

Down Woody Debris and Standing Dead Trees of Homestead National Monument Riparian Forest, 2019



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Cover photograph of the forest at Homestead National Monument of America taken by Allie Schiltmeyer during field data collection.

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Introduction

A 2011, vegetation survey of Homestead National Monument of America recorded vegetation in the prairie habitat and sixty acres of woodland along Cub Creek (Kindscher, et al., 2001).

However, forest ecosystems consist of more than a grouping of trees with associated flora and fauna; they also contain standing dead trees and down woody material. The ecological necessity of forest trees persists even after their death with standing dead trees (snags), and down woody material providing habitat to a variety of organisms. The population density of some species rely on the adequate volume of down woody material and number of snags. The big brown bat (*Eptesicus fuscus*) may use cavities in snags originally excavated by sapsuckers (Agosta, 2002). Dead woody materials are also critical for healthy forest soils through nutrient cycling, water retention, and reducing erosion. Down woody material and snags are vital to a healthy forest ecosystem and should be managed to reduce potential fire hazards and to continue providing valuable ecosystem services such as carbon storage, nutrient cycling, tree regeneration, and wildlife habitat.

As with any managed system, an inventory of the resource is crucial to inform management decisions. The USDA Forest Service recognizes the importance of monitoring not only a forest's trees, but also the associated woody debris (Woodall & Williams, 2005). However, specific details for down woody material in Nebraska forests are minimal and primarily highlight the relatively small amount of biomass and carbon in coarse woody materials in the state as a whole (Woodall, et al., 2013) and not for individual forested ecosystems. Specific inventory details regarding down woody material for woodland in Homestead National Monument are lacking.

The 2002 inventory of the forest and vascular plants at Homestead National Monument found that the species composition of the forest in the northern portion of the park is consistent with the description of a mesic bur oak forest (Mlekush & DeBacker, 2002). According to Steinauer & Rolfsmeier (2000), mesic bur oak forests are critically imperiled communities in Nebraska. In this report, park managers were encouraged to resist suggestions to restore this area to savanna type woodlands. More specifically, burning and mechanical thinning were not recommended.

Diseases and Pests

While there are many pests and pathogens capable of causing damage to forests, there are three serious issues relevant to the forest at Homestead National Monument of America and one potential future issue (Table 1). Dutch elm disease (DED): a vascular wilt affecting species in the genus *Ulmus* (USDA Forest Service, 2019); emerald ash borer (EAB): an invasive insect from

Asia affecting species in the genus *Fraxinus* (Nebraska Forest Service, 2020); oak wilt: a vascular wilt affecting species in the genus *Quercus* (USDA Forest Service, 2019); and the thousand cankers pathogen negatively affecting black walnut (Nebraska Forest Service, 2020). The first three issues have been detected either in Gage County, Nebraska or in nearby counties and are likely to be issues currently or in the near future. The last issue, thousand cankers, was recently detected in western Nebraska (Nebraska Forest Service, 2020).

Table 1. Diseases and pests of major significance to trees in Homestead National Monument of America

Issue	Genera affected
Dutch elm disease (DED)	<i>Ulmus</i> spp. (elm)
emerald ash borer (EAB)	<i>Fraxinus</i> spp. (ash)
Oak wilt	<i>Quercus</i> spp. (oak)
Thousand cankers	<i>Juglans nigra</i> (black walnut)

Project Purpose

In the spring of 2019 Jesse Bolli, Resource Management Specialist, Homestead National Monument of America contacted the Nebraska Cooperative Fish & Wildlife Research Unit with the purpose of conducting an assessment of the down woody material and snags to better understand the current state of non-living woody material for wildlife habitat and ecological function of the lowland forest.

The primary objective was to create a survey and estimate the current coarse down woody material and snags to provide data for management decisions regarding wildlife habitat and ecological function at Homestead National Monument of America. The survey of coarse woody material and snags will also serve as baseline data for future forest monitoring.

Study Area

Homestead National Monument of America is located on the ancestral lands of the Kansa and Pawnee tribes (Nebraska Educational Telecommunications, 2020) in what is now Gage County, 3.5 miles west of Beatrice, Nebraska covering approximately 195 acres (Figure 1).

Approximately 60% of the acreage is located in the 100-year floodplain of Cub Creek. The hardwood forest occupies approximately 60-acres along the Cub Creek and includes two zones based on past land use. The southern portion was intensively logged in the 1930s, almost completely clearing the canopy, and the northern portion was mostly undisturbed (National Park Service, 2020). In 1939, thousands of oak (*Quercus* spp.) and hackberry (*Celtis occidentalis*) saplings were planted in the riparian site.

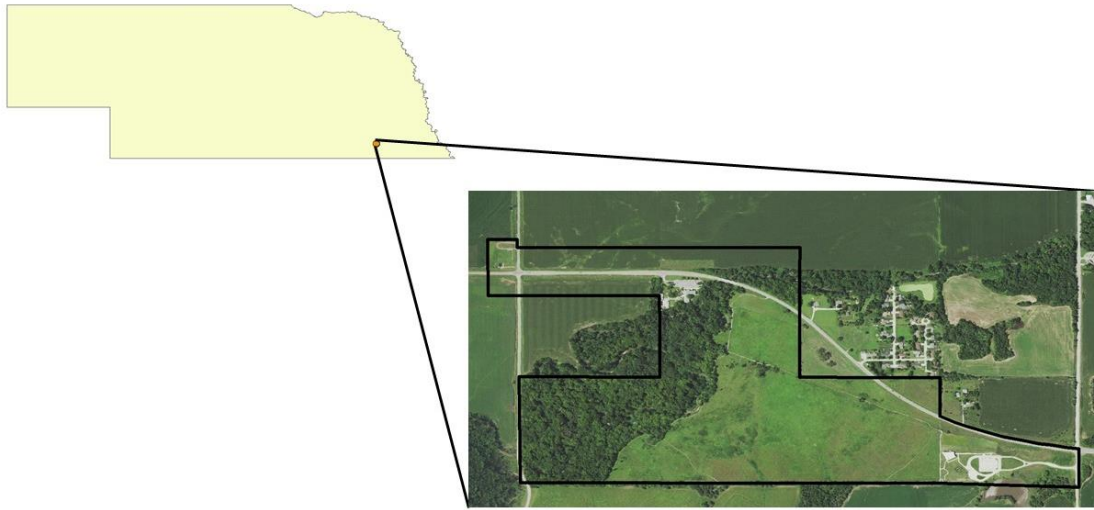


Figure 1. Location of Homestead National Monument of America.

Methods

The Homestead National Monument of America forested area was divided into grids 1/10 acre in size use a GIS. Twenty fixed-radius plots were selected at random (Figure 1). A Garmin GPS with coordinates of plot centers was used to navigate to each plot. All living trees larger than 3-inches in diameter at breast height (DBH, 4.5 feet) were measured and identified. All standing dead trees larger than 3-inches were measured and recorded as snags if the tree had less than a 45-degree lean (US Forest Service, 2018).

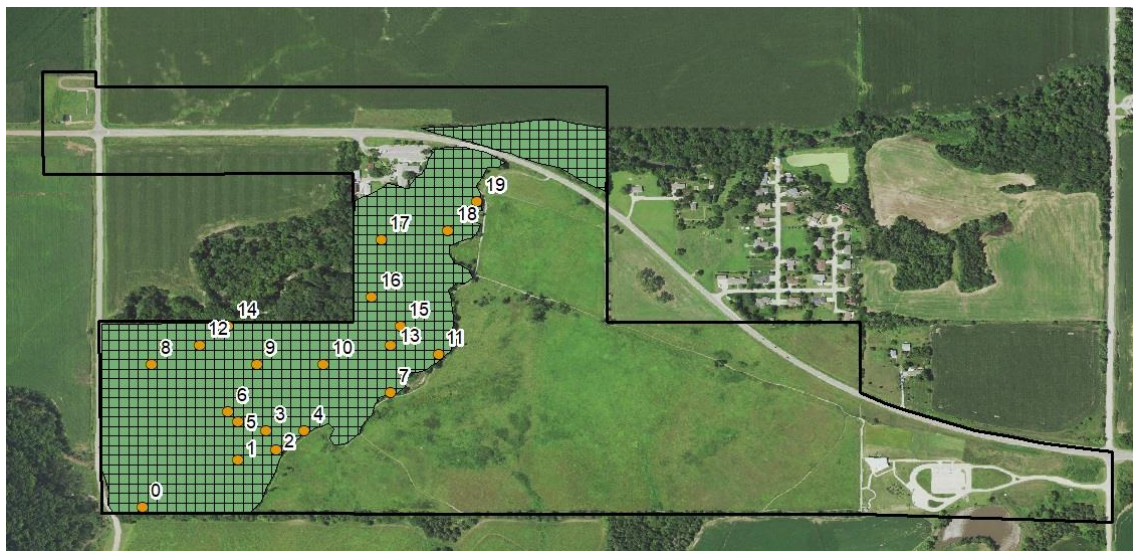


Figure 2. Randomized forest plots of 1/10 acre.

After all standing trees in the plot were measured, two approximately 37-foot transects were run from the plot center at separate random azimuths. Coarse woody debris intersecting the transect

line was measured (Figure 2). Coarse woody debris (CWD) was defined as dead wood larger than 3-inches in diameter at the intersection of the transect including standing debris with greater than a 45-degree lean (US Forest Service, 2018). The diameter of all CWD along the transect was measured at the intersection, small and large ends of the piece of CWD (Figure 4). The length of each CWD piece was also measured.

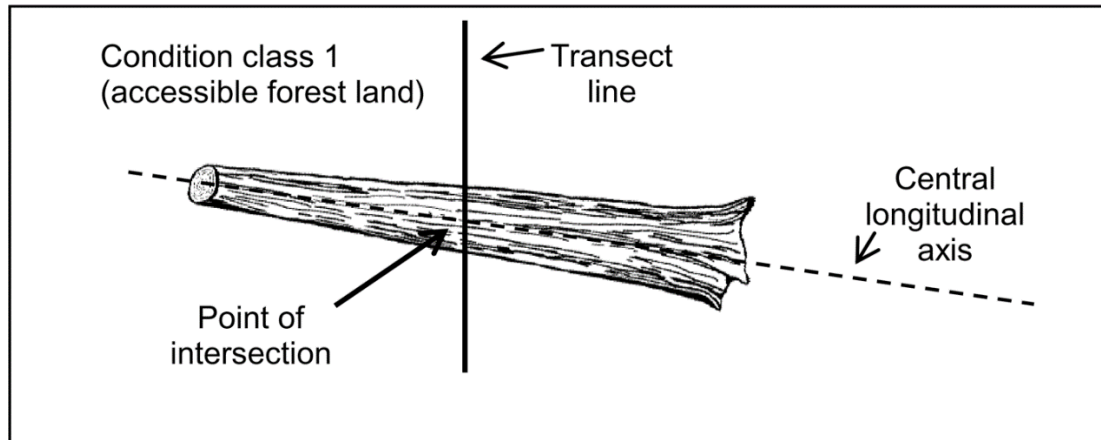


Figure 3. Coarse woody debris measurement protocol along the transect (US Forest Service, 2018).

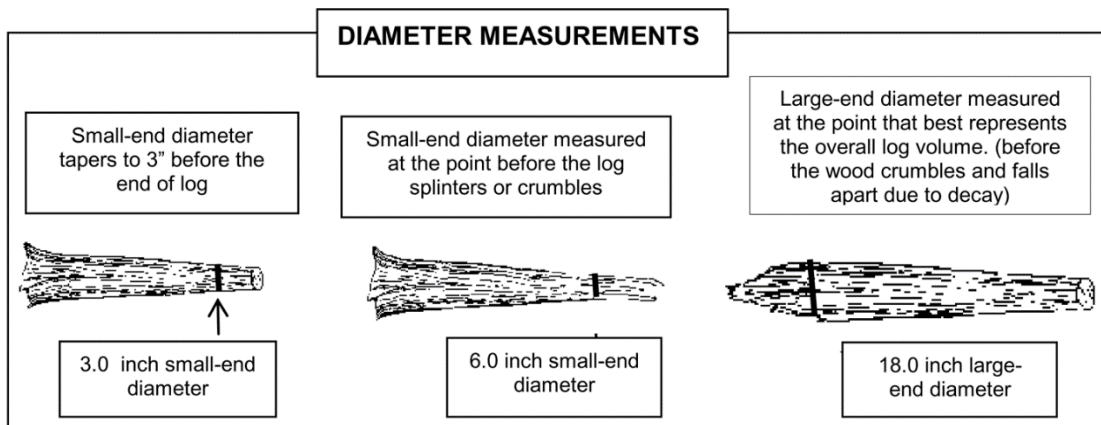


Figure 4. Coarse woody debris measurement protocol (US Forest Service, 2018).

Each piece of CWD was assigned a decay class between 1 and 5 (Table 1). For decay classes 1 to 4, a piece of CWD was counted if it was greater than 3-inches in diameter at the point of intersection with the transect and if it were greater than 36-inches in length. For decay class 5, a piece was counted if it was greater than 5-inches at the point of intersection and greater than 5-inches high from the ground. Decay class 5 is treated differently as these pieces were harder to identify, especially when highly decomposed. Decay class information allows determination of tonnage and habitat condition for CWD pieces (US Forest Service, 2018). Volume estimated for

live trees and standing dead trees were calculated based on the 1981 northeastern forest survey revised cubic-foot volume equations (Scott, 1981).

Table 2. Decay class criteria for coarse woody debris (US Forest Service, 2018).

Decay Class	Structural Integrity	Texture of Rotten Portions	Color of Wood	Invading Roots	Branches and Twigs
1	Sound, freshly fallen, intact logs	Intact, no rot; conks of stem decay absent	Original color	Absent	If branches are present, fine twigs are still attached and have tight bark
2	Sound	Mostly intact; sapwood partially soft (starting to decay) but can't be pulled apart by hand	Original color	Absent	If branches are present, many fine twigs are gone and remaining fine twigs have peeling bark
3	Heartwood sound; piece supports its own weight	Hard, large pieces; sapwood can be pulled apart by hand or sapwood absent	Reddish-brown or original color	Sapwood only	Branch stubs will not pull out
4	Heartwood rotten; piece does not support its own weight, but maintains its shape	Soft, small blocky pieces; a metal pin can be pushed into heartwood	Reddish or light brown	Through-out	Branch stubs pull out
5	None, piece no longer maintains its shape, it spreads out on the ground	Soft; powdery when dry	Red-brown to dark brown	Through-out	Branch stubs and pitch pockets have usually rotted down

Fieldwork was conducted in July 2019, recording observed live trees, snags, and CWD in each of the plots. Inventory methods followed those outlined above according to the Field Guide-Down Woody Materials, Version 8.0 (US Forest Service, 2018).

Results

There were 282 live trees and 13 snags greater than 3-inches DBH observed and measured in the 20 plots. Table 3 and 4 provide details of the live trees and snags, respectively.

Table 3. Detail of observed live tree greater than 3-inches DBH.

code	species	common name	# observed
ACSA	<i>Acer saccharinum</i>	silver maple	12
CEOC	<i>Celtis occidentalis</i>	hackberry	161
FRPE	<i>Fraxinus pennsylvanica</i>	green ash	29
GLTR	<i>Gleditsia triacanthos</i>	honeylocust	9
JUNI	<i>Juglans nigra</i>	black walnut	15
MOAL	<i>Morus alba</i>	white mulberry	12
PODE	<i>Populus deltoides</i>	eastern cottonwood	3
QUMA	<i>Quercus macrocarpa</i>	bur oak	9
ULSP	<i>Ulmus</i> spp.	elm genus	32
Total			282

Table 4. Detail of observed snags greater than 3-inches DBH.

code	species	common name	# observed
CEOC	<i>Celtis occidentalis</i>	hackberry	5
FRPE	<i>Fraxinus pennsylvanica</i>	green ash	1
GLTR	<i>Gleditsia triacanthos</i>	honeylocust	1
ULSP	<i>Ulmus</i> spp.	elm genus	5
Unknown		species unidentified	1
Total			13

The trees per acre and volume estimates of live trees and snags are detailed in Table 5. For living trees the mean trees per acre (TPA) was estimated at 146 with an average of 2 (1.5) snags per acre (Table 5). Live trees consist of approximately, 98.9% of the total standing TPA and 94.1% of the volume, with snags contributing 1.1% and 5.9%, respectively.

Estimates of species abundance show hackberry (CEOC) as the most abundant tree per acre (56.36%) and in volume (31.79%; Table 6). Species in the elm genus (ULSP) were the second most abundant TPA; however, eastern cottonwood (PODE) had the second highest estimate of volume (28.38%), although this may be due to an individual tree that was substantially larger than other trees encountered in the observed plots (Table 6).

Table 5. Estimated mean tree per acre (TPA), estimated total number of trees, and estimated volume for live trees and snags. Estimates were rounded to the nearest whole number and species level numbers may not sum to the totals due to averaging and rounding errors.

variable	species	mean TPA	# trees	volume ft³
live trees		146	8,760	391,230
	ACSA	6	360	12,878
	CEOC	82	4,890	41,383
	FRPE	15	870	7,943
	GLTR	5	270	5,491
	JUNI	8	450	4,165
	MOAL	6	360	1,895
	PODE	2	90	36,963
	QUMA	5	270	8,515
	ULSP	17	990	9,688
snags		2	90	24,431

Table 6. Estimated live tree at species level abundance for TPA and volume. Estimated values may not sum to 100% due to rounding errors.

species	TPA	volume ft³
ACSA	4.12%	9.89%
CEOC	56.36%	31.79%
FRPE	10.31%	6.28%
GLTR	3.09%	4.23%
JUNI	5.15%	3.20%
MOAL	4.12%	1.46%
PODE	1.03%	28.38%
QUMA	3.09%	6.54%
ULSP	12.71%	8.24%

Coarse woody debris (CWD) was observed on the transects of 13 out of 20 plots (plots: 1,2,3,6,8,10, 11, 12, 13, 15,16, 17, 18). There was an estimated 843 ft³ of CWD per acre with a total of 50,554 ft³ in the forested area of Homestead National Monument of America (Table 7). The CWD contributes approximately 11% of the total estimated woody volume in the 60-acre forest.

Table 7. Estimated volume for live trees, snags, and coarse woody debris (CWD). Estimated values may not sum to 100% due to rounding errors.

variable	per acre volume ft ³	total volume ft ³	percent
live trees	6,521	391,231	83.92%
snags	407	24,431	5.24%
CWD	843	50,554	10.84%
Total		466,216	

The distribution of CWD decay class is non-uniform with class 2 and class 4 representing the majority of the observations. Decay classes 1-3 are relatively solid and intact pieces of wood, indicating the decay process is in the early stages. Decay classes 4-5 are relatively advanced, there was only one CWD piece observed in class 5.

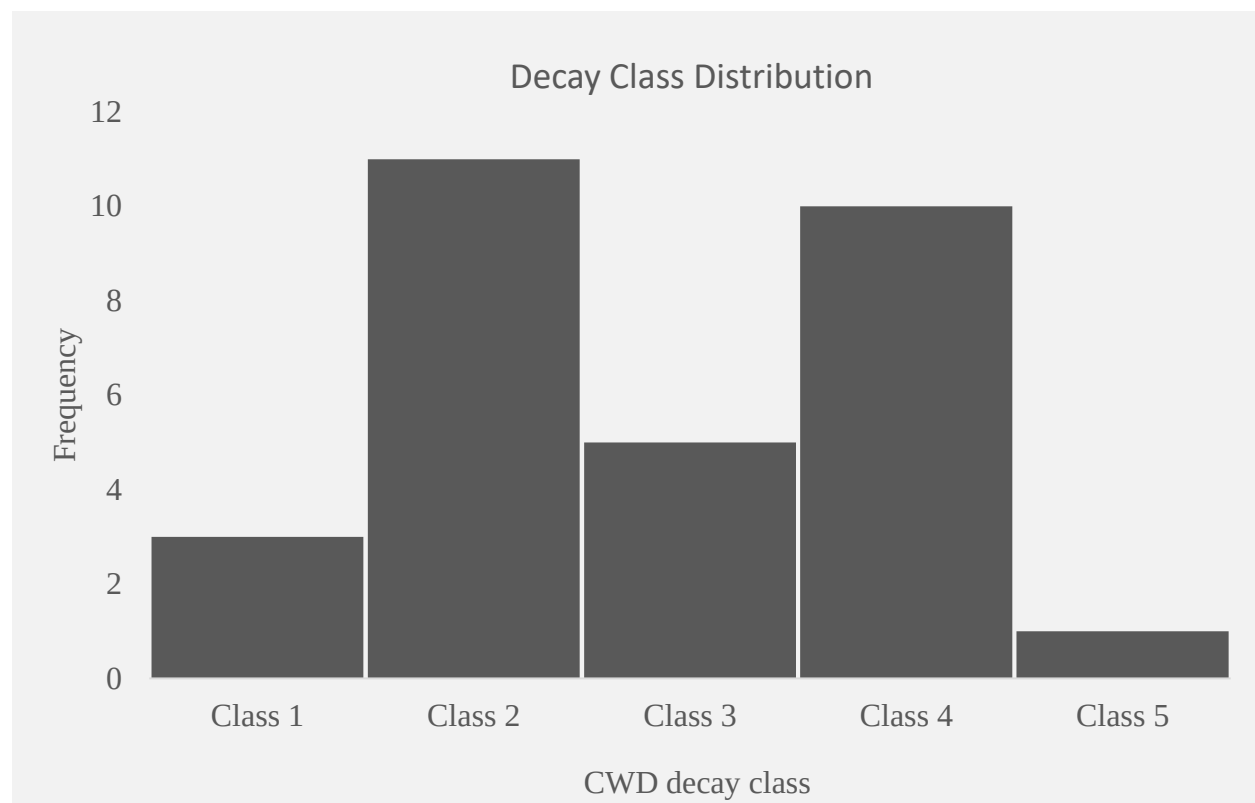


Figure 5. Histogram of CWD decay class distribution. See Table 2 for decay class descriptions.

Discussion/Management implications

The observed snags and CWD contribute approximately 5% and 11%, respectively, of the wood volume in Homestead National Monument of America. In seral plots, there was no CWD observed and the majority of plots contained no snags. In terms of the management of the forest

for nutrient cycling, carbon storage, and wildlife habitat continued monitoring for the CWD and snags is recommended with a goal of retaining or increasing CWD and snags in the forest. The ‘correct’ amount of CWD and snags for Nebraska forest has not been studied and specific recommendations are difficult as many of the current best management practices (BMP) come from more heavily forested states. The amount of coarse woody debris needed to maintain nutrient balances, carbon stocks, or wildlife habitat will vary by plot location, however, as Hagan and Grove (1999) stated, “assume that some is better than none, and that more is almost always better.”

A recommendation out of New Hampshire BMP is to retain an average of six snags per acre (Hagan & Grove, 1999). Currently, the forest at Homestead National Monument of America only contains an estimated 2 (1.5) snag per acre, which may provide less habitat for native bat and bird species.

New snags will develop in time; however, there is an opportunity to improve wildlife habitat and deal with invasive tree species and the negative impacts of EAB on green ash. Non-native trees (white mulberry, some elms) and the green ash could be girdled or otherwise killed and left onsite to provide habitat. Girdling non-native tree species helps to reduce their numbers and could be accompanied with planting of more desirable tree species. The girdling of green ash before the arrival or establishment of EAB serves to improve wildlife habitat and reduce breeding grounds for the invasive and destructive pest.

Species selection

Non-native elms and white mulberry contributed up to 12.71% and 4.12%, respectively, of TPA. Green ash accounted for over 10% of the TPA and black walnut at 5.15% (Table 6). While bur oak only contributed a little over 3% of the TPA. Creating snags or CWD from the non-native elms and white mulberries will help to reduce their presence while improving habitat, however, at least some of those trees should be replanted with new trees.

Current pest and diseases of note (Table 1) should be considered when selecting planting stock. Oak (*Quercus*), elms (*Ulmus*), ash (*Fraxinus*), and black walnut (*Juglans nigra*) all have serious disease and pest issues in Nebraska. Dutch elm disease is still active and any new elm planted should be a disease resistant variety. Oaks are susceptible to oak wilt and oak populations should be monitored for signs of the disease so quick action can be taken should the disease be detected. No ash (*Fraxinus*) should be planted until a reliable EAB resistant variety is available and efforts should be made to reduce the number of ash before EAB populations become established. Black

walnut should also be monitored for signs to Thousand Cankers disease, which has recently been detected in Nebraska (Nebraska Forest Service, 2020).

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