

Bison Weights from National Parks in the Northern Great Plains

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On the Ground

- Female bison at three Northern Great Plains parks reached maximum size at 5.5 years of age. Male bison reached maximum size around 10.5 years of age.
- The mean weight for females 5.5 years old and older was 473 kg, and for males 10.5 years old and older was 816 kg. The mean weight for yearling females was 307 kg, and for yearling males was 325 kg.
- There were significant differences in bison weights between the three parks even though the herds were all stocked well below the forage-based carrying capacity.
- Heavier calves and yearlings tended to be heavier adults; however, there was much variability among individuals.
- Accurate and unambiguous data on bison weights can be used to set stocking rates and make other management decisions and therefore should be collected whenever possible.

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Bison (*Bison bison*), also known as buffalo, are the largest native grazer in the North American Great Plains, and when present can comprise more biomass per area than any other native fauna. Bison carrying capacity and stocking rates are often determined in part on known or assumed bison weights,¹ therefore, accurate and detailed information on weights is needed. However, unambiguous age, sex, and regional-specific information on bison weights are surprisingly sparse in the scientific literature (for a summary see Reynolds et al.²).

Badlands, Theodore Roosevelt, and Wind Cave National Parks (NP), located in the Northern Great Plains of North America, have a long history of bison management. The parks routinely round up bison for the primary purpose of culling surplus animals. As part of that effort animals are given unique lifetime marks that facilitate accurate aging. A suite of biological data is also collected, including weight information. I present and analyze bison weight data from the three parks from 1983–2014.

Background on the Three Herds

Badlands, Theodore Roosevelt, and Wind Cave NPs manage their bison herds per National Park Service policies.³ The policies call for the conservation of natural processes and conditions to the extent possible, with minimal anthropogenic intervention. The herds are confined to the parks year-round by a 2.1–2.4 m high woven-wire fence and natural barriers. There is no cross-fencing or pasture rotation. The parks do not provide supplemental feed or minerals for the bison. There is no forced weaning. The animals are not provided growth hormones, antibiotics, or other treatments sometimes given to cattle or privately-owned bison herds. Culled animals are selected randomly within a cohort, i.e., selection is not based on morphological characteristics; however, selective culling apparently occurred to an unknown extent in the early years of bison management at the parks. As a result of these policies and practices the herds are classified by some as “conservation herds”.⁴

Badlands National Park

Badlands NP lies in southwestern South Dakota (lat 43°51'00"N, long 102°20'00"W) about 11 km south of Wall, South Dakota. Habitat within the park consists of a mosaic of rugged and barren badlands topography intermixed with flatter areas of mixed-grass prairie. Dominant vegetation in the prairie includes western wheatgrass (*Pascopyrum smithii*), green needlegrass (*Nassella viridula*), and little bluestem (*Schizachyrium scoparium*). Average rainfall is about 41 cm. Natural Resources Conservation Service (NRCS) plant productivity data⁵ indicates that the 19,500 ha available to bison produce about 26.2 million kg of forage in a

normal-precipitation year. Bison were reintroduced to the park in 1963. Fifty of the founder animals came from Theodore Roosevelt NP and three from Fort Niobrara National Wildlife Refuge. Another 20 bison were supplemented in 1984 from Colorado National Monument. The park manages for a population of 700 bison, a level based on drought conditions.⁶ The bison probably consume about 12% of plant productivity in a normal-precipitation year.

Theodore Roosevelt National Park

Theodore Roosevelt NP is located in western North Dakota. The park consists of a South Unit (lat 46°58'00"N, long 103°30'00"W) immediately north of Medora, North Dakota, and a North Unit (lat 47°36'00"N, long 103°23'00"W) 21 km south of Watford City, North Dakota. The South Unit has about 18,400 ha available to bison and the North Unit has about 9,600 ha. Habitat within the two units consists of a mosaic of rugged and barren badlands topography intermixed with flatter areas of mixed-grass prairie. Dominant vegetation in the prairie includes needle-and-thread (*Hesperostipa comata*), green needlegrass, and western wheatgrass. Average rainfall is about 38 cm. Based on NRCS data⁵ the South Unit produces about 23.6 million kg of forage and the North Unit about 12.7 million kg in a normal-precipitation year. Twenty-nine bison were reintroduced to the park in 1956 from Fort Niobrara National Wildlife Refuge in Nebraska. The park manages for a population of 200–500 bison in the South Unit and 100–300 in the North Unit, which equate to forage allocations of about 7% for each herd. Other notable grazing ungulates include about 360 elk (*Cervus canadensis*) and 100 feral horses (*Equus caballus*) in the South Unit.

Wind Cave National Park

Wind Cave NP (lat 43°36'00"N, long 103°27'00"W) lies on the southern edge of the Black Hills 10 km north of Hot Springs, South Dakota. Habitat within the park consists of a mosaic of mixed-grass prairie and ponderosa pine (*Pinus ponderosa*) forests. Dominant vegetation in the prairie includes blue grama (*Bouteloua gracilis*), western wheatgrass, and little bluestem. Average rainfall is about 46 cm. Based on NRCS plant productivity data⁵ the 11,500-ha park produces about 18.7 million kg of forage in normal-precipitation years. Bison were reintroduced to the park in 1913 and 1916. Founder animals came from the New York Zoological Park and Yellowstone NP. The park manages for a winter population of 350–500 animals, which equates to a forage allocation of about 10% based on NRCS normal-year plant productivity data. Elk are the other noteworthy grazing ungulate; the park manages for a population of about 300.

How the Information Was Collected and Analyzed

The three parks rounded up bison in September–November of most years from 1983–2014 for the primary purpose of removing surplus animals. The roundups typically collected most, if not all, of the cow-calf herds; however, bachelor herds and single bulls were generally avoided, as they

were difficult and dangerous to handle. Captured adult bulls were typically pushed into the corrals as part of a cow-calf herd. Captured animals were individually pushed into a restraining chute where they were processed. Calves and other un-marked animals were marked with a uniquely-numbered external ear tag and a uniquely-numbered passive microchip injected subcutaneously in the ear. Calves were identified by coloration, size, horn development, association with a cow, and if necessary, tooth eruption.⁷ The age of other un-marked animals was estimated based on tooth eruption and wear. Weights were recorded via a scale located in the restraining chute. Scales were typically calibrated by having multiple people of known weight stand on the scales before the roundups and periodically during the roundups. Weight and other information were logged in a park-specific bison database.

From each database I retrieved all records with complete sex, age, and weight data. Outliers were identified using nonlinear regression⁸ and box plots for each park/gender/age subset. Outliers were retained if they were deemed plausible, e.g., if injuries were reported for an exceptionally lightweight animal, or an extraordinarily heavy animal retained the heavy weight across the years. Non-sensible records were removed.

Wind Cave NP had the most frequent roundups and therefore a relatively large percentage of animals first marked as calves or yearlings. I used that park's database to look for bias in age estimation. I classified all records from animals first marked as calves or yearlings as records from known-age animals. Records from animals first marked at 2.5 years or older were classified as estimated-age records. Although bison in the 2–4-year-old range can be aged by tooth eruption and wear,⁷ the accuracy likely deteriorates in field conditions with wild un-sedated animals, hence, I assumed only calves and yearlings could be accurately

Table 1. Modeled composition of the herds when subjected to an annual 16% cull of all cohorts.

Age	% Female	% Male
0.5	10.2	10.2
1.5	8.4	8.2
2.5	6.9	6.7
3.5	5.5	4.9
4.5	4.4	3.5
5.5	3.5	2.7
6.5	2.9	2.0
7.5	2.4	1.6
8.5	2.0	1.1
9.5	1.8	0.9
10.5+	6.9	3.3
Total	55.0	45.0

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