index are presented in Figure 1.



Plots scoring 38 or above are considered to be adequately stocked at low deer density and those scoring 115 or above are considered adequately stocked at high deer density. The sapling score is 1/7th that of large seedlings (>1.5m in height) to take into account the fact that saplings are monitored in an area that is seven times larger than that of seedlings.

Seedling Size	Score
15-30cm height	1
30cm – 1m height	2
1-1.5m height	15
1.5m+ height	30
Saplings (<2.5 cm diameter)	4.25

Figure 1: Scoring system used to determine stocking index.

bars), no park had more than 40% of the plots adequately stocked. Only Greenbelt, Harpers Ferry, Piscataway, and the part of the Potomac Gorge managed by the George Washington Memorial Parkway have over 30% of their plots adequately stocked. Only eight areas have any plots that are adequately stocked at the high deer density typical of the parks (green bars). None of the parks are more than 25% stocked at this deer density.

The lack of forest regeneration is a cause for concern. If low levels of regeneration persist, the forests may undergo long term decline. Currently Catoctin Mountain Park is reducing its deer population and Rock Creek Park has plans to begin deer reduction soon. An increase in the stocking index will be an important indicator that these programs are improving forest regeneration.

Results

As Figure 2 shows, no NCRN parks have adequate tree regeneration. Even at the low deer density threshold (yellow

References:

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Seedling Stocking Index 2008-2011

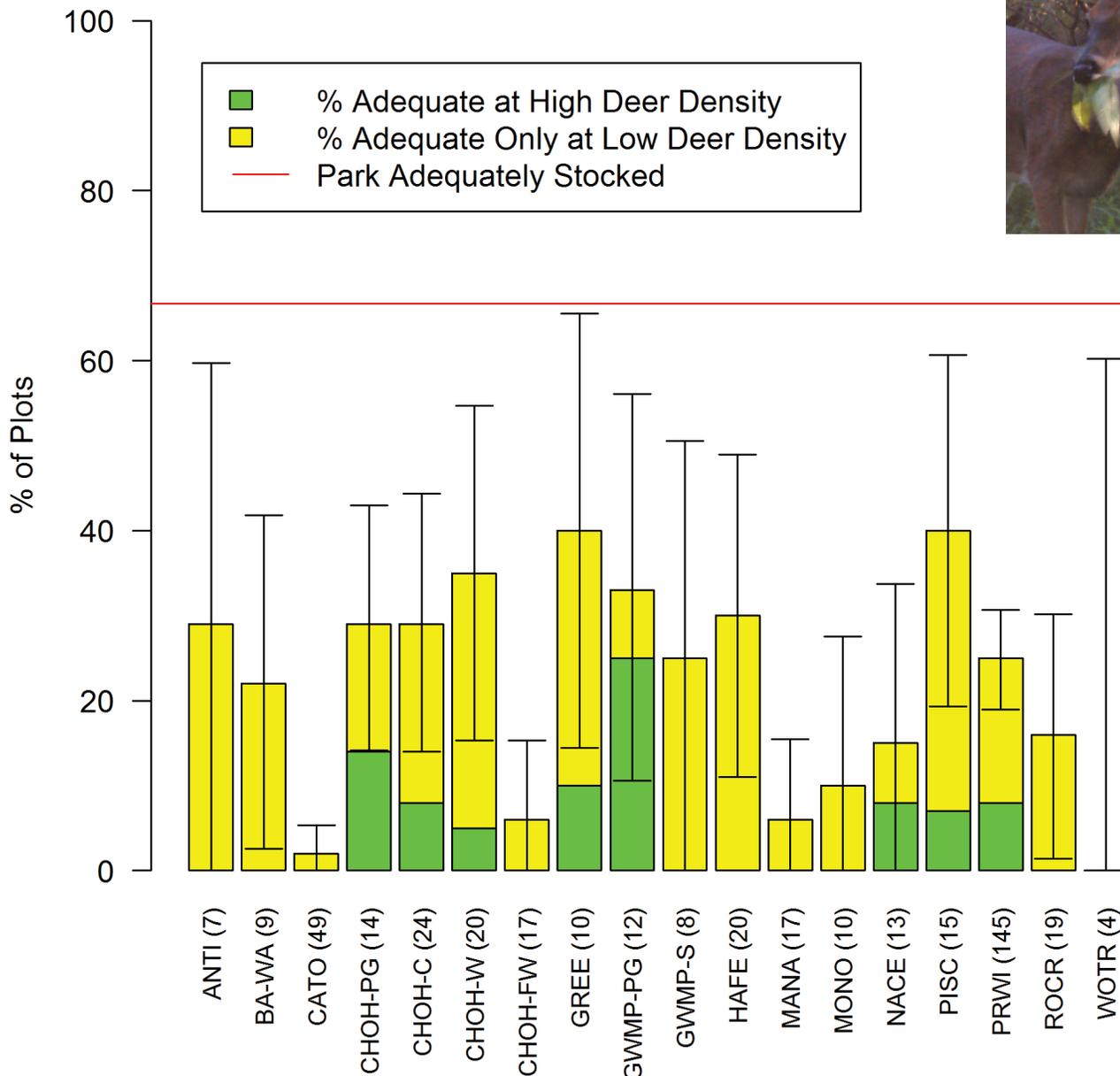


Photo: NPS

Figure 2: Percent of plots adequately stocked at high and low deer density. The red horizontal line indicates the percent of individual plots (about 2/3rds) that must be adequately stocked for a park as a whole to have adequate forest regeneration. T-shaped error bars indicate 95% confidence intervals for percent of plots with adequate seedling stocking at low deer density (yellow bars). On the x-axis, numbers in parenthesis indicate the number of plots in each park.

Park abbreviations: ANTI = Antietam National Battlefield, BA-WA = Baltimore–Washington Parkway, CATO = Catoclin Mountain Park, CHOH-C = Central part of C&O Canal National Historical Park from Violettes Lock to Harpers Ferry, CHOH-PG = Potomac Gorge managed by C&O Canal, CHOH-C = C&O Canal from Violettes Lock to Harpers Ferry, CHOH-W = C&O Canal from Harpers Ferry to Four Locks, CHOH-FW = C&O Canal from upstream of Four Locks to Cumberland, GREE = Greenbelt, GWMP-PG = Potomac Gorge managed by George Washington Parkway, GWMP-S = George Washington Memorial Parkway south of Key Bridge, HAFE= Harpers Ferry National Historical Park, MANA = Manassas National Battlefield Park, MONO = Monocacy National Battlefield, NACE = DC portion of National Capital Parks - East, PISC = Piscataway and Fort Washington Parks, PRWI = Prince William Forest Park, ROCR = Rock Creek Park, WOTR = Wolf Trap National Park for the Performing Arts