

MORTALITY RATE BY CAUSE SUMMARY

Review of Mortality Rates Discussed in Draft GTR Timber Growth and Yield in the Black Hills Nation Forest: A Changing Forest

August 3, 2020

RESULTS

- The mortality rate for the 2019 inventory, excluding insect related mortality, is 0.47%.
- The mortality rate for the 2011 inventory, excluding insect related mortality, is 0.44%.
- Weather related mortality increased from 1962 through 2011 then slightly decreased in 2019: 0 reported in 1969, 0.17% in 1988¹, 0.18% in 1999, 0.27% in 2011, 0.20% in 2019.
- Fire related mortality has also increased since 1962: 0 reported in 1962, 0.2% in 1999², 0.13% in 2011, and 0.20% in 2019.
- The increase in weather related mortality is consistent with the findings in van Mantgem et al. that regional warming and drought stress may be the dominant contributors to increased mortality rates for all major western tree genera. Mortality rate doubling periods for pinus species in the interior west were estimated to be 29 years. Endogenous causes of increasing tree mortality such as changes in forest structure, density, fire exclusion, life history traits, and successional dynamics were considered unlikely to be major contributors to the observed trends. Increasing mortality rates were due to both direct and indirect (insects and pathogens) causes associated with regional warming trends and drought stress.

Table 1. Annual mortality (CCF) by cause of death. UKN = unknown, unable to derive from available data.

Report #	Annual Mortality, CCF, Trees ≥ 5"DBH						
	Total	Insect	Disease	Fire	Weather	Vegetation	Unknown/ other
1 - Choate & Spencer Jr., 1969	Softwoods, National Forest 12,810 CCF (0.16%)	UKN	UKN – (0.09% for western SD inventory)	0	0	0	UNK
	Softwood, all commercial timberland 14,650 CCF (0.15%)	343 (0.04%)	827 (.08%)	UKN	UKN	UKN	295 (0.03%)
2 - Collins and Green, 1988	Pine, National Forest 34,910 CCF (0.26%)	UKN	0	UKN	UKN	0	UKN
	Pine, all commercial timberland 45,020 CCF (0.26%)	5,690 (0.03%)	0	5,150 (0.03%)	2,350 (0.17%)	0	4,830 (0.03%)

¹ The weather related mortality reported in 1988 was for ponderosa pine on all commercial timber ownerships but may have been underreported for the Black Hill NF (see discussion under Report 2 – Inventory Considerations).

² Collins and Green, 1988, reported that 9% of the overall mortality rate was caused by fire. This is for all timberlands and is not specific to the national forestlands.

3 – Delander, 1999	Pine, National Forest 40,000 CCF (0.26%)	4,000 (0.03%)	3,600 (0.02%)	3,600 (.02%)	27,600 (0.18%)	0	1,200 (0.01%)
4 - Walters et al.	Pine, National Forest 140,460 CCF (1.04%)	UKN	UKN	UKN	UKN	UKN	UKN
FIA 2011	Pine, National Forest, SD only 148,017 CCF (1.24%)	95,380 (0.80%)	248 (0%)	15,842 (0.13%)	31,870 (0.27%)	0	4,678 (0.04%)
5 - Graham et al. Draft, 2020	Pine, National Forest 244,703 CCF (3.07%)	207,308 (2.60%)	4,268 (0.05%)	15,651 (0.20%)	15,510 (0.20%)	962 (0.01%)	1,003 (0.01%)

INVENTORY CONSIDERATIONS

Reports 1 & 2 (1 - Choates and Spencer, Jr. 1969) (2 - Collins and Green 1988)

- Report 1 provides total mortality estimates for national forestlands by species group (softwoods and hardwoods). Estimates by cause of death are provided for all ownerships only.
- Report 2 provides total mortality estimates for national forestlands. Estimates by cause of death are provided by species for all ownerships only.
- Report comments specific to mortality rates in South Dakota:

Report 1 (p. 6)

- Estimates of annual net growth of growing stock indicated above are about 2.9% greater than the average for the 10 years preceding the survey. Mortality estimates are 28% less. These differences arise in large measure from the fact that estimated mortality for 1962 in the eastern part of the State is the average of only 3 years – years during which rainfall was greater and growing conditions better than the 10-year average. Differences are less for sawtimber.
- Another reason for low normal mortality is that forest fires are not as extensive as in many other areas.

(Tables 11, 21, & 22, p. 11, 34, & 35)

- 1962 mortality = 12,180 CCF/7,810,000 CCF (softwood, national forest) = 0.16%.
- Mortality rates for the previous decade: 30,360 CCF per year/1,085,000 CCF (all species group, all ownerships) = 0.28%

Report 2 (p. 7)

- Annual mortality of growing stock on timberland resulted in a loss of 5.9 million cubic feet of volume, which is 14 percent of the net annual growth. Weather caused over 65 percent of the total mortality (fig. 11 and table 16). In 1982, a wet snowfall in the Black Hills caused extensive mortality to ponderosa pine trees (fig. 12). Mortality on the Black Hills National Forest accounted for most of the weather-caused mortality. However, table 15 (Table 15 reports 34,910 CCF annual mortality, softwoods, national forest) does not reflect this loss, which has been estimated to be 50 million board feet (100,000 CCF) (Fowler 1986).

Report 4 (Walters et al.)

- Mortality estimates by cause of death are not provided in report number 4.
- Mortality by cause data was obtained from the Northern Research Station, FIA (July 2020), for survey years 2002-2006 and 2007-2011 for the Black Hills National Forest, South Dakota, ponderosa pine growing stock on timberlands. This data will vary slightly from the data used in

the 2011 report by Walters et al. A special study database was created to support the preparation of the 2011 report. This database is no longer available. Reasons for slightly different results include:

- 1) use of a different set of plots which may result in different strata, different estimation unit assignments, and different expansion factors, and
- 2) any updates or changes made to the database over time.

Report 5 (Graham et al.)

- Rates by cause of death were derived from Evaluator, inventory years 2017 - 2019.

Table 2. Forest Inventory summary for reports cited in Graham et. al. 2020.

Inventory Report #	Report Year	Author	Source	Inventory Year	Area Description	Acres	Growing Stock, Trees ≥ 5" DBH	
							Volume, CCF	Species/Material
1	1969	Choate and Spencer, Jr.	Western SD - Rocky Mountain & Intermountain Forest & Range Experiment Station (1960), Eastern SD - North Central Forest Experiment Station (1964-1965)	1960 - 1965	Commercial Forestland in SD only, National Forest only	957,000	7,810,000	Values are for softwoods, pine and spruce
2	1988	Collins & Green	East SD - Forest Survey, North Central Research Station (1979) & West SD-1983, Forest Survey, Intermountain Research Station	1979 & 1983	Timberlands in SD (not reserved?), National Forest only	952,500	13,449,000	Values are for softwoods, pine, spruce, and eastern redcedar
3	2002	Delander	FIA	1999	Forestland including reserved land, National Forest only	1,150,627	15,353,000	ponderosa pine
4	2011	Walters et. al.	FIA	2002 - 2006, 2007 - 2011 SD, end of cycles 2002, 2005 WY	Timberlands (not reserved), National Forest only	1,135,200	13,477,960	ponderosa pine

FIA South Dakota inventory 2011	n/a	n/a	FIA	2002-2006 & 2007-2011 surveys, SD	Timberlands, National Forest		11,932,981	ponderosa pine
5	2020	Graham et. al. Draft	FIA	2017 - 2019	Suitable Timberlands (not reserved)	765,733	7,958,314	ponderosa pine