

An Investigation of Biological Variation and Illness Control in Border Shepherd Canines

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Abstract

Preserving genetic variety in dog breeds is crucial for managing hereditary illnesses. This extensive research explores the many facets of Border Shepherd dogs, with particular attention to breeding procedures, environmental factors, health issues and genetic diversity. The research highlights the critical function of genetic screening in conscientious breeding by examining frequent health problems like hip dysplasia, progressive retinal atrophy (PRA) and epilepsy. The identification of environmental variables, such as pesticides and pollutants, as possible contributors to the development of illness highlights the need of a comprehensive approach to well-being. In addition, the research will examine current disease prevention strategies, like as immunizations and preventative care and assess their effectiveness in the Border Shepherd community. To improve breed health, breeders, veterinarians and researchers work together. It made possible by genetic screening, selective breeding and shared databases. More research is done on the complex connection between Border Shepherds' dietary requirements and genetic diversity. It is possible to create knowledgeable dietary plans that promote optimum health and handle potential sensitivities by taking into account the influence of genetic diversity on dietary needs. The study depicts a worrying drop in effective population size that is linked to breeding techniques and owner decisions. The results of this study merely advance our knowledge of the biological variety seen in the Border Shepherd breed but offer significant novel perspectives in the field of individualized medicine for canines with comparable traits. In the end, this study aims to maximize sickness prevention tactics, enhancing the welfare of Border Shepherd dogs and acting as a prototype for the larger canine community.

Keywords: Border Collies; Genetic Variability; Health Concerns; Breeding Practices; Genomic Diversity

INTRODUCTION

German Shepherds and Border Collies were crossed to create the rare breed known as Border Shepherds. These canines, which are well-known for their intellect, flexibility and adaptability, combine protective tendencies with herding characteristics. Border Shepherds are sought after for their versatility, trainability, along with their strong determination and devotion. The study explores the connection between biological diversity and disease prevention in Border Shepherds, focusing on genetic foundations, health concerns and environmental elements (1). Genetics of Border Shepherds is crucial for understanding their biological diversity. Over generations, selective breeding has improved guarding and herding traits, but this has led to increased inbreeding and population bottlenecks (2). Population bottlenecks and inbreeding in the Border Shepherd breed lead to decrease in genetic diversity and an increase in hereditary illnesses, resulting in a genetic composition that mirrors the consequences of both factors (3). Recent studies show variations in the prevalence of homozygosity and identity-by-descent segments across different breed lines, indicating a restricted gene pool and increasing hereditary illness likelihood. To implement targeted

disease control measures, a nuanced examination of past breeding practices' influence on biological diversity is essential (4). Border shepherds, despite their athleticism and robustness, are at risk for health issues due to genetic predispositions and environmental conditions. Common health issues include hip dysplasia, progressive retinal atrophy, epilepsy and autoimmune diseases (5). Genetic screening is crucial for understanding the genetic basis of diseases, particularly hereditary ones like hip dysplasia in Border Shepherds. This helps breeders make informed decisions about mating practices and helps to identify individuals susceptible to these issues (6). Identifying genetic factors is crucial for breeders to reduce progressive retinal atrophy in Border Shepherds through selective breeding. While heredity is a significant factor, environmental factors impact the dogs' health (7). Breed well-being is influenced by various factors like nutrition, physical activity, living conditions and environmental pollutants. A balanced diet is crucial for maintaining overall health, especially for breeds with high energy levels and dynamic lifestyles. Understanding the relationship between dietary factors and genetic variations is essential, as nutrition, gene expression and health outcomes are interconnected (8). The Border Shepherd breed's well-being relies on mental engagement and physical activity, due to their agility and herding instincts. A balanced regimen of mental stimulation, regular physical activity and sufficient rest is crucial for their overall health and preventing behavioral issues (9). Border Shepherds are exposed to environmental hazards such as pollutants, pesticides and household materials, which can lead to the development of diseases (10). Understanding the genetics, environmental factors and health complexities of Border Shepherds is crucial for their overall well-being, resilience as well as collaborative efforts between breeders, veterinarians and researchers can enhance their health. The aim is to develop a comprehensive strategy for optimal disease prevention in this intelligent breed.

The research (11) explored the worldwide rabies environment, highlighting the high mortality rate and acute nature of the disease. The ambitious 2030 plan whose performance indicators were shown in the Americas to end dog-mediated human rabies was the main topic of discussion. Dog rabies removal was best shown by the Costa Rican experience, although problems exist, particularly with regard to vampire bat transmission and one health issues. The research (12) carried out a thorough literature analysis of the zoonotic protozoan parasite *Trypanosomacruzi*, which was spread across the Americas by triatomine insects. The study concentrated on monitoring in working dogs owned by the US Department of Homeland Security, finding a 7.5% seroprevalence and pinpointing regional risk variables that were essential for better disease treatment. The research (13) described about canine Chagas disease emphasizes how serious a health issue it has become for dogs in the USA and the way it can be a marker of human illness risk in some areas. Scattered among ten Texas kennels, the research found a significant occurrence rate that highlights the urgent need for coordinated vector management and potent anti-parasitic medicines to protect human and canine health. The research (14) employed a TMT label-based proteomic technique to examine the blood protein composition in dogs suffering from Chronic Valve Disease (CVD). Of the 290 proteins that were discovered, antithrombin-III, adiponectin and gelsolin were among the 15 that showed notable variations. Bioinformatics study demonstrated both parallels and divergences with human illness by revealing participation in pathways like as complement cascades and lipid metabolism. The research (15) adopted Cavalieri's principle to estimate the volumes of the lateral ventricle (LV), subarachnoid space (SAS) and forebrain (FB) in afflicted dogs in comparison to controls. Even though there were no notable variations discovered, dogs with a history of status epilepticus had bigger FB, suggesting possible therapeutic importance. Breed, however, could have an impact on these results, highlighting the need for further study with bigger, more varied groups to make firm conclusions. As useful as Cavalieri's approach was in estimating, widespread clinical usage cannot be feasible given its applicability. The research (16) investigated a hair cortisol concentration (HCC) in Border Collies to examine the chronic HPA axis activity. Numerous dogs as a psychosocial stressor, competitive fly ball as a lifestyle, non-social, stranger-directed anxiety, an epilepsy diagnosis that was connected with HCC and medicine (anti-epileptic medications) were some of the factors that influence HCC. The findings imply that long-term stress can cause hypocortisolism, highlighting the need of taking stressor recency and recurrence into account when interpreting HCC data. The research (17) found

that there was a lack of knowledge on vector-borne infections in dogs in Northeast India, particularly in Mizoram and Tripura close to the Myanmar border. After examining 130 dog blood samples, the research found that 52% of the samples were infected with common infections such as *Hepatozoon canis* and *Babesia gibsoni*. The study (18) determined an unrestrained dog in western Kenya, using GPS loggers on 73 dogs, found a median daily travel distance of 13.5 km. older dogs had more extensive home ranges. The findings provided valuable insights into dog ecology, resource utilization and disease transmission models, contribute to understand dog behavior. The study (19) focused in Norway and Sweden examined the risk of orthopedic conditions in 12 dog breeds, focusing on elbow dysplasia, cranial cruciate ligament disease, medial patellar luxation and radius-ulna fractures. High risks were found in Labrador retrievers, Rottweilers, German shepherds and Staffordshire bull terriers, emphasizing the need for robust caseloads and precise control groups in evaluating breed susceptibility. The study (20) explored the impact of population bottlenecks, inbreeding and artificial selection on canine genetics. It revealed an increased identity-by-descent and homozygosity runs in breed dogs, highlighting the influence of inbreeding on genetic diversity along with potential disease-related variations in dogs.

DATASET

The research consist of 13,339 individuals in the population under examination were drawn from the computerized herd records and pedigrees of breeders. Of them, 7,750 were female and 5,649 were male. Including 1,877 border collies (929 males and 948 females), born between 1990 and 2016, the reference group includes relevant information on Canine Elbow Dysplasia (CED) and Congenital Hip Dysplasia (CHD).

HEALTH CONCERNS

Common Issues in Border Shepherds

The unique and perceptive breed of border shepherds, famed for their guarding and herding skills, is prone to a number of common health problems. To protect the wellbeing of these exceptional canines, breeders, vets and pet owners must comprehend these difficulties. Hip dysplasia is a common health issue in Border Shepherds, causing discomfort, pain and reduced mobility due to abnormal hip joint development. Genetic factors play a significant role, emphasizing the need for responsible breeding practices and genetic screening to identify and mitigate the risk. Border Shepherds are susceptible to progressive retinal atrophy (PRA), a degenerative eye disorder that can lead to blindness. Genetic predisposition can cause PRA in these dogs. Regular eye examinations and genetic testing can help detect PRA early and inform breeders to reduce its prevalence. Epilepsy is a neurological disorder affecting Border Shepherds, causing seizures with varying intensity and frequency. Genetics can contribute to the condition, ongoing monitoring as well as consultation with veterinarians is crucial for effective management and treatment of epileptic episodes. Genetic screening is a crucial tool for identifying carriers of specific genes linked to hereditary conditions in Border Shepherds. Responsible breeders use this to make informed decisions about mating pairs, aiming to reduce common health issues in future generations. Understanding genetic landscapes helps the breeders to minimize the impact of genetic disorders on the overall health of Border Shepherds. Environmental factors like pollutants, pesticides and household materials can contribute to disease development. Promoting a healthy lifestyle through nutrition, exercise and mental stimulation is essential for managing and preventing common health issues in Border Shepherds. The genomes of the dogs are shown in Figure (1) and their pedigrees of Border Shepherds.

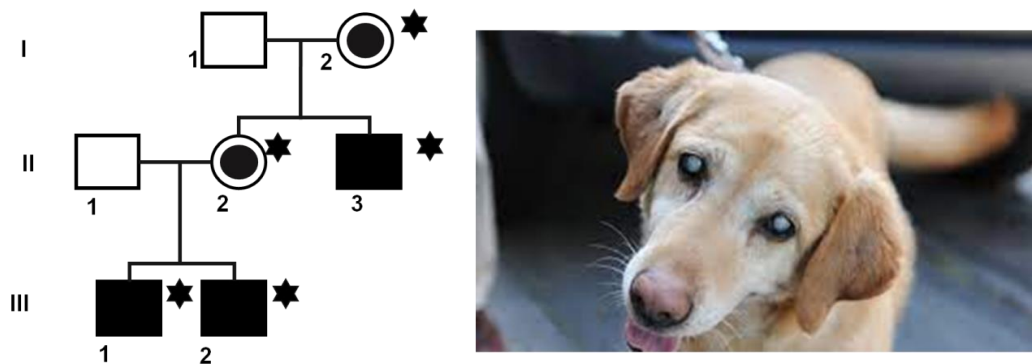


Figure (1). Progressive retinal atrophy (Source: Author)

Because they have impacted sons, females I2 and II2 are required carriers. The X chromosome is faulty inherited by the two afflicted men, III1 and III2, from their II2 mother. An image of a blind and afflicted two-year-old Border collie is depicted.

Genetic Screening and Selective Breeding

Responsible breeding practices, including genetic screening and selective breeding, aim to promote animal health and well-being, including Border Shepherds. These practices involve systematic evaluation coupled with intentional choices to minimize hereditary diseases and undesirable traits.

Genetic screening

Genetic screening is the analysis of an individual's genetic makeup to identify genes or markers linked to hereditary conditions, particularly important in understanding the genetic landscape of Border Shepherds and identifying carriers of genes linked to common health issues.

Identification of Genetic Predispositions

Early identification of possible genetic predispositions to conditions including hip dysplasia, PRA, epilepsy and autoimmune illnesses is made possible by genetic screening. By identifying carriers, breeders can choose mating pairings with more knowledge and less chance of passing on dangerous genes to their progeny.

Well-Informed Breeding Selections

Breeders can reach informed judgments about breeding by using the information gathered from genetic screening. Breeders can lessen the chance that carriers of certain genetic disorders will mate and pass on their condition to their offspring.

Improving the General Health of Breeds

The improvement of overall breed health is facilitated by the methodical use of genetic screening. Genetically-based responsible breeding methods can lower the incidence of hereditary disorders in the Border Shepherd population and produce healthier litters.

Selective Breeding

Maintaining Desirable Features

Breeders can maintain and improve the qualities that make Border Shepherds unique, such intellect, speed and husbandry impulses, by using selective breeding. This guarantees that the breed continue to possess its distinctive traits into subsequent generations.

Reducing Unwanted Attributes

Breeders can decrease the incidence of health problems in the breed by preventing mating animals with unattractive features or known genetic predispositions to illnesses. This method enhances the general health and happiness of Border Shepherds.

Sustaining Genetic Variability

Responsibly-minded breeders focus equal emphasis on preserving genetic variety and discriminating for certain features. Preventing the risk of genetic illnesses linked to a few genes can be achieved by avoiding excessive interbreeding which helps to prevent population constraints. Genetic screening and selective breeding are effective strategies for managing the genetic health of Border Shepherds. By utilizing genetic science advancements along with informed breeding decisions, breeders can create healthier, more resilient generations, ensuring the breed's longevity and vitality.

Environmental Influences on Health

The environment that Border Shepherds constitute has a significant influence on their general health due to a multitude of reasons. This is based on having sufficient living circumstances, which include a healthy diet and a suitable place to live. Proper shelter offers safety and ease, as well as a healthy meal catered towards their high activity levels is essential. For these perceptive and quick canines, frequent mental and physical stimulation is crucial as it helps to avoid issues with conduct and being obese. However, there are possible concerns associated with environmental factors, such as herbicides, contaminants and home chemicals that might be harmful to their health. Protecting against respiratory diseases and external parasites is dependent on preventative methods including vaccines, vaccinations and infection management. Climate adaptation is essential because of their vulnerability to very high and low temperatures. To avoid injuries and incidents, owners must design safe spaces and reduce any possible risks. Frequent veterinarian examinations can identify health problems early and enable prompt treatment. In order to maintain the lifespan, well-being and general health of Border Shepherds, competent pet management becomes essential in navigating the many environmental factors.

WELL-BEING FACTORS

Border Shepherds' well-being is influenced by various factors such as care, lifestyle and environmental factors. Nutrition is crucial for their health, as it supports their high energy levels and maintains optimal health. A well-balanced diet contributes to their overall vitality and longevity. Regular physical activity and mental stimulation are essential for their well-being, preventing obesity, promoting cardiovascular health and addressing their need for mental engagement. Activities that stimulate intelligence, like interactive play and puzzle-solving, contribute to a fulfilled mental state. A supportive living environment, including adequate shelter, protection from extreme weather and comfortable spaces, is essential for their physical comfort and mental security. Regular veterinary care helps to detect health issues early and prevent diseases. Timely intervention and social interaction are vital for their mental well-being. Border Shepherds' loyalty and strong bond with their owners contribute to their emotional health.

The Relationship between Genomic Diversity and Nutritional

The complex correspond that exists between variation in genomics and nourishment of Border Shepherd dogs highlights the significant impact that genetic variety has on their nutritional needs and general health. The variety of genetic features seen in the breeds, or genomics diversity, is a major factor in determining whether Border Shepherds metabolize and react to nutrition. Some genetic variants can impact the way that nutrients are processed by enzymes, which can affect the way of nutrients are absorbed, digested and used in the body. Beyond the metabolism, this diversity includes Shepherd dog-specific dietary requirements and allergies. Understanding the genomic environment is crucial for designing nutrition for Border Shepherd dogs, considering individual differences and busy lifestyles. This interaction between genetics and nutrition is essential to address potential dietary sensitivities and health issues. By acknowledging and using genetic variability, educated dietary regimens can be developed to promote optimal health, minimize nutritional deficiencies that meet individual needs. Following precise and customized dietary guidelines is essential to protect this unique breed, emphasizing the importance of understanding the genomic environment in dietary design.

Risks Associated with Environmental Hazards

The environmental dangers that the Border Shepherd canine species is affected have a serious negative effect on its health. It is dangerous to be exposed to contaminants, herbicides and everyday objects because these substances can trigger respiratory disorders, irritation to the skin and digestive problems. These environmental elements can leave a negative impact on Border Shepherds health and lead to the development of illnesses. Furthermore, long-term effects from pollution and herbicides can influence the breed's general health and perhaps exacerbate genetic susceptibility to specific disorders. It is essential to avoid being around toxic substances, regulate living circumstances carefully that have regular veterinarian check-ups to mitigate these risks as well as protect the health and lifespan of Border Shepherd dogs in their varied further to sometimes demanding situations.

COLLABORATIVE STRATEGIES

Improving the health of Border Shepherd canines requires cooperative approaches from breeders of breeders, vets and specialists. The genetic environment of the breed is better understood via shared databases, health monitoring partnerships and genetic screening programs. Owners are empowered to provide the best care possible through joint efforts in managing the environment, dietary counseling and educational programs. Breed health can continue to increase through support for sustainable breeding methods and continuing development throughout communication channels. In both hereditary and environmental situations, supporting the general health and toughness of Border Shepherd dogs requires a multidisciplinary strategy that prioritizes communication and exchange of knowledge.

Breeders, Vets and Research Collaboration

The term "breeders, vets and research collaboration" describes a collaborative, interdisciplinary endeavor in the context of canine health and genetics that involves breeders, veterinary professionals and investigators. Through this partnership, the knowledge of veterinarians providing clinical care and health monitoring, breeders choosing and preserving healthy bloodlines and researchers conducting studies to enhance knowledge of genetic factors and general health in a particular dog breed are combined. Together, these stakeholders exchange information, statistics and best practices, promoting a comprehensive breed management strategy that puts the general welfare, genetic variety and health of the canine community first.

Implementing Disease Prevention Measures

Incorporating genetic screening, environmental management and routine veterinarian treatment into a multimodal approach is the implementation of disease preventive strategies in Border Shepherd dogs. In order to uncover inherited diseases and selectively breed for genetic health, breeders use thorough screening. Ensuring the timely implementation of immunization regimens and preventative care is ensured by close collaboration with veterinarians. A comprehensive strategy incorporates behavioral health factors, parasite control and nutritional management. Education programs aimed at breeders as well as owners increase awareness, ongoing observation and adjustment to new health information guarantee a pro-active approach. These cooperative initiatives aim to strengthen the breed against possible health problems, enhancing the lifespan and well-being of Border Shepherd dogs, by combining the knowledge of breeders, veterinarians and ongoing investigation.

PERFORMANCE ANALYSIS

• Unmatched Trainability and Herding Instinct in Border Collies

A brief for the behavioral profile's trainability shows that the Border collie is rated highest in Figure (2) and table (1). The early growth of this breed is responsible for this proclivity toward easy trainability and a strong herding instinct.

Table (1). Numerical values of Decile Ranking (Source: Author)

	Decile Ranking
Snapping	4
Territorial Defence	6
Aggression to Dogs	4
Aggression to Family	5
Watch dog Barking	7
Trainability	10
House training Erase	10
Activity Level	8
Excessive Barking	6
Demand for Affection	6

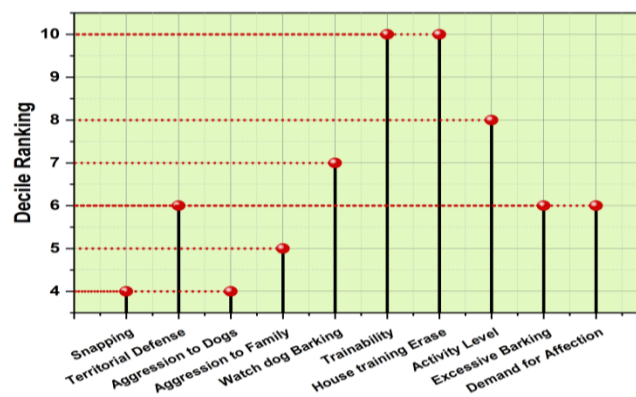


Figure (2). Analysis of Decile Ranking (Source: Author)

As an example, consider the motivation the Celts received to create a better herding dog. Here is a decile rating of Border Shepherd dogs, broken down into three categories: aggressiveness, reactivity and trainability. Shepherds exhibit a variety of aggressive behaviors, including protecting their territory, snapping, attacking family members, attacking other dogs and vigilant barking. There are other kind of reactivity as well, including activity level, continuous barking and need for attention. Lastly, the trainability is far greater than others, such as the convenience of home training.

- **Genetic disease variants**

Autosomal dominant features in Border Shepherd canines show up in a single afflicted parent, but autosomal recessive characteristics in the breed need both parents to have the gene for manifestation. Genes located on the X chromosome that has unique inheritance patterns are involved in X-linked characteristics. For appropriate breeding methods and the management of hereditary problems in the breed, an understanding of these genetic pathways is essential. The majority of genetic diseases observed in canines are attributed to numerous recessive mutations. Typically, canines exhibit a healthy state when possessing one copy of the mutation alongside one copy of the normal genotype. However, if a canine inherits two copies of the mutation, the gene's intended function in the body remains inactive, as they naturally lack a copy of the normal gene. In such instances, the absence of the normal gene copy prevents the manifestation of the gene's intended function, elucidating the influence of recessive mutations on canine genetics and health.

Table (2). Numerical values of Genetic variants (Source: Author)

Autosomal recessive	80
Autosomal dominant	7
X-linked	10
Other	3

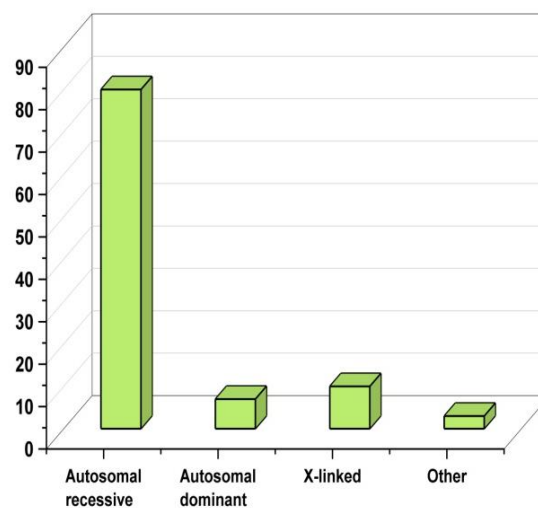


Figure (3). Analysis of Genetic variants (Source: Author)

A genetic condition in dogs can show symptoms that are easily detected and shown in table (2) and Figure (3), or it might be invisible if the effects are mild that include decreased fertility, slowed enzymatic responses, or slowed growth. If a dog inherits two copies of a mutation, a functional impairment is anticipated, irrespective of whether the consequences are visibly apparent. Recessive features cannot result from mutations, but problems caused by dominant genes can be largely resolved by removing carriers from the gene pool. Moreover, the complex interactions among genes in a given dog's genome might affect how a gene expresses itself.

• Trends in Breeding and Genetic Dynamics

The breed's effective population size is shown in Figure (4) and table (3), which spans the time from the first litter's birth in Hungary to the present. This graphical depiction sheds light on the genetic diversity and demographic patterns of the breed over the analyzed period.

Table (3). Numerical values of population count (Source: Author)

Appropriate population count		
Years	Female	Male
2005-2007	190	130
2007-2009	185	120
2009-2011	180	115
2011-2013	175	111
2013-2015	150	107
2015-2017	135	105
2017-2019	120	100
2019-2021	115	95
2021-2023	105	90

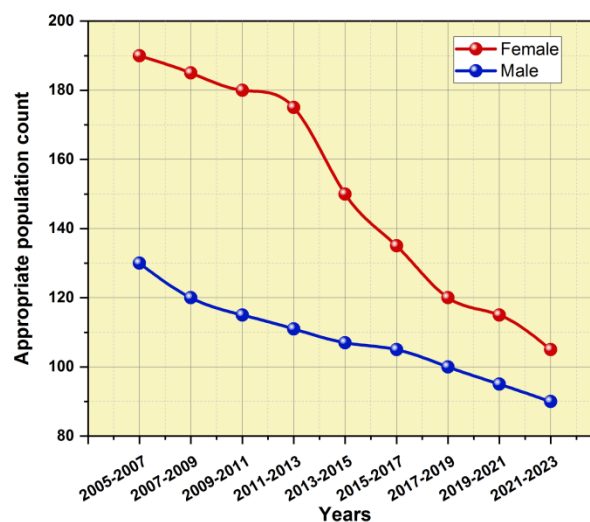


Figure (4): Analysis in Breeding and Genetic Dynamics (Source: Author)

The actual size of canines, male and female, has been decreasing year after year. Even with the breed's increasing popularity, many owners choose to purchase less expensive puppies from unregistered breeders, which means that

the number of dogs with certified pedigrees declines every year. Furthermore, it is common in dog breeding to choose some males over others in mating, which can limit the size of population and encourage inbreeding. Despite its consequences for genetic diversity, this strategy could improve litter uniformity, a desired result for breeders.

CONCLUSION

This research provides a thorough understanding of the biological diversity and disease prevention in Border Shepherd dogs. The results highlight how important it is to use genetic screening, appropriate breeding methods and cooperative approaches to reduce common health problems and protect genetic variety. The hazards associated with environmental conditions are explained, encouraging owners to take precautionary action. The research clarifies the fine balance that must be struck when breeding procedures are implemented to achieve desired features while preserving genetic variety. To preserve a healthy and diversified Border Shepherd population, breeding decisions must be reevaluated in light of the observed trends in breeding and genetic dynamics. The complex interactions between genetics, health and the environment make it clear that a multidisciplinary, cooperative approach is essential. The knowledge gathered from this research helps with the continuous endeavors' to improve the lifespan, health as well as general welfare of Border Shepherd dogs, guaranteeing a strong and prosperous future for this remarkable breed.

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