

The Importance of Keeping Dogs

Subjects: Biodiversity Conservation

Contributor: Ripfumelo Success Mabunda, Mahlako Linah Makgahlela, Khathutshelo Agree Nephawe, Bohani Mtileni

The dog has been man's faithful companion throughout history. They help with daily activities and make their families happy. Dogs can be a source of comfort in times of emotional difficulty, as well as having positive psychological and physical health impacts.

Keywords: genetic conservation ; genetic diversity ; microsatellite markers ; pedigree information

1. Introduction

Dogs are descended from the grey wolf (*Canis lupus*) and were domesticated in Southeast Asia around 33,000 years ago ^{[1][2]}. Canine ancestors migrated alongside humans to Africa and the Middle East around 15,000 years ago, and then to Europe around 10,000 years ago ^[3].

Domestic dog breeds (*Canis familiaris* L.) were the earliest domesticated animals, with over 400 breeds around the world ^[4], and more than 150 being bred in Korea ^{[5][6]}. These dog breeds have evolved into a broad collection of breeds with diverse morphological and physiological features through domestication, and natural and artificial selection ^[1]. Some are stray dogs throughout the world, mostly in villages and cities near humans ^[7]. Domestication of a canine ancestor is very likely to have occurred during first settlements and early agriculture and is accepted as a first population bottleneck during which the size of genetic variation within the population was effectively reduced ^{[8][9]}. Regardless of the precise timeframe, it is undeniable that for many years, people have been selecting for certain behavioural traits such as peacefulness, agreeableness, non-aggressiveness, and loyalty, as well as physical characteristics such as coat colour, coat length, height, and facial appearance ^{[10][11]}.

Dogs have evolved into one of the most common domestic species, as well as the most common carnivore. Their global population is estimated to be close to 900 million, and it is undoubtedly growing ^{[12][13]}. Modern dog breeds differ from other domesticated species due to the large amount of phenotypic variation caused by human selective desire ^[14], and because of their intelligence and behavioural abilities. The dog has evolved into hundreds of races with various variations, ranging from the Chihuahua's height of a few tens of centimetres to the Irish Wolfhound's height of more than one meter ^[15]. Thus, their appearance and behaviour are significantly different ^[16].

The development of a new generation of domestic dog breeds entirely dependent on genetic variation as observed through genetic differences within and between breeds ^[17]. However, the process of domestication has resulted in genetic bottlenecks, which have impacted the evolution of modern dog breeds ^[4]. Genetic bottlenecks are evolutionary events that cause a random decrease in the genetic variation, resulting in small founding populations and genetic drift ^[18]. The first bottleneck occurred >15,000 years ago during the domestication from the grey wolf ^{[19][20]}. The second bottleneck was caused by the isolation of the current dog breeds during the past >300 years, resulting in a smaller number of potential parents. The third bottleneck was from the use of popular sires after an intense selection for exterior traits ^[21].

Furthermore, most dog breeds are closed populations with no gene flow from outside, and only a small number of dogs are utilized for breeding ^{[22][23]}, resulting in a loss of genetic diversity within and between breeds ^[24], and inbreeding with the occurrence of genetic defects and depression in fitness traits. Therefore, genetic variation management is necessary to prevent high levels of inbreeding, the loss of genetic diversity, and the emergence of genetic disorders in small populations ^[25].

2. The Importance of Keeping Dogs

The dog has been man's faithful companion throughout history. They help with daily activities and make their families happy ^[26]. Dogs can be a source of comfort in times of emotional difficulty, as well as having positive psychological and physical health impacts ^[27]. Different behavioural responses, or temperaments, have resulted from the diversity of dog

breeds, making dogs ideal for a variety of roles ranging from pets to working dogs. However, the owner's expectations of the dog may differ from what the dog is required to provide [28]. It is, therefore, the owner's responsibility to give appropriate care to the dog, and to realize that it is a descendant of the wolf and should have the possibility to show its natural behaviour.

Some dogs are calm in nature, while others are aggressive, which changes their utility as they perform many roles for mankind [29]. Law enforcement uses service and working dogs to assist the police and military, while government agencies use them for a variety of purposes such as explosives and drug detection [30]. They were used for a wide range of purposes, including heading, pulling loads, therapy, sports activities, medical and genomics research, customs, rescue, security work, identifying biological material, companionship [6][31][32][33][34], as a fighter, hunter, hauler, and source of food and fur [13]. Dogs are also used to help people with disabilities, such as guide dogs for the blind, seizure alert dogs, and hearing dogs [35][36]. People have also used dogs in specialty positions in which their superior sense of smell has been used to seek out termites, missing persons, and, in some instances, malignant tumours, due to their ability to learn and be directed by humans [11].

Ownership of a dog is likely to benefit the owner's physical and mental health, including decreased depression, increased oxytocin levels, and lower blood pressure and cholesterol levels [37][38]. Dogs also encourage their owners to exercise on a regular basis, lowering the risk of cardiovascular disease for both parties [39]. Exercising with their owner is likely the primary source of exercise for a companion animal, and therefore it is strongly influenced by owner-related factors such as their physical and social environment, personal capabilities, interests, motivating factors for exercise, and relationship with their dog [40]. Dog owners promote social contact among themselves, which reduces feelings of loneliness [41]. Owning a dog has been shown to have positive psychological impacts, including less stress effects, a larger social communication network, and a high sympathetic ability and sense of mercy. Furthermore, people who live with dogs are less likely to become ill because of their gratifying life with the dog [42]. Companion animals are also ideal research subjects for investigating the genetic and environmental factors that influence human behaviour, personality, and psychiatric diseases [43].

Domestic dogs are important for many economic reasons [44]. Pet dogs are the driving force behind a multibillion sector that includes food production, veterinary care, specialty services, and, of course, dog breeding [45]. Breeding and selling dogs accounts for 5% of all dog-related income in Belgium and is a major source of employment [46]. However, because of genetic improvement, the focus of breeding shifted away from working ability and toward morphological characters (such as coat colour, texture, size, and skull shape) [28]. Consequently, this phenotypic selection of around 400 breeds is now regarded as the second bottleneck [28]. Therefore, conserving dogs with special abilities in these situations will preserve the genetics underlying them, allowing for their continued use and study [47].

The United Kingdom Kennel Club recognizes 215 dog breeds and separates them into seven divisions by function. Hound group hunting dogs are those that hunt by scent and sight. Gundog track (Pointers and Setters), hunt (Spaniels), and recover game (Retrievers). The terrier category consists of canines that were used to hunt vermin or foxes. Utility dogs were originally employed for working or guarding but are now largely companions. Working dogs were used for house guarding, and hunting. Pastoral herd and guard livestock [48]. Because of small body sizes, toy dogs are mostly kept as pets [48].

References

1. Mastrangelo, S.; Biscarini, F.; Tolone, M.; Auzino, B.; Ragatzu, M.; Spaterna, A.; Ciampolini, R. Genomic characterization of the Braque Français type Pyrénées dog and relationship with other breeds. *PLoS ONE* 2018, 13, e0208548.
2. Gajaweera, C.; Kang, J.M.; Lee, D.H.; Lee, S.H.; Kim, Y.K.; Wijayananda, H.I.; Kim, J.J.; Ha, J.H.; Choi, B.H.; Lee, S.H. Genetic diversity and population structure of the Sapsaree, a native Korean dog breed. *BMC Genet.* 2019, 20, 66.
3. Wang, G.D.; Zhai, W.; Yang, H.C.; Wang, L.U.; Zhong, L.I.; Liu, Y.H.; Fan, R.X.; Yin, T.T.; Zhu, C.L.; Poyarkov, A.D.; et al. Out of southern East Asia: The natural history of domestic dogs across the world. *Cell Res.* 2016, 26, 21–33.
4. Lampi, S.; Donner, J.; Anderson, H.; Pohjoismäki, J. Variation in breeding practices and geographic isolation drive subpopulation differentiation, contributing to the loss of genetic diversity within dog breed lineages. *Canine Med. Genet.* 2020, 7, 5.
5. Lee, E.W.; Choi, S.K.; Cho, G.J. Molecular genetic diversity of the Gyeongju Donggyeong dog in Korea. *J. Vet. Med. Sci.* 2014, 14, 189.

6. Parker, H.G.; Dreger, D.L.; Rimbault, M.; Davis, B.W.; Mullen, A.B.; Carpintero-Ramirez, G.; Ostrander, E.A. Genomic analyses reveal the influence of geographic origin, migration, and hybridization on modern dog breed development. *Cell Rep.* 2017, 19, 697–708.
7. Hiby, E.F.; Hiby, L.R. Dog population management. In *The Domestic Dog: Its Evolution, Behavior and Interactions with People*; Cambridge University Press: Cambridge, UK, 2016; p. 385.
8. Thalmann, S.; Behrens, M.; Meyerhof, W. Major haplotypes of the human bitter taste receptor TAS2R41 encode functional receptors for chloramphenicol. *Biochem. Biophys. Res. Commun.* 2013, 435, 267–273.
9. Freedman, A.H.; Wayne, R.K. Deciphering the origin of dogs: From fossils to genomes. *Annu. Rev. Anim. Biosci.* 2017, 5, 281–307.
10. King, T.; Marston, L.C.; Bennett, P.C. Describing the ideal Australian companion dog. *Appl. Anim. Behav. Sci.* 2009, 120, 84–93.
11. King, T.; Marston, L.C.; Bennett, P.C. Breeding dogs for beauty and behaviour: Why scientists need to do more to develop valid and reliable behaviour assessments for dogs kept as companions. *Appl. Anim. Behav. Sci.* 2012, 137, 1–12.
12. Gompper, M.E. The dog-human-wildlife interface: Assessing the scope of the problem. In *Free-Ranging Dogs and Wildlife Conservation*; Oxford University Press: Oxford, UK, 2014; pp. 9–54.
13. Lescureux, N.; Linnell, J.D. Warring brothers: The complex interactions between wolves (*Canis lupus*) and dogs (*Canis familiaris*) in a conservation context. *Biol. Conserv.* 2014, 171, 232–245.
14. Kim, J.; Williams, F.J.; Dreger, D.L.; Plassais, J.; Davis, B.W.; Parker, H.G.; Ostrander, E.A. Genetic selection of athletic success in sport-hunting dogs. *Proc. Natl. Acad. Sci. USA* 2018, 115, E7212–E7221.
15. Chyan, P. Decision Support System for Selection of Dog Breeds. In *Proceedings of the 2018 International Seminar on Research of Information Technology and Intelligent Systems (ISRITI)*, Yogyakarta, Indonesia, 21–22 November 2018; pp. 343–346.
16. Jung, C.; Pörtl, D. How old are (pet) dog breeds? *Pet Behav. Sci.* 2019, 7, 29–37.
17. Sheriff, O.; Alemayehu, K. Genetic diversity studies using microsatellite markers and their contribution in supporting sustainable sheep breeding programs: A review. *Cogent Food Agric.* 2018, 4, 1459062.
18. Ali, A.; Roossinck, M.J. Genetic bottlenecks. In *Plant Virus Evolution*; Springer: Berlin/Heidelberg, Germany, 2008; pp. 123–131.
19. Vonholdt, B.M.; Pollinger, J.P.; Lohmueller, K.E.; Han, E.; Parker, H.G.; Quignon, P.; Degenhardt, J.D.; Boyko, A.R.; Earl, D.A.; Auton, A.; et al. Genome-wide SNP and haplotype analyses reveal a rich history underlying dog domestication. *Nature* 2010, 464, 898–902.
20. Freedman, A.H.; Gronau, I.; Schweizer, R.M.; Ortega-Del Vecchyo, D.; Han, E.; Silva, P.M.; Galaverni, M.; Fan, Z.; Marx, P.; Lorente-Galdos, B.; et al. Genome sequencing highlights the dynamic early history of dogs. *PLoS Genet.* 2014, 10, e1004016.
21. Marsden, C.D.; Ortega-Del Vecchyo, D.; O'Brien, D.P.; Taylor, J.F.; Ramirez, O.; Vilà, C.; Marques-Bonet, T.; Schnabel, R.D.; Wayne, R.K.; Lohmueller, K.E. Bottlenecks and selective sweeps during domestication have increased deleterious genetic variation in dogs. *Proc. Natl. Acad. Sci. USA* 2016, 113, 152–157.
22. Mäki, K. Population structure and genetic diversity of worldwide Nova Scotia Duck Tolling Retriever and Lancashire Heeler dog populations. *J. Anim. Breed. Genet.* 2010, 127, 318–326.
23. Wijnrocx, K.; François, L.; Stinckens, A.; Janssens, S.; Buys, N. Half of 23 Belgian dog breeds has a compromised genetic diversity, as revealed by genealogical and molecular data analysis. *J. Anim. Breed. Genet.* 2016, 133, 375–383.
24. Ács, V.; Bokor, Á.; Nagy, I. Population structure analysis of the border collie dog breed in Hungary. *Animals* 2019, 9, 250.
25. Windig, J.J.; Hulsegge, I. Retriever and pointer: Software to evaluate inbreeding and genetic management in captive populations. *Animals* 2021, 11, 1332.
26. Bouirmane, J. Genetic Variation Influencing Body Size in Purebred Dogs. Bachelor's Thesis, Turku University of Applied Sciences, Turku, Finland, 2016.
27. Fratkin, J.L.; Baker, S.C. The role of coat color and ear shape on the perception of personality in dogs. *Anthrozoös* 2013, 26, 125–133.
28. Dendoncker, P.A. On the Origin of Puppies: A Multidisciplinary Investigation into Belgian Dog Breeding Facilities. Ph.D. Thesis, Ghent University, Ghent, Belgium, 2019.

29. Singh, A.P. Labrador retriever a perfect apartment dog: A review. *Bhartiya Krishi Anusandhan Patrika* 2021, 36, 353–354.
30. Lazarowski, L.; Foster, M.L.; Gruen, M.E.; Sherman, B.L.; Case, B.C.; Fish, R.E.; Milgram, N.W.; Dorman, D.C. Acquisition of a visual discrimination and reversal learning task by Labrador retrievers. *Anim. Cogn.* 2014, 17, 787–792.
31. Jansson, M.; Laikre, L. Recent breeding history of dog breeds in Sweden: Modest rates of inbreeding, extensive loss of genetic diversity and lack of correlation between inbreeding and health. *J. Anim. Breed. Genet.* 2013, 131, 153–162.
32. Jansson, M. Assessing Inbreeding and Loss of Genetic Variation in Canids, Domestic Dog (*Canis familiaris*) and Wolf (*Canis lupus*), Using Pedigree Data. Ph.D. Thesis, Stockholm University, Stockholm, Sweden, 2014.
33. Pedersen, N.C.; Liu, H.; Leonard, A.; Griffioen, L. A search for genetic diversity among Italian Greyhounds from Continental Europe and the USA and the effect of inbreeding on susceptibility to autoimmune disease. *Canine Genet. Epidemiol.* 2015, 2, 17.
34. Radko, A.; Podbielska, A. Microsatellite DNA Analysis of Genetic Diversity and Parentage Testing in the Popular Dog Breeds in Poland. *Genes* 2021, 12, 485.
35. Wells, D.L. Domestic dogs and human health: An overview. *Br. J. Health Psychol.* 2007, 12, 145–156.
36. Serpell, J.A.; Kruger, K.A.; Freeman, L.M.; Griffin, J.A.; Ng, Z.Y. Current standards and practices within the therapy dog industry: Results of a representative survey of United States therapy dog organizations. *Front. Vet. Sci.* 2020, 7, 35.
37. Westgarth, C.; Christley, R.M.; Jewell, C.; German, A.J.; Boddy, L.M.; Christian, H.E. Dog owners are more likely to meet physical activity guidelines than people without a dog: An investigation of the association between dog ownership and physical activity levels in a UK community. *Sci. Rep.* 2019, 9, 5704.
38. Krouzecky, C.; Emmett, L.; Klaps, A.; Aden, J.; Bunina, A.; Stetina, B.U. And in the Middle of My Chaos There Was You?—Dog Companionship and Its Impact on the Assessment of Stressful Situations. *Int. J. Environ. Res. Public Health* 2019, 16, 3664.
39. Bray, E.E.; Otto, C.M.; Udell, M.A.; Hall, N.J.; Johnston, A.M.; MacLean, E.L. Enhancing the selection and performance of working dogs. *Front. Vet. Sci.* 2021, 8, 430.
40. Griss, S.; Riemer, S.; Warembourg, C.; Sousa, F.M.; Wera, E.; Berger-Gonzalez, M.; Alvarez, D.; Bulu, P.M.; Hernández, A.L.; Roquel, P.; et al. If they could choose: How would dogs spend their days? Activity patterns in four populations of domestic dogs. *Appl. Anim. Behav. Sci.* 2021, 243, 105449.
41. Cutt, H.; Giles-Corti, B.; Knuiman, M.; Burke, V. Dog ownership, health and physical activity: A critical review of the literature. *Health Place* 2007, 13, 261–272.
42. Ozcan, M.; Ekiz, B.; Ozturk, N.; Berk, H.O.S. Factors Affecting Turkish Dog Owners' Breed Choices, and Their Associations with Socio-demographic and Dog-Related Variables. *Anthrozoös* 2019, 32, 647–664.
43. Salonen, M. Complex traits, complex results: The genetic, demographic, and environmental factors of cat and dog behaviour. Ph.D. Thesis, Helsingin yliopisto, Helsinki, Finland, 2020.
44. Calboli, F.C.; Sampson, J.; Fretwell, N.; Balding, D.J. Population structure and inbreeding from pedigree analysis of purebred dogs. *Genetics* 2008, 179, 593–601.
45. FEDIAF. Nutritional Guidelines for Complete and Complementary Pet Food for Cats and Dogs; Fédération Européenne de l'Industrie des Aliments pour Animaux Familiers: Brussels, Belgium, 2018.
46. Westgarth, C.; Pinchbeck, G.L.; Bradshaw, J.W.; Dawson, S.; Gaskell, R.M.; Christley, R.M. Factors associated with dog ownership and contact with dogs in a UK community. *BMC Vet. Res.* 2007, 3, 5.
47. Boyko, R.H.; Boyko, A.R. Dog conservation and the population genetic structure of dogs. In *Free-Ranging Dogs and Wildlife Conservation*; Oxford University Press: Oxford, UK, 2014; pp. 185–210.
48. Farrell, L.L.; Schoenebeck, J.J.; Wiener, P.; Clements, D.N.; Summers, K.M. The challenges of pedigree dog health: Approaches to combating inherited disease. *Canine Genet. Epidemiol.* 2015, 2, 3.