

## AGGRESSION IN THE SOCIAL BEHAVIOR OF ROOSEVELT ELK

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Abstract: Aggressive behavior of Roosevelt elk (*Cervus canadensis roosevelti*) was studied at Prairie Creek Redwoods State Park in north-western California for a one year period. The principle method used was field observation. Aggressive behavior was expressed within the bounds of a fairly well-developed dominance hierarchy, with more overt forms of aggression occurring where a less stable hierarchy existed. Little aggression was observed within different age groups of elk, other than within the calf group; a relatively high degree of aggression was observed between age groups, with the older individuals usually being dominant. Redirection of aggression resulting in chain reactions of aggressive activity was common. Aggressive patterns were observed developing among calves at one month of age, and a stable calf hierarchy was observed formed by the time the calves were six months of age. Size seemed to be the major determining factor in the outcome of encounters between calves. Antlers proved to be an important display mechanism used in aggressive interaction between bull elk. Sign-posting is one of the more complex aggressive patterns observed, functioning as a means of spacing groups and individuals; feeding may be a secondary function of this behavior during certain periods of the year. Special aggressive patterns are observed for the bull elk during the rutting season. Initiated aggressive responses often are observed to conflict with withdrawal and fear drives, resulting in redirection, displacement, immobility, appeasement, and response combinations. Through these patterns of aggressive behavior expressed within the limits of a dominance hierarchy basic life requirements can be more efficiently fulfilled at both the group and individual level.

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This report is based on some of the findings made during a field study of the social behavior of Roosevelt elk at Prairie Creek Redwoods State Park, Humboldt County, California, during the year 1967. The study was conducted under an agreement between Humboldt State College and California Division

of Beaches and Parks. It partially fulfills the requirements for a Master of Science degree at Humboldt State College.

Prairie Creek Redwoods State Park has within its boundaries a number of herds of free-ranging Roosevelt elk. Due to the location of a few major roads, two of these herds of elk have, over a number of years, become quite tolerant of human presence and activity. For this reason these two herds have become prime subjects for study. Most of the animals in these two herds have been marked with ear tags for herd and individual identification, for both in this, and in other studies. Direct observation was the principle method used in this study; experimentation was attempted on a limited basis.

Elk respond to a disturbing stimulus by withdrawing from it, driving it away, or modifying it by intimidation or physical assault. This aggressive behavior is directed both interspecifically, for the purpose of defense against potential predators, and intraspecifically, for the purpose of maintenance of free-space. Free-space refers to the unoccupied area around an individual or a group of individuals (Marler, 1966). This space is a variable factor related directly to the amount of food, mates, shelter, etc., which are available to the individual. Elk, being social animals, maintain this space both at the group and the individual level. Aggressive behavior, like other forms of behavior in elk, functions to increase the efficiency in fulfilling life functions by furthering the integration and organization of individuals in their attempt to maintain free-space at the group level.

Aggression takes many overt forms in elk, and is controlled by a number of variable factors. Fighting has been, for the most part, ritualized. Aggressive encounters are usually settled by threat display and gesture, expressed within the limits of a well structured dominance hierarchy.

Aggressive behavior is observed among calf elk while they are quite young. By one month of age calves have been observed performing the head-high gesture, with raised chin and laid back ears. Other aggressive patterns observed include striking out with forelegs, poking the muzzle at other calves, and resting the muzzle on the back or rump of other calves. By the time the calf is six months old a relatively stable dominance hierarchy has been developed; this hierarchy appears to be based on size, which is in turn related to age, since the first born calves remain larger than their late-born peers 'til the growth rate decreases towards the beginning of the second year. Since very few major encounters between yearlings were observed, the hierarchy developed as calves may very well remain 'til maturity when this hierarchy is incorporated into the overall herd hierarchy.

Among both adult cow groups and adult bull groups, a well developed hierarchy exists. This hierarchy is based on age and sex, with size playing a secondary role, since it is usually correlated with age and sex. Within these groups overtly expressed aggression is relatively rare; when it occurs it is usually between individuals closely ranked in the hierarchy, and often it is under conditions of disturbance. Subordinate individuals, widely separated from those dominant in the hierarchy, give way readily to the gesture of dominant individuals.

Factors which play a role in initiating aggressive behavior include: prior experience in an area; an external reference, such as a food source, a calf, or a harem; endogenous influence, such as androgen buildup in bull elk prior to the rutting season; and prior experience in aggressive encounters, where an animal might be conditioned to either be aggressive or submissive.

The gesturing patterns in the adult cows include all of the ones observed with the calves. In addition there tends to be a hierarchy of these gestures related to the degree aggressiveness is stimulated. In the usual encounter the head-high gesture is initiated first; if this does not settle things, one of the two elk may raise up on its hind legs, with the head-high gesture still held. This is often followed by a kick of the foreleg.

During the non-rutting season bull elk usually live together in small groups. Among these bulls gesturing is, during this period, primarily accomplished by thrusting and swinging the antlers in the direction of an antagonist.

Sparring, primarily a form of exercise and not aggression, is usually only engaged in by bulls close in hierarchical rank and age. During the period following antler drop, and when the new antlers are soft and developing, the bulls will still gesture with their head and antlers, but contact is never made. Madson (1966) observed bulls with developing antlers, of the Rocky Mountain subspecies of elk (C. c. nelsoni), raising up on hind legs and striking out with forelegs. During the brief period when some of the bulls have dropped their antlers and others still have their antlers, subordinately ranked antlered individuals have been observed to gesture antlerless bulls, whom normally they would not dare to approach.

Adult cows show little aggression towards young calves, especially their own. Only when a calf tries to nurse a cow other than its own mother will it be the recipient of aggressive behavior, and then only in the mild form of head gesture, or a push with the muzzle. On the other hand, yearling and two-year-old elk tend to be the recipients of much of the redirected aggressive drives of the adults. Two-year-olds in turn redirect this aggression towards the yearlings, and the yearlings in turn redirect the same towards the calves, completing the hierarchical relationship. New

elk which occasionally enter the herd and take up residence, tend, if adults, to take up a ranking somewhere between the two-year-old and the yearling rank-level. One such cow moved up to a mature cow ranking within four months (a mature elk is one three years of age or older).

Aggression between the sexes is rare, except in the case of immatures. Mature bull elk are dominant over cow elk. Only when pushed hard by a rutting bull will a non-receptive cow aggressively respond; such aggression usually takes the form of a ritualized kick of the hind leg, or a ritualized biting movement with the mouth. Cow elk are practically always dominant over yearling-spike elk, but begin to lose this dominance as the bull begins to grow his second year antlers.

Sign-posting is probably one of the mechanisms used by elk to intraspecifically space themselves. This activity consists in elk scraping bark off trees and then rubbing different parts of their body over this scraped area. Graf (1955) postulated that this behavior functioned to scent-mark an elk's home range, for the purpose of keeping other non-resident elk away. Other elk supposedly avoid areas where fresh sign-posting exists. During the study no positively correlated avoidance of such areas by non-resident elk was observed. This sign-posting is done by both sexes and all age groups. Bulls, from the age of two years on, scrape the bark with the base of their antlers, in addition to using incisor and canine teeth. During the period when antlers are soft, the bulls, like cow elk, use solely their teeth. A male yearling was observed rubbing his nose and cheek against a tree, but no scraping was observed. An eight month old female calf was observed rubbing her forehead, nose, and lips across the branch of a tree, but again no scraping of the bark was observed. On a number of occasions this incomplete sign-posting--without the scraping--was also observed in adult elk. Sign-posting was mostly observed in the post-rutting winter months, when a seasonal shortage of forage would make such spacing behavior most beneficial. Sign-posting was also observed being undertaken by harem bulls during the rutting season, at an increased rate--a probable attempt to further limit intrusion by other bulls into the vicinity of their harems. Sign-posting may in addition have a secondary foraging function. Although no direct observations of feeding on tree scrapings were made, there is some evidence that this may occur during the late winter months when the sap of certain tree species--especially red alder (Alnus rubra)--becomes active. During this period sign-posting activity increased to a high degree; during this same period little if any scraping piles were found beneath freshly scraped trees, where normally during other periods of the year they are found.

Elk will also sign-post in response to human disturbance. It is possible for elk to be stimulated to sign-post in response to the approach of a number of different species of animals within the right size range, under

certain conditions. The elk approached must be in familiar surroundings, have objects available for sign-posting on, be relatively dominant on the hierarchical scale, and be given the impression of uncertainty by the approaching animal. Sign-posting under these conditions has been observed to be accompanied by other aggressive display patterns such as thrashing and broadside-marching.

Thrashing normally is a pattern made use of in the rutting season. All bulls thrash vegetation during the pre-rutting season, resulting in the velvet being cleaned off their hardened antlers. Mature rutting bulls with harems continue this thrashing into the rutting season; here thrashing seems to take on a dual function of aggressive display and erotic self-stimulation. Thrashing was not observed in bulls not possessing a harem during the rutting season. Thrashing by the harem bull can be initiated by the approach of another bull, or may occur spontaneously. It is always accompanied by penile erection, and usually, if continued for a minute or more, will result in the release of urine, squirted forward over the underside of the animal. Often urine will be squirted between the front legs, where the bull will lower his head, and allow his head and neck to be doused. This is usually followed by thrashing in the vegetation where most of the urine fell; this vegetation is often ripped up and tossed up and back over the bull's head, landing on his back. On a couple of occasions a bull has been observed to lie down in this vegetation, and swish his antlers around while reclining. If this behavior has been initiated in response to another bull, the thrashing bull will then slowly approach; if it has been apparently initiated in the absence of any external stimuli, the bull may begin feeding, or sexually approaching one of the members of his harem. McCullough (1966) has postulated that one of the functions of this ritual is that of sign-posting. The metabolites in the urine are supposed to be distinguishable enough for bulls to be able to mark areas, and members of harems during the rutting season.

During the rutting season the bull elk spends much of his time engaged in one form or another of aggressive behavior. Reproduction by its very nature is a conflict situation, resulting in a highly complex patterning of aggressive, withdrawal, and copulatory elements. The harem bull attempts mainly by threat and bluff to control a group of cows ranging in number from one to thirty or more, and to keep other bulls away from this harem. He controls the cows by means of the present-gesture. The present-gesture consists in the extension of the neck, the laying back of the antlers, and then, the bull moving towards the cows; this movement is often accompanied by a deep hissing. The present-gesture is very similar to the bovine-grimace, given by the bull in response to olfactory sexual stimulation, resulting from smelling the genitals of the cows. This gesture has all the elements of the present-gesture; in addition the mouth is opened and the tongue is slightly extended.

The harem bull attempts to intimidate a challenging bull in a number of ways. If the challenging bull is obviously of inferior stature the harem bull will take off running at him. If this bull is more equal in size, the harem bull will approach more slowly and give the present-gesture. If this, together with thrashing and bugling, does not intimidate, then broadside-march behavior is initiated. The two bulls parade side by side, within a few feet of each other, with heads held high. This is accompanied by thrashing, drooling, and hissing. At some point during this ritualized display one bull will dart in the direction of the other bull, with a downward thrust of its antlers. This is as far as I have observed such encounters to go before one of the antagonists breaks off and gives ground. Geist (1965) stated that Rocky Mountain elk often lock antlers and fight fiercely following the broadside-march.

All bulls from the two-year-old stage on up will attempt to control harems, but usually the older mature bulls control all the cow herds in the area, and prevent the younger bulls from participating during most of the rut. Yearling bulls will attempt to sexually approach female elk, but no harem formation or control is attempted.

Aggressive behavior in elk also takes more subtle forms. In situations where two antagonistic responses are elicited simultaneously, conflict arises. Normally wild elk flee from the presence of man; in this situation the withdrawal response resulting from fear of man more than cancels out any attack response that might be initiated. The elk in this study area, as mentioned earlier, have had their fear of man reduced; now the attack response is able to approach balancing the withdrawal response, resulting in conflict. This example of conflict can be resolved in a number of ways. Immobility often occurs. It can be seen when elk freeze and stare at humans; this can have survival value by helping an elk to hide. An intermingling of responses can occur, in which the elk may fluctuate between incomplete acts of both withdrawing and attacking. The broadside-march display has probably evolved from this pattern.

Conflict is often resolved by redirection activity. This is often seen where an elk attacks an individual other than the one who evoked the conflict. Often the aggressive response is reoriented towards an inanimate object, such as some nearby vegetation. Such activity is responsible for the chain reactions of aggressive gesturing often observed among a group of cows. It can occur in response to human approach. During early summer elk will redirect their frustration caused by flies of a number of species.

In appeasement behavior, the elk responds to conflict by attempting to eliminate the aggression in the antagonist, by eliminating the stimulus or stimuli in itself which released that aggression. This appeasement takes the form of postures which are usually just the opposite of those used in aggression. In aggression the head is usually held high; in submission the

elk will often lower its head as it moves off from the advance of an aggressive individual. The aggressive individual will stare directly at an opponent, while a submissive elk usually looks away. Any specialized features adapted for aggressive display, such as antlers, are de-emphasized in appeasement. Non-receptive cows during the rutting season, adopt an exaggerated submissive slinking posture when pursued by a rutting bull.

Displacement is still another means of responding to aggressive conflict situations. Here the elk respond with behavior which seems irrelevant to the actual situation. Grooming and feeding are the most common activities engaged in as displacement, when confronted with a conflict. It's postulated that as a result of the hierarchial arrangement of behavior, subordinate patterns are confined to those occasions when the dominant patterns aren't active. This cancelling out of major behavior patterns in conflict can thus allow some subordinate patterns to be expressed, although inappropriate to the situation (Marler, 1966).

Aggressive behavior, functioning within the limits of patterns of ritualized combat, display, gesture, and the dominance hierarchy, assists in the efficient functioning of the life processes in the elk social group. For the high ranking individual within the group there is the advantage of precedence to food, mates, habitat niches, etc. When some commodity, such as food, is in extremely short supply the dominant individuals in a well established hierarchy would most likely secure most of the available food, while the subordinates would be starved out early; under such conditions of stress, the resulting survival of a few individuals might also allow for group survival. This survival of the group is something that would not have probably occurred if a high degree of dominance patterning did not exist (Etkin, 1964). Another associated value is that the dominant elk may be the parent of the next generation more often than subordinate individuals. This is obviously so with the bulls; with the cows it would be a matter of better fetus and calf survival, due to better nutrition, under conditions where nutrients are somewhat limited. Another advantage is that an elk group's home range is usually larger than the combined area which the individual elk herd members could set up as a home range on their own: each herd member has thus a larger area in which it can attempt to perform its life functions. Lastly there is an increased protection from potential predators resulting from group formation, due to either increased active defense, or increased watchfulness and thus earlier warning for flight.

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