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SV Mavadiya

Livestock Farm Complex,
College of Veterinary Science &
A.H., Kamdhenu University,
Junagadh, Gujarat, India

DG Vaghamashi

Livestock Farm Complex,
College of Veterinary Science &
A.H., Kamdhenu University,
Junagadh, Gujarat, India

PM Lunagariya

Livestock Farm Complex,
College of Veterinary Science &
A.H., Kamdhenu University,
Junagadh, Gujarat, India

MR Parmar

Livestock Farm Complex,
College of Veterinary Science &
A.H., Kamdhenu University,
Junagadh, Gujarat, India

Corresponding Author:

SV Mavadiya

Livestock Farm Complex,
College of Veterinary Science &
A.H., Kamdhenu University,
Junagadh, Gujarat, India

Role of scavengers in disease control and prevention: Ecological and public health perspectives

SV Mavadiya, DG Vaghamashi, PM Lunagariya and MR Parmar

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Abstract

Scavengers are an essential functional group within ecosystems, providing vital services such as carcass disposal, nutrient recycling, and disease regulation. By rapidly consuming animal carcasses, scavengers reduce pathogen proliferation and limit opportunities for disease transmission among wildlife, livestock, and humans. Avian scavengers, such as Vultures, and mammalian scavengers, including Hyenas and Jackals, act as natural sanitation agents in many ecosystems. Their highly acidic digestive systems can destroy pathogens responsible for diseases such as Anthrax, Rabies, and Brucellosis. The decline of scavenger populations, particularly vultures in South Asia, has demonstrated the ecological and public health consequences of reduced carcass removal. This article reviews the ecological importance of scavengers, their mechanisms of disease suppression, and implications for veterinary and public health management.

Keywords: Scavengers, carcass disposal, zoonotic diseases, ecosystem services, vultures, One Health, public health

1. Introduction

Scavengers are animals that feed primarily on dead animals and decaying organic matter. They play a crucial role in maintaining ecological balance by accelerating carcass decomposition and preventing the accumulation of organic waste in the environment. The removal of carcasses from the landscape is an important ecological process because decomposing carcasses can harbour numerous pathogenic microorganisms that can infect wildlife, livestock, and humans (Ogada *et al.*, 2012) [3].

Carcasses represent concentrated sources of nutrients that support microbial growth and attract vectors such as insects and rodents. Without efficient scavengers, carcasses remain exposed for extended periods, increasing the risk of disease transmission and environmental contamination (Sekercioglu, 2006) [5]. Therefore, scavengers function as natural sanitation workers who contribute significantly to disease prevention and ecosystem stability.

2. Diversity of Scavengers

Scavengers occur across multiple taxonomic groups, including birds, mammals, reptiles, and insects. Among vertebrates, avian and mammalian scavengers are the most important contributors to carcass removal.

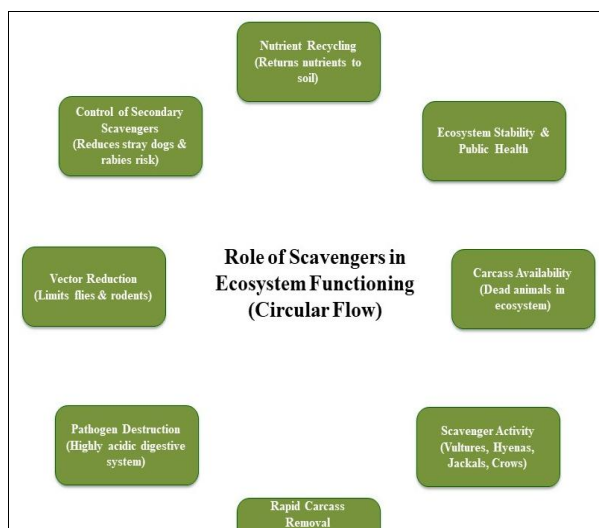
2.1 Avian Scavengers

Birds are highly efficient scavengers due to their strong vision and ability to locate carcasses over long distances. Species such as the vulture and Crow play a major role in carcass consumption in natural and agricultural ecosystems. Vultures are considered the most specialised avian scavengers because of their powerful beaks, bald heads that reduce microbial contamination, and highly acidic digestive systems capable of destroying dangerous pathogens (Houston and Cooper, 1975) [1].

2.2 Mammalian Scavengers

Several mammalian species also participate in carcass removal, especially where avian scavengers are scarce. These include species such as Hyena, Jackal, and Fox. These animals contribute to the decomposition process and nutrient cycling within ecosystems.

3. Mechanisms of Disease Control by Scavengers



3.1 Rapid Carcass Removal

The most important function of scavengers is the rapid removal of dead animals. Animal carcasses can serve as reservoirs for pathogens capable of infecting both animals and humans. Efficient scavenger activity significantly reduces the duration for which carcasses remain in the environment, thereby limiting pathogen proliferation (Ogada *et al.*, 2012) [3].

For example, groups of vultures can completely consume a large livestock carcass within a short time, drastically reducing the opportunity for microbial growth.

3.2 Destruction of Pathogens in the Digestive System

Many scavengers possess highly specialised digestive systems that enable them to safely consume decomposing tissues.

Vultures, for instance, have extremely acidic stomach secretions (pH approximately 1) that can destroy many disease-causing microorganisms (Houston and Cooper, 1975) [1].

Pathogens that may be neutralised in the digestive tract of scavengers include organisms responsible for diseases such as Anthrax, Brucellosis, Botulism, etc. This biological filtration mechanism prevents pathogens from re-entering the environment.

3.3 Reduction of Disease Vectors

Carcasses provide breeding sites for insects such as flies and attract rodents that can transmit diseases. These organisms may spread pathogens to livestock, wildlife, and humans. By removing carcasses rapidly, scavengers reduce the availability of substrates for vector breeding (Sekercioglu, 2006) [5]. Consequently, scavengers indirectly help control diseases such as Plague and Salmonellosis.

3.4 Regulation of Secondary Scavengers

The absence of natural scavengers can lead to increased populations of opportunistic scavengers such as stray dogs and rodents. These animals often act as reservoirs or vectors for zoonotic pathogens. Increased stray dog populations have been associated with higher transmission rates of Rabies. Thus, natural scavengers indirectly regulate disease risk by limiting food availability for these animals (Markandya *et al.*, 2008) [2].

One of the most prominent examples illustrating the ecological importance of scavengers is the dramatic decline of vulture populations in South Asia during the 1990s. This decline was largely attributed to the veterinary use of the anti-inflammatory drug Diclofenac in livestock. Vultures feeding on carcasses of animals treated with this drug developed renal failure and died (Pain *et al.*, 2008) [4]. The decline of vultures resulted in several ecological and public health consequences, including accumulation of livestock carcasses, rapid growth of feral dog populations, increased transmission of rabies and greater environmental contamination. Economic analyses have shown that the loss of vultures in India imposed substantial public health costs due to increased rabies incidence (Markandya *et al.*, 2008) [2].

Table 1: Major infectious diseases transmission risk is reduced by scavenger

Disease	Causative agent	Major hosts affected	Role of scavengers in disease control	Key references
Anthrax	<i>Bacillus anthracis</i>	Livestock, wildlife, humans	Rapid carcass consumption reduces exposure of spores to scavenging mammals and insects, limiting environmental contamination and transmission.	Houston & Cooper, 1975 [1], Ogada <i>et al.</i> , 2012 [3]
Rabies	Rabies virus (<i>Lyssavirus</i>)	Dogs, wildlife, humans	Efficient carcass removal limits food availability for feral dogs and other opportunistic scavengers, indirectly reducing rabies transmission cycles.	Markandya <i>et al.</i> , 2008 [2]
Brucellosis	<i>Brucella</i> spp.	Cattle, sheep, goats, humans	Removal of infected tissues and aborted fetuses reduces environmental persistence of bacteria and limits transmission to susceptible animals.	WHO, 2017 [6]
Botulism	<i>Clostridium botulinum</i> toxin	Birds, livestock	Rapid consumption of carcasses prevents toxin accumulation in decomposing tissues that may contaminate water sources or feed.	Sekercioglu, 2006 [5]
Tuberculosis	<i>Mycobacterium bovis</i>	Cattle, wildlife, humans	Removal of infected carcasses limits pathogen exposure to wildlife reservoirs and reduces environmental contamination.	Ogada <i>et al.</i> , 2012 [3]
Plague	<i>Yersinia pestis</i>	Rodents, humans	By eliminating carcasses quickly, scavengers reduce food resources for rodent populations that serve as reservoirs of infection.	Sekercioglu, 2006 [5]
Salmonellosis	<i>Salmonella</i> spp.	Livestock, poultry, humans	Rapid carrion removal reduces bacterial multiplication and limits contamination of soil and water sources.	Mateo-Tomás <i>et al.</i> , 2022 [7]

4. Implications for Veterinary and Public Health

The ecosystem services provided by scavengers have significant implications for veterinary medicine and public health. Efficient scavenger populations help maintain environmental sanitation by removing carcasses that may contain infectious agents.

These services contribute to:

- Prevention of zoonotic disease transmission
- Reduction of insect and rodent vectors
- Improved environmental hygiene
- Natural carcass disposal systems

From a One Health perspective, maintaining healthy scavenger populations is essential for integrated disease management involving humans, animals, and ecosystems (WHO, 2017)^[6].

5. Conservation and Management Strategies

Conservation initiatives aimed at sustaining scavenger populations are critical for maintaining their ecosystem services and public health benefits. Several evidence-based strategies have been proposed and implemented globally:

1. Regulation of harmful veterinary pharmaceuticals:

The restriction of non-steroidal anti-inflammatory drugs such as diclofenac has been identified as a key intervention to prevent vulture mortality and promote population recovery (Green *et al.*, 2004)^[9]

2. Protection of habitats and nesting sites:

Preservation of natural habitats and breeding grounds is essential to support viable scavenger populations and ensure long-term ecological stability. (Margalida *et al.*, 2012)^[10]

3. Conservation breeding and reintroduction programs

Captive breeding initiatives have been successfully employed to restore critically endangered vulture populations and reintroduce them into the wild. (Prakash *et al.*, 2012)^[11].

4. Safe and hygienic carcass disposal practices;

Establishment of controlled carcass dumping sites (vulture restaurants) reduces exposure to toxic substances while ensuring a safe food supply for scavengers. (Moreno-Opo *et al.*, 2015)^[12]

5. Public awareness and community engagement:

Educational programs aimed at farmers, veterinarians, and local communities are essential to promote sustainable practices and enhance conservation outcomes (Ogada *et al.*, 2012)^[3].

6. Conclusion

Scavengers are indispensable components of ecosystems and play a fundamental role in disease regulation and environmental sanitation. Through rapid carcass removal, pathogen destruction, and vector control, these organisms contribute significantly to public health and ecological stability. The decline of scavenger populations can have severe epidemiological and economic consequences. Therefore, conservation and protection of scavengers are essential for maintaining ecosystem health and preventing disease outbreaks.

Conflict of Interest

Not available

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Not available

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