

EFFECTS OF ANTHELMINTICS ON MANURE-EATING ARTHROPODS

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ed as more knowledge becomes available.

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Despite all our good intentions, we nature managers sometimes make mistakes without understanding it until later. One example of this is the practice of worming livestock which graze in nature areas. Manure excreted by treated animals contains traces of anthelmintics, which is tracked down most selectively and effectively by insects such as dung beetles. Dung beetles lay their eggs in the fresh manure, but their newly hatched larvae are killed by the drug residues. The result is that there is no new generation of dung beetles. Mortality is extremely high because of the high efficiency with which dung beetles detect fresh manure. The same dramatic effect may also occur on extensive and popular networks of bridleways in nature areas.

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Youngstock is particularly susceptible to intestinal parasites, and regular worming is common normal agricultural practice. Their manure, however, does contain residues of anthelmintics which pose a serious threat to arthropods whose life cycle is linked with manure. About 250 arthropods, including several rare species, are dependent on manure. Some species require manure from one or more specific herbivore species.

There are several anthelmintic compounds: ivermectin, benzimidazoles, pyrimidines or imidazothiazoles. As yet, little is known about the toxicity of the different substances (Montfoort, 1997), apart from ivermectin. In both laboratory tests and field tests, ivermectin was found to be toxic for flies and dung beetles. Anthelmintics can be administered in a variety of ways. They are available as injectable preparations, drench and paste preparations, in-feed preparations and sustained-release boluses. The withholding time during which residues are found in manure and the concentration occurring during this period depend on the drug type and the method of administering. Slow-release boluses have the longest withholding period.

There are four arguments for a more stringent regulation of worming. Although little knowledge is available of

the risks of most substances, and more specifically of the effects of these drugs on arthropod eggs and the development of larvae, the harmful side-effects of some substances on manure fauna have been scientifically established. Secondly, these drugs are still used in nature areas and pose a selective risk to the biodiversity of manure fauna. This risk is the result of a complex relationship between grazing young stock which are commonly treated with these substances and the selective use of this manure by arthropods, as well as the time and duration of treatment. Thirdly, in our crowded country arthropods in nature areas might also be affected by anthelmintic residues on neighbouring farmland. Fourthly, a decline in populations of dung beetles and other manure-dependent species might also negatively affect predator populations, mainly birds and smaller mammals.

There are strong indications, both in scientific literature and from observations in the field, that anthelmintics have negative effects on manure fauna. Until further scientific knowledge is available, measures should be taken in practice to restrict or ban the use of substances with a proven negative effect (ivermectin). This condition could be laid down in a management agreement and formulated in such a manner that it could be amend-

ETHOLOGY AND LARGE HERBIVORES: WHAT DO WE WANT?

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Large herbivores should behave more naturally in their natural surroundings. But what exactly is natural behaviour in animals that have been domesticated for generations? Ethologists study the behaviour of large herbivores in nature areas and ask site managers: what is it you want; do you want to adapt the animal to its natural surroundings or the surroundings to the animal?

What is ethology?

Ethology is the science of animal behaviour, the study of behaviour in all its aspects. It should not be confused with ethics, which is a set of moral principles that governs a person's behaviour. Behaviour is the way in which an animal or person responds to a particular situation or event. If there is no change in the existing situation, there is no need to respond. An intrinsic stimulus may change that: if you feel hungry, for instance, you will first look around you for something to eat, after which you will go and find it. Extrinsic stimuli also prompt a response. If it starts raining you look for a place to get out of the rain, or if a pack of wolves is approaching you, you start defending yourself or run away. Obviously all kinds of internal physiological changes take place, but outwardly a response is first visible by a change in behaviour. Ethology describes all these natural changes in behaviour and the mechanisms motivating them.

The behaviour of Khaan, a Przewalski stallion, was observed two weeks before and two weeks after the horse was introduced in a Mongolian nature reserve. Both before and after his introduction the stallion spent 47% of its time grazing, resting went down from 36% to 16% and moving increased from 5 to 22%. There was nothing strange in his behaviour that might indicate stress. This illustrates how fairly simple observations may give a certain measure of certainty about the success of the stallion's introduction. It takes some effort but the answer to 'How is Khaan doing' can be given fairly accurately.

Animal welfare

When you have animals grazing in a nature area you might wonder about the state of the animals' welfare. For an answer you can either observe the whole herd or the individual animal. In both cases an animal's behaviour is about the only way to assess its welfare. Welfare is generally understood to be the way the animal feels in its surroundings or the way it copes with the problems it encounters. We should distinguish between acute, short-term problems and persistent, long-term problems.

Ethology researchers from Wageningen University have studied the social structure of the Scottish Highlanders in Imbos nature reserve for some years now. Together with

Natuurmonumenten, the Dutch Society for the Preservation of Nature, we are trying to find answers to questions regarding social structure and the place of the individual in it. Specifically, our research questions concern cow-calf relations, how nurseries are formed and how the bulls deal with one another and communicate.

Cattle herds are organised along a hierarchical line. Bulls literally fight their way to gain or maintain a place in the hierarchy. The status of top-ranking bull in a herd is accorded to the bull with the most favourable wins to losses ratio. Bellowing is an indication of the animal's position in the hierarchy, so that the top-ranking bull will bellow more often than the numbers two or three. The hierarchy and make-up of a herd of large herbivores, such as highlanders, changes continually. Some individuals are together more often than others but herds are by no means close-knit groups. Individual animals may prefer other individuals and characters may differ. Sometimes groups seem loosely organised if at all, but at other times bulls show territorial behaviour and groups are close. We have seen this happen at Imbos nature reserve. We now find territorial groups with bulls, where once there were none, which clearly is a cultural change.

Groups of Konik horses also show different organisational structures. Most

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Ethology studies look into social structure, cow-calf relationships, the creation of crèches and how bulls communicate and interacts with each other.



'De-domestication', 'feralisation', 'naturalisation' or just simply adapting?

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often you find harems with their own home range but sometimes you find large groups of several harems as in Oostvaardersplassen. It may be that these harems will each take up their own home range again.

We can safely say therefore that behaviour and social structure in large herbivore groups are flexible and often adapted to the food situation and social circumstances.

De-domestication

The introduction of domesticated herbivores in nature areas is now common practice in the Netherlands. We assume that the animals will gradually regain their 'wildness'. This begs the question whether wild herbivores are not suited for natural grazing in our nature areas. Apparently, we in western Europe believe that European bison are too dangerous to range in areas with public access, although it is done in Poland. In any case, in the Netherlands domesticated herbivores are used, as they are tame and less dangerous to the public. At the same time, we hope and expect that these animals will eventually return to their natural behaviour. But what constitutes natural behaviour in animals that are in essence domesticated? One of the most important characteristics of animals in the wild is that they know how to respond to their environment, particularly in matters where their sur-

vival is at stake. Fear of man and a tendency to avoid man then count as positive qualities. It won't however be easy to reverse a process that has been going on for thousands of years, particularly not if our requirements for their behaviour are ambiguous. We want them 'wild' in the sense of 'untamed' but not 'wild' in the sense of 'savage'.

In the Netherlands we use the term de-domestication for the process of an animal's adaptation to the conditions of a nature reserve. It is a slow process that will take generations. An animal must learn new ways of behaviour and internalise this behaviour to pass on to future generations.

Feralisation and naturalisation

The terminology for the de-domestication process is confusing. In British literature the term feralisation is used to denote an animal's return to self-sufficiency as a result of a minimum of human intervention. This concept includes animals' ability to reproduce naturally and build up a viable population. The British term naturalisation can be used as a synonym of feralisation but it also means that the animal has found its natural place in the ecosystem.

Instances of domesticated animals which have 'gone wild' can be found all over the world (horses, cattle and pigs are good examples). Such animals have

found ways to survive without and often in spite of human intervention. Sometimes they have even turned into pests. This process of feralisation is often completed within one generation.

Adaptation

In general we find that wild animals when reintroduced in nature areas find it difficult to adapt or return to their natural state. They may never have been domesticated (zoo animals for instance) but having always been surrounded by people they must reacquire the ability to cope on their own in spite of their genetic make-up. Their offspring is often more successful.

In dogs it does not seem to work at all. Reproduction remains poor and wild dogs continue to be dependent on people for food. Genetic alterations as a result of domestication seem to have blocked the process of de-domestication one way or another. This proves that de-domestication is not always possible. Biologists will have to monitor processes of de-domestication to find out how animals cope in natural surroundings and how they deal with the problems encountered on the way.

The confusion of terms is the result of the fact that site managers are a varied bunch who do not have a common, clear objective. The process of de-domestication primarily depends on ethical views, the availability of suitable sites and the burden site managers and visitors are prepared to accept.

What do we want?

Why do we introduce large herbivores in nature reserves: do we want the animal to adapt to its natural surroundings or the surroundings to the animal? If we opt for wild herbivores and natural behaviour we should populate our nature reserves with European bison and adapt the area to the requirements of the animal.

If we opt for feralisation we want the animals to return to their natural state, with naturalisation we want the animals

to return to their natural state in harmony with their natural surroundings and if we simply opt for de-domestication we are not really sure about what we really want.

If we want the animals simply as management tools, we should put them out to graze and get them in again once the job is done. The terminology does not really matter, what counts are the relevant processes. Animals will have to survive and reproduce in circumstances that are largely determined by us. Ethologists can advise us on what we want and see whether this has actually been achieved.

Conclusion

Domestication is a process that has been going on for thousands of years. Sometimes the process was initiated by man, sometimes by the animal. In the case of many large herbivores, the animal's ancestors have disappeared. The tarpan has become extinct and the Przewalski horses may look natural, but apart from genetic information, they have lost much of their natural behaviour. We know that many animals that return to their natural surroundings do adapt and go back to their natural state fairly quickly, but whether their behaviour can in fact be called natural still remains to be seen. We tend to assume behaviour is natural when animals survive and reproduce. During the de-domestication process ethologists look at the way the animal adapts to the herd, the welfare of its survivors and the condition of the animals that have died.

Clarity is needed about the reason why we want large herbivores to go back to their natural state. Once we know what we expect, we can give the process a proper name. Since the term de-domestication is too vague it should be abolished. It is better to talk about feralisation or naturalisation, in which cattle and horses return to their natural state and acquire a degree of 'wildness'.

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BATTLES OF NATURE; THE ETHICAL SIDE OF GRAZING BY LARGE HERBIVORES

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These days, nature is often a manmade product. By our actions, our interventions, nature recedes, develops or evolves. We feel a sense of stewardship, of responsibility towards nature. Introducing animals in nature areas seemed like a natural thing to do. And it seemed so easy. But what are we to do when the animals that we introduced encounter hardship? Are we to help wild animals, thus in effect domesticating them? Or should we leave them to die because by our definition they are wild creatures? In situations of life and death, ethical dilemmas inevitably arise. In this article, we introduce the principle of self-reliance and make an appeal for ethical pluralism.

We briefly describe different types of dilemmas. Mainly, the dilemmas concern conflicts between individual animals, between species and between ecosystems. These are the battles that take place in nature. But nature is also a scarce commodity, and much fighting takes place about nature. Scientists, managers, ethicists and interest groups all fight for domination of their view on nature and nature management. Nowadays, the very word 'nature' gives rise to debate.

Researchers have shown that all parties concerned with nature - nature managers, farmers, visitors and animal welfare groups - can roughly be divided into two categories: nature lovers and animal lovers. Animal lovers regard large herbivores as pets, which must be cared for as such. Nature lovers, on the other hand, see large herbivores as wild animals, no different from deer and foxes. These perspectives completely oppose each other, and all ethical debates end in stalemate. There is no



'Naturalness' brings with it the risk of injury. But we can depend on the self-reliance of these Konik horses.



Heck cattle scrape together their own food and can easily live to the ripe old age of 20.

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legal precedence for solving this stalemate either. Ethical issues regarding animals all concern the health and well-being of animals kept as pets, while ecological or environmental ethics concerns wild animals that are part of a natural ecosystem.

Respect for self-reliance

In our opinion, nature and culture, wild and tame, need not be absolutely opposite states. They can occur in varying degrees. Along the same vein, human intervention and the concept of 'naturalness' are not necessarily mutually exclusive either. We therefore make a plea for a new principle, that of respect for the self-reliance of herds of large herbivores. If research shows that individual animals and herds can survive in an area over longer periods of time, we should respect their self-reliance and not intervene the minute something happens.

Our own reliance on the animals' self-reliance is a reflection of our knowledge of the functioning of a species in its ecosystem. In other words, our respect for animals' self-reliance and potential wildness is not based on some natural criterion. The principle is not based on a definition of pristine wildness, nor on ecological definitions such as genetic progress or decline. Quite simply, the

concept of self-reliance means that we have to know which circumstances are necessary for individual animals and the herd as a whole to live in a certain area. Concretely, this concerns adequate availability of food, adequate opportunity for reproduction, life expectancy, herd size and presence of other species. The principle of self-reliance acknowledges that there are different ways of looking at nature and at animals. It acknowledges that domesticated and undomesticated are two poles on a graduated scale. At one end, there are animals which gather their own food and may live to an old age, on the other end, there are animals which are fed daily, whose health is guarded over by veterinary practitioners, and whose lives are always short.

Ethical pluralism

We wish to restore the moral compromise and seek to establish a new equilibrium, new possibilities. Concepts such as morally commendable, morally desirable and morally acceptable cannot be avoided. Nor can differences in moral stances. But in resolving ethical questions one's moral stance is only of secondary importance, as there are usually several sound answers.

In preparing for a debate about moral standpoints, we need to consider

three various issues at three levels. The first is: can an animal suffer, does it have an understanding, can it save itself? The second level concerns the species: is it a rare species, what constitutes natural behaviour, what is the minimum viable population size, what degree of genetic variability? The principle of self-reliance concerns questions at this level. The third and last level is the ecosystem: is the ecosystem stable, is it sustainable, what is the direction of energy flow in the system? The ethical questions and standpoints of site managers and the public cover all three levels.

Knowledge, ethics and beauty

We tread nature filled with knowledge, conscience and deep feeling. As we discover nature, we succeed in explaining its characteristics and functioning. Ethics is another matter. Here we judge the right to live of an individual, a species or an ecosystem. It is on ethical grounds that we ban, for example, the collection of certain protected plant species. Our aesthetic appreciation for nature is revealed in our description of it: a flamboyant flower, a proud stag. These three ways of assessing nature are inevitable. In debates they often become mixed up. Theoretically, we can distinguish between these three dimensions, but in practice we find ourselves on all three dimensions at the same time.

All too often, a scientific description contains a moral stance and a judgement of aesthetic beauty between the lines. We usually base our ethical stand and our aesthetic judgement on our knowledge of the natural object. These three dimensions mutually presuppose each other.

We take a **scientific approach** to nature when we describe nature as a synthesis of events that obeys certain laws of nature, which are embedded in scientific theories or paradigms. In the mid-twentieth century, nature was generally viewed as a well-ordered systematic whole. This perspective was followed by the chaos theory, which stressed natural dynamics and present-

ed development as the result of an unpredictable association of events rather than a linear sequence.

The scientific approach to large herbivores is best illustrated by Vera's theory of park-like landscapes (elsewhere in this issue). In his view, the role of herbivores is to maintain the semi-open character of the landscape, to prevent the development of closed forest. Other scientists reject his theory, stating that large herbivores cannot be caught in theories. Their behaviour diverges from Vera's assumption. They eat threatened plants and do not always keep the landscape open. Vera's plea to introduce large predators is rejected on similar grounds: they too do not necessarily behave in practice as we would have them do. The scientific approach does not have any real consequences for us. The facts do not tell us how we should act or behave. We are not obliged to create park-like landscapes and introduce large grazing animals.

We have an **ethical approach** to nature when we are aware of our responsibility towards nature. For example, to help an animal or other living thing in need, to help a species or system of living things, or to preserve a habitat. Our knowledge of nature does not prescribe what nature should look like. This principle is central to philosophy, and implies that decisions must be made to be able formulate obligations. Knowledge can never dictate obligations. This is deftly illustrated by the following example. In the Permian age, some 225 million years ago, 90% of the species of that time became extinct. These events do not justify human action that would have a similar effect on the world's species diversity today.

We see nature **aesthetically** when we express our appreciation for its beauty. There is usually no ulterior interest for this appreciation. Although appreciation seems more subjective than scientific explanations of natural phenomena, it is in fact no more subjective than these or ethical declarations.

In his poem 'Miracles', Walt Whitman explained how city and countryside, culture and nature make him feel. 'Animals



We can see from the black stripe down this young Konik horse's back and the zebra-type pattern on its front legs that it is already fairly de-domesticated.

feeding in the fields, one and all, are to me miracles.' Large herbivores have an aesthetic meaning. They generate experiences that people value. Some people are in favour of introducing the wolf, not only on scientific grounds but also from an aesthetic point of view. To them, wolves in a natural setting are beautiful. It is because of this aesthetic meaning of nature that we need to reinforce the relationship between nature managers and the public.

Conflicts often arise because of the co-existence of these three approaches. Many people are curious about the consequences of genetic engineering for animals, but our ethical intuition often precludes such research. We call for respect for all three approaches on the basis of pluralism as described above.

Relationship with the public

Conscious efforts to bring about spontaneous nature development and to introduce large grazing animals are a new trend. We are still learning how to put these ideas into practice. Site managers and the public are slowly starting to realise that there is such a category as semi-domesticated animals next to livestock and pets. This is a learning process which is far from finished. We need to acquire more knowledge, but also need to develop our ethical and

aesthetic sides. The affection between people and animals which forms the basis for respect is often based on direct contact between a person and his or her favourite animal. The renaissance philosopher Montaigne once wrote: 'When I play with my cat, I do not know whether I am a playmate for her, or she for me? We both amuse ourselves on equal standing... we have a sense of respect and obligation which ties us not only to animals that live and feel but also to trees and plants.'

Perhaps we shall one day respect potential wildness in a long-distance relationship between man and animal. Informing and educating the public will be crucial in this.

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