The Role of One Health Approach Research for the Conservation of Endemic Wild Animals and Mitigation of Future Public Health Threat in Bale Mountains National Park

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The Role of One Health Approach Research for the Conservation of Endemic Wild Animals and Mitigation of Future Public Health Threat in Bale Mountains National Park, Ethiopia.

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Abstract

One of the things that made the Bale mountains park attract international attention is the home of many endemic wild animal including the world rarest canid, Ethiopian wolf. However, the park's major issues, especially public health study, wildlife and environmental sanitation, have not been adequately researched. The main objectives of the review is to highlight the study needed for prevention of animal and human health threat at Bale mountains national park. The water (river) rises from the park is used for drinking by the people downstream. As human approach to new area of the park, there is a chance for infected with new pathogens which may cause for newly emerging outbreak of the disease. The endemic animal in the park is infected with many disease from different reservoirs such as another wild animal and environment they reside in. As an example the Ethiopian wolf which listed as critically endangered species of the animal is infected with many disease which are transmitted from the rodents, carcass, stray dogs, human and the environment specially water bodies. Due to that infectious disease in rodents, stray dogs, human lives in the park and presence of pathogenic agents in water bodies should be investigated for prevention and controlling of infectious disease which could be causes extinction of the Ethiopian wolf. Wildlife waste is major water pollutants which may excreted and released from large animals to rodents found in Bale mountains national park. The pathogen from wild animal and human can made contamination of water bodies rise from mountainous area of the Bale and flow to the downstream can easily made the pathogen transported to lowland area of Ethiopia and Somalia which results a health risk of livestock, wild animal and human. Thus integrated research related to identification of pathogens found in wild animal, human lives in surrounding the park, and presence of pathogen in environment of the park (water bodies, soil) should be performed.

Keywords: Bale Mountains National Park, Ethiopian Wolf, One Health, Public Health, Rodents, Water Bodies

1. Introduction

The Ethiopian highland is the largest Afroalpine habitat on the African continent and part of Conservation International's Eastern Afro-Montane Biodiversity Hotspot with a high level of endemism [1].

Bale mountains national park is a globally important center of endemism, harboring 26 percent of Ethiopia's endemic species, including more than half of the global population of the endangered Ethiopian wolf, two thirds of the global population of the endangered Mountain nyala (Frankfurt Zoological Society, 2007), and the entire global population of the giant mole-rat. Ethiopia's Bale Eco-region is home to 1.6 million people and is a biodiversity hotspot with 29% of species unique to the country. Currently, over a million people rely on Bale's forests to earn a living. Ethiopian mountain ecosystem is well-known as headwater to several national and transboundary rivers. Populations of Ethiopia and the neighboring countries heavily rely directly and indirectly on Ethiopian mountain resources for freshwater supply. Wildlife waste is major water polluter which may include those faeces of rodents, Ethiopian wolf and other animals found in Bale mountains national park.

Infectious diseases can dramatically influence the dynamics of endangered species and populations but, until recently, disease has been a relatively neglected issue in conservation biology (Scott, 1988). The proper conservation of C. simensis should have involved not only the health of the wolves but also the health of their diet such as rodents and mouses. Working towards the aim to determine the SARS-CoV-2 susceptibility of common wildlife species, the researchers in the United States have found that red fox (Vulpes vulpes) can experimentally become infected with SARS-CoV-2 and can shed virus in its oral and nasal secretions [2]. Similarly there are supposedly as many rats as people in New York City carry variants of the virus that causes COVID-19, according to a study published recently [3].

1.1 Bale mountains national park

The park is a globally important center of endemism, harboring 26 percent of Ethiopia's endemic species, including more than half of the global population of the endangered Ethiopian wolf, two thirds of the global population of the endangered Mountain nyala (FZS, 2007), and the entire global population of the giant mole-rat. Ethiopia's Bale Eco-region is home to 1.6 million people and is a biodiversity hotspot with 29% of species unique to the country. Currently, over a million people rely on Bale's forests to earn a living. For example, deforestation in the highlands of the Bale Eco-region is currently threatening water supplies in the lowlands, forcing pastoralists living in the lowlands to migrate temporarily during the dry season in search of water, shelter and forage. As pastoralists move their cattle to highland forest during dry season, the cattle damage the forest regeneration and may be contaminated water sources [4].

Endemic to Ethiopia, the Bale monkey were discovered quite recently hence relatively little is known about their natural history. This indicated that there is a few research and investigation related to the ecosystem of the area. Bale monkeys are thought to be endangered. The main threats to their survival include expansion of settlements and cultivation of land within their range [5].

These biodiversity hotspot areas are comprised of a high level of endemism and diversity of flora, fauna, and micro-organisms. Moreover, Ethiopia is a megadiverse country in terms of natural ecosystems, farming systems and cultural diversity [6]. Ethiopian mountain ecosystem is well-known as headwater to several national and transboundary rivers. Populations of Ethiopia and the neighboring countries heavily rely directly and indirectly on Ethiopian mountain resources for freshwater supply. For instance, close to 80 percent of the total annual renewable surface water resource of Ethiopia leaves the country through its transboundary rivers [6]. Mountains are important sources of vital ecosystem services and have a significant role in economic development, environmental protection, ecological sustainability, and human well being [7]. Mountain environments are essential to the survival of the global ecosystem. They provide a direct life-support base for about one-tenth of mankind as well as goods and services to more than half of the world's population [8, 9]. For example, more than half of human race depends on freshwater that is captured, stored, and purified in mountain regions. Mountain regions are hotspots of biodiversity. They are used as key destinations for tourists and recreation activities [10].

1.2 Ethiopian wolf infectious disease

The Ethiopian wolf action plan (Sillero-Zubiri and MacDonald, 1997) indicated the urgent need for a complete survey of all areas of potential habitat as a priority for the development of a global strategy to protect the species from extinction. It is one of the world's rarest canids, and Africa's most endangered carnivore. Ethiopian wolves are carnivorous and they mainly eat the rodents that are plentiful within their range. They hunt and eat hares, common grass rats, and giant mole rats. They also eat goslings, eggs, and young ungulates and sometimes scavenge on carcasses. Nevertheless, with evidence of rabies, CDV, CAV and CPV infections in sympatric domestic dogs and Ethiopian wolves, canid diseases clearly pose a significant threat to the future persistence of this Ethiopian wolf population. Infectious diseases can dramatically influence the dynamics of endangered species and populations but,until recently, disease has been a relatively neglected issue in conservation biology.

The proper conservation of C. simensis should have involved not only the health of the wolves but also the health of their diet. Working towards the aim to determine the SARS-CoV-2 susceptibility of common wildlife species, the researchers in the United States have found that red fox (Vulpes vulpes) can experimentally become infected with SARS-CoV-2 and can shed virus in its oral and nasal secretions [2]. There's no evidence that any of these sparked an outbreak in people, but the possibility for transmission is there, particularly among animals that come in close contact with people. Urban wildlife "is a reservoir from which we can anticipate further infection of humans. There are supposedly as many rats as people in New York City some of them carry variants of the virus that causes COVID-19, according to a study published this week [3].

It's not entirely clear how the rats contracted SARS-CoV-2 or whether they pose a particular danger to human health. Thus the diet of wolf, water and environment should be investigated for the conservation of the wolf, wildlife and human [3]. In many of these examples epidemics have occurred when a pathogen, which has the ability to infect a range of host species, has crossed from a reservoir host into a new susceptible species [11]. Often, changes in land use by humans have altered the distribution and abundance of host species and increased exposure of susceptible hosts to novel pathogens [12]. In particular, pathogens that can affect both wild and domestic species are becoming a conservation problem as human populations expand and contact between wildlife and domestic animals increases [13]. For example, domestic dogs in Africa are becoming more widely distributed and more abundant, leading to increased concern about disease transmission between dogs and wild carnivores [14].

1.3 The impact of rodents on the disease of Ethiopian wolf, human and contamination of water bodies.

In the highlands, rodent species are key for the survival of many species including the endangered Ethiopian wolf (Canis simensis) and over 25 species of diurnal raptors [15]. Rodents are key components in several ecosystems playing a major role in predator-prey relationships and maintaining ecological balance [16]. In the Bale Mountains, for instance, the total density of three rodent species, giant mole rat (Tachyoryctes macrocephalus), Blick's grass rat (Arvicanthis blicki), and the brush-furred mouse (Lophuro- mys melanonyx), is estimated at 8,000 individuals/km2 [17].

Rodents play a major role in maintaining the structure and natural functioning of grassland ecosystems of the Ethiopian highlands, which is an important factor for the long-term survival of several endangered species [18]. Rodents are prey for many carnivores and birds of prey in the Ethiopian highlands. One of the world's rarest canids with less than 500 individuals, the Ethiopian wolf (Canis simensis), which is endemic to the Ethiopian highlands, relies on rodents as its main food source [19]. The conservation implication of declining rodent densities in the Ethiopian highlands is due to the increased human activity and livestock grazing affect rodent density, which in turn affects the survival of Ethiopian wolves and other wildlife species that rely on rodents as their main food source. The Bale Mountains have much higher density of rodents and giant molerats (Tachyoryctes macrocephalus), which is endemic to the Bale Mountains, compared to the Northern Ethiopian highland [18]. The giant molerats are the architects of the Afroalpine region, building rounded domes and continually turning over the soil as they forage. They have a significant effect on the landscape due to their extensive burrow systems and mounds of vegetable refuse and soil. These practices result in more grass growth, increasing suitable habitats for grass rats, mice and shrews, which provide food for the birds of prey and Ethiopian wolves.Rodents are the natural grazers of the Afroalpine areas, performing important duties of cryoturbation (soil-mixing). At least eight Ethiopian endemic rodent species have been identified within in the park, including the impressive giant molerat [5].

Rodents are known to be reservoir hosts for at least 60 zoonotic diseases and play a major role in their transmission and spread in different ways such as salmonellosis, plague, leptospirosis, leishmaniasis, toxoplasmosis, rat-bit fever, taeniasis-like Capillaria hepatica, zoonotic babesiosis, Lassa fever, hemorrhagic fever with renal syndrome (HFRS), and the hantavirus cardiopulmonary syndrome (HCPS), both caused by Hantavirus. In addition, other Arenaviruses are responsible for South American Hemorrhagic Fevers (SAHF), Mycobacterium tuberculosis and Mycobacterium microti, Escherichia coli, agents of tularemia, tick-borne relapsing fever, bartonellosis, listeriosis, Lyme disease, Q fever, ehrlichiosis and others [20, 21]. More particularly, rodents may harbor different complex bacteria, virus, protozoa helminth and other causative agents of the disease so that it may contaminated the water sources in Bale mountains national park and health risk for Ethiopian wolf and communities which uses water rises from the highland.

In Senegal, many studies documented the sanitary effects of invasive rodents. This allowed the evaluation of rodent-associated health risk [22]. In addition, new potential bacteria, whose pathogenicity remains unknown, continue to be isolated from rodents [23]. A recent study conducted in Senegal has shown the difficulty in predicting the relationship between biodiversity and the risks of transmission of pathogens, especially zoonotic ones, and recommends some prevention strategies based on the global monitoring of pathogens, but especially the precise characterization of the potential zoonotic agents [21, 24]. At the same time, rodents are found to be infested with several species of helminth parasites throughout the world ([25, 26]. Wildlife waste is major water polluter which may include those rodents found in Bale mountains national park.

1.4 Water resources management at BMNP

BMNP is increasingly recognized as a regionally important water tower for the crucial role it plays in climate control for the region. Rainfall in the ecosystem feeds four major regional rivers (Web, Wabe, Dumel and Welmel), which in turn flow into two major Ethiopian rivers, the Genale and Wabe-Shebelle. The park also has significant dry season water-holding capacity in its swamps and lakes and in the moist, tropical Harenna Forest. This complex hydrological system is of critical importance to 22 million downstream water users in the arid and semi-arid lowlands of southeast Ethiopia and Somalia.

Water-borne diseases (i.e., diarrhea, gastrointestinal illness) caused by various bacteria, viruses, and protozoa have been the causes of many outbreaks [27]. In developing countries, such as those in Africa, water-borne diseases infect millions [28]. According to World Health Organization (WHO), each year 3.4 million people, mostly children, die from water-related diseases [29]. According to United Nations Children's Fund (UNICEF) assessment, 4000 children die each day as a result of contaminated water [30]. WHO (2010) reports that over 2.6 billion people lack access to clean water, which is responsible for about 2.2 million deaths annually, of which 1.4 million are in children. Improving water quality can reduce the global disease burden by approximately 4%. The U.S. EPA, which monitors water quality of various ambient water bodies, estimated that pathogens impair more than 480,000 km of rivers and shorelines and 2 million ha of lakes in the U.S. [31]. It is difficult to identify points of origin of pathogens and the pathways by which they enter streams. As an example, pathogens are likely to enter rivers from many sources, including lateral inputs from pastures and riparian zones, influx of pathogen-contaminated groundwater, direct deposit of fecal matter from livestock and wildlife, discharge to contaminated rivers. In rainy events pathogens in rivers are influenced by fresh input from watersheds as well as sub-surface flow. In addition, the resuspension of pathogens from bed sediments can considerably increase pathogen levels [32]. Controlling pathogen contamination from livestock/

wildlife to streams is challenging [33]. For example, it is doubtful that pathogen contamination can be prevented by fencing off riparian buffers, and even if buffers are useful in controlling stream water pathogens, it is not certain what their width must be [34]. Waterborne pathogens can survive for long periods in different environmental matrices (e.g., soil, manure, and water) when conditions are favorable. Low temperatures, appropriate moisture levels, nutrient availability, and protection from external factors, such as ultraviolet radiation, can prolong survival for many common waterborne pathogens. Temperature, in particular, is an important factor affecting survival [35]. Higher air and water temperatures are projected to occur throughout the United States (Hill et al. 2014) and could reduce survival rates for some common pathogenic organisms such as pathogenic strains of E. coli (Schijven and Husman 2005). Conversely, other species could experience faster growth and prolonged survival [36]. For example, naturally occurring Vibrio spp. and Legionella grow faster in warmer water and could become more common geographically and seasonally throughout the year and can transport to long distance from sources of contamination area [37]. A warmer climate also could lead to the expansion of new microorganisms such as amoeboid pathogens (e.g., Naegleria and Acanthamoeba), vectors, and/or intermediary hosts [38]. Some waterborne pathogens also could spread to new areas due to warming temperatures [39].

2. Conclusion

There are many species of animals in the park which their disease have not been studied. The endemic wildlife is identified but there is also a possibilities of endemic microorganisms such as virus, bacteria, parasite, fungus and protozoa. These endemic wild animals pollute the water that flows there. If an unknown and very dangerous disease suddenly breaks out in these animals for various reasons, the disease can cross many borders because of this water and put the public health situation in trouble. Therefore, the disease should be investigated extensively in this park. The Ethiopian wolf disease should be properly diagnosed. Therefore, we need to know which diseases the community living in and around the park have and which of their diseases can infect the Ethiopian wolf. Again, contact between Ethiopian wolf and the community can create a wide range of opportunities for emerging of new diseases.Thus, the possibility of waterborne transmitted disease should be investigated. Again, the rats there can have various diseases that can infect Ethiopian wolf and contaminate water sources. Therefore, it is very important to determine which disease could infect the mouse. Overall, identifying which diseases and infectious pathogens are present in the park area has a great benefits for Ethiopian wolf conservation and prevention and control of human disease. Thus one health approach should be implemented for conservation of rarest wild animal and human welbeing of more than 22.26 million people live in southeastern Ethiopia and Somalia directly contact with rivers which rises from the park

References

1. Yalden, D. W., & Largen, M. J. (1992). The endemic mammals of Ethiopia. Mammal Review, 22(3), 115-150.
2. Porter, S. M., Hartwig, A. E., Bielefeldt-Ohmann, H., Bosco-Lauth, A. M., & Root, J. J. (2022). Susceptibility of wild canids to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). BioRxiv, 2022-01.
3. Karen Weintraub (2023). Another reason to avoid rodents: NYC's rats found infected with virus that causes COVID. USA TODAY
4. Farm Africa(2023). what we do? https://www.farmafrica.org/what-we-do/what-we-do
5. Bale Mountains National Park (BMNP) (2023). Mammals
6. Ethiopian biodiversity institute (EBI) (2022). Annual report of year June, 2022, Handbook Pp 22.
7. De Groot, R. S., Wilson, M. A., & Boumans, R. M. (2002). A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological economics, 41(3), 393-408.
8. Dax, T. (2002). Research on mountain development in Europe: Overview of issues and priorities. Manuscript. Vienna, Austria. Federal Institute for Less-Favoured and Mountainous Areas, 15.
9. Spehn, E., & Körner, C. (2009). Mountain biodiversity–a global heritage. In Mountain Forum Bulletin.
10. Sarvašová, Z., & Dobšinská, Z. (2016). Provision of ecosystem services in mountain forests–case study of experts' and stakeholders' perceptions from Slovakia. Journal of forest science, 62(8), 380-387.
11. Dobson, A. P., & Miller, D. (1989). Infectious diseases and endangered species management. Endangered Species Update, 6(9), 1-5.
12. Schrag, S. J., & Wiener, P. (1995). Emerging infectious disease: what are the relative roles of ecology and evolution?. Trends in ecology & evolution, 10(8), 319-324.
13. McCallum, H., & Dobson, A. (1995). Detecting disease and parasite threats to endangered species and ecosystems. Trends in ecology & evolution, 10(5), 190-194.
14. Perry, B. D. (1995). Rabies control in the developing world: can further research help?. The Veterinary Record, 137(20), 521-522.
15. Atickem, A., & Stenseth, N. C. (2022). The role of rodents in the conservation of endangered species in the Ethiopian highlands. Therya, 13(1), 73-77.
16. Nyirenda, V. R., Namukonde, N., Simwanda, M., Phiri, D., Murayama, Y., Ranagalage, M., & Milimo, K. (2020). Rodent assemblages in the mosaic of habitat types in the Zambezian Bioregion. Diversity, 12(10), 365.
17. Vial, F., Macdonald, D. W., & Haydon, D. T. (2011). Response of endemic afroalpine rodents to the removal of livestock grazing pressure. Current Zoology, 57(6), 741-750.
18. Sillero-Zubiri, C., Tattersall, F. H., & Macdonald, D. W (1995). Habitat selection and daily activity of giant molerats Tachyoryctes macrocephalus: significance to the Ethiopian wolf Canis simensis in the Afroalpine ecosystem. Biological Conservation, 72(1), 77-84.
19. Johnson, N., Mansfield, K. L., Marston, D. A., Wilson, C., Goddard, T., Selden, D., ... & Fooks, A. R. (2010). A new outbreak of rabies in rare Ethiopian wolves (Canis simensis). Archives of virology, 155, 1175-1177.
20. Taylor, P. J., Arntzen, L., Hayter, M., Iles, M., Frean, J., &

Belmain, S. (2008). Understanding and managing sanitary risks due to rodent zoonoses in an African city: beyond the Boston Model. Integrative Zoology, 3(1), 38-50.
21. Dahmana, H., Granjon, L., Diagne, C., Davoust, B., Fenollar, F., & Mediannikov, O. (2020). Rodents as hosts of pathogens and related zoonotic disease risk. Pathogens, 9(3), 202.
22. Granjon, L., & Duplantier, J. M. (2009). Les rongeurs de l'Afrique sahélo-soudanienne (pp. 173-174). Marseille, French: IRD.
23. Mediannikov, O., Aubadie, M., Bassene, H., Diatta, G., Granjon, L., & Fenollar, F. (2014). Three new Bartonella species from rodents in Senegal. International Journal of Infectious Diseases, 21, 335.
24. Diagne, C., Galan, M., Tamisier, L., d'Ambrosio, J., Dalecky, A., Bâ, K., ... & Brouat, C. (2017). Ecological and sanitary impacts of bacterial communities associated to biological invasions in African commensal rodent communities. Scientific reports, 7(1), 14995.
25. World Health Organization. (2010). World health statistics 2010. World Health Organization.
26. Morand, S., Krasnov, B. R., & Poulin, R. (Eds.). (2007). Micromammals and macroparasites: from evolutionary ecology to management. Springer Science & Business Media.
27. Craun, M. F., Craun, G. F., Calderon, R. L., & Beach, M. J. (2006). Waterborne outbreaks reported in the United States. Journal of water and health, 4(S2), 19-30.
28. Fenwick, A. (2006). Waterborne Infectious Diseases Could They Be Consigned to History?. Science, 313(5790), 1077-1081.
29. World Health Organization (WHO). (2014). Water Quality and Health. Drinking water chlorination–A review of disinfection practices and issues.
30. United Nation Children's Fund (UNICEF) (2014) World Water Day 2025: 4,000 children die each day from a lack of safe water., http://www.unicef.org/wash/ index_25637.html
31. EPA, U. (2014). Watershed assessment, tracking & environmental results. Retrieved from US Environmental Protection Agency: http://iaspub. epa. gov/tmdl_waters10/ attains_watershed. control.
32. Cho, K. H., Pachepsky, Y. A., Kim, J. H., Guber, A. K., Shelton, D. R., & Rowland, R. (2010). Release of Escherichia coli from the bottom sediment in a first-order creek: Experiment and reach-specific modeling. Journal of Hydrology, 391(3-4), 322-332.
33. Terzieva, S. I., & McFeters, G. A. (1991). Survival and injury of Escherichia coli, Campylobacter jejuni, and Yersinia enterocolitica in stream water. Canadian Journal of Microbiology, 37(10), 785-790.
34. Nagels, J. W., Davies-Colley, R. J., Donnison, A. M., & Muirhead, R. W. (2002). Faecal contamination over flood events in a pastoral agricultural stream in New Zealand. Water Science and Technology, 45(12), 45-52.
35. Cho, K. H., Pachepsky, Y. A., Kim, M., Pyo, J., Park, M. H., Kim, Y. M., ... & Kim, J. H. (2016). Modeling seasonal variability of fecal coliform in natural surface waters using the modified SWAT. Journal of Hydrology, 535, 377-385.
36. Coffey, R., Benham, B., Krometis, L. A., Wolfe, M. L., & Cummins, E. (2014). Assessing the effects of climate change on waterborne microorganisms: implications for EU and US water policy. Human and Ecological Risk Assessment: An International Journal, 20(3), 724-742.
37. Trtanj, J., Jantarasami, L., Brunkard, J., Collier, T., Jacobs, J., Lipp, E., ... & Thurston, J. (2016). Ch. 6: Climate impacts on water-related illness. The impacts of climate change on human health in the United States: a scientific assessment, 157-188.
38. Harrus, S., & Baneth, G. (2005). Drivers for the emergence and re-emergence of vector-borne protozoal and bacterial diseases. International journal for parasitology, 35(11-12), 1309-1318.
39. Hoskisson, P. A., & Trevors, J. T. (2010). Shifting trends in pathogen dynamics on a changing planet. Antonie Van Leeuwenhoek, 98, 423-427.