

# Host genetic diversity and infectious diseases. Focus on wild boar, red deer, and tuberculosis

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## Supplementary Material.

**Table S1.** Number of studies on genetic diversity for ungulate species. Results from a search on the Web of Science with the following search terms: *genetic diversity* and *inbreeding* and *ungulates* (217 studies were obtained). Studies on genetic diversity of ungulate populations published in scientific journals were selected (204 papers). Total: number of studies that explicitly relate genetic diversity to conservation and to disease spread. Cons.: studies that explicitly relate genetic diversity to conservation (papers in which the word ‘conservation’ appeared in the title, abstract, or the name of the journal; 101 studies, 49.5%). Dise.: studies that explicitly associated genetic diversity with diseases (papers in which the title, abstract, or name of the journal used, at least, one of the following terms: ‘disease’, ‘pathogen’, ‘parasite’, any variation of ‘immunity’ or the name of any disease; 23 studies, 12.3%). The search was last consulted on 15th April 2021. See Figure 1 and Table S2. Note that the sum of the Total column does not equal 204 because some studies were conducted on several ungulate species.

| Ungulate                    | Total | Cons. | Dise. | Ungulate                      | Total | Cons. | Dise. |
|-----------------------------|-------|-------|-------|-------------------------------|-------|-------|-------|
| <i>Equus caballus</i>       | 19    | 8     | 1     | <i>Axis porcinus</i>          | 1     | 0     | 0     |
| <i>Cervus elaphus</i>       | 16    | 7     | 6     | <i>Beatragus hunteri</i>      | 1     | 1     | 0     |
| <i>Bison bonasus</i>        | 10    | 7     | 1     | <i>Bos javanicus</i>          | 1     | 1     | 0     |
| <i>Oryx leucoryx</i>        | 9     | 4     | 1     | <i>Camelus dromedarius</i>    | 1     | 0     | 0     |
| <i>Ovis aries</i>           | 9     | 4     | 1     | <i>Camelus ferus</i>          | 1     | 1     | 0     |
| <i>Ovis canadensis</i>      | 9     | 2     | 0     | <i>Capra aegagrus</i>         | 1     | 0     | 0     |
| <i>Bos taurus</i>           | 7     | 2     | 1     | <i>Capra pyrenaica</i>        | 1     | 0     | 0     |
| <i>Cervus nippon</i>        | 7     | 1     | 0     | <i>Cervus albirostris</i>     | 1     | 1     | 0     |
| <i>Sus scrofa</i>           | 6     | 3     | 0     | <i>Cervus unicolor</i>        | 1     | 1     | 0     |
| <i>Bison bison</i>          | 6     | 5     | 1     | <i>Choeropsis liberiensis</i> | 1     | 0     | 0     |
| <i>Diceros bicornis</i>     | 6     | 5     | 0     | <i>Dama dama</i>              | 1     | 1     | 0     |
| <i>Cervus eldii</i>         | 5     | 4     | 0     | <i>Gazella gazelle</i>        | 1     | 1     | 0     |
| <i>Elaphurus davidianus</i> | 5     | 3     | 1     | <i>Gazelle dorca</i>          | 1     | 0     | 0     |
| <i>Rangifer tarandus</i>    | 5     | 3     | 0     | <i>Giraffa camelopardalis</i> | 1     | 0     | 0     |
| <i>Capreolus capreolus</i>  | 4     | 0     | 1     | <i>Giraffa giraffa</i>        | 1     | 1     | 0     |
| <i>Equus hemionus</i>       | 4     | 2     | 0     | <i>Hippocamelus bisulcus</i>  | 1     | 1     | 0     |
| <i>Gazella cuvieri</i>      | 4     | 1     | 0     | <i>Hippotragus niger</i>      | 1     | 1     | 0     |
| <i>Oreamnos americanus</i>  | 4     | 2     | 1     | <i>Hydropotes inermis</i>     | 1     | 0     | 0     |
| <i>Capra hircus</i>         | 3     | 0     | 0     | <i>Moschus moschiferus</i>    | 1     | 0     | 0     |

|                               |   |   |   |                               |   |   |   |
|-------------------------------|---|---|---|-------------------------------|---|---|---|
| <i>Ceratotherium simum</i>    | 3 | 3 | 0 | <i>Muntiacus crinifrons</i>   | 1 | 0 | 0 |
| <i>Equus zebra</i>            | 3 | 2 | 3 | <i>Naemorhedus baileyi</i>    | 1 | 1 | 0 |
| <i>Gazella spekei</i>         | 3 | 1 | 0 | <i>Naemorhedus griseus</i>    | 1 | 1 | 0 |
| <i>Moschus berezovskii</i>    | 3 | 2 | 0 | <i>Nanger soemmerringii</i>   | 1 | 0 | 0 |
| <i>Nanger dama</i>            | 3 | 1 | 0 | <i>Odocoileus hemionus</i>    | 1 | 1 | 1 |
| <i>Odocoileus virginianus</i> | 3 | 2 | 0 | <i>Okapia johnstoni</i>       | 1 | 1 | 0 |
| <i>Ovibos moschatus</i>       | 3 | 0 | 0 | <i>Ovis orientalis</i>        | 1 | 0 | 0 |
| <i>Antidorcas marsupialis</i> | 2 | 0 | 1 | <i>Porcula salvania</i>       | 1 | 1 | 0 |
| <i>Bos mutus</i>              | 2 | 1 | 0 | <i>Rhinoceros unicornis</i>   | 1 | 1 | 0 |
| <i>Bubalus bubalis</i>        | 2 | 0 | 1 | <i>Rucervus duvaucelii</i>    | 1 | 0 | 0 |
| <i>Capra ibex</i>             | 2 | 1 | 0 | <i>Rucervus eldii</i>         | 1 | 1 | 0 |
| <i>Cervus canadensis</i>      | 2 | 1 | 0 | <i>Rusa timorensis</i>        | 1 | 0 | 0 |
| <i>Equus quagga</i>           | 2 | 1 | 1 | <i>Saiga tatarica</i>         | 1 | 0 | 0 |
| <i>Lama guanicoe</i>          | 2 | 1 | 0 | <i>Sus cebrifons</i>          | 1 | 1 | 0 |
| <i>Oryx dammah</i>            | 2 | 2 | 0 | <i>Tapirus bairdii</i>        | 1 | 1 | 0 |
| <i>Rupicapra rupicapra</i>    | 2 | 2 | 0 | <i>Tapirus terrestris</i>     | 1 | 1 | 0 |
| <i>Syncerus caffer</i>        | 2 | 1 | 1 | <i>Trafelaphus imberbis</i>   | 1 | 0 | 0 |
| <i>Taurotragus derbianus</i>  | 2 | 2 | 0 | <i>Tragelaphus angasii</i>    | 1 | 0 | 0 |
| <i>Vicugna vicugna</i>        | 2 | 1 | 0 | <i>Tragelaphus imberbis</i>   | 1 | 0 | 0 |
| <i>Addax nasomaculatus</i>    | 1 | 1 | 0 | <i>Tragelaphus sylvaticus</i> | 1 | 0 | 0 |
| <i>Alces alces</i>            | 1 | 0 | 0 | <i>Trofelaphus isaaci</i>     | 1 | 0 | 0 |

**Table S2.** Number of studies in scientific journals (ungulates). Number of studies published in scientific journals for the search on the Web of Science with the following search terms: *genetic diversity* and *inbreeding* and *ungulates*. See Figure 1 and Table S1.

| Journal                                   | Studies | Journal                          | Studies |
|---|---------|----------------------------------|---------|
| Conservation Genetics                     | 19      | Biology Letters                  | 1       |
| Plos One                                  | 11      | Biology of Reproduction          | 1       |
| Journal of Heredity                       | 9       | BMC Genetics                     | 1       |
| Molecular Ecology                         | 8       | Chinese Science Bulletin         | 1       |
| Zoo Biology                               | 8       | Contributions to Zoology         | 1       |
| Journal of Wildlife Management            | 7       | Cryobiology                      | 1       |
| Biological Conservation                   | 6       | Current Zoology                  | 1       |
| Animal Conservation                       | 5       | Frontiers in Ecology & Evolution | 1       |
| Biochemical Systematics and Ecology       | 5       | Gene                             | 1       |
| Ecology and Evolution                     | 5       | Genes & Genetic Systems          | 1       |
| Journal of Zoology                        | 5       | Genética                         | 1       |
| Mammalian Biology                         | 5       | Genetics                         | 1       |
| Animal Genetics                           | 4       | Genetika                         | 1       |
| Biological Journal of the Linnean Society | 4       | Genome Biology and Evolution     | 1       |
| Conservation Biology                      | 4       | Genomics                         | 1       |
| Evolutionary Applications                 | 4       | Global Change Biology            | 1       |
| Indian Journal of Animal Sciences         | 4       | Iceland Agricultural Sciences    | 1       |

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|---|---|---|---|
| Acta Theriologica                       | 3 | Infection Genetics and Evolution                    | 1 |
| BMC Genomics                            | 3 | International Journal of Genomics                   | 1 |
| Conservation Genetics Resources         | 3 | Italian Journal of Animal Science                   | 1 |
| European Journal of Wildlife Research   | 3 | Journal of Animal and Plant Sciences                | 1 |
| Genetics and Molecular Research         | 3 | Journal of Applied Genetics                         | 1 |
| Molecular Ecology Resources             | 3 | Journal of Biogeography                             | 1 |
| Russian Journal of Genetics             | 3 | Journal of Experimental Zoology                     | 1 |
| Biochemical Genetics                    | 2 | Journal of Fish and Wildlife Management             | 1 |
| BMC Evolutionary Biology                | 2 | Journal of Mammalogy                                | 1 |
| Canadian Journal of Zoology             | 2 | Journal of the South African Veterinary Association | 1 |
| Evolution                               | 2 | Journal of Zoo and Aquarium Research                | 1 |
| Folia Zoologica                         | 2 | Mammal Study  | 1 |
| Global Ecology and Conservation         | 2 | Mitochondrial DNA                                   | 1 |
| Heredity                                | 2 | Mitochondrial DNA part A                            | 1 |
| Journal of Animal Breeding and Genetics | 2 | Oecologia   | 1 |
| Mammal Review                           | 2 | Pachyderm   | 1 |
| Scientific Reports                      | 2 | Plos Genetics                                       | 1 |
| Wildlife Biology                        | 2 | Reproduction in Domestic Animals                    | 1 |
| African Journal of Biotechnology        | 1 | Revista Brasileira de Zootecnia                     | 1 |
| African Journal of Ecology              | 1 | Revista de Investigaciones Veterinarias del Perú    | 1 |
| Animal Behaviour                        | 1 | South African Journal of Wildlife Research          | 1 |
| Animal Biodiversity and Conservation    | 1 | South American Camelids Research                    | 1 |
| Applied Animal Behaviour Science        | 1 | Western North American Naturalists                  | 1 |
| Australian Journal of Zoology           | 1 | Zoological Journal of the Linean Society            | 1 |
| Belgian Journal of Zoology              | 1 |   |   |

**Table S3.** Number of studies in scientific journals (wild boar). Number of studies published in scientific journals for the search on the Web of Science with the following search terms: *wild boar* and *Sus scrofa* and *tuberculosis*. See Figure 2 and Table 1.

| Journal                               | Studies | Journal                                  | Studies |
|---------------------------------------|---------|--|---------|
| Transboundary and Emerging Diseases   | 20      | Biomed Research International            | 1       |
| Preventive Veterinary Medicine        | 19      | Comp. Immun. Microbiol. Infect. Dis.     | 1       |
| Plos One                              | 16      | Ecological Indicators                    | 1       |
| European Journal of Wildlife Research | 11      | Environmental Toxicology and Chemistry   | 1       |
| Veterinary Microbiology               | 11      | Expert Review of Vaccines                | 1       |
| Journal of Wildlife Diseases          | 9       | Fems Immunology and Medical Microbiology | 1       |
| BMC Veterinary Research               | 6       | Food Control                             | 1       |
| Frontiers in Veterinary Science       | 6       | Foodborne Pathogens and Disease          | 1       |
| Journal of Clinical Microbiology      | 6       | Frontiers in Microbiology                | 1       |
| Pathogens                             | 6       | Infection Genetics and Evolution         | 1       |
| Research in Veterinary Science        | 6       | Int. J. System. Evol. Mycobiol.          | 1       |
| Veterinary Record                     | 6       | Journal of Animal Ecology                | 1       |
| Veterinari Medicina                   | 5       | Journal of Fish Diseases                 | 1       |

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|---|---|---|---|
| Veterinary Research                       | 5 | Journal of Food Protection                      | 1 |
| Veterinary Journal                        | 4 | Journal of Veterinary Diagnostic Investigation  | 1 |
| Emerging Infectious Diseases              | 3 | Journal of Veterinary Science                   | 1 |
| Epidemiology and Infection                | 3 | Journal of Zoology                              | 1 |
| Mammal Review                             | 3 | Medical Hypotheses                              | 1 |
| Molecular Ecology                         | 3 | Medycyna Weterynaryjna-Vet. Med.-Sci. Prac.     | 1 |
| Scientific Reports                        | 3 | Microbial Pathogens                             | 1 |
| Vaccine                                   | 3 | Microorganisms                                  | 1 |
| Veterinary Immunology and Immunopath.     | 3 | Molecular Biology Reports                       | 1 |
| Clinical and Vaccine Immunology           | 2 | Monatshefte für Veterinarmedizin                | 1 |
| Ecohealth                                 | 2 | New Zealand Veterinary Journal                  | 1 |
| Journal of Veterinary Medicine            | 2 | One Health                                      | 1 |
| Magyar Allatorvosok Lapja                 | 2 | Philosophical Transactions of the Royal Society | 1 |
| Tieraerztliche Umschau                    | 2 | Plos Neglected Tropical Diseases                | 1 |
| Tuberculosis                              | 2 | Polish Journal of Veterinary Sciences           | 1 |
| Veterinarski Arhiv                        | 2 | Proteomics                                      | 1 |
| Veterinary Medicine International         | 2 | Sensors   | 1 |
| Acta Tropica                              | 1 | Slovenian Veterinary Research                   | 1 |
| Acta Veterinaria Hungarica                | 1 | The Veterinary Record                           | 1 |
| Acta Veterinaria Scandinavica             | 1 | Tropical Animal Health and Production           | 1 |
| Adv. Microbiol., Infect. Dis, Pub. Health | 1 | Veterinary Medicine                             | 1 |
| American Naturalist                       | 1 | Wiener Tierärztliche Monatsschrift              | 1 |
| Animal Genetics                           | 1 | Wildlife Research                               | 1 |
| Animals                                   | 1 | Zoonoses and Public Health                      | 1 |

**Table S4.** Number of studies in scientific journals (red deer). Number of studies published in scientific journals for the search on the Web of Science with the following search terms: *red deer* and *Cervus elaphus* and *tuberculosis*. See Figure 2 and Table 1.

| Journal                               | Studies | Journal                                   | Studies |
|---------------------------------------|---------|---|---------|
| New Zealand Veterinary Journal        | 19      | Vaccine                                   | 2       |
| Veterinary Record                     | 16      | Veterinary Research Communications        | 2       |
| Journal of Wildlife Diseases          | 15      | Wiener Tierärztliche Monatsschrift        | 2       |
| Preventive Veterinary Medicine        | 14      | Acta Veterinaria Hungarica                | 1       |
| Veterinary Microbiology               | 10      | Animal Production Science                 | 1       |
| European Journal of Wildlife Research | 8       | Animals                                   | 1       |
| Plos One                              | 7       | Archivos de Medicina Veterinaria          | 1       |
| Transboundary and Emerging Diseases   | 7       | Biological Journal of the Linnean Society | 1       |
| Veterinary Journal                    | 6       | Canadian Journal of Zoology               | 1       |
| Research in Veterinary Science        | 5       | Clini. Diag. Lab. Immun.                  | 1       |
| Veterinarni Medicina                  | 5       | Food Control                              | 1       |
| BMC Veterinary Research               | 4       | Food Microbiology                         | 1       |
| Clinical and Vaccine Immunology       | 4       | Immunology and Cell Biology               | 1       |
| Journal of Clinical Microbiology      | 4       | ISRN Veterinary Science                   | 1       |

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|--|---|--|---|
| Journal of Veterinary Diagnostic Investigation | 4 | Journal of Applied Microbiology            | 1 |
| Veterinary Immunology and Immunopathology      | 4 | Journal of The Royal Society of New Zeland | 1 |
| Veterinary Research                            | 4 | Journal of Veterinary Science              | 1 |
| American Journal of Veterinary Reserach        | 3 | Journal of Wildlife Management             | 1 |
| Canadian Veterinary Journal                    | 3 | Lancet                                     | 1 |
| Epidemilogy and Infection                      | 3 | Magyar Alltorvosok Lapja                   | 1 |
| Frontiers in Veterinary Science                | 3 | Mammal Review                              | 1 |
| Infection and Immunity                         | 3 | Microorganisms                             | 1 |
| Berliner Und Munchener Tierarztliche Wochens.  | 2 | Oecologia                                  | 1 |
| Canadian Journal of Veterinary Research        | 2 | Rev. Scient. Tech. Office Intern. Epiz.    | 1 |
| Cattle Practice                                | 2 | Scandinavian Journal of Immunology         | 1 |
| Comp. Immun. Migrobiol. Infect. Dis.           | 2 | Scientific Reports                         | 1 |
| Developmental and Comparative Immunology       | 2 | The Veterinary Record Volumen              | 1 |
| Emerging Infectious Diseases                   | 2 | Tijdschrift voor Diergeneeskunde           | 1 |
| Infection Genetics and Evolution               | 2 | Trends in Game Meat Hygiene                | 1 |
| Journal of Comparative Pathology               | 2 | Tropical Animal Health and Production      | 1 |
| J. Am. Vet. Med. Assoc.                        | 2 | Tubercle and Lung Disease                  | 1 |
| Journal of Veterinary Medical Science          | 2 | Veterinary Pathology                       | 1 |
| Pathogens                                      | 2 | Wildlife Society Bulletin                  | 1 |
| Pesquisa Veterinaria Brasileira                | 2 | Zoonoses and Public Health                 | 1 |
| Tuberculosis                                   | 2 |  |   |

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