

# Musth in Elephants: A period of peril

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## Abstract

Musth is the natural process in male elephants where male hormone that is testosterone -fluctuate and shows behaviour changes such as aggression, dominance, and reproductive activity. The physiological, behavioural, and environmental elements that affect elephant musth in both the wild and in captivity are the main topics of this article. Difference between patterns in the wild and in captivity, and management techniques like behavioural, medicinal, and ethno veterinary approaches were also covered. This script explains how modern research and traditional methods help in understanding and managing musth in elephants, ensuring the safety of both the animals and the people around them.

**Key words:** Musth, male elephants, testosterone, elephant management, and hormone regulation.

## Introduction

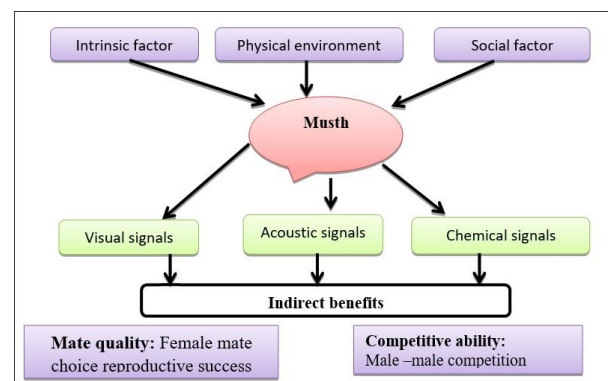
A natural process called musth happens in male elephants, during which their testosterone levels go up and they often become more aggressive. This phase plays a prominent role in breeding, but it also brings challenges for people who care for elephants, whether in zoos or in the wild. Shorter musth period is observed in those male elephants which are in better physical condition and socialize with other males. The level of stress hormones also changed depending on the elephant's age and body condition, while thyroid hormones stayed mostly the same. Some elephants show slight rises in testosterone without showing full signs of musth, which may be linked to puberty or the presence of nearby females. These findings help zookeepers and wildlife managers make better choices for managing elephant health, reproduction, and overall well-being, especially when caring for them in human-controlled environments (LaDue et al., 2023).

A study at Kabini, India concluded that older male elephant has more access to female during musth as they can roam with large group of females but younger ones are not having these advantages. But younger male elephant usually come to musth very early as compared to older ones (Keerthipriya et al., 2020). Asian male elephants reach sexual maturity around 14–15 years and show

musth behaviour driven by high testosterone. Musth symptoms are aggression, urine dribbling, and temporal gland secretion (TGS) with strong-smelling chemicals. The musth fluid is denoted as Temporin is rich in pheromones. Musth can make elephants aggressive and risky for handlers and other animals (Youn et al., 2024).



## Factors influencing musth in elephant (LaDue et al., 2021)



**Table 1: Developmental Stages in Bull Elephants (LaDue et al., 2021)**

Age Class	Age (Years)	Description
Calf	0-1	Closely associated with mother.
Adolescent	2-5	Commonly extends associations to other members of nuclear family.
Prepubescent	6-10	Frequently observed at the periphery of nuclear family.
Postpubescent	11-15	Generally, separate from nuclear family, but maintains some contact.
Young adult	16-20	Disperses from nuclear family, forming smaller, more temporary 'bachelor' group(s) with other young adults.
Adult	20-30	Mostly solitary, but may retain membership in bachelor group(s).
Mature adult	>30	Sexual peak in 30s. Do not associate with other mature adults; can be completely solitary or associate with younger bachelor groups

**Table 2. Musth Condition Scoring and Behavioural Index in Male Elephants (Duer et al., 2016)**

Parameter	Score 1 (None)	Score 2 (Mild)	Score 3 (Moderate)	Score 4 (Severe)
Temporal Gland Secretion	No secretion	Slight: 3–12 cm wet area	Moderate: 12–25 cm wet area	Heavy: Continuous secretion/dripping off face
Aggressive Behaviour	Calm, no aggression	Mild irritation or restlessness	Agonistic displays (mock charges, ear flapping)	Extreme aggression with physical attempts to harm
Response to Crush Entry	Cooperative	Enters hesitantly	Refuses to enter	Must be restrained or isolated
Urine Dribbling	None	Occasional spots	Wet inner legs	Heavy visible drainage
Sexual/Breeding Behavior	No interest	Shows interest (vocalizing, approaching females)	Mounting attempts	Confirmed mating with penetration

**Mechanism of Hormonal Changes during Musth**

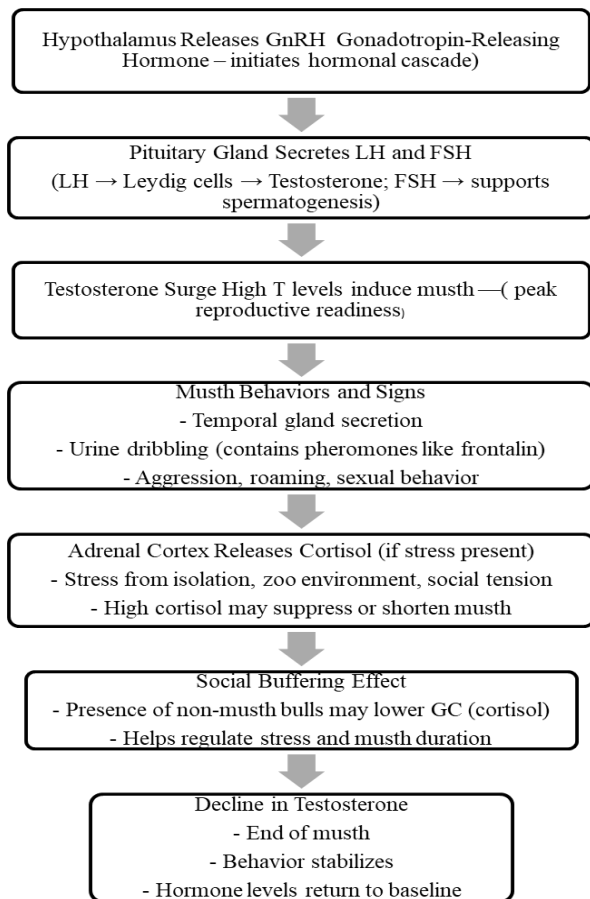
Musth is mainly controlled by the hypothalamic–pituitary–gonadal (HPG) axis, with testosterone acting as the key hormone. The process begins in the hypothalamus, which releases gonadotropin-releasing hormone (GnRH). This, in turn, stimulates the pituitary gland to release luteinizing hormone (LH), which acts on the testes and boosts testosterone production. During musth, testosterone levels can rise up to 60 times higher than in non-musth periods. Cortisol stress hormone also increases—especially in male elephants that are socially isolated or when they face dominance challenges. This increased level in cortisol points to the added stress experienced during musth. Thyroid hormones usually remain stable, but they may still help support the increased energy needs during this time. These combined hormonal

changes result in more aggressive behaviour, a stronger display of dominance, and heightened sexual activity (Glaeser et al., 2020).

**Mechanism of Hormonal Changes during Musth in Elephants (Schulte et al., 2021)**

**Behavioural & Neurobiological Changes during Musth**

Musth leads to pronounced neurobehavioral changes in male Asian elephants due to drastic rises in androgens, especially testosterone and dihydrotestosterone (DHT). A detailed hormonal-behavioural study in captive animals showed that testosterone increased nearly 26-fold and DHT around 12-fold during peak musth. These hormonal spikes out were strongly associated with aggression, dominance behaviours especially at musth (such as mock charges, head-high posture),



increased moments, and reduced feeding activity. The study confirmed a strong correlation between androgen levels and behavioural changes, with  $r = 0.82$  for testosterone and  $r = 0.89$  for DHT, indicating a direct neuroendocrine basis for musth-related behaviours (positive correlation, where increase of one variable tends to increase the other variable too) (Somgird et al., 2016).

**Chemical Communication and Pheromonal Signalling**

Male elephants in musth release strong chemical signals through TGS and urine dribbling, which communicate their dominance and reproductive status to other elephants. A study by Kioko et al. (2017) on African elephants reported that TGS during musth has a distinctly sweet odour and contains the pheromone frontalin. The amount of frontalin varies with the age of the animal and how intense the musth phase is, helping both females and rival males recognize his current condition. Secretions from the temporal gland, mouth, and genital areas carry scent signals that indicate both the social position of the elephant and whether it is in musth. These scent profiles are partly shaped by the microbiome and contain compounds

that change with age. This helps other elephants recognise bulls in musth just by their smell. The study also suggests that frontalin is a clear chemical sign of musth, and those microbes in the gland secretions make the scent more detailed, allowing elephants to communicate through smell (von Dürckheim et al., 2022)

**Captive vs. Wild Musth Patterns**

Musth is a natural process in wild male elephants, but in captive conditions, the pattern frequently changes due to lack of space and less social interaction. Male elephants kept only with other males tend to show musth less often than those interact more with females. In the wild, musth usually begins after 20 years of age and follows a seasonal cycle, lasting from a few weeks to a few months. In contrast, captive elephants may enter musth at a younger age, even as early as 11 and the condition may last longer or come at irregular intervals. Captive elephants show different physical and behavioural responses during musth compared to wild ones. Captive animals may display signs of stress like repetitive swaying or pacing, and musth may begin earlier than usual. Because they are often housed alone, they miss the social control from dominant bulls that naturally helps regulate musth, which can lead to abnormal hormone patterns (Turko et al., 2023).

**Diet in musth**

During musth, the male elephants should be fed a diet that is low in energy and high in bulk to help manage their behaviour and hormonal levels. Foods such as banana stalks (chopped to hand-length), green squash, and dry grass sprinkled with salt water are ideal. High calories diet and rich concentrates food should not be given as they can increase the duration of musth duration. In case of nutrition even they are not harmful but they stimulate continued hormonal activity, making the musth last longer. Clean and sufficient drinking water must be provided, as hydration is essential for elephants under stress during musth.

**Management and Treatment Strategies**

Managing musth in captive elephants needs proper planning to keep both the animal and the people around it safe. In the past,

keepers often used chains or kept bulls in isolation during musth, but these methods usually caused more stress. Today, better techniques are used, such as protected contact systems, special musth enclosures, and hormone-based treatments. Goeritz et al. (2018) showed that giving GnRH antagonists like degarelix can reduce testosterone levels, which helps stop musth for a short time. This lowers aggression and makes the bull easier and safer to handle. Somgird et al. (2016) also noted that giving the elephant a controlled diet, proper enrichment, and using trained positive reinforcement can help manage difficult behaviours during musth without using harsh methods or punishment. The challenges of musth in captive elephants often become worsen due to chronic stress. During musth, captive male elephants commonly show high levels of faecal glucocorticoid metabolites (FGMs), a stress hormone indicator, along with stereotypic behaviours such as pacing, trunk swinging, and weaving—especially when they are kept in small or empty enclosures.

To improve their welfare, management includes environmental enrichment factor, regular social contact, and proper diet changes. In Southeast Asia, ethno veterinary practices are also followed to reduce musth symptoms. These include herbal and homeopathic treatments. One off the method uses Belladonna 200, Gelsemium 200, Zincum metallicum, and a combination of Sulphur, Silica, and Carbo, given in planned doses over several days to calm the elephant and reduce aggressive behaviour. When these practices are used along with regular observation by keepers and without using too much force or restraint, they have been reported to lower faecal glucocorticoid metabolite (FGM) levels and reduce unwanted behaviours in elephants. However, there are still not enough proper scientific studies to fully confirm these results. Combining enrichment methods that are supported by research with traditional treatments like herbal and homeopathic remedies may help connect local practices with modern standards of elephant care and welfare.

## Conclusion

Musth is normal process that occurs in mainly in male elephants in periodically. Musth helps with breeding, but it can be hard to manage in zoos or captivity. Captive elephants tend to show signs of musth earlier than wild ones, and the condition usually last for long time and causes more stress. To manage musth safely and improve elephant welfare, it is important to use hormone treatments carefully, provide better living spaces, and train elephants using kind and consistent methods. In the future, researchers should look into how musth control affects elephants in the long term and find early signs (biomarkers) of musth. This will help caretakers take better care of elephants in a humane and safe way.

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