Domestication: the Evolution of the Dog

To many it is strange to think of the dog as descending from grey wolves. Depending on which literature one looks at, dogs are still counted as a sub-species of Grey Wolf (*Canis lupus familiaris).* It is perhaps ironic to consider an animal so closely linked to man to be an exceedingly close relative (1.8% genetic sequence divergence) of an animal whose existence encompasses so much conflict with humans. What we consider to be a grey wolf today is believed to have evolved around 2.7 million years ago. Evidence from morphological factors and the fossil record suggests dogs generally diverged from Grey Wolves around 14-15000 years ago; however some genetic studies suggest a much older divergence of up to 135000 years ago whilst others still suggest divergence of around 15/000 years ago. They have however interbred with wolves throughout their history, to this day wolves in low population numbers desperately searching for a mate are known to settle for domestic dogs. The black colouration found in some wolves has come about as a result of breeding with domestic dogs. Genetic studies suggest that either wolves were domesticated in several places and at different times, or that there was one domestication event followed by several episodes of admixture between dogs and wolves.

Physiologically it can sometimes be hard to believe that a Chihuahua can be so closely related to a wolf, but the same basic structure and build is there even though in a varied level of size scales and pelage forms and colours. Dogs vary greatly from wolves in body form. Whether this be fighting dogs with short muzzles bred to hold on to their opponent, and wrinkles to filter blood from the eyes, or guarding dogs broader and more muscular no longer requiring the slender frame of the wolf for long distance travel. By the removal of the wolves' independence becoming the domestic dog through the formation of a mutualistic relationship with man, a whole avenue of adaptions from the wolves' initial form and abilities have become possible.

Once one begins to learn about wolves and realise they are not the mythical beasts of legend, it becomes very clear how much wolf can be seen in your faithful companion at home. Many attributes seen in wolves are expressed in our dogs, many of which were specifically selected and bred by man to enhance or specialise a specific dog breed. Similar body postures and behaviours to wolves are apparent in dogs. Body postures indicating mood and activity such as a dog lowering its front in indication of play all stem from the dogs origin as a wolf.

Behaviours such as scent rolling in something having a strong smell, (much to the dismay of their human counterparts) may seem to serve no function to us. Yet in the eyes of the dog he is bringing back the smell of something interesting to inform the rest of the pack, or perhaps covering his own scent when in another dog's territory. It just so happens that our family pet views us as his family unit and pack.

Essentially most dogs are adult animals which retain juvenile behaviour and morphology, a phenomenon known as neoteny. Remaining playful and in need of adult direction (dog owners) whilst maintaining puppy sized proportions and facial characteristics which have clearly appealed to human favour so have become prevalent. Wagging tails, playfulness and strong social ties to family members (dog owners) are all seen in domestic dogs. This is not to say that adult wolves do not exhibit these behaviours but the domestic dog no longer has the same ecological and lifecycle requirements that a wild wolf must fulfil in order to survive. In essence the domestic dog fulfils the role of a low-ranking puppy within the human family for the entirety of its life.

In working dogs we see different wolf behaviours and attributes expressed, purposely selected by man to serve certain functions. Territorial guard dogs, scent dogs, hunting dogs and racing dogs all have attributes from the wolf that have become more specific to their function. Guard dogs are an interesting example here. Warning barks given by wolves to warn pack members of danger or possible intruders have been advanced to become the guard dog's sole purpose. The territoriality of the wolf is seen in guard dogs defending a property from intruders. Similarly, the hunting prowess of wolves has been utilised in the development of specific dogs for specific types of hunting, such as pointers to indicate prey location, sight hounds to chase down prey and scent dogs to source prey from the hunting area following scent trails. It is highly likely that these two behaviours, hunting and guarding/warning, were some of the very first for which man began to utilise dogs.

There is still much debate about the reasons and directional pressures that caused some wolves to become dogs. What factors determined the loss of wild reactions in dogs' behaviours and caused the formation of such a strong bond and devotion to man?

During the first stage of establishing relationships between the dog and man, humans were the novel environmental factor. Regardless of the scenario of this early period, the process was largely determined by selection on the behaviour of the animals and their ability for adaptation to, and coexistence with humans. During this earliest stage of domestication man

was only a factor that shifted the direction of selection to favour behaviour and ability of the dog to exist in the new, anthropogenic environment.

An experiment still on-going to this day at the Russian institute of cytology and genetics involving the selection of domestication in Silver Foxes has illustrated the possible processes of dog domestication. Animals with minimal defensive reactions to humans were selected to be bred from, with the initial task of removing defensive response to humans. This may have been the factor initially selected in wolves that had a reduced fear response to humans and benefitted positively through the ability to scavenge from human hunts. During contact with people, defensive responses in some foxes weakened or disappeared and in some cases emotionally positive reactions were formed. With Foxes whining and wagging their tails in anticipation of a positive interaction, licking their humans' face and hands upon contact. Some Foxes even following humans like a dog and getting excited when seeing a human from a distance. Using strong systematic selection of behaviour, a unique population of domesticated Foxes was created that has a complex of behavioural reactions characteristic of the dog not the wild Fox from whence it came.

The sensitive period for such adaption is known to begin in the early postnatal development period. Animals perceive the environment and respond to it. In dogs fearful responses develop between 4 and 6 months of age whereas in Wolves this occurs by 1.5 months. Domestication and the loss of fear of humans must therefore have occurred at an early age in wolves, possibly with successive generations of those adapting to close human presence being exposed to man during their early development. Any modern day keeper wishing to socialize his wolves with people knows well that this needs to occur at an early age and that individuals pivotal in this hand rearing remain important to the individual wolves with a lifelong bond being formed.

Many morphological changes similar to those found in dogs were noted in the domesticated Fox population, some of which seemingly came attached with and linked to behavioural changes. Inbreeding was ruled out as a factor due to populations being purposefully outbred, random mutations were also discounted. The level of adrenal stress in Foxes was found to decrease as domestication occurred with substantial hormonal changes. Colour changes appeared. Yellowing-brown mottling and localized depigmentation areas (piedbaldness) appeared on the standard silver-black fur. Historical data documents similar changes in early dog history. Some alterations such as floppy ears are prevalent juvenile traits. Alterations in craniological measurements determining skull shape appeared and are related to changes in rates of growth and development. The alterations are manifested as shortened and widened face skulls and reduced width and height of brain skulls in domesticated animals. Analysis showed that selection for behaviour shifts both the time of appearance of the skull structures

and their growth rates. In addition, domesticated males become smaller with respect to all measurements, which reduce sexual polymorphism (differences between the sexes) that exists in undomesticated populations. Again, similar traits are found for the domestication of the dog. Reproductive traits also altered with multiple breeding periods being recorded. All of these traits were deemed to have occurred as a correlated response to domestication.

The study occurring with the domestication of Foxes gives a fantastic inclination and understanding of the processes involved with domestication and the alteration of the wolf's morphological and physiological characteristics to become the dog. Many features of the evolutionary pathway of the dog that this species passed in the process of historical domestication can be reproduced in tens of generations of extremely strong selection pressure directed on specific behavioural traits promoting domestication. We will probably never construct the pathway through which this came about, and can only envisage the factors which directed it. However it is likely that strong behavioural selection was one of the key factors.

It is possible that wolves began to build a similar mutualistic relationship with us as they have with Ravens today. By helping indicate food sources to one another and utilising each other in obtaining food, a bond began to be formed from which we both benefitted. The wolves' social attributes fitted in well with our own and pack bonding began to be displaced onto humans. It is such a close bond that dogs have evolved to be able to gauge human facial expressions and body language which is so different from their own. Over the decades we may have inadvertently selected for certain characteristics that helped to form the dog. Only relatively recently have we begun to selectively breed those dogs with attributes useful to us for more specialist jobs, with most modern breeds originating within the last 400 years. It is clear that when we look at a more primitive breed such as the Husky or Malamute that less dog-like and more wolf-like attributes are noted.

Whatever the causal factors, the domestication process of wolves to dogs is a fascinating subject. With a little knowledge of wolves, one can fully understand and appreciate the inner workings and instincts of their dog and hopefully truly appreciate just how amazing our relationship with them is.