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## Bull Bison Behavior Traits<sup>1</sup>

DANIEL M. HERRIG<sup>2</sup> AND ARNOLD O. HAUGEN<sup>3</sup>

*Abstract.* Behavior of bull bison (*Bison bison bison*) was studied during June, July, and August 1968 at Fort Niobrara National Wildlife Refuge, Valentine, Nebraska. Ingestive, eliminative, grooming, sexual, agonistic and investigative behavior patterns were observed. Movement patterns and inter-specific relationships were also observed.

Information on bull bison has been published by McHugh (1958), Fuller (1960), and Egerton (1962). Published information, however, does not provide sufficient data for a good basic understanding of the relationship of old bulls—sometimes referred to as “loners”, to the rest of the herd.

With bison herds becoming more numerous in local, state, and national parks and with more leisure time for recreation available to people, additional information on bison behavior may make the animal more important as a recreational resource. Visits to public parks would be more rewarding and meaningful if people could recognize behavior patterns and understand their implications.

American Plains Indians depended on bison for food, shelter, and implements and incorporated images of bison into their religion, superstitions, and ceremonial rites. Basic data on the behavior of bison may therefore also become useful in anthropological studies of these people.

### METHODS

Behavior of bull bison was studied at Fort Niobrara National Wildlife Refuge, Valentine, Nebraska, during May 29-August 30, 1968. This is an area located along the Niobrara River near the northern edge of the rolling sandhills of north-central Nebraska. The refuge currently supports approximately 300 bison with an approximately equal (normal) sex ratio. The animals spend their summer seasons in two pastures totaling 4,403 acres. The pastures are enclosed with 8-foot wire-mesh fences. As a result of repeated tests in the past, the herd is now considered free of Brucellosis, a cattle disease present in some other bison herds.

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Data on the behavior of bison were collected by direct observation from a car parked in the pasture, from a Honda motorcycle, and from vantage points where the observer remained hidden from the bison. Most of the data were obtained from within a vehicle since it could be driven anywhere in the pasture and allowed the observer to get closer with little disturbance to the bulls. Because there was only a scattered number of small trees in either pasture, stalking to within good observation distance without being noticed was almost impossible. Observing from a car also provided maximum safety for the observer.

Most of the observations were made with 6x30 binoculars and a 20X spotting scope. A range-finder 35mm camera, with 50mm lens, and a Bell and Howell Super-8mm movie camera, with a zoom wide-angle to telephoto lens, were used for recording behavior on film. Other equipment included a stop watch, a compass, wind gauge, maximum-minimum thermometer, mechanical counter, and a 12-volt 20,000 candle power sealed-beam spotlight.

Behavior observed was categorized according to the classification established by Scott (1958), including ingestive, eliminative, investigative, sexual, and agonistic behavior. Grooming behavior was also recorded.

Each animal at Fort Niobrara is branded with the last digit of the year in which calved. Brands, along with scars and other physical characteristics, made it possible to identify 22 bulls as individuals. The brands were useful for determining the age of bulls and the cows that were "tended."

## RESULTS

*Ingestive Behavior.* Bison at Fort Niobrara National Wildlife Refuge are pastured on the gently rolling Nebraska sandhills. Grasses common to the hills are wheatgrass (*Agropyron smithii*), buffalograss (*Buchloe dactyloides*), sand bluestem (*Andropogon hallii*) and sand lovegrass (*Eragrostis trichodes*). No data were obtained on the particular species eaten during summer. The food of the bison consisted almost entirely of grasses, with little of anything else available. On only one occasion was a bull observed nibbling on a branch of a tree or shrubby growth. Water was available in large tanks kept full by windmills.

Most ingestive behavior observations from day to day were limited to two particular bulls during June and July, before the rut began (Table 1). The actual time when individual bulls fed varied considerably from day to day, more so than the feeding time of the herd as a whole. Generally a bull fed five times during a day: at midnight, dawn, late morning to early afternoon, mid-afternoon and early evening until after dusk. This is the approximate periodicity found by Shult (1968). Fischer (1966) observed that grazing periods were 2 to 3 hours long. Observations in our

Table 1.  
Comparison of Bison Movement with Major Activity and Time of Day

Period	Bull Number	Clock Time of Day*	Total Hours Observed	Distance Traveled (Miles)	Distance Moved per hour	Major Activity
Daybreak to sunup	1	0400-0500	1	.25	.25	Walking
Sunup to midmorning	8	0600-0930	3.5	.55	.16	Grazing, ruminating
	1	0500-0830	3.5	.50	.14	Walking, grazing
Midmorning to noon	1	1030-1330	3	.66	.22	Grazing, standing
	8	0930-1130	2	.75	.37	Walking, grazing
Noon to midafternoon	8	1200-1700	5	.5	.10	Walking, lying in wallow
	1	1200-1400	2	.25	.13	Walking, ruminating
Midafternoon to sunset	8	1500-2000	5	.5	.10	Grazing, ruminating
	8	1600-1830	2.5	.5	.20	Walking, grazing
Sunset to dark	8	1900-2200	3	1.25	.42	Grazing, walking
Night time	1	2000-0530	9.5	.2	.03	Grazing, lying

\*Mountain daylight time.

study varied with the particular feeding period, the mid-afternoon feeding period being the shortest, often only 1 hour or slightly longer in duration, and the evening period being several hours longer.

In general, each grazing period started with the bulls rising from a wallow or from the grass and beginning to graze nearby. Grazing, at first, was very intense. The extent of moving around while grazing varied. The bulls at times continued to graze with decreasing intensity and gradually moved toward a water tank. At other times, such as during the hotter period late in the day, a bull would graze to a wallow, stop abruptly, lie down, and ruminate. Changes in the day-to-day grazing habits of the bulls were noted.

High summer temperatures and rain seemed to have little influence on behavior. On July 15, for example, the temperature ranged from a high of 96°F to a low of 74°F, with an average of 85°F. The mid-morning was spent standing and lying, often ruminating. The late morning was spent grazing with little movement, and the whole afternoon was spent lying in one area. Around 1600 to 1700 hours (mountain daylight time, MDT), the bulls moved toward water and drank at 1813 hours. On this particularly hot day, the buffalo bulls were, in general, less active than on the following 2 days which were cooler. By combining the hourly data for June 25 and 26, we have an interesting comparison of behavior on cooler days. The lows for these 2 days were 49° and 47°F, respectively, with highs of 59° and 65°, with daily averages of 54° and 56°, respectively. The bison were active and grazing at sunrise of these cloudy days. The bulls spent the mid-morning lying and standing in a small area. In the late morning, the bulls rose and walked to the water tank, grazing as they went. Increased movement was observed during the afternoon. The bulls drank at the hour of 1510 (MDT) and grazed a short period thereafter. The latter part of the afternoon was spent lying and ruminating. These are examples of activity on the hot day of July 15 as compared to activity in the cooler period of June 24-25. The only real difference was the greater activity during the afternoon on the cooler days. A slight increase in activity of the bison was associated with the cooler days. Bison have likely evolved to adapt to the extreme temperatures of the plains, and it seems logical to assume that temperature may affect their daily habits only slightly.

When feeding, the bulls grazed continually for an average time of approximately 2 minutes. Repeated interruptions resulted when the bulls looked up to stare at the observer or to swing their heads back to their flanks to brush away flies. The bulls averaged about one bit of grass per second when grazing intensively.

The bison obtained water at three tanks spaced about 1 mile

apart. The tanks, which overflowed almost constantly, caused small pools to form nearby. Bulls were never observed to drink from these pools. Due to the proximity of the tanks, the daily drinking habits of the bulls may have been different from what might have occurred under "natural" conditions. Fischer (1968) did not observe the bulls to drink daily although McHugh (1958) claims they do. Shult (1968) found that cow-calf groups visited water areas at least once a day. There is a strong indication that one of the bulls we observed drank water at 1000 hours (MDT) on July 18 and not again until 0830 hours on July 19. These data, plus other observations, seem to indicate that bulls probably do attempt to drink water daily. Bulls drank one-third to half as often as did the cow-calf herd at the refuge.

Bulls displayed what seemed to be a distinct and consistent pattern when drinking at the water tanks. The animals would walk up to the tank, pause, swing their noses down and sideways, just skimming the water and causing a slight splash. They would then drink for a period of 45 to 100 seconds (average, 72 seconds), pause with heads up for 10 to 20 seconds, and drink again for 10 to 30 seconds. When through drinking, bulls often rubbed their faces and noses on the edge of the tank, turned, and walked away. This pattern of taking a "long" drink, pausing, and then drinking for a shorter time was common and was observed more often than not. On a few occasions when the bulls were hurried by other "dominant" bulls, and in instances when tending cows, only the initial longer drink was taken. The amount of water consumed could not be measured. Swallowing averaged once each 2 seconds for one bull.

Rumination by lone bulls occurred while they loafed, in either a standing or lying position. From 55 to 57 chews were noted for each bolus. Fischer (1968) found bulls chewed their bolus 38 to 70 times at a rate of one chew per second. The bulls, in this study, chewed steadily, increased the rate with the last few chews, swallowed the masticated food, and then, in 2 to 3 seconds, produced a new bolus.

Ingestive behavior by the bulls was altered somewhat with the advance of the rutting season. The activity of the animals was generally increased, but the actual time spent in feeding decreased. The effect of this decrease in feeding was accompanied by a noticeable loss of physical condition. When certain bulls lost their interest in breeding activity toward the end of rut, they appeared to resume their former feeding habits.

*Eliminative Behavior.* Bulls exhibited distinct eliminative patterns. While urinating, they generally held their tails in a position approximately 45 degrees above the dorsal line of the rump area

(Figure 1a). This position of the tail seemed to serve as an indicator of urination. No data were recorded on the frequency or duration of urination by the bulls.

No evidence has been found to indicate that bulls use urine to "mark" a particular area or to defend it. On several occasions, bulls urinated in a wallow while vigorously pawing the sand and then rolling, especially during the breeding season. The urine-wetted sand often stuck to their sides. Such behavior was observed only when the bulls were tending cows and being agonistic toward other bulls nearby. Urination appears to stimulate sexual response among both sexes and all ages, except in calves.

Both urination and defecation occurred often near watering tanks. After drinking at the tank, bulls often walked away either grazing slowly or ruminating. Several times they were observed to pause within 60 to 100 feet of the tanks and to urinate. Defecation also occurred at such times, but not as frequently.

When defecating, a bull arches its back and raises its tail up to a point where the basal portion is vertical to the dorsal line of the rump area. The hind legs of the animal are generally spread apart, resulting in the posterior end being lowered slightly (Fig. 1b).

Defecation was quite frequent. Observations include 3 defecations in 3.7 hours, 5 defecations in 5.8 hours, and 2 defecations in 2.6 hours. The first two observations were made of one bull on 2 consecutive days. It may be possible that the bull was having some elimination difficulty at the time because it was seen to squat and attempt to defecate, but without passing feces. Excitement stimulates defecation and urination. A typical reaction to the sudden arrival of the investigator in a vehicle is for bison to rise from their wallow or to stop grazing and then to urinate or defecate before leaving. When disturbed, a bull may defecate while walking away.

*Grooming Behavior.* The major grooming behavior of bull bison consists of wallowing (rolling). A wallow is a shallow bowl-like depression in sand and varies greatly in size depending on the amount of use by bison (Fig. 2). It is first formed when a bison "paws" or "horns" the ground to produce a bare spot which becomes progressively deeper and wider with additional use. From general observation, bulls wallow much more frequently than cows and calves, although the latter were seen wallowing at various times.

A bull usually approaches a wallow, sniffs the ground, and begins pawing and (or) horning the sand. The bull then drops to its knees and rubs its throat area in the sand while in a kneeling position. It then slowly lowers itself into the wallow as it moves its hind feet forward. This procedure is described by Fischer (1968). The

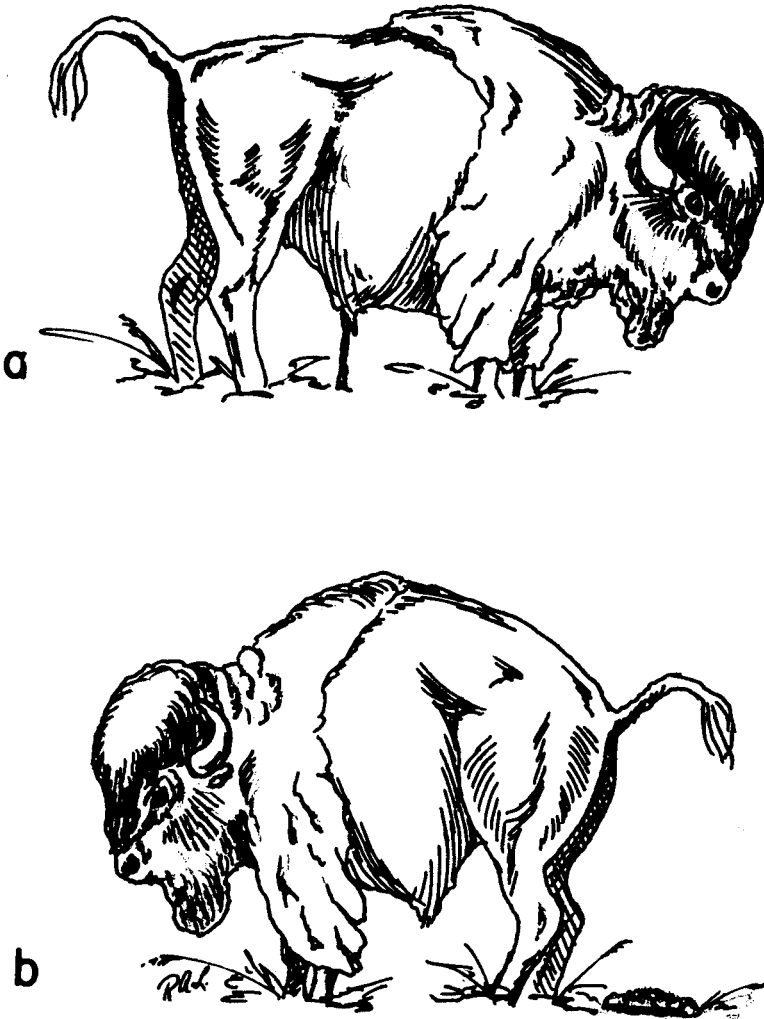


Figure 1. Typical eliminative postures for bison, (a) urinating, (b) defecating.

bull then lies on its side and kicking with the feet, dust or sand flying, rolls rhythmically from side to back. The exact procedure varies from bull to bull. On occasions, for instance, a bull lay on its side and simply rolled its head up and down from the ground in a behavior pattern referred to as the neck roll. The number of times a bull rolls varies, as does the vigor with which it rolls. Because of the shoulder hump, it is probably physically impossible for a bull to roll completely over. However, calves, also do not roll





Figure 2. A bison wallow is a shallow bare-earth depression produced by pawing and rolling. Those that receive repeated use may be hollowed out to about a foot in depth at the center.

completely over. After rolling, a bull often shook itself to remove sand like a dog shakes itself to remove water.

As a general observation, bulls horned the sand and rubbed their chins and necks in the wallow more often than they pawed the wallow. During the rut, however, bulls were much more vigorous in their rolling movements and also appeared to paw the sand more readily.

At times, before rising to their feet after lying or rolling in a wallow, the bulls would sit on their haunches in a position similar to that of a dog. They would then throw their heads and fore-quarters forward and upward, and back again, creating a motion that would rub their posteriors back and forth on the sand. On two different occasions, adult cows, one with a calf, were observed displaying this butt-rubbing behavior before rising after wallowing. The see-saw action, as it will be referred to, may be merely a method of scratching. On one occasion, a bull moving away at a fast walk suddenly stopped at a wallow, sat down, rubbed its posterior, rose, and continued on. It appeared as though it merely stopped to scratch and relieve an itch.

The wallowing behavior may be a form of displacement activity by the bull. Often when disturbed a bull lying in a wallow, and even on grass, will roll once or twice before rising and trotting

away. The role of wallowing in agonistic behavior will be discussed later.

Bulls also used fence posts and the few trees in the pasture for rubbing. As mentioned earlier, they often rubbed their faces and foreheads on the water tanks and used windmill legs as favorite rubbing places. On one occasion, a bull was observed rubbing intermittently for 15 minutes on the leg of a windmill.

At times, the bulls were observed scratching themselves with their hind feet. One bull, with a sore area around one of its eyes, probably the result of biting flies, was seen to reach forward and scratch the eye with its hind hoof with surprising daintiness.

Fischer (1968) mentions bulls using small juniper trees for grooming behavior. He states that the animals broke the trees in two instances. There were no small trees on the sandhills, but the bulls were observed to rub and "horn" small bushes, often tearing them out of the ground.

*Sexual Behavior.* Sexual behavior of bison was observed frequently at Fort Niobrara. This behavior included smelling and licking of cows' vulvas, forming tending bonds (a sort of temporary pairing forced on the cow by the bull), and actual breeding.

The lip curl was a common form of sexual activity among bulls (Fig. 3a, b). In exhibiting a lip curl, the bull would elevate its upper lip with the hairless area of the nose pad (muzzle). The resulting nasal expression is similar to that of domestic bulls. It was usually accompanied by the elevating of the bull's tail. This behavior was observed throughout the summer, but became more pronounced during the rut. On one occasion, a young bull smelled the rump of a second bull and then displayed the lip curl for 10 seconds. The lip curl itself was often displayed for this length of time, during which the bull would slowly turn his extended neck from side to side (Fig. 3b). It did not appear to matter if the bull was facing into the wind or away when displaying the lip curl. On one occasion after a 5-year-old bull was observed to urinate, it moved backwards a few steps, smelled its own urine, and displayed the lip curl. As a general observation, it was not uncommon for a bull to smell grass, then display the lip curl. This behavior may be a reaction to the scenting of urine from a cow that had passed by earlier.

On several occasions, the penis of older bulls was noted protruding partially from its sheath. One such bull with an unsheathed penis who entered the periphery of a small group of cows made an unsuccessful attempt to mount a cow, then displayed the lip curl after smelling the vulva. On another occasion, a bull with a partial erection was seen to squat but it did not defecate. This was fol-

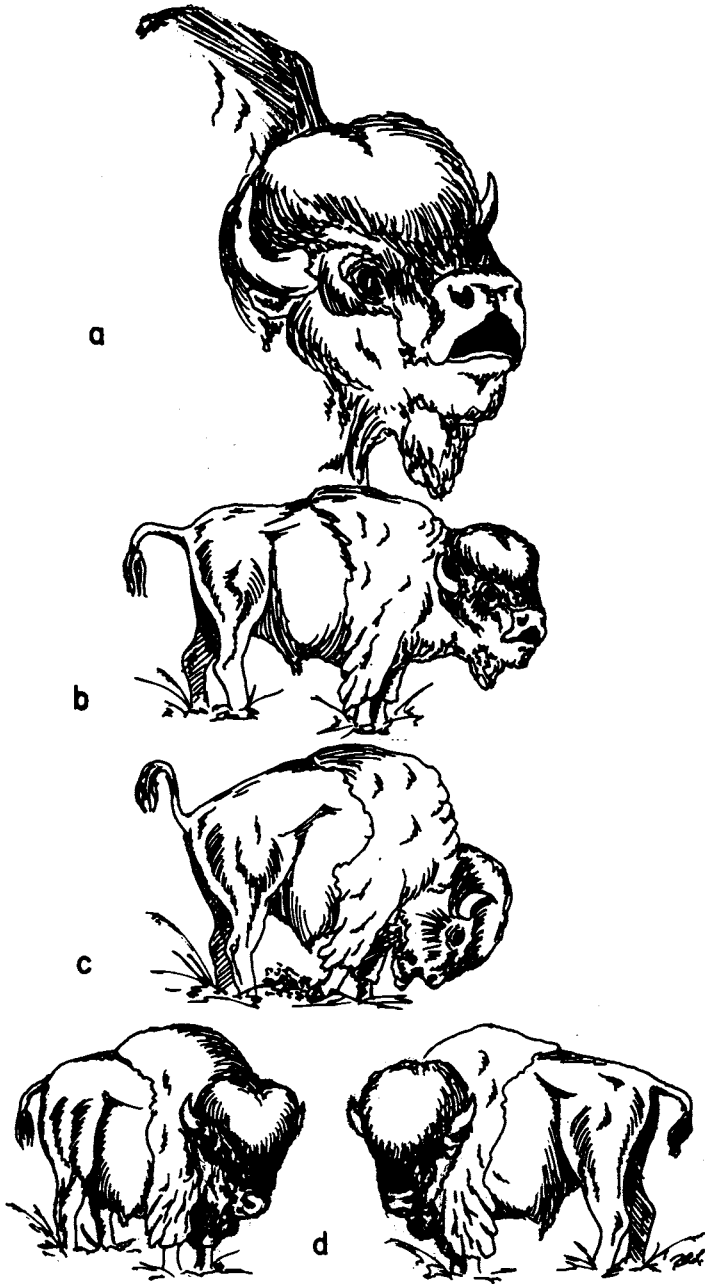


Figure 3. Some postures commonly associated with reproductive activity of bison. The tail positions are typical for each case. (a, b) Lip curl commonly exhibited following touching of nose to vulva or urine of female bison.

lowed by roaring, snorting, and pawing the ground as it displayed agonistic behavior toward a nearby bull. Later the same day, a younger bull was observed with a similar posture, but agonistic behavior did not follow. No observation has been made of masturbation.

No. 1 bull (7 years old) was alone much more of the time than was No. 8 bull (8 years old). When an old bull is referred to as being alone (often referred to as "loners" by area administrators who believe they are outcasts), it means that it is neither with an individual bull nor with a group of animals and that it does not move with any bison while grazing and walking to salt or water. Neither bull No. 1 nor No. 8 were associated for any period with the cow-calf herd before the onset of the rut, whereas certain other bulls were often observed mingling with the cows. "Lone" bulls did occasionally enter the cow herd for instance, when it grazed nearby or as the herd passed enroute to water. On these occasions, the so-called "lone" bulls would move through the group, smelling a number of cows, and then walk out of the area.

On several instances cows were observed to be reluctant to allow sexual attention by any bulls. On June 10, for example, No. 1 followed a cow around in circles several times before she would submit to his smelling of her vulva. On July 9, No. 8 smelled (nosed) a young cow's vulva, which resulted in her kicking at him with one hind leg. No. 8 also pursued one cow 50 feet that day before she stopped long enough to permit him to smell her vulva. Only one record was made of a bull smelling a cow's vulva and not displaying a lip curl. This occurred when No. 1 was being driven from the cow herd by an older and larger bull.

By mid-July the amount of roaring increased noticeably among bulls in the cow-bull herd. When "lone" bulls would approach within 50 to 100 yards of the herd, "herd" bulls would display agonistic behavior and the incoming bulls responding similarly (Fig. 3c). Individual bulls displayed agonistic behavior toward invading bulls earlier in the summer but, in general, such occurrences were not frequent. Several instances were recorded of bulls entering a cow herd and moving slowly about for several hours before a "herd" bull would approach the intruding bull and follow it out of the periphery of the herd, roaring and snorting as he followed at a walk. The invading bulls appeared more reluctant to leave as the breeding season set in.

The first tending bond was observed on July 22. It involved No. 8 bull. A tending bond occurs when a bull remains by the side of a single cow, attempting to isolate her by keeping between her and

(c) Bull displaying agonistic behavior toward another bull during the rut.

(d) Two antagonistic bulls in typical position just prior to swinging heads together for combat.

the other members of the herd. The cows often seemed reluctant to remain with the bull and attempted to escape by running, but the bull herding her would run closely beside her to head her off and isolate her at the fringe of the herd. This tending bond effort supposedly is followed by the cow eventually being bred by the tending bull. This, however, does not always appear to be the situation. The duration of the tending bond varies, and on occasions, the "turnover" of bulls tending a cow seemed to indicate that many of these bonds were interrupted. Number 8 bull tended one cow for at least 3 days. It was then observed tending another cow for 2 days. On the second morning with the second cow, the bull was seen to mount and serve her. The copulation took place at dawn. Number 8 mounted the cow several times, but it appeared that he actually served her on only two occasions. At first, the cow attempted to mount the bull by swinging her head onto his back, possibly to stimulate sexual response from him. The cow's tail was held almost parallel to the ground after being served. During the whole process, a group of bulls was constantly running around in an excited fashion, causing the tending bull to run after the cow to keep her away from the eager intruders. The cow, after having been mounted eight times, two of which were successful, and a lapse of 50 minutes, would not allow the bull to remount, and the two began to graze together. The same pair remained together the rest of the day, but the bull was seen with another cow on the following day.

Several instances were recorded of bulls being driven away from a particular cow by a more aggressive bull. A 7-year-old bull (No. 1) fought successfully with a tending bull on July 23, but the next morning, the cow was being tended by a third and older bull which had dominated No. 1 earlier in the summer. Number 1 was away from the herd by itself that day. In general, such interruptions in tending bonds occurred quite frequently among the bison. It is possible that a limited number of the older and more dominant bulls did most of the breeding, while many of the bulls recorded as tending were merely with the cows early in their oncoming estrus period. The youngest bull that appeared to exhibit an active tending bond was 5 years old. The younger bulls generally followed the tending bonded pairs and remained as small ("satellite") groups near the old bulls. In contrast, the older bulls not tending a cow would either be away from the herd or moving about alone and investigating cows. The observations of the 8-year-old bull did prove that it was not only the bulls that remained with the herd throughout the summer that did the breeding. Table 2 shows the number of cows tended by particular bulls and the dates on which each cow was tended. In some instances, a cow could have been tended by more than one bull or by the same bull twice.

Breeding activity continued throughout August, with decreased interest being noted among the older bulls. Many fights occurred, and several bulls suffered wounds before the end of August. As the end of the month drew near, the older bulls grew less and less interested in the cows. Roaring continued throughout the month, almost constantly both day and night.

Data on bull-cow tending bonds involving 22 bulls and 8 individual cows on 19 different days were secured between July 22 and August 28 (Fig. 4, Table 2). Unfortunately, a gap exists in the data because the investigator was absent from the area and therefore could not secure information for July 30 to August 6. From the tending bond data available, indications are that considerable rutting activity occurred in the last week of July and first 3½ weeks of August. There are indications that the cows without calves attracted the breeding bulls to form tending-bonds earlier in the breeding season than did the cows with calves.

Table 2

Bull-cow Tending Bonds at Fort Niobrara, 1968, for 22 Bulls and 72 Cows. Total number of cows for each bull is indicated with dates listed on which tending bonds were recorded

Bull Number	Age of Bull	Number of Cow Tended	Dates on Which a Cow was Tended	
			July	August
1	7	1	23	
2	7	1	24	
3	8	3	24	7,9
4	9	3	24	9,15
5	6	2	24,25	
6	10	3	24,29	11,13
7	12	4	29	5,7,9
8	8	7	22-24,26*,27,29	7,9,11-12
9	10	6		7,11,13,15,19,20
10	9	2		7,11
11	—	4		13,14,15,20-22
12	6	1		7
13	5	1		7
14	8	3		7,9,11
15	8	5	27	7,9,11,12
16	9	10		7,9,11,12-13,14,15,19,20,22,23
17	8	4		9,11,13,14
18	9	3	24-26,27,29	
19	10	3		9,14-15,19
20	8	3		11,12,13
21	7	1		11
22	11	2		12,13

\*Actual breeding observed.

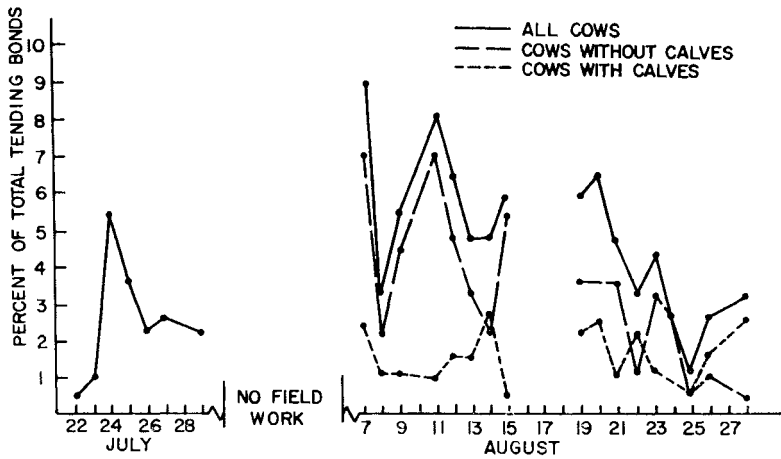


Figure 4. Occurrence of bison bull-cow tending bonds at Ft. Niobrara National Wildlife Refuge. (Expressed as percentage of total bonds observed.)

*Agonistic Behavior.* Many instances of agonistic behavior (driving off intruders) among bulls were recorded. Agonistic actions ranged from stares from a distance, with pawing and rolling, to a number of actual fights. Such behavior was observed throughout the period from June 2 to the end of August, the period of the study.

Many of the interactions were between older bulls entering or passing near a bull group. Most often it involved only roaring, pawing and (or) horning the sand, and rolling in a wallow. This horning and pawing was accompanied by urination as mentioned in elimination behavior. Except during the breeding season, the bulls in all instances observed went to a wallow to display, even though the wallows were up to 20 yards away. After this the bulls would stare at one another, maybe roll a few more times, and finally begin grazing and moving away. During breeding season, however, the bulls pawed and rolled wherever they stood, often tearing out clumps of sod as they pawed.

Caution was often observed when a bull walked in a stiff-legged manner in front of another bull. The bull moved slowly with short, choppy steps; its tail was raised only slightly and held 2 or 3 inches from its buttocks, and its neck was held straight forward with its face vertical with the ground. The stiff tail held only slightly away from the buttocks was often observed in agonistic behavior, especially when bulls were close, within a 25 to 30-foot range. Submissive behavior was displayed when a bull turned its head away from the dominant bull, and this was often the reac-

tion when a dominant bull approached or walked past another bull. This was also noted just before and just after a fight. In such instances, both bulls would stand parallel to each other but with their heads turned to the side, usually in the same direction (Fig. 3d).

Because of the large number of animals in the pasture, few data could be secured on order of dominance of bulls. Bulls, however, were not always dominant over the same bulls. From observation, age did not seem all-important because 6-year-old bulls often dominated older ones. An adult might just swing its head toward a younger bull to scare it away, or the dominant bull might make a short threatening bound in the direction of the bull to be displaced. At times a stare and low bellow was sufficient to cause a challenged bull to rise from a wallow and move away from a more dominant bull. Most of the minor interactions before breeding season occurred where bulls were most likely to confront one another, at a wallow, at water tanks, or near salt boxes. At times a dominant bull would merely walk up to another bull lying in a wallow and, with no observable communication of interaction of the two, the bull reclining would rise and walk away, allowing the intruding bull to lie in the wallow. Although not always obvious, bison bulls are very aware of happenings around them. Many subtle interactions, not apparent to the observer, have resulted in behavior which could not be interpreted.

All fights observed were between bulls, one of which was tending a cow. Such bulls would approach each other at a fast walk, slowing to a "stiff-legged" cautious approach when they drew within 20 feet. They would both look to the side avoiding a direct look, and stop when their heads were side by side and about 3 to 6 feet away from each other; they would then almost simultaneously lower their heads and butt them together (Fig. 3d). A pushing contest would start, with the break occurring when one bull would suddenly jerk its head up, twisting one horn up and toward the other bull with a vicious hooking motion. Hair often flew into the air when this occurred. When one bull turned away too soon, the other bull would keep coming, and the retreating bull would have to sidestep or receive a stab in its side. The tail of each bull was almost straight up during combat. Such fights lasted but a few seconds, the longest continuing approximately 20 second. When the fight ended, the bulls stood a few feet apart, breathing heavily and eyes bulging, the "loser" usually turning first to walk away. Many such battles occurred during the rut when the bulls were tending cows. Injuries suffered were usually on the faces of the bulls, and at times the eyes were swollen for several days. Two bulls were found limping from injuries.



On one occasion, a bull was attacked from the rear. This seemingly is not uncommon since scars were often seen on the sides and hindquarters of bulls. One 3-year-old bull was punctured in its rib cage and died during the last week of August, presumably from the wound. At Wind Cave, an old bull was observed to puncture the right rear leg of a younger bull that came too near as it walked by.

During the height of the breeding season, the bulls seemed to show less concern for vehicles and were less willing to run away than previous to that time. Data were also obtained on increasing agonistic behavior by observing the distances between bulls outside the cow herds for the 3 months (Fig. 5). As a general trend, bulls were found further and further apart as the breeding season neared and spread apart even greater distances as the rut continued (Fig. 5).

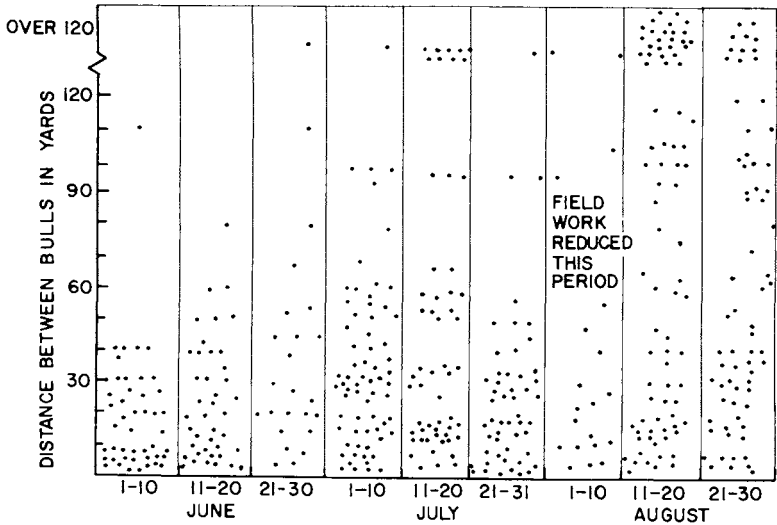


Fig. 5. Distances between bulls found away from cow herds in the summer months. Note the tendency for greater distances of separation as the July and August breeding season progressed.

*Investigative Behavior.* A number of investigative responses were noted among the bulls toward a wide range of disturbances—both natural and manmade. A common reaction to the smell of urine or feces was the lip curl. Bulls and cows of all ages displayed this behavior in some degree. In general, however, it was much more common in bulls and was observed throughout the summer. It was common for bulls to suddenly stop grazing, smell of a cow's

urine on the ground and then lip curl. Bulls ordinarily do not wander off their paths to investigate, but one instance was recorded where a bull stopped suddenly on a trail, turned off, walked a few yards, rubbed its nose in the grass, and produced a lip curl. This may support McHugh's (1958) reported keen sense of smell in bulls.

The eyesight of the bison bull is keen. On one occasion several bulls stopped grazing and stared at another approaching bull, even though it was a mile away and the wind direction was such that they could not have scented it. Two bulls stopped grazing and stared at the investigator's vehicle when it began moving even though approximately one-quarter mile away. Several instances were noted of bulls interrupting their ruminating or grazing to stare at vehicles or horsemen several hundred yards distant.

Reaction to sounds also presented some unique behavior observations. Throughout much of the summer, for instance, there occurred one or two very loud sonic booms over the area almost daily. There was no reaction to any of these sounds. Although planes flew over at low altitude several times each day during midsummer, only once did a bull even look up. Loud thunder caused no reaction, and the sonic booms probably sounded like thunder to bull bison. The noise of a motorcycle on a road behind a hill and out of sight caused one bull to look at the investigator, probably associating the noise with him, even though he remained motionless. The honk of a car horn merely caused one bull to cease grazing and stare for 5 seconds before resuming feeding.

The bison were curious of foreign objects in the pasture. On several instances a small herd of bison surrounded the investigator's car, licking and rubbing on it. Such behavior was not exhibited by a solitary animal although two young calves did approach the car close enough for the investigator to reach out and touch their heads. A motorcycle used at times by the investigator generally caused bison closer than 35 yards to move away. Lone animals took flight at even greater distances. In one instance, the animals ran 80 yards before turning to stare. A jackrabbit, which ran within a few yards of one bison, caused no discernible reaction. Coyotes howling at dusk did cause a bison bull tending a cow to stare in the direction from which the sound came.

When spotlighted at night for a period longer than a few seconds the bison "froze" for a few seconds then began to run, no matter how far away. The sound of a car moving did not appear to frighten the bison unless the headlights were turned on, in which case they reacted as to a spotlight. The bison's eyes, when spotlighted in the dark, shone bright pale yellow.

The bison were aware of the investigator's presence almost all the time they were observed for behavior. One day a bull came to

drink on the opposite side of a water tank where the observer was stationed. After drinking, it walked around the tank to where it could see the observer, or so it seemed. Awareness of an observer's presence may have altered the bison's behavior somewhat at times.

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