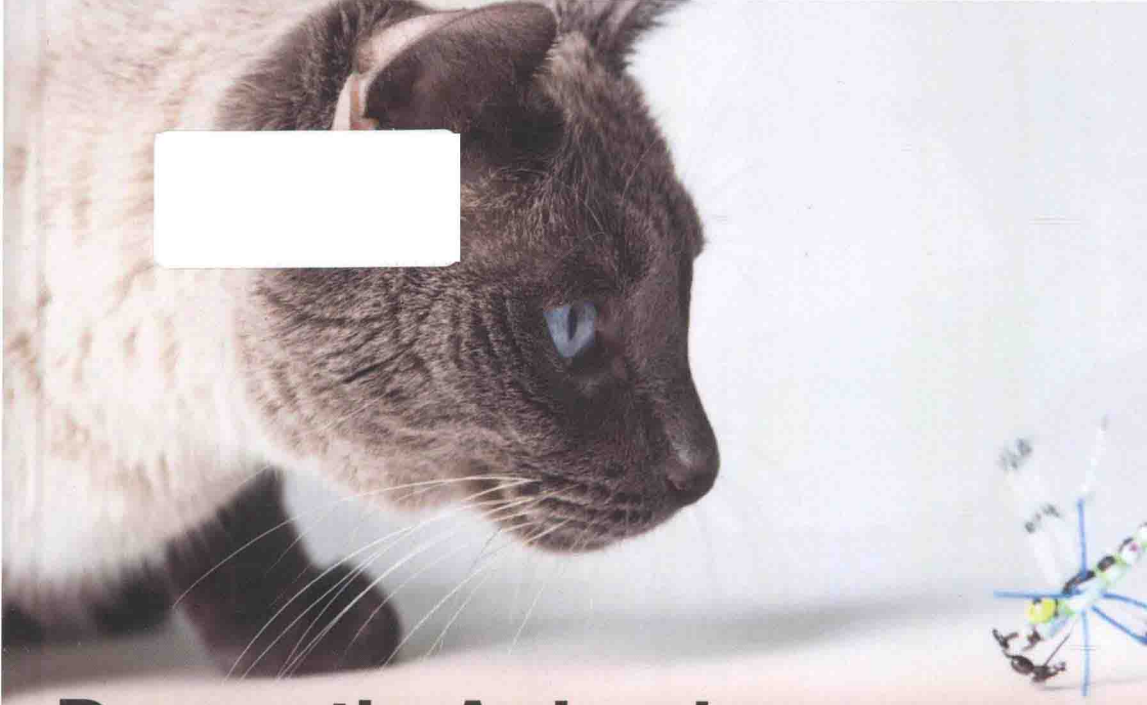

Domestic Animal Behaviour for Veterinarians and Animal Scientists

Mechanisms, Ecology, Evolution

Vivek Pande
Editor

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Preface

Early in the 17th century, Descartes came to the conclusion "that the bodies of animals and men act wholly like machines and move in accordance with purely mechanical laws" (in Huxley 1874). After Descartes, others undertook the task of explaining behaviour as reactions to purely physical, chemical, or mechanical events. For the next three centuries scientific thought on behaviour oscillated between a mechanistic view that animals are automatons" moving through life without consciousness or self-awareness and an opposing view that animals had thoughts and feelings similar to those of humans. In "On the Origin of the Species" (1859), Darwin's ideas about evolution began to raise serious doubts about the mechanistic view of animal behaviour. He noticed that animals share many physical characteristics and was one of the first to discuss variation within a species, both in their behaviour and in their physical appearance. Darwin believed that artificial selection and natural selection were intimately associated (Darwin, 1868) and cleverly outlined the theory of evolution without any knowledge of genetics. In "The Descent of Man" (1871) Darwin concluded that temperament traits in domestic animals are inherited. He also believed, as did many other scientists of his tune, that animals have subjective sensations and could think. Darwin wrote: "The differences in mind between man and the higher animals, great as it is, is certainly one of degree and not of kind." Other scientists realized the implications of Darwin's theory on animal behaviour and conducted experiments investigating instinct. Herrick (1908) observed the behaviour of wild birds in order to determine, first, how their instincts are modified by their ability' to learn, and second, the degree of intelligence they attain. On the issue of thinking in animals, Schroeder (1914) concluded: ~The solution, if it ever comes, can scarcely fail to illuminate, if not the animal mind, at least that of man." It is evident that by the end of the 19th century, scientists who studied animal behaviour in natural environments learned that the mechanical approach could not explain all behaviour.

During the middle of the 20th century', scientific thought again reverted to the mechanical approach and behaviourism reigned throughout America. The behaviourists ignored both genetic effects on behaviour and the ability of animals to engage in flexible problem solving. The founder of behaviourism, J. B. Watson (1930), stated that differences in the environment can explain all differences in behaviour." He did not believe that genetics had any effect on behaviour. In The Behaviour of Organisms]' the psychologist B. F Skinner (1958) wrote that all behaviour could be explained by the principles of stimulus-response and operant conditioning. The first author visited with Dr. Skinner at Harvard University in 1968. Skinner responded to a question from her about the need for brain research by saying, '~We don't need to know about the brain because we have operant conditioning" (T. Grandin, personal communication, 1968). Operant conditioning uses food rewards and punishments to train animals and shape their behaviour. In a simple Skinner box experiment, a rat can be trained to push a lever to obtain food when a green light turns on, or to push a lever very quickly to avoid a shock when a red light appears. The signal light is the '~conditioned stimulus." Rats and other animals can be trained to perform a complex sequence of behaviours by chaining together a series of simple operant responses. Skinner believed that even the most complex behaviors can be explained as a series of conditioned responses. However, a rat's behaviour is very limited in a Skinner box. It's a world with very little variation, and the rat has little opportunity to use its natural behaviors. It simply learns to push a lever to obtain food or prevent a shock. Skinnerian principles explain why a rat behaves a certain way in the sterile confines of a 30 x 30-cm Plexiglas box, but they don't reveal much about the behaviour of a rat in the local dump. Outside of the laboratory, a rat's behaviour is more complex.

This book is a rich source of information on biological rhythms, behavioural ecology, social behaviour, physiology of behaviour, molecular markers in behavioural studies and applied aspects of behaviour. The sheer range of animals studied makes the book a virtual treasure of information on tropical fauna. This book will be extremely useful to all persons at national and international level who are directly involved with the science of animal Behaviour.

—Editor

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Chapter 1

Introduction

Domestication (from Latin *domesticus*) is the process whereby a population of living organisms is changed at the genetic level, through generations of selective breeding, to accentuate traits that ultimately benefit humans. A usual by-product of domestication is the creation of a dependency in the domesticated organisms, so that they lose their ability to live in the wild. It differs from taming in that a change in the phenotypical expression and genotype of the animal occurs, whereas *taming* is simply the process by which animals become accustomed to human presence. In the Convention on Biological Diversity, a domesticated species is defined as a "species in which the evolutionary process has been influenced by humans to meet their needs." Therefore, a defining characteristic of domestication is artificial selection by humans. Humans have brought these populations under their control and care for a wide range of reasons: to produce food or valuable commodities (such as wool, cotton, or silk), for types of work (such as transportation, protection, and warfare), scientific research, or simply to enjoy as companions or ornaments.

Plants domesticated primarily for aesthetic enjoyment in and around the home are usually called *house plants* or *ornamentals*, while those domesticated for large-scale food production are generally called *crops*. A distinction can be made between those domesticated plants that have been deliberately altered or selected for special desirable characteristics and those plants that are used for human benefit, but are essentially no different from the wild populations of the species. Animals domesticated for home companionship are usually called *pets* while those domesticated for food or work are called *livestock* or *farm animals*.

Figure: *Dogs and sheep were among the first animals to be domesticated.*

Background

Charles Darwin described how the process of domestication can involve both unconscious and methodical elements. Routine human interactions with animals and plants create selection pressures that cause adaptation as species adjust to human presence, use or cultivation. Deliberate selective breeding has also been used to create desired changes, often after initial domestication.

These two forces, unconscious natural selection and methodical selective breeding, may have both played roles in the processes of domestication throughout history. Both have been described from man's perspective as processes of artificial selection.

The domestication of wheat provides an example. Wild wheat falls to the ground to reseed itself when ripe, but domesticated wheat stays on the stem for easier harvesting. There is evidence that this critical change came about as a result of a random mutation near the beginning of wheat's cultivation. Wheat with this mutation was harvested and became the seed for the next crop. Therefore, without realising, early farmers selected for this mutation, which would otherwise have died out. The result is domesticated wheat, which relies on farmers for its own reproduction and dissemination.

Mutation is not the only way in which natural and artificial selection operate. Darwin describes how natural variations in individual plants and animals also support the selection of new traits. It is speculated that tamer than average wolves, less wary of humans, selected themselves as domestic dogs over many generations. These wolves were able to thrive by following humans to scavenge for food near camp fires and garbage dumps. Eventually a symbiotic relationship developed between people and these proto-dogs. The dogs fed on human food scraps, and humans found that dogs could warn them of approaching dangers, help with hunting, act as pets, provide warmth, or supplement their food supply. As this relationship progressed, humans eventually began to keep these self-tamed wolves and breed from them the types of dogs that we have today.

In recent times, selective breeding may best explain how continuing processes of domestication often work. Some of the best-known evidence of the power of selective breeding comes from an experiment by Russian scientist, Dmitri K. Belyaev, in the 1950s. His team spent many years breeding the Silver Fox (*Vulpes vulpes*) and selecting only those individuals that showed the least fear of humans. Eventually, Belyaev's team selected only those that showed the most positive response to humans. He ended up with a population of grey-coloured foxes whose behaviour and appearance was significantly changed. They no longer showed any fear of humans and often wagged their tails and licked their human caretakers to show affection. These foxes had floppy ears, smaller skulls, rolled tails and other traits commonly found in dogs.

Despite the success of this experiment, it appears that selective breeding cannot always achieve domestication. Attempts to domesticate many kinds of wild animals have been unsuccessful. The zebra is one example. Despite the fact that four species of zebra can interbreed with and are part of the same genus as the horse and the donkey, attempts at domestication have failed. Factors such as temperament,

social structure and ability to breed in captivity play a role in determining whether a species can be successfully domesticated. In human history to date, only a few species of large animal have been domesticated. In approximate order of their earliest domestication these are: dog, sheep, goat, pig, ox, yak, reindeer, water buffalo, horse, donkey, llama, alpaca, Bactrian camel and Arabian camel.

Animals

According to evolutionary biologist Jared Diamond, animal species must meet six criteria in order to be considered for domestication:

1. Flexible diet — Creatures that are willing to consume a wide variety of food sources and can live off less cumulative food from the food pyramid (such as corn or wheat), particularly food that is not utilised by humans (such as grass and forage) are less expensive to keep in captivity. Carnivores by definition feed primarily or only on animal tissue, which requires the expenditure of many animals, though they may exploit sources of meat not utilised by humans, such as scraps and vermin.
2. Reasonably fast growth rate — Fast maturity rate compared to the human life span allows breeding intervention and makes the animal useful within an acceptable duration of caretaking. Large animals such as elephants require many years before they reach a useful size.
3. Ability to be bred in captivity — Creatures that are reluctant to breed when kept in captivity do not produce useful offspring, and instead are limited to capture in their wild state. Creatures such as the panda, antelope and giant forest hog are territorial when breeding and cannot be maintained in crowded enclosures in captivity.
4. Pleasant disposition — Large creatures that are aggressive toward humans are dangerous to keep in captivity. The African buffalo has an unpredictable nature and is highly dangerous to humans; similarly, although the American bison is raised in enclosed ranges in the Western United States, it is much too dangerous to be regarded as truly domesticated. Although similar to the domesticated pig in many ways, Africa's warthog and bushpig are also dangerous in captivity.
5. Temperament which makes it unlikely to panic — A creature with a nervous disposition is difficult to keep in captivity as

it may attempt to flee whenever startled. The gazelle is very flighty and it has a powerful leap that allows it to escape an enclosed pen. Some animals, such as the domestic sheep, still have a strong tendency to panic when their flight zone is encroached upon. However, most sheep also show a flocking instinct, whereby they stay close together when pressed. Livestock with such an instinct may be herded by people and dogs.

6. Modifiable social hierarchy — Social creatures whose herds occupy overlapping ranges and recognise a hierarchy of dominance can be raised to recognise a human as the pack leader:
7. tapirs and rhinoceroses are solitary and do not tolerate being penned with each other
8. antelope and deer except for reindeer are territorial when breeding and live in herds only for the rest of the year
9. bighorn sheep and peccaries have nonhierarchical herd structures and do not follow any definite leader: instead males fight continuously with each other for mating opportunities
10. musk ox herds (although having a defined leader) maintain mutually exclusive territories and two herds will fight if kept together.

However, this list is of limited use because it fails to take into account the profound changes that domestication has on a species. While it is true that some animals, including parrots, whales, and most members of the Carnivora, retain their wild instincts even if born in captivity, some factors must be taken into consideration.

In particular, number (5) may not be a prerequisite for domestication, but rather a natural consequence of a species' having been domesticated. In other words, wild animals are naturally timid and flighty because they are constantly faced by predators; domestic animals do not need such a nervous disposition, as they are protected by their human owners. The same holds true for number (4) — aggressive temperament is an adaptation to the danger from predators. A Cape buffalo can kill even an attacking lion, but most modern large domestic animals were descendants of aggressive ancestors. The wild boar, ancestor of the domestic pig, is certainly renowned for its ferocity; other examples include the aurochs (ancestor of modern cattle), horse, Bactrian camels and yaks, all of which are

no less dangerous than their undomesticated wild relatives such as zebras and buffalos. Others have argued that the difference lies in the ease with which breeding can improve the disposition of wild animals, a view supported by the failure to domesticate the kiang and onager. On the other hand for thousands of years humans have managed to tame dangerous species like the elephants, bears and cheetahs whose failed domestications had little to do with their aggressiveness.

Number (6), while it does apply to most domesticated species, also has exceptions, most notably in the domestic cat and ferret, which are both descended from strictly solitary wild ancestors but which tolerate and even seek out social interaction in their domestic forms. Feral domestic cats, for example, naturally form colonies around concentrated food sources and will even share prey and rear kittens communally, while wildcats remain solitary even in the presence of such food sources. Zoologist Marston Bates devoted a chapter on domestication in his 1960 book *The Forest and the Sea*, in which he talks a great deal about how domestication alters a species: Dispersal mechanisms tend to disappear for the reason stated above, and also because people provide transportation for them.

Chickens have practically lost their ability to fly. Similarly, domestic animals cease to have a definite mating season, and so the need to be territorial when mating loses its value; and if some of the males in a herd are castrated, the problem is reduced even further. What he says suggests that the process of domestication can itself make a creature domesticable. Besides, the first steps towards agriculture may have involved hunters keeping young animals, who are always more impressionable than the adults, after killing their mothers.

Another strong factor deciding whether a species will be considered for domestication is quite simply the availability of more suitable (or even better already domesticated) alternatives. For example a community that had been introduced to domestication by neighbouring peoples will generally find it much more practical, economical and time saving to import already domesticated species than experiment with wild animals (even if they are of the same species). Generally speaking, the species of animals originally domesticated by early humans in the interconnected landmasses of Eurasia and Africa were far superior, both in working capacity and in food production, than the species found in the other continents, namely the Americas and Oceania.

Degrees

The boundaries between surviving wild populations and domestic clades can be vague. A classification system that can help solve this confusion surrounding animal populations might be set up on a spectrum of increasing domestication:

- *Wild:* These populations experience their full life cycles without deliberate human intervention.
- *Raised in Captivity/Captured from Wild (in zoos, botanical gardens, or for human gain):* These populations are nurtured by humans but (except in zoos) not normally bred under human control. They remain as a group essentially indistinguishable in appearance or behaviour from their wild counterparts. Examples include Asian elephants, animals such as sloth bears and cobras used by showmen in India, and animals such as Asian black bears (farmed for their bile), and zoo animals, kept in captivity as examples of their species. (It should be noted that zoos and botanical gardens sometimes exhibit domesticated or feral animals and plants such as camels, mustangs, and some orchids)
- *Raised commercially (captive or semidomesticated):* These populations are ranched or farmed in large numbers for food, commodities, or the pet trade, commonly breed in captivity, but as a group are not substantially altered in appearance or behaviour from their wild cousins. Examples include the ostrich, various deer, alligator, cricket, pearl oyster, raptors used in falconry and ball python. (These species are sometimes referred to as *partially domesticated.*)
- *Domesticated:* These populations are bred and raised under human control for many generations and are substantially altered as a group in appearance or behaviour. Examples include sweet potato, garlic, pigs, ferrets, turkeys, canaries, domestic pigeons, budgerigars, goldfish, koi carp, silkworms, dogs, cats, sheep, cattle, chickens, llamas, guinea pigs, laboratory mice, horses, goats and (silver) foxes.

This classification system does not account for several complicating factors: genetically modified organisms, feral populations, and hybridization. Many species that are farmed or ranched are now being genetically modified. This creates a unique category because it alters

the organisms as a group but in ways unlike traditional domestication. Feral organisms are members of a population that was once raised under human control, but is now living and multiplying outside of human control. Examples include mustangs. Hybrids can be wild, domesticated, or both: a liger is a hybrid of two wild animals, a mule is a hybrid of two domesticated animals, and a beefalo is a cross between a wild and a domestic animal.

Figure: *A herd of Pryor Mustangs*

A great difference exists between a tame animal and a domesticated animal. The term "domesticated" refers to an entire species or variety while the term "tame" can refer to just one individual within a species or variety. Humans have tamed many thousands of animals that have never been truly domesticated. These include the elephant, giraffes, and bears. There is debate over whether some species have been domesticated or just tamed. Some state that the elephant has been domesticated, while others argue the cat has never been. Dividing lines include whether a specimen born to wild parents would differ in appearance or behaviour from one born to domesticated parents. For instance a dog is certainly domesticated because even a wolf (genetically share a common ancestor with all dogs) raised from a pup would be very different from a dog, in both appearance and behaviour. Similar problems of definition arise when domesticated cats go feral.