

Draft: November 8th, 2006

This is a draft of a paper on wildlife habituation I presented at a symposium entitled “*Wildlife Habituation: Advances in Understanding and Management Application*”. by The Wildlife Society in Madison, Wisconsin on Sept. 27th 2005. Due to personal circumstances I was not able to finish this paper for publication. It is now accepted by *Human-Wildlife Conflict* for publication (Ja. 9th 2010), however, only one short portion was published so far.

Habituation of wildlife to humans: research tool, key to naturalistic recording and common curse for wildlife and hapless humans.

Valerius Geist, Professor Emeritus of Environmental Science, The University of Calgary, Calgary, Alberta, Canada. E-mail: kendulf@shaw.ca, phone-fax (unlisted): 250-723-7436.

ABSTRACT. Getting close to wildlife in order to study it is difficult and the investigators trials to do so are not normally reported as part of their scientific papers. The following paper is thus not “science”, but an account of what was done in order to do science. Stalking is possible, but beset by problems. Ironically, stalking may be used for negative conditioning of herbivores and carnivores. Deliberate habituation of wildlife, while enormously useful, at times indispensable, is a double-edged sword. It does lead to a rich harvest in scientific knowledge and imagery, but it is also a source of mortal danger to its practitioners, to the subjects as well as to hapless third parties. Inadvertent habituation, in which wildlife accepts or seeks out the presence of humans in order to benefit from food, shelter and security, entails similar risks and generate management and public relations problems for public agencies, let alone those directly affected. Negative habituation, in which systematic human activities lead to a systematic avoidance of humans by wildlife, also has costs, such as the loss of wildlife populations via alienation, as well as benefits, such as the systematic avoidance by predators of humans. This allows us to use natural sites freely for recreation purposes without danger from carnivores. There is a universal model that applies to problem situations in ungulates and carnivores alike. Habituation follows a predictable pattern that can be exploited for management. It is unsafe unless the practitioner has a fair understanding of the signals communicated by the species being habituated. Misinterpretation of such has led to fatalities. Most important of all is the predictable switch when the study animal, which is being followed, turns to closely explore the human being. This is a danger point, which, with some species, must be avoided at all cost. Furthermore, well into the study – occasionally years into the study – the subject may test the observer as a social companion. That may have disastrous consequences. Habituation is not without subtle costs, as indicated by elevated heart rates in thoroughly habituated mountain sheep. It plays a role in confrontations between large predators and humans, to the detriment of large predators, noticeably those in national parks and in rural areas. To maintain large predators they have to be systematically conditioned to avoid humans, for people will try to approach big animals no matter what! Food shortages can force larger predators into human vicinity, starting habituation with

grave consequences all round. In the last century wildlife was restored continentally bringing large prey and predators to our places of residence and work. Now we must learn how to co-exist with large mammals, large predators in particular.

Habituation in Practice. To study the behavior of animals, it is essential to get close. In the early days of Ethology, it was not known that some species of free-living large mammals readily habituate and tame. Consequently, when I began my fieldwork in 1959 on moose, I tried to overcome the limitations of the spotting scope by stalking close to my quarry. As Darling (1939) discovered, stalking succeeded well if one took off one's shoes, but I succeeded better if I took off the clothing as well. This suggested that the evolutionary reasons for the soft, pliable, sensitive human foot, which one anthropologist described as "unnecessarily well endowed with tactile receptors" (Campbell 1974 p. 171), as well as (among mammals) the uniquely human ability to balance on one leg were adaptations for stalking (Geist 1978, pp 252-253). Stalking requires not only a consistent suppression of noise, but also the freezing of all motions, even in mid-stride, should the animal lift its head to look and listen. Stalking is probably an instinct that allowed us to close in on potential prey, an ability crucial to our ancestors accessing the huge protein biomass of ungulates, thereby insuring our enormous evolutionary success.

While stalking worked well enough with ungulates, as a tool in the study of animal behavior it had limitations. It took a lot of time getting into position before useful observations could be made and it took a lot of time disengaging without the animal noticing one's presence. If this failed, the animal was spooked and lost to study for days or forever, and it took a lot of time and effort finding another one in a good position for observation. My freezing in position did not fool carnivores. Notebook, camera and recorder could not be used, as they were too noisy. Stalking was next to impossible in snow or during leaf fall in autumn, nor was it without danger approaching closely to a large unsuspecting moose. Disrobing – besides the obvious - was problematic during mosquito season, during hail, sleet and cold weather.

When considering habituation one must consider stalking, as it has a long-standing evolutionary context, especially for carnivores which stalk, but may also be stalked by con-specifics. As detailed below, it's an anti-habituation tool, an Achilles heel of bears and wolves, which one can exploit in management.

To improve my success, when working with Stone's sheep and mountain goats from 1961-63, I dressed in white overalls mimicking a mountain goat. I got close by keeping down-wind, approaching from above and showing only part of my body to the goat or sheep below. Today I suspect that my study animals would have become as tolerant had I used a clown's suite, for what I did would have resulted in their habituation anyway. In 1963 I met tame bighorn sheep in Banff National Park and learned that they had been systematically tamed and tagged by two park wardens, H. Green and E. Stenton. I subsequently re-tamed many of those sheep in order to read their tiny ear tags as most had dispersed and lived without human contact far in the park's interior. From then on I began systematically habituating and – when needed – taming free-living large mammals. This is ultimately necessary in order to observe in detail how animals act. Although one

can do fairly effective observations at a distance using spotting scopes and binoculars, compared to observing habituated or tamed animals at close range it is an inferior way of getting information.

At close range one can identify individuals without artificial marking, one can get vital insights such as hearing the soft submissive calf-calls of an old bull elk, blind on one eye, when other bulls approached, one can follow the progress of wounds, one can discover monster bucks that shirk rutting and live secluded, pointedly avoiding contact during the rut with all deer, and one can observe the same bucks recovering and becoming huge master-bucks who then breed uncontested, one can discover surprising details of food habits, or of social behavior such as the self impregnation on the pre-orbital gland of subordinate rams on dominant ones, one can recoil from the high pitched blast of baby mountain goats crying for maternal help when endangered by yearlings, one learns that mountain sheep systematically tamed in the wilds will trustingly follow one wherever one cares to lead them, but one also discovers the hidden dangers of habituation and taming. In addition, habituation is essential if one is to record effectively with the camera the identity or actions of animals observed. Consequently, how to *habituate* or how to *tame* large mammals in the field is an ongoing *practical* concern for a field-ethologist.

Habituation has non-trivial ramifications for the safety of the observer, for that of visitors' naïve about habituated or tame wildlife, as well as for the animals being studied. Habituation can lead to attacks on the observer, or visitors, which leads ultimately to the demise of the habituated animals. These are ongoing concerns when supervising graduate students in the field, for habituated animals will signal attacks and the observer must be able to interpret such signals correctly. Failure to do so has led to injuries and to deaths. Habituation and its ramifications are, therefore, almost constantly on one's mind when doing field observations. The utterly predictable demise of Timothy Treadwell and his girl friend Amie Huguenard, killed and eaten by grizzly bears they habituated, is here a case in point (Medred 2003). Unfortunately, there are other cases. However, these failed to receive the same ghoulish public attention, primarily as the victims were not guilty of the misleading messages and self-promotion typical of Treadwell - at the expense of hapless bears. We have now reasons to suspect that Treadwell lasted as long as he did in part because carnivores are more timid and thus less likely to attack than ungulates.

While in my career as an animal behaviorist I had to worry about habituation only while in the field, I have to worry about it in retirement on a daily basis. We live in a rural area close to a large provincial park and the matter of how to handle numerous black bears, which are attracted to orchards and salmon streams close to our residence, so as to minimize killing is a daily family concern. We also live with wolves. My wife and I have had to handle one attack by a black bear male, I have been brazenly investigated several times by wolves and my wife has been harassed twice by wolves, once on our very doorstep!

However, not every animal that tolerates humans is habituated. Some may already be *tame*, that is, engaged in predictable, voluntary reciprocal interactions with humans. Others may have had negative experiences with humans at close range and tolerate such

only at a distance before moving off. Some may do so due to a maternal tradition. There is no way to tell a priori why the animal in question tolerates humans. Tame and negatively conditioned animals are usually not very dangerous. Unfortunately, habituated animals are potentially dangerous, because habituation is a state of *unconsummated* interest on the part of the animal, expressing itself as tolerance of humans. One discovers this through systematic habituation and taming.

The Model: Habituation, De-habituation, Conditioning. In systematically taming free-living wildlife, I first deliberately habituated animals. *Habituation* begins when the animal begins to tolerate the observer at a distance. As it learns that the observer does not address it (looks at it, walks towards it or pursues it), it allows closer and closer approaches. The animal's *security* adaptations, however, prevent rapid habituation. During the process of habituation, which can take many days, the animal learns about the images, the smells, the sounds and the movement patterns of the observer. That habituation is but an unstable state of *unconsummated* interest is revealed quite dramatically: the animal suddenly turns towards me, closes the distance and begins to explore me physically. This allowed me to proceed with *taming* (conditioning through some positive reinforcement such as food or salt). One can of course also consummate habituation with deliberate negative conditioning in which I have also practical experience. Thus habituation progresses via the animal's own initiative to de-habituation as it consummates its curiosity about the observer. This exploration is, of course, species specific, but in all cases I observed it deals in the first instance with whether the observer is edible. That is one reason why the observer cannot survive the explorations of a merely *habituated* large carnivore. The observer can work with that animal only if he or she survives the exploratory attack and still dominates the animals, as demonstrated in the classical studies of Woolpy and Ginsburg (1967) with captive wolves.

However, this exploration, this process of making the unfamiliar familiar, proceeds in stages. Another type of exploration can happen after years of total tameness, when the tame animal suddenly challenges the observer *socially*. In essence, it tests if it can dominate the observer. The challenge comes in the form of a *dominance display*, an exceedingly dangerous challenge! Therefore, habituation is always and tameness is sometimes a state of *unconsummated interest* by the animal in the observer.

Working at close range with animals requires, therefore, that the observer can either anticipate or trigger these exploratory contacts and be in a position to exploit them or to avoid them. Exploiting means to *tame* the animal and teach it to accept what the observer will be doing subsequently with it. I taught mountain sheep to tolerate my hand on their bodies so that I could read ear-tag-numbers, pick ticks, turn their head to examine injuries or fresh horn-growth etc. (bighorns are ticklish behind the front legs). I also had to teach them not to run towards visitors expecting salt. I did this by making myself distinct via yodeling and arm waving, trusting my intuition that no other human appearing in sight of distant mountain sheep would do the same. I taught a long-tailed weasel to come to me, but only when I whistled. A red fox I taught to expect a little handout, but only at my cabin, as the fox followed me otherwise onto the sheep range which the sheep did not tolerate readily and my work suffered.

Large-bodied species need to be *negatively conditioned* when they approach the observer. That is, they must learn that getting close to a human is somehow painful or unpleasant – the skunk strategy! Running away is not an option as such is likely to trigger attack. However, complications do arise. The animals discover that in the presence of humans they are secure from predation, and so, ungulates, notoriously, seek out human habitations. There is evidence to suggest that predators are more security sensitive than ungulates, which is why the latter can enjoy the safety of human settlements that most predators are reluctant to enter, at least initially. Females with young are especially affected. Little wonder that even cub-leading grizzly females will seek out the safety of visiting humans at salmon fishing grounds since boars, a perpetual danger to cubs, are reluctant to approach humans (Stringham pers. com., Herrero et al. 2005).

Negative Conditioning, Population Decimation and Conservation Actions. Negative conditioning is the flipside of the coin to habituation and taming. Disturbance is so potent that it can lead inadvertently or deliberately to the destruction of populations, by making the affected animals avoid large areas of their habitat. Here are two examples which also show that we have long ago comprehended power of behavioral manipulation.

Here is how to use *negative conditioning* to destroy a deer population. It was done in an experimental study in New Zealand by Dr. Les Batcheler (1968). His experiment aimed to alienate red deer from valuable forests in order to reduce forest damage. His chosen noxious stimulus was stalking. However, Batcheler limited stalking to high quality habitats. This made surviving deer shift to low quality habitats. Subsequently, the deer shrank in body size, reduced reproduction, declined in numbers and for some years stayed faithful to the poor habitat without re-colonizing the good habitat. Small body size, low reproduction, lack of exploration, spookiness are linked features, typical of extreme *maintenance* or efficiency phenotypes. This is an *epigenetic* response to low quality living conditions, in this case experimentally induced by persistent stalking.

Observations on mountain sheep led to the conclusion that each populations home ranges were maintained as living tradition passed on from generation to generation (Geist 1967). Consequently harassment could alienate sheep permanently from crucial habitat. We suspected that populations were lost because of this, leaving large aread of empty sheep habitat. An aggressive policy of re-introduction was the logical antidote to such losses due to negative conditioning (Geist 1975). This was actualised resulting in an increase in mountain sheep continentally in a quarter century by almost fifty percent (Toweill and Geist 1999).

I have noticed that bear-biologists concerned with habituation appear not to be aware of the *consummation* of habituation, that is, the predictable exploration terminating habituation. They are, however, well aware of *negative conditioning* (Herrero et al. 2005). I would suggest that an exploration response by a habituated bear – in contrast to a habituated mountain sheep - could be lethal to the observer. In *practice* one must, therefore, assume that all animals tolerating humans are merely habituated and thus be on guard! The above model is universal and applicable to some serious habituation problems

with large carnivore, as illustrated below. Why habituation is a state of danger requires some exploration of the psychology of habituation

Theoretical Basis for Habituation. A fundamental characteristic of all living beings is to search for predictable conditions. It allows the organism to live at the lowest maintenance costs, allowing it to save a maximum of energy and nutrients for reproduction. This goes back to elementary bioenergetics, which shows that food-energy is costly to procure, that it is digested inefficiently and metabolized even more inefficiently into work. A simple calculation shows just how little work energy may be obtained from food, how rapidly the cost of locomotion increases with speed or with lift and how expensive mere excitement can be. In order to minimize maintenance costs an animal must, consequently, live in surroundings it is familiar with, so that it can minimize travel, running, climbing, excitement or costly interactions with con-specifics (see Geist 1978 pp. 2-13). The requirement for predictability generates the *Law or Principle of Least Effort*, or Zipf's Law (1949), which is fundamental to life. We too are slave to it, except when consciously opposed. Zipf's Law can be readily demonstrated whenever there are measurements made of energy or its proxy, such as heart-rate: acts are used in an inverse relationship to their size and complexity so that the cheapest actions dominate daily behavior. (MacArthur et al.1982).

Zipf's Law interacts, however, with another fundamental law governing all live, namely that of maintaining *security*. The animal must act so as to protect itself against predators, parasites, pathogens and against any break-down of the body. Because security has priority over other life-strategies, security adaptations can even segregate sympatric species ecologically as found in the deer family (Geist 1998). However, to comply with Zipf's Law, as well as with Security, individuals must have mechanisms of exploration that allow them to create a predictable environment, but at a reasonable cost. It cannot, for instance, run from any potential danger as this would increase the cost of living and thus reduce reproduction. Consequently, it must explore potential danger so as to minimize the high cost of escaping, be the costs direct – such as the high costs of running and climbing, or indirect – such as vacating good feeding areas for secure escape terrain or replacing feeding time with time being alert and watching. This is incompatible with maximizing energy and nutrients toward reproduction. Consequently, all organisms have ongoing sophisticated ways of exploring and making *predictable* their environments – physical, social, commensal (Geist 1978 pp.24-40).

Danger Signals. To stay out of trouble, it is imperative that the observer be able to read the silent signals of the habituated species and avoid the animal in time, so that it never approaches the observer. I know how to handle the challenges of mountain sheep rams. I do not know how to handle those of an elk, grizzly or even a deer! I have worked closely for years with habituated, but also tamed mule deer in the field, but I was careful to leave the moment I noticed the slightest interest of bucks in my person. I have handled the attacks of bighorn rams; I could never handle those of buck-deer! I do not think a human can!

What danger signals must the observer look for in habituated or tame animals?

In predators, in the first instance, it is a noticeable attention to, and following of, the observer. I have experienced personally such by wolves about my home on Vancouver Island. These wolves also began following riders and confronted, but did not attack, persons. Such visual investigations are most likely the draw-out prelude to predatory attacks.

Observers approaching wildlife deliberately and brazenly may see behaviors, some of which the encroached animal emits in order to deter the observer from coming closer. Herrero et al. (2005) published a detailed list of signals denoting anxiety or threat from bears approached by humans. The authors, commendably, drew attention to the likelihood that the animal is likely to exhibit internal stress reactions well before it shows such in its overt behavior. They also suggested to re-label individual distance, personal space or critical distance into *overt reaction distance* (ORD), so as to keep in mind the hidden cost of excitement to the approached animal which sets in well before it shows an overt behavioral response.

Dominance Displays. In ungulates, but also bears, the most important signal to watch for is the *dominance display*. Unfortunately, we humans, due to our primate origins, have a very difficult time recognizing this signal, let alone recognizing it as a signal of high danger. Primate communication focuses on the face and rear, a legacy of ancient arboreal existence early in the Tertiary. In most terrestrial vertebrates, however, communication focuses on the broadside of the body. Face-to-face signaling tends to be avoided, so that eyes in the dominance display are averted from the individual addressed. That's the problem for us. A grizzly bear or mountain goat in a dominance display intended for us, look away from us. And with that, their intentions are concealed from us to the point of being not recognized as communication or at best not recognized as an addressed display and a challenge or threat. We have to learn that the usual dominance display of terrestrial larger mammals, primates excluded, is a broadside display with *eyes averted*. In dominance displays various attention-getting mechanisms are used to arrest the onlooker's attention to the broadside picture plane in which size and mass of the displayer is emphasized (Geist 1978 pp. 86-98). In addition, the relaxed normal motions of every-day life are replaced, usually, by slower, stiffer motions. During the display the head of the displayer is averted and the object of displayer is viewed through the rear of the eye. The displayer does not approach directly, but at a *tangent*. That is, it *circles* onto the object of display. The human observer normally interprets the scene as an animal walking slowly past not paying any attention to the observer. The attack comes suddenly from the dominance display. It may be triggered by the human observer losing interest and *looking away*. I have never permitted myself to lose eye contact when close to a potentially dangerous large mammal - except when deliberately triggering attacks while protected by an adequate fence.

There are exceptions to the body-display, as the dominance display may focus on horns as it does in bighorns, so that the displaying ram turns and twists his horns so as to show them off to an opponent or to a prospective mate (Geist 1971). The subordinate-to-be

may counter display, and close the eye towards the displayer. Dominance displays are discussed in detail and context by Fritz Walther (1984).

I am aware of several attacks, one fatal and two nearly fatal, of ungulates in captivity as well as in the field on humans, that had in common a laps of attention by the human, which apparently triggered the attacks. The lapse in attention was due to judgments that no immediate danger existed. In every case the evidence or the words of the observer indicate that they saw, but did not recognize, the danger from the species *dominance displays*. It happened to me too, and triggered an attack by a very large bighorn ram. While working in zoological gardens I was able, repeatedly, with displaying captive male deer behind good fences to trigger attacks by demonstratively looking away. I am also aware that in dominance fights between mountain sheep males, the attacker's feeding bouts during which it watched the defending ram appeared to be deception to throw the defender off guard. If successful, the attacker would be able to hit the defender before the latter was fully prepared to counter and neutralize the clash (Geist 1971).

In short, when large mammals show an interest in the observer, or perform the first, faint dominance displays, it is high time for the observer to leave. This must, of course, not be done by a direct retreat, or worse still at a run, but by – fainting indifference – retreat so as to place trees or stumps or big rocks between the observation animal and the observer.

Brazenness on the part of the observer is an excellent deterrent to such inquisitions or attacks. Fearfulness, timidity, on the other hand, can trigger attacks! Every animal we observe at close range also observes us, and wolves and bears may even follow one's tracks and sit close to one's cabin, apparently listening to what goes on inside. And, unfortunately, "familiarity does breed contempt" and can become an inducement to attack the observer. In short, the observed animal after habituation and taming can, through continuous observation of the observer, be induced into an attack. Such happened to me after some *three years* of close association with bighorns.

"Wildness": False Expectations for Indigenous North American Species. The dangers posed to tourists by tame and habituated animals in North American national parks, as well as the plethora of problems generated by tame wildlife continentally, have given rise to an understandable desire by managers to "free" these animals from their "unnatural" tameness and see them thrive "wild and free", away from humans. This desire is based on false biological premises. It is as "natural" for indigenous North American animals to grow extremely tame, as it is for their European counter parts to remain extremely wild.

Please note: although the European roe deer and the North American white-tailed deer are closely related, it is the whitetail which crowds into cities right in among humans and which has given rise to a deer farming industry. Roe deer by comparison shun humans, are very weary and "wild" and cannot be ranched or domesticated despite no lack of trying! While we love to admire tame elk beside roads in protected areas, there is no European counterpart with red deer. European chamois do not tame and follow climbers to lick holes in the ground where humans urinated, as did American mountain goats in the Olympic Mountains. European wild sheep, the mouflon, does not stop crowds along

roads and freely mingle with people as our American mountain sheep do. In Arizona and Texas it is not razorback hogs, feral derivatives of European pigs and wild boars, which enter towns, but American peccaries. Coyotes, raccoons, black bears as well as pronghorns – all North American indigenous, notoriously learn to accept humans, their habitations and their activities and to fully take advantage of them.

Why do European mammals shun people while their American equivalents seek them out? And it's not only American mammals that tame so readily, but so does the turkey in protected areas, literally foraging between the legs of visitors. However, where hunted, turkeys, and American indigenous big game, are notoriously hard to hunt.

The answer to this behavioral difference may be found in the Pleistocene faunal histories of North America and Europe, respectively. For the duration of the Pleistocene, some two million years, North America was characterized by a *predator-limited* fauna while Europe was characterized by a *food-limited* fauna. North America's mega-fauna contained many diverse specialized predators whose skeleton showed ample signs of sever damage from pugnacious confrontations with prey. The large herbivores in turn showed great specializations in anti-predator adaptations and a tendency towards large body size. In sharp contrast to these specializations, however, were their *primitive teeth and primitive organs of food acquisition*. That suggests that food availability was not a limitation to body growth, and that high quality, low-fiber food was so abundant for herbivores, as to preclude selection for improvements in teeth and food handling organs. That can only happen if the mortality from predation keeps down the number of prey relative to the available forage. However, because predators were diverse it required from prey a judicious choice of how to act, depending on the predator species. Consequently, in order to reduce costly flight to a minimum, it is advantageous to scout out potential danger and flee only when absolutely required, and only as long and as far as necessary. Here natural selection favors prey that is able to explore and judge closely whether to escape or not. This results in inquisitive individuals, tolerant of potential danger, ready to exercise various anti-predator adaptations. They become very clever, often large-bodied, pugnacious, large-brained species, which quickly explore and adjust to new stimuli and take advantage of new foods. It is, therefore, just as "natural" for a mule or white-tailed deer to feed on a town's lawns and gardens and sleep on or below porches, as it is for roe deer to act "wild", that is, to shun humans, hide and emerge only at dusk and dawn and to feed only when far away from humans.

The European Pleistocene mega-fauna, by contrast, is characterized by slow declines in body size with a concurrent improvement of the organs of food acquisition and processing. No European predators compare in size and specialization to those of the Late Pleistocene in North America. Quite the contrary! While America's largest bear, the short-faced bear, was a carnivore, the huge European cave bear was a specialized herbivore. It thus appears that in Pleistocene Eurasia prey was not as readily available as was the case in North America. Profoundly different glaciation patterns, based on the general east - west orientation of mountains in Eurasia and predominant north - south orientation of mountains in North America, account for the observed differences. In essence: Europe was a "mouse trap" within with each major glaciation extinguished all

warm-climate mammals (and their evolutionary advancements) that had colonized the north during warm, productive inter-glacials. Simultaneously each glaciation left Africa severely desiccated and thus of low productivity. In northern Eurasia there formed from England across Asia to the Canadian Arctic a long east - west “mammoth steppe” populated by cold-adapted species. By contrast, glaciations in North America kept the mega-fauna in *continual contact* in highly productive southern landscapes through each of the major glaciations of the Pleistocene, some twenty in all. That would select for specialized predator and security adaptations in North America’s Pleistocene mega-fauna.

Not only is there a difference in behavioral adaptations between North American and European mammals, but there is also one between American indigenous and Siberian post-Pleistocene immigrants within our current North American fauna. The Siberians are not as flexible and adaptable to human presence and, therefore, more of a conservation concern than are indigenous North American species. Contrast the Siberian wolf with the American coyote, the grizzly bear with the black bear, or the cougar with the wolverine. However, the recent herbivorous immigrants from Siberia tame more readily than European species, a possible consequence of the two faunas meeting periodically in Alaska.

There are also within-species differences in habituation: pink-tongued bighorns, compared to black-tongued ones, are notoriously shy and flighty and do not habituate readily, if at all.

Habituation and Taming Gone Astray. We learn from our mistakes, not our successes! I have made mistakes in dealing with tame or habituated animals, inadvertently. One mistake led to a near-tragedy. It was rooted in the reading of the small metal tags in the ears of tame bighorns. I used rock salt to “hold” the sheep while I cleared the hair from the tag to read its number. One day during the rutting season I discovered a tightly bunched band of some 40 sheep on a high plateau. Large rams and ewes intermingled in body contact. I moved in trying to read the tags of two strange females. However, the big rams always plowed through to me - and the salt I was holding - making tag-reading impossible. I decided to leave. However, I could not merely walk away from these bighorns, as they would follow me, faithfully, down the mountain into the valley. What I did normally was to wait a little at a herd’s edge then suddenly run away downhill. That startled the sheep long enough for me to get away. As I bounded off down hill, I suddenly felt a blow in my back as a big full-curved ram brushed his horns across my pack-board and smashes his head into the scree slope, skidding along, all legs splayed out. As I stopped in surprise, the ram rose to his feet and at once licked the piece of salt I was still holding. That was a mistake! That ram learned instantly that smashing into me lead to salt! I turned and ran again and he repeated his attack, smashing his horns down my back and trailing parka. To get away I first extended my arm with salt so that several sheep could get between me and the ram sucking on the salt. Next I pushed a small piece into his mouth as he stood as if transfixed, sucking. Now I succeeded in getting away without him bolting after me.

Every day thereafter when I showed up on that range this ram attacked me – unfailingly! He would rush down hill towards me at full flight. About 50 yds away he would rise on his hind legs, assuming a pre-clash approach. At this point I stepped behind a feeding sheep. Now the ram had to detour around us. However, when he again rose to clash he was below me on the slope. Consequently, I was taller than he. This led to some dancing on hind legs, in sheep’s language “daring” me to clash into him. Then he became unsure, as he dropped onto all four, yet still giving me the horn display. Since I did not budge, he became more uncertain, he turned and lowered the head to feed – a “peace” gesture in ruminants. At this moment I stepped forward (downhill) and gave him a swat on the rump. He would hop forward and quickly lower his head to feed. For the rest of the day he would be just fine, peaceful and utterly predictable. However, come next day and the spectacle would repeat itself.

I lived in fear that he might meet a backcountry tourist. A colleague of mine, hiking in sheep country, rounded a bend in the sheep-trail on a ridge with cliffs rising on one side of the trail and dropping off on the other. As he did so he saw this ram who suddenly rose, rushed him on his hind legs and smashed into him. When my colleague awoke he was lying at the edge of the abyss. This ram disappeared that winter and no further incidents resulted from my inadvertent teaching of misbehavior.

Predators: How to Eliminate Bears from National Parks with Photography. It is the conventional wisdom that bears are attracted to human food and, consequently, to be safe, one must distance oneself from potential bear food. Also, making bears aware of one’s presence, avoiding surprise meetings is the safe way to go. While these conventional wisdoms are valid, they are by themselves insufficient to understand bear behavior. They imply that as long as one views or even photographs a bear that ignores humans, all is well. Not so! This generates a false sense of security, which translates into innocent brazenness about bears and which, ironically, protects the visitor – temporarily - from attacks. The problem with the conventional wisdoms is that they lead people innocently into habituating bears, which in turn leads to bears initiating explorations of humans and their habitations. That in turn brands them as “problem bears” which national parks must remove to insure visitor safety. Consequently, Lake Louise and Banff are the primary grizzly killing spots of the continent (Nielsen et al. 2004); black bears are also rare in the parks. As matters now stand national parks can turn, inadvertently, into “black holes” for bears.

Consider the following scenario: a young wilderness bear walking into a national park is subjected to photography by laymen and professionals. We expect the bear, initially, to flee all advances by people. Then, driven by hunger and feeding in a nice patch of young and digestible horsetails, or in an alpine meadow, or on an avalanche slope, it initially resists running from encroaching humans, but runs off in the end. As more contacts follow it begins to tolerate humans. It starts to grow “tame” becoming a magnet for photographers and film-crews, let alone tourists with camera and camcorder! Our bear is now habituated, but still avoids brazen approaches, as in bear society only the dominants are brazen. The habituated bear is in a state of *unconsummated* interest in humans and one day it will consummate that interest - at its choosing! Every habituated animal will

go through that exploration stage, *unless negatively conditioned*. Such a habituated bear can be expected to begin de-habituation by exploring campgrounds, parking lots, road kills – and defend the latter. It is now branded a “nuisance bear”, and even if it has not yet “explored” a human physically, its fate is sealed. The cause of its demise: ceaseless attention by curious tourists and photographers bent on getting pictures. And these are the well-behaved visitors. Then there are those who tease wildlife, who throw rocks, charge, slap or kick tame bears, let alone aggressive drunks trying to feed escaping bears potato chips and coke!

In circumstances when the bear is *well fed*, such as during salmon runs, it may stay merely habituated a long time, and tolerate brazen humans and their provocations. Now, carnivores consummate habituation like any other animal by testing if this strange being is edible. And that always means an attack! Testing carnivores attack suddenly, unpredictably! Sometimes they stop short and threaten. Bears SWAT the ground with their paws. Sometimes a lucky bear gets a – lifesaving – dosage of pepper-spray into its face and runs off, never to try testing again. Sometimes they are truly frightened by an aggressive human and sense that it’s best to run. That might stop them from trying to consummate curiosity for some time. Unfortunately, bears do have cyclical metabolic demands and bears change behavior with such demands. A bear in April is not the same as in September. Fattening is then upon them, and so is hyperphagia! Bears need to fatten up for hibernation. And then they become super-hungry, and earlier constraints weaken - if there is not enough food about. A well-fed bears is usually not dangerous. A hungry one is! Late August, September, October are the months of very hungry bears! And blessed the land that is full of spawning salmon, rich crops of berries, well-fattened caribou or moose or dead whales on the beaches or whatever! And woe to bears when commercial fishing reduces salmon runs to a trickle, for desperately hungry bears will seek out human habitation, act dangerously and be killed. We have had such in British Columbia. Canadian federal salmon quotas do not include an allocation for bears! One can be lured into false security when being close to habituated bears that are on full feed and show great tolerance towards humans, because the same bear under condition of seasonal hyperphagia may respond with a predatory attack. And habituation is the essential prelude to such! It is fortunate that bears appear to have a very high threshold to approaching humans and prefer to stay their distance – unless we disrupt such with constant approaches to satisfy curiosity or photograph the bear.

Theoretically, the difficulties arising from people following bears in order to photograph them can be reduced by limiting photography of bears to fixed observation sites, such as viewing platforms or roads. Under such circumstances bears are *un-addressed* and *un-encroached* and are thus free to habituate slowly. Nevertheless, under such circumstances one still expects bears to seek out humans and their abodes, but mainly if induced to do so by the smell of food. Still, any persistent contact between humans and bears will in the long run lead to bears “exploring humans”. Negative conditioning of bears is thus essential, *the earlier the better*.

An American Wolf Pack turns Russian. Free-living wolves also follow the general habituation-exploration model; however, they are quite slow as well as very selective

when exploring alternative prey, humans included. We experienced such personally with a pack on Vancouver Island. Following that experience, I realized that our current views about wolves in North America may be due to the fact that ungulate prey populations have been building over the last eight decades and that wolf population expansion not merely followed with a time-lag, but that control measures thwarted the rapid built-up of wolves. Consequently, our insights about wolf behavior are based on wolves that grew up in sparse wolf populations with abundant natural prey. At low wolf to prey density there arise large-bodied, shy wolves that avoid humans and their settlements. These are *dispersal (luxury) phenotypes* Geist 1978 pp.116-144; 1989). They are the type of wolves, which, to romantics, increase the quality of their wilderness experience. The Vancouver Island wolves we dealt with, by contrast, were small-bodied *maintenance (efficiency) phenotypes*. Consequently, our current North American conception about wolves and their relation to people is one-sided and flawed. To my regret I realized that I made a serious error by assuming that the European, but especially the Russian, experience with wolves, was irrelevant to an understanding of North American wolves. The experiences Russians and others have had with wolf attacks (Heptner et al. 1967, Will Graves, in press) can be repeated with North American wolves – under similar circumstances! These circumstances are:

- (a) Severe depletion of natural prey.
- (b) Followed by wolves searching for alternative food sources among human habitations.
- (c) The brazen behavior of wolves was due to the wolves being undeterred by and habituated to inefficiently armed humans (or ineffectual use of weapons or outright protection of wolves),
- (d) Wolves shifted to preying on pets and livestock, especially on dogs. (In our neighborhood one or several wolves attacked dogs despite the physical intervention by their owners which the wolves more or less ignored).
- (e) Wolves tested and killed livestock; the tests resulted in docked tails and ears of cattle.
- (f) The wolves commenced deliberate, drawn-out exploration of humans be such on foot or on horseback, (this is not merely visual and olfactory, but included – weeks before these wolves attacked a human – the licking, nipping and tearing of clothing. Beatty 2000).
- (g) This was followed by wolves confronting humans.
- (h) Wolves attack humans.

My wife and I and our neighbors experienced between 1999 and 2003 stages (a) to (g) when a wolf pack settled close to us in an agricultural area on central Vancouver Island (Geist 2003). These wolves were terminating habituation by seeking out humans and their habitation, killing and maiming pets and livestock and inspecting and confronting

humans. No attacks on humans materialized by “our” wolves after they began approaching us for they were shot. A predator control officer trapped others. Stage (h), attack on humans, was done not by the pack close to us, but by two wolves from another Vancouver Island pack. Two wolves from a pack of seven attacked a man in a campground on July 2nd 2000, leading to sever injuries. The pack had become habituated and then, apparently, food-conditioned to the camp ground on Vargas Island just off Tofino, British Columbia (Beatty, 2000). These wolves for weeks prior had not merely approached people, but had sniffed and licked visitors and performed hesitant attacks and were warded off. They attacked the camper at night while he was sleeping in the open. He was saved by fellow campers, but sustained injuries severe enough requiring hospitalization and some 50 stitches to close the wounds. The lethal danger from wolves, as compared to bears, is attacks by a pack. These no unarmed human can expect to survive. Urban coyotes attacking humans followed much the same pattern we observed for wolves (Baker and Timm 1998).

Our personal experiences with the wolf pack are matched by those in Eurasia, that is, the wolves we observed did not act like North American wolves, but like “Russian” wolves. They followed the general habituation-exploration model, but extended exploration. Consequently, between early fall of 1999 and March 12th 2003, 13 wolves were killed within a mile of our house. I must emphasize that only wolves in the pack that had settled close by behaved in a “Russian” fashion. Wolves that merely passed through, before or after have all been shy and difficult to detect except after the occasional snowfall that allowed tracking.

The great fear of wolves in Russia is based not merely on predatory attacks, but also on diseases carried by wolves, which are based on wolf-ungulate life cycles, or are picked up from other predators. Bites by rabid wolves were fatal as were infections with hydatid disease (Heptner et al. 1967, Will Graves in press). We must expect that wolves in North America will act like Russian wolves under appropriate circumstances.

The intrusion of wolves into settled areas has followed much the same pattern we observed and is a current problem not only in New Mexico, or the Yellowstone region, but also in Sweden (C. Seleborg, personal communication), Finland (M. Hagelstam (magnus.hagelstam@kolumbus.fi +358-41-545 3803, +358-9-262 8166) informed me of Finish studies as follows: “On October 19th, 2005 the historian Dr. Antti Lappalainen (opetusneuvos.lappalainen@kolumbus.fi, +35895416946) published his research findings on lethal wolf attacks on humans in Finland under the title “*Suden jäljet*”, *The Tracks of the Wolf*, ISBN 952-5118-79-7) and most recently in eastern Germany. As in Russia and Finland, so scientists in Indian found that children were the primary victims of wolf attacks, apparently by individual wolves who began to specialize on humans as prey due to the scarcity of natural prey (Jahala and Sharman 1997). The common factors were: a high human population, poverty, too few or heavily guarded livestock, and little wild prey (Jahala 2003; Raipurohit 1999). To date there is no solution to how humans can safely co-exist with protected wolves.

My daily chore: teaching black bears to stay alive. We live currently on a property bisected by two salmon streams, with a small, productive orchard surrounding the house. The closest salmon stream is about 100 yds from the house, close enough for us to hear black bears fishing at night when the salmon are running. In addition there are highly productive hay and silage meadows close by, avidly used by bears for grass or for the hunting of voles. Bears hibernate within 500 yds of our residence. Seven evening trips in May resulted in the sighting of 45 bears, 60 elk and one deer. Bears are currently common on Vancouver Island.

The salmon streams are great attractions to bears in season, as are our fruit trees. A couple of bears have made quick raids killing a few of our free-ranging geese, chickens and turkeys. I must emphasize that these bears are not “wild” bears, but entirely integrated into the farming and suburban landscape. They tend to be tame, but shy and very “well-behaved” (that is, *conditioned* not merely *habituated*), but there have been exceptions most of which, but not all, can all be tied to noticeable failures in the food supply such as failure of salmon runs, or poor berry crops or closing of an agricultural dump. In all cases the offending bears were big males in fall during hyperphagia.

For a decade it has been my aim to teach bears to stay away from our fruit trees, garden and stables while having full access to the salmon streams and meadows. I want bears to flee from my approach. I hypothesized that as long as they stayed away from humans and their habitation they would survive. Essential for these lessons are a dog that warns early of the approach of bears - night or day - so that such bears can be intercepted early. I used a pump action shotgun with which to generate loud, sharp clapping noises by racking the empty action back and forth, possibly imitating the clapping of teeth, an aggressive behavior of bears. Clattering with the pump-gun becomes a super-stimulus. I also use assertive movements. Consequently, when a bear had been detected by the dogs, I move out at once directly and unmistakably at the bear and advance rattling the action. In case of necessity it is very easy to throw a cartridge into a pump shotgun and have it ready for action. Small bears responded unambiguously and run off. Large males do so, but with noticeable reluctance. The only attack on my wife and myself occurred while we were walking down a forest road. I was armed, but was able to finally deter the large male by counter-displaying, by walking in on him in the same manner, as a dominant bear would while he was charging. He stopped, clapped teeth, then went into a broadside (back arched) dominance-display, fled tangentially through a ditch, paused and counter-displayed again and then ran off. The system failed if the bear was not intercepted *before* it successfully raided a rich food source, such as ripe fruit or livestock. One such male, unfortunately, learned within two weeks that it could intimidate neighbors who, without a dog, were trying to protect fruit trees. Although it fled from my assertive approach, after it preyed successfully on our domestic fowl, it returned to prey and was destroyed.

Some conclusions and the “Freedom of the Woods”. How do we conserve large carnivores while – safely - deriving a modicum of enjoyment from their presence?

One critical and universal policy to endorse must be that predators never run out of *natural* food. Otherwise they will turn for food to humans and their habitations. This

policy implies that we must intervene to balance predators and prey, *national parks included*. The criterion for success is to generate predators of the *dispersal phenotype*, which tend to avoid people. Such develop only with abundant food. Thus in protected areas, predators feeding on a rich food source can be viewed from a distance with minimum danger to observers. However, the seasonal needs for food, as exemplified by pre-hibernation *hyperphagia* in bears and the seasonal food abundance must be taken in consideration to insure visitor safety. It may be safe to approach and view grizzly bears feeding avidly on salmon, but it may be disastrous during a failed salmon run, or in early fall after a failed berry crop. Wolves in expanding prey populations may shun human contact, but not in depleted prey populations. To insure that meetings between humans and predators are benign, the predators must be well fed!

Nevertheless, we must also counter the notion that bears that feed and rest peacefully are always so disposed. Here we need good public information, as well as some enforcement power to protect bears and people. We need to confer with professional photographers and scientists that need to be close-up what to do so that professionals and visitors and the wildlife itself be safe. We must see what consistent following of wildlife really is, not a macho activity, but certain death for the animals affected. Like it or not it means that a modicum of animal behavior principles must be taught to those in charge of conservation.

The habituation by people following predators closely and persistently to observe and photograph must be discouraged as it is likely to be lethal, particularly to the animals. Designing and managing viewing and photo opportunities from fixed sites is then essential. However, this must be followed by a policy of negatively conditioning habituated animals so that they avoid, consistently, people and their habitations. The ongoing management of artificial food sources remains an imperative.

Then there is the potential management of “fear” or the difficulty, even inability to habituate. This goes back to the most basic of security adaptations. For instance, elk are driven by predation pressure (fear) into “selfish herds” and into grazing on their escape terrain, which is open landscapes with visibility all round and few obstacles to sustained high-speed running. They feed here on grasses *not by preference*, but from “fear” venturing into the rich and preferred riparian vegetation, such as willows, along valley bottoms as they are more readily caught here by wolves. Not food, but “fear” shape the (Eltonian, not Hutchinsonian) niches of deer species (Geist 1998).

We are aware that, although ungulates are sensitive to dangers, large predators appear to be more sensitive still. We are aware that ungulates notoriously exploit human habitations for the security from predation generated by the presence of people. For managers of national parks this is no happy situation as ungulates so conditioned, understandably, resist efforts to remove them, especially if the town’s lawns and gardens are also sources of excellent food.

It is the factor of “fear” that offers hope in carnivore conservation beyond national parks and equivalent reserves as they are but a small fraction of the land inhabited by large carnivores. Theoretically, we can protect predators if we link humans to stimuli that

predators cannot possibly habituate to. If humans can be linked systematically to something that predators fear innately, then predators will avoid humans and their habitation systematically. For bears and wolves there are indeed such innate “fears” that we can manipulate to our mutual advantage.

We know that large bears kill small bears and that large bears are a constant danger to small bears. Consequently, small bears, in order to survive, must be highly sensitive to sounds resembling another bear stalking them, as well as to bold, brazen, fearless acting by potential foes. We expect bears to be very sensitive to being stalked. That coincides with my experience in trying to stalk unsuspecting bears, camera in hand, as compared to ungulates. How sensitive even large grizzly bear males are to being followed is revealed by the observations of William H. Wright, who, over a century ago systematically tracked grizzly bears for years, initially for hunting and then for photography (Wright 1909). He developed an understanding tracking grizzly bears over a quarter century such as cannot be matched today. Moreover, he was exceptionally accurate in his observations and deductions, as emphasized in the foreword to his book by Frank Craighead. Wright found that even large grizzly bear males during normal travel would ever so often detour and check on their tracks, as if checking if someone followed. That grizzly bears are sensitive about their tracks is suggested by grizzly bears going into hibernation during snow storms. Large males have been known to kill other bears in their dens. From the above it follows that bears ought to be very difficult to hunt since they are expected to be exceptionally sensitive to being stalked, as well as being very capable of avoiding humans once they detect such. Wright makes a point of stressing just that (see his chapter 9 on trailing). Consequently, we can make bears meticulously shun humans if they encounter systematically humans that stalk and follow them, and which in encounters act boldly. This suggests that inefficient hunting of bears makes bears very weary, so that they avoid humans. If so, then hunting inefficiently by many hunters over long time spans, generates a protection for both the bears and the public. Such hunting generates a free public good, which I would label “The Freedom of the Woods”, which allows the general public to enjoy the outdoors without fear of predatory attacks.

We can make for gray wolves a similar case as for bears, in that lone wolves must be exquisitely sensitive to being stalked by other wolves, as territorial wolves will hunt down and wound or kill strangers. We are well aware that hunting per se makes wolves and bears very weary. However, we can exploit this in a much more efficient systematic manner. Ironically, we can use our innate capacity for stalking to generate panic in predators, for the lasting benefit of both!

To succeed in conserving predators we must not forget the precious lesson of the past century, especially that pertaining to wolves. We experienced in North America that a low predator to prey ration leads to large, shy wolves that shun contact with people. North America’s ungulate populations were recovering in the 20th century from near extinction in the 19th. Predator populations are expected to follow after a lag, and once they do, wolves are expected to increasingly act like their Eurasian counter parts when such run out of prey. Taken to its final conclusion it means that reintroduced wolves within national parks will need to be controlled so as to retain large prey base, otherwise

wolves will depopulate the prey in the park and move beyond causing far-reaching grief. The Eurasian experience indicates that wolves and settled landscapes are incompatible. The North American experience would suggest that they are compatible, but only if natural prey is very abundant relative to the number of wolves. And this means hands-on management of predators.

In addition, we must keep in mind that following the return of carnivores to an ecosystem, there will be next the arrival of parasites and pathogens which dependent on both, predators and prey. And that raises the question whether comprehensive restoration of ecosystems with their full complement of prey, predators, parasites and pathogens is, ultimately, a desirable public policy.

Beyond these matters lies a greater goal, a grand strategy of conservation for predators. It requires a continental approach, such as was historically initiated in creating the North American Model of Wildlife Conservation. To thrive, carnivores require large contiguous areas of land. This is a potential matter for a US-Canadian Terrestrial Wildlife Treaty incorporating the North American Model of Wildlife Conservation (Geist et al. 2001)..

References

Baker, R. O. and R. M. Timm 1998. Management of conflict between urban coyotes and humans in southern California. Pp. 229-312 in R. O. Baker and A. C. Crabb eds. *Proc. 18th Vertebrate Pest Conference*, University of California, Davis).

Batcheler, C. L. 1968. Compensatory responses of artificially controlled mammalian populations. *Proc. N.Z. Ecol. Soc.* 15, 25-30.

Beatty, J. 2000. Vargas Island wolves too used to human contact, observer says. *The Vancouver Sun*, July 5th, pp. A1-2.

Campbell, B. G. 1974. *Human Evolution*. (2nd ed) Aldine, Chicago, Illinois.

Darling, F. 1939. *A Herd of Red Deer*. Oxford University Press, Great Britain.

Geist, V. 1967. A consequence of togetherness. *Natural History* 76 (8) 24-30.

Geist, V. 1971. *Mountain Sheep*. University of Chicago Press, Chicago, Illinois, USA.

Geist, V. 1975 On the management of mountain sheep. Theoretical considerations. Pp. 77-105 in J. B. Trefethen (ed.) *The Wild Sheep in Modern North America*. The Winchester Press, New York.

Geist, V. 1978. *Life Strategies, Human Evolution, Environmental Design*. Springer-Verlag, New York, USA.

Geist, V. 1989. Environmentally guided phenotype plasticity in mammals and some of its consequences to theoretical and applied biology. In M.N. Bruton (ed.) *Alternative-Life History Styles of Animals*. Kluwer Academic Publishers. Symp 22-26 June 1987. pp. 153-176.

Geist, V. 1998. *Deer of the World*. Stackpole Books, Mechanicsburg, Pennsylvania, USA.

Geist, V. 2003. Vancouver Island wolves. *The Virginia Wildlifer*. June 2003, pp. 35-39.

Geist, V., S.P. Mahoney, and J. F. Organ. 2001. Why hunting has defined the North American model of wildlife conservation. *Transactions of the North American Wildlife and Natural Resources Conference*. 66:175-183

Graves, W. (in press) *Wolves in Russia. Anxiety through the Ages*. Edited by V. Geist. Destselig, Calgary, Alta.

Heptner, V. G., N. P. Naumov, P. B. Yurgenson, A. A. Sludskii, A. F. Chirkova and A. G. Bannikov. 1967. *Mammals of the Soviet Union Vol. II, Part 1a, Sirenia and Carnivora*, English Translation from the Russian, Smithsonian Institution and The National Science Foundation, Washington, DC, USA.

Herrero, S., T. Smith, T. D. DeBruyn, K. Gunther, and Colleen A. Matt. 2005. From the Field: Brown bear habituation to people – safety, risks and benefits. *Wildlife Society Bulletin* 33 (1): 362-373.

Jahala 2003 Status, Ecology and conservation of the Indian wolf *Canis lupus pallipes* Sykes *J. Bombay Natural History Society* 100 (2&3) Aug.- Dec. pp. 293-307.

Jahala and Sharma 1997 Child-lifting by wolves in Eastern Uttar Pradesh, India. *J. Wildlife Research* 292:94-101.

McArthur, R. A., V. Geist and R. H. Johnson 1982. Cardiac and behavioral responses of mountain sheep to human disturbance. *Journal of Wildlife Management* 46:432-442.

Medred, C. 2003. Wildlife author killed, eaten by bears he loved (10-8-03) *Anchorage Daily News*, October 9th 2003.

Nielsen, S. E., S. Herrero, M. S. Boyce, R. D. Mace, B. Benn, M. L. Gibeau, and S. Jevons. 2004. Modeling the spatial distribution of human caused grizzly bear mortalities in the Central Rockies Ecosystem of Canada. *Biological Conservation* 120:101-113.

Rajpurohit, K. S. 1999. Child Lifting: wolves in Hazaribagh, India. *AMBIO* 28(2), 162-166.

Toweill, D. E. and V. Geist (eds) 1999. *Return of Royalty*. Boone and Crockett Club, Missoula. Montana.

Walther, F. R. 1984. *Communication and Expression in Hoofed Mammals*. Indiana University Press, Bloomington, Indiana, USA.

Wright, W. H. 1909. *The Grizzly Bear*. Charles Scribner's Sons. 1977 The University of Nebraska Press, Lincoln, Nebraska.

Woolpy, J. H. and B. E. Ginsburg. 1967. "Wolf Socialization. A Study of Temperament in a Wild Species". *American Zoologist* 7:357-363.

Zipf, G. K. 1949. *Human Behavior and the Principle of Least Effort*. Addison-Wesley, Cambridge, Mass. USA.