

## Chapter 11

### Rating our Conservation Herds

#### Today's "Conservation" Herds

As noted in Chapter 10, "conservation herds" of plains bison are those owned by public agencies or by private organizations dedicated to conservation, as defined by the International Union for Conservation of Nature. The 44 conservation herds of plains bison on native range in the USA contain about 16,500 bison. Here, I review some important characteristics of these 44 herds to demonstrate their inadequacy for maintaining wildness in bison. This information comes from personal investigations and from other sources.<sup>1</sup> Characteristics of these herds and their management are dynamic, though changes occur slowly. This review represents conditions during 2010-2011, as best I could discern them.

#### Herd Size

Thirty-four of our 44 conservation herds of plains bison have 400 or fewer animals (Charts 11.1, 11.2). Of these, 19 have 100 or fewer bison. These 34 herds are certainly losing genetic diversity and are in danger of creeping inbreeding, especially the 19 herds with 100 or fewer bison (Chapter 5). Six of these herds are managed, with exchanges of animals among herds, as a federal metapopulation.<sup>2</sup> In addition, a few other conservation herds occasionally exchange breeding bison. This intensive handling of bison may alleviate some inbreeding, but will not eliminate much loss of genetic diversity unless the federal and other herds are greatly expanded. Herds with fewer than 2000 - 3000 bison have compromised evolutionary potentials (Chapter 5). There are only 4 conservation herds south of Canada with more than 1000 bison, and only the Yellowstone National Park herd is large enough to limit loss of genetic diversity to moderate levels in the long term.

## Rewilding Plains Bison

**Chart 11.1.** Conservation herds of plains bison on native USA range, 2011.

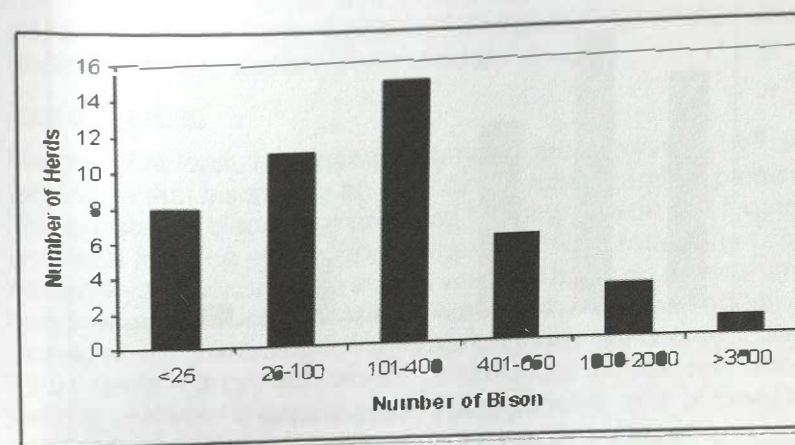
	<u>Number of bison</u>	<u>Range (sq. mi.)</u>
* Yellowstone NP, WY, MT	3700	3500
* Medano Ranch, TNC, CO	2000	70
* Tallgrass Preserve, TNC, OK	1950	36
* Custer SP, SD	1100	110
* Wichita Mtns. NWR, OK	650	67
* Badlands NP, SD	600	100
* Ft. Robinson, SP, NE	500	5
* Niobrara Valley, TNC, NE	500	30
* Antelope Island, UT	500	43
* Jackson Valley, WY	500	110
* Wind Cave NP, SD	400	43
* National Bison Range, MT	350	29
* T. Roosevelt NP South, ND	350	72
* Clymer, TNC, TX	320	2
* Ordway Prairie, TNC, SD	300	5
** Henry Mtns., UT	300	45
* Ft. Niobrara NWR, NE	290	25
* Konza Prairie, KS	275	4
* Broken Kettle, TNC, IA	250	4
* Cross Ranch, TNC, ND	200	6
* Amer. Prairie Reserve, MT	200	50
* T. Roosevelt NP North, ND	175	38
* Maxwell State Reserve, KS	165	4
* Land between Lakes, KY	120	1
** Prairie SP, MO	120	5
* Tallgrass Nat. Preserve, KS	100	2
* Book Cliffs, UT	100	uncertain
* Neal Smith NWR, IA	71	3
* Caprock SP, TX	62	1
* Sully at Ft. Niobrara NWR, NE	61	shared
* Blue Mounds SP, MN	56	1

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Chart 11.1 continued

** Rocky Mtn. Arsenal, CO	55	4
Smoky Valley, TNC, KS	45	5
** Genesee Park, CO	34	1
Fermi Lab, IL	32	<0.5
** Daniels Park, CO	28	1
* Sandsage State Preserve, KS	20	6
Sandhill State Wildl. Area, WI	15	<0.5
Hot Springs SP, WY	11	1
Bear Butte SP, SD	11	?
Wildcat Hills State Recr. Area, NE	10	1
Bear River SP, WY	8	<0.5
Sully's Hill NWR, ND	7	1
Lame Johnny Creek, TNC, SD	?	for sale
Total bison	16,541	

\* 24 herds visited in this study. \*\* 5 herds, managers contacted by mail in this study. SP = State Park. NWR = National Wildlife Refuge. TNC = The Nature Conservancy.



**Chart 11.2.** Sizes of 44 conservation herds of plains bison on native range in the USA, 2011.



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Aside from maintaining genetic diversity, large bison herds allow evolved social/dominance relations to contribute normally to natural selection. Almost all our conservation herds are maintained with low, relatively stable numbers of bison living at relatively low ecological densities. This weakens natural selection for wild traits that adapt bison to living in both good and bad times (Chapter 5).

### Range Size

At least 11 of the 44 conservation herds of plains bison on native range in the USA live on ranges of no more than a square mile (Charts 11.1, 11.3). These are only display herds in exhibition pens. Their contribution to the future of wild bison will be minimal, at best. More than 60% of the 44 conservation herds have ranges of 10 or fewer square miles.

Only 4 of the 44 herds have ranges of at least 100 square miles (Charts 11.1, 11.3). However, 3 of these come with limitations for wild bison: (1) Bison range at Badlands National Park includes much

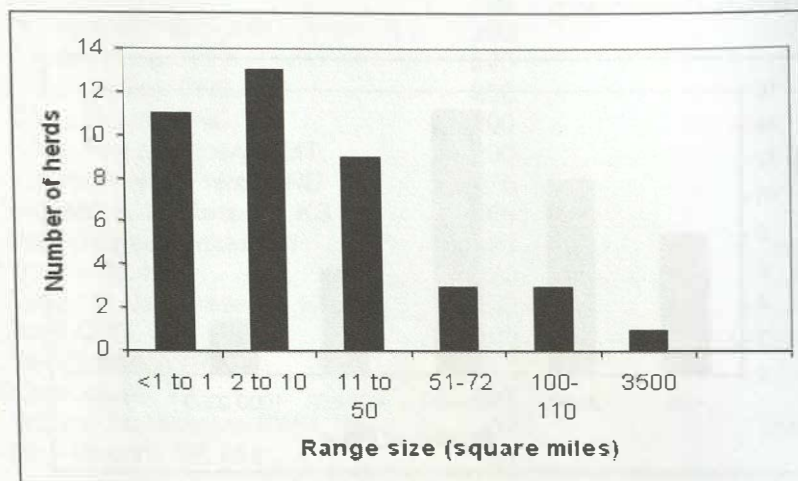


Chart 11.3. Range sizes for 44 conservation herds of plains bison on native range in the USA, 2011.

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barren ground. (2) Most of the 110 square miles within Custer State Park is forested. There are but 28 square miles of grassland to provide optimal bison habitat. (3) The Jackson Valley, Wyoming bison herd, with about 110 square miles of available range, will be limited to 500 animals and is artificially fed during winter. Even the Yellowstone National Park herd of plains bison, which roams over about 3500 square miles, has important limitations. Their range is mostly high elevation habitat. Bison leaving this range during severe winters or seeking early-spring green forage have been culled or penned and fed. An interagency team including the state of Montana is seeking to find additional range where Yellowstone bison will be welcome.

Obviously, small ranges limit the numbers of bison that can be sustained. Moreover, a large, diverse habitat is necessary for bison to express many of their ecological relations with the environment (Chapter 3). Bison evolved as mobile grazers selecting forage patches and habitats as needed to meet changing vegetation and weather conditions. These abilities lose their value and will not be maintained by natural selection when bison are tightly confined.

The small range sizes for almost all these 44 conservation herds of plains bison are a major limitation for wildness and a major factor leading to domestication of the species.

### Interior Fencing

Ranges of at least 14 conservation herds are subdivided by cross-fencing so that bison may be periodically rotated among pastures. This constrains bison from selecting foraging habitat and creates unnatural foraging effects upon vegetation. Rest-rotation grazing is necessary to support more than a very few bison on several small bison ranges. However, at least 8 herds with more than 100 bison are managed with rotation grazing systems, much like domestic livestock. This reflects a prevalent thinking of bison as livestock, and a common need to produce large numbers of bison for sale, with proceeds often used to fund continuing intensive management of bison.

### Roundups and Handling

At least 25 of the 44 conservation herds are subjected to annual, or more frequent, roundups and handling by running animals through pens and handling chutes. At least 8 more herds have less frequent, but regular roundups with handling. These roundups facilitate many of the practices leading to domestication of bison (Chapter 8).

### Selective Culling

Selective culling of bison to control herd size is routine in 35 of the 44 conservation herds, and probably will occur in 5 more herds when their bison numbers reach established goals. As bison are removed periodically from these 40 herds, few bison managers emphasize randomness in selecting animals for removal or retention. Animals are removed based on sex, age, size, appearance and behavior. Sometimes selection is an unconscious process. Inadvertent selection for characteristics based on genetically-linked traits likely is common. In this manner, selective culling is a major factor weakening or replacing natural selection (Chapter 8).

Often, culling is used to remove bison by middle age. Older bulls become difficult to handle. Older bison are no longer growing, producing meat; and they are less valuable for sale. However, bison are removed from the herds before the full values of the fittest individuals are fully realized in natural selection.

Numbers of bison are or will be managed primarily with hunting in only 3 herds in Utah and Wyoming. Selection of animals for harvest is influenced by hunter choice and by hunting rules. Hunting rules are rarely, if ever, based upon any consideration of evolutionary effects. These effects of hunting are uncertain and will depend largely upon the proportion of natural mortality that is replaced with harvest. Lastly, the Yellowstone Park bison herd is limited by a combination of significant natural mortality, hunting outside the Park, and selective culling of animals with roundups. Bison carrying antibodies against *Brucella* infection are emphasized in this culling, although some culled animals are not infected and some may be the most *Brucella*-resistant individuals.

### Natural Mortality

Of 28 conservation herds that I contacted during 2010-2011, it was noted that "very few" bison die naturally on the range in 18 of the herds. Herd sizes are controlled by regular removals of animals. Significant natural mortality was noted in only 6 of these 28 herds. The remaining 4 herds were new or had a new management plan, such that the amount of natural mortality that will occur has not been tested. While these numbers relate to 28 of the 44 conservation herds, it is likely that natural mortality is even less common in the 16, mostly smaller, herds I did not contact. The percentage of conservation herds without significant natural mortality is almost certainly much larger than indicated by my survey.

### Supplemental Feeding

Thirteen of our 44 conservation herds of plains bison are routinely fed, at least seasonally. However, at least 8 other herds are fed during "crisis" periods of forage deprivation, usually during periods with deep snow, occasionally during drought. So, for at least 21 of 44 conservation herds, natural selection for dominant, energy efficient bison (Chapter 4) is at least weakened. In addition, unnatural concentrations of bison in feeding areas results in unnaturally increased rates of disease transmission among animals, and increased densities of disease organisms in the feedground environment.

### Disease Management

At least 17 of our 44 conservation herds of plains bison are regularly vaccinated for from 1 to 8 diseases. In addition, vermicides to control internal and external parasites are applied in many of these 17 herds. These practices weaken natural selection for disease resistant bison and modify coevolution of disease organisms (Chapters 4, 8). Unintended effects may involve resistance to and evolution of disease species other than those targeted by each specific vaccine.

Active vermicides, passing through a bison's digestive tract, may act as insecticides in bison feces. Effects on the flora and fauna of bison



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feces, and on rates of nutrient turnover in the environment have not been studied.

### Bull:Cow Ratios

At least 16 of our 44 conservation herds are managed with skewed, or highly skewed, adult bull:cow ratios of 1:3 to 1:15. This weakens or eliminates the important natural-selective value of bull competition (Chapter 5). It is encouraging that at least 20 of the 44 herds are managed with more natural adult bull:cow ratios near 1:1. Some management agencies, especially the National Park Service and the U. S. Fish and Wildlife Service, recognize the natural-selective values of bull competition.

### Predators

Of the 44 conservation herds, only the Yellowstone Park herd faces significant natural predation by bears and wolves. Bison also live with these predators in Jackson Valley, Wyoming. However, there has been very little predation on bison in this area where numerous elk on winter feedgrounds are the primary prey. It seems unlikely that the significant natural-selective values of predation will be restored in any other conservation herds in the near future.

### Legal Status

At least 28 of the 44 conservation herds are located in states, or parts of states, where bison have no legal recognition as wildlife. These state laws recognize bison only as livestock (Chapter 10).

### Synopsis

Summarizing the above for the 44 plains bison conservation herds on native range in the USA:

- |                                    |               |
|------------------------------------|---------------|
| • Herds with fewer than 400 bison  | 77%           |
| • Ranges 10 or less square miles   | >60%          |
| • Rest/rotation grazing management | 32%, at least |
| • Roundups and handling            | >75%          |

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- |                                     |               |
|-------------------------------------|---------------|
| • Selective culling                 | >80%          |
| • Little or no natural mortality    | >64%          |
| • Supplemental feeding              | 48%, at least |
| • Vaccinations, etc.                | 39%           |
| • Skewed bull:cow ratio             | 36%           |
| • No effective predators            | 95%           |
| • No state legal status as wildlife | >64%.         |

### Wild Bison Scorecard

The above review of domesticating practices in our 44 conservation herds of plains bison on native range in the USA causes much concern for the future of the species. While alarming, this review could be misleading if herd limitations and artificial management that diminish wildness are concentrated in a subset of the 44 herds, while another subset remains relatively wild. In contrast, every herd may have some significant problems, with few or no really wild herds. To assess this possibility, I needed to rate and combine values for several wildness characteristics, producing an average "wildness score" for each herd.

In 2008, a convention of 28 bison biologists published a "scorecard" for measuring contributions of bison herds to ecological recovery of the species.<sup>3</sup> The complex scorecard provides 5 standards of ecological recovery for each of 18 rating factors: a large 18 X 5 matrix. The authors considered their scorecard as a work in progress, needing refinement to become operational. Still, it is an excellent summary of the issues and requirements for restoring wild bison. It should influence those who manage bison with a goal of restoring and maintaining wildness.

However, I need a simple scorecard to communicate the status of wildness in plains bison today. With apologies to those 28 biologists, I have selectively abstracted their contribution into a much simpler

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matrix (Chart 11.4). One may argue I have oversimplified: that I have not selected the 12 most important wildness categories; or that I have omitted important herd characteristics related to the future of wildness in plains bison. I admit there are such issues; but suggest that, for all the tweaking that might be done with my simple scorecard, results would be quite similar anyway. I choose not to wait for a consensus on the relative importance of every factor related to wildness in plains bison. Consensus may never come.

I rated each of 12 factors of wildness at 4 levels along the domestic-to-wild continuum (Chart 11.4). My somewhat arbitrary selection and scoring of factors is based on the foregoing chapters. I include "public access" as a scoring factor although it is not likely to have a significant impact on natural selection and the genetics of wildness in bison. I include public access because there will be less value in retaining wild bison if few people can visit, view, enjoy and use their wild bison herd.

I used the scorecard to assess the values of 28 herds for restoring and maintaining wildness in plains bison in the USA. These herds are noted with asterisks in Chart 11.1. For this analysis, I combined 2 herds, the Fort Niobrara National Wildlife Refuge herd and the herd from Sully's Hill Preserve, now at Fort Niobrara NWR. These herds have the same management regime.

The 28 analyzed herds include the 13 largest conservation herds and 23 of the 27 conservation herds with at least 100 bison. The observed herd characteristics and management practices I scored for these herds can change over a few to several years. In two cases, I credited conservation herds with more or fewer bison than existed during my investigation, using the stated management goals for animal numbers when one herd was being allowed to grow and another was being reduced. However, I believe my results present a fair picture of the wildness vs. domestication status of 28 of the most important conservation herds during 2010-2011.

My subset of 28 of the 44 conservation herds of plains bison on native range in the USA is, no doubt, biased towards the wildest

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herds, because I selected mostly the largest among the 44 conservation herds. The average herd size for the 28 scored herds is 553 bison (range = 20 – 3700). The average herd size for 15 of the 16 unscored herds is 70 bison (range = 7 – 320. (One small herd is omitted.) Results from this subset of 28 scored herds understate the prevalence of domestication in our 44 conservation herds because elements of domestication are more common in the smaller herds.

In scoring these herds during 2010-2011, I visited 23 herds to discuss management practices with bison managers. I also contacted 5 bison managers by phone or e-mail. I choose not to identify most herds in this discussion because comparisons among closely ranked herds are not justified. Neither methods nor results are sufficiently precise for such comparisons.

Maximum wildness on my scorecard would result in a score of 36 points. I arbitrarily classify scores as: 0-9, domestic; 10-17, semidomestic; 18-27, semiwild; and 28-36, wild. (These arbitrary definitions, simply quartering 36, are used only to facilitate describing the results.)

### Wildness Values of "Conservation" Herds

Ordinating the wildness scores (Chart 11.5) shows a continuous trend from domestic to wild herds. One state herd, with 5 points, stands out as being exceptionally domesticated (Fig. 11.1). Only two herds met my arbitrary criterion of wild. The overall average score was 17.6, right on the cusp between semi-domestic and semi-wild. About half the herd scores exceeded this benchmark of mediocre wildness.



**Chart 11.4. WILDNESS CHARACTERISTICS OF PLAINS BISON HERDS**  
**A Brief Scorecard**

Wildness Score	Domestic 0	Semi-Domestic 1	Semi-Wild 2	Wild 3
1. Herd Size*	<100	100-500	500-200	>2000
2. Range	<3 sq. mi.	3-10 sq. mi.	10-500 sq. mi.	>500 sq. mi.
3. Constriction	Tightly confined	Exterior and interior fences	Exterior fences only	Fences only in conflict Areas
4. Roundups	Annual	Biennial	Occasional	None
5. Population control**	Stable herd (< 10%)	Little natural fluctuation (10-25%)	Modest natural fluctuation (>25%)	Unregulated
6. Culling***	Highly selective by sex & age, commercial purposes	Some selection for commercial purposes. Very few die on the range	Random culling, juveniles only. Most adults die on the range	Hunting only, on the range
7. Disease control	Annual, several diseases	Routine, $\geq 1$ diseases	Rarely	Never

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Chart 11.4. continued

8. Feeding	Constant	Seasonal	In crisis only	Never
9. Public access	None	Perimeter only	<50% of area, time open	Few or no restrictions
10. Cattle genes	>5% of markers show introgression	<2-5% of markers show introgression	<2% of markers show introgression	No known introgression
11. State legal status	Livestock only, wild bison prohibited	State has legal constraints for wild bison	Bison are wildlife in state recovery plan	Bison are wildlife in state recovery goals
12. Ecological interactions	Few native vertebrates, artificial habitat	10-50% of native vertebrates, >20% artificial habitat	Most native vertebrates, >80% natural habitat	Complete, natural ecosystem****

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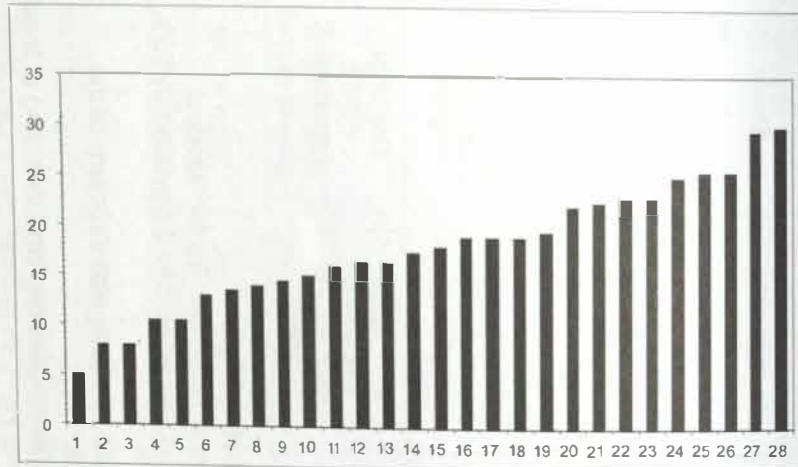
\* Breeding herd size, usually measured over-winter or post-culling.

\*\* Population control limits the amount of natural variation in herd size. So for "Modest Fluctuation", the herd would be artificially manipulated or culled whenever it deviated by 25% from its long-term average herd size.

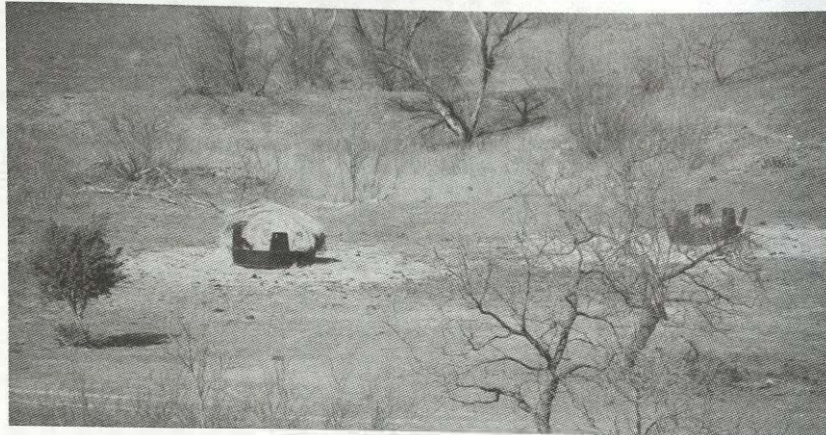
\*\*\* Culling for commercial purposes includes managing the sex- and age-structure of the population, and/or culling to select for body conformations.

\*\*\*\* Complete natural ecosystem = essentially all native vertebrates present, including at least one effective bison predator species.

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**Chart 11.5.** Wildness values for 28 of the 44 plains bison conservation herds on native range in the USA. See text for explanation of wildness scoring.



**Fig. 11.1.** Bison feeders in display pen at Caprock State Park, TX. Artificial watering facilities are nearby. Note paucity of natural forage for bison.

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For each of the 12 wildness factors, a herd may be rated from 0 to 3. (In some cases, I awarded half points for intermediate situations.) The overall average score per factor was 1.46, which is low but not very interesting. However, average scores (across herds) for each of the wildness factors are of interest. They may demonstrate pervasive problems throughout our conservation herds of plains bison. These average factor-scores are:

• State legal status of bison	0.46
• Roundups and handling	0.70
• Managed herd stability	0.79
• Herd size	1.15
• Culling practices	1.41
• Range size	1.44
• Cattle-gene introgression	1.67
• Interior range fencing	1.69
• Disease management	1.79
• Ecological relations	2.04
• Public access	2.19
• Supplemental feeding	2.20

Thus, the most pervasive wildness deficiencies in conservation herds of plains bison in the USA are the first three cited above.

The confusing and lacking legal status of wild plains bison was cited by the International Union for Conservation of Nature as "the single most important obstacle impeding ecological restoration and hindering a nationwide conservation strategy".<sup>4</sup> My low average score for state legal status, above, coincides with this conclusion.



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In this subset of conservation herds, the 2<sup>nd</sup> most pervasive problem for conserving wildness in plains bison is the prevalence of roundups and bison handling. Only 8 of the 28 herds are rounded up less than annually or not at all.

Almost equally pervasive is the prevalent practice of controlling bison numbers to maintain stable herd sizes at relatively low ecological densities. In a review of the bison conservation literature, I found the subverting impact upon natural selection from maintaining a stable, relatively low population of bison is not recognized.

At the other extreme, any lack of natural ecological relations, public access, and use of supplemental feeding were the 3 least prevalent problems for wildness in my subset of 28 evaluated conservation herds.

While most of these herds are in relatively natural environments, only 2 live with effective predators. A high score for public access provides little comfort because, unlike the other 11 factors, public access will have little direct impact upon the genetics of wildness in bison. The high score for supplemental feeding misrepresents the prevalence of this practice across all 44 conservation herds. I expect supplemental feeding is more common in the smaller conservation herds living on smaller bison ranges, whereas my sample emphasized the largest herds.

Overall, my analysis of 28 of the wildest herds confirms and accentuates conclusions reached in the above review of all 44 conservation herds. Practices leading to domestication are common throughout these herds, and very common in most of them. There is no subset of conservation herds that scores well for most or all the wildness criteria.

In this subset emphasizing the wildest of the 44 plains bison conservation herds on native range in the USA, a strong majority of herds is rated as either semi-domestic or semi-wild (Chart 11.5). Most of the wildest herds are located in the northern Great Plains and the Rocky Mountains. All but one of several herds in the central Great Plains is rated semi-domestic. Most of the wildest herds are managed

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by the National Park Service and the US Fish and Wildlife Service. A majority of the most-domesticating herds are managed by the states, local governments and private organizations.

### Our "Wildest" Plains Bison Herds

Based on the above criteria, the two wildest plains bison herds on native range in the USA are in the Henry Mountains of Utah and in the Yellowstone Park area. But how wild are these herds? Each has severe limitations detracting from their value as our best examples of wild plains bison to leave for future generations.

Aside from living in an unusual bison habitat surrounded by semi-desert shrubland, the Henry Mountains herd is limited to 325 animals. This low number fosters some degree of inbreeding and is far below the number of bison needed to thwart genetic drift and maintain genetic diversity. As of 2011, Utah has not addressed the inbreeding issue. Periodically bringing additional genes from another herd into the Henry Mountains herd should be considered. The Henry Mountains bison originated from Yellowstone Park and appear to be free of cattle-gene introgression. Maintaining this genetic purity is desirable. Therefore, Utah should consider obtaining bison from the Yellowstone herd or from one of the few herds that originated with Yellowstone bison and has remained cattle-gene free. Still, periodic interjection of "new blood" into the Henry Mountains bison herd will do little to combat losses due to genetic drift in this small herd.

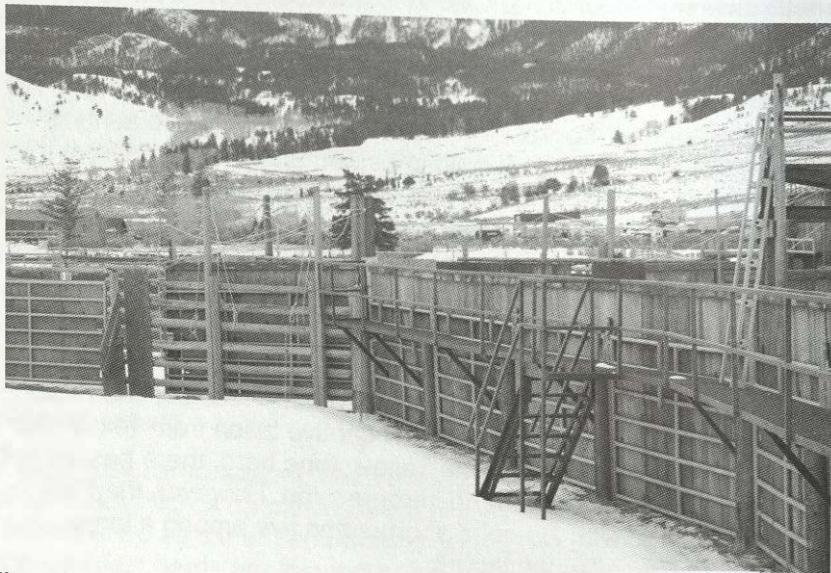
Yellowstone National Park has our premier herd of wild plains bison. Yellowstone is the only place where wild bison were not eliminated about 100 years ago. All other herds have been reestablished with bison from captive herds. While a few captive bison from Texas and Montana were once added to the Yellowstone herd, there has, as yet, been no evidence of cattle-gene introgression. However, the Park bison are infected with *Brucella abortus* and live among a large population of *Brucella*-infected elk.

Despite the low and controllable risk of bison infecting domestic



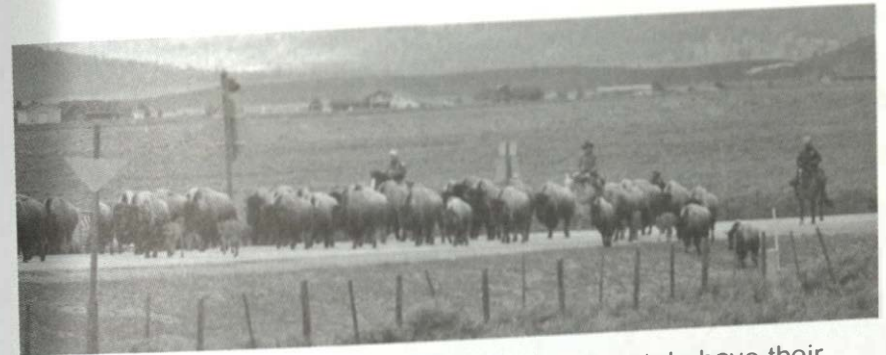
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livestock with brucellosis, the Park Service and Montana have subjected Yellowstone bison to several interventions that replace or weaken natural selection and lead toward domestication. Herd size has been limited with selective culling. Bison have been vaccinated. In the winter of 2011, up to 700 bison were held and fed for up to 4 months in crowded pens (Figs. 8.5, 11.2). Bison that leave the Park in early spring are driven back into the Park each May (Fig. 11.3). Additional domesticating interventions are being considered, including an additional pen for holding and feeding more bison in winter and an attempt to remotely vaccinate all Park bison, including very many that never leave the Park and pose no risk to livestock. Experiments with immuno-contraceptive drugs are being conducted. Even our most wild herd of plains bison on native range in the USA is being subjected to many interventions that jeopardize its wild genome.



**Fig. 11.2** Facilities for handling "wild" bison inside Yellowstone National Park.

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**Fig. 11.3.** Bison leaving Yellowstone National Park to have their calves amid fresh green forage at lower elevations are rounded up and driven back into the Park each May (Buffalo Field Campaign photo).

## Pervasive Domestication of Plains Bison

This summary of the wildness status of 44 conservation herds of plains bison, and the more intensive analysis of a subset of 28 of these herds, demonstrate pervasive, ongoing domestication of the plains bison genome. This insidious threat is more serious than cattle-gene introgression. It is more serious than the loss of genetic diversity because gradual domestication is receiving less attention (and loss of genetic diversity is part of the domestication process). The brush with extinction is not over. For more than 100 years, we have been slowly domesticating plains bison, leading to genetic extinction of the wild form.

## Footnotes

<sup>1</sup> During 2010-2011, I surveyed 28 of the largest and most important conservation herds of plains bison on native range in the USA. This information was supplemented with data from Boyd (2003) and from Dratch and Gogan (2010).

<sup>2</sup> Jones and Roffe (2008) recommended this USFWS metapopulation



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strategy. Its implementation is described in Refuge Update, USFWS, January/February, 2011.

<sup>3</sup> Sanderson et al. (2008).

<sup>4</sup> Gates et al. (2010).

## Part IV

### Restoration of Wild Plains Bison

*In wilderness is the preservation of the wild bison genome.  
(with acknowledgment to Henry David Thoreau)*

*The path toward restoring wild bison is not entirely clear.  
Much remains to be tested and learned.*

*However, if we wait for all the answers, we will never restore wild  
bison. We must go to learn, and learn as we go.*