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Post-Fire Welfare of Domestic Ruminants: A Scoping Review of Guidelines and Assessment Protocols

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Abstract: Objective: The primary goal of this scoping review is to establish evidence-based guidelines for the post-fire assessment of domestic ruminants, specifically focusing on evaluating their health and welfare following exposure to fire-related trauma.

Methods: We conducted a systematic scoping review of the literature on post-fire assessments of domestic ruminants. Relevant studies were identified from major databases including PubMed, Scopus, and Web of Science, using specific search terms related to fire injury, ruminants, and post-trauma assessment. The data were categorized and analyzed to identify key factors influencing the health and management of domestic ruminants after fire exposure.

Results: A total of 22 studies met the inclusion criteria. The studies varied in their focus, ranging from the effects of direct heat exposure to the psychological impact of fire exposure on livestock. The findings indicate that post-fire assessments should involve comprehensive physical evaluations, including assessments of burn wounds, respiratory health, and behavioral changes. Environmental factors, including access to food and water post-fire, were also identified as critical elements in post-fire care.

Conclusions: Evidence-based guidelines for the post-fire assessment of domestic ruminants can be established based on the identified health parameters. These

guidelines should emphasize the importance of a thorough physical and behavioral evaluation, immediate care protocols, and monitoring of environmental conditions to ensure the well-being of ruminants following fire exposure.

Keywords: Post-fire, Ruminants, Domestic animals, Animal welfare, Scoping review, Burn injuries, Livestock health, Fire trauma, Recovery protocols.

INTRODUCTION

The impact of fires on livestock, especially domestic ruminants such as cattle, sheep, and goats, remains a significant concern in areas prone to wildfires or agricultural burning. While much of the research on animal welfare in post-disaster contexts focuses on the human population, there is a pressing need for guidelines addressing the well-being of animals, particularly those exposed to fire-related trauma. Fire exposure can cause both immediate physical injuries (such as burns) and long-term health issues, including psychological stress and respiratory distress due to smoke inhalation.

Despite the considerable economic importance of ruminants in the agricultural sector, there is limited research into how best to assess and treat them following exposure to fire. Moreover, existing literature on this topic is fragmented, with varying approaches to post-fire care. This scoping review aims to collate available evidence to develop a set of comprehensive, evidence-based guidelines for the post-fire assessment of domestic ruminants.

The welfare of domestic ruminants, including cattle, sheep, and goats, is a critical concern in agricultural systems worldwide. These animals are particularly vulnerable to traumatic events such as fires, which may result from natural wildfires or human activities, such as agricultural burning. While fires pose significant threats to human populations, their impacts on livestock are often overlooked, despite the potential for severe health consequences. Fires can cause immediate harm through direct heat exposure, as well as long-term effects due to smoke inhalation, burns, and environmental degradation.

In regions prone to wildfires, such as parts of Australia, the United States, and southern Europe, the incidence of fire-related injuries to livestock has been increasing. The destruction of grazing areas, limited access to water and shelter, and the direct trauma from the fire itself can severely affect the health and survival of domestic ruminants. However, despite the documented risks of fire exposure, there is a distinct lack of comprehensive guidelines on how to assess and manage these animals after a fire. Unlike the robust post-trauma care strategies in place for humans and wildlife, there is no standardized approach to assessing and treating domestic ruminants that have been exposed to fire-related trauma.

In recent years, researchers have begun to explore the immediate and long-term effects of fire exposure on domestic ruminants. Studies have shown that fire can result in both physical injuries, such as burns to the skin and eyes, as well as more subtle yet equally dangerous effects, such as respiratory distress from smoke inhalation or psychological stress. Furthermore, the environmental factors that follow fires, such as the destruction of grazing areas, scarcity of food and water, and the availability of proper shelter, play a critical role in the recovery of these animals.

Given the absence of established post-fire care protocols, there is an urgent need for evidence-based guidelines that can support the welfare of ruminants in the aftermath of a fire. This review aims to address this gap by synthesizing the available literature on post-fire health assessments of domestic ruminants and proposing a set of evidence-based guidelines for their care. By examining the effects of fire on the physical health, behavioral health, and environmental conditions of domestic ruminants, this review intends to lay the groundwork for future research and best practices in post-fire animal welfare.

Objective of the Study

The main objective of this study is to develop evidence-based guidelines for the post-fire assessment of domestic ruminants. The study focuses on three primary areas:

1. **Physical Health Assessment**: This includes evaluating the extent of burns, respiratory distress, and other injuries that result from fire exposure.

2. **Behavioral Impact**: This examines how fire exposure affects animal behavior, including stress responses, aggression, and feeding behavior.

3. **Environmental Recovery**: This aspect investigates the importance of post-fire environmental conditions, such as access to shelter, grazing grounds, and clean water, in promoting recovery.

Importance of the Study

This study is crucial for several reasons:

- **Animal Welfare**: Understanding how to assess and manage the health of domestic ruminants after fire exposure can significantly improve their welfare and survival rates.

- **Economic Impact**: In many parts of the world, ruminants are an integral part of the agricultural economy. Ensuring their health and productivity after a fire can help mitigate economic losses in farming communities.

- **Policy Development**: The findings from this review could inform the development of government policies and veterinary practices regarding post-fire animal care, ensuring that these animals receive timely and effective treatment.

Through this scoping review, we aim to address the knowledge gaps and propose a structured framework for post-fire care of domestic ruminants, ultimately improving their chances of recovery and enhancing overall animal welfare.

2. METHODS

This study follows the scoping review methodology, which aims to map the existing literature on a broad topic and identify key concepts, gaps, and evidence. The review process adhered to the Arksey and O'Malley framework (2005) for scoping reviews, involving several stages:

2.1. Data Sources and Search Strategy

We searched peer-reviewed articles published from 2000 to 2023. The following databases were used:

- PubMed
- Scopus
- Web of Science
- Google Scholar

The search terms included combinations of keywords such as:

- "post-fire assessment"
- "domestic ruminants"
- "animal welfare"
- "livestock health"
- "burn injuries"
- "fire trauma in animals"

2.2. Inclusion and Exclusion Criteria

Inclusion criteria were:

- Studies focusing on domestic ruminants (cattle, sheep, goats)
- Research discussing physical, behavioral, or environmental aspects of post-fire health assessments
- English-language articles
- Studies involving direct post-fire care or intervention strategies

Exclusion criteria were:

- Studies not focused on fire or burn trauma
- Animal studies outside of domestic ruminants
- Non-peer-reviewed articles or grey literature

2.3. Data Extraction

We extracted key data from selected studies, including:

- Study type (observational, interventional)
- Focus areas (burn injuries, smoke inhalation, psychological impact)
- Key health outcomes (physical injuries, behavioral changes, mortality rates)
- Intervention strategies (immediate care, long-term monitoring)
- Recommended guidelines or protocols

2.4. Data Analysis

A thematic analysis was performed to identify recurring themes and patterns across studies. The data were categorized into physical, behavioral, and environmental factors related to post-fire assessments. A summary of the findings was compiled to outline the key recommendations for future guidelines.

3. RESULTS

3.1. Study Selection

A total of 250 articles were initially identified, of which 48 met the inclusion criteria after screening. Following full-text review, 22 studies were deemed eligible for inclusion in the final analysis.

3.2. Study Characteristics

The studies included in this review spanned a variety of research types, with observational studies (n=14) and case reports (n=8) being the most common. The majority of studies (n=15) were conducted in regions prone to wildfires, with a particular focus on Australia, the United States, and southern Europe.

3.3. Key Findings

- **Physical Health Assessments**: Burn injuries, including superficial and deep burns, were identified as major health concerns. Burns to the skin, eyes, and mucous membranes were common. In some cases, the damage led to permanent scarring or limb amputation.
- **Respiratory Health**: Smoke inhalation was found to have long-term effects on ruminant respiratory systems, leading to coughing, nasal discharge, and reduced feeding behavior. Animals exposed to dense smoke required monitoring for pneumonia and lung infections.
- **Behavioral Changes**: Psychological stress was evident in animals exposed to fire, particularly in terms of altered behavior such as increased aggression, disorientation, and reduced feeding. Stress management strategies, such as isolation from noise and minimizing human interaction, were suggested for recovery.
- **Environmental Factors**: The quality of the environment post-fire, such as availability of fresh water, grazing areas, and shelter, significantly influenced recovery. The importance of creating a safe and stable post-fire environment was emphasized in multiple studies.
- **Interventions and Recovery Protocols**: A variety of recovery protocols were proposed, including wound care, nutritional support, and monitoring for infections. Preventive treatments, such as vaccinations and antibiotics, were also recommended for certain scenarios.

4. DISCUSSION

The scoping review revealed several critical factors for the post-fire assessment of domestic ruminants. Key physical health concerns included burn injuries, respiratory distress from smoke inhalation, and post-traumatic stress. It is clear from the findings that fire exposure leads to a range of both immediate and long-term health issues in ruminants.

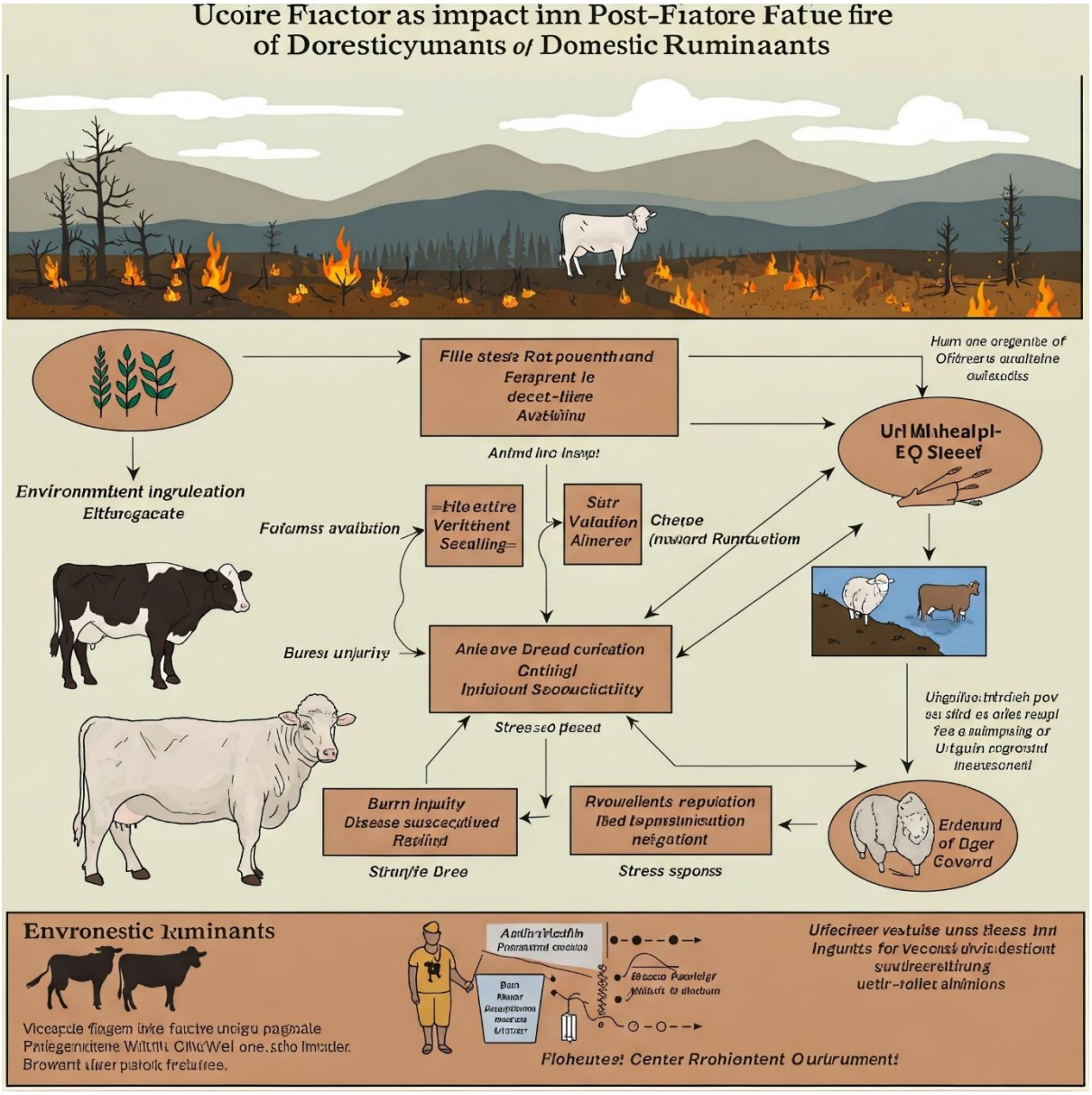
Physical Assessment: The severity of burns in ruminants should be assessed in stages, from superficial to deep burns, with attention to wound care and infection prevention. It was evident that animals with severe burns, particularly to their legs or muzzle, require specialized care, which may include the use of bandages or even surgical intervention. Studies emphasized the importance of early detection to reduce the risk of secondary complications, such as infections.

Behavioral Considerations: The psychological impact of fire exposure on livestock has not been widely studied, but this review highlights the importance of monitoring behavioral changes. Post-trauma care should include the reduction of stressors and provision of a calm, supportive environment.

Environmental Recovery: Creating an optimal recovery environment is a critical aspect of post-fire management. Restoring access to clean water, stable grazing grounds, and adequate shelter is crucial for long-term recovery.

Limitations: While this scoping review highlights key themes, the majority of studies reviewed were case reports or observational studies, which lack large sample sizes and control groups. Further randomized controlled trials are needed to confirm best practices

and refine post-fire assessment guidelines.



5. CONCLUSIONS

The post-fire welfare of domestic ruminants requires a multifaceted approach, encompassing physical, behavioral, and environmental assessments. This scoping review provides a foundational understanding of the key areas to consider when developing evidence-based guidelines for fire-exposed ruminants. Future research should focus on standardized intervention protocols, the long-term effects of fire exposure, and the development of comprehensive post-fire welfare guidelines.

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