BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL,
SOUTHERN ZONE, CHENNAI
IN
ORIGINAL APPLICATION No. 259 OF 2024 (SZ)
[Earlier O.A. No. 1043 of 2024 (PB)]

IN THE MATTER OF:
Suo Moto matter in respect of news item appearing in the Hindu dated 19.07.2024 titled "845 elephant deaths recorded in Kerala in eight years".

Versus

MOEF & CC,
Through its Regional Office,
Bengaluru and Ors. **...RESPONDENT(S)**

INDEX

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REPLY-AFFIDAVIT ON BEHALF OF THE MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE (RESPONDENT NO.1)

I, B. N Anjankumar son of Narayana, aged about 43 years, resident of Bengaluru, do hereby solemnly affirm and state as under:

1. That I am working as Assistant Inspector General of Forest (Central) in the Ministry of Environment, Forest and Climate Change, Regional Office, Bengaluru (hereinafter referred as **'MoEF&CC'**), Government of India, which has been arrayed as Respondent No. 1 in the present Original Application (hereinafter referred as 'O.A.'). That I have been duly authorized to file the reply affidavit on behalf Respondent No.1.

श्री बी. एन. अंजन कुमार
Shri B.N. Anjan Kumar
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Ministry of Environment, Forest & Climate Change
एकीकृत क्षेत्रीय कार्यालय
Integrated Regional Office
बेंगलूरु/Bengaluru.

STATEMENT OF FACTS:

2. The Hon'ble NGT, Principal Bench, New Delhi had registered the present O.A. under O.A. No. 1043 of 2024 based on a news report which was titled as ***"845 elephant deaths recorded in Kerala in eight years."*** The said matter has been transferred to this Hon'ble Tribunal for further look. The increase in number of the deaths of the elephants is a major concern in the entire country including the **State of Kerala**.

REPLY ON MERITS:

It is being most humbly submitted before this Hon'ble Tribunal that:

3. In the year 1992, the Government of India launched the Project Elephant as a Centrally Sponsored Scheme (hereinafter referred as **'CSS'**), with the primary objective of ensuring the protection and conservation of elephants, their habitats, and vital migration corridors. The Project also addresses the pressing challenges of human-elephant conflict and promotes the welfare of captive elephants across the country. The mandate of Project Elephant encompasses both administrative and policy-related aspects of managing wild and captive elephant populations. A significant aspect of this scheme is to provide comprehensive technical and financial support to all states with elephant populations, including the **State of Kerala**. In a strategic move to enhance conservation efforts, Project Elephant was merged with Project Tiger in the financial year 2023-24 and is now known as **"CSS Project Tiger & Elephant".** The merger of the schemes facilitates better allocation of resources,

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synergy in activities and it also allows the managers for a focused approach in conserving both the species. Moreover, now States have to submit only one Annual Plan of Operations (*in short* 'APO') combining the activities to be under Project Tiger and Project Elephant so that financial assistance may be expedited. Consequent to the merger of both the CSS Project Tiger and CSS Project Elephant as Centrally Sponsored Scheme – CSS Project Tiger & Elephant has been formed into a new division called Project Tiger & Elephant (hereinafter referred as 'PT&E') to strengthen the functioning and execution of both the projects in synergy.

4. Since the establishment of the **CSS Project Elephant**, there has been an unwavering commitment to the protection and conservation of the Asiatic elephant *(Elephas maximus)*, one of the most revered species in India. Listed as a Schedule I species under the Wildlife (Protection) Act, 1972 (hereinafter referred as **'the Act'**), the Asiatic elephant benefits from stringent legal protections and dedicated conservation efforts. In line with this, the Central Government provides both financial and technical support to all elephant-range States, including the **State of Kerala**, to ensure the sustainable management of elephant populations and their habitats. The State of Kerala, according to the 'All-India Estimation of 2017', is one of the foremost elephant habitats in the country, with a remarkable population of over **5,706 wild elephants**.

5. It is most humbly submitted that, as per the data received from the State of Kerala, a total of **57 elephant deaths** have been recorded

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over the past eight years, from 2016-17 to 2023-24. These deaths were attributed to a range of causes, including train-hits, electrocution, poaching and poisoning. Information regarding deaths of natural and other unnatural causes including **Elephant Endotheliotropic Herpes Virus-Hemorrhagic Disease** (hereinafter referred as **'EEHV-HD'**) are not collated by the Project Elephant, MoEF&CC. Moreover, in certain cases of elephant deaths due to the suspicious causes, the matters are referred to the Wildlife Crime Control Bureau (herein as **'WCCB'**), constituted under Section 38Y of the Act, for conducting a detailed investigation and to take appropriate actions as per the law.

6. The answering Respondent hereby submits that, the Asiatic elephant *(Elephas maximus)* has been accorded the highest degree of legal protection under Schedule I species of the Act. Considering the degree of protection provided to the Asian Elephants in India, the PT&E Division of MoEF&CC issued a letter dated 13.09.2023 to the Chief Wildlife Wardens of all Elephant range States, directing them to report the death of each elephant within 24 hours of the incident to MoEF&CC and to submit a detailed report after the post-mortem in the prescribed format. The PT&E Division is proactive to each death of the elephants in order to take crucial steps to prevent the further deaths caused by other unnatural factors. A true copy of the letter dated 13.09.2023 of PT&E Division, MoEF&CC is annexed herewith as **Annexure-I**.

7. It is humbly submitted that a **Steering Committee** was originally constituted in the year 1995 by the MoEF&CC as part of the Project

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Elephant initiative. Serving as the apex body overseeing the Project, the Committee is chaired by the Hon'ble Minister of Environment, Forest & Climate Change. The core mandate of the Steering Committee is to continuously assess the progress and implementation of Project Elephant, offering strategic guidance and recommendations as deemed necessary. In adherence to its established three-year term, the Steering Committee was reconstituted on 28.03.2022 ensuring the continued effectiveness and oversight of the Project. A true copy of the Office Memorandum dated 28.03.2022 on re-constitution of **Steering Committee** is annexed herewith as **Annexure-II**.

8. It is respectfully submitted that, pursuant to the Supreme Court's Order dated 22.10.2018, in *W.P. (C) No. 489/2018* titled *Prerna Singh Bindra & Ors. v. Union of India & Ors.*, another committee, the Central Project Elephant Monitoring Committee (hereinafter referred to as **'CPEMC'**), was constituted. The CPEMC was established with the primary objective of diligently monitoring and ensuring the effective implementation of the directions, instructions, and guidelines issued by the Ministry, as well as the orders of the Hon'ble Courts, in relation to the conservation and protection of elephants. The **CPEMC** is chaired by an officer holding the rank of Additional Director General of Forests, who provides strategic oversight to the Committee's functioning. A true copy of Office Memorandum dated 28.12.2018 on the constitution of **CPEMC** is annexed herewith as **Annexure-III**.

9. It is further respectfully submitted that, in furtherance of the welfare

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of captive elephants, the MoEF&CC under the framework of Project Elephant, has constituted the Captive Elephant Healthcare and Welfare Committee (hereinafter referred to as **'CEHWC'**). This Committee has been entrusted with the critical responsibility of addressing the various issues related to the healthcare, welfare, and management of captive elephants throughout the country. The **CEHWC** is chaired by the Inspector General of Forests and the Director of Project Elephant, ensuring strategic oversight and guidance. The primary objective of the CEHWC is to propose a comprehensive veterinary care plan for the management of captive elephants, which is to be implemented by both government and private agencies. Additionally, the Committee is assigned with reviewing the operations of existing state-level captive elephant welfare committees to ensure the effectiveness of their functions. A true copy of the Office Memorandum dated 22.08.2019 by which CEHWC was constituted, is annexed herewith as **Annexure-IV.**

10. The answering Respondent respectfully submits that there are three Committees at present, as outlined above, working synchronously for the welfare of Wild as well as Captive Elephants. It is also to submit that a Committee was constituted by the Project Elephant, MoEF&CC during the year of 2019 to put forward the **Standard Operating Procedure** (hereinafter referred as **'SOP'**) **for dealing with captive and wild elephant deaths due to anthrax/suspected cases of anthrax**. The said SOP was duly circulated *vide* its letter dated 31.12.2019 to the Principal Chief Conservator of Forests (HoFF) of

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all States & UTs; Chief Wildlife Warden of all States & UTs; Director, Wildlife Institute of India, Dehradun; and to all the Non-official Members of the Steering Committee of Project Elephant. A true copy of the letter dated 31.12.2019 along with the SOP for dealing with Captive and Wild Elephant mortalities due to Anthrax and suspected cases of anthrax is annexed herewith as **Annexure-V**.

11. The answering Respondent respectfully submits that, in the year 2022, a comprehensive document titled ***"Caring for Elephants - Managing Health and Welfare in Captivity"*** was released, which addresses all aspects of health, disease management, and welfare for elephants in captivity. Specifically, **Chapter 8** of this document focuses on both infectious and non-infectious diseases affecting Asian elephants, providing detailed guidance on the identification, prevention, and management of such conditions. A copy of the said document is annexed as **Annexure-VI.**

12. As far as **EEHV-HD** is concerned, the issue was discussed in the 4th meeting of Captive Elephant Health Care and Welfare Committee held on 07.08.2024 at New Delhi through virtual mode and it was decided to circulate the SOP for EEHV-HD issued by Central Zoo Authority (herein as 'CZA'), a statutory body of the MoEF&CC, from the hand of PT&E Division of the Ministry. As a result, PT&E Division *vide* its Office Memorandum (hereinafter referred as 'O.M.') dated 09.08.2024 circulated the SOP for EEHV-HD to all the Elephant range States/UTs to address this fatal disease by implementing the said SOP. A true copy of the O.M. dated

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09.08.2024 along with SOP for EEHV-HD is annexed herewith as **Annexure-VII.** The matter was further deliberated in the 20th meeting of Steering Committee of Project Elephant held on 12.08.2024 at Raipur, Chhattisgarh.

13. Furthermore, it is also submitted that the periodic awareness campaigns are conducted to educate the public on the importance of coexistence with wildlife, specifically elephants. These initiatives aim to sensitize the local population about the potential risks and provide practical advice on how to avoid or address situations that could lead to human-elephant conflicts. The information is disseminated through multiple media channels to ensure broad public reach and engagement. Additionally, the forest departments actively involve local communities as animal trackers, who play a critical role in monitoring elephant movements. By tracking elephants' movements and issuing timely alerts, these community members help to prevent potential conflicts, thereby reducing the risk of harm to both humans and elephants. This collaboration not only fosters a sense of shared responsibility but also empowers local communities to play a central role in wildlife conservation efforts.

14. The Wildlife Institute of India, Dehradun, in association with the **MoEF&CC**, the National Highway Authority, the National Tiger Conservation Authority, and the World Bank Group, has developed a valuable resource—***'Eco-friendly Measures to Mitigate Impacts of Linear Infrastructure' (2016)***. This document provides critical guidance to infrastructure development projects, particularly railways

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and highways, on how to design and implement eco-friendly measures that minimize the impact of such projects on wildlife and reduce the likelihood of human-elephant conflicts. The aim is to design infrastructure that accommodates both human development and wildlife conservation, ensuring a harmonious balance between progress and the preservation of our natural heritage.

15. The answering Respondent submits that an advisory on dealing with human-wildlife conflict has been issued by this Ministry on 06.02.2021. The advisory recommends coordinated inter-departmental action, identification of conflict hotspots, adherence to Standard Operating Procedures, establishment of rapid response teams, formation of State and District level committees to review the quantum of *ex-gratia* relief, issuing guidance/instructions for expedited payments, and provision of adequate funds for suitable portion of ex-gratia relief to be paid within 24 hours to the affected persons in the case of death and injury to persons. A copy of the said advisory is annexed herewith as **Annexure-VIII**. In addition, the Ministry also released the guidelines on ***"Human-Elephant Conflict Mitigation-Taking a Harmonious Coexistence Approach (2023)"*** for addressing human-elephant conflicts. A copy of the said guidelines is annexed as **Annexure-IX.**

16. To reduce man-elephant conflict and to avoid retaliatory killing of elephants, compensation is provided to local communities for loss of their property and life caused by wild elephants. The Ministry has notified enhancement of *ex-gratia* rates related to wildlife

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depredation *vide* O.M. dated 22.12.2023, which includes increase in *ex-gratia* from ₹5lakh to ₹10 lakh in case of death by wild animals. In this respect, PT&E Division of MoEF&CC circulated the said O.M. *vide* its letter dated 25.01.2024 to the Chief Wildlife Wardens of all Tiger & Elephant range States/UTs. A true copy of the letter dated 25.01.2024 along with the O.M. dated 22.12.2023 is annexed herewith as **Annexure-X**.

17. The answering Respondent submits that another advisory on implementation of measures to mitigate the impact of power transmission lines and other power infrastructure on elephant and other wildlife. Death of elephant due to power transmission lines and other power infrastructure is a major concern in the country. The issue was discussed during the 17th meeting of the Steering Committee of Project Elephant, held on 12.08.2022 at Peiryar Tiger Reserve under the Chairmanship of Hon'ble Minister, Environment, Forest & Climate Change with the officials of Ministry of Power. In compliance to the discussion held, an advisory on implementation of measures to mitigate the impact of power transmission lines and other power infrastructure on elephant and other wildlife has been issued by Ministry of Power to all Distribution Companies (herein as 'DISCOMs') and Transmission Corporations (herein as 'TRANSCOs'). Further, the MoEF&CC circulated the advisory issued by Ministry of Power to all DISCOMs and TRANSCOs *vide* its letter dated 16.09.2022. A true copy of the letter dated 16.09.2022 along with the advisory of Ministry of Power is annexed herewith as

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Annexure-XI.

18. The answering Respondent submits that critical elephant habitats are notified as 'Elephant Reserve' for focus and synergy in elephant conservation and to reduce conflict. So far, **33 Elephant Reserves** of about 80,777.778 Km^2 area have been established and notified in 14 major elephant States including the **State of Kerala**. In respect to the State of Kerala, at present, four elephant reserves have been notified. A true copy of the **list of 33 notified Elephant Reserves** is annexed herewith as **Annexure-XII**.

19. The answering Respondent also submits that the **MoEF&CC**, in coordination with the State Forest Departments, has identified a total of **150 elephant corridors** across 15 elephant range states, including the State of Kerala. Following this identification, the corridors were presented to the Steering Committee and subsequently ground-validated. In respect to this, Project Elephant, MoEF&CC *vide* its letter dated 22.08.2023 circulated the Report titled "**Elephant Corridors in India (2023)**" to all the States & Union Territories to take necessary steps to protect and conserve the elephant corridors. Specifically, in the State of Kerala, four elephant corridors have been successfully ground-validated. A true copy of the letter dated 22.08.2023 along with the list of Elephant Corridors in India is annexed herewith as **Annexure-XIII.**

20. It is humbly submitted that, in response to the reported deaths of 845 elephants in Kerala over a span of 8 years, the PT&E Division of the

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MoEF&CC issued a letter dated 12.09.2024 to the Principal Chief Conservator of Forests and Chief Wildlife Warden of Kerala, seeking a detailed report on the matter. In response to the MoEF&CC's letter, the Additional Principal Chief Conservator of Forests (Administration) and Chief Wildlife Warden of Kerala, through a communication dated 07.11.2024, clarified that the reported figure is derived from the wild elephant population estimation report published by the Kerala Forest Department. It was further conveyed that the Government of Kerala has established an Expert Committee, comprising five members, to conduct a thorough investigation into the causes of wild elephant mortality in the state over the past decade. The Expert Committee, in consultation with relevant experts, will examine the detailed data regarding elephant mortalities and is expected to submit a comprehensive report to the Government within three months. Moreover, it was noted that the first meeting of the Expert Committee was convened on 30.10.2024, during which several action points were identified. A true copy of the letter dated 12.09.2024 of PT&E Division of MoEF&CC; a copy of letter dated 07.11.2024 of Chief Wildlife Warden, Kerala; and a copy of the action points derived at the first meeting of the Expert Committee held on 30.10.2024 are annexed herewith as **Annexure-XIV (Colly).**

21. The answering Respondent submits that there is no specific violation of any provision of the Biological Diversity Act, 2002. The key objective of the Biological Diversity Act, 2002 is to conserve biological diversity, promote the sustainable use of its components,

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and ensure fair and equitable sharing of benefits arising from the use of biological resources and traditional knowledge. It is also to submit that the Impact Assessment division grants prior Environmental Clearance under the provisions of Environment Impact Assessment Notification, 2006 issued under the provisions of the Environment Protection Act, 1986 for projects covered in the schedule of the Notification.

22. It is humbly submitted that the MoEF&CC is taking all the necessary steps for the protection and conservation of elephants and their habitats & corridors by way of conducting capacity-building workshops, taking up matter with the appropriate authorities and concerned stakeholders. To reduce death of elephants by electrocution, train-hits, illegal poaching and other unnatural factors, the MoEF&CC provides technical & financial assistance to all the elephant range States & Union Territories in the country. Various other Centrally Sponsored Schemes including Integrated Development of Wildlife Habitat are being implemented by this Ministry to contribute the improvement in the natural habitat of elephants by augmenting water sources, planting of fodder trees, regeneration of bamboo etc.

Date: 31.12.2024

Deponent

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VERIFICATION

I, the answering Respondent do hereby verify at Bengaluru on this 31st of December 2024 and declare that the contents of paragraphs from 1 to 22 of the above affidavit are true to the best of my knowledge derived from the office records maintained in the office. No part of it is false and nothing material has been concealed therefrom.

DATE: 31.12.2024

PLACE: Bengaluru

Deponent

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Annexure-I

I/52919/2023

F.No. 12-1/2019-PE (Part-I)
Government of India/ भारत सरकार
Ministry of Environment, Forests & Climate Change/ पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
(Project Tiger & Elephant Division / व्याघ्र एवं हाथी परियोजना प्रभाग)
****

3rd Floor, Prithvi Wing,
Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj,
New Delhi-110003

Dated 13th September, 2023

To,
The Principal Chief Conservator of Forests (WL)
& Chief Wildlife Warden,
All PE States/UTs.

Sub: Reporting death of elephants (Schedule-I species) to the Project Elephant, MoEF&CC - reg.

Madam/Sir,

As you are aware that number of elephant and human deaths are being reported due to Human Elephant Conflicts in the country. However, the real time information on elephant and human deaths is not submitted by the States at present. Hence, you are requested to send the report on elephants and human deaths on the same day, as and when such incidents are reported by the field officers of your State.

Since the real time information on such incidents is being sought by Hon'ble Minister, EF & CC and Hon'ble Minister of State, the details may be sent on the same day itself. Therefore, Chief Wildlife Warden of the States are once again requested to send the death reports on the same day to this ministry for providing information to Hon'ble MEF&CC and also for filing reply to Parliamentary questions, RTI, Hon'ble Supreme court, High courts and also to the NGT etc.

The preliminary information may also be submitted to the Ministry as per the enclosed format for reporting of death of Schedule –I and/or Part-II, Schedule-II listed species, followed by the detailed report after the post-mortem of the elephants.

This may be treated on "TOP" priority.

Yours faithfully,

Signed by
Ramesh Kumar Pandey
Date: 13-09-2023 11:00:23

Encls: As above.

(Ramesh Kumar Pandey)

Inspector General of Forests (PT&E) & Director (PE)

Format for reporting of death of Schedule –I and/or Part-II, Schedule-II listed species

1.	Name of the species	
a.	Common Name	
b.	Scientific name	
2.	Number of animals reported dead	
a.	Male	
b.	Female	
3.	Location (Please specify details like: area, District, within/outside Forest, etc.)	
4.	Date of death/reporting	
5.	Probable reasons for death	
6.	Details of person who reported the incident first	
7.	Action taken at the field level	
8.	Whether post-mortem conducted or not. If yes, details	
9.	Preliminary findings	
10.	FIR lodged, if any (Details)	
11.	Details of missing body parts, if any	
12.	Any other relevant information	

Name:
Designation:
Date:

Signature

Annexure-II

F.No. 2-7/1998- PE (Vol.I)
Government of India
Ministry of Environment, Forests & Climate Change
(Project Elephant Division)
****

6th Floor, Vayu Wing,
Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj,
New Delhi-110003

Dated 28th March, 2022

OFFICE MEMORANDUM

Sub: Re- Constitution of the Steering Committee of Project Elephant-reg.

In supersession of this Ministry's Office Memorandum No. 2-7/1998-PE (Vol.I) dated 4th September, 2017 the Steering Committee of Project Elephant is reconstituted as under:

1.	Minister of Environment, Forests & Climate Change	Chairperson
2.	Minister of State, Environment, Forests & Climate Change	Vice Chairman
3.	Secretary, Environment, Forests & Climate Change	Member
4.	Director General of Forests & Special Secretary	Member
5.	Additional Director General of Forests (Wildlife)	Member
6.	Additional Director General of Forests (Forest Conservation)	Member
7.	Joint Secretary & Financial Advisor	Member
8.	Dr. K. K. Sarma, Senior Veterinarian, Guwahati Veterinary College, Assam (Padamshri Awardee 2020).	Member
9.	Shri P. C. Tyagi, IFS (Retd), Dehradun	Member
10.	Sh. Manoj Ram Phookun, Assam	Member
11.	Sh. B S Bonal, IFS (Retd), Assam.	Member
12.	Sh. Kumku Gam Singpho, Arunachal Pradesh	Member
13.	Dr. Sandeep Kumar Tiwari, WTI, New Delhi	Member
14.	Dr. Dipankar Ghose, WWF-India, New Delhi	Member
15.	Dr. Bibhuti Prasad Lahkar, Aaranyak, Guwahati	Member
16.	Inspector General of Forests & Director (Project Elephant), MoEF&CC.	Member Secretary

2. In addition to above, the Director, Wildlife Institute of India; Director, Zoological Survey of India; Director, Botanical Survey of India; Commissioner, Animal Husbandry, Department of Animal Husbandry & Dairying ; ADG (PT)/MS, NTCA; Additional Director, Wildlife Crime Control Bureau (WCCB); Representative from Ministry of Agriculture and Farmer Welfare; Representative from Ministry of Power; Representative from Ministry of Railways (Joint Secretary level or above) and Chief Wildlife Wardens of States having Project Elephant scheme would be permanent invitees for meeting.

True Copy

3. The term of the Steering Committee of the Project Elephant will be for duration of three years from the date of issuance of this Office Memorandum, subject to modifications, if any, in the composition and functions of the committee, with the approval of competent authority.

4. The committee will review the implementation of Project Elephant and provide suitable guidance from time to time for which the committee may meet as and when necessary.

5. Travelling Allowance and Daily Allowance will be payable to non-official members of the Committee as admissible to Grade I officers of the Government of India.

(Dr. K. Muthamizh Selvan)
Scientist 'D' (Project Elephant)
Email id: km.selvan@gov.in
Telephone No. 011-24695067

Distribution:

1. PS to Hon'ble Minster, Environment Forests & Climate Change.
2. PS to Hon'ble Minster of State, Environment Forests & Climate Change.
3. PPS to Secretary, Ministry of Environment Forests & Climate Change.
4. PPS to DGF&SS, Ministry of Environment Forests & Climate Change.
5. PSO to Addl. DGF (WL)/PPS to AGF (FC)/PPS to IGF(Wildlife) PS to JD (WL), EF&CC
6. All Members of the Steering Committee (Non-official)

Copy to:

1. The Chief Secretaries and Forest Secretaries of all the State Governments/UTs.
2. The Advisor, Forest and Wildlife, Planning Commission.
3. PAO, Ministry of Environment Forests & Climate Change.
4. Director, Public Relations, Ministry of Environment Forests & Climate Change.
5. Principal Chief Conservator of Forests (HoFF) of all States and UTs.
6. Chief Wildlife Warden of all the concerned States.

Annexure-III

F. No. 6-3/2018-PE
Government of India
Ministry of Environment, Forests & Climate Change
Project Elephant Division

Indira Paryavaran Bhawan,
Jor Bagh Road, New Delhi-110003
Dated 28th December, 2018

OFFICE MEMORANDUM

Sub: Constitution of the Central Project Elephant Monitoring Committee (CPEMC) for monitoring and implementation of directions/instructions/guidelines of the Ministry and Court's direction related to conservation and protection of elephants-regarding

As per the decisions in the 15th Steering Committee Meeting of the Project Elephant held on 22nd November, 2018, a Central Project Elephant Monitoring Committee (CPEMC) for monitoring the implementation of directions/instructions/guidelines of the Ministry and Court's direction related to conservation and protection of elephants is constituted. The composition of the committee is as follows:

i. ADG (WL), MoEF&CC- Ex-Officio Chairman
ii. Director, Wildlife Institute of India- Ex-Officio Member
iii. IGF (WL), MoEF&CC- Ex-Officio Member
iv. Shri N. K. Vasu, Retd. PCCF of Assam – Expert Member
v. Shri R. K. Srivastava, Ex- IGF (PE)- Expert Member
vi. Shri Vinod Rishi, Ex- ADG (WL)- Expert Member
vii. Shri G. Harikumar, Retd. PCCF & CWLW, Kerala- Expert Member
viii. Shri Vivek Menon, ED & CEO, WTI- NGO Member
ix. Dr. Prachi Mehta- WCRS, Pune - NGO Member
x. Dr. Surendra Verma, ANCF, Banglore- NGO Member
xi. PCCF (WL), of two range states (on rotation basis) Currently PCCF (WL) West Bengal and PCCF (WL) Karnataka- Ex-Officio Members
xii. IGF and Director (Project Elephant)- Ex-Officio Member- Secretary

2. The Committee shall have the following Terms of Reference:

i. Regular monitoring of various directions/instructions/guidelines issued by the Ministry and directions from the Courts regarding conservation and protection of Indian elephants within the country including implementation of the measures taken to avoid the violence against the elephants.
ii. The field visits to the states for examination of emergent human –elephant conflict situation on the advice of the Government of India and to submit the report to the Government of India/Steering Committee of Project Elephant.

True Copy

iii. To review in general human – elephant conflict situation in the country and suggest the measures to deal with conflicts effectively.

iv. Monitoring the implementation of the works under "Project Elephant" component of Centrally Sponsored scheme, Integrated Development of Wildlife Habitats" (IDWH) as and when advised by the MoEF&CC/Steering Committee

v. Any other work assigned by the Ministry related to elephant conservation.

3. The Committee shall have the following other Terms and Conditions:

i. The Committee shall meet at least twice in a year. In addition to this meeting, Committee can hold any meetings or organize visit to HEC area on advice of the Ministry

ii. The Committee will be at liberty to constitute a sub-committee out of its members for emergent visits to HEC areas to deal with emergent HEC situation.

iii. Terms of members other than ex-officio members shall be two years and extendable by one year.

iv. The TA/DA and sitting fees to non –official members shall be Rs. 4000/- paid by the Ministry through RTGS after submission of original bills of Airlines (Air India), Taxi etc. As per the Government of India Instruction Non-officials members will have to travel by Air India and book the tickets directly through Government approved agent or directly from Air India.

v. TA/DA of non –official members shall be paid as per SR-190 whereas official members shall get the TA/DA from their respective organizations.

4. This issues with the approval of the Hon'ble Minister of Environment, Forests and Climate Change.

(Noyal Thomas)
Inspector General of Forests & Director
(Project Elephant)

Distribution:

1. PS to Hon'ble Minister, EF&CC
2. PPS to Secretary, EF&CC
3. PPS to DGF & SS, EF&CC
4. PPS to ADGF (WL), EF&CC
5. PPS to IGF (WL), EF&CC
6. Principal Secretary (Forests), All Elephant Range States
7. Chief Wildlife Wardens, All Elephant Range States
8. All Members of the Committee

Annexure-IV

F. No. 2-7/98-PE (Vol.II)
Government of India
Ministry of Environment, Forests and Climate Change
Project Elephant Division

Indira Paryavaran Bhawan,
Aliganj, Jor Bagh Road, New Delhi-110003
Dated 22nd August, 2019

OFFICE MEMORANDUM

Sub: Constitution of the Captive Elephant Healthcare and Welfare Committee (CEHWC), Project Elephant, Ministry of Environment Forest & Climate Change (MoEF&CC).

In compliance of the decision taken during the 15th Steering Committee meeting of Project Elephant, a Captive Elephant Healthcare and Welfare Committee Captive is constituted to look into the issues related to healthcare, welfare and management of captive elephants in the country. The composition of the committee is as follows:

(i)	Shri. Noyal Thomas, IGF & Director, Project Elephant	- Chairman
(ii)	Dr. K. K. Sharma, Member, Steering Committee, Project Elephant	- Member
(iii)	Dr. Easwaran E.K., Sr. Forest Veterinarian, Kerala Forest Department, Kerala	- Member
(iv)	Dr. Rajeev, Professor Kerala Veterinary University, Kerala	- Member
(v)	Dr. N. S Manoharan, Addl. Director, Department of Animal Husbandry, Government of Tamil Nadu	- Member
(vi)	Dr. Bhaskar Choudhary, Coordinator & Head Veterinarian, Wildlife Trust of India, Manas Tiger Reserve	-Member
(vii)	Dr. Prajna Panda, Consultant, Elephant Cell, MoEF&CC	-Special Invitee
(viii)	Dr. K. Muthamizh Selvan, Scientist D, Project Elephant	- Member Convener

2. The Committee shall have the following Terms of References:

(i) To suggest the detailed veterinary care plan for management of the captive elephants to be implemented by the Government and private agencies

(ii) To suggest the various activities for which the captive elephants could be utilized while fully ensuring welfare and wellness of the captive elephants.

(iii) To review the functioning of the existing state level captive elephant welfare committees.

(iv) Verification of health status of captive elephants as and when referred by the Ministry of Environment Forest & Climate Change.

(v) Any other issues related to captive elephants management to be decided by the Ministry.

True Copy

3. (i) The committee will be at liberty to constitute a inspection team/sub committee of veterinary experts for fulfilling the mandate assigned to it or may also visit the captive elephant sites for the verification of the health status of the captive elephant/s for discharging its duties.

(ii) The travelling allowance, daily allowance and sitting fees etc. will be payable to Non-official members of the Committee through RTGS as per SR-190 after submission of original bills of Airlines, Taxi etc. whereas official members will get TA/DA from their respective organizations.

4. The term of the Captive Elephant Healthcare and Welfare Committee (CEHWC) shall be for two years from the date of issue of this Office Memorandum and extendable depending on the completion of the tasks assigned.

5. This issues with the approval of the Hon'ble Minister, Environment, Forests & Climate Change.

(Dr. K. Muthamizh Selvan)
Scientist 'D' (Project Elephant)
Email id: km.selvan@gov.in
Telephone No. 011-24695067

Distribution:

- All the members of the Committee.
- The Principal Chief Conservator of Forests & Chief Wildlife Wardens, All Elephant Range States.

Copy to:

- PS to Hon'be Minister, EF&CC
- PS to Hon'ble MoS, EF&CC
- PPS to Secretary, MoEF&CC
- PPS to DGF&SS, MoEF&CC
- PPS to Addl. DGF (WL),MoEF&CC
- PPS to IGF (WL), MoEF&CC
- PPS to Joint Director, PE/WL, MoEF&CC.
- Shri Surender Gugloth, Scientist 'D', MoEF&CC.
- Shri R.K. Srivastava, Consultant, PE, MoEF&CC.

True Copy

Annexure-V

F. No. 2-4/2012-PE
Government of India
Ministry of Environment, Forests and Climate Change
Project Elephant Division

Indira Paryavaran Bhawan,
Jor Bagh Road, New Delhi-110003
Dated 31st December, 2019

To

1. Principal Chief Conservator of Forests (HoFF) of all States & UTs
2. Chief Wildlife Wardens of all States & UTs
3. Director, Wildlife Institute of India, Dehradun
4. All Non-official Members of the Steering Committee of Project Elephant

Sub: Standard Operating Procedure (SOP) for dealing with Captive and Wild Elephant Mortalities Due to Anthrax/Suspected Cases of Anthrax -reg.

Project Elephant Division of the Ministry had constituted a committee for finalizing a Standard Operating Procedure (SOP) for dealing with captive and wild elephant deaths due to anthrax/suspected cases of anthrax. Veterinary Experts and NTCA were also consulted on the committee report for finalizing the Standard Operating Procedure (SOP). It is requested this SOP may be used for dealing with mortalities of captive and wild elephants due to anthrax and suspected cases of anthrax.

This issues with the approval of the competent authority for necessary action.

(Noyal Thomas)
IGF & Director, Project Elephant
E-mail: igpe-mef@nic.in

Encl: As above

Copy to:

- PS to Hon'ble Minister, EF&CC
- PS to Hon'ble Minister of State, EF&CC
- PPS to Secretary, EF&CC
- PPS to DGF & SS, MEF&CC
- PPS to ADG (WL), MoEF&CC
- PPS to IGF (PE), MoEF&CC
- NIC Cell, MoEF&CC- with request to upload in the MoEF & CC website

True Copy

A Standard Operating Procedure for

Dealing with Captive and Wild Elephant mortalities due to Anthrax and suspected cases of anthrax

2019

Project Elephant Division, Ministry of Environment, Forest and Climate Change, Government of India

सत्यमेव जयते
Goverment Of India

हाथी परियोजना
भारत सरकार
PROJECT ELEPHANT
GOVT. OF INDIA

प्रकृतिः रक्षति रक्षिता
Nature Protects if She is Protected

Table of Contents

Standard Operating Procedure for Dealing with Captive and Wild Elephant Mortalities Due to Anthrax and Suspected Cases of Anthrax

1. Reference

In response to sporadic deaths of wild elephants, reportedly due to anthrax and the ubiquitous threat that it poses to elephants and other wildlife populations, an expert committee was constituted vide F. No. 2-4/2012 –PE dated 21/08/17 to suggest ways to deal with anthrax and EEHV (Elephant endotheliotropic herpes virus) cases pertaining to elephants.

2. Purpose of this SOP

The main objective behind preparation of this SOP is to ensure that the carcasses of elephants suspected/diagnosed with anthrax are disposed off in a scientific as well as transparent manner to prevent any spread of anthrax to other wildlife populations.

3. Short summary

This Standard Operating Procedure (SOP) attempts to provide minimum steps, which need to be undertaken at the field level (reserve forest, Protected Area, revenue land, tiger reserve, elephant reserve or elsewhere) for disposing of elephant carcasses suspected to be affected by anthrax.

4. Scope of the SOP

The SOP shall be useful to the field staff of the Forest Department in elephant range Forest Divisions and other areas elephants are likely to be affected by anthrax/suspected anthrax.

5. Authorities responsible for implementation of SOP

The overall responsibility at the State level would rest with the Chief Wildlife Warden of the concerned state.

i. In the case of Tiger Reserves, the Field Director would be responsible in the case of a tiger reserve.
ii. For a Protected Area, (National Park/Wildlife Sanctuary), the concerned Protected Area manager would be responsible.
iii. In case of other areas revenue land/conservation revenue/community reserve/township) the Wildlife Warden, as per the Wildlife (Protection) Act, 1972, or Divisional forest Officer/Deputy Conservator of Forests (under whose jurisdiction the area falls), would be responsible.

6. Line of action required in dealing with cases of suspected anthrax in elephants

i. Constitution of a team to oversee assessment and disposal of elephant carcasses diagnosed / suspected to be affected by anthrax
   a. Protected Area manager in case of National Parks and Wildlife Sanctuaries. The Field Director in a Tiger Reserve/DCF in whose jurisdiction the area falls.
   b. A nominee of the Chief Wildlife Warden of the state
   c. A representative of the NTCA if the incident pertains to a Tiger Reserve
   d. A representative from the local Non-Governmental organization
   e. Veterinarian of the Tiger Reserve/Protected Area, if any
   f. District Veterinary Officer (DVO) or his representative, who should necessarily be a veterinarian from Animal Husbandry Department. A person from a teaching institute may be co-opted if required.
   g. A representative of the local Panchayati Raj Institution

ii. Assess if the elephant is suspected to have died due to anthrax by carefully examining the following external signs:
   a. Bleeding from natural orifices (ears, mouth, eyes, genetalia, rectum, trunk) wherein blood is dark, tarry coloured and does not clot
   b. Absence of rigor mortis or incomplete rigor mortis
   c. Saw horse posture of carcass
   d. Excessive bloating of carcass
   e. Rapid decomposition/ putrification of carcass
   f. Subcutaneous swelling/edema in cases of acute/chronic case of anthrax

   It may be noted that the aforesaid signs may be detected / externally noted in the case of other diseases and conditions as well. Therefore, as a general precaution, carcasses should not be opened up if any of the external signs discussed above are observed. Decision of opening the carcass at the field level shall be taken by the DVO or his representative. Their decision would be deemed final.

iii. Preventive Protected Equipment (PPE):
   a. The personnel handling the carcass should wear appropriate PPE **(indicative list with pictures is provided in Annexure I**) to safeguard themselves, as anthrax is a zoonotic disease

iv. Steps for collecting biological samples:
   a. Blood samples should be collected from the veins of ear pinnae by a personnel properly wearing PPE
   b. Preparation of smear using the aforesaid collected blood sample for new methylene blue staining **(Procedure outlined in Annexure 2).**
   c. Samples from natural orifices should also be collected.

v. Disposal of carcasses suspected to have died due to anthrax:
   a. Carcass in all Anthrax/suspected Anthrax cases should be burnt completely and under no circumstance be buried
   b. Prior to burning, spray the carcass with 10% formalin solution
   c. Area up to a radius of 50 metres around the carcass should be sanitized using a flame gun

d. Further, an area up to 50 metres around the carcass should be fenced off using appropriate material for a period of 6 months
e. Disinfect and guard off the water holes in which carcass was located to prevent disease spread to other wildlife.
f. No parts like tusk/tushes from carcass should be collected or preserved as it could also a source of infection to human as well.
g. To prevent damage and rupture of carcasses due to dragging or lifting by the machineries and escape of vegetative spores, carcasses should be burned at site of death to minimize the contamination.
h. Used equipment and contaminated inanimate object like boots, slippers and clothes of handlers should also be sanitized with 10 % formalin.
i. The area where carcass is disposed should be abundantly dusted/mixed with lime powder which will help prevent earthworms penetrating and bringing out the underneath soil.

7. Capacity building of staff and veterinarians is required in the following aspects

i. Recognition of anthrax signs during post mortems. In this context, photographic reference material should be provided to all frontline personnel
ii. Carcass disposal methods
iii. Preventive actions to be taken consequent to carcass disposal.

8. Mapping spatial distribution of anthrax zones

It is advised to prepare a histogram of anthrax-related deaths using retrospective data overtime to forest disease occurrence. In addition, spatial distribution should be plotted to identify "anthrax zones" in the given area.

9. Continuous monitoring

i. Field staff should perambulate their area and report any elephant death immediately. Staff should report the death of other species as well, which show symptoms that are similar to anthrax.
ii. Revisit the Anthrax carcass site after 6 months for soil testing.
iii. Based on the spatio – temporal dynamics of the disease, soil testing should be done yearly.
iv. In case soil samples test positive, sensitize the area in a 50m radius using 10% formalin followed by flaming.
v. Advise the district livestock department to carry out ring vaccination programme to the livestock in the fringe areas of sanctuaries to safeguard the livestock as well as to reduce spill over of infection if affected animal die in the sanctuary limit.

10. Videography of elephant necropsy

It is advised that the entire post mortem process and elephant carcass disposal be video-graphed and supplemented with still photographs

11. Suggested test for confirmation

i. Culture of blood (collected from vein as well as from natural orifices), which is to be collected in whole blood collection tube over cold chain
ii. Polymerase Chain Reaction using blood. Blood to be collected in EDTA and transported over cold chain.

ANNEXURE I: Care taken while carrying out necropsy of anthrax suspected elephants

Photo-1: Using N95 respirator for autopsy

Photo-2: Carcass examination with protective gears

Photo-3: Double gloves and boots for elephant necropsy

ANNEXURE II: Vital stains used

New Methylene Blue Stain

Stains used to demonstrate the reticulum of immature erythrocytes are called vital stains. New methylene blue stain has many other areas of use like in evaluating vaginal smears during estrus and examining for blood parasites like heartworm microfilariae. New methylene blue can be used in wet mount preparation or in the more conventional air dried mount.

DIRECTIONS FOR USE

Reticulocyte count/Heartworm screen

1.) Two drops of blood and an equal amount of stain are left mixed for 15 to 20 minutes in a small test tube. A slide is then prepared from the mixture in the usual manner. The reticulum will stain intensely blue and the erythrocytes are seen as ghost outlines. The reticulocyte count is expressed in percentage after counting 500 RBCS.

Dry unfixed blood or cytology.

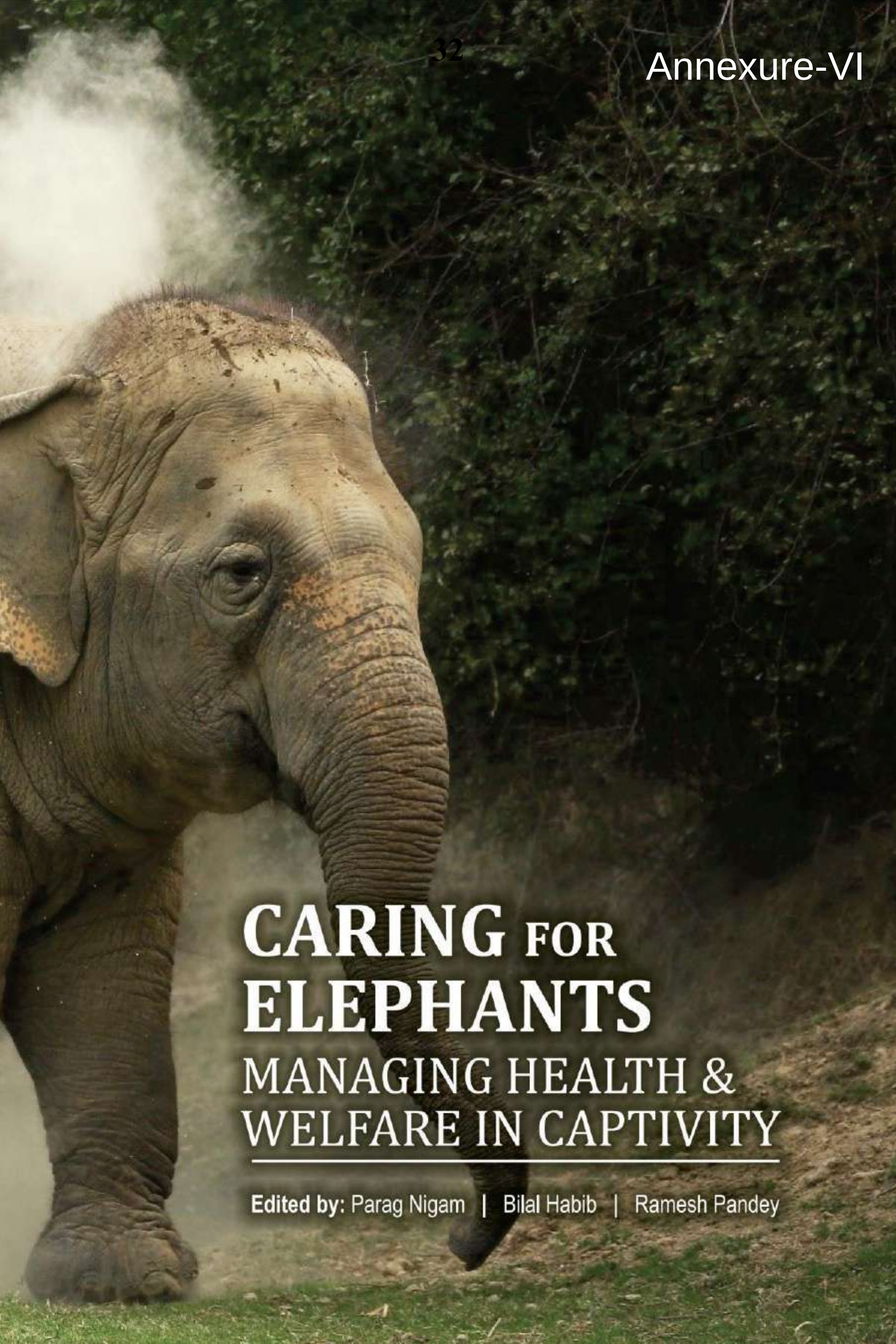
2.) One drip of stain is applied evenly over the dried film. The slide is immediately ready to read. Also since the stain is contained in physiologic saline, the film is not permanent and will only last a few hours.

Contents: 60ml.
Catalog #J-324A

Jorgensen Laboratories, Inc.
Loveland, CO 80538

GENTLY SHAKE BEFORE USE
KEEP COVERED
STORE AT ROOM TEMPERATURE

Annexure-VI


CARING FOR
ELEPHANTS
MANAGING HEALTH &
WELFARE IN CAPTIVITY
Edited by: Parag Nigam | Bilal Habib | Ramesh Pandey

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Citation for chapters: *Lakshminarayanan, N. (2022). Elephant ecology and behavior: Implications for captive elephant management. In: Nigam, P., Habib, B. and Pandey, R. (Eds.). Caring for Elephants: Managing Health & Welfare in Captivity. Project Elephant Division, MoEF&CC, GoI- Wildlife Institute of India. Pp. 220.*

CARING FOR ELEPHANTS

MANAGING HEALTH & WELFARE IN CAPTIVITY

Edited by
Parag Nigam
Bilal Habib
Ramesh Pandey

Ministry of Environment, Forest & Climate Change
हाथी परियोजना
PROJECT ELEPHANT
GOVT. OF INDIA
भारतीय वन्यजीव संस्थान
Wildlife Institute of India

FOREWORD

Asian elephants were first tamed during the Indus valley civilization, almost 4000 years ago. Since then, captive elephants have had a spectacular history in India as cultural icons. Historically, captive elephants have been extensively used in wars before the advent of firearms. In modern times, utility of captive elephants in forestry and wildlife management is invaluable. The importance of captive elephant's wellbeing is well recognized in India. In fact, one of the stated mandates of the Project Elephant – a centrally sponsored scheme created during 1992 to protect elephants and their habitats in India, is captive elephant welfare. Regardless of whether elephants occur in the wild or in captivity, elephants remain integral part of our heritage and conservation legislations including the provisions of the Wildlife (Protection) Act, 1972 extend to both.

Unlike free ranging wild elephants, captive elephants can be vulnerable to host of physical and psychological problems including abnormal behaviors if proper care, and attention are not provided. Poor captive elephant management can result in chronic suffering and reduced lifespan of elephants. Inhumane treatment of elephants is also a moral and ethical concern, and therefore, improving welfare conditions of captive elephants assumes greater importance. Improving welfare conditions of captive elephants and providing humane care is dependent on improving our understanding of the basic biological and psychological needs of elephants. In particular, the elephant handlers, frontline staff of the forest department and the veterinary personnel involved in the captive elephant management would require training on best husbandry practices to improve the standard of welfare conditions for captive elephants.

With this overarching objective, the Project Elephant Division of the MoEF&CC, Government of India along with the Elephant Cell at Wildlife Institute of India has prepared this document that covers various aspects of elephant biology and status, captive care, welfare management, health management, personnel concern and genetic characterization. The document draws expertize from a spectrum of experts from across the country for managing health of captive elephants. I would like to thank all the contributors for providing their valuable inputs.

I am hopeful that the document would be a ready reference for professionals and help in paving the way for improving the standards of captive elephant welfare in the country.

Chandra Prakash Goyal, IFS
Director General of Forest & Special Secretary
MoEF&CC

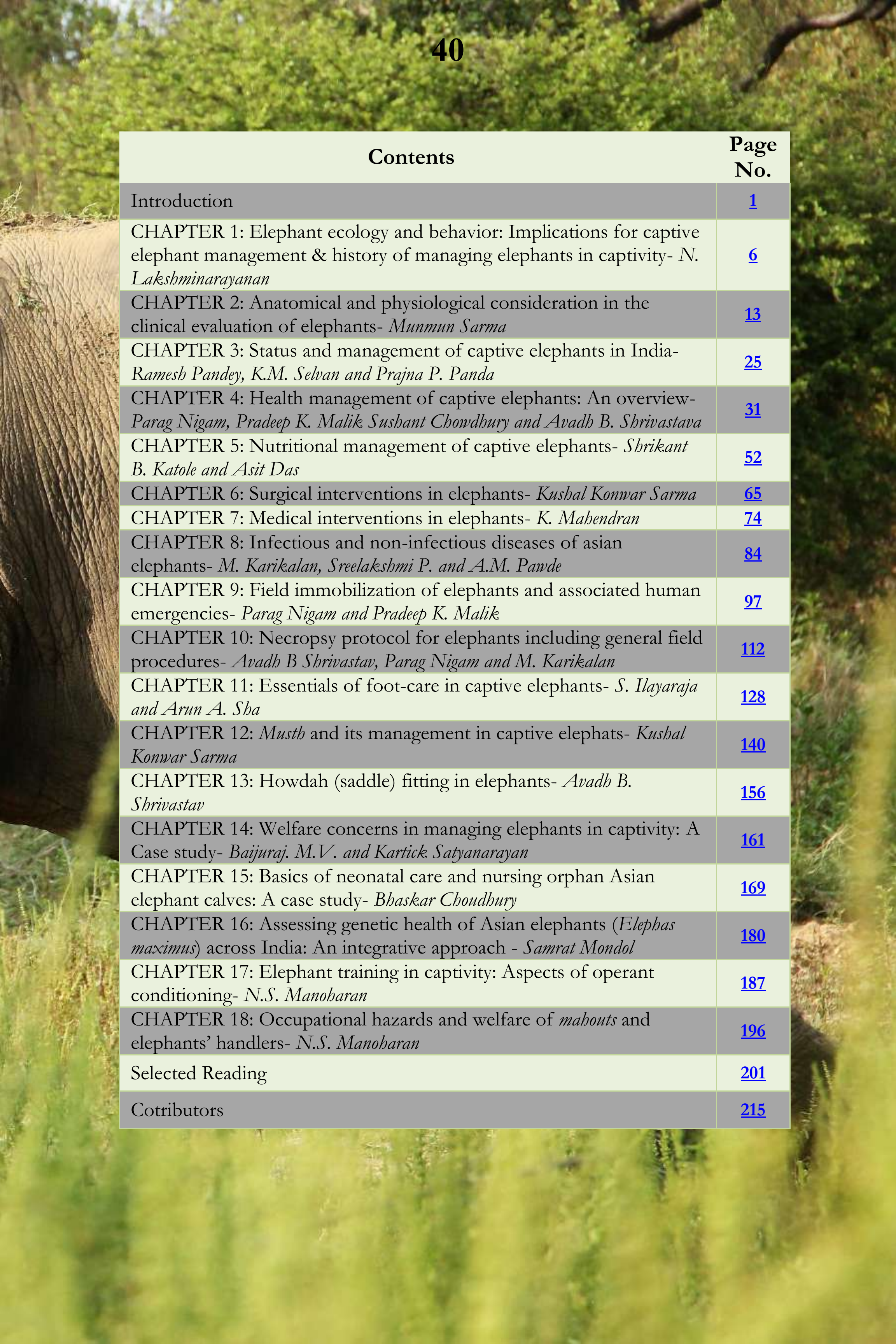
FOREWORD

Although Africa was the cradle of elephant evolution, as cultural mascots and object of deep reverence, the bond between elephants and people in India is unparalleled in terms of association anywhere in the world. The country harbors the largest wild Asian elephant population in the world and also maintains close to 3000 elephants in captivity. Captive elephants are an integral part of wildlife management in India and have become indispensable in patrolling rugged forest terrains and remote mountainous regions, and in assisting in conflict management with wild elephants. Captive elephants serve as important genetic repositories and living laboratories for applied research as they readily accessible for them. A major downside of captive elephant management is the host of welfare concerns including inhumane handling that can be a consequence of inadequate understanding of animal biology and sheer neglect.

Project Elephant of the MoEF&CC has been in the forefront in improving captive elephant welfare conditions, which remains since inception one of its central objectives. Developing veterinary expertise is one of the important means towards improving captive elephant welfare conditions. In India, there are few professionals specifically trained in the nuances of elephant management. Recognizing these lacunae, the Project Elephant Division and the Elephant Cell at the Wildlife Institute of India have been working on a host of activities aimed at improving the technical know-how of field veterinarians in India.

The present compilation documents various aspects of elephant biology, medicine and management and has been contributed by eminent professionals working in the area of elephant conservation and management. I wholeheartedly congratulate the authors for this excellent contribution that elaborates of multitude approaches for managing health and welfare of elephants in captivity. The contents of the document are well illustrated and I am hopeful that the document becomes a ready reference material for the professionals working with elephants in captivity.

Satya Prakash Yadav, IFS
Director
Wildlife Institute of India



Acknowledgements

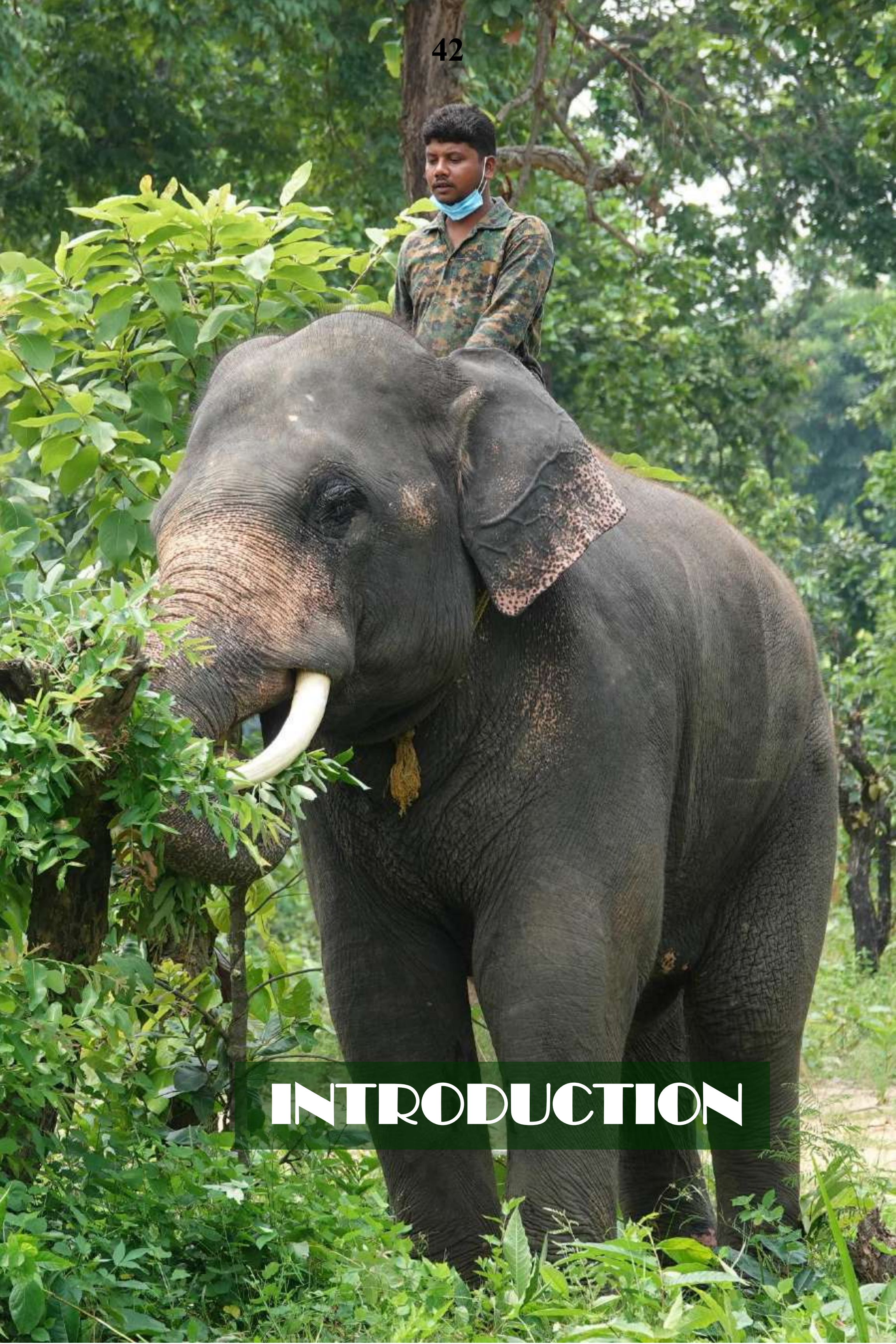
Ministry of Environment, Forest & Climate Change
Sh. Bhupender Yadav, Hon'ble Minister (EF&CC)
Sh. Ashwini Kumar Choubey, Hon'ble MoS (EF&CC)
Ms Leena Nandan, Secretary, (EF&CC)
Sh. Chandra Prakash Goyal, Director General of Forest & Special Secretary, MoEF&CC
Mr. Bivash Ranjan, IFS, Addl. Director General (Wildlife)
Dr. Satya Prakash Yadav, IFS, Addl. Director General (FC) & MS (NTCA)
Dr. Gowri Mallapur, Veterinary Consultant, CZA

Wildlife Insitute of India
Dr. Satya Prakash Yadav, IFS, Director
Dr. Yadvendradev V. Jhala, Dean, Faculty of Wildlife Sciences
Dr. Ruchi Badola, Registrar
Dr. Bitapi C. Sinha, Research Coordinator
Mr. Udhayaraj, A. D., Mr. Ritesh Vishwakarma, Mr. Vijaybabu Nandwanshi

Wildlife S.O.S
Ms. Geeta Sheshmani, Co-Founder and Secretary
Mr. Harendran Pratap, Mr. Shresth Pachouri, Mr. Shivam Rai, Ms. Aarti Singh, Sh. Mradul Pathak, Sh. Sooryodaya S Mann, Ms. Malvika Jayachandran

Special thanks to
Sh. Priya Ranjan Sinha, Dr. Vinod. B. Mathur, Dr. Dhananjai Mohan, Sh. S.S. Bist, Dr. A. J. T. Johnsingh, Dr. Pradeep. K. Mathur, Dr. Pradeep K. Malik, Dr. Sushant Chowdhury, Dr. Surendra P. Goyal, Dr. Syed A. Hussain

All Chapter Contributors



INTRODUCTION

INTRODUCTION

- Parag Nigam, Ramesh Pandey
& Anupam Srivastav

The first elephant like forms called *Erythreum azzourzorum*, evolved in the Palaeocene (65 – 55 MYA) in what is now Africa and the Arabian Peninsula. The area then had a much warmer climate than what we experience today. The species was extremely small as compared to the present-day elephants, weighing between 3 – 8 kg (Mothé & Avilla, 2015). They evolved by a complex speciation process involving dispersal into continents that were then newly formed as a result of tectonic shifts; climate change induced phenotypic and genotypic variations, inter-species hybridizations, and adaptive radiation in newly available niches. Presently, there are three recognized elephant species, two occuring in Africa (*Loxodonta africana* and *Loxodonta cyclotis*) and one in Asia (*Elephas maximus*) with multiple racial variations. Besides these three extant species of elephants, the other species of Proboscideans emerging during the evolutionary process were lost due to cataclysmic events that caused their mass extinctions.

Todays' elephants are the largest terrestrial and an iconic mega-faunal mammal species belonging to the order Proboscidea – these are characterized by a prehensile proboscis or trunk made up of over 150,000 separate muscles with no bone. Their immense size and trunk set them apart from other terrestrial mammals. The trunk, which is formed by the fusion of upper lips and the nose is effectively used by elephants to perform a variety of functions that include olfaction, breathing, touching, grasping etc., which humans and other species would require multiple organs to perform. Elephants are attributed with cultural transmission and learning practices akin to human societies. Both elephants and human beings also share several characteristics such as late maturation of young to adults, extensive parental care with strong bond formation and complex social networks.

Humans and elephants co-evolved and throughout human history, elephants have occupied an important position in most civilizations (Rangarajan *et al.,* 2010). Historical records indicate that they have been tamed and used for a variety of anthropogenic uses ranging from agriculture to weapons of war. The Asiatic elephant (*Elephas maximus*) and its various subspecies in India have been used extensively for the last 5000 – 8000 years since pre-Aryan times (Lahiri-Choudhury, 1995). With the arrival of the Aryans around 1500 BC, literary evidences such as the Rig-Veda suggest of extensive use of elephants for depicting royal grandeur and as weapons of war. The sheer quantities of fodder and manpower required for taming and training the animals restricted their keeping except by a select few primarily the royalty (Lahiri-Choudhury, 1995). This fascination of human societies has continued into present day civilization with the keeping of elephants for work purposes by forest departments (for patrolling and timber operations), by zoos (as exhibits), and until recently by circuses as performing animals. Additionally, they are maintained by temples for participation in ceremonial occasions (Lahiri-Choudhury, 1995).

While much of the exploitative use of elephants had been discontinued owing to welfare concerns, they continue to be housed in a few select zoos, in camps of the state forest departments and at rescue facilities spread across the country. It is essential that such animals housed in captive facilities receive optimum care that best addresses their welfare needs. Currently skills of veterinary professionals engaged in the care and management of the species in several places are limited and do not adequately address the various aspects of elephant health-care. It thus becomes imperative to upgrade the skills of these professionals to enable them to adequately address the assigned responsibilities. As a step in this direction the Project Elephant Division of the Ministry of Environment, Forest & Climate Change (MoEF&CC) and the Elephant Cell at the Wildlife Institute of India (WII) have been proactively engaging with various stakeholders in enhancing their skills. While extensive literature on captive elephant management is available, there is also a long-felt need for ready-reference material that can be used by field veterinarians and captive elephant managers. Further, such reference material needs to be concise, lucid with minimal of scientific jargons, and attractive for the field personnel. Considering this, the Elephant Cell at the WII with support from Project Elephant Division of the MoEF&CC, has come up with a ready reference aimed at documenting the best-practices in health-management for veterinary professionals. The document draws expertize from a spectrum of experts from across the country for managing health of captive elephants. The document includes 18 chapters with details on various aspects of elephant biology and status, captive care, welfare management, health management, personnel concerns and genetic characterization. The salient points of each chapter are summarized below.

The initial three chapters address the natural history and biology of the species, besides describing the status of the species in captivity and the actions initiated by the Project Elephant Division, MoEF&CC. The first chapter provides an overview of the ecology, evolution and natural history of the species with an emphasis on aspects that facilitate their effective management. The chapter also briefly summarizes the history of elephant captive management. The second chapter provides insights into the anatomical details and physiological functions of elephants with a special emphasis on aspects that facilitate captive management. The third chapter provides an overview of the status of captive elephants in the country, the statutory provisions for their ownership and the action being undertaken by the Project Elephant including legal provisions for the acquisition and keeping of elephants in captivity. The fourth chapter addresses various aspects of health management of the species and provides an overview of signs of health and indispositions in elephants. It also provides insights into aspects of statutory provisions for housing elephants in captivity and best practices for keeping captive elephants. This is followed by chapter on nutritional management of captive elephants that deals with various aspects of elephant's digestive system, microbial ecology and fermentation, nutrition characteristics in free ranging, animal's requirement in captivity besides detailed account of nutritional disorders and management. The sixth chapter titled 'Surgical interventions in elephants' discusses restraint procedures during surgical intervention and common conditions necessitating surgical interventions. The author also describes procedures to be adopted for surgical interventions of these conditions. The seventh chapter on 'Medical interventions in elephants' briefly describes essential drugs and dosages for effective management of diseases in Asian elephants.

Since disease control and prevention is an integral part of captive management, the eighth chapter on 'Infectious and non-infectious diseases of Asian elephants' discuss common infectious and parasitic diseases, their aetiology, disease manifestations and diagnostic methods. The ninth chapter on 'Field immobilization of elephants and associated human emergencies' discusses various classes of drugs used for the chemical immobilization of elephants, drug delivery systems, post immobilization emergencies and their management. The chapter also provides detailed information on human drug emergencies and their management.

The tenth chapter in the document titled 'Necropsy protocol for elephants including general field procedures' provides details of necropsy procedures to be adopted in various situations including carcasses of animals suspected to be infected with Anthrax. It lists the essential equipment and supplies required for conducting a detailed post-mortem and personal protection measures to be adopted by the persons carrying out the examination. It provides detailed information on the factors to be examined, samples to be collected and protocols for storage of the same. It also briefly describes the protocols to be adopted for disposal of carcasses after necropsy.

The eleventh chapter on 'Essentials of foot-care in captive Elephants' provides an insight on the effect of flooring substrates, working hours and type of work on the feet of elephants. The chapter also provides a detailed description of procedures to be adopted for undertaking foot-care of captive elephants, a key concern in captive elephant management as elephants are often housed on artificial substrates that can injure or cause abnormalities in their feet. The twelweth chapter titled 'Essentials for managing Bull elephants with special reference to *Musth* management' discusses *Musth* in bull elephants and its seasonality in detail and factors that cause predisposition of elephants to come in *Musth*. The chapter also discusses physical and behavioural manifestations of *Musth* and management of animals manifesting the condition. The thirteenth chapter on 'Howdah (saddle) fitting in elephants' deals with critical concerns for proper howdah fitment and the harnessing tools and support system. The chapter also highlights precautions to be taken while fitting howdah. The fourteenth chapter on 'Welfare concerns in managing elephants in captivity: Case study' briefly describes methods to reduce stereotypies and other abnormal behaviour in captive elephants. A detailed account of housing and nutritional and environmental enrichment based on learnings from managing rescued elephants housed at Elephant Care & Conservation Centre, Mathura is provided.

The fifteenth chapters on 'Basics of neonatal care and nursing orphan asian elephant calves: Case study' discusses challenges faced by professionals in managing orphaned and neonates in captivity. Detailed account of nursing essentials for orphaned elephant calves, milk formulations and feeding regimen, husbandry and disease threats are discussed at length. The sixteenth chapter on 'Assessing genetic health of asian elephants (*Elephas maximus*) across india: An integrative approach' present the current research that has been taken up by the MoEF&CC and the Elephant cell of the Wildlife Institute of India to understand the genetic makeup of the elephant populations (both wild as well as captive) across India.

The seventeenth chapter in the present volume includes information on training of elephants in captivity taking due account of the operant conditioning. The last chapter provides an understanding of role of mahouts in managing elephants in captivity and additionally gives an account on their welfare and associated occupational hazards.

CHAPTER I

ELEPHANT ECOLOGY AND BEHAVIOR: IMPLICATIONS FOR CAPTIVE ELEPHANT MANAGEMENT

- *N. Lakshminarayanan*

Introduction

Elephants have been integral to Asian culture for several thousand years (Rangarajan *et al.,* 2010). In India, elephants are associated with cultural heritage, myths and history for thousands of years. Importance of the functional role of elephants in the tropical forest ecology is well documented. Equally well recognized are the host of ecosystem services that elephant habitats provide to mankind, which assumes greater importance particularly in the face of climate change. India is undoubtedly the global leader in Asian elephant conservation as the country holds the largest wild elephant population and has strong legislations to protect elephants and their habitats. In addition to wild elephants, India also has close to 2800 captive elephants.

In elephant conservation, captive elephant management has often remained a sore spot owing to host of welfare concerns including the physical and physiological challenges that elephants face, primarily owing to lack of due regard of their biological and social requirements. Captive elephants can be a great source of learning about their counterparts in wild with direct implications in the field management and, vice-versa. Therefore, furthering the understanding of ecology of elephants in the wild will be invaluable in improving husbandry practices by adequately recognizing the behavioral and emotional complexities of elephants, which are often disregarded in captivity resulting in life-long pain, suffering and emotional breakdown of elephants. The severity of problems facing captive elephants includes a host of medical issues, low fertility, reduced reproductive span, hyper-aggression, intermittent *musth* in bulls, stereotypic and other behavioral syndromes rarely seen in wild elephants. Given this, The chapter is an attempt to provide basic insights on elephant evolution, ecology, and behavior in the wild so that restitutions, as appropriate, can be made in captive elephant management.

Evolution

Fossil evidences show that prehistoric forms of elephants (of the Order Proboscidea) first evolved over 60 million years ago in sub-Saharan Africa as relatively small creatures (Shoshani and Tassy, 1996). Overtime, they evolved large body size and long-distance movement that helped them in colonizing all the continents in the world with an exception of Australia and Antarctica (Sukumar, 2003). There are three extant species of elephants that include, Asian elephants (*Elephas maximus*), African bush elephants (*Loxodonta africana*) and African forest elephants (*Loxodonta cyclotis*) all belonging to the family Elephantidae of the Order Proboscidea. Elephant colonization of Europe and Asia from Africa occurred primarily during the Pleistocene epoch (26 million years to 12000 years ago), which was characterized by repeated glaciation events. Pre-historic elephants must have used the frozen sea as land bridges during one of the interglacial periods to immigrate into Asia. After arriving into Asia, elephants further evolved and colonized most of the continent spanning from the river basins of Tigris and Euphrates in the west (present day Iraq, Iran and Kuwait) to eastern end of China, near the mouth of River Yangtze (Sukumar, 2003).

The closest relatives of elephants are the group of extinct marine herbivorous mammals of category Tethytheria, Sirenia (sea-cows) and hyraxes of the order Hyracoidea (Gaeth *et al.,* 1999). The recent aquatic ancestry of elephants is further exemplified by their renal, reproductive and respiratory systems. Elephants have intra-abdominal testes, lack pleural cavity with lungs being directly attached to ribs and presence of nephrostome – a funnel shaped duct in the kidneys of extant elephant embryos (Shoshani and Tassy, 1996; Gaeth *et al.,* 1999). All of the aforementioned features are typical of aquatic mammals. Thus, the primary consideration for housing elephants would be ample water availability for consumption as well as soaking, wallowing, and bathing. Further to this, convection is one of the main means of heat dissipation in elephants, and thus ensuring walking and bathing behavior in the captivity would be crucial.

Ecology of elephants

Social organization: Elephants exhibit high levels of sexual dimorphism with the elephant bulls being much larger than the adult cows. The life history strategies of male and female elephants may differ significantly (Desai and Johnsingh, 1995). Female herds live in a complex social organization characterized by fission and fusion of groups. Generally, elephant society is multi-tiered comprising of basic family units (mother and its offspring), bond-groups (joint families), and clans (extended family units) forming populations. Evidence shows that clans do not easily intermingle (Desai and Baskaran, 1996). Males usually disperse from natal groups upon attaining puberty (>10 years). Such dispersing males can associate with other males forming all-male groups and eventually establish their home ranges as adult bulls. Female offspring are usually philopatric, occurring with the family units in the natal areas (Moss, 2012). Females learn the art of raising calves at a very young age. Calf's wellbeing is wholly dependent on the experience of mothers and aunts in the family (Moss, 2012). Thus, the social relationship of elephants can be complex and individuals continuously interact with several members of the species across the population on a regular basis. An elephant in captivity lacks this social interaction with potential long-term consequences on psychological and emotional wellbeing. Thus, maintaining some level of social interactions in the captivity among elephants is crucial.

Foraging strategy: A large body size in combination with behavioral and physiological adaptations enable elephants to occur in a wide variety of tropical and sub-tropical habitats. Elephants attain high densities in the ecotone mosaics comprising of multi-stratal grasslands, woody plants, and forests with reasonably good level of protection. They grow almost throughout their lives. Elephants are bulk feeders and do not possess foregut fermentation chambers. Instead, elephants use their large intestines and the caecum to ferment food for obtaining energy. Elephants have evolved 'time-maximizing' foraging strategy that entails high throughput rate. This means, they can process large quantities of food in a short duration of time regardless of the forage quality. In the wild, elephants may feed at any time. However, their feeding patterns in the wild tend to be bimodal, with two major feeding peaks occurring during the relatively cool hours of the day. Elephants consume about 4% of their body weight as (wet) forage every day (Sukumar, 1990). Adult elephants may consume over 100 liters of water every day. In addition to surface water, pre-formed water (in plants) would also be crucial for elephants. In the wild elephants consume a wide variety of plant material from hundreds of species depending on their habitat. Thus, in natural habitats, wild elephants actively engage in locating the right food involving sensory and visual cues. Their organs, in particular the trunk is intensively used in obtaining food from different heights deploying both force and tenderness in equal measure. Captive elephants miss this kind of versatile foraging behavior and thus, wherever possible, elephants should be allowed to feed naturally.

Home range: Elephants have evolved long-distance movement. Home range is the area traversed by animal while doing its normal course of activities like foraging, avoiding predation, seeking mates and raising offspring. Elephant home ranges in Asia are generally large, but highly variable as well. Home ranges spanning 100 km² to 3000 km² have been recorded across the elephant range in Asia (Sukumar, 2003; Williams, 2005; Nigam *et al.,* 2021). Generally, if habitat conditions are good with high productivity and less fragmentation, elephant home ranges tend to be relatively small. On an average, elephants cover about 3 – 5 kilometers everyday as observed in elephants' satellite collared by WII in Chhattisgarh and Uttarakhand. However, they may cover large distances of up to 20 to 30 kilometers in day, if need be. The forested habitats of wild elephants are rugged with terrain complexity and heterogeneous substrates. Elephants have evolved for walking in such conditions. Thus, in captivity walking elephants in semi-natural conditions for at least a few kilometers everyday would be crucial for their psychological wellbeing.

Activity patterns in the wild: In the wild, elephants are never still except when sleeping. Evidence shows that elephants sleep for about 3 to 4 hours every day. While sleeping elephants tend to lie down completely, in laterally recumbent positions. They may also rest while standing. Elephants continuously explore their habitats using a range of sensory, auditory and visual cues scanning for food, looking for mates, and avoiding dangers. In the wild, elephants spend over 50% of time feeding (usually interacting with others and feeding), 15% of the time in moving, 15% of the time in resting and over 20% of the time in simply interacting with each other. Elephants in captivity may immensely benefit if the aforementioned time-activity budgets are considered and suitably emulated. Further to this, in the wild conditions, particularly in habitats that have minimal levels of human disturbance, elephants of all age groups engage in elaborate play and friendly spars. Although the frequency of play is comparatively higher in young elephants, even older elephants of both the sexes play throughout their lives. In the captive conditions, elephants often do not get the opportunity to play.

Elephant communication patterns: Elephants have evolved elaborate means of visual, tactile, auditory, and chemical forms of communication. Visual communication in elephants involves a variety of displays and gestures. Tactile communication in elephants involving use of trunk and other body parts is elaborate. Elephants have both high and low frequency auditory communication, with the low frequencies of 14 – 40 hertz and 100 decibels of pressure that travel farther in noise-free environments (Payne *et al.,* 1986; Poole *et al.,* 1988). Elephants have also evolved elaborate means of chemical communication and have a vomero-nasal organ (or the Jacobson's organ) located above the upper palate serving as chemical signal processor (Sukumar, 2003). There is also evidence of seismic communication in African elephants (O'Connell-Rodwell, 2007). The trunk tip of elephants is endowed with free-ending nerves along with the fatty cushion in their sole that can pick up delicate vibrations coming through the ground. Elephants have evolved in relatively noise-free natural environments. In captivity, continuous exposure to machinery, noisy crowd and vehicular traffic can all be devastating for emotional and psychological wellbeing of elephants. Therefore, maintaining a relatively noise-free environment is a crucial aspect of captive elephant welfare.

Demography: Female elephants start reproducing when they are about 15 years' age and continue to reproduce till they get into their 60s (Moss, 2001, 2012). The adult females that are not lactating and pregnant, may get into oestrous cycle once in 100 days for a short duration of 3 – 4 days. Synchrony in oestrous has been reported in elephants. This synchrony in oestrous could result in simultaneous pregnancy among receptive females. In a growing elephant population, more than 30 to 40% of elephants would be adult cows. In good habitat conditions, the inter-calf intervals could be about 4.5 years. The gestation period of elephants is about 22 months. The litter size is usually 1 and rarely birth of twins has been reported. Stable, large populations can grow at 2 to 3% per annum. The life expectancy of elephants in the wild can be 60 to 65 years, which is reportedly less for males. The adult wild elephants are immune to mammalian predators with an exception of human beings. However, one of the main sources of population regulation in elephants is that of the effect caused by parasites and and pathogens.

Distribution of wild elephants in India

Wild elephants are distributed across four major regions in India that include the northwest (along the Himalayan foothills and parts of Terai region in the states of Uttarakhand, Uttar Pradesh and parts of Bihar), northeast (almost all the northeastern states including the northern West Bengal), east-central (in the Peninsular Indian states of Odisha, Jharkhand, Chhattisgarh, south West Bengal and lately into Madhya Pradesh) and southern (in the Western Ghats and Eastern Ghats mountain ranges of Tamil Nadu, Karnataka, Kerala with splinter populations in southern Andhra Pradesh and southern Maharashtra) (Bist, 2006). The overall distributional range of elephants in India is about 1,25,000 km2 with an estimated 30,000 elephants (Project Elephant Division, 2020).

Human–elephant conflict in India

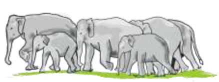
Human–elephant conflict involves a two-way interaction between elephants and people with potential negative consequences. As human–conflict can pose a serious threat to local livelihood, which in turn can erode support for elephant conservation, minimizing human–elephant conflict is crucial. In India, human–elephant conflict seems to be increasing. Every year, close to 500 human and over 100 elephant lives are getting lost due to human–elephant conflict (Rangarajan *et al.,* 2010). Further to direct loss of elephant lives due to human–elephant conflict, elephants are also being removed from the wild and brought into captivity when conflict situations worsen. Many such elephants remain in captivity throughout their lives.

Elephants in captivity

Unlike the African elephants, Asian elephants have a long history of being in captivity. History of taming wild caught Asian elephants dates back to over 4000 years and originated in the Indus valley civilization (Sukumar, 2003). In India, using numerous methods wild elephants have been captured for extensive use in the armies. In modern times, captive elephants are used in forestry and wildlife operations, conflict management, and religious and recreational purposes like tourism and exhibits. Stracey (1963) elaborated on use of different elephant capture methods. An emperor from Mauryan dynasty, Chandragupta reportedly had over 9000 elephants in his army. Most of the elephants in this were wild caught. Large-scale capture and concomitant loss of habitat were major reasons for population crash and range decline of elephants in India.

Conclusion

Conditions in captivity may fall short of the behavioral and social requirements of a highly intelligent species like elephants. However, improving the welfare conditions based on better understanding of elephant ecology and behavior would certainly help in ameliorating the concerns.



CHAPTER II

ANATOMICAL AND PHYSIOLOGICAL CONSIDERATIONS IN THE CLINICAL EVALUATION OF ELEPHANTS

- *Munmun Sarma*

Introduction

The subject of anatomy is the backbone of the veterinary curriculum. Veterinary anatomy is the mother of all the subjects of veterinary medicine and animal production and it helps to understand the actual mechanism of the cause of disease, deformity and the methods or techniques of correction of the deformities. Therefore, anatomy can be defined as the branch of biological science that deals with the study of form and structure of living organisms; and physiology is the branch of biological science that deals with the study of normal functions of living organisms and their parts.

The entire body of the elephant is divided into five parts or regions namely the head, neck, trunk or body, tail and appendages (thoracic limb and pelvic limb). Each region is again subdivided for proper anatomical descriptions of sites in respect to fracture, or injection or description of any lesion etc. Raghavan (1964) stated that anatomy unfolds the knowledge of hidden tissues and structures, very essential for correct diagnosis of ailments of animals and aids the physician and surgeon in their quest to locate the seat of injury or disease.

Elephant practice does not necessarily mean that one shall go directly to the animal and treat it. Rather, it is a holistic approach by taking into account its social structure and behavior, its mental and social factors, its senses, physical symptoms of the disease etc. Therefore, thorough knowledge on the different body systems is essential to diagnose a disease and render necessary treatment. Veterinary Gross Anatomy is the branch which deals with the scientific description of all the organs of the different body systems of the principal domesticated animals and the birds. The same now is not only restricted to the domesticated animals but has extended even to the wild animals.

Description

The locomotor system: It includes all those organs that provide the body with stability, which permits independent movement and at the same time, provide the basis for the characteristic conformation of individual species (Nickel *et al.,* 1986). It has got two divisions namely passive locomotor system or skeletal system and active locomotor system or muscular system. Passive locomotor system is composed of bony framework of the body which has a considerable weight bearing capacity. The bones are reinforced by cartilage and connective tissue elements of no lesser importance. Provisions for movement are made by means of joints. In addition, the skeletal system surrounds cavities, thereby affording the viscera protection from traumatic injury. Active locomotor system performs the various movements of the individual body parts such as limbs, the trunk and the head, and it provides the individual with the means for locomotion. The system is comprised of a large number of muscle fibers which are anchored together by connective tissue. Connective tissue is also the constituent material of muscle tendons, which are attached to the bones.

The orientation of the limb bones is almost vertical without angulations; the heads of the long bones are facing upward or dorsal. This is because these limb bones have to support the enormous body weight of the animal. Because of such anatomical arrangement of limb bones in elephants, they are unable to trot, canter, gallop or even cross a seven-foot trench. The only movement they can do is to walk forward or backward in a great speed. Elephants have a digitigrade forefoot structure and therefore the weight bearing is on the digit. The hind foot is semiplantigrade; weight bearing is on the digits and partially on the plantar surface of the pes. The number of nails in Asian elephants are restricted to generally five on the front foot and four on the hind foot, but this number varies sometimes being four on the front foot and three on the hind foot. Hence both the skeletal and muscular systems are responsible for the locomotion or movement of elephants. Movement of animals is of two types- muscular and non-muscular (where part of the body is moved).

The total number of bones found in elephant are 228 (unossified elements are not counted) Kalita and Sarma (2003)
Nos. of bones in the forelimb = 50; Nos. of bones in the hind limb = 40
Vertebral formulae = C_7, $T_{19\text{-}20}$, L_4, S_4, $Cy_{28\text{-}30}$

The trunk of the elephant is the prolongation of the upper lip and nose composed of soft tissue. With the extensive musculature of over 1,00,000 muscles arranged longitudinally, radiating and transverse (Shoshani, 1994) it can move the trunk in different directions. The trunk has got a prehensile tip (called finger) in Asian elephants and two in the African elephants for extreme delicate manipulations like transfer of food and water to the mouth, pick up small objects when required, touch the temporal gland or urogenital region of the opposite sex etc. It is highly sensitive to tactile stimuli.

The digestive system: The digestive system of elephant is more or less similar to that of horse and consist of following

- Mouth and pharynx
- Alimentary canal –Esophagus, stomach, small intestine (duodenum, jejunum and ileum, large intestine (caecum, colon and rectum), anus
- Associated glands - Major salivary glands, minor salivary glands, liver and pancreas

They are hind gut fermenters (Dumonceaux, 2006). The stomach is simple with expansible folds in the mucosa of the cardiac region of the stomach and a thick cardiac sphincter. Although partial digestion of the ingested food takes place in the stomach it acts as a storage organ. Seventy per cent of digestion occurs in the huge sacculated caecum and proximal colon due to presence of anaerobic microbial and fungal population with fermentative capacity for the breakdown of plant cell wall carbohydrates, simple sugars, starches and proteins. These digested materials are absorbed through the relatively thin and highly vascularized mucosa of the caecum. As clinicians, the digestive capacity of the animal can be confirmed by seeing the dung samples. If grains are fed to the animal and if dung of the same animal contains undigested grains, the condition of the cheek tooth or teeth (premolars and molars together can be called as cheek teeth) may require examination. At a given time, there are only four molars in use in the mouth of an elephant. These 4 molars in use in the mouth of an elephant form a set of molars. There are such six sets of teeth during the whole life span of an elephant. Each molar in elephants is a combined massive structure of particular number of laminae that are cemented together. By counting the laminae one can know which set of molars is in use and also the age of the animal.

Table 2.1: Age estimation in Asian elephants based on molars eruption and replacement

Molar set	No. of laminae	Eruption	Replacement
1	4	4 months	2 – 2 1/2 years
2	8	6 months	6 years
3	12	3 years	9 years
4	12 (wide)	6 years	25 years
5	16	20 years	50 – 60 years
6	24	40 years	60+ years

In case of aged elephants' molars may be worn out making it difficult to chew. This would require necessary modification in feeding strategies and constituents with provisioning of crushed grains/ soaked in water prior feeding including access to soft and juicy fodder/ chopped fodder for easy digestion.

The respiratory system: It consists of following trunk and nasopharynx; pharynx, larynx and trachea and lungs. Respiratory system of elephant consists of unique anatomical features-

- Typical pleural sac of other mammals is absent. The visceral layer and parietal layers of the pleura is occupied by a pleural sac connective tissue. It is a 3-dimensional fibrous network with fluid filled pockets allowing movement and sliding of visceral pleura during breathing.
- Respiratory rate is 4-6 per minute in standing and 3-8 per minute in sleeping.

The cardiovascular system: It consists of heart, arteries, capillaries and veins. Anatomical consideration of the heart of elephant in relation to its peculiarity is mentioned hereunder –

- Bifid apex due to development of both right and left ventricles, single in neonate formed by left ventricle (Sarma *et al.,* 2009)
- It weighs 0.5% of the body weight (Bartlett, 2006)
- Moderator band or septomarginalis absent
- Right and left coronary vessels originate from a single common branch from the aortic arch
- Presence of paired cranial *venae cavae* and single caudal vena cava

Preferred sites for phlebotomy

- Auricular vein (most preferred site)
- Cephalic vein (proximal part of foreleg)
- Internal sephanous vein (medial aspect of leg)
- Vena caudalis centralis (ventral to 14th caudal vertebra where caudal fold of skin ends)

Sites for recording pulse are-

- Auricular artery (preferred site)
- Caudal vertebral artery (ventral aspect of the tail)

Some of the important clinical features of elephants are-

- Heart rate = 25-50 beats per minute, standing
- Mean arterial pressure = 144.6 ± 2.9 mm Hg (manometer)
- Systolic pressure = 178.6 ± 2.9 mm Hg
- Diastolic pressure = 118.7 ± 3.1 mm Hg
- Total blood Volume = 3.5% of body weight (Adult Asian elephant)

The female reproductive system: It consists of the following organs namely paired oviducts, paired ovaries, uterus, vagina, vestibule or urogenital canal, vulva and clitoris. The ovaries of Asian elephants are situated in the abdominal cavity cranial to the pelvic inlet, ventral to the iliac crest and caudal to the caudal extremity of the kidneys. Each ovary is 2.5 cm long and 1.8 cm wide. The hilus is in the middle of the cranial border. At the hilus the ovary is lobulated showing 6-8 round eminences. The paired oviduct of Asian elephants a tortuous tube consisting of infundibulum, isthmus and ampulla. The uterus of the elephants is the important compartment of the female genitalia and consist of 3 part including two uterine horns, body and cervix. In adults, the length of body of the uterus and uterine horn is 100 cm and 280-300 cm respectively (Shoshani *et al.,* 1982). The vagina is a canal lined by mucous membrane. It is about 30-40 cm long. Clitoris is regarded as rudimentary penis and is prominent which consists of root, body and gland. Its measured about 30-40 cm long. The vulvae are not situated near the anus as in other animals. It is completely hidden from rear view being placed between the thighs below the pelvic symphysis. In the adults, the circumference of labia major is 81 cm (Shoshani *et al.,* 1982).

The mammary gland or udder consists of two glands. In young animals, it is small and only during the later period of gestation it becomes considerably enlarged. The milk of elephant is said to be very rich with an agreeable taste and odor, its fat and sugar being largely increased at the expense of water as compared to other milk. Wallach and Boever (1983) reported that milk is present in the mammary glands one month before delivery.

The temporal glands are paired organs located in the temporal fossa on either side of the head of Asian elephants in between the lateral canthus and the opening of the external ear. The glands are roughly ovoid in shape and measures 10.5 cm and 5.5 cm respectively in length. Histological sections revealed that the glands were covered with thick fibrous capsules consisting of mostly collagen fibers from which trabeculae extended into the parenchyma of the gland dividing it into a number of lobes and lobules. The alveoli of the *musth* bull showed that it was lined by tall cuboidal and columnar cells having distinct vesicular nuclei placed centrally. In the post *musth* bull, the lining epithelium of the alveoli was cuboidal cells (Sarma *et al.,* 2007).

Brief account of reproductive behavior or courtship

It includes contact promoting behavior by which the female elephant investigates the temporal glands of male and the males in return investigate the urogenital areas of the female. In pre-copulatory reproductive behaviour, the elephant manifests trunk wrestling, reaching over the back (by the male), neck biting and attempted mounts (Eisenberg *et al.,* 1971). Copulatory readiness of the receptive females is shown by cooperating with the serving bull by being stationary during mount and intromission is achieved through independent movement of the penis. In Asian elephant's intromission lasts for 8 seconds and the total duration of the mount is 30 seconds (Eisenberg *et al.,* 1971). In African elephants, duration of the mount is approximately 45 seconds (Moss, 1983).

Important points to be remembered

1. Age of maturity of elephant heifers: 10 to 12 years
2. Length of gestation period : 20 to 22 months
3. Length of estrous cycle : 15 weeks (Jainudeen *et al.,* 1971)

The male genital system: The system consists of paired testicles (intra-abdominal), epididymis (not adhered to the testes), vas deferens and penis. Accessory sex glands in the males include seminal vesicles, prostate and the bulbourethral glands. The testicle are two glandular bodies, globular in shape and light brownish colour and suspended freely in the abdomen and situated below the posterior extremity of kidney. In adult the left testis weighs about 1.8 kg while the right weighs about 2.2 kg and measures 7.5 cm long, 15 cm wide and 11.5 cm thick. The epididymis lies laterally between the testes and kidney. There is a hilus on the dorsomedial surface in which the spermatic artery and nerve enters; the spermatic vein exits from the hilus. The *ductus deferens* runs parallel to and on the medial side of the ureter. At the caudal end near the bladder the ductus deferens crosses ventral to the ureter and forms a highly coiled vascular spongy mass. The caudal 20 cm of ductus deferens are straight having a width of 6 mm and 2 mm wide lumen. Then they become dilated and forming the ampulae 17 cm long, 4 cm wide and lie between the bladder and seminal vesicle. The fusiform seminal vesicle is 22.5 cm long and 7.5 cm wide (Kalita and Sarma, 2003) lie ventral to the caudal end of ductus deferens and dorsal to the bladder and ampulae. Each gland is surrounded by a thick muscular coat. The secretion is high in fructose (Short *et al.,* 1967). The prostate gland lies along the dorsal wall of the urethra just caudal to the seminal vesicles. The different biometrical values are of length 4 cm, width 5 cm and height 2.5 cm. It is situated on the pelvic part of the urethra with its hilus pointing towards the bladder and its pore directed laterally with two distinct lobes. A pair of bulbourethral gland oval in shape measuring 12.5 cm long, 6.5 cm wide and 10 cm high lie caudal to the bulbous urethra and dorsal to the crura of penis. The penis is 150 cm long with a pendulous part 50 cm in length covered by white skin mottled with grey patches. The glans is conspicuous. The external urethral orifice is ellipsoidal and not 'Y' shaped as reported earlier. The structure of the penis is similar to other mammals (Kalita and Sarma, 2003).

Characteristic anatomical record

1. Elephant testes are unique because as there is no pampiniform plexus for cooling the testes below body temperature (34-36º C)
2. The penis is like that of horse but small considering its huge body size
3. Male elephant attains puberty at 14-20 years.

Adult male elephants periodically enter a state of *musth*, it is physiological condition which is characterized by aggressive behavior, restlessness, dribbling of urine from the prepuce, and temporal gland secretions (temporin); flowing out of the temporal gland and flowing down the cheeks. They consist of volatile compounds emitting a strong smell. It has been reported that temporin consists of a compound called 2-nonanone. Blood sampling and hormone assay of male elephant in *musth* showed enormous rise in androgen level, the blood testosterone level increase from 0.2-1.4/ ml (non-*musth* phase) to 29.6-64.4 ng/ ml during full *musth* phase (Jainudeen *et al.,* 1971).

The urinary system: The system consists of kidneys, ureters, urinary bladder and urethra. The kidneys are oval in shape and divided into lobes, each lobe had cortex peripherally and a medulla directed towards the centre. The cortex is studded with Malphigian corpuscles. In Asian elephant renal pyramids end in papillae which are surrounded by minor calices which in turn unite to form the major calices. The renal artery and vein enter the kidney at the hilus. The ureter leaves the kidney from the hilus and travel caudally to the urinary bladder; they are round and held in the peritoneal fold (Mariappa, 1986). Ureters open on the dorsal surface of the urinary bladder by a semilunar slit like opening. Schulte (1937) reported that the ureters in male cross the ductus deferens close to the urinary bladder, and in the female (Paterson, 1898) stated that the ureters originate opposite the ovaries near the base of the broad ligament and pass on either side of the rectum and uterus. The urinary bladder is covered partly by the peritoneum and lined by transitional epithelium. The volume of the bladder ranges from 6-18 liters (Mikota *et al.,* 1994). Urethra is short and terminates in between vagina and vestibule in the females. In the males the urethra is long and approximates 100 cm in length and extends from the neck of the urinary bladder to the glans penis.

Table 2.2: Parameters of elephant urine

Parameters	Values
Average urine excreted	50 liters
Urine void (at a time)	5-11 liters
Normal color	Amber to straw color and clear, slightly acidic and no unpleasant odour
Specific gravity	1.002 - 1.030
Normal pH	6.8-8.0
Elephants urinate	10 to 14 times a day

The nervous system

1. Central nervous system (Brain – cerebrum, cerebellum and brain stem; spinal cord)
2. Peripheral nervous system in Asian elephants (Cranial nerves-12 pairs; spinal nerves-40 pairs)
3. Autonomic nervous system, (Sympathetic system and parasympathetic system)

Elephants are considered to be intelligent animals because of the anatomy of their brain and ability to learn (Mikota *et al.,* 1994). Nervous system of elephant's controls both voluntary and involuntary functions.

- Brachial plexus = $C_{6\text{-}8}$ and T_1
- Lumbosacral plexus = T_{19}, $L_{1\text{-}4}$ and S_1

The organ of sight: The eyeballs and its accessory parts consists of ocular sheath, ocular muscles, eyelids and conjunctiva (lacrimal apparatus – absent). The eyeball is placed in the orbit and surrounded by muscles and fat that is protected rostral by the eyelids and conjunctiva. The eyeball is composed of 3 coats or tunics and three humors or the refractive media. The three tunics include the fibrous layer (cornea and sclera), vascular layer (choroid, ciliary body and iris) and nervous layer (retina). The three refractive media are aqueous humor, vitreous humor and crystalline lens Although it has been a general belief that elephants have least developed eyesight since their eyes are comparatively much smaller, the actual situation is different. Since the eyes in the elephants are placed lateral to the skull, the temporal vision is remarkably wider (123 degree) and is comparable to the other herbivores like horses (146 degree). However, the binocular vision (nasal field) is only 67 degrees for which the elephants have a deficiency in the perception of distance from the larger visual field except the front, baring a small triangular blind area in front of the head. The rear blind area is 47 degrees (Fowler and Mikota, 2006). Therefore, a surgeon or a clinician must be very careful while taking position for darting to avoid the vision of the animal. Anatomical peculiarities:

1. Lacrimal apparatus absent (Harderian gland lubricates the eye)
2. Retractor oculi muscle not well developed
3. Vision – both uni-ocular and binocular

The Organ of hearing: Elephants have an acute sense of hearing and the ears provide four major functions including acoustics, balance, thermoregulation and information transfer. Heffner and Heffner (1980) reported that elephant's audiogram differs from those of other mammals in two major ways. First, the elephant cannot hear above 10.5 kHz at an intensity level of 60 db, and second, the elephant is able to hear best at 1000 Hz; their auditory threshold at this frequency is 8 db. The pinna is used for sound location. It is believed that elephants have poor thermoregulatory system; therefore, the pinna plays an important role in heat dissipation by flapping the ears. Sweat glands though sparse in the skin play an important role in thermoregulatory mechanism. The high degree of vascularity, high surface to volume ratio, thin epidermis and stratum corneum (the most superficial layer of the epidermis) of the ear makes the skin an important organ of thermoregulation. The anatomy of epidermis and dermis, allows significant water loss by evaporative cooling from the skin. Lillywhite and Stein, 1987 reported that sculptures skin surface absorbs water and facilitates the movement of water over the skin's surface. The clinician can ascertain the age of the animal by the degree of folding of the edge of the ear (Evans, 1910). For intravenous administration of drug, the most preferred site is ear vein.

The taste or gustatory sense is well developed in elephants with the presence of numerous taste buds in the circumvallate and fungiform papillae. Mayer's organ present on the caudo-lateral aspect of the tongue consists of numerous fungiform papillae that contain numerous taste buds.

Olfaction and other types of chemo-communications are widely used by elephants. In both Asian and African elephants, chemosensory systems are located in the ethmoturbinates and nasoturbinate bones which are convoluted and lined by an epithelium rich in olfactory receptor cells for detection of different aroma. Elephants also possess a second chemosensory system, the vomero-nasal organ that can detect less volatile, more liquid substance, and substance of more persistence in nature. This organ is also involved in male female interaction. Matured male elephants can readily determine the reproductive status of a cow through 'Flehmen's response' or 'urine test' from the cow's urine. Female Asian elephants can differentiate the temporal secretion of a *musth* bull. Rasmussen and Schmidt (1993) reported that individual elephants can respond differentially to the urine of their mothers even after years of separation. This is all because of the well-developed vomero-nasal organs of the elephants. The pheromones in the urine and cervical mucus are spread in the air by the cow by constantly twitching the tail, which is picked up by the sensitive vomero-nasal organ in the male that remains smartly programmed to detect that particular odour during *musth*. Knowing that the elephant possesses a sensitive vomero-nasal organ, one has to avoid applying cosmetics during risky jobs like tranquilization of *musth* bulls.

Touch or tactile communication in elephants is well developed and the sense of touch is mediated by nerve endings and specialized cutaneous receptors. The nerve endings are located in the deep layers of the skin (specially the skin of the trunk) mediate the sensation of pain, cold, heat and touch which make the skin the largest sense organ in elephants. Elephant touches with the help of the trunk tip (presence of one finger in the trunk of Asian elephants and two in case of African elephants) as can be seen in case of the calves frequently touching the mother's nipples, sometime one elephant pats the body of another with the trunk tip or places the trunk tip to the mouth, ear, ano-genital region or temporal region (Eisenberg *et al.,* 1971). The trunk-tip-to-mouth behavior is described as a "greeting ceremony" in African elephants (Douglas-Hamilton, 1972). During courtship one observes that elephants wind their trunks. Therefore, trunk is the primary appendage for actively investigating the environment.

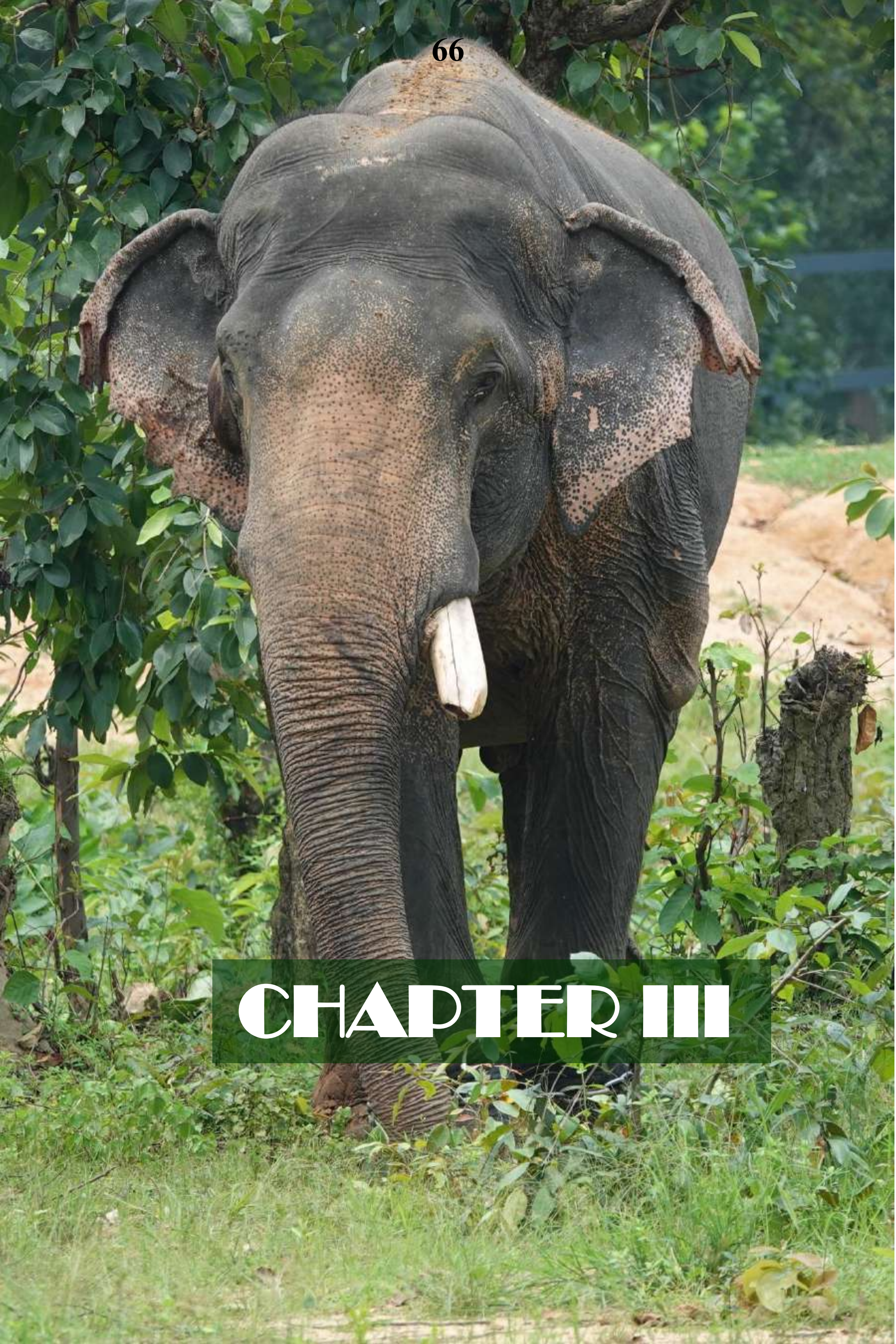
From a practitioner's point of view, one needs to be careful while approaching animal and anatomical peculiarities should form basis while attempting any intervention.

(Photo by: Dr. Jose John Chungath)

Plate 2.1: Elephant skeleton at Mannuthy Veterinary College

Photo by: Parag Nigam[1] & Dr. Jose John Chungath[2]

Plate 2.2: (1) Molars in elephants & (2) Lamellar plates of molars
Dental formula: 2 (Incisors 1/0, Canine 0/0, Premolar 3/3 and Molar 3/3) = 26



CHAPTER III

STATUS AND MANAGEMENT OF CAPTIVE ELEPHANTS IN INDIA

- *Ramesh Kumar Pandey, K. Muthamizh Selvan & Prajna Paramita Panda*

Introduction

The Asian elephant (*Elephas maximus)* listed as 'endangered' by the IUCN (International Union for Conservation of Nature Red List-2008), presently exists as fragmented populations in southern and south-eastern Asia. Currently, Asia has about 45,000 elephants in the wild and over 15,000 captive elephants distributed across 13 Asian countries. *Elephas maximus* is placed in Schedule I and Part I of Indian Wildlife Protection Act (1972) conferring it the highest level of protection. India holds by far the largest number of wild Asian elephants, estimated at about 30,000 nearly 60% of the population of the species and the third highest population of captive elephants with nearly 2,800 captive elephants, 20% of the global populations of elephants in captivity.

History of captive elephants

Captive elephants have an important place in the history, religion and culture of many countries, especially in Asia. In prehistoric times, elephants were used by humans as a source of meat and fur. The capture and taming of elephants began in the Indus valley civilization more than 4,000 years ago (2000 BCE) and peaked during the Mauryan times. Sculpture and paintings from centuries ago stand as testimony to the elephants' arduous journey across battlefields in India, as war machines, for the Mauryas, the Mughals and the Mewars. Logging and military purposes were the biggest reasons for keeping elephants then. Large numbers of elephants were captured for this purpose. Both these reasons are invalid today. Today elephants are used for forestry and wildlife management, for cultural, religious and commercial purposes, and as zoo exhibits.

Captive elephants in India

While elephants found in the wild are in 17 of the 28 states in India, captive elephants are found in 26 states and union territories, including the Andaman and Nicobar Islands. In India, captive elephants, numbering 2675 are distributed both in non-range states as well as range states, the majority found in the north-eastern (41%) and southern (26%) states (Data collated by

MoEF&CC, 2017). In the northeast, they are found in larger number in the states of Assam (n=905) and Arunachal Pradesh (n=109). In South India, captive elephants are majorly found in Kerala (n=518), Karnataka (n=184) and in Tamil Nadu (n=138).

The state wise status of captive elephants in India is detailed in Fig. 1.1. The captive elephants in India are kept in elephant camps and rescue centers managed by the Forest Department, in zoos, temples, in circuses and also owned by private individuals. Unlike systematic and regular estimation of wild elephants conducted every 5 years, the enumeration of captive elephants in the country is sporadic. The latest figures collated in 2019 reports presence of 2675 captive elephants in the country of which 1678 (63%) are in custody of individual owners. About 28% of the country's captive population remains in the custody of Forest Department that are housed in elephant camps, rescue and rehabilitation centers and in zoos.

Fig.3.1: Distribution of Captive elephants in India

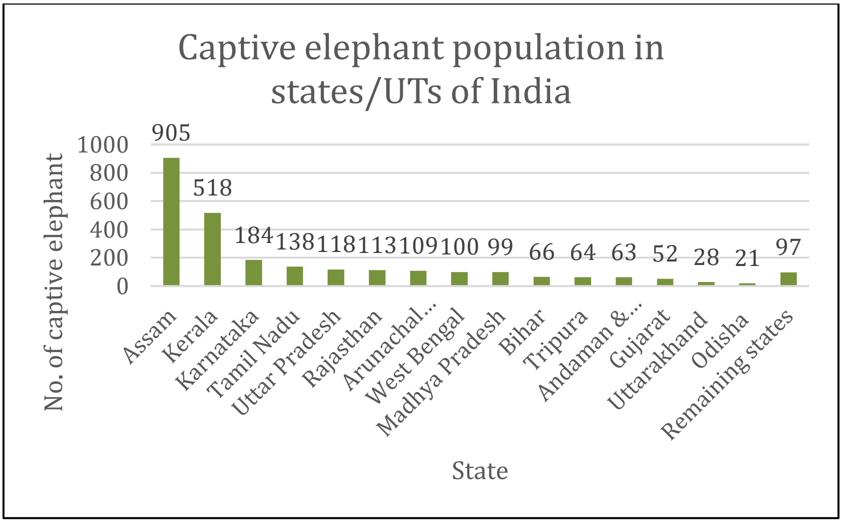


Fig.3.2: Captive elephants in States and UTs of India

The adult male to female ratio is elephants in captivity in India is estimated to be 1:1.2 in India substantiating that a greater number of females are present in captivity than males (Fig.1. 2). This could be probably due to the reason that the females are comparatively easier to handle by captive elephant owners in comparison to adult males/tuskers. However, with increase in human – elephant conflict, there is a likelihood of tuskers being captured to alleviate conflict situations.

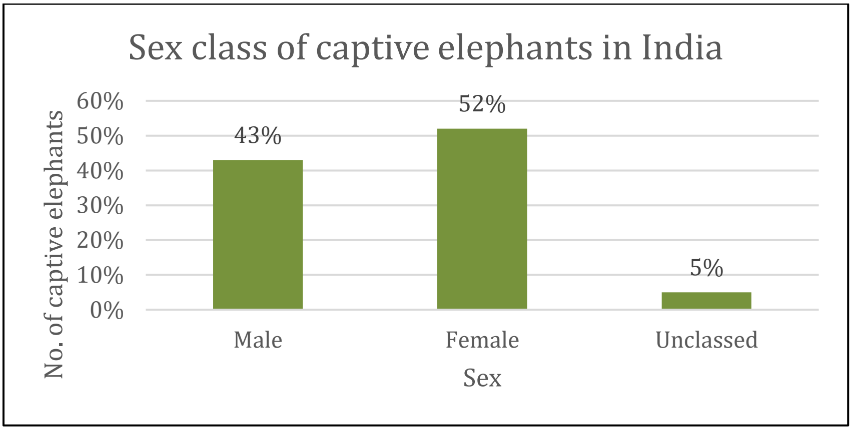


Fig. 3.3: Sex class of captive elephants in India

A large fraction of captive elephants in India are under private ownership. Majority of these are used for commercial or ceremonial purposes and rituals. The Wildlife (Protection) Act mandates suitable upkeep and maintenance as prerequisite for issuing ownership certificates. Till date a total of 1251 ownership certificates have been issued by the states.

Mahout-elephant relationship

Elephant-keepers manage the captive elephants on a day-to-day basis, but their living standards and well-being has declined over the years with the dwindling of the importance of the elephant in daily life. Unlike in the past, where profession as a *mahout* was one of the prides and profession of a specialized class of people, now it has lost its charm due to lack of comparable economic benefits and poor welfare owing to the dwindling importance of captive elephants. Many private facilities cannot afford to pay appropriate remuneration to *mahouts*. Therefore, the art of elephant-keeping is dying at a faster rate and effective steps must be taken urgently to improve the economic status of the keepers and care for their welfare through better pay, risk allowance, insurance and family accommodation, as suggested by Project

Elephant Expert Committee, Government of India. All facilities should strictly adhere to the norms of the State Forest Department regarding the number of keepers per elephant.

Legal provision

The Wildlife (Protection) Act 1972, which was amended in 2002, banned the sale of captive elephants which were not registered with the forest department. However, the exemption under Section 40 giving special status to elephants regarding possession, inheritance or acquisition, has enabled the elephant traders to defy the ban and continue with the illegal trade of these elephants. The modus operandi involve 'gifting' elephants using a loophole in the law and the trade flourishes. Some of the laws pertaining to captive elephants are as below:

- As a Schedule I animal, under Section 40 (2) of the Wildlife Protection Act, 1972, it is prohibited to possess, acquire, dispose of and transport a captive elephant without written permission of the Chief Wildlife Warden or the Authorized officer under the WPA, 1972.
- Section 43 of the Wildlife Protection Act, 1972, restricts the sale, purchase or transfers of captive elephants from one person to another for monetary considerations or any other profitable gain.
- Sub section (2A), Section 40: No person other than a person having a certificate of ownership, shall, after the commencement of Wildlife (Protection) Amendment Act, 2002, acquire, keep in his control, custody or possession any captive animal, animal article, trophy or uncured trophy specified in Schedule I or Part II of Schedule II, except by way of inheritance.
- Sub section (2B), Section 40: Every person inheriting any captive animal, animal article, trophy or uncured trophy under sub section (2A) shall within ninety days of such inheritance make a declaration to the Chief Wildlife Warden or the authorized officer and the provisions of sections 41 and 42 shall apply as if the declaration has been made under sub section (1) of section 40 provided that nothing in sub-sections (2A) and(2B) shall apply to the live elephant.

Initiatives taken by the Project Elephant division

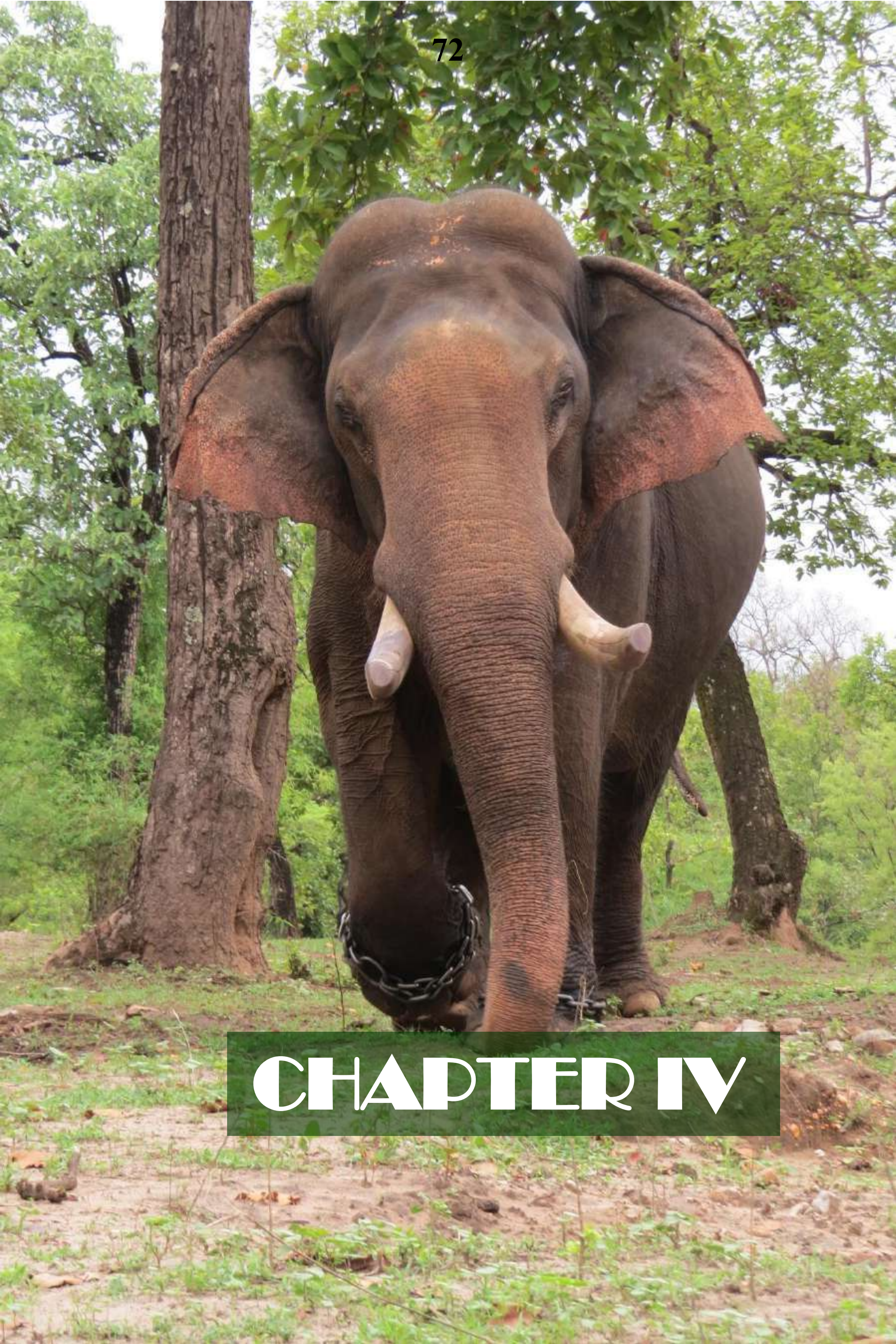
The Project Elephant Division of the Ministry established in 1992 aims to ensure the long-term survival of the population of elephants in their natural habitats and also address the welfare of elephants in captivity. The Ministry has been providing technical and financial assistance to the State Forest Departments for the welfare and upkeep of the captive elephants.

The Central Government has issued guidelines for care and management of captive elephants in the country on 8th January 2008. These guidelines have laid down norms for transportation, housing, feed, veterinary care and other norms for care and management of captive elephants in the country.

The declaratioarcn of elephant as the National Heritage Animal in 2010 was a step up to increase protective measures for the country's iconic animal, the elephants. The Gajah Report (The Report of the Elephant Task Force) published in 2010 laid down elaborate recommendations for improving management of wild and captive elephants in India. While some of the recommendations suggested by the Task Force have already been implemented the Ministry is working towards achieving the measures to manage the captive elephants of the country. As a step forward addressing the welfare standards of elephants in captivity, a Committee constituted by CZA under the Chairmanship of IGF (PE) delved into various parameters for housing of captive elephants and developed the Standard/Norms for recognition of Elephant Rehabilitation/Rescue Centres under Section 42 of WLPA, 1972 in 2017. Ministry has constituted the Captive Elephant Healthcare and Welfare Committee to look into the welfare conditions of elephants in captivity. Under the aegis of this Committee, health investigations of 99 captive elephants in *Haathi Gaon*, Rajasthan has been done in 2019 and the recommendations have been circulated. The standards of upkeep and management of elephant camps of India were also evaluated by the Committee to ensure safer and hygienic living standards of living. Despite India's best efforts, illegal trade in live elephants appears to continue. For addressing this issue, Ministry has embarked on creation of central repository of genetic database of captive elephants. The database is expected to have individual-level genetic data along with pictures of the captive elephants, to help curb illegal trade of wild elephants and introduction in the captive stock.

Conclusion

India has a long history of keeping elephants in captivity. The use of elephants and managing them in a humane manner has been a contentious issue and this needs to be addressed in a responsible manner. Management of captive elephants needs to be addressed in a comprehensive manner so as to develop a clear and practical national policy that is backed by a defined long-term vision or goal for captive elephants. At this unction, it is imperative to establish monitoring and enforcement mechanisms to ensure that captive elephants are managed in a humane manner and no illegal captures are done from the wild.



CHAPTER IV

HEALTH MANAGEMENT OF CAPTIVE ELEPHANTS: AN OVERVIEW

- *Parag Nigam, Sushant Chowdhury & Avadh Bihari Shrivastav*

Introduction

Ensuring health of captive elephants is a challenging task for managers, veterinarians and animal keepers. It essentially requires a detailed knowledge of the species, its biology, behavior and physiology besides aspect of captive management, diseases, animal restraint etc. These are more important due to the constraints in space and resources and also due to controlled social, sexual and parental behaviors of animals in captive environment. Good management can therefore be achieved effectively by integrating principles of wildlife medicine and wildlife management. The combined and coordinated efforts of all concerned with the upkeep, management and disease control will go a long way in maintaining captive elephants free from disease and in sound health.

Health management of elephants in captivity

Captive elephants need utmost care with respect to their physical, psychological, nutritional and medical requirements. Zoo managers and veterinarians have the legal and ethical responsibility to insure the welfare of wild animals under their control. The basic concerns to managing health of elephants in captivity include provisioning of space and shelter facilities suiting their physical and behavioral requirements, adequate balanced food and water to meet nutritional requirements, regular monitoring of health and well-being of animals and maintaining hygienic standards to ensure a healthy environment. It is important to understand signs of health and indispositions in elephants. These are summarized as Table 1.

Table 4.1: Signs of health and indispositions

Parameters	Healthy individual	Remarks
Physical appearance and Bodily condition	Physical body condition assessed by observing temporal depression, scapular spine, ribs, flank, lumbar shelf, pelvic and tail vertebra and assigning values. The scoring increases with corresponding decrease in	Though visibility of vertebral spines and pelvic girdle is inherent to the species, the other condition of other visible prominences should be considered while assessing bodily condition. Age, sex and

	condition quality (Wemmer, 2006) a. Other visible features (eyes should be bright, clear with slight overflowing of tears; trunk tip moist; mucous membranes of tongue, mouth and inside of trunk rosy pink; and skin should be soft and resilient, b. Gait should be normal animal should bear weight on all limbs. c. Characteristic of dung: Well formed, brownish and darkens on exposure to the air. No evidence of straining. d. Urine copious, faintly yellow tint with no unpleasant odour. No evidence of straining	physiological changes should be accounted while assessing health. Animal defecates 15-20 times a day and produces 5-8 boluses each weighing 1-2 kg at a time Animal urinates 10-15 times a day and animal excrete 50-55 ltr of urine per day
Normal behavior	a. Bodily movements: Healthy individuals are preoccupied in some or the other activity and are never stationary throughout the day. Elephants lies down once or almost twice during night but avoids during day. Normal behaviour includes incessant movements of trunk, tail, ears and legs; animal is involved in grooming, dusting and feeding. b. Good appetite (Daily roughage intake of 150-250 kg. based on size, physiological status) and daily water intake is 200-250 liters.	These movements are slowed or seized entirely during illness and animal is less alert/weak It is important to differentiate movement exhibited by healthy individual with that of the monotypic behavior (continuous swaying of head, circling) exhibited by elephant. This is primarily a displacement activity and an indicator of boredom, lack of exercise and even over feeding in elephants. Frequent groaning, restlessness, lying down and getting up, placing the trunk in the mouth, biting the tip of the trunk or assessing abnormal posture, yawning, crossing of rear legs, diarrhea, constipation, decreased urine output, and dependent edema are other indicators of ill health.

Physiological parameters	a. Temperature: 96.6^{0} F (36.9^{0}C) b. Pulse: 28 per minute during standing and 35 per minute in recumbency c. Respiration: 10 per minute during standing and 5 per minute in recumbency d. Visible mucus membranes-rosy pink	Temperature of 38^{0}C or 100^{0}F indicate significant fever. Respiration and pulse rate may show alterations during chemical immobilization, improper posture and positioning, poisoning, disease. Mucous membrane might be pale, hyperemic, icteric or congested during ill health

Husbandry and care

Designing and upkeep of housing facility: The housing for elephants in captivity should be designed keeping in view the animal 's basic requirement and should provide adequate space for free and natural movement especially in zoos; have covered shelter to protect them from adverse weather conditions, easy to clean and prevent exposure of the animal to waste material. The tethering area should be carefully selected and should be selected on a high well drained ground to ensure proper drainage and hygiene. Posts supporting the roof should not be used as a chaining point. The floor should preferably be made of tightly packed earth (earthen flooring) instead of the hard-cemented floors. Though cemented floors are easy to clean, the chances of animal developing arthritis and foot injuries are more. A standard of minimum floor area for different age group has been specified by the Directorate of Project Elephant.

Table 4.2: Minimum floor area requirement as per guidelines of Directorate of Project Elephant (ref. no. 9-5/2003-PE dated 8-1-08)

Sr. No.	Age Classification	Minimum floor area requirement
1.	Weaned calf (height below 1.5 meters)	5m x 2.5m
2.	Sub-adult elephants (height between 1.5 to 2.25 meters)	7m x 3.5m
3.	Adult (height above 2.2 meters) and cow elephants with unweaned calf	9mx6m

The height of the covered shed should not be less than 5.5 meters and the roof if made using corrugated iron sheet/asbestos may be covered with cooling material like gunny bags, grass, coconut leaf etc.

Proper sanitation and hygiene of the elephant housing/ camps/ exhibits is essential for maintaining good health, preventing spread of infectious agents and ensuring good foot care. Accumulation of dung and urine is unhygienic and predisposes animals to foot ailments besides leading to buildup of pathogens. For earthen flooring, it is necessary to keep it dry by spreading sand as moist and wet conditions may also result in foot rot condition. Proper waste disposal is a critical component of overall health management and should be periodically disposed off. It is also necessary to control invertebrate (flies etc.) and vertebrate pests as they may serve as vectors/ intermediate hosts for many viral, bacterial, parasitic and protozoan diseases. The effort needs to be continuous and concerted.

Bathing and grooming: Bathing and grooming of animals are integral and important part of overall health management and provides opportunity to thoroughly inspect/examine the elephant for any abnormality including injuries, wounds sore, swellings besides cleaning the animal's body of external parasites and reducing the body temperature. Additionally, the activity also provides opportunities for the *mahout* to established bondage with the elephant and should always be encouraged. Lack or improper grooming may result in the skin overgrowing thus leading to accumulation of dirt and external parasites. The skin of the animal is quite sensitive and scrubbing should be done using pumice stone or coconut husk. It is important to scrub the entire body with due care on the foot, nail and deep skin folds. Nails should not be scrubbed with rough stone as it can result in loss of protective waxy coating and increase incidence of cracked nail. Rough surfaces (Wall, trees) should be part of the housing to allow animal to rub and groom itself.

Nutrition and feeding: Provision of adequate, hygienic and balance diet is essential for upkeep of animals in good condition in captivity. It requires a thorough understanding of nutritional requirement, physiological functions, sociological and behavioural needs, food preference and acceptability/palatability, locally available food ingredients and their nutritional value is necessary. Important relationships have been demonstrated between nutrient intake and rate of growth, reproductive performance, digestive functions and disease process. Improper diet may cause suppression of growth, delayed sexual maturity, low conception rate, high prenatal/neonatal mortality, infertility and increased susceptibility to infectious diseases. Understanding nutritional needs of elephants though complex is essential as the animals have certain peculiarities that make them different from other herbivores. Considering the huge physical structure of the elephant and caloric requirement for its sustenance, elephants in natural habitat eat incessantly throughout the day and night (spending on an average 12-20 hours of the day eating anywhere from 150-200 kg of jungle fodder i.e. 6-8% of their body weight each day) to satisfy their insatiable appetite. Since elephants derive nutrition of about 45% from what they eat, they compensate by being continuous and voracious feeders; assimilating energy from large quantities of even low-quality forage and including variety of plants in their diet. These may include wide variety of grasses, tree leaves, twig, barks, trees, roots, fruits and even flowers. More than 200 species of plants have been documented to be used by elephants however their use varies regionally and even seasonally and are restricted to only a few plant taxa. It is important to expose animals to variety of fodder/diets to meet nutritional deficits. Elephants have a simple stomach and are primarily hindgut fermenters. As they lack the endogenous enzymes necessary for digestion of the fiber components; they rely on anaerobic fermentation by symbiotic gastrointestinal microorganisms. Colon primarily forms fermentation sites that support a large and active population of bacteria, protozoa and fungi responsible for metabolizing nutrients in ingested feed to produce volatile fatty acids that are then metabolized by the host animal. Rapid changes in diet (sudden diet supplementations/alterations, pH changes, improper/stale/putrefied feed or plants) that lead to disruptions in microbial fermentation system can lead to severe veterinary disorders such as bloat, acidosis and diarrhea. The energy requirement and feeding protocols are provided in subsequent chapters.

Water requirement: It is essential that elephants are provided with clean water both for drinking and bathing. An adult elephant may consume on average 140-200 liters of water per day. Elephants often urinate and, more particularly, defecate in water in which they bathe and also drink at the same time. Thus, it is essential that the mahout encourages elephant to drink before bathing. This would lessen chances of elephant contracting water borne diseases. Alternatively, elephants need to be watered at a site and bathed at different site preferably downstream so as to avoid chances animal consuming dirty water. Elephants should not be allowed to drink immediately after work as the animal's body temperature may be high and drinking at this time may lead to cold and even colic.

Foot care: Foot ailments are common and serious problems of captive elephants. The predisposing factors are broadly classified as internal (poor nutrition, malnutrition, mineral and vitamin deficiency) and external (inadequate exercise and wear, unsanitary and unhygienic conditions, animal tethered on hard surfaces and contamination due to standing in own excrement). Treating foot and nail problems requires immediate attention and needs to be done correctly. The routine foot care involves inspection of individual foot after the animal returns from duty, proper cleaning and removal of excessive nail/ sole, foreign objects if any, and application of mineral or vegetable oils.

Table 4.3: Common foot and nail problems in elephants and their management

Sr. No.	Conditions	Signs	Management
Nail problems			
1.	Ingrown nail	Difficult in walking and the animal may hobble	Trimming of excessive nail and file it smooth to allow normal growth, antiseptic dressing if required
2.	Overgrown nail	Oddly shaped nails with layered appearance, may even spilt and may expose sensitive lamina to infection. Animal finds difficulty in walking	Regular trimming and special attention at nail-sole junction
3.	Spilt nail	Animal avoids putting weight on the foot and shows severe limping if sensitive laminae are exposed	If split is detected early, trimming to release pressure on the nail is beneficial. Dry conditions help in faster recovery. Deeper splits may be managed using corrective trimming procedures and antiseptic cover
Sole and heel problems			
4.	Cracked sole	Foot pad peels off and can expose the deep tissues to dirt and infection, painful conditions and animal is not able to put full weight on the foot Exudation, erosion and ulceration of the edges of the crack may be noticed	Debridement of crack, flushing with antiseptic solutions (potassium permanganate solution, diluted povidine iodine solution) and application of topical dressing (Castallani's paint) have proved beneficial. Parentral antibiotic therapy based on sensitivity test is indicated in severe cases. Efforts to keep foot dry are important.
5.	Cracked heel	Crack can be appreciated between the junction of skin of the leg and sole at the posterior of the foot.	Similar to cracked sole
6.	Overgrown sole	Lameness, reluctance to move and tender sole on palpitation, irregular hoof shape and layered appearance of sole	Provide rest and keep the foot dry, trimming away the overgrown sole combined with appropriate therapy is recommended
Cuticle problems			
7.	Overgrown cuticles and deep crevices	Appear as roughened split area of the skin at skin and nail junction. Roughened cuticle are quite sensitive and the animal will not readily tolerate its removal	Application of mineral or vegetable oil to soften the skin is a good way to manage. Deep crevices need to be open and trimmed to prevent buildup of manure in them

Diseases affecting elephants: Captive elephants are susceptible to number of infectious diseases. The etiology, mode of transmission, clinical signs, prevention and control are briefly discussed below.

Bacterial infection

Anthrax: Anthrax is an acute infectious disease caused by spore forming bacteria; *Bacillus anthracis* and manifested by high fever, hemorrhagic septicemia, and sudden collapse and death. Other signs include anorexia, subcutaneous swelling (behind jaws, between limbs, groins, front of shoulders, belly, hind quarters), trembling, hemorrhage on mucus membrane, colic and bloody diarrhea. Diagnosis may be made by demonstration of Gram-positive bacilli in blood smear made from peripheral blood. Treatments consist of massive repeated dosage of penicillin at 500-20000 IU per kg body weight. Prophylactic vaccination and vaccination of other potentially exposed elephants includes use of Anthrax spore vaccine given subcutaneously at the base of the tail in the caudal fold. Chandrasekharan, (2002), recommended ASV vaccination for elephants at following doses of different age groups. For elephants aged 20 years and above (3 ml), between 15-20 years of age (2.5 ml), between 10-15 years of age (2 ml), between 5-10 years of age (1.5 ml) and between 2-5 years of age (1 ml). Vaccination should be avoided in weak, debilitated aged and those in advanced stage of pregnancy. Post mortem should not be conducted in individuals suspected to have died of Anthrax as it would facilitate sporulation of the vegetative form and subsequent contamination of the environment. Proper disposal of carcass by burning or deep burial along with disinfection of the site is essential in controlling the spread of infection.

Tuberculosis: Tuberculosis in captive elephant is an important zoonotic disease that primarily affect and compromises the respiratory system though other systems may also be affected. The infection is caused by *Mycobacterium tuberculosis* (human strain). *Mahouts* and animal handlers harboring the infection can transmit the disease to animal through close contact. The transmission of infections is through aerosol means though other portals such as ingestion of contaminated food and water is also important. The major signs of TB in elephant include progressive weight loss despite adequate nutrition, emaciation, dyspnea and coughing with foul smelling purulent nasal discharge. Lethargy, anorexia, rapid exhaustion is other manifestation. Intra-dermal Tuberculin test at the base of ear for *Mycobacterium tuberculosis* and *My. bovis* have been used to detect the disease. Culture of trunk lavage for mycobacterial isolation and microscopic examination of smears for acid fast organisms may confirm disease. Annual medical checkup of *mahouts*, caretakers and other involved personnel including chest X-ray is good to diagnose disease in humans. They should be allowed to provide services only if cured of disease. Chandrashekharan (2002) recommended oral administration of 30 capsules each containing rifamycin 450 mg plus Isoniazid 300 mg daily twice for a period of 6-12 months in elephants to be effective in controlling symptoms of chronic cases. Treatment of several positively confirmed cases of TB in elephants by Isoniazid therapy has been reported to be effective.

Salmonellosis: Salmonellosis is an important enteric disorder of young elephants and manifested by fever, loss of appetite, weakness and severe diarrhea. Inadequate and poor hygienic and sanitary practices, over-crowding, sudden change in diet or stress are the predisposing factors. The severity of infection in animal depends on infective dose, resistance of host to colonization within GI tract and the particular serovar. The infection assumes septicemic form in immune-compromised individuals or individuals with low resistance that are infected with the virulent serovar. Salmonellosis should always be considered as part of differential diagnosis for diarrhea in elephants. Diagnosis may be made by fecal culture or serological investigation. As the bacteria are shed intermittently, analyses of multiple fecal samples are important. The treatment should be prompt and should include high doses of antibacterial drugs along with fluid therapy. Chloramphenicol, kanamycin, gentamycin and ampicillin are drugs that may be given before culture and sensitivity results are available. CST results would guide the change of antibiotic if required. High doses of antibiotic are required for treatment to avoid chronic carrier state. Maintaining electrolyte balance and fluid is important in disease management. For profuse losses 50-200 liters of replacement fluids per day for 5-10 days may be required. Recovered individuals may be suspected of being chronic carriers of Salmonellosis until prove otherwise. Proper sanitary practices and disposal of waste are critical to controlling infection.

Tetanus: Tetanus is an acute infectious disease caused by exotoxin produced by spore forming anaerobic bacteria (*Clostridium tetani*) characterized by spasmodic tonic muscular contraction principally involving the voluntary muscles. Bacteria are abundant to soil, in moist areas, and lives freely in the GI tract of many animals. The organism grows in deep punctured wound with low oxygen tension. Animals can get infections due to infection of deep punctured wound that may arise from unsanitary housing condition, poor foot care, tusk infection and hook wounds. The incubation period for the disease is 15-20 days and an animal may appear normal during this period. Following contamination of the wounds, the bacteria multiplies locally in the anerobic condition of deep wounds and produces neurotoxins which are absorbed into the host body. The toxins act at the nerve ending that cause typical muscular spasm. Characteristic clinical signs of tetanus in elephants include general dullness, muscle rigidity, stiff gait and increased sensitivity to loud or physical stimuli. Anorexia, adipsia, lameness (site of puncture wound), reluctance to open mouth (locked jaw condition), pressing of head against wall and physical collapse were the terminal sequences of reported events. Prolapse of nictitating membrane has also been reported similar to that in horses. Diagnosis of Tetanus in elephants is made based on characteristic clinical symptoms. Adult elephants should be immunized against tetanus by administering 4000 IU of tetanus antitoxin for active protection up to 2 weeks. Simultaneously tetanus toxoid should also be administered and repeated after a month. Annual boosters are recommended to maintain immunity. Early treatment of disease with penicillin (450 lakh units I/V), massive repeated doses of antitoxin (2.0 to 2.5 lakh units I/V every 6 hrs. or as needed), muscle relaxant and supportive care have found to be useful. Original wound should be identified, the foreign object removed and drainage established.

Pasturellosis (Hemorrhagic septicemia): Hemorrhagic septicemia is an acute febrile disorder of elephant characterized by sudden onset of high fever, oedematous, subcutaneous swellings, broncho-pneumonia leading to pleurisy and death. The disease is caused by *Pasteuralla multocida* type II and *P. haemolytica* through aerosol means or directly from diseased livestock through close contact, by ingestion of infected material deposited on herbage, water and even through insect bite. The bacterium is also a normal inhabitant of the nasal tract. During periods of stress (that may arise due to change in season, temperature, chilling, sudden rain, shipment/transport) the organism flares up and produces disease in the host. In acute cases, the infected individual may die in 3-36 hours. Clinical symptoms though not very prominent, may include complete loss of appetite, frequent yawning, trembling, subcutaneous swellings of variable sizes in different parts of the body (chiefly throat and face) and hyperemic mucous membranes. Animal shows labored, noisy and altered (high rate) respiration. Urine may be cloudy and richly colored. Field diagnosis can be made based on acute nature of disease, typical clinical signs and microscopic examination of blood smears for bipolar gram-negative organisms. Sulphamethazine 200 – 250 gms orally followed by half dose daily for 3 days has been found to be useful. Sulphamethazine sodium 33.3% (800 ml.) has also been tried and proved effective through subcutaneous or intravenous routes. Vaccination should be done during pre-monsoon and recommended in areas showing regular bouts of outbreaks in livestock. It can also be practiced prior to situations where animal may be subjected to stress.

Colibacillosis: Collibacillosis is primarily an enteric disorder of young elephants caused by a combination of faulty feeding, unhygienic and unsanitary conditions and infection with normally occurring enteric pathogen *Escherichia coli.* Though ingestion of contaminated feed is the primary cause, the disease can also be transmitted by humans who do not practice sanitary practices. The predisposing factor of sudden multiplication of the intestinal coliform bacteria is over feeding, regardless of whether these bacteria are part of normal intestinal flora or are introduced by infection. The disease is characterized by prostration, profuse diarrhea, septicemia and pneumonia. Clinical sign include fever, loss of appetite, profuse foul-smelling diarrhea, severe dehydration, prostration, and acute death. Diagnosis is possible through fecal culture. Therapy should start early and include prompt treatment with antibacterial drugs together with restoration of fluids and electrolyte balance. Antibacterial drug sensitivity testing is helpful to identifying effective medication. Prevention includes reducing predisposing factors such as gradual change in diet, proper feeding schedule, quantity and quality and improving sanitary conditions.

Enterotoxemia: Enterotoxemia is an important enteric disorder of elephants caused by anaerobic *Clostridium perfringens* and manifested clinically by sudden acute odorous diarrhea, lack of appetite, fatigue and a mildly elevated temperature. The disease has been reported to be fatal; young elephants are especially susceptible. Unsanitary and unhygienic housing condition and food contamination are the predisposing factors for developing the disease. Diagnosis is by laboratory culture of infective agent and identification of toxin. Treatment includes used of antitoxin and high level of antibiotic in addition to supportive care. Early treatment of disease with penicillin and massive repeated doses of antitoxin including supportive care aid in management of disease.

Viral diseases

Foot & Mouth Disease (FMD): FMD is an acute, highly contagious viral infections caused by enterovirus of the picorna virus group. Asian elephants are susceptible to FMD caused by type O virus. Disease in elephants is characterized by hyperthermia, depression, anorexia, acute painful stomatitis, excessive salivation, ulceration, and vesicle formation on buccal mucosa, hard palate and tongue. Incubation period varies from 36 hours to 4 days and the disease may last from few days to 3 months. Transmission occurs through ingestion of contaminated feed, through contact with infected cattle and even aerosol. The virus is shed in all excretion of infected individuals. Foot lesions are also present wherein vesicles appear on the feet, in the area of coronary band. Limping is sometime the first indicator of disease and in severe cases the foot pad can even slough off. Diagnosis of FMD may be made from typical clinical signs and can be made by submitting vesicular fluids or crusts to an appropriate laboratory for examination of the virus or virus culture. It is important to identify distinct type of FMD virus as it would provide basis for vaccination of infected/in contact individuals. Though no known cure of disease is available, palliative treatment alleviate signs, it does not prevent infection. Infected individuals need to be segregated and treatment provided. Administration of chloromycetin, foot bath with 1% formalin and application of Castellani's paint have been reported to be effective. Sanitary and hygienic measures should be practiced to avoid secondary bacterial infections.

Elephant Pox: Elephant pox is an important zoonotic viral disease caused by vaccinia virus and essentially characterized by development of pustules on skin which tends to ulcerate including erosion and ulceration of visible mucus membrane. The disease can even be fatal. Clinical signs include loss of appetite, dysphagia, muscle stiffness, pox lesions on head and trunk, sever conjunctivitis and swollen temporal. Ulceration of mucus membrane may result in difficulties in swallowing, general debility, fever, hoof sloughing and limpness. Vesicular lesions may develop on tongue, lips, trunk tip, eyelids, and skin surrounding, anus and vulva. Transmission of disease is by direct contact and the incubation period ranges from 2-4 weeks and the disease has duration of 1-6 weeks. It is important to differentially diagnosis disease from FMD which shows similar clinical picture. Treatment consists of isolation of infected individuals, good supportive care and administration of antibiotic to prevent secondary bacterial infection. Being zoonotic, adequate care should be taken by mahout and health professionals while handling and treating infected individuals.

Rabies: Rabies is a highly fatal infection of the central nervous system transmitted by bite of infected animal. Elephants may get infection by bite of infected dogs, jackal, fox etc. or even through contact of saliva with wound. Infected elephants show restlessness, refuse to eat and drink, frequently lies down, prefer to stay in dark and as the disease progress the animal writhes in pain, becomes violent and shows nervous involvement manifested by irritability, unaroused provocation, eye rolling, unsteady gait, locked jaw, salivation, paralysis and death. There is no effective treatment once the symptoms have appeared. Local wound treatment and post exposure vaccination may help in disease management.

Elephant Endotheliotrophic Herpes Virus (E-EHV): EHV is a relatively novel herpes virus that causes acute fatal disease syndrome in elephants. The disease was incidentally reported from pulmonary nodules of African elephants. The African elephants harbor the infection and may act as reservoir of disease for both African and Asian elephants. The onset of disease is rapid with per acute death in 24-36 hours. The disease primarily affects young elephants and clinical signs are subtle. The signs include anorexia, colic, lethargy, edematous swelling of the head and thoracic limbs, oral ulceration and cyanosis of tongue. The virus damages the endothelia cells of heart, liver, tongue, GI tract and leads to hemorrhage which is usually fatal. Prognosis is poor however initial treatment with famciclovir (12.8 mg/kg) along with supportive therapy may be helpful. Examination of oral cavity particularly for evidence of cyanosis of tongue and for oral ulcers of the palate of young elephants on routine basis may check for early evidence of herpes. Post mortem lesions include haemorrhagic diathesis, petecchial hemorrhage in heart and through peritoneal cavity, hepatomegaly, cyanosis and oral and intestinal ulcers are indicative of disease. Intra-nuclear inclusions in capillary endothelium of effective organs aids in diagnosis.

Miscellaneous Viral Disease: Other viral diseases known to occur in elephants include fatal acute disease caused by group of antigenically related virus in the family Picorna viridae, a genus of cardio virus named Encephalomyocarditis virus. The disease has been reported in captive elephants in American zoos and from free ranging African elephants from South Africa. The disease is believed to be transmitted from wildlife reservoir in zoos animals. The exact mechanism is unknown. There is no treatment available however control of vector is one of the management options.

Protozoan diseases

Trypanosomiasis: Trypanosomiasis is an important vector borne disease of elephants caused by *Trypanosoma evansi* that is generally common during rainy season when there is abundance of biting flies of the genus *Tabanus* and *Stomoxys*. The disease is characterized by intermittent fever, dullness, anorexia, lacrimation, anemia, rapid exhaustion and marked swelling of dependent parts including trunk, neck, brisket and lower abdomen. Constipation, alternating with diarrhea is a common sign. Skin is dried and hair becomes coarse and brittle. Diagnosis is based on clinical signs supported by demonstrating trypanosomes in peripheral blood smears.

Two to three weekly intramuscular injection of Berenil 5-8 mg per kg body weight or subcutaneous injection of antricide methyl sulphate 3-5 mg per kg body weight have been found useful. Prevention includes controlling vector population, maintain sanitation and hygiene and regular disposal of dung and soiled bedding.

Parasitic Diseases: Parasitic diseases are the most common diseases among the captive elephants and include both internal and external parasites. The major internal parasites of elephants with the exception of larvae of flies are primarily nematodes and trematodes and few cestodes. Elephants may acquire infection with these parasites early in life but the development of disease depends on the number and species of the parasite present which in turn depends on various environmental and epidemiological factors. Animal gets infection primarily through ingestion of contaminated food and water though other routes of transmission are also prevalent. Mixed infections are the rule, though a number of specific disease syndromes (Filarial worm, eye worms, liver flukes etc.) may also emerge. The internal parasites may inhabit the gastro intestinal tract, abdominal cavity and blood vessels in different organ system and produce deleterious effects on the host. A variety of arthropods are also found to infest elephants. These arthropods may act as vectors of number of diseases and need to be controlled. The major arthropod and internal parasites in elephants are summarized as table 4.4 and 4.5. Naturally the elephants have been found to get rid of internal parasites either by consuming mineral/earth at a salt lick or consuming certain parts (bark, roots) and varieties of plants that are rich in tannic acid and alkaloids. Rubbing against trees and rocks and dusting mud on the body is also an effective way to keep a check on the external parasite. However, when animals are maintained in captivity, their approach to resources are restricted and it is important to control infections as these produce deleterious effect on the host and can even pose threat to human. Routine faecal sample examination for parasitc ova and coccidial oocyst should form an integral component of health management. The examination should be carried out every 3-4 months and should form the basis for anthelmintic treatment. Maintaining proper sanitation and hygiene in and around the elephant camp/ enclosure is key to effective parasite control.

Table 4.4: Major arthropods reported in elephants

Major groups	Species involved	Site	Signs	Treatment
Louse	*Haematomyzus elephantis*	Behind ear, at the end of trunk, near	Pruritis (localized or generalized), dryness of skin	Ivermectin 0.059 – 0.087 mg/kg administered orally using injectable

		perineum and tip of tail. Generalized infection has also been reported	and scale formation, animal irritated and agitated, does not rest, off feed becomes weak and anaemic	preparation may re-treat at 5- 6 weeks. Oral Ivermectin preferred since, i/m injections can lead to development of local inflammation and soreness at the injection sites. Dusting of organo-phosphorus insecticide
Blood sucking flies	*Tabanus sp., Haematopota sp., Stomoxys sp., Chrysops sp.*	Around feet and nails	Animal keeps moving continuously to keep the flies away, Severe irritation, loss of blood, anaemia	Dusting of organo-phosphorus insecticide/ Acaricide sprays. Maintaining good sanitation and hygiene practices and proper waste disposal are key to management
Larvae of flies	Bot fly (*Cobboldia elephantis*) Gad fly *Elephantoloemus indicus* (Thialand). Fly larva producing skin eruptions also reported from Nameri, Assam	Fly lays eggs on the skin at the base of tusks. The larvae hatch and develop in the mouth cavity and later move to the stomach. Eggs are laid on skin larvae penetrate skin, mature and bore out and fall on the ground to pupate	Anorexia, dullness, animal weak and anaemic, colic loose faeces, Eruptions on the skin 1cm in diameter, produces an "oily appearance" of the skin especially on the sides, buttocks and belly. These breaks open and produce sore from where the larvae emerge.	Ivermectin at doses of is found suitable. Levamisole at 4mg/kg orally has been found to be effective. Ivermectin along with antihistaminic and mineral/ vitamin supplementation had been tried and found effective
Ticks	*Boophilus annulatus, Haemaphysalis spinigera, Rhipicephalus hamophysaloides*	Below the ears, on the perineum, under the tail and	Bite injury, irritation, anaemia Identification of the parasite involved	Remove ticks physically Regular bathing and thorough grooming, Dusting of organo-

	and Ornithodorus savignyi	along the belly.		phosphorus insecticide

Table 4.5. Internal parasite in elephant and their management

Major internal parasite	Clinical signs	Diagnosis	Treatment
NEMATODES			
Gastro-intestinal nematodes: *Amira pileata, Bathmostomum sangeri, Bunostomum foliatum, Choniangium epistomum, C. megastomum, Decrusia aditicta, Equinubria sipunculiformis, Haemonchus contortus, Murshidia murshidia, M. falcifera, M. indica, Parabronema indicum, P. smithii, Quilonia travancra, Q. remmie, Strongyloides elephantis, Syngamus indicus, Toxocara lancoptera, Trichostrongyles sp.,*	Dullness, depression, emaciation, mud eating tendency, colic, exhaustion, acute enteritis, foetid diarrhea, pale mucous membrane, dependent oedema (throat, brisket and lower abdomen, stunted growth in young elephants	Clinical signs and confirmation of parasitic ova in dung	Fendendazole 25% - 5 mg/kg orally, Levamisole 3mg/kg orally, mebendazale 3-4 mg/kg orally, thiabendazale 40mg/kg orally Ivermectin 0.1 mg/kg orally
Hepatic parasites: *Grammocephalus varedatus, G. hybridatus,*	Marked hyperplasia, fibrosis and degenerative changes in liver	Demonstration of parasitic ova in dung	Fendendazole 25% - 5 mg/kg orally, Levamisole 3mg/kg orally, mebendazale 3-4 mg/kg orally, thiabendazale 40mg/kg orally
Filarid worms: *Indofilaria pattabiramani,* *I. elephantis* *Stephanoflilaria srivastavi, S. assamensi*	-2 cm haemarragic nodules over the body that may exude small quantities of blood, Probably in portal vessels Stephanofilarial lesions may be seen on the shoulder blades in front of the howdah, toes,	Demonstration of Microfilaria in blood	Anthiomaline 50ml per 2000 kg s/c at weekly interval for 8 doses, Acetylarsan 30-40 ml s/c, 5 injections on alternate days for a week. Metrifonate 8% in gelatin base for topical application in addition to above mention drugs.

	heels, hind feed and on the abdomen.		
Eye worms: *Thelazia sp.*	Adult worm on cornea		
TREMATODES			
Gastrointestinal worms (amphistomes): *Gastrodiscus secundus, Pseudodiscus collinsi, P. hawkesi, Pfenderius papillatus, P. birmanicus, P.heterococca*	Diarrhoea, frequent urination, anorexia and weakness	Demonstration of parasitic ova. Amphistomes can be appreciated grossly on PM	Hexachlorophene 8-10 mg/kg orally, Rafoxanide 2.5-5 mg/kg orally, Oxyclozanide 7.5 mg/kg orally
Blood flukes: *Bivitellobilharzia nairi*	Chronic wasting disease, deranged appetite and strongly colored urine. Pale mucus membrane and diarrhoea alternating with constipation	Demonstration of parasitic ova	Anthiomaline 50ml per 2000 kg s/cat weekly interval for 8 doses, Acetylarsan 30-40 ml s/c, 5 injection on alternate days for a week.
Liver flukes: *Fasciola jacksoni, F. hepatica*	Colic, diarrhea, constipation, depression, icterus, hypoproteinemia, dependent oedema, anaemia, chronic ill health and death. Changes in Liver on PM (hardening, fibrosis and atrophied)	Clinical signs and demonstration of fluke eggs in faeces	Triclabendazole 7.5mg/kg and repeated after 6 months Oxyclozanidde
CESTODES			
Liver & Intestinal cestodes : *Anoplocephala manubriata*	Anorectic, loss of condition, mud eating tendency, diarrhoea	Demonstration of parasitic ova	Praziquantel 2.5-4 mg/kg, Oxyclozanide 3.4 mg/kg, Niclosamide 70mg/kg, Hexachlorophene 10mg/kg

Other aspects

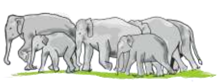
Veterinary records: Sound medical records form the basis for planning and formulating effective health management strategies. Proper veterinary records reduce loss of animal due to disease since one can track the nature of all treatments (type of medication, dosage, duration), surgical procedures, anesthetic procedures (type of agent, dosage, effect), result of all laboratory tests and immunization records with all relevant dates. Ideally these records should be computerized for easy retrieval.

Personnel: Maintaining elephants in captivity is a complex matter and requires that those involved in care and management have appropriate qualification and experience in care of the species. This helps in ensuring that the needs of the animal are cared for in a professional and humane manner. Daily observation for abnormities such as anorexia, inactivity, abnormal feces and changes in behaviour are important tools in managing medical problem at an early stage. It is also important that zoo personnel are regularly sensitized on various aspects of health management. Another aspect of relevance is managing zoonotic diseases. Several infectious diseases such as tuberculosis, measles, amoebic dysenteric, salmonellosis can be acquired by captive elephants from humans.

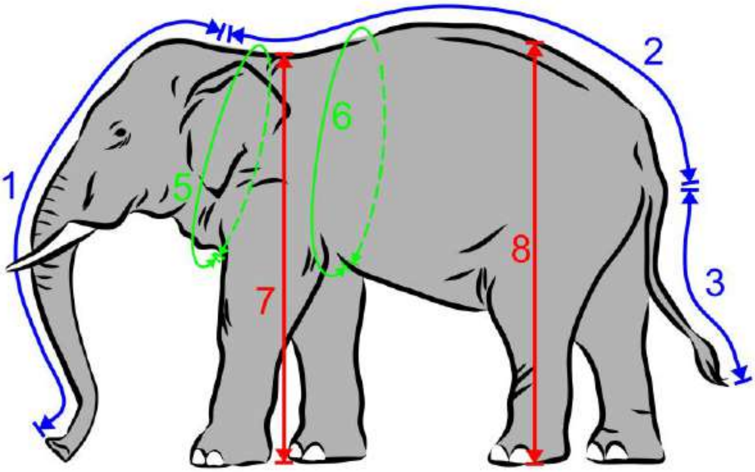
Several infectious diseases such as tuberculosis, measles, amoebic dysenteric, salmonellosis can be acquired by captive elephants from humans. Periodic health monitoring of the personnel will minimize the potential for disease transmission from caretaker to the animal. It should form a part of the overall management.

Conclusion

Maintenance of good animal health is one of the most challenging tasks for Zoo/Park managers and veterinarians. Number of factors contributes to the overall health of the individual. It is important to understand these factors and the relationship between them to have an efficient healthcare management of captive elephants.



Bodily Measurements and Weight estimation in elephants

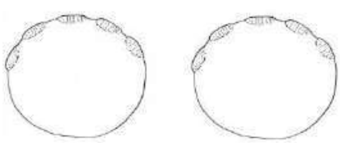


1) Trunk tip to base of Occiput………
2) Body length (Base of occiput to base of tail)…….
3) Tail Length…………………………
4) Tail Description (Full/ broker/ kinked) Tail tip …
5) Neck Girth…………………………
6) Chest Girth ……………………………….……
7) Shoulder Height ……………………
8) Hind limb length ……………………..………

Weight (Kg)=12.8 (G +Ng)-4281 [G =chest girth in cms, Ng=neck girth in cms]
Weight (Kg) (Male)=18 (HG)-3336 [HG=heart girth in cms]
Weight (Kg) (Female)=15(HG)-2562 [HG=heart girth in cms]
Weight (Kg)= 1010 + 0.036 (LXG) [L= Body length (cm) from base of forehead to the base of tail, G= Chest girth (cm) measured just caudal to elbow]

Estimation of Height

Height=Double the circumference of the front foot



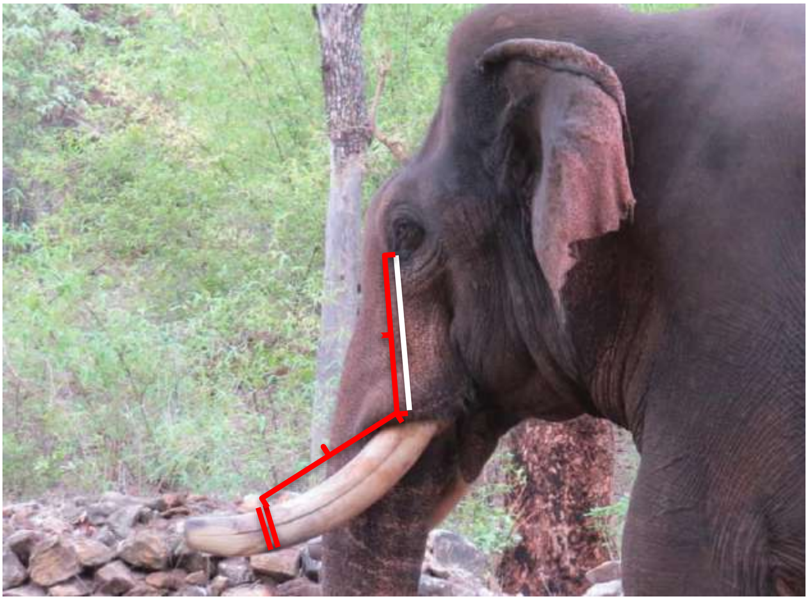


Photo by: Parag Nigam

Plate 4.1: Measurements for Tusk trimming

Photo by: Parag Nigam

Plate 4.2: Scrubbing of elephants in Sanjay Dubri Tiger Reserve as part of daily routine

Photo by: Lakshminarayanan, N

Plate 4.3: Emaciated and weak body condition

Photo by: Parag Nigam

Plate 4.4: Obese captive elephant


யானைகளுக்கு கொடுக்கப்படும் உணவுகள்:-
கொள்ளு
ராகி
அரிசி
உப்பு
வெல்லம்
வைட்டமின் கலவை
தேங்காய்
கரும்பு
SUMANGALA
WASIM
சந்தோஷ்
Santhosh
விஜய்
Vijai

CHAPTER V

NUTRITIONAL MANAGEMENT OF CAPTIVE ASIAN ELEPHANTS

- *Shrikant B. Katole and Asit Das*

Introduction

Asian elephant is categorized as an endangered species by IUCN. It is also protected from international trade by listing it in Appendix I of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Average weight of a male elephant ranges from 3500-5000 kg, whereas bodyweight of a female (cow) ranges from 2500-3500 kg and height is up to 6-10 feet. Life span recorded of Indian elephant is up to 70 years. Elephants are browsers as well as grazers and in wild browse on variety of plant materials. They may consume tree leaves, branches, bark, twigs and fruits. Elephants have access to all three tiers of vegetations i.e. lower (grass), middle (bush), and upper tier (canopy). The elephants are classed under mega-herbivore (Owen-Smith, 1988). They are monogastric herbivores with hindgut fermentation. Various bacteria, protozoa and fungi are present in hind gut which helps in degradation of fiber. Proportion and concentration of VFA in hind gut of elephant was similar to that recorded for horses (Drochner and Meyer, 1991). Supplementation of concentrates increases VFA concentration in elephant (Clauss *et al.,* 2003). Although their relative energy requirements are less, because of large size, elephants require large amount of food. Majority of these feedstuff is poor quality roughage characterized by low digestibility. So, the digestive mechanism adopted by elephant is to derive maximum nutrient within a shortest possible time. Consequently, elephants have faster passage rate (Loehlein *et al.,* 2003). Faster digestive passage rate and more feed consumption are the adaptive mechanism to survive on poor quality roughages. Mean retention time could be as low as 33 h.

In India, semi-captive elephants are fed concentrates (usually twice a day) and allowed to graze for 6-8 hours in the daytime. During night time, they are kept in the shelter and provided with forage which are cut from the nearby forests in the vicinity of the camp area. These forage materials along with the different type of grasses, trees, barks, leaves and fruits consumed by elephants while grazing is the main stay of their diet. Such diets are characterized by high fiber-low energy density and could be deficient/ imbalanced in micro nutrient make-up. Nutrient deficiencies/imbalances of poor-quality forages can only be detected through laboratory analysis of a representative sample. These deficiencies can then be balanced with the provision of specific supplements, such as limited amounts of concentrate feeds. Ideally, every forage should be analyzed for a set of nutrients (Ullrey, 1997) and concentrate feeds or mineral supplements should be provided accordingly. In this regard, selection of right type of forage material is of paramount importance. Further, the amount of forage to be offered to elephants during night hours is also equally important. If the amount is less there is likelihood of energy deficiency, on the other hand feeding in excess may cause obesity. Thus, it is of utmost importance to know the type and exact amount of forages to be offered to elephant during night hours.

Regardless of the forage chosen, several nutrients are likely to be in short supply. So, choosing a right type of supplement which can correct the deficiency/imbalance of forage-based diet is essential. Further, in many captive facilities the elephant has to work for several hours and may not get enough time to fulfill their nutrient requirement from high fiber forage diet. To compensate, the elephants are supplemented with various amount of cereals. This however is not safe always. Excessive feeding of concentrates may lead to obesity, infertility and chronic foot lesion. Before designing a diet schedule for working elephant it is necessary to study the effect of work on physiological and nutritional performance of elephants. Then only we can work out a diet schedule suitable for working elephants. Excessive concentrate feeding may induce laminitis lesion and thus contribute to the phenomenon. It is difficult to assess the nutritional status of very large animal as the animal cannot be weighed on a regular basis. Although body condition scores for large animals have recently been made available (Wemmer *et al.,* 2006), an obese condition may go unnoticed due to large size of these animals. In this manuscript we will discuss the constraints associated with feeding of elephants in captivity and shall try to provide suggestive measure to correct nutrient imbalances to promote captive propagation and to overcome nutritional health hazards.

Digestive system and function

The elephant is a non-ruminant mega herbivore and its digestive system is comparable to that of a horse or a zebra. The elephant has a separate distensible pharyngeal pouch that terminates into sphincter which controls the flow of food or fluid into the esophagus. Elephant stomach is about 100 cm long with distinct cardiac and pyloric end. The cardiac end is long and tapering. Small intestine of an adult Asian elephant could be 2 m long, large intestine 12.8 m long and caecum 0.6-1.5 m long (Fowler, 1986). The large intestine has got sacculated caecum and colon. The sacculation is achieved by longitudinal band of muscles. The average wet weight of digestive tract contents of 10 wild African elephants in the Kruger National

Park of South Africa was 415 kg (van Hoven *et al.,* 1981). While grazing, elephants pull out grass from the ground with the help of trunk, remove the dust and mud by beating on the forelimb and then eat the dressed food. In elephants, the lateral movement of the jaws is not pronounced during mastication. This along with the comparatively lesser volume of the buccal cavity does not permit proper chewing of the feed which is one of the reasons for poor digestibility. As the elephants have adopted a digestive strategy of extracting maximum nutrients from highly fibrous diets within a shortest possible time they have to continue to eat for better part of the day. They spend about 12-16 h of a day eating. Food is chewed and mixed with saliva and through esophagus it passes into the simple stomach which is connected to caecum and colon. About 70-75% of contents of stomach were found in the caecum and colon, which is the main site of microbial fermentation. The passage of digesta and its mean retention time (MRT) in the gastro-intestinal tract is reported to vary with diet. The retention time depends primarily on length of digestive tract and type of diet. The MRT in Asian elephant is relatively shorter (Clements and Maloiy, 1982) than ruminants. It might be due to proportional size of the digestive tract, which is longer in ruminants than elephant. Further, ruminants have complex digestive system and compartmentalized stomach which aids in retention of digesta for longer period. In elephants, defecation occur around 14 -18 times in a day. In a singular defecation 5-6 boluses of 1.5 - 2 kg each are passed out. Elephant can urinate 10 - 14 times a day. Volume discharged at each urination time varies from 5 - 11 l with a total discharge of about 50 l/d (Wallach and Boever, 1983).

Microbial ecology and fermentation

Elephants are simple stomach animals with hind gut fermentation. The complex carbohydrates are not digested by the mammalian enzymes, and therefore, for the digestion of structural carbohydrates these animals have to rely on symbiotic microorganism present in the hind gut. In elephants, caecum and colon are inhibited by anaerobic bacteria and protozoa which are reported to be similar with those found in rumen of ruminants. Smith et al. (1982) reported that microflora of wild elephants consisted of large number of different species of bacteria and protozoa as compared to the captive elephant. Number of bacteria per gram of elephant faeces may range from 10^7 to 10^{12} (Stevens and Hume, 1995). The bacterial species isolated from elephant were similar with those isolated from horses (Stevens and Hume, 1998). In horse, caecal and colonic microbes consists of bacteria, fungi, protozoa. Out of these, bacteria make substantial contribution to biological degradation of fiber. Major cellulolytic bacterial species responsible for fiber digestion are *Ruminococcus falvefaciens* and *Ruminococcous albus* (Julliand *et al.,* 1999). Similar microbial profile was also reported in Asian elephant (Katole, 2012). Like other herbivorous animals, ciliate protozoa are nutritionally important in elephant also (Regensbogenova *et al.,* 2004). Obanda et al. (2007) reported seven ciliate families and 27 genera in faecal samples of African elephant in Tsavo West National Park, Kenya. The *holotrich* and *entodiniomorph* have wide enzymatic profile which helps in digestion of cellulosic and hemicellulosic from partially chewed feed materials which are otherwise indigestible. The genus *Triplumaria* had been reported along with 11 other ciliate species in Asian (*Elephas maximus*) and African elephant (*Laxodanta Africana*) (Timoshenko and Imai 1995).

Microorganisms found in the hind gut ferment sugars, starches, cellulose, hemicellulose and pectin into short chain fatty acids, CO_2, CH_4 and H_2. The enzymatic fibre degradation of fibrous feeds, partly chewed plant materials and lactic acid formed in upper digestive tract results in production of volatile fatty acids (VFA). These VFA's are readily absorbed in body and are major source of energy to elephant. The short chain fatty acids (SCFA) contribute to the maintenance requirement. The proportion of different VFA was about 70:15:15. The VFA concentrations and proportions in faeces of the elephants were reported to be similar to those recorded for horses (Drochner and Meyer, 1991), but proportion of propionic acid is less as compared to other animals. This might be compensated by absorption of carbohydrates from the foregut. When captive Asian elephants were fed on hay based diet, proportion of acetate, propionate and butyrate was 76, 18, 6%, respectively (Clauss *et al.,* 2003). In free ranging African elephant, respective values were 74, 13 and 8% (Clements and Maloiy, 1982). Lower proportion of propionate in free ranging elephants indicates that wild elephants do not consume more seeds or other energy rich dietary rich items. However; they can still produce enough VFA by more fermentation of fibrous materials to meet 100% of their maintenance requirement (Clauss *et al.,* 2003). An increase in VFA concentration was observed in elephants as proportion of concentrates in the diet was increased (Clauss *et al.,* 2003). Gunther (1984) observed an increase in faecal pH as VFA concentration was increased, but other study (Clauss *et al.,* 2003) indicated that faecal pH of elephant is unlikely to change as faeces contain high amount of undigested protein which may acts as a buffer. Hackenberger (1987) reported that African elephant are adapted to the diet with a higher proportion of browsing materials than Asian elephant. As the browse material can be fermented faster (Short *et al.,* 1974), VFA produced by browsing elephants are higher than grazing elephants. The methane production in this species is lower than ruminant livestock (Jenson, 1986).

Urea is released into all segments of intestine of the elephant, but nitrogen recycling is most effective in the hindgut. Major substrates that are degraded for the production of ammonia and synthesis of protein are urea, creatinine, enzyme, mucus, sloughed cells and nitrogen contained in feed residue. Even though there is no direct evidence/experimentation on elephant, it can be easily assumed from the studies conducted in other hindgut fermenters that most of the ammonia is either incorporated into microbial protein or absorbed or recycled to the liver for synthesis of nonessential amino acids. Urea nitrogen was extensively recycled through the hindgut of equids (Prior *et al.,* 1974) and rock hyraxes (Hume *et al.,* 1980), which are the closest relatives of elephant.

Nutrition in free ranging habitat

In the wild, elephants can consume grasses and also browse on branches of variety of trees. Asian elephant consumes dry browse material having large amount of fibre. A typical diet of a wild elephant may contain 30-50% dry matter (DM), 57-70% NDF up to DM, 8-12%, crude protein (CP) (McCullagh, 1969). Free ranging Asian elephant in southern India consumed 112 plant species out of which 25 species contributed nearly 85% on total intake. In areas where mixed tall grasses were available there was more grazing as compared to browsing. During rainy season, growth of new grass was found to encourage grazing (Sukumar, 1989). Food preferences of the Asian elephant (*Elephas maximus*) were studied at Rajaji National Park, Uttarakhand (Joshi and Singh, 2008). It was reported that elephants diet comprised of more than 50 plant species. It was observed that that diet composition varied significantly during different seasons. Majority of the diets were comprised of various trees (74%) followed by grasses (14%) and shrubs (8%). Elephants extensively feed on Rohini *(Mallotus phillipinensis)*, khair *(Acacia catechu)*, dhauri *(Lagerstroemia parviflora),* chamror *(Ehretia laevis),* shisham *(Dalbergia sissoo)*, teak *(Tectona grandis)*, ber *(Zizyphus mauritiana)*, bel *(Aegle marmelos)* and barh *(Ficus bengalensis)*. They also utilized various grasses and shrubs as their food, which mainly included bamboo *(Dendrocalamus strictus)*, kapasi (*Helicteres isora)*, pula *(Saccharum munja)*, kans *(Saccharum spontaneum)*, doob grass *(Cynodon dactylon),* dav/kush *(Desmostachya bipinnata)* and bichhloo grass *(Neyraudia arundinacea)*. Crop raiding is a sporadic problem caused by elephants and its incidence increases towards the onset of monsoon. Bamboo (*Dendrocalmus strictus*) was reported to be a favourite food of Asian elephant at Palamau National Park. In that area, elephant also relished wild plantains (*Musa sp.*) and grasses of the genus *Imeperata, Panicum, Cymbopogon, Andropogon* etc. (Mishra, 1985). In wild, daily dry matter intake was 1.5-1.9 % of body weight reported in adult Asian elephant (Sukumar, 1989). The Dry matter digestibility in free ranging African elephant has been estimated to be 30-45% (Meissner *et al.,* 1990).

Nutrition and feeding in captivity

As captive animals are totally dependent on care takers for food hence, it becomes very important to provide all required nutrient in diet of captive animals in appropriate quantity. Gokula (1993) compared diet schedule of temple and zoo elephants in south India. Temple elephants received 10.3±5.87 kg of cooked food and 54.7±39.87 kg of fresh forages, whereas, zoo elephants received 9.0±5.1 kg cooked food and 133.3±86.17 fresh forages. In Karnataka, elephant's diet is generally supplemented with rice, wheat, ragi, horse gram either alone or in combination. The ingredients are blended and cooked before feeding. Forest Department of Karnataka state feed their elephants on the basis of body size, work, age, pregnancy and lactation (Nair and Gadgil, 1978). At Kanha National Park, Madhya Pradesh, semi-captive working elephants were supplied with diet supplement of wheat roti (5-9 kg), rice ball (300 g) and jaggery (500 g) and salt (200 g). After this supplementary feeding, elephants are released in the forest for grazing. In forest, they browse on bamboo, *ficus* leaves, Rohini, sal, teak tree and also graze all types of grasses (Saxena, 1991). At Kaziranga National Park, Assam, elephants were released for grazing in winter for about 8 hours while in summer they were released during midday and night for grazing. Working and resting elephants were offered soaked gram at 10 and 5 kg/d, respectively. All animals are supplied with salt (Arora, 2001).

Captive elephants at National Zoological Park, New Delhi were supplied with 200 kg of sugarcane/green fodder, 50 kg of tree fodder, 50 kg of dry fodder, 2 kg of jaggery, 1 kg of rice, 1 kg of green gram, 100 g of salt, 2 dozen bananas and 100 ml mustard oil (Arora, 2001). Captive elephants at Zoological Garden, Lucknow, Uttar Pradesh, were fed with diet that comprised of green fodder (~200kg) such as Jowar/sugarcane/tree fodders, 5 kg of wheat roti, 1 kg of jaggery, 50 g each of common and black salt. At Zoological Park, Vandalur, it was observed that elephant preferred Napier grass followed by paragrass, subabul and tree fodder (Arora, 2001).

The dry matter intake relative to body weight is mainly influenced by dry matter digestibility (Meissner *et al.,* 1990), environmental factors, maintenance, growth, lactation, species difference and other factors. When palm (*Caryota ureus*) leaves were fed *ad libitum* to three Asian elephants of body weight 2220, 1880, 1160 kg, their respective DMI was 4.5, 4.5 and 5.1 kg for 100 kg. In this study, higher DM was attributed to chopping of palm leaves (Nair and Ananthasubramaniam, 1979). In most of the other studies, on an average 1-1.5% DM intake was observed in captive elephants

(Ullrey *et al.,* 1997), young animals show little more DMI up-to 2% of body mass (Loehlein *et al.,* 2003; Das *et al.,* 2014b). Krishnamurthy and Wemmer (1995) worked out that on DM basis, grains requirement of Asian elephant was 0.5% of BW. He further opined that the daily ration of elephants should be provided according to age and physiological function. Dry matter digestibility in captive Asian and African elephant on grass hay was reported to be 38-45% (Hackenberger, 1987). Passage rate is higher in elephants (Table 1) which contribute to lower digestive efficiency (Loehlein, *et al.,* 2003). Elephants use the digestive strategy of passing large amounts of low-quality forage through their gut within a short period of time (Loehlein, *et al.,* 2003). The passage time of food materials through the gastrointestinal tract ranges from 18 to 24 hours.

Intake and digestibility of Timothy (*Phleum pratense*) hay in winter and summer was compared (Roehrs *et al.,* 1989) where authors used two young female African elephants. CP content of Timothy hay was 8.6 and 7.7% and ADF content was 57.3 and 44.0% during summer and winter, respectively. Dry matter intake ranged from 1.4-1.6% BW. Apparent digestibility was 39 and 34% for DM; 45 and 30%for ADF and 36 and 24% for CP, in summer and winter seasons, respectively.

Table 5.1: Estimated body weights according to Hile, et al. (1997) and mean retention times of chromium oxide determined in by Loehlein et al. (2003).

Animal No.	Age (yrs)	Sex	BW (kg)	MBW ($kg^{0.75}$)	MRT (h)
1	4	M	888	163	21.8
2	4	F	1067	187	21.4
3	8	F	2200	321	32.0
4	31	F	3217	427	-
5	27	F	3177	423	28.1
6	38	F	4013	504	32.1

Clauss *et al.,* (2003) studied the digestibility in captive Asian elephant (n=6) fed on different diets using double marker method (acid detergent lignin as internal and chromium oxide as external marker). Dry matter intake (kg/d) was 32.04, 34.4, 37.98 and 35.39 in hay only diet, hay plus pelleted feed-based diet, hay plus oat-based diet and hay plus beet-based diet, respectively. Apparent digestibility of organic matter (OM) was 35.53, 38.25, 38.16 and 35.1%: apparent digestibility of crude fiber (CF) was 31.8, 32.76, 24.52 and 22.88%, in the four respective diets. Proportionate to body size, intake of DM, CP, and DE was higher in juveniles, followed by sub-adults and adult Asian elephants. Digestibility of NDF was lower in juveniles as compared to sub-adults and adult Asian elephants. However, this deficit was more than overcome by increasing the digestibility of NDS. Results showed that the digestibility of CP and GE and intake of DE decreases with age (Das *et al.,* 2014b).

As protein deficiency has been reported in captive animals on poor grass hay-based ration sufficient amount of protein in diet of young and growing captive elephants should be provided (Ullrey *et al.,* 1988). Ullrey et al. (1997) estimated the protein requirement of elephants based on extrapolation of data of horses (NRC, 1989) and recommended 8-10% of crude protein for maintenance, breeding and early pregnancy, 12% for late pregnancy and 12-14% of CP for lactation and growth.

According to Das et al. (2014b), a diet containing 8.1-10.1 and 7.3 - 8.2 % CP would be able to meet estimated requirements when DMI ranged from 1.99- 2.38 and 1.51-1.80 % of BW, in juveniles and sub-adult, respectively. It was further showed that a diet containing 12% CP would be adequate to meet requirement for Asian elephant juvenile fed zoo diets. A study conducted in southern India on wild Asian elephant implies that leaves of 11 plants browsed by elephant in free ranging contained 13-26% CP, while wild grass *Themeda cymbaria* contained 9-10% CP during rainy season. However, during dry season, browse leaves contained 6-18% CP and wild grass contained 3% CP (Sukumar, 1989). It is reported that large size males can tolerate more fiber than smaller one and MRT positively correlates with body size in captive elephants. Moreover, MRT significantly correlates with digestibility of fiber (Hackenberger, 1987) and so larger animals show more digestibility of fiber. Increase in concentrate ingredients in diet results in faster passage rate in African elephants (Hackenberger, 1987).

While suggesting feeding guidelines for Asian elephants it is of paramount importance to use right kind of feed ingredients in appropriate amount. Feeding of WR at 0.06% of BW was able to supply adequate amount of DE and CP to maintain body weight. Feeding of WR in excess of 0.06% of BW supplied DE in excess of requirement, increased blood glucose concentration and may cause obesity (Das *et al.,* 2014a). Dry matter intake and digestibility were similar in elephants fed either wheat roti (WR) or rice-lentil mixture (RLM). However, intake and utilization of CP in elephants fed RLM than those fed WR. It was demonstrated that rice-lentil mixture could be a better supplement than wheat roti for growing Asian elephants in captivity. However, further research involving more number of replicates is warranted to examine if long term feeding of RLM can support normal growth and health of captive Asian elephants or not (Katole *et al.,* 2015b). Rohini contained adequate amount of CP and trace minerals and supplied higher amount of minerals to elephants than cut grass fed either alone or in combination. Feeding of 100 kg of Rohini was sufficient to fulfill DE requirement of grazing elephants (~3500 kg BW) while elephants offered 80 kg of Rohini received energy in short of their requirements. Thus, amount of Rohini fed to semi-captive Asian elephants should be restricted to 100 kg (Katole, 2012)

Minerals

Macro and micro minerals perform many vital functions in the body. Minerals are involved in activation of several enzymes, physiological processes, maintaining acid base and electrolyte balance of the body. Mineral status of animals can be judged from the mineral contents of soil and plants consumed by animals. When animals graze on grassland, and vegetations deficient in minerals they are prone to mineral deficiency.

Calcium absorption coefficient in captive Asian elephant averaged 60%, independent of concentration of Ca in diet (Meyer and Coenen, 2002). High urinary calcium concentration in captive elephants was reported by Ruedi (1995). Calcium absorption from the hay or pelleted diet was significantly lower than grasses in elephant. As there is no data on requirements of micro minerals in elephant, recommendations of micronutrients for horses may be used (Ullrey *et al.,* 1997; Ange *et al.,* 2001). Deficiency of minerals in case of captive elephants is rare except Zn (Schmidt, 1989) and calcium deficiency in some cases. Requirement of 60 g Ca/d was estimated for Asian elephant (Sukumar, 1989).

In southern India, bark and tree leaves browsed by elephants contained 0.25-5.72% calcium and 0.08-0.21% magnesium; grass leaves contained 0.19-0.46% calcium and 0.06-0.08% magnesium (Sukumar, 1989). In Nepal, *Saccharum arundinecium*, commonly consumed by Asian elephant contained Fe, Cu, Mn, Zn and Se at the concentration of 296, 39, 29, 52 and 0.12 ppm, respectively (Shrestha *et al.,* 1998).

The minerals are found in blood, tissues and body fluids of animals in various concentrations. The concentration of these minerals must be maintained within normal level required for bodily function. Mineral concentration in soil and plants varies from place to place, which influence the mineral status of animals. Continuous ingestion of plants deficient in minerals may leads to mineral deficiency and affects the health of animals. Serum mineral status of Indian elephants was studied by Sreekumar and Nirmalan (1992). They found that calves showed significantly higher (2.36

mmol/l) values of serum calcium than adult females (2.17 mmol/l). Copper concentration in calves, tuskers and adult female elephant was 24, 29, 34 μmol/l, respectively. Similarly, zinc concentration was 31, 34, 43 μmol/l in calves, tuskers and adult female elephant, respectively.

Serum mineral status of elephants at Kaziranga National Park and Manas Wildlife Sanctuary were studied by Sarmah et al. (1999). They observed that the concentration of Fe and Cu were significantly higher in elephant at Kaziranga National Park (4 vs0.82 ppm) than Manas Wildlife Sanctuary (3 vs 0.61 ppm). Gromadzka-Ostrowska, et al. (1988) studied the plasma minerals concentration in 10 Indian elephants. They observed that plasma concentration of Na, K, Mg, Ca and inorganic phosphorus was 3044, 530, 34,182 and 45 μg/ml, respectively. They further concluded that concentration of Ca and Mg was higher and that of Na and inorganic P was lower during winter. Brown and White, (1978) reported serum electrolytes in African elephant from game parks of Uganda. They observed mean values of 137 and 6.24 mmol/l for Na and K, respectively. These authors also observed seasonal changes in serum electrolytes as higher Na concentration was observed during dry season. The higher values might be due to water depletion arising from restricted intakes of water during that period.

Apparent absorption of P and Fe were better in elephants fed RLM than those fed WR. Intake of zinc was also higher in elephants fed RLM (Katole *et al.,* 2015b). Feeding of WR at 0.06% of BW resulted in decreased intake and apparent absorption of P. At this level of feeding of WR, it would be desirable to include a supplementary source of P in the diet. Intake and apparent absorption of Ca, Fe, Cu and Zn were not affected by gradual reduction of WR in the diet of semi-captive Asian elephants. Novel data on true absorption and endogenous fecal losses of minerals were generated which could be useful for determination of mineral requirements of semi-captive Asian elephants (Das *et al.,* 2014a). Significant improvement in serum mineral profile could be achieved by imparting exercise through moderate level of touristic work. Benefit of 4 h of touristic work was improved utilization of Ca, P, Co, Cu and Fe in captive Asian elephant fed sugarcane-based diet (Katole *et al.,* 2015a, b).

Nutritional disorders

Obesity: Animal feeds until its energy demands is satisfied. Energy, however, being a major aspect in feeding is overlooked at most of the places. Captive elephants are sometimes provided with adequate amount of easily digestible feed materials. This causes supply of more energy rich feeds which results in obesity and other health related problems. Reasons for obesity might be regular consumption of readily digestible energy rich feed ingredients like grains, breads along with low fibre pelleted feeds, fruits etc. which needs to be restricted. It is reported that in most of the Western zoos elephants are in obese condition (Ange *et al.,* 2001; Hatt and Liesegang, 2001). Obesity in captive-elephant may results in development of foot lesions (Csuti *et al.,* 2001). Along with foot lesions, benign uterine tumors of female genital tract may also develop, which results in infertility, frequently diagnosed in elephants (Hildebrandt and Goritz, 1995). So, it is prudent to practice moderate level of feeding based on field studies and extrapolation of data from related species and diets should be adjusted accordingly to reduce obesity in semi captive elephants. To monitor obesity, there is a continuous need to observe the body condition of elephants. As regular weighing is not possible in elephant, other means such as noting bony structure of hips and spine could be useful. Besides, regular body measurements may also be useful for determination of body weight (Hile, *et al.,* 1997; Wemmer, *et al.,* 2006). Providing exercise could be an effective measure to reduce the possibility of obesity in captive Asian elephants. Digestibility of GE was higher in working than non-working elephants. Energy demand is increased due to work which causes animals to improve the energy absorption and utilization (Katole *et al.,* 2015a). Working elephants digested energy more efficiently than non-working elephants. Research conducted at ICAR-IVRI revealed that Four hour of touristic work has no adverse impact on food consumption and blood metabolite profile of semi-captive Asiatic elephants rather digestibility of nutrients was improved in working elephants.

Foot lesions: Foot lesions are the most important nutritional disorder observed in captive elephants. It is a major problem in semi-captive elephant in most of the zoo and national parks in Indian subcontinent. This problem is reported to be a common ailment in nearly 50% of captive elephants (Csuti, *et al.,* 2001). It includes penetrating injuries, trauma, sole cracks, cracks in the cuticle, overgrowth, arthritic condition, abscesses etc. Major reasons behind these problems might be lack of exercise, concrete floors of enclosures, standing over water soiled with urine and faeces, contamination etc. Standing water in indoor enclosures can cause foot problems. As standing water acts as a breeding ground for bacteria, secondary infections further aggravate the condition. Thus, floors should be impervious to water, quick to dry, and sloped to a drain. Floor surfaces should be relatively smooth, but not so that become slippery when wet. Conversely, very rough surfaces may cause excessive wear or irritation of footpads. Foot lesions are curable and most of the time treated successfully, but sometime it may become complicated resulting in limping. Hence, care and management of this disorder and prevention of foot lesions, are essential parts of elephant rearing in captivity. Local and systemic antibiotics, analgesics, and protective sandals to heal pododermatitis in elephants are some measures taken up by various practitioners. But its probable link with mineral deficiency in diet of elephant cannot be ruled out. Zinc deficiency in captive elephants results in hyperkeratosis and poor inflammatory response in infected vesicles above the toenails. Supplementation of zinc carbonates cured this condition and confirmed the role of zinc in this disorder (Schmidt, 1989). Further biotin supplementation improved the foot health. Biotin is the least absorbed vitamin, when ingested by elephant only 1% of it is absorbed and remaining excreted through urine. It is believed that elephant like horse also absorb very small amount of ingested or supplemental biotin (Ullrey *et al.,* 1988).

Conclusion

Feeding of concentrates to captive Asian elephants with ad libitum access to forages should be restricted to 0.06% of BW to get maximum nutritional benefits and to reduce the risk of health problems associated with feeding of excessive concentrates. Restriction of 50% of the concentrate of conventional zoo diet resulted in decreased intake and digestibility of DM, CP, and GE, but was still able to meet requirements of energy, protein and in all age-group of elephants. Rice-lentil mixture was found to be a better supplement than wheat roti for growing Asian elephants in captivity. Four hour of tourist work has no adverse impact on food consumption and blood profile rather digestibility of nutrients was improved in working elephants. Rohini *(Mallotus philippinensis)* tree seems to be a better source of roughage to the elephants than cut grass fed either alone or in combination.

CHAPTER VI

SURGICAL INTERVENTIONS IN ELEPHANTS

- *Kushal Konwar Sarma*

Introduction

There are an estimated 27-30 thousand wild elephants (*Elephas maximus*) in India and another 2800 elephants in captivity. The captive elephants are maintained in forest camps, logging camps, eco-tourism camps, zoos, temples and in life time care centers. Surgical affections are not of rare occurrence in both wild and captive elephants. Of course, the injuries may be much higher in percentage in the captive elephants. Injuries in wild elephants are mostly inflicted by aggressive farmers who attack the raiding elephants for protection of their farms and dwellings or other properties. These are mostly firearm injuries, spearhead or piercing arrow injuries or burn injuries from throwing of burning tyres or bitumen etc. In the recent years, different kind of injuries have been noticed *viz.* damage to the oral cavities including fracture of mandibles, splitting of tongue and severe lacerations of oral cavity from biting of pressure bombs concealed in fruits etc. Injuries in wild animals are also taking place from predator attacks, train hits which are often fatal. Injuries from electrocution are also almost entirely fatal; few may escape with burn injuries. Injuries have also been seen occurring due to infighting causing fractures, penetrating or punctured wounds from tusk goring, and biting of the tails. In captive elephants, frequently occurring surgical affections are bursitis, galls, tail gangrene, tusk injuries, foot affections, fractures, rope/chain burns, accidental or malicious firearm injuries and a large percentage of foot affections.

Managing wild elephants for surgical interventions

The first step in rendering treatment to an injured wild elephant is in ensuring immobilization or deep sedation. Immobilization is done with etorphine HCl (1mg/400-500kg body weight) and deep sedation with xylazine HCl (100mg/1000kg) or medetomidine HCl (5µg/kg) with ketamine. Etorphine brings the elephant down to lateral recumbency in 6-10 minutes) but the α_2 agonist agents give standing sedation by around 25-30 minutes. The drug selection depends upon availability, terrain etc. One notable concern with the opiate is that there will a possibility that the elephant lies down with the injury underneath which will make the surgical intervention impossible. The drug has to be delivered with a dart syringe using a syringe projector gun and the procedure involves risk to the sniper if the injury has not incapacitated the target elephant from chasing. A point that should be kept in mind is that immobilization itself is not the treatment, it is only the first step. We must have a team of surgeons to carry out the required surgical operation and they should be ready with all surgical equipment for the same. It is also necessary to apply some temporary physical restrain by tying the feet to one another with soft ropes to prevent any sudden movement that can cause injuries to the surgical team.

Another issue that may be of concern is that a wild elephant will not be available for follow-up treatment every day. We may not be able to choose the antibiotic based on laboratory antibiogram. Hence, we should use a broad spectrum and long acting antibiotic. Severe injuries may warrant to construct a boma to keep the elephant to provide necessarily follow up treatment besides food and water.

Managing captive elephants for surgical interventions

A well-trained captive elephant may present itself for various minor procedures. The vet should approach the animal with compassion and confidence and offer tit-bits of food to establish a relationship. However, it is wise to restrain the elephant for many procedures in a restrain chute or commandeer to a suitable and reasonably safer position like lateral recumbence (vernacular: *tere boith*) or at least a sternal recumbence (vewrnacular: *sam boith*) position. It is advisable to induce sedation with a suitable and available α_2- agonist whenever the surgery is likely to be painful, of longer duration and/or the animal is aggressive in nature. Sedation can be supplemented with local analgesics. Whenever possible, it is wise to go for laboratory investigation to make an objective evaluation of the haemato-biochemical status of the animal and undertake remedial measures before the anaesthesia if it is not an emergency. Suitable preanaethetic medication is also suggested in captive elephant anaesthesia, which is not possible in their wild counterparts.

Experience with some surgical interventions in elephants

Gun-shot wounds: They are seldom fatal if the bullet does not affect a vital organ. Out of over 25 cases, one captive bull died within 24 hours due to fire-arm injury, when a bullet accidentally fired from a .315 rifle entered the upper flank and shattered a kidney and another wild bull dropped dead immediately when hit by a bullet fired from a .303 rifle on the forehead leading to brain injury. Pellet gun bullets get encapsulated in the muscle. In many other cases involving the bullets hitting various parts of the bodies, the animals survived. After proper sedation, the bullet injury point is cleaned under jet of antiseptic solution. Since radiographic assistance is often farfetched in our field conditions, a hand held metal detector comes in handy to confirm the presence of a bullet as well as to judge its depth.

A metallic probe should be gently inserted to find the location of the bullet and judge the direction of the wound leading to the bullet. Based upon surgical judgment, we may cut through the tissues to extract the bullet or just widen the opening of the wound and expect automatic movement of the bullet in the outward direction. Tetanus prophylaxis and antibiotic course must be given. When the bullet remains deep seated, it might be encapsulated by fibrous tissues and occasionally lead to a sinus or fistula fastidious to treatment. There are no documented records of lead poisoning from a lifelong persistent bullet in an elephant.

Trunk injuries: The trunk is the most sensitive organ serving multiple functions in the elephants. Minor to severe trunk injuries have been encountered. These are caused by sharp rocky edges, falling stones, accidental injuries from the machete of the mahout or from infighting. The animal may require moderate to deep sedation depending upon the severity of the injury. The wound should be treated in the general principle of open wound management. Notable aspect here is that proper apposition of edges after debridement can affect a third intension healing, but it is extremely difficult to retain the sutures because of the mobile nature of the organ even when a superimposing retention suture was applied to reinforce the primary line of sutures.

Abscesses: Abscesses are common in working elephants, also happen in wild elephants secondary to a spear, arrow or fire-arm injury. Treatment of abscess is somewhat tricky in elephants, as the pus cannot come out to the head owing to the thick skin of the animal. Though an abscess can develop pointing, it may not burst spontaneously and instead spreads under the skin towards other parts of the body as the enzymes present in the pus can melt the tissue barriers. There may be a secondary abscess, sinus or fistula formation. So, when an abscess occurs, first it should be allowed to mature facilitated by hot fomentation with mag-sulf etc. and drained out when the pus feels soft. It should be opened at the most dependent part to facilitate spontaneous drainage. For this a counter opening may become necessary. The cavity should be explored for foreign bodies and packed with sterile cotton gauze dipped in tincture of iodine to break the pyogenic membrane.

Gall: Gall is separation of the skin from the subcutis due to severe friction. It is very painful and can be resolved at the formative stage by using cold packs, steroid with antibiotic and complete rest. It can be judged by observing the behavior of blowing of a particular area of the body with the tip of the trunk or a peculiar zig-zag motion of the back (usually gall happens over the back). When improperly handled, it becomes an abscess.

Bursitis: Repeated rubbing of a prominent part of the body like point of elbow, zygomatic bone etc. on hard surface leads to bursitis (Nath *et al.,* 2011). Acquired bursitis should be treated with steroid and antibiotic administered aseptically after drainage of the fluid and measures to avoid repeated injuries. In very chronic cases surgical bursectomy is advised.

Haematoma/ Bleeding: May occur due to trauma or rubbing against hard surfaces. Small haematoma may resolve automatically and should be monitored but large ones should be treated by evacuation.

Tail injury/necrosis: Tail injuries are very common in captive elephants, mostly caused by bites of dominant bulls. Such injuries often lead to gangrene and need to be amputated.

Fractures: Best results were obtained in the treatment of simple fracture involving weight bearing long bones by placing the elephant in sufficiently deep water where the animal is partially submerged. This is useful as the buoyancy keeps the animal partially floating, reducing stress on the fractured limb and additionally the vertical orientation of the limb bones also favour early healing in the species even without internal or external fixations. Designing an external fixation devise and keeping the same in position is also a big challenge. For internal fixation, only plating can be thought of and not intramedullary pinning because the long bones in elephants lack medullary cavities. Compound fractures are still very critical, animals are required to be put on sling to restrict movement of the limb which is immobilized using external and/or internal devises.

Phlebitis: The condition is reported due to perivascular infusion of drugs especially in the ear vein and may result in necrosis or even sloughing of the ear pinna

Tumor: Tumors are very rare in elephants. There are papillomatous growths in the lower third of the trunk which we have successfully treated with autohaemotherapy. Vaginal fibroma and uterine fibromas and leiomyomas have also been recorded.

Photo by: K.K. Sarma

Plate 6.1: Trunk injury and surgical intervention

Photo by: Parag Nigam; K.K. Sarma

Plate 6.2: (a)Infected wound at base of tusk, (b & c) Abscess at temporal and shoulder region, (d)Abscess being drained as part of surgical intervention

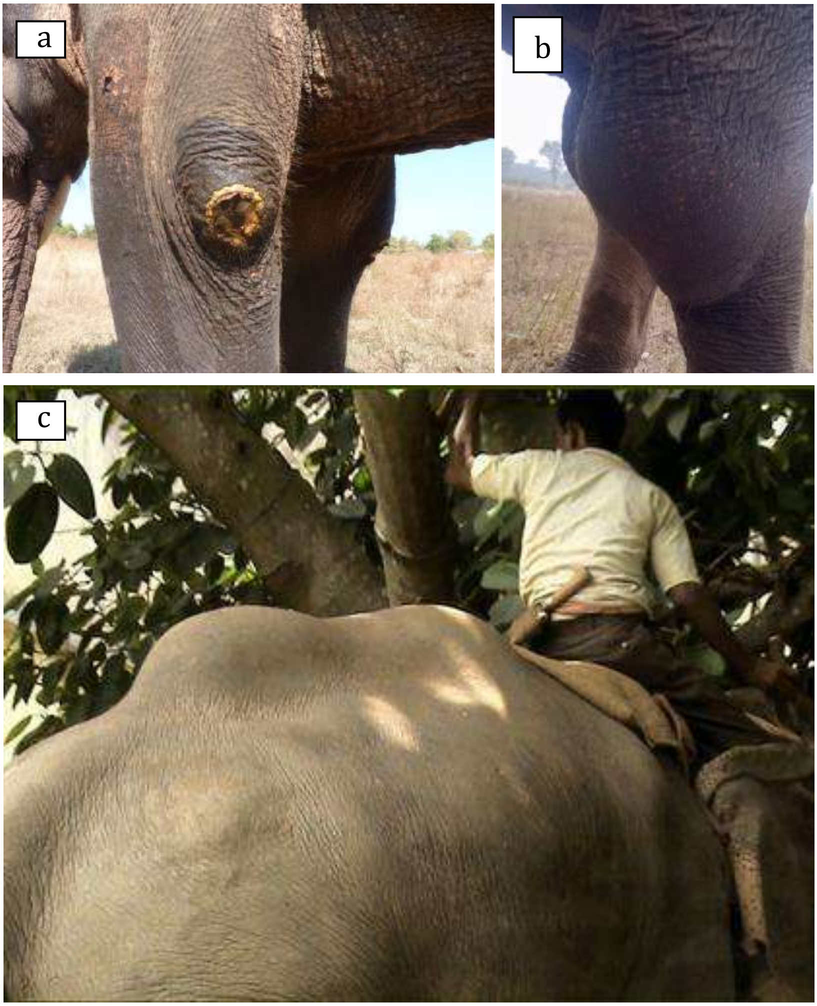


Photo by: Parag Nigam, Nitin Gupta & K.K. Sarma

Plate 6.3: (a)Infected elbow gall, (b) Bursitis of the stifle joint and (c) Farra gall on the spine

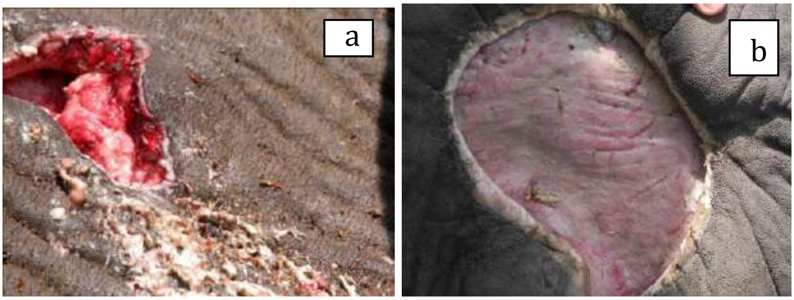


Photo by: K.K. Sarma

Plate 6.4: (a) Ruptured *Farra Gall* and (b) wound showing healing

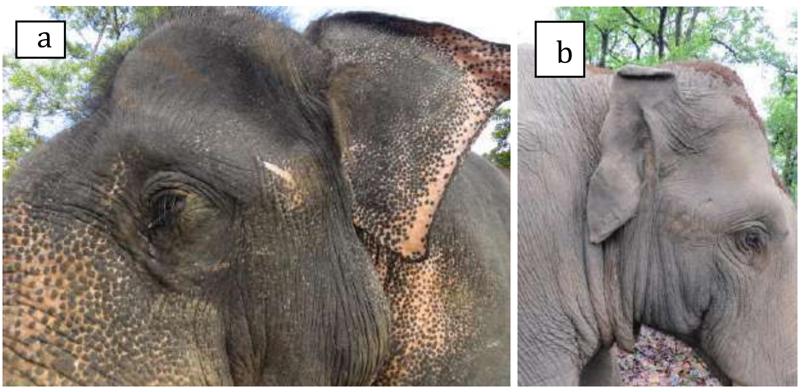


Photo by: Parag Nigam

Plate 6.5: (a) Puckering of ear pinna and (b) loss of ear pinna resulting from perivascular infusion of drugs

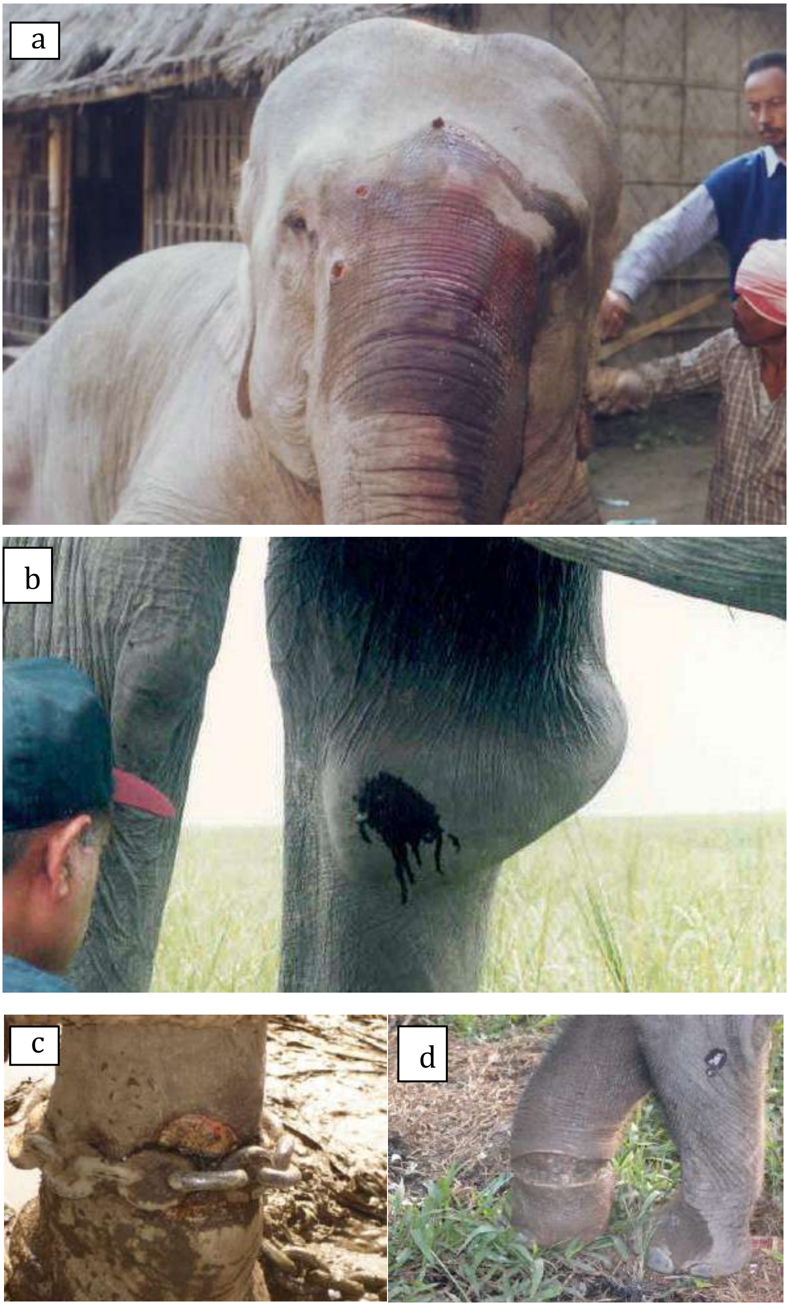
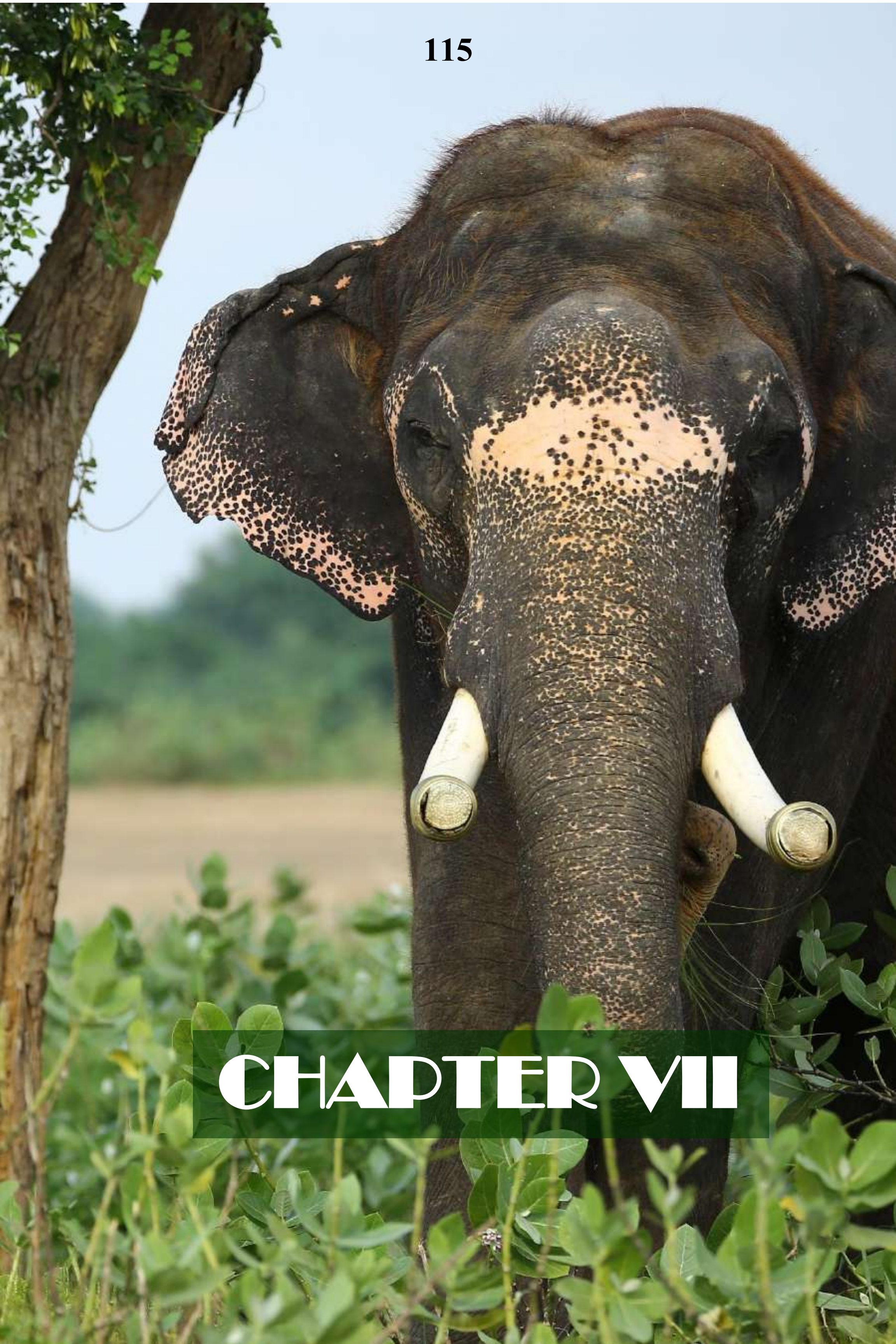


Photo by: K. K Sarma

Plate 6.4: (a) Splinter bullet injuries on forehead, (b) Peribursal haematoma and (c & d) Chain rope burns/ cuts



CHAPTER VII

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MEDICAL INTERVENTIONS IN ELEPHANTS

- *K. Mahendran*

Introduction

Pharmacological studies in elephants have thus far been limited, so clinicians are often left to extrapolate doses for elephants from those published for domestic hoof stock. Few specific pharmacokinetic studies that determine dosage regimens have been conducted; generally, with small sample sizes that have precluded determining differences between age groups, or between captive and free-ranging elephants. In recent years many scientific publications mainly focusing on the health management of elephants have been reviewed. Various medical interventions like use of antibiotics, anti-tuberculosis drugs, anti-viral drugs, analgesics, anthelmentics, acaricidals, emergency medicines, drugs for gastrointestinal disorders are discussed in this chapter.

Antibiotics and antimicrobials

Antibiotics should not be used indiscriminately. Although many organisms demonstrate predictable susceptibility patterns, there are enough variations indicating that selection should be based on results of *in vitro* sensitivity testing whenever possible. The commonly used antibiotics in elephants based on available literature are β lactum groups (Penicillin & Cephalosporins), Aminoglycosides, Enrofloxacin, Metronidazole, Sulpha – Trimethoprim.

Procaine penicillin G & Benzathine penicillin- ß-lactam antibiotics that inhibit bacterial cell wall formation and are bacteriocidal. They are effective against *Clostridium, Fusobacterium, Actinomyces, Bacillus anthracis, Corynebacterium diphtherae*, *Streptococci spp,* and non-penicillinase producing *Staphylococci*. Dose of penicillin used in Asian elephants is 4,545 IU/kg, IM q 96h or 2,273 IU/kg, IM q 48h hours.

Amoxycillin is found to be effective for *Staphylococcus, Streptococcus and Proteus*. The dose rate is 11 mg/kg Intramuscular once daily or 8 mg/kg used orally 8–12 h interval.

Ampicillin: They are effective against *Clostridium perfringens (Clostridum perfringens biotypes (A-E)* that *produce* different enterotoxins (alpha, beta, epsilon and iota) which cause enterotoxemia in animals. The dose rate used is 8 mg/kg orally (PO) at 8 or 12h interval in Asian elephant. Ampicillin is used in the treatment of Salmonellosis at 6g PO BID.

Cephalosporins: Cephalosporins are semisynthetic ß-lactams, similar to the penicillins. They inhibit cell wall synthesis and are usually bacteriocidal. They are broad spectrum, effective against gram positive and many gram-negative bacteria. Commonly used cephalosporins in elephants are Ceftiofur (short acting) at 1.1 IM, q8 or 12h & 1.1 IV, q24h. Ceftiofur (long acting) at 6.6 mg/kg subcutaneously (SC), q7-10d and Cephalexin at 10mg/kg orally twice daily. Intramammary cephalosporin preparations for topical treatment have been found to be effective.

In one case report by Sanchez, *et al.,* (2004), during pyelonephritis management in an Asian elephant, a pure culture of *Streptococcus zooepidemicus* was isolated from urine sample. It was found resistant to sulfamethoxazole–trimethoprim in ABST and found susceptible to cephalosporins. They have used Ceftiofur 6 g, i.v., t.i.d. at 1.5 mg/kg tid. On day 5 of ceftiofur therapy, intramuscular administration was attempted, but the elephant resisted the second injection, and intravenous therapy was resumed for a total of 7 days. After 7 days' antibiotic was switched to oral cephalexin (Cephalexin capsules 500 mg, 50g, p.o., b.i.d.) for 8 wk at 11 mg/kg bid. After 8 wks, the elephant remained clinically normal, and the hemogram and serum chemistries were within reference intervals. In another case report by Das *et al.,* (2014a), cephalosporin was used for the management of traumatic wound, after ABST, treatment was initiated with Ceftriaxone – tazobactum at 10 mg/kg bid. Khadpekar *et al.,* (2020) in their case report provide supportive treatment with cephalosporin (Inj. Ceftriaxone –Tazobactum at 4 mg/kg) to manage secondary bacterial infection in the bowel wall due to impaction. In another case of complete GI obstruction in an Asian elephant reported by Greene *et al.,* (2019), Ceftiofur sodium @ 1.1 mg/kg IM q 24 hr was given for seven days to prevent infection from a potential compromised bowel wall.

Amikacin: Amikacin belongs to the Aminoglycoside group which are effective against gram-negative organisms such as *E. coli* (most), *Enterobacter, Klebsiella, Proteus, Pseudomonas, Salmonella, Serratia, Shigella, Mycoplasma,* and *Mycobacteria*. Asian elephants me be treated with dose of @ 6.0–8.0 G intramuscularly (IM) q24h.

Enrofloxacin: belongs to the Quinolone group, is bacteriocidal (concentration dependent), and found effective against most gram-negative bacteria viz., *Pseudomonas, Klebsiella, E. coli, Enterobacter, Campylobacter, Salmonella, Shigella, Proteus, Serratia,* and other organisms like *Staphylococcus,* *Mycoplasma, Rickettsia, Mycobacterium*. The distribution of enrofloxacin is good in kidney, liver, bile, skin, bone, CSF, urine, female genital tract. The dose rate in asian elephants is 2.5 mg/kg orally once daily. In one case report by Sanchez, *et al.,* (2004), in the management of urinary tract infection *E. coli* organisms were isolated and enrofloxacin used at10 g, orally twice daily for 4 weeks (around 2.3 mg/ kg twice daily).

Metronidazole: Metroniidazole is an antibacterial and antiprotozoal drug and effective against anaerobes, including *Clostridium, Bacteroides, Fusobacterium.* In Asian elephants, Metronidazole (15 mg/kg q 24 h) can be used as a rectal suppository.

Trimethoprim sulfa: Sulfonamides and trimethoprim interfere with bacterial thymidine synthesis. They are effective against most gram-positive bacteria and *Nocardia*; anaerobic bacteria, including those isolated from chronic tusk infections, most gram negative *Enterobacteriaceae, Coccidia*, and *Toxoplasma*. In asian elephants dose of 22 mg/kg PO q 12h would be clinically effective.

Anti-tuberculosis drugs: Pharmacokinetic studies have been conducted in elephants for isoniazid, ethambutol, pyrazinamide, and rifampin. The duration of treatment is 12 months. Three drugs are administered for two months followed by two drugs for 10 months using a combination of isoniazid (INH), pyrazinamide (PZA), rifampin (RIF), and ethambutol (ETH). TB drugs may be given by oral or rectal administration. Adequate drug levels cannot be achieved if drugs are mixed with food offered by free choice. Some drugs are bitter and elephants will refuse them. Elephants can be trained to accept a bite block and medications delivered via a large animal dose syringe. Most elephants can also be readily trained to accept rectal administration. Adequate blood levels can be achieved for INH and PZA (but not RIF) by this route. Treatment is challenging and elephants, like humans, may experience side effects.

Combinations of at least three first line anti tuberculosis drugs can be started in TB cases as follows.

1. Tab. Isoniazid 100mg at 4 mg/kg PO once daily
2. Tab. Pyrazinamide 500mg at 30mg/kg PO once daily
3. Tab. Rifampicin 600mg at 10 mg/kg PO once daily

The above therapy with 3 drugs can be administered for minimum of 90 days. The serum level of all the three drugs to be monitored once in a month. If sufficient levels are noticed in serum, then the treatment should be continued further. In case the sufficient serum drug levels are not maintained then the dose has to be increased. After three months only two drugs can be continued for 10 months, preferably Isoniazid should be included in that two drugs. The complete treatment should be continued for 12 months. Hematology and serum biochemistry (mainly ALT, AST, Total Bilirubin, Direct Bilirubin, Bile acids) should be monitored once in a month as there is chance of hepatoxicity by these antituberculosis drugs. As a supportive therapy Vitamin B6 (Pyridoxine) can be given at 1 mg/kg daily. The trunk wash and blood should be tested for PCR and LFA once in 3 months to assess the therapeutic efficacy.

Anti-viral drugs: Only one antiviral drug has been reported in elephants, Famciclovir was used successfully to treat three cases of Elephant Endotheliotrophic Herpesvirus infection -two juvenile Asian elephants and a subadult bull. Famciclovir is a pro-drug of penciclovir and has been used one juvenile. Treatment was initiated with a loading dose of 12.8 mg/kg po on day 1 followed by 6.4 mg/kg po q 8h, On day 9 the dose was reduced to 4.06 mg/kg q 8 h, on day 14 it was changed to 6.4 mg/kg po q 12 h for 5 days and then withdrawn.

In one case report, a 2-year, 11-month-old female, captive Asian elephant calf was treated with oral acyclovir for EEHV that had presented with facial edema and a mild fever (Khammesri *et al.,* 2020). Blood samples were collected and showed EEHV1A positivity with a high viral load by real time PCR. Acyclovir 800 mg tablets at 45 mg/kg, tid PO was administered in a banana 3 days after clinical signs and, continued daily for 28 days. The initial EEHV1A load was 2.96 × 104 viral genome copies (vgc)/ml, with a 22.21 cycle threshold (CT), which increased to Day 7 to a peak of 1.15 × 106 vgc/ml and 14.74 CT, although day-to-day variability was high with no apparent explanation. The viral load was then undetectable on Day 8 and remained at a low level (<1,000 vgc/ml with CT value >30) throughout the remainder of the treatment period.

Anthelminthic drugs

Trematodes:

Fasciola jacksoni is a liver fluke unique to elephants. The acute form sof fasicolasis causes hepatic insufficiency, anorexia, constipation, diarrhea, anemia, icterus, and death. A hyperplastic cholangitis, allows leakage of plasma protein causing hypoproteinemia. Adult flukes suck blood, causing intrabiliary hemorrhage, which results in anemia.

Management of *Fasciola jacksoni*:

- Clorsulon at a dose of 7 mg/kg body weight per os, twice at 45–60-day intervals. Albendazole is also effective
- Triclobendazole at 9 mg/kg (not to exceed 7200 mg/animal)
- Oxyclozanide 7.5 mg/kg (not to exceed 6.0 g/animal) were used successfully

Schistosomes of Asian elephant: (*Bivitellobilharzia nairi*)

- Fenbendazole and praziquantel (Fentas plus®) at 2.5 mg/kg was administered orally (bread soaked in Fentas plus® liquid and given with jaggery) (Bhoyar *et al.,* 2014)

Nematodes: Common nematodes in elephants are *Strongyloides elephantis*, *Choniangium sp., Murshidia sp., Bunostomum sp., Toxocara elephantis*. They cause severe protein losing gastroenteropathy and hypoalbuminemia.

- Albendazole at 2.5 mg/kg PO
- Fenbendazole at 5mg/kg PO
- Levamisole HCl at 2.5 to 3.0 mg/kg PO
- Ivermectin at 0.1 mg/kg P.O

Cestodes: Elephants are commonly affected by *Anoplocephala* infection. Praziquantel (600 mg tablets), is considered the best drug against *Anoplocephala* infection at 2.5–4.0 mg/kg PO.

Acaricidal agents: Elephant lice (*Haematomyzus elephantis*) are controlled by feeding injectable Ivermectin at 0.15 mg/kg live weight.

Anti-inflammatory and analgesics: Antiinflammatory medications are administered to elephants primarily for the treatment of musculoskeletal disorders, arthritic conditions, and colic. The nonsteroidal antiinflammatory drugs (NSAIDS) are used most commonly. Corticosteroids and dimethylsulfoxide (DMSO) also fall in this category but corticosteroids have not been studied in elephants and the use of DMSO is anecdotal. Commonly used drugs are:

- Butorphanol tartrate: Dose of 0.015 mg/kg IV or IM Asian elephants.
- Flunixin meglumine: 1 mg/kg every 24 hours (route of administration not specified) 0.28-1.1mg/kg PO SID-BID (African and Asian).
- Ibuprofen: Dose of 6.0 mg/kg PO, q12h
- Ketoprofen: Dose of 1.0–2.0mg/kg PO, or IV q24 or 48h

- Phenylbutazone: Dose of 3.0mg/kg PO, q48h

Drugs for digestive disorders

Bloat: Supportive therapy, per-rectum neurostimulation, antibloat agents, rectal enemas, exercise and flunixin meglumine.

Constipation: Fluids, rectal palpation, manual evacuation of stool, supportive therapy, enemas, purgatives, broad-spectrum antibiotics, parasympathomimetics, spasmolytics and calcium borogluconate intravenously and calcium pantothenate intramuscularly.

Impaction/ obstruction: Oral fluids and mineral oil, Flunixin meglumine (1.75 mg/kg IM BID); Butorphanol at 0.1mg/kg IM; Bismuth salicylate; supportive therapy; enemas; purgatives; parasympathomimetics; Spasmolytics.

Antacids: Decreases stomach acidity and excess gas.

- Systemic: They reduces the total acid load in the GI tract; elevate gastric pH to reduce pepsin activity; help strengthen gastric mucosa. Example: Sodium bicarbonate at 0.5-1mEq/kg IV slowly; 10-12 grams PO to adult large animals.
- Non-systemic: Neutralize HCl, bind bile acids, decrease pepsin activity, stimulate local PGE1 production; eg., Alluminum hydroxide, magnesium hydroxide, calcium carbonate.
- Combined antacids: Aluminum / magnesium hydroxide suspension at 15 ml 4 times a day.

Anti-diarrheal: Commonly used drugs, Bismuth salicylate: up to 4 L (500 kg horse) PO BID; 30 ml q4h (foal); Loperamide: 0.04-0.2 mg/kg PO BID.

Antiemetics: Commonly used drugs, pheniramine: 1700-2300 mg/animal in Asian elephants; and Metoclopramide, Cisapride: 250-400 mg/elephant IV as an antiemetic as Continuous infusion at 0.04 mg/kg BW/h.

Anti-inflammatory: NSAIDs, they produce Anti-inflammatory, anti-pyretic, analgesic effects. They inhibit cyclooxygenase catalysis of arachidonic acid to prostaglandin precursors, thereby inhibiting the synthesis of inhibition of cyclooxygenase catalysis of arachidonic acid to prostaglandin precursors (endoperoxides), thereby inhibiting the synthesis of prostaglandins in tissues. Commonly used drugs are:

- Flunixin meglumine: 1 mg/kg every 24 hours (route of administration not specified) 0.28-1.1mg/kg PO SID-BID (African and Asian).
- Ibuprofen: 6mg/kg PO BID (Asian), 7mg/kg PO BID (African) 1-6mg/kg (Asian) 1-7mg/ kg (African) PO SID-BID.
- Ketoprofen: 1-2mg/ kg every 24-48 hours IV; 2700mg IM.
- Phenylbutazone: 0.25- 6mg/kg PO SID-BID, 3mg/kg PO q48 hours (African), 2mg/kg PO q48 hours (Asian) 1-2mg/kg SID.

Antispasmodic: Relieves spasms in the gastrointestinal tract, Buscopan 20 mg/mL ampoules, 10- 12 ampoules, 200-240mg injections can be used.
Histamine (H2) receptor antagonists: Treatment and prevention of gastric ulcers by causing a decrease in acid.

Omeprazole: 10,800 mg PO (around 250 tablets/capsules) can be used.

Emollient laxative: Stool softener, Eg.: Docusate at 10 to 30 mg/kg as a 10% solution used.

Lubricant laxative: Stool softener/ laxative: Eg: Mineral oil, paraffin, Mineral oil: up to 4 L SID to BID

Stimulant laxative: Most powerful laxative type, Eg.: Bisacodyl: 300mg PO BID for 3-5 days; suppositories: 400mg applied to rectal mucosa q12 hour intervals.

Hyperosmolar/ osmotic: Hyperosmotic laxatives are substances that cause the intestines to hold more water and create an osmotic effect that stimulates a bowel movement. Eg., Magnesium sulfate, Lactulose, Phosphate enemas. Dose 0.1-0.2mL/kg PO q8-24 hours.

Prokinetic: They have a cholinomimetic action. A parasympathomimetic drug that stimulates the parasympathetic nervous system (PSNS). The mechanism of action is increased acetylcholine (Ach) either by stimulating ACh receptors (directly acting parasympathomimetic agents) or by inhibiting cholinesterase (indirectly acting parasympathomimetic agents). Neostigmine: 4-5 mg/animal IM as a purgative may be used in impactions.

Fecal transfaunation: To correct potential microbial imbalances that may have resulted from the prolonged ileus. Four kg of feces can be manually mixed with 1.6 L of 0.9% NaCl and 1.9 liters of warm water and maintained at 99°F. The mixture was strained through a sieve to remove large pieces and resulting liquid was used to fill 5 mL (size 12) gel capsules. The fecal capsules administered rectally (nine capsules) and orally (12 capsules in bread).

Emergency medicines and antidotes

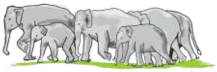
- Any types of colic, Hyoscine butyl bromide (Buscopan®, 20 mg/ml ampoules, 10- 12 ampoules, 200-240 mg) injections.
- Elephants while in the forest may get stung by hornets and bees, injections of Triamcinolone (Vetalog®, 3-6 vials, 90-180 mg) or Antihistamines (Anistamin®, 40-60 ml/adult) can be used.
- Epinephrine HCl 0.1 ml/kg Elephant calves 1: 1000 solution may be used during anaphylaxis.
- Diazepam 0.1–0.2 mg/kg IV or 400–800 mg total dose IM may be used to control seizures.
- Atropine sulfate may be used at 0.02–0.04 mg/kg IV, IM, SC Asian elephants in OP poisoning.
- Calcium magnesium borogluconate may be used at 750 ml IV infusion with 12 g calcium borogluconate in dystocia.
- Dexamethasone 1 mg/5 kg bw or Prednisolone 1 mg/3 kg bw: For the treatment of heatstroke.
- For the treatment of heatstroke. Sodium bicarbonate 0.5–1 mEq/Kg slowly IV: For metabolic acidosis.

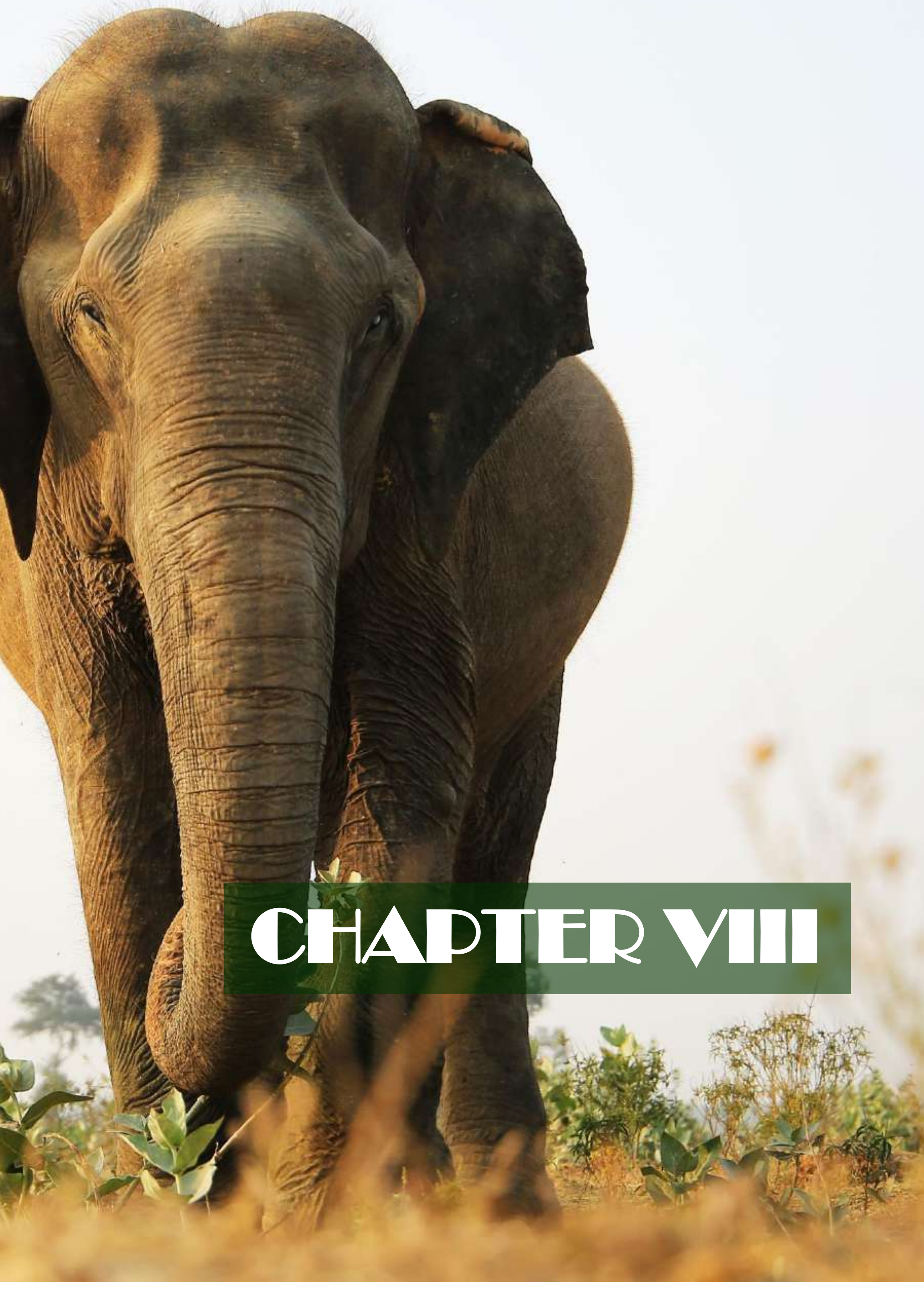
OP compound poisoning: Atropine at a dose of 0.1-0.2 mg/kg, give 1/3 of the total dose I/V and the rest I/M. The I/M administration is for protracted action. 2-PAM 20-50 mg/kg as a 10% solution I/M or slow I/V, repeat the I/M treatment at 8-12 hour intervals, 2-3 times. Activated charcoal (3-6 g/kg as a water slurry) administered orally. This will help to eliminate the OP compounds through the faeces.

OC compound poisoning: No antidote (symptomatic). Convulsions can be controlled by using muscle relaxants or anesthetics like barbiturates and chloral hydrate. Phenobarbitone 12-20 g I/V can be given. Calcium borogluconate (CBG) I/V with glucose saline could be administered to avoid liver damage and neutralize the preconvulsive hyperkalemia. CBG in a dose of 2-3 litres, activated charcoal at a dose of 1-2 g per kg body weight are recommended for administration.

Pyrethroids poisoning: No antidote (symptomatic). Seizures are controlled by barbiturates (pheno/pento barbiturates 6 mg /kg body weight I/V), Phenobarb is the preferred anticonvulsant for most species.

Fluid therapy: For an average adult elephant weighing 4000 kg, maintenance fluids (40ml/kg) alone would total 160 liters q 24h. The volume of replacement fluid (liters) = the body weight (kg) x percent dehydration. Lactated Ringers solution is an adequate replacement fluid for most situations.





CHAPTER VIII

INFECTIOUS AND NON-INFECTIOUS DISEASES OF ASIAN ELEPHANTS

- *M. Karikalan, Sreelakshmi P. and Abhijit M. Pawde*

Introduction

Elephants are susceptible to numerous infectious and non-infectious disease conditions. The major infectious diseases reported in elephants include tuberculosis, anthrax, leptospirosis, tetanus, pasteurellosis, salmonellosis, streptococcosis, staphylococcosis, bacillary necrosis, foot and mouth disease, encephalomyocarditis virus, rabies, pox, herpes virus infection, mycosis, trypanosomosis, piroplasmosis, 'stomach bots', toxoplasmosis, helminthiasis and ectoparasitism. In addition to numerous infectious aetiologies, various non-infectious disease conditions are also encountered in captive and free ranging elephants. Dental diseases like malocclusion, abscesses, foot lesions, electrocution, automobile injuries, gunshot wounds, dermatitis and skin lesions, traumatic injuries, atherosclerosis, chronic interstitial nephritis, trunk paralysis, degenerative joint diseases, gastric ulcers, renal papillary necrosis and neoplastic conditions are also invariably noticed in elephants.

Tuberculosis: Tuberculosis (TB) was first described in elephants 2000 years ago and is a major infectious disease encountered in captive elephant populations. Presence of infection among wild free ranging elephant populations have also been confirmed. The main aetiology of tuberculosis in elephants is *Mycobacterium tuberculosis*. Mycobacteria are non-sporulating, non-motile, gram positive acid-fast intracellular bacteria Cases of tuberculosis in elephants caused by *Mycobacterium bovis* and other non-tuberculous mycobacteria have also been reported. Transmission of the disease is primarily through inhalation of aerosols. The source of infection is presumed to be due to contact with humans and also due to spill over from domestic and wild ruminants. Mycobacteria are highly specialized to evade the immune surveillance mechanisms of the host and persist in the host leading to chronic disease conditions.

The disease is mainly affecting the pulmonary system with lesions mainly confined to the thoracic lymph nodes. Diffuse form of infection resulting in pathological changes in reproductive system, bones and abdominal lymph nodes have also been reported. Susceptibility to infection depends on the immune status of the host. Clinical signs of tuberculosis in elephant are not specific with lethargy, anorexia, weight loss and rarely ventral oedema. The pathological changes are mainly in lungs and thoracic lymph nodes, less severe cases characterized by small granulomatous nodules in pulmonary tissues and bronchial lymph nodes. In case of severe infections there can be formation of extensive caseo-calcified granulomas that further leads to cavitation's and subsequently pulmonary abscesses with proliferation of secondary bacterial flora. The major histopathological changes noticed include granulomas with epithelioid cells and giant cell formation. Pyogranulomatous pneumonia is a characteristic finding. Diagnosis can be made by demonstration of acid-fast bacilli in the centre of the granulomas. Culture and isolation of the organism is considered as the gold standard diagnostic test.

Although, trunk wash culture is considered as an ideal method to isolate the organism, contamination with soil bacteria can give low sensitivity. Intermittent shedding of the bacteria by elephants in the secretions also results in low sensitivity of trunk culture as a diagnostic aid. Intradermal tuberculin test has low sensitivity and thoracic radiography is practically not feasible in elephants due to the massive size. Sero surveillance of tuberculosis using various serological tests are also reported. Interferon gamma assay is also used as a diagnostic aid in tuberculosis in elephants. Lateral flow assay kits based on multiple antigens give immediate results. Sero-diagnostic tests (Elephant TB STAT-PAK, Dual Path Platform (DPP) VetTB, and multiantigen print immunoassay (MAPIA), ChemBio Diagnostic Systems, Inc., Medford, NY) have proven valuable in the diagnosis of TB in elephants. Control of tuberculosis is by prompt intervention and administration of anti-tubercular therapy. The common drugs administered include isoniazid, rifampicin, pyrazinamide and ethambutol.

Anthrax: Anthrax, caused by *Bacillus anthracis*, a gram positive, nonmotile bacilli is a highly infectious and fatal disease in elephants. The elephants die without premonitory signs characterized by oozing of un-clotted blood from the natural orifices and absence or delayed rigor mortis. It is advised not to open the carcass of an animal suspected of death due to anthrax infection. Examination of peripheral blood smears for acid fast organisms, isolation and identification of the organism, PCR and serological assays like Ascoli's precipitation test can be employed for a definitive diagnosis. The carcasses suspected of anthrax may be disposed of by burning as per MOEF&CC, 2019 guidelines. Vaccination of livestock animals in and around National Parks/Elephant Reserves can potentially reduce the incidence of anthrax in wild free ranging elephants.

Other bacterial infections: Clostridial affections including enterotoxaemia, fatal enterocolitis, gangrenous dermatitis and tetanus have been reported in elephants. Death of an eight-year-old female elephant in Assam Zoo was reported after initial symptoms of anorexia, weakness, pyrexia and bloody diarrhoea. Necropsy revealed severe necrotic and haemorrhagic enteritis. Detailed microbiological investigation and PCR revealed the aetiology as *Clostridium perfringens* type A. Reports of infection with *Clostridum difficile* leading to severe fibro necrotic enterocolitis in Asian elephants indicate that elephants are quite susceptible to these infections. Inadvertent antibiotic therapy and use of antimicrobials in feed must be checked to prevent the expansion of *Clostridum difficile* population in the gut. Salmonellosis is manifested primarily as enteric disease in elephants with *S. typhimurium, S. dublin*, and *S. enteriditis* as the major serovars. Abortions due to salmonellosis have also been reported in Asian elephants.

Leptospirosis: Leptospirosis is another major disease in elephants with public health significance. Leptospirosis is caused by spirochetes of the genus *Leptospira*. Serious infections with various serovars of *Leptospira* are documented in domestic animals. Rodents are the major reservoir hosts of leptopsiral organisms. Shedding of pathogenic leptospires in the urine of captive Asian elephants were reported recently indicating that the captive elephant population can be a zoonotic risk to humans. Microscopic agglutination test is considered to be the gold standard test for diagnosing leptospirosis.

Haemorrhagic septicaemia (*Pasteurella multocida type B*) is a highly infectious septicaemic disease in elephants. The incidence of pasteurellosis has been reported in various wild animals. Death of three captive Asian elephants in Karnataka state of India have been reported which was confirmed to be due to HS after gross and microscopic examination of tissues, microbiological investigation and mouse inoculation test. Recently seroprevalence of haemorrhagic septicaemia have been documented in Asian elephants. Isolation and identification of the organism, examination of heart blood smears and serological tests and molecular tests usually performed for confirmatory diagnosis.

Elephant endothelial herpes virus-haemorrhagic disease: Elephant endothelial herpes virus is a highly infectious deadly disease affecting captive and free ranging elephants leading causing acute illness and mortality. The disease is caused by a herpes virus under the Proboscivirus genus of Betaherpesvirinae subfamily of Herpesviridae. Seven distinct species of elephant herpes virus, EEHV1A, EEHV1B, EEHV2, EEHV3, EEHV4, EEHV5, EEHV6 and EEHV7 have been described so far out of which EEHV1, EEHV3, EEHV4, EEHV5 affect Asian elephants and EEHV2, EEHV3, EEHV6 and EEHV7 affects African elephants. The subtypes of EEHV1, EEHV1A and EEHV 1b are considered to be chimeric variants. The type most responsible for causing fatal disease in Asian elephants is 1A. The virus is double stranded enveloped DNA virus, which is primarily endotheliotropic. The disease is manifested as severe haemorrhagic disease associated with endothelial damage and vasculopathy. The disease has a course of seven days with rapid development of haemorrhagic lesions. The initially clinical signs are non-specific and include, dullness, lethargy and anorexia. The ensuing vascular damage results in subcutaneous oedema and effusions, characteristic cyanotic tongue, petechial haemorrhages on mucosal and serosal surfaces. These clinical signs are late in onset and waiting for specific symptoms to initiate the therapy can aggravate the condition and a poor prognosis result. Lameness, temporal gland swelling and gastrointestinal discomfort is also seen in some cases. The disease occurs in young animals of 1-8 years of age.

The virus damages the endothelial cells permitting vascular hyperpermeability and thereby oedema. The viral multiplication induces widespread haemorrhagic lesions. The potential of the virus to alter the coagulation cascade leads to formation of emboli within the vasculature leading to consumption coagulopathy. The altered coagulation mechanism and increased activation of platelets leads to disseminated intravascular coagulation resulting in thrombocytopenia. Ensuing vascular damage and associated haemorrhage leads to rapid fatality due to hypovolemic shock and cardiac failure. Monitoring blood picture of animals with initial signs helps in commencing the treatment at the earliest to prevent further damage. Haematological changes include thrombocytopenia, decreased erythrocyte and leucocyte count. Hypoproteinaemia due to blood loss may occur. The gross picture of the disease involves extensive systemic multiorgan haemorrhage. Histologically microhaemorrhages are seen in between the cardiac muscle fibres and infiltration of inflammatory cells. Intranuclear amphophilic to basophilic viral inclusions could be demonstrated in the endothelial cells of heart, tongue, liver and lungs. Even though attempts were made to isolate the virus in various cell lines, the results were not favourable. Therefore, diagnosis is based on molecular tests mainly PCR and real time PCR is employed. Serological diagnosis based on ELISA is also reported. Human anti-herpes viral drugs are mainly employed for treating the condition. Famciclovir, ganciclovir and acyclovir are used to treat clinically ill elephants. Supportive care includes aggressive fluid therapy and plasma therapy to counteract the hypovolemic shock. Using antioxidants, and immunomodulators like vitamin C is also recommended. Immediate therapy should be ensured at the initial stage to prevent further damage.

Other viral diseases

Rabies is a deadly zoonotic disease described since ancient times. The disease is caused by a negative sense single stranded RNA virus, Lyssavirus of the rhabdoviridae family. The virus is neurotropic with lesions primarily in the central nervous system and the characteristic clinical picture of nervous system involvement. Rabies in elephants is characterised by posterior paralysis, aggressive behaviour and musth with temporal gland secretion. Diagnosis is by fluorescent antibody test and RT-PCR. Seller's staining is used to demonstrate intracytoplasmic acidophilic inclusion bodies in the impression smears from brain tissues.

Acute fatality is reported in African elephants (not Asian elephants) due to encephalomyocarditis virus caused by picorna virus. The virus has affinity to the cardiac myofibres causing acute myocarditis, cardiac failure and rapid fatality. The gross pathology includes myocardial and epicardial haemorrhages, serosal petechiae and peritoneal or pericardial effusions.

Foot and mouth disease, which is a contagious and infectious disease of domestic ungulates is also reported in wild ungulates and elephants. The disease is caused by aphthous virus, a single stranded RNA virus of the picornaviridae family. The virus has affinity to the epithelial cells resulting in the characteristic gross and microscopic pathology. the disease is manifested with symptoms including anorexia, mild fever, lameness, lesions on hoof and tongue with blisters and erosions. the gross lesions include the presence of vesicles in the tongue, cheeks, mucosa of the trunk, swelling and hyperaemia around the toe nails. The rupture of these vesicles leads to painful ulcers, which would further result in inappetence and wasting. Diagnosis of foot and mouth disease is done by virus isolation and identification, ELISA, RT-PCR. Lateral flow kits, RT-LAMP and Immunostrip tests are also developed for rapid field diagnosis.

Pox viruses are epitheliotropic double stranded DNA viruses affecting most of the livestock species. Elephant pox is caused by orthopox virus of the poxviridae family. The disease is highly contagious and manifested as local cutaneous mild infection or severe systemic illness. Cutaneous lesions due to pox viral infections are confined to the head, trunk, perineal area in elephants. Initially papules form which progress to vesicles, pustules and ulcers. Histological picture of pox virus is characteristic ballooning degeneration along with epithelial cell hyperplasia.

Parasitic diseases of elephants

Parasitic diseases are often underreported in elephants even though they are susceptible to numerous endoparasites. The lack of awareness about parasitic diseases and the causes of illness associated with these diseases often go unnoticed. Only few reports about prevalence of parasites of Asian elephants in the free range and in captive conditions were reported. Prevalence of parasitic diseases in elephants in wild varies according to seasons. Few reports also indicate that the dietary stress and parasitic load are synergistic and could lead to significant mortalities. The parasites mainly reported from elephants in free living conditions in India include *Strongyle* spp*, Strongyloides* spp*, Ancylostoma* spp, and *Anoplocephala* spp. Studies on microscopic coprological examination of dung samples of temple elephants reported highest prevalence of *Fasciola* spp followed by *Paramphistosomum* spp, *Strongyloides* spp and *Oesophagostomum* spp. Recently, reports of incidental recovery of slender whitish worms from the stomach of a juvenile male elephant calf that died of electrocution in Odisha. was published in which morphological and molecular characterization revealed 98% homology to *Murshidia linstowi*. The occurrence of a parasite in elephant liver and named it as *Schistosoma nairi*. Later, occurrence of *Bivitellobilharzia nairi* among Asian elephants in India was reported from captive and wild Asian elephants in India. *Bivitellobilharzia nairi* a schistosome commonly affecting Asian elephants and these are obligate parasites of the vasculature with mesenteric blood vessels and portal vessels being the common predilection site.

Blood parasites are another major concern for health of elephants as these can significantly impact the health status of these megaherbivores. The major blood parasites reported from elephants include microfilaria, and hemoprotozoans (not in Asian elephants) including trypanosomes and babesia. Filarial infections in elephants are manifested as cutaneous nodules and dermatitis. Filarial worms reported from African elephants include *Loxodontofilaria loxodontis* and *Loxodontofilaria gossi* while *Loxodontofilaria asiatica*, *Indofilaria parabiramani*, and *Stephanofilaria* spp. are reported from Asian elephants. Reports of infections with *Theileria, Babesia, Ehlirchia* and *Anaplasma* in African elephant has been documented based on the presence of these parasites in the host and the tick vectors which was identified based on genetic analysis.

Non-infectious disease conditions of elephants

Flaccid paralysis along with atrophy of the trunk has been reported from Asian elephant in which microscopical examination revealed necrotic and atrophied musculature of the trunk. Pathological conditions of the foot are commonly encountered in captive elephant populations. The major ailments of foot recorded among Asian elephant populations recorded include foot rot, podo-dermatitis, abscess (Nail, Cuticle, Nail and Pad, Pad & sole), necrotic wound and specific ailments like ankylosis, degenerative joint disease, hyperextension of leg, whereas crack nail or split nail or broken nail condition, excess cuticular growth or hang nail, uneven or over grown nails or deformed nails, nail damage, abrasion of sole or uneven wear and tear of foot pad, hyperkeratosis were the minor foot lesions observed. Foot lesions can be invaded by secondary bacterial and fungal pathogens that have been observed as single infections or as mixed infections. Degenerative joint disease is another major musculoskeletal disorder affecting captive Asian and African elephant population. Gunshot wounds are commonly encountered in elephants due to human elephant conflict. Fatalities associated with electrocution have been reported from various parts of India. A study report from Odisha, documented accidental contact with domestic power lines accounting for 73.68% as a major cause of elephant mortality. Lethal fence electrocution is also a major threat to wild elephants in Assam as per latest study reports. Atherosclerotic plaques were observed in renal and iliac arteries, aorta, coronary and carotid arteries. Reproductive system disorders like Cystic endometrial hyperplasia have been reported in Asian and African elephants characterized by cystic and polypoid growths in endometrium.

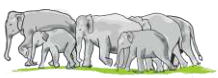
Neoplasms are rarely reported in elephants as isolated single case studies. Literature reveals that mortality rates in elephants due to neoplasms were less than 5% whereas in humans it ranged between 11-25%. Recent study reveals that elephants are less susceptible to cancers probably due to their massive size and long lifespan. Cancer resistance in elephants is also attributed due to the presence of multiple alleles for TP53 gene in comparison to humans. TP53, a major tumors suppressor gene which gets mutated in majority of the neoplastic conditions in humans, it encodes for protein p53 commonly referred as "the guardian of genome". Uterine leiomyomas, adenocarcinomas, endometrial hyperplasia, eccrine carcinoma of foot are some of the neoplastic conditions reported in elephants.

Table 8.1: Summary of Major Diseases in Elephants

Disease	Aetiology	Species	Disease manifestation
Bacterial diseases			
Tuberculosis	*Mycobacterium tuberculosis* (*M bovis* and other MTBC organisms rarely)	Asian and African elephant	Chronic wasting disease
Haemorrhagic septicaemia	*Pasteurella multocida* type B	Asian and African elephant	Haemorrhages in all visceral organs (Septicaemia)
Anthrax	*Bacillus anthracis*	Asian and African elephant	Thick tarry blood from the natural orifices
Salmonellosis	*Salmonella typhimurium, Salmonella* dublin, and *Salmonella Enteriditis*	Asian and African elephant	Abortion, enteritis
Clostridial affections **Tetanus** **Clostridial enterocolitis, enterotoxaemia**	 *Clostridium tetani* *Clostridium perfringens, Clostridum difficile*	Asian and African elephant	Haemorrhagic enteritis, necrotic enterocolitis, myonecrosis
Leptospirosis	*Leptospira interrogans*	Asian and African elephant	Seroprevalence reported with no associated clinical illness
Fungal diseases			
Dermatophytes	*Microsporum canis*		Itching, cracking of skin and white spots
Viral diseases			
Elephant endotheliotropic herpes virus-hemorrhagic diseases	EEHV1 (A&B), EEHV4, EEHV 5	Asian Elephants	Dullness, lethargy and anorexia, subcutaneous oedema, swelling of head and face, lingual cyanosis, petechial haemorrhages at the tip of the tongue, pericardial effusion, epicardial and endocardial haemorrhages, systemic multiorgan haemorrhages
	EEHV2, EEHV 3, EEHV6, EEHV 7	African elephants	Cutaneous nodules, Dullness, lethargy and anorexia,subcutaneous oedema, swelling of head and face, lingual

Disease	Aetiology	Species	Disease manifestation
			cyanosis, petechial haemorrhages at the tip of the tongue, ulcers in oral mucosa, limb stiffness and lameness, bilateral temporal gland swelling and abdominal discomfort, renal medullary haemorrhages and retinal damage (EEHV3)
Foot and mouth disease	Picorna virus	Asian and African elephant	Anorexia, mild fever, lameness, lesions on hoof and trunk, tongue with blisters and erosions
Rabies	Lyssa virus	Asian and African elephant	Anorexia, posterior paralysis, behavioural changes similar to musth and temporal discharge
Encephalomyocarditis virus*	Picorna virus	African elephant	Acute myocarditis leading to cardiac dysfunction and death
Elephant Pox	Pox virus	Asian and African elephant	Pox lesions on the head and trunk, conjunctivitis, temporal gland discharge
Parasitic diseases			
Cestodes	*Anoplocephala* spp	Asian and African elephant	Anaemia and gastroenteritis
Gastro intestinal nematodes	*Strongyle spp, Strongyloides spp, Ancylostoma spp, Paramphistosomum, Ascaria, Murshidia linstowi, M. falcifera, M. indica, and M. neveulemairei, Q. renniei, and Q. travancra*		
Biliary nematodes	*Grammocephalus hybridatus, Grammocephalus varedatus*		
Hepatic flukes	*Fasciola jacksoni*		

Disease	Aetiology	Species	Disease manifestation
Blood fluke	*Bivitellobilharzia nairi,*		
Filarial worms	*Loxodontofilaria asiatica, Indofilaria parabiramani, Stephanofilaria*		
Gastric myiasis	*Cobboldia elephantis,*		
Ectoparasites			
Elephant louse	*Haematomyzus elephantis*		*Anaemia*



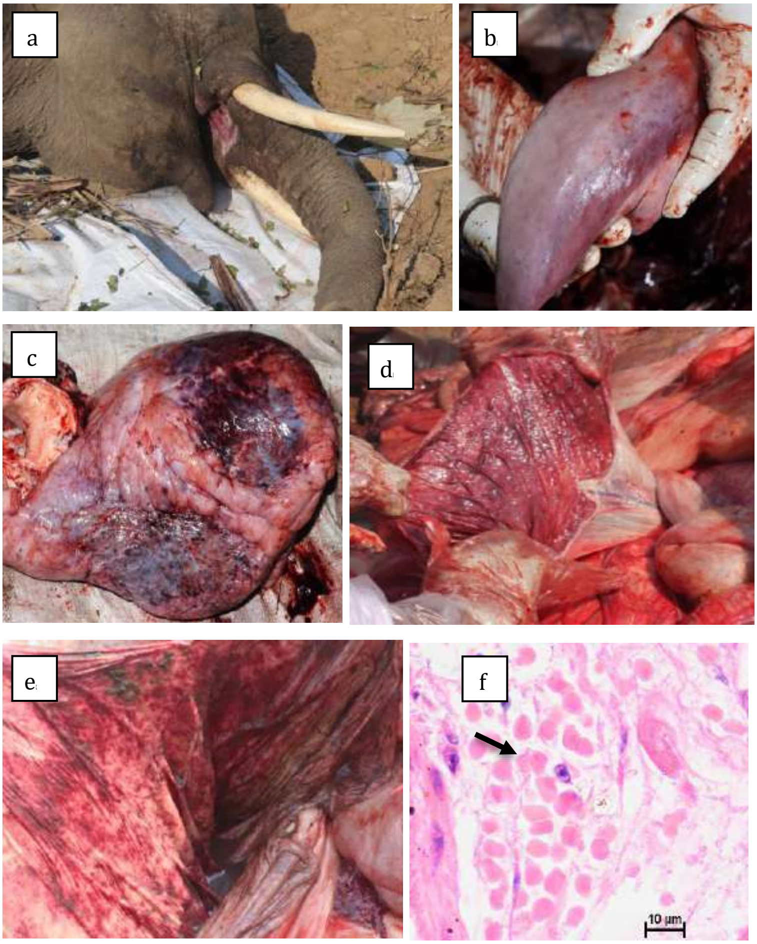


Photo by: Dr. Karikalan, M, Bijnor Forest Division, UP, Bhagwan Birsa Biological Park, Ranchi

Plate 8.1 (a) Edema of head and cyanotic oral mucosa, (b) Cyanotic and edematous tongue, (c) Diffuse pericardial and epicardial haemorrhages, (d) Diffusely congested and haemorrhagic intestinal mucosa, (e) Diffusely congested and haemorrhagic gastric mucosa, (f) Basophilic intranuclear inclusion body in the endothelial cells of heart blood vessels

Photo by: Dr. Karikalan, M,

Plate 8.2: Bloated carcass showing chocolate tarry blood oozing from natural orifices (Suspected for Anthrax).

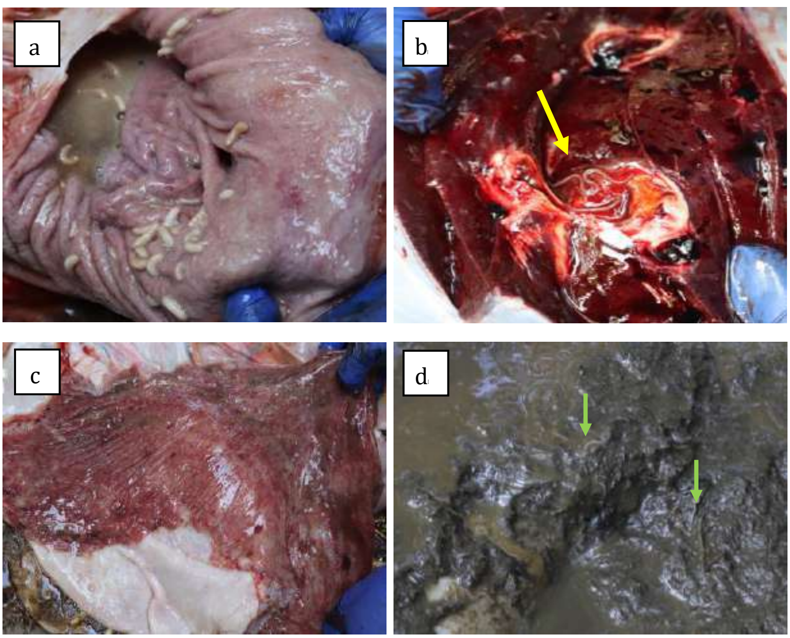


Photo by: Dr. Karikalan, M,

Plate 8.3: (a) Stomoch bots, (b) *Grammochephalus* hook worm, (c) Parasitic gastroenteritis and (d) *Murshidia* infestation in stomach

CHAPTER IX

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FIELD IMMOBILIZATION OF ELEPHANTS AND ASSOCIATED HUMAN EMERGENCIES

- *Parag Nigam & Pradeep K. Malik*

Introduction

Advancement and development in the field of wild animal capture has resulted in use of newer and safer drugs for immobilization; availability of better, efficient and reliable systems of drug delivery and considerable information on scientific handling. Chemical immobilization, thus has become an important and integral part of wildlife management. Though these advancements have changed the approach, handling and management of wild animals in distress, the technique still poses a challenge for professionals. It requires clear understanding of animal's biology, behavior, physiological/emotional status, nutritional and health status, environmental conditions, terrain, availability of appropriate drug and equipment etc. Successful immobilization of wild animal is an art as much as science as number of factors determines the success of the procedure.

Elephant immobilization & restraint: Chemical immobilization of elephants has been practiced over last few decades for management of sick and injured animals; problematic/nuisance animals; elephants in distress; as management option for dealing with man-animal conflict and for conservation projects. Though the tool of chemical immobilization appears to be simple, it needs a serious concern with thorough understanding of the drug protocols, procedures and risks during field immobilization and management of emergencies if any. Planning and preparedness form the basis for any successful and safe field immobilization operation. Besides information on the human and material resources, it should necessarily include detailed information on the dangers of specific drugs and equipment and emergency response protocols. A thorough knowledge of personal strengths and weaknesses, time of induction and recovery, signs and fallouts of drug induction, possible complications and the capacity to handle any such emergencies both for the animals and human is necessary.

Elephants are large bodied pachyderms weighing about 3000-5000kg with variation between sexes. Asian elephants have been routinely immobilized for ecological research involving radio-telemetry studies, as part of population management and conflict mitigation exercise involving translocation, treatment of injuries or as part of *musth* management. Being thick skinned animals, drug delivery needs to be facilitated using specific darts delivered through appropriate syringe projectors. Selection of the dart projector needs to be based on proven accuracy, compactness, easy maneuverability on elephant back/ vehicle, light weight and cause minimal trauma and negligible disturbance to the animal. It is important to choose appropriate highly concentrated drugs that and can be handled in minimal volumes to ensure a single injection for drug delivery.

Primary immobilization drugs

Variety of drugs and their combinations have been effectively used in elephants. The drugs presently used for immobilization act on the central nervous system and produce a state of anaesthesia either by diminution of central nervous system excitability leading to depression or by increasing the CNS irritability leading to hyper excitability. The commonly used drug classes for elephants belong to benzodiazepines, alpha-2-agonists, and dissociative anaesthetics and narcotics. The dosage can be decided on the spot, taking into consideration the animal's health and condition, level of excitement, physiological status, sex, time of the day, and ambient temperature besides other habitat parameters. It is beyond the scope of this article to provide detailed pharmacological description of all the anaesthetic agents and their regimes used in elephants; however, a brief description of some of the commonly used agents in India is provided.

Alpha-2-agonists: Alpha-2-agonists also called as sedatives cause depression of central nervous system functions and have good muscle relaxation and analgesic properties. These drugs need to be used with caution in animals as they have been reported to produce initial hypertension followed by severe hypotension, bradycardia, hyperglycaemia and glucosuria, disrupts thermoregulation. The drug has low therapeutic dose, smooth induction, smooth recovery, produces trunk immobilization and has excellent analgesic and sedative properties. These drugs also have the advantage of being non-controlled, inexpensive and reversible. The drugs have been extensively used in captive elephants in combination with dissociative anaesthetics and produces 'standing sedation'.

Xylazine hydrochloride: Xylazine has sedative, analgesic and muscle relaxation properties that are mediated by central nervous system depression. Stimulation during induction may prevent optimum sedation. Side effects may include disruption of thermos-regulation, bradycardia, profuse salivation and partial atrio-ventricular block. It has been used extensively in combination with ketamine for anaesthesia in elephants. A drug dosage of 0.08 – 0.14 mg/kg has been used in elephant for wide variety of procedures. Yohimbine hydrochloride as well as atipamezole hydrochloride effectively reverses the effect of xylazine.

Medetomidine hydrochloride: Medetomidine has rapid onset of action and it is more potent than xylazine. It has potent sedative and analgesic effects. Profuse salivation appears to be less of a problem than the xylazine. The rapid onset of action of medetomidine makes it a useful drug in combination with dissociative in species that are prone to excitement during induction. Atipamezole may be used to reverse the effect of medetomidine. Elephants in *musth* have been successfully immobilized employing narcotics like etorphine (M-99) or Immobilon. Cheeran, 2007 reported photosensitization as an adverse effect while using XYL, though no such incidence was reported in study conducted by Pathak, 1991; Sarma & Pathak, 2001, Nigam *et al.,* 2006 and Nigam, 2006.

Dissociative anaesthetics: The drugs act by separating the conscious mind from sensory and motor or control mechanism in the brain (dissociative) producing, rapid analgesia and a trance-like state (psychosis) which may be as a result of over stimulation of the CNS. They have the advantage of being rapidly absorbed following IM, IV administration, produces rapid, smooth induction with good analgesia (unresponsive to painful stimuli), have good safety margin and cause little depression of the respiratory and circulatory system. Pronounced muscle rigidity, hyperthermia, hyper salivation, convulsion and rough recovery are common side effects. These effects can be considerably reduced by combining these drugs with a tranquilizer or sedatives. Their effect cannot be reversed as these drugs lack specific antidote and the animal has to be monitored for long till complete recovery takes place.

Ketamine hydrochloride: Ketamine hydrochloride has been used to hasten the attainment of recumbency and induce anaesthesia in felids. It provides balanced anaesthesia in large felids in combination with Alpha-2-agonists. It has been reported to mildly mitigate the bradycardia and can remarkably improve the mean arterial pressure when used in combination with xylazine

Narcotics: Variety of narcotics alone or in combination have been used in elephants Etorphine hydrochloride has been effectively used in both African and Asian wild elephants (Chowdhary and Malik, 1991; Kock, *et al.,* 1993; Osofsky and Hirsch, 2000; Dangoila, 2004; Still, *et al.,* 1996; Thongtip *et al.,* 2015; Buranapim *et al.,* 2019). Etorphine used either singly or in combination with other agents is the drug of choice for immobilizing elephant (Fowler and Mikota, 2008).

Table 9.1: Select combinations and drug dosages for use in elephants

Sr. No.	Drug	Dosage	Effect
1.	Etorphine hydrochloride	1mg per foot shoulder height/ 1 mg/450 kg/ 1ml Large Immobilon (2.45mg/ml) per 1000kg BW/ 0.002-0.004 mg/kg	Lateral recumbency (Immobilized elephants suffer fewer respiratory problems when in lateral as opposed to lateral recumbency)
	Medetomidine hydrochloride	3-5 mcg/kg body weight	Relaxation of trunk to the extent of touching ground and immobility, complete protrusion of penis, loud snoring and total flaccidity of the tail are the signs of relaxation of muscles by medetomidine
2.	Xylazine hydrochloride	0.04 -0.08mg/kg (Sedation effect)	Alpha-2 agonist for use in captive elephants (*musth* / minor veterinary management/ Produces standing sedation
3.	Thianil	African elephant: Male 15mg total dose/ Female 12mg total dose (15 – 40mg total dose)	Lateral recumbency
REVERSAL			
4.	Naltrexone	1mg Naltexone produces reversal of immobilizing action of 40-50 mg of etorphine/ 10-20 X etorphine dose on mg/mg basis	Reversal (Antidote for Etorphine)
5.	Diprenorphine	1.3-2.0mg Diprenorphine produces reversal of the immobilizing action of 1 mg Etorphine/ 2-3 X etorphine dose on mg/mg basis	Reversal (Antidote for Etorphine)
6.	Naloxone	0.04-0.07mg/kg on mg/mg basis	Reversal (Human antidote for Etorphine)
7.	Atipamezole hydrochloride	1mg per 8-12 mg xylazine 5-10 mg kg per 100mg xylazine	Reversal (Antidote for Xylazine)

Sr. No.	Drug	Dosage	Effect
8.	Yohimbine hydrochloride	0.125mg/kg body weight	Reversal (Antidote for Xylazine)
TRANQULIZERS			
9.	Acepromazine	40-50mg/1000kg BW	Tranquilization (Avoid exposing animal to direcsunlight for long periods as may cause photsensitization)
10.	Azaperone	0.240.038 mg/kg IM	Short-acting tranquilizer (effective for managing initial excitement phase of drug induction)
11.	Haloperidol	40-100mg total dose	Intermediate-acting tranquilizer
12.	Perphenazine enanthate	200-250 mg total dose	Long-acting tranquilizer
SUPPORTIVE			
13.	Hyaluronidase	4500IU per dart	Enzyme facilitating

Drug delivery systems

Projected darts have proved to be effective and safe option for delivering drugs to animals. The dart is projected through equipment and discharges the medicaments intramuscularly upon impact. Different power projection and air pressurised systems have been used for projecting the darts. The darting sites include buttock (preferred site) and triceps brachii muscle. Needle length is critical factor while darting elephants and the length of the needle selected should be 60-100 mm.

Table 9.2: Physiological parameters

Sr No.	Physiological parameters	Range
1.	Temperature	37-39.9°C (96.3-99.5° F)
2.	Respiration	10/min (Standing) 5/ min (Recumbent)
3.	Pulse	28/min (Standing) 35/min (Recumbent)
4.	Mucus membrane	Rosy pink

Hydration Levels: There is a likelihood of immobilized animals to be dehydrated. It is important to properly assess the condition and provide fluid therapy, if necessary.

Table 9.3: Emergency Drugs

Sr. No.	Drug	Remarks
1.	Doxapram	Analeptic, 100 mg/1000kg BW IV/IM for respiratory depression.
2.	Ephedrine	Sympathomimetic, 200-400 mg/animal IV/IM to reverse Xylazine
3.	Prednisolone	Glucocorticoid, 0.33mg/kg for circulatory collapse.
4.	Dexamethasone	Glucocorticoid, Dose 1 mg/kg IV for circulatory collapse
5.	Atropine	Anticholinergic 40-50 mg/1000kg BW

Post immobilization concerns

Animal Positioning: The preferred position to maintain an elephant in immobilized state is in lateral recumbency. Keeping animal in sternal recumbency for long may even be fatal due to respiratory arrest. Efforts should be made to pull or push the animal to lateral recumbency within no more than 15- 20 minutes of recumbency.

Respiration Function: Majority of drugs produce respiratory depression. This together with over dosage, improper position of immobilized animal or obstruction of airway passages can aggravate the condition. Efforts should be made to properly position the animal along with straightening of the trunk to facilitate breathing. Respiratory stimulant (Doxapram) has proved to be beneficial in managing emergencies.

Thermoregulation: There is a likelihood of bodily temperatures to increase during immobilization and more so when captures are done during hot periods of the day. These can be managed by providing shade or spraying water over the body. Antipyretics are beneficial in managing such situations.

Physical Injuries: Animal may sustain injuries during the capture operation. These injuries can range from small wounds resulting from improper darting and bruises to even fatal ones (falling on a tree stump or harp ground object and damaging internal organs).

Re-narcotization: This condition is seldom seen in elephants but may occur if multiple supplementary doses of narcotics are given and appropriate drug reversal is not done.

Human drug emergencies

Several cases of drug related accidents especially inadvertent injections of capture personnel with drug doses destined for animal capture, improper judgement of immobilization state resulting in injuries that can be even fatal and improper use of drug delivery equipment have been reported. It is essential that the persons involved in immobilization operation are aware of the danger associated with chemical immobilization.

Accidents during drug handling: Wildlife immobilization involves handling and use of drugs. Immobilizing drugs are potent poisons and dangerous to both humans and animal if not appropriately used or handled. A person may accidently inject the drug (either to self or to other persons) during loading of syringes/darts or may accidently come in contact with drug during extracting or mixing and even as a result of drug spillage. It is important to avoid spraying, squirting, or spilling drugs when loading. Certain drugs (Fentanyl) can be absorbed through intact skin (as it is often made up in Dimethylsulfoxide); certain drugs (narcotics- etorphine, carfentanil) gain entry through break in continuity of skin (cuts and abrasions) while most of them can be readily absorbed through intact mucous membranes of eye, nose and mouth. All the drugs used in immobilization must always be handled with the greatest of care taking due personal protection. Use of eye protectors and gloves while handling narcotics should always be practiced. It is important that the individuals using or handling immobilizing drugs have a clear understanding of the drug protocols, the dangers associated and the emergency response required. Entire team involved in the operation should also be briefed about the potential hazards of immobilization beforehand. A brief on the immobilization drugs used in elephants, symptoms of poisoning, preventive measures and management in case of accidental administration is provided as Table 9.4.

Accidents during use and handling immobilization equipment and accessories: Accidents may happen during handling of remote drug delivery equipment and the accessories either as a result of their malfunctioning, improper use or even due to operator's fault. There are frequent unpublished reports of individual human handlers being exposed to various hazards resulting from improper handling. For example, too much of pressure while preparing air-pressurized syringes/ darts may result in squirting or spilling of drug leading to accidental poisoning; handling of equipment and accessories by inexperienced individual or casual and careless approach on part of experienced operator may result in accidental injection or injury. It is important that only authorized personnel should be allowed to carry loaded and unprotected darts. While handling narcotics, metal darts should only be used to avoid accidental release/squirting of drugs. Metal syringes should be handled with care as accidental bursting of syringe charges has been occasionally encountered. Additionally, the loaded syringes should always be properly marked and appropriately carried to avoid any confusion, inappropriate handling or accidental injuries. Proper care should be taken while handling used darts, syringes and needles to avoid any accidental injection/injury. All darting equipment and projectile syringes/ darts should be used with the utmost care, cleaned and maintained well and used by authorized individuals having necessary skills and experience in handling equipment and accessories.

Threats from animal due to improper immobilization/ misjudgment of immobilization state: Immobilization of wild animals in the field is different from that of domestic animals. Access to wild animals and use thereto of an anesthetic is difficult. It may be noted that neither exact weight nor actual health status prior to immobilization can be determined which is possible in case of domestic animals. Additional factors such as nutrition, estrus, pregnancy, lactation, disease, parasite load and infection are major anesthetic considerations, but usually cannot be assessed with certainty from a distance. The procedures have to be carried out based on presumptions of weight, condition, pathological condition etc. These can result in accidents as a result of misjudgment of animal's status prior to immobilization, inadequate drug doses and inability/wrong assessment of immobilized state in the animal. Successful elephant immobilization is a challenge for the wildlife professionals as they pose serious threat to the human if proper sedation levels are not achieved. Every individual should be considered as a new and unique subject for immobilization as temperament, behavior, attitude, psychological makeup, and physiological status varies with individual and requires appropriate modification of the procedures. The choice of drug, equipment and post immobilization procedures would vary accordingly. Induction time is the most critical part of any immobilization operation and any disturbance during this period would results in improper sedation thereby enhancing the chances of accidents. Even after the animal is darted, the animal is quite capable of attack, as the drug induction takes some time during which animal can cause significant problem. Many accidents have happened as a result of misjudgment of the immobilization state prior to approach for handling that have even been fatal. It is important that the persons carrying out the operation have a clear understanding and knowledge of the above-mentioned factors.

Prevention and Management: Accidents during field immobilization can be effectively avoided by having a thorough knowledge of the drug protocol and the procedures, awareness on hazards associated with drug immobilization and undertaking preventive measures for personal protection (eye and hands) and during handling (drugs, loaded darts, immobilized animal). A first aid kit is an important component of any immobilization operation to meet any eventuality and should have following:

First Aid Kit
Emergency drugs: When narcotics are used atleast 20 mg Naloxone and Naltrexone should be part of the first aid kit besides 250 mg hydrocortisone, 40 mg diazepam (VALIUM), 5 mg atropine, 20 mg adrenalin.
Other medical supplies: Stethoscope, thermometer, intravenous saline (0.9%) solution-2 litres, IV drip set -2, disposable syringes-2,5 & 10 ml, hypodermic needle, 18g & 21g, adhesive plaster and scissors, sterile bandage/gauge 2" & 4", antiseptic lotion and haemostyptics
Medical supplies to meet respiratory depression
Portable Oxygen cylinders with mask¸ Doxapram HCL (CAROPRAM/ DOPRAM)-4vials and muscle relaxants.

Besides above, communication, transport and medical support aids in responding to any emergencies. In the event of any accident, the basic principles of management include keeping the patient calm and comfortable, arranging for medical support, limiting drug absorption by washing any contact surface with large quantities of water or application of tourniquet, administering antidotes if symptoms of poisoning are noted, proper positioning of the patient (horizontal sideways position to prevent choking in case the patient vomits or on his back to provide cardiopulmonary resuscitation CPR). A person needs to be trained in providing CPR before hand.

Note: *Antidotes should be given only if there is certainty of administration of etorphine or similar substance and symptoms of poisoning appears. The antidote for narcotic substances can aggravate the condition if given for compounds against which they have no effects, or produce misleading symptoms in subjects who have no need for them. If the symptoms of poisoning do not appear within three minutes after the injection of a narcotic substance or mixture, it is unlikely that treatment with a specific antidote is required.*

Conclusion

Field immobilization is as much an art as a science. A thorough understanding and knowledge of the animal being immobilized, drug protocols and procedures, hazards associated with the use of drugs and management of any eventuality are important.

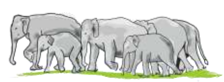

Table 9.4: Likely drug accidents during field immobilization of elephants and their management (Adapted from Morkel, 1993)

Class of drug	Name of drug	Symptoms of poisoning	Prevention and care	Management of accidental poisoning	Remarks
Narcotic (Opioids)	Etorphine hydrochloride M-99, Etorphine + ACP = Large Animal IMMOBILON	Dizziness, in-coordination, nausea, vomiting, pinpoint pupil, slow, shallow or stertorous breathing, cyanosis of mucous membranes, clammy cold skin, sweating, weak or imperceptible pulse due to fall in blood pressure, loss of consciousness, and ultimately coma. Note: As little as 0.1 mg of etorphine may be fatal to an adult man. The depressant effect may be enhanced if combined with sedative.	General field precautions as above Always handle drug in presence of another person who is qualified and aware of providing first aid in case of accident. Prior to loading of narcotic into the dart, load Naloxone HCL (NARCAN) in a separate syringe to meet any emergency, if any.	Immediately make the second person aware of the problem and ensure medical supervision at the earliest. If etorphine has come in contact of skin, wash immediately but if it has come in contact with mucous membrane, treat with antidote and wash thoroughly. In case the drug has been absorbed, immediately inject 0.8 mg naloxone (2 ampoules of NARCAN) into the most available muscle, and 0.8 mg into a vein of the forearm. In case of non-availability of naloxone, 5mg naltrexone can give positive results. This may be repeated every three minutes (up to 4 times) until improvement occurs. Keep the patient calm and in shade. The patient should be made to lie on his side in a horizontal position. Take the patient to nearest medical facility at the earliest.	Drugs used in wild animals are different from the ones used in human. The medical practitioner may not be aware or knowledgeable about these drugs. It is relevant to provide all the knowledge and information, including package inserts etc.

Class of drug	Name of drug	Symptoms of poisoning	Prevention and care	Management of accidental poisoning	Remarks
	Fentanyl citrate (Fentanyl+ Droperidol= INNOVAR-VET) Carfentanil (WILDNIL)	Similar to etorphine poisoning. Additionally, large doses of fentanyl cause muscle rigidity making breathing difficult.	Similar to that of etorphine.	Similar to etorphine. Muscle rigidity in Fentanil poisoning can be abolished by giving naloxone IV. 0.2 mg naloxone is necessary to antagonize 1mg Fentanyl 5 mg naloxone is necessary to antagonize 1mg carfentanil	Renarcotization after antagonism occurs often with carfentanil than with etorphine. Note: (15mg fentanyl is equivalent to 1mg etorphine. 1mg carfentanil is equivalent to 2.5 mg etorphine)
Sedatves Alpha-2-agonists	Xylazine HCL (ROMPUN, XYLAZIL-100) Medetomidine (ZALOPINE, DOMITOR) Detomidine (DOMOSEDAN)	Unlikely to be fatal, even at high doses. Symptoms of poisoning include severe hypotension, respiratory depression, unconsciousness, and a slow, irregular heartbeat.	General field precautions as above	Note: Do not use antidotes such as yohimbine and tolazoline as these drugs are not pure alpha-2-antagonists, and may cause tachycardia, thus compounding the problem.	The drugs are less hazardous though potentiate depressant effects of opioids.

Class of drug	Name of drug	Symptoms of poisoning	Prevention and care	Management of accidental poisoning	Remarks
Dissociatives Cyclohexylamines	Ketamine HCL (KETAMIL-100, KETAMIN-50)	As these are used in combination with neuroleptics, accidental injection may result in 'behavioural toxicity' even in small doses. Manifested as agitation, in-coordination, aggression, self mutilation, and other bizarre behaviour. Large doses may result in convulsions, coma, severe respiratory depression, and even death.	Proper handling of drug is key to avoiding any mishap. Medical help and knowledge of general precautions during handling are beneficial.	Drug can be absorbed through broken skin or membranes. Keep patient in an environment where there is little sensory stimulation. Keep patient quiet and calm. Diazepam(10mg) or midazolam (10mg) IV or IM has been reported to control muscle rigidity and convulsions in addition to artificial respiration, diuretics and urinary acidifier helps in eliminating drug from the body. Hyper-salivation may be controlled using atropine 0.5 mg IM.	Unlikely to be fatal but serious problems may occur if large amount is absorbed.
Tranquilizers Butyrophenones	Haloperidol (SERINACE), Azaperone (STRESNIL)	Large doses will cause extra-pyramidal symptoms, including uncontrolled muscular movements.	General principles of management are beneficial in management.	Call for medical help. Diazepam (10mg) IM may help in some cases	The drug is relatively safe
Phenothiazine	Acepromazine (ACP)	Similar to above		As the drug disrupts thermoregulatory mechanism, it may be necessary to provide extra clothing or cooling depending on the ambient temperature.	
Benzodiazepines	Diazepam (VALIUM) Midazolam (MIZOLAM)	Similar to above		Flumazenil (0.3 mg) IV can be used as antidote.	The drug is very safe and victims usually recover uneventfully

Photo by: Parag Nigam

Plate 9.1: Preferred darting sites

Photo by: Uttarakhand Forest Department

Plate 9.2: Standing sedation following xylazine sedation

Photo by: Wildlife Institute of India

Plate 9.3: Lateral recumbency following administration of narcotics

CHAPTER X

NECROPSY PROTOCOL FOR ELEPHANTS INCLUDING GENERAL FIELD PROCEDURES

- *Avadh B Shrivastav, Parag Nigam & M. Karikalan*

Introduction

Post mortem examination particularly of elephants is important to understand the cause of death and provide further directions for management. Post mortem needs to be carried out by skilled and experienced wildlife veterinarians taking into account all appropriate directives before initiating the necropsy. The strength of an effective and efficient post mortem depends on the knowledge of the professionals carrying out the procedure and calls for proper preparation prior to attempting necropsy. Authors have had multiple experiences where essentials to be observed during a post mortem examination and the nature and type of biological samples to be collected are often overlooked. All the personnel handling the carcass should wear protective coverings like gum boots, apron, gloves, face mask and head cover to avoid any accidental infection of zoonotic importance. One person should be assigned to write all the team's observations in a prescribed format. Another person trained in digital photography and videography should also be engaged to record the entire procedure, which will be useful for review in future, particularly for cases of forensic importance. The team must carry the following essential documents / items:

- Request letter for post mortem examination from the competent authority.
- Copies of the format for post mortem examination report, approved by PCCF (wildlife)/ competent authority.
- In case of forensic post mortem examinations, crime scene details / photographs of crime scene and photographs from different angles to be recorded.
- Brief information on nature of death, suspected cause of death, history of illness and treatment given, if the carcass is of captive animal to be recorded.
- A good quality postmortem set, tissue preservatives for various types of biological samples and variety of vials / containers / plastic zip bags for collection of different samples. should be kept.
- Protective clothing for the team and supporting staff.
- First aid kit for the team and supporting staff

Types of necropsy

Where no necropsy is conducted: If the blood smear from ear vein or smear from oedematous fluid from throat or abdominal region reveals Anthrax bacilli no necropsy should be conducted on the carcass since the organisms are aerobic spore formers. The spores survive as long as 18 years.

Table 10.1: Differentiating Anthrax and Anthracoids

S.No.	Particulars	Anthrax bacilli	Anthracoids
1.	Organism	*Bacillus anthracis*	Other than *B.anthracis*
2.	Capsule	Predominantly pink stained	Less predominant
3.	Spores	Absent	Present
4.	Length of chain	Short-usually 2 to 3 organisms	Long chains
5.	End of bacilli	Truncated	Rounded

Partial necropsy: In case of rabies only the brain of the carcass is examined for diagnosis. Here only a part of the body (head) is opened for the purpose. Other parts of the body are not opened.

Complete necropsy: All parts of the body are thoroughly examined to arrive at an etiological diagnosis.

<u>Items for documentation:</u> Copy of Necropsy protocol (1), Hand held GPS (1), Digital camera (1), Digital video camera (1), Measuring tape (1), Clip board (2), Necropsy format (5), Ball point pen (2), Metal detector (1)

Table 10.2: Equipment required for postmortem examination

Sr. No.	Item	Minimum requirement
1.	Sharp high-quality necropsy knife ss	**4**
2.	Skinning knife curved ss	**2**
3.	Autopsy knife curved ss	**2**
4.	Slicing knife 22 mm blade ss	**1**
5.	Knife sharpener stone or steel	**1**
6.	Bard Parker Handle (BP) handles and blades (No. 20,22,26 with handle no. 4)	**5 each**
7.	Small plain forceps	**2**
8.	Artery Forceps straight 203mm ss	**2**
9.	Dissecting Scissors (160, 215 mm) ss	**2 each**
10.	Large Mayo dissecting scissors fine point 215mm	**2**
11.	Rib shear heavy duty 23cm	
12.	Hack saw or bone saw blade 254mm	**1**
13.	Chisels 8½" X1.0" (22.00cm with blade 2.50 cm), 8½" X1¼" (22.00cm with blade 3.00 cm)	**1 each**

Sr. No.	Item	Minimum requirement
14.	Hammer Wrench end 200mm	1
15.	Portable autopsy saw heavy duty (Electric/battery)	1
16.	Axe (Roofing axe SS) 60mm blade	1
17.	Spirit lamp SS or gas burner	1
18.	Measuring tape SS	1

Collection of various biological samples During postmortem examination: The items of the kit should of best quality and nonreactive to formalin, alcohol and chemicals. The wildlife veterinary officer before proceeding for post mortem examination, should verify availability of the following items in the sample collection kit.

Table 10.3: Sampling supplies for postmortem examination

Sr. No.	Item	Minimum requirement
	General items	
1.	Disposable syringes (1ml, 5 ml & 10 ml)	10 each
2.	20G needles	10 no.
3.	Ziplock bags (12x15, 15x25 cm)	25 each
4.	large white plastic cutting boards (For cutting and photographing tissues)	2
5.	Clean and grease free Glass slide	1 box
6.	Slide container for 25 slides	2
7.	Wide mouth plastic bottles with tight screw cap, 100ml capacity	20
8.	Aluminium foil	2 rolls
9.	Labels/ labelling tape	2 sheets
10.	Insulated cooler boxes with gel cool packs	1
11.	Mobile refrigerator	1
12.	Alcohol wipes	1 box.
13.	Methanol	1 Bottle
	Blood / serum investigations	
14.	Vacutainer for whole blood (EDTA Coated)	20
15.	Vacutainer (Plain)	20
16.	Vacutainer for serum (Clot activator coated)	20
17.	Barcode Cryogenic vials (0.5 ml, 1.5ml, 2.0 ml)	20 each
18.	PC freezer box (25 cell)	2
19.	Marker pen (black, red, green)	One each
20.	Insulated cooler box with gel cool packs	1
	Microbiological Investigations	
21.	Sterile culture tubes and swabs	100 no.
22.	Bacterial RNA Isolation Kit	1
23.	Tubes-Transport media for bacterial investigations	10
24.	Spirit lamp SS or gas burner	1

Necropsy procedure

- It is important to verify the details of the carcass including information on species, sex, approximate age, body markings etc. as mentioned in the requisition letter issued by the competent authority.
- Necropsy for captive animals should always be carried in an organized post-mortem hall, however, in free-ranging condition, the post mortem examination should be carried out in an open and clean area away from natural or manmade waterholes. The zoo / park authority must have sufficient facilities for scientific disposal or burning of a carcass, after examination. Necropsy should be done preferably in sufficient natural day light.
- The team should try to collect all possible information related to the carcass i.e. clinical signs before death, duration of the illness, vaccination records, age and sex, correlation between illness and change in climate. History related to forensic point e.g., automobile accidents, poaching and poisoning should also be taken into consideration. It is essential to record the date and time of death and also of postmortem examination. The veterinary officer or the team should proceed for postmortem examination with open mind and should not be guided by the history of the carcass.
- The carcass should be thoroughly checked for
    - i. General health condition from appearance (good, fair, weak, cachectic or hide-bound),
    - ii. Post-mortem stage of the carcass including information on algor mortis, rigor mortis or livor mortis which provides a lead into approximate time elapsed after death;
    - iii. Condition of the natural orifices should be examined for any discharge (colour of discharge) and prolapse. The brownish watery and tarry red colour is suggestive for putrefactive changes and anthrax, respectively. The natural orifices of the carcass should be plugged with cotton soaked in a disinfectant solution before transporting the carcass to place of postmortem examination.
    - iv. Visible mucous membranes (normal pink, pale, red, yellowish, ulcerated or haemorrhagic),
    - v. Marks of injuries or types of wounds (fresh or old, incised, lacerated, piercing) or any other pathological lesions (abscess, growth, alopecia, exudative dermatitis, mange, ectoparasites etc.).
    - vi. Evidences of snare marks, gunshot wounds, fangs marks on carcass should be observed.

vii. If poisoning is suspected, try to smell the carcass and its surrounding for unusual odor and also for presence of live or dead flies / maggots on the carcass and its surroundings.
viii. The anatomical location and actual measurements of the lesion should be recorded simple and if possible, a line diagram may be sketched on the rough format during writing post mortem observations
ix. In case the animal is suspected to have died of Anthrax, make smears of the peripheral blood preferably by pricking the tip of the external ear. Such cases should not be autopsied unless the possibility of Anthrax is completely eliminated.
x. Carcass measurements like length (pole to base of tail), length of the tail, height (from sole of fore limb to point of wither), girth (body circumference) and circumference of foot pads, and length and circumference of both tusks etc.
xi. Approximate age of the animal can be assessed by body appearance and dentition.
xii. Discharge from temporal glands, which are located between the orbital fossa and the external ear canal, should be observed.
xiii. Physical health should also be assessed. The appearance of a temporal fossa and buccal depression are indication of poor physical condition. A loose 'baggy pants' appearance of the skin over the hindquarters is also an indication of poor condition.
xiv. Faecal bolus from the rectum is an indicator for digestion, difficulty in mastication due to abnormalities of the molars, old age or abnormal diet. The presence of large, undigested portions of wood, fibre, fruit and leaves may indicate poor digestion.
xv. Elephant carcass may at times be seen in unnatural positions that may be suggestive of fracture and death due to the lack of mobility. Most animals killed in fights are bulls, and in poached animals, the tusks are frequently removed or there are signs of attempted removal

- All the persons handling the carcass should wear protective clothing like full length postmortem apron, gloves, face mask, gum boots and head cover to avoid any accidental infection of zoonotic importance.
  i. The veterinarians, technicians, researchers, post mortem attendants participating regularly in postmortem examinations should take prophylactic vaccination against rabies and tetanus, regularly.
  ii. One person of the team should be entrusted to write the observations (lesions in different tissue / organs / body cavities /

body fluids) in a prescribed format. Additionally, a trained person for photography and videography may be included.

Morphometry: It is necessary to take the measurement of following parts for record. (All length in cm): length from head (poll) to base of tail, height at withers, chest girth, neck girth, tail length, trunk length, circumference of foot pads and number of nails, tusk length and circumference at base.

External Examination

The necropsy should be performed soon after death as possible, since post-mortem decomposition sets in rapidly, especially in hot weather. Post mortem changes (autolysis) including changes that occur in the tissues soon after death of an individual. Understanding of these changes are important to distinguish changes due to disease (lesions) from the tissue alteration following death. The changes become more advanced with the passage of time and quite a few factors influence the rapidity of their onset. These include the environmental temperature (since elevated summer temperature increases the rate of enzymatic and bacterial activity animal decomposes rapidly); size of animal (in large size animals post mortem changes occur early) and nutritional state of animal (the fatter the animal the slower will be the heat loss and the carcass will be rapidly decomposed. Rigor mortis occur more rapidly in fat animal than in emaciated animals). It is essential to know the time of death and can be determined by noting post-mortem changes such as rigor mortis, cadaveric lividity and autolytic changes.

1. Cadaveric lividity (hypostatic congestion): Common in a large animal like elephant. These are irregular livid patches observed in the subcutis on the side upon which the animal has been lying. This should be differentiated from a hemorrhage.
2. Rigor mortis: Rigor mortis or stiffness starts soon after death. It may be delayed by 4 to 24 hours or even longer. In weak and emaciated animal rigor sets in earlier and is less pronounced than in healthy and well nourished. Usually, it appears within 1-4 hours after death and lasts for 16-18 hours and, at times, even up to 48 hours depending upon the ambient temperature. Rarely it may pass off within 3 hours.
3. Decomposition: Usually decomposition begins from 6 to 36 hours and again depending upon the time of death, atmospheric moisture and temperature. When advanced post-mortem changes take place, the muscles get softened, become pale red and watery, resembling slightly cooked meat.

Skin conditions: In a healthy animal, the skin is thick but flexible and easily moved over the underlying tissues. It is essential to remove skin of one side from the entire lateral thoracic and up to lower abdominal and other suspected regions. Examine the subcutaneous tissues and muscles for abscesses, wounds, haemorrhages and other pathological conditions.
Cutaneous papillomatosis is generally seen in juvenile elephants, characterized by warty lesions (1 cm to 6 cm in diameter) as reddish pink 'button' appearance. These are found predominantly on the trunk skin, cheeks, lips and neck. The warts may be single or numerous, and are caused by a herpesvirus, rather than a papilloma virus and shown to cause acute fatal systemic infection in Asian elephant calves in zoos in the USA. Similarly, another condition characterized by focal raised circumscribed lesions (1 cm to 5 cm in diameter) has been seen in the skin of the ear pinna of young elephant. These lesions later develop necrotic centers and ulcerate. Biopsies revealed dermal capillary thrombosis with infarction, as well as perivascular lymphocyte cuffing. A viral aetiology is suspected, but no inclusion bodies have been seen. Other skin conditions recorded are acanthotic dyskeratosis and fibrosarcoma.

Ectoparasites are generally rare on free-ranging and include the ixodid ticks. *Amblyomma tholloni* and *Rhipicephalus maculatus* are less commonly seen. The elephant louse, *Haematomyzus elephantis* is highly species-specific, and is found in the skin folds of the head and the external ear canal. A flea, *Echidnophaga larina* has occasionally been encountered on elephants.

Superficial lymph nodes: Examination of lymph nodes is important to suspect any infectious disease. The parotid, mandibular and superficial cervical and prescapular lymph nodes may be observed approximately in the same position as seen large herbivores. Lymphadenitis is frequently observed in focal pyogranulomatous reactions by *Staphylococcus* spp., *Nocardia asteroids* and *Cryptococcus* spp. in free-ranging elephants.

The elephant digestive tract consists of the mouth (including proboscis), pharynx, oesophagus, simple stomach, small and large **intestines**, caecum, rectum and anus. Additional organs, such as molar teeth, tongue, salivary glands, liver and pancreas, complete the gastrointestinal system. Elephants have cylindrical simple stomach (monogastric) about 100 cm to 140 cm in length and about 40 cm in diameter. The cardio-oesophageal junction is clearly demarcated and narrows towards the pyloric end.

Abdominal cavity: The Asian elephant has twenty pairs of ribs. Draw a vertical straight line between the last rib and the tuber coxae close to lower abdominal. The incision should be a vertical one, and then down to the ground surface. The incision can then be extended towards the sternum. The triangle of the abdominal wall and associated skin flap to examine the organs of the cavity. The abdominal cavity may contain 1 to 3 liters of straw-colored fluid.

Stomach: Examine the stomach contents for ingested quantities of food material and mud along with their moisture and gut parasites i.e. Parasites of the genus *Parabronema* (a spirurid helminth) may cause parasitic granulomas and focal ulcerations in the gastric mucosa.

Intestinal tract: The intestinal tract is approx. 18-20 m in length. The pancreas is about 50 cm long and is highly lobular and should be examined for fecal contents, nature of bolus and parasites.

Thoracic organs: The lungs of an elephant are large and adhere firmly to the inside of the chest wall, pericardium and part of the diaphragm by means of tough white connective tissue. There is no pleural cavity. The trachea is about 30 cm in length and is supported by very stout cartilaginous rings, which are incomplete dorsally. The lungs, trachea and bronchial lymph nodes should be examined for pathological changes. Presence of lymphoid nodules is suggestive for subclinical or latent herpesvirus infection.

Heart: The pericardium is attached to the diaphragm posteriorly and may also be attached to the adjoining lung lobes. Between the serous membrane and the epicardium is a small quantity of clear yellowish pericardial fluid. The heart is large with two distinct apices. Heart should be examined for septicaemic lesions, aortic aneurysm and arteriosclerosis and parasitic lesions. The heart may weigh up to 25-28 kg in adult elephants, Sikes (1971) suggested the linear relationship between heart weight and body mass in the ratio of 0.5 kg of heart tissue is indicative of 100 kg of body mass. The heart should be examined for pericardial or endocardial hemorrhages, myocardial degeneration, necrosis /myocarditis. Endocardial clotted blood should be examined for electrocution or presence of chicken fat.

Uro-genital system: The urine of a healthy elephant is generally slightly acidic, light straw coloured without any marked smell. Remove kidneys and examine for congestion, hemorrhage and also for inflammatory changes. The kidneys are lobulated. In the healthy elephant, the capsule of the kidney can easily be removed and is covered with quantities of fat, which is an indication of body condition. The junction between the cortex and medulla is clearly demarcated in the healthy kidney. The adrenals are elongated strap-like organs and the cortex appears dark yellow on section. The testes hang ventral to the kidneys and are oval in shape. The penis can be reflected posteriorly by dissecting it loose from the abdomen right up to the crura.

Tongue and Thyroid: The tongue and thyroid should be examined for pathological changes, if any. Tongue should be specially examined for lesions of EEHV.

Dentition: Elephants develop six sets of molars, and these can be used for age determination. The permanent tusks protrude beyond the lips at about 30 months and grow throughout life.

Trunk: The trunk should be examined for signs of trunk discharge and its colour and consistency. The trunk mucosa should be examined for lesions of FMD.

Spleen: This is a dark, bluish-red elongated organ, covered by a tough whitish connective tissue capsule. It should be examined for changes shape and size.

Liver: It may weigh up to 7-70 kg in an adult elephant. The gallbladder is absent but the main hepatic duct is large. The liver should be examined for change in size, consistency focal or extensive or subcapsular haemorrhages, hepatitis and presence of gallstones in the larger branches of the biliary system and parasites (*Grammocephalus spp/ Dipetalonema spp*).

Adrenals: Adrenals are paired long but narrow endocrine organs. They are located retroperitoneal and must be carefully dissected loose for pathological changes. The cut surface of cortex is commonly yellowish and the medulla is grey in colour.

Head: Dissection of head is best completed after separating it from the body. Dissect and remove the ears. Cut and remove the trunk at the level of the lower lip. Disarticulate the head while cutting through the atlanto-occipital joints and separate from the body. Dissect out the tusks. Several cuts are required to sever the bones to reach the base of the tusk. A good portion of the cranium must be cut to reach the brain (Large knives, long axe, chain saw and chisels can be used for cutting). Make three connecting deep cuts in the margins of the triangle formed at the base of the skull using an axe. Remove the bony plates by lifting them with a crowbar and expose the brain. The brain is dissected out after severing the attachment.

Detailed examination of the organs: All parts of an organ should be examined thoroughly. Emphasis should be given to differentiate lesions from post-mortem changes. After opening the carcass system-wise, individual organ should to be examined in detail. The elements of gross description include.

1. Distribution – What is the spatial arrangement of lesions?
2. Demarcation – How clearly set off from the adjacent is it?
3. Contour - Are the lesions raised, flat or depressed
4. Shape – Do the lesions have a geometric shape?
5. Colour
6. Size – absolute vs. Relative; lesion, whole organ, paired organs
7. Texture - What does the cut surface look like? Amorphous or solid
8. Consistency - How does the lesion feel? Fluid, soft, firm, hard
9. Special features - Odor, sound

General guidelines for collection, preservation, storage of samples for diagnostic purposes: For a specific diagnosis histopathological, microbiological. Parasitological, molecular and toxicological investigations may be undertaken and suitable biological samples should be collected in appropriate preservatives.

Table 10.4: Summary of biological sampling for specific diagnostic activity

Diagnostic activity	Type of specimen	Preservation method	Type of container	Comments
Histopathology	Tissues samples	10% buffered formalin	Wide mouthed, Leak-proof glass or plastic bottle	Sections no more than ¼ inch thick. Ratio of 10:1 formalin to tissue. Storage at room temperature.
Toxicology	Organs, fat, blood and ingesta or suspected contaminated foods	Refrigeration or freezing	Clean glass, plastic, or container	Accurate records are critical. Appropriate sampling varies with suspected toxin

Diagnostic activity	Type of specimen	Preservation method	Type of container	Comments
Parasitology	Worms External parasites Blood parasites	5% formalin 70% alcohol or 5% formalin Air dried blood films	Glass or plastic Glass or plastic Glass slides	Storage at room temperature Storage at room temperature Blood slides stored at room temperature.
Haematology	Whole blood in anticoagulant	Refrigeration	Glass or plastic tubes	Gently rotate tubes to mix blood with anticoagulant. Generally short storage
Serology	Blood/serum	Refrigeration or freezing of serum portion of blood or in merthiolate	Clean, dry glass or plastic vials	Handle gently to avoid rupture of red cells. Transfer serum to separate container before freezing.
Virology	Organs, tissue, lesions or body fluids	50% glycerol saline PBS Hank's balanced salt solution	Sterile plastic/glass containers	Care to avoid contamination is critical. Appropriate sampling varies with different diseases
Bacteriology	Whole blood, Organs, tissue, lesions, or body fluids, swabs	Usually refrigeration/on ice	Sterile plastic/glass containers	Care to avoid contamination is critical. Appropriate sampling varies with different diseases
Mycology	Hair sample & skin scraping Tissues/Deep skin scrap	At room temperature Usually refrigeration or freezing	Sterile plastic/glass containers	Care to avoid contamination is critical. Appropriate sampling varies with different diseases

Carcass disposal: The disposal of carcass and disinfection of the site as well as of the persons involved in handling the carcass during necropsy examination is one of the most important tasks after postmortem and collection of morbid materials for laboratory investigations. In the field, the disposal of carcass and disposable material used by the handlers is done either by burning or burial. It should be incinerated without releasing any suspended particles in the atmosphere. The soil of the area contaminated by blood, fluid or ingesta from the carcass should also be buried or burnt leaving no chance of spread of infection in case of contagious disease. The area should be disinfected with bleaching powder. The disposal of the carcass should be done as per extant guidelines.

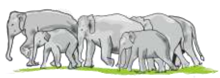

Photo by: Avadh B. Shrivastav

Plate 10.1: (a) Opening and (b) flapping of skin of carcass

Photo by: Anil.K. Sharma

Plate 10.6: Sampling supplies during postmortem

Photo by: Jayjit das[a,c,d] & Karikalan, M[b]

Plate 10.2: Death due to electrocution-Burn injury on (a)Trunk, (b) Forehead, (c) Lower lip and (d) Subcutaneous congestion

Photo by: Parag Nigam

Plate 10.3: Case of Organophosphorus poisoning

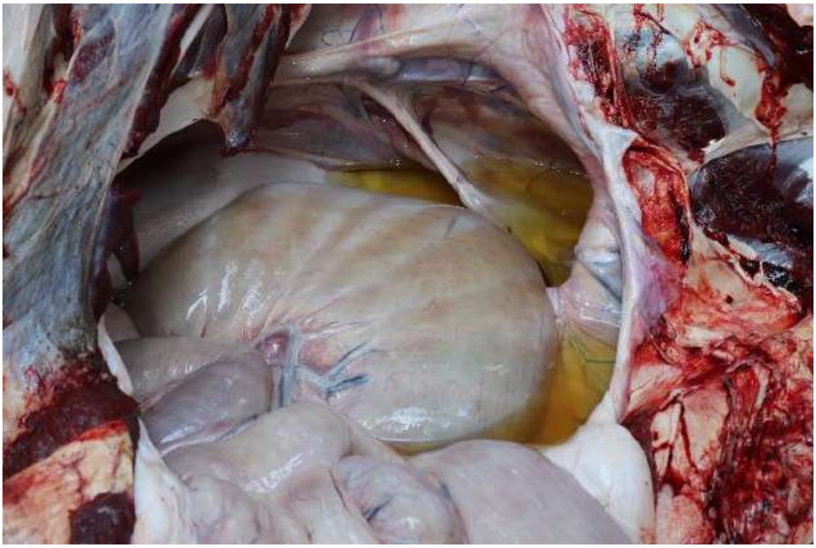

Photo by: Karikalan, M

Plate 10.4: Straw coloured fluid in abdominal cavity

Photo by: Jayjit das

Plate 10.5: Burial of carcass

CHAPTER XI

ESSENTIALS OF FOOTCARE IN CAPTIVE ELEPHANTS

- S. Ilayaraja and Arun A. Sha

Introduction

Elephants are kept under captive conditions across the world for various purposes. Historical records indicate that peaks in captive elephant management (or more specifically, war elephants) were during the Mauryan period in the 3rd century BC and the Mughal period in the early 17th century, and many elephants were captured for the purpose. For example, during the period 1868-1980, records indicate that 30,000–50,000 wild elephants were captured, especially in the northeastern part of the country. Elephants have been fascinatingly interlaced with Indian culture, tradition, and mythology from time immemorial. Asian elephants are worshiped in India due to their resemblance to Lord Ganesha. They are therefore housed in temples and are utilized in many religious ceremonies. The principal activity of captive elephants depends on the form of management regimen under which they are kept. The forest department maintains elephants mainly for carrying out range of forestry and wildlife activities. The elephants under private ownership are exploited for commercial activities like timber logging, processions and even for begging in the streets. During the year 2009, the Central Zoo Authority placed a ban on use of elephants in zoos and circuses. Indian elephants are placed in Schedule I and Part I of the Indian Wild life (Protection) Act (1972), conferring it the highest level of protection.

Due to lack of proper elephant husbandry practices and knowledge, non availability of traditional *mahouts* and experienced veterinarians combined with abuse and overexploitation, the captive elephants suffer from different kinds of health issues that are often fatal. Neglected foot care in captive elephants resulting in traumatic foot conditions remains one of the significant causes of morbidity and mortality. Disseminating necessary foot care and management procedures is the need of the hour.

Elephant foot & limb fact

Thorough knowledge about the unique anatomy of the elephant foot & limb is of paramount importance to recognize the need for foot care in them (Ramsay and Henry, 2001). The foot of an elephant is a masterful piece of evolutionary development, designed with the concept of a graviportality to support the enormous weight of the largest terrestrial mammal. Generally, adult Asian males may weigh around 3.5 to 5.5 tons, and adult females weigh approximately 2.5 to 4.0 tons. Elephants are sub-ungulates; digitigrade on the forefeet (like Hippos and Tapirs) and semi-plantigrade on hind feet. Elephants walk in an ambling way wherein the hind foot treads in the print of the forefoot. Elephants cannot trot or gallop due to the almost vertical orientation of their bones. Both forelimbs and hind limbs have slight angulation compared to other mammals. The legs are straight, and the articular surfaces are in line with the axis of the portion. The limbs avoid excess exertion by flexing minimally during locomotion. The bones of the limbs are massive and have a narrow or nil marrow cavity. The radius and ulna are fixed in a prone position. The fibula is separate from the tibia. The elephant leg length increases by lengthening the proximal limb segments but not the distal limb segments. There is a bit of exterior definition of leg segments, and there are no externally identifiable digits. Elephants have nails instead of hooves and most of the elephants have 18 nails, 5 nails on each front foot and 4 in the hindfeet. Twenty nails are very rare (5 nails on each fore and hindfoot), which is considered very auspicious according to Gajasastra. The footpad has a thick fatty cushion that provides a good grip while walking and improves blood circulation throughout the body. The forelimb is longer than the hind leg, and the front feet bear much of the body weight. The hindfoot is smaller than the forefoot and has an oval shape.

The carpal bones are block-like and arranged in two rows of four in the forefoot. The proximal row includes the radial, ulnar, intermediate, and accessory carpal bones. The distal row of bones is referred to as carpal bones one to four (C-1 to C-4). C-1 to C-4 articulate with their corresponding metacarpal (MC) bones, with C-4 articulating with MC-5. The elephant carpal bones' position and articulation are different from other ungulates. They permit very little abduction of the carpus. In the Asian Elephant, the three carpal joints (the radioulnar joint, the intercarpal joint, and the carpometacarpal joints) each contain its synovial sac. In the hindfoot, the tarsus is composed of seven bones and arranged in three rows. The talus and calcaneus make up the proximal row, and there are two articular facets between them. The talus is disc-shaped and compressed dorso-plantarly, while the tuber calcaneus points plantarly. The central tarsal bone is the sole bone of the second row of the tarsal bones. The four tarsal bones (Tl-4) make up the distal row of tarsal bones and are wedge-shaped. Each tarsal bone articulates the corresponding metatarsal bone, with T-4 also articulating with metatarsal five (MT-5). There are four separate synovial sacs in the tarsus of the African Elephant. The metatarsal bones have an expanded distal extremity for articulation with the proximal phalanx. Metatarsal three (MT-3) is the largest, while MT-1 is the smallest and somewhat triangular. The elephant possesses an unusual structure-the prehallux, a cartilaginous segment that extends distally from MT-1 and T-1. The prehallux attaches to the sole at a position medial to the midline. The prehallux function is unknown, but it appears to stabilize the tarsus over the digital cushion. The hind foot has five digits that radiate in a craniocaudal orientation.

Digits three and four are more significant than the other digits in both species, and each has three phalanges. In the African elephant, digit one (D-1) is represented by only a single sesamoid bone (Smuts and Bezuidenhout, 1993, 1994). Still, in the Asian elephant, this digit is described as having one phalanx (P) without a sesamoid bone. The other digits have paired sesamoid bones, plantar to the metatarsal-phalangeal articulation. In the African elephant, D-2 has two phalanges, and in the Asian elephant, it has three. Digit five has two phalanges in each species. The proximal and intermediate phalanges are quadrilateral in shape. The third phalanges are slightly spindle-shaped with bilateral transverse processes and a single dorsal process. The third phalanx only loosely articulates with P-2 and appears to be buried in the tissue medial to the corresponding toenail. There is a slight but distinct axial angulation of digits two and four towards the third digit.

Common foot ailments in elephants

Foot problems constitute the single most crucial ailment in captive elephants. Feet disorders can involve the integumentary and the musculoskeletal system. They can be infectious, traumatic, or degenerative. Common foot problems encountered at the nail, skin, sole, or pad include penetrating injuries, trauma, cracks in the sole, nail, or cuticle, overgrown nail, sole, or cuticle, laminitis, foot rots, ingrown nails, pododermatitis, osteomyelitis, arthritis, fractures, dislocations, abscesses, and degenerative joint disease. Neglected chronic foot disease in the advanced stage may become unresponsive to medical and surgical management and may subsequently require euthanasia.

Reasons for foot ailments: Many factors have been suggested to predispose captive elephants to foot disorders, and they are all related to a greater or lesser extent to husbandry. Several factors predisposing the captive elephants to foot disorders have been identified and are strongly associated with the husbandry practices followed:

- Neglected foot care
- Tethering on hard and unhygienic floor
- Forced to stand on the hard floor for prolonged periods

- Overloading and long working hours
- Inappropriate hobbles
- Lack of access to ad libitum water source
- Debility and nutritional deficiencies due to monotonous feeding
- Obesity due to overfeeding, feeding with unconventional food items, and lack of proper exercise.
- Mixed infections due to untreated wounds
- Compensatory weight bearing

Diagnostic approach

Digital radiography and thermography technique are effective diagnostic modalities in the clinical investigation of musculoskeletal problems in elephant feet.

Digital radiography: The elephant foot is a massive structure, and conventional radiographic protocols and equipment do not always result in diagnostic quality images due to inadequate penetration of the x-ray beam. The differences in topography and bone density of various parts of the foot skeleton demand different techniques, therefore, multiple films of the foot. Health and safety as well as welfare reasons. This would demand radiographic protocols to ensure efficiency, speed, and repeatability. Therefore, upgrading to an appropriate advanced technique with protective gear becomes mandatory to get a better result. Radiography of the feet identifies the extent of an abscess, damage to the phalanges, and osteitis/osteomyelitis lesions in a chronic case of a foot abscess. The portable direct digital radiography with a portable X-ray machine with the capacity of 35 mA, 100 kVp & 100 mAs is the minimum requirement to get a good quality diagnostic radiographic image of the foot and limbs of an elephant. Exposure factors of 55 to 60 mAs and 25 to 30 kVp will provide better image quality of the foot, contributing to the diagnostic value.

For quick and proper radiographic examination, basic training to the elephant for presenting its foot is important. That can be achieved by free contact or positive conditioning through protected contact methods. A minimum of three persons are required in addition to the *mahout* to handle the DR unit, focusing the X-ray beam and positing the flat panel X-ray detector. A small stool/foot rest with a covering case is mandatory to protect the X-ray detector from an elephant's foot pressure. The projection angles that were found to be most useful were 65–70° for the front limb and 55–60° for the hind limb. The beam was centered 10–15 cm proximal to the cuticle in the front and 10–15 cm dorsal to the plantar edge of the sole in the hindfoot, depending on the size of the foot. Since image quality always depends on the factors such as kVp, mAs, time, source image distance (SID), and tissue absorption factor, depending on the x-ray machine capacity and digital radiography units, we must standardize our exposure charts for getting good image quality. The exposure technique guidelines for Asian elephant limbs can be designed by using the equations of kVp = (2 × Tissue thickness [in cm]) + SID (in inches) + 5 and mAs = Tissue thickness (in cm)/2.5.

Thermography: Infrared thermography (IRT) is a safe, modern, non-invasive, non-contact thermal profile and its visualization technique. Elephants are ideal models for thermal imaging studies as their skin is scarcely covered with hair. Thermal or infrared energy is a part of the electromagnetic spectrum with a high wavelength over and above the visible range of the human eye. Instead, we perceive it as heat. Electromagnetic radiation is ubiquitous and may be classified according to its frequency or wavelength. The radiation restricted to the wavelengths from 760 nm to 1 mm is referred to as infrared radiation or "thermal radiation." Unlike visible light, everything with a temperature above absolute zero emits heat. The higher the temperature of an object, the greater the amount of infrared radiation it emits. Even icy objects, such as ice cubes, emit infrared radiation.

Typical exam procedures with a thermal imager for veterinary applications may involve uncontrolled environmental conditions. The imager used should stand up to consistent measurement under extreme environments. Author has used FLIR-E 60 thermal imaging camera for the study and examined 3mts distance. To measure temperature accurately, it is necessary to compensate for the effects of several different radiation sources. This is done automatically by the camera. However, the following object parameters must be supplied for the camera: the object's emissivity, the reflected temperature, the distance between the object, the camera, and relative humidity. Since the skin possesses high emissivity (0.98), the effect of reflected temperature will not affect the thermal measurement. Hence, it can be ignored. We used digital temperature & humidity meters (HTC-2) for recording the environmental temperature & humidity. An important concept is the "color palette." A color palette is the set of colors used in a thermal image, with specific colors varying with temperature. Thermal cameras allow a wide choice of color palettes. It is essential to select a palette that is easy to interpret when examining animals. The instrument used was 'high rainbow' as it has easily distinguishable colors - a palette displaying the coldest areas in blue and the hottest areas in white with red and yellow in between. Factors such as wet skin, skin contamination due to dirt, moisture in the fur, windy locations, direct sunlight, and other heat sources will affect the appearance of thermal images. They can lead to an error in thermal measurements. Thermal imaging cameras are a great tool to determine whether an animal is suffering from pain as in inflammatory conditions. As physiological diagnostic tool, thermography makes it possible 'to see the unseen' before anatomical changes have developed. The diagnosis of localized inflammation would not have been probable without thermography. Since it is portable, easy to use/learn, not stressful to the animal as it is a non-contact, safe remote sensing method, and cheaper when compared to digital radiography, it can be considered an efficient diagnostic tool in the health care of captive elephants.

Foot care tools All the tools used to maintain foot care in equines can be used in elephants effectively. The electric grinder can be used, but it requires considerable handling experience to avoid severe consequences to the Elephant's feet.

Treatment approaches and standard protocol The overgrown toenail, cuticle, and sole need to be trimmed by using suitable knives and rasps. If any swelling around the nail beds and discoloration of the skin is noticed, the radiographic examination is mandatory to understand the level of osteomyelitis changes of the underlying bony structure. Always choose the antibiotic based on ABST to avoid inappropriate antibiotics / antibiotic resistance. Meloxicam at 2mg /kg BWT, Combination of trypsin, bromelain, rutoside trihydrate (Rutoheal) 20 tablet can be administered effectively to manage the pain and swelling. Supplementation with vitamin B-complex, vitamin C, E, and A with trace minerals will aid in quick healing. Therapeutic management with oral or injectable antibiotics and anti-inflammatory drugs needs to be continued for a minimum of 10 to 14 days initially. The anti-inflammatory medications can be used as and when required. However, topical dressing, cleaning, and washing the lesions should be done twice daily until complete healing is achieved. The healing period for foot abscesses may be longer based on the stage of infection and the quality of intensive treatment care. This could take a minimum of 45 days to 90 days. Periodical evaluation of kidney and liver functions may also be necessary to overcome drug-induced nephritis and hepatitis, respectively. Any discontinuity in regular dressing and periodic pain management will delay the healing and increase further complications in weight-bearing and locomotion. The inability of the commercially available ointments to percolate the elephant skin and produce the desired effects were observed. Using DMSO and creams such as Soframycin, silver sulphadiazine, and mupirocin, Fusidic acid ointments have been recommended.

Frequent use of irritants (povidone-iodine, Tincture iodine, Copper sulfate) to clean and dress foot abscess should be avoided. Cold fomentation with ice is highly recommended. Don't interchange the foot soaking between formalin and $KMNO_4$ suddenly without proper time intervals to prevent further damage to the soft tissues of the foot. $MgSO_4$ foot soaking (400mg per two litter of Luke warm water) is safe and gives the desired effect. Direct daily application of $MgSO_4$/ Himax ointment on the lesion will also be effective and enhance quick healing.

Preventive foot care

- Since foot care is a major husbandry component for keeping Asian elephants in captivity; every elephant holding facility must have its foot care protocol. It is important to maintain a schedule of foot trimming as a preventive care practice. Adequate and accurate records are needed. There are several ways to keep good records such as the written record-keeping system along with radiograph images, digital still photos, and video clips.
- Offering good quality fodder and nutritional supplements (Biotin, Vitamin-E, C, & A., Zn, Se, and As) for managing the ideal body weight should be of prime significance to support proper foot care.
- Providing adequate exercise is one of the most important aspects of proper elephant husbandry. One to two hours of walking each day should be considered the minimum amount of time an elephant needs for cardiovascular activity without just strolling around the exhibit. Anything less predisposes an elephant to foot problems and obesity, especially later in an elephant’s life. Exercise of all joints, tendons, and ligaments is necessary to maintain a healthy foot.
- Proper hygiene practices and minimal time of confinement in stalls must be followed in all captive facilities to avoid constant exposure of the elephants’ feet to their faeces and urine. The corrosive nature of urine and the infective components of the faeces sticking to their feet and legs can increase their susceptibility to infection. Regular scrubbing of feet and legs using neem soap and water aided by a hard-bristled brush may ensure better foot hygiene.
- Natural substrates allowing an elephant to dig will exercise and strengthen leg and foot muscles, tendons, and joints. This exercise and activity directly support healthy feet throughout the elephant’s life in captivity. Elephants should be housed for much of the day on

resilient, interactive, yielding surfaces to enhance their natural behaviors.

- Having the correct equipment, experienced staff, and regular training for the elephants to present their feet without fear is essential for a productive elephant pedicure along with the suitable facility design to implement the foot care protocol.

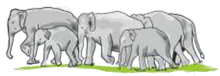

Plate 11.1: (a) Multiple abscess with toenail avulsion (b) Severe toenail abscess, (c) Contusion of footpad, (d) Severe pododermatitis of foot pad

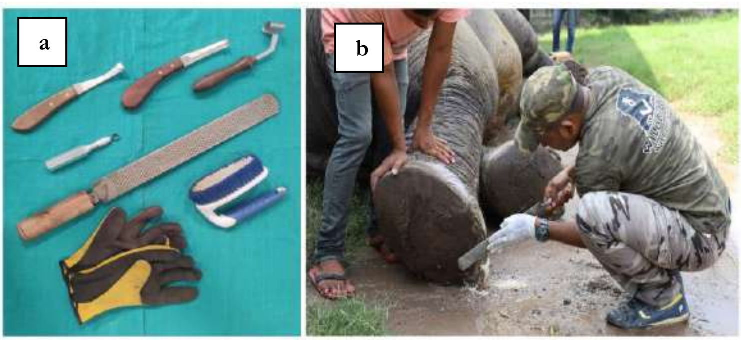

Plate 11.2: (a)Foot care kit (Knifes, Rasp, Protective glove and Brush), (b) Overgrown toenail trimming

Plate 11.3: (a) Elephant foot soaking in rubber tub for desirable effect (b) Cleaning out foreign bodies from footpad (b)

Plate 11.4: (a) Performing radiography examination with portable direct digital X-ray unit (b) Radiographic result suggesting cracked toenail with various degree of p3 degeneration

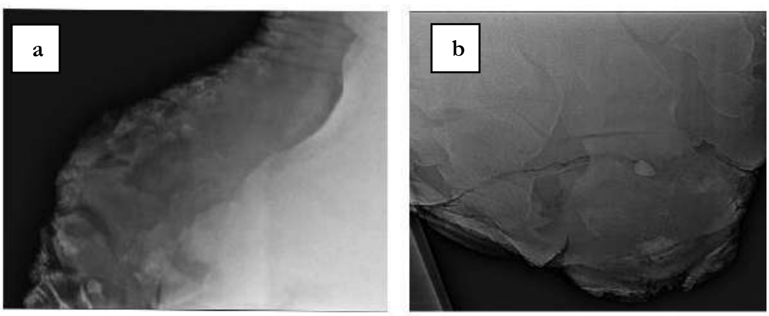

Plate 11.5: (a) Lateral view of toenail abscess revealing excessive thickness of skin layer pus pockets (b) Dorso-palmar view showing embedded foreign body: pebbles in foot pad

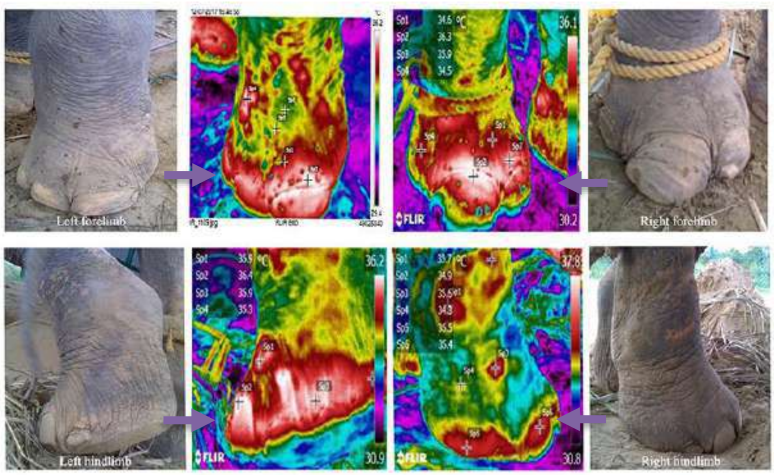

Plate 11.6: Infrared thermography (IRT) of elephant foots showing irregular thermal patches suggesting focal inflammatory changes

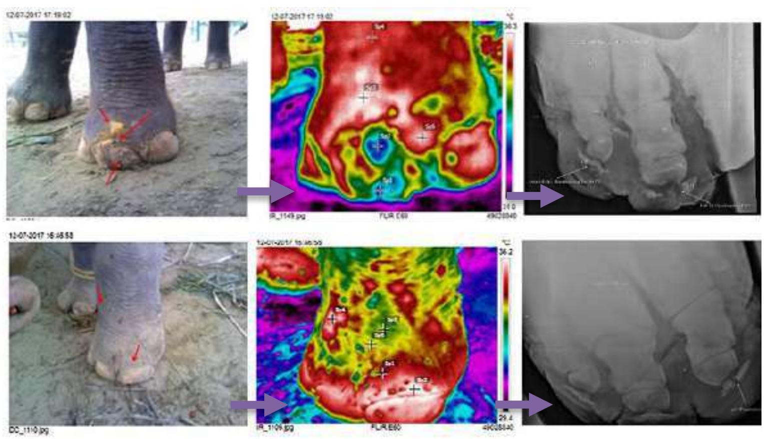

Plate 11.7: Comprehensive variability in evaluation of footpad through visual, thermography and radiography (from left to right)

CHAPTER XII

MUSTH AND ITS MANAGEMENT IN CAPTIVE ELEPHANTS

- *Kushal Konwar Sarma*

Introduction

Charles Darwin (1871) once wrote about Asian elephant bulls; "No animal in the world is as dangerous as an elephant in *musth*". This statement may be deemed true based on personal encounters with 141 *musth* elephant bulls. Although *musth* in the Asian elephant has been widely recognized in scientific literature for over one hundred years, many misconceptions existed about the periodical exhibition of this violent event until very recently. *Musth* is now well understood as a natural phenomenon exhibited by virile bull elephants, which is characterized by a manifold (about 50 times) increase in the blood testosterone levels, temporal secretions, dribbling of urine, remarkable aggressions and heightened libido. This phenomenon has been regarded as genetic selection, by which the phenotypically and genetically weaker males are precluded from the procreation process ensuring that the selected genetic materials only pass down the generations from the virile bulls. In the wild, this is ensured as the better and stronger bulls exhibit *musth* and thereby exercise dominance over others and make the weaker bulls give them a wide berth. Increased aggression associated with *musth* appears to be the driving force to motivate a new generation young bull to challenge an older male for usurping dominance and the right to breed with the female/s in oestrous. Through the Temporin, the term used to describe the *musth* fluid rich in pheromones, the bull appears to announce that he is prepared to aggressively defend or gain access to an oestrous female (Wheeler *et al.,* 1982). It is a period of heightened libido, sexual awareness and aggressive behaviour to scare away all possible competitors. *Musth* is experienced once a year by mature males in peak condition (Poole,1987; Sarma,2001, 2002, 2003).

Musth, the healthy reproductive behaviour of the elephant society in the wild, makes keeping male Asian elephants in captivity a hazardous business, since the bulls become extremely violent and difficult to handle during their periodical rutting season and frequently go on rampage if they can free themselves. Although male elephants make up only 20% of approximately 600 captive elephants in North America, they were involved in nearly 50% (7 of 15) fatalities in the U.S. and Canada since 1976 (Lehnhardt,1991).

However, all male aggression is not linked to true *musth*. Many aggressive outbursts have been recorded in elephants that were definitely out of *musth*. In Assam, there are about 1250-1500 captive elephants, the majority of which were engaged in the region's burgeoning timber industry; and this continued till December of 1996, when the Supreme court of India had to intervene at the alarming scale of loss of forest covers and clamped a ban on all logging activities. The sudden lay-off from the strenuous lumbering work resulted in a remarkable rise in the incidence of *musth* in these elephants with a good number of them breaking loose and running amok. Chemically immobilizing these rampaging bulls for tethering and rehabilitating, was a great opportunity for studying and documenting various facets of this interesting phenomenon. Cases have been documented in terms of season, age, degree and pattern of aggression, social factors, control measures etc. Certain management practices and medical means are useful to contain this destructive form of elephantine behaviour have been found useful. Enormous information about *musth* has also been generated and knowledge gathered from the state of Kerala, where about 1000 captive elephants, majority of which are vigorous males and being maintained in the temples, forest camps and private ownerships (Chandrasekharan *et al.,* 1992).

About one third of the world population of Asian Elephants numbering about 16,000 live in captive conditions throughout the world in zoos, circuses and amusement parks. In Asia, as many as 15,000 captive elephants have been put to work for tourism or in timber camps, or have been kept isolated in holding facilities to decrease conflict with human population (Indonesia). In India's southern regions, elephants have been traditionally maintained in temples, with the state of Kerala accounting for the highest number of such elephants (about 1000). In India's North East, a large number of elephants in captivity belong to private owners who have traditionally employed them in the regions timber industry. The state of Assam alone accounts for about 1000 elephants, Arunachal Pradesh being home to about 700-800 duty elephants. Apart from that, the state's Forest and Wildlife Department has in its care about another 140 elephants. Keeping bull elephants in captivity has, however, remained a difficult and challenging task as the bulls can potentially turn aggressive. Poor training, lack of understanding, improper communication, unimaginative social grouping and inherent male dominances or interplays of some of these factors are certain reasons for a captive bull becoming dangerous. But most frequently, the violent behaviour of a bull elephant is associated with *musth* which is a peculiar periodical phenomenon characterized by a volatile mental state and extremely aggressive behaviour. In this chapter various aspects of *musth* and its managements in captive Asian Elephants is being discussed.

Musth: A natural phenomenon.

Musth is a natural phenomenon in healthy male elephants. It is the physical and behavioural manifestation of physiological changes, primarily a gradual increase in testosterone level induced by favorable conditions over a period of time (Jainudeen *et al.,* 1972a). In the wild, dominant bulls experience *musth* for a period generally ranging from 1-30 days during which they remain preoccupied with the females of the herd. *Musth* in captive bulls lasts an average of 3 months (Sukumar, 1994). What happens during that period in effect is that an otherwise docile and obedient animal often turns emotionally volatile, unpredictable, extremely aggressive and potentially dangerous. That is why *musth* is considered to be a major problem in maintaining male Asian elephants in captivity (Eisenberg *et al.,* 1971; Fowler, 1973, Olsen *et al.,* 1993). A number of tragic accidents have occurred resulting in loss of lives due to inadequate precaution and laxity in management and handling of elephants in *musth*. There were times when it had to be considered whether to put the male Asian elephants to sleep for difficulties in managing them in some of the zoos in the western countries. This prompted scientists (Fowler, 1973; Flanagon & Flanagon, 1983; Olsen *et al.,* 1993) to try to perform castrations in young bulls to prevent occurrence of *musth* and the difficulties associated with its management.

Keeping the fact in mind that any bull elephants whether in or out of *musth* is capable of a productive sexual congress, a question naturally arises as to the reason of this violent ruttish behaviour in the elephants. Numerous studies and observations carried out has proved that only the bull with dominant disposition that is healthy, in prime age will develop *musth* and create conditions to ensure that only the better genome available in the herd will percolate down the generations. The chemical signals delivered by the pheromones present in the temporal secretions, while attracting the oestrous cows, will force out the weaker bulls from the herd and thereby, the procreation process to give the master a wide berth and a monopoly over the harem. *Musth* is therefore, only a part of the nature's superb ways of selection and is a wonderful reproductive behaviour of the elephants.

Occurrence of *Musth* in captive male Asian elephants in India's North East: Incidence and factors: Most of the captive elephants in India's North East, numbering not less than 2000 animals, belong to private owners and have been traditionally engaged in logging operations in the region's extensive timber industry. Naturally there have always been incidences of *musth* and resultant difficulties in management among this substantial captive population. In the month of December 1996, the Supreme Court of India imposed a blanket ban on all logging activities to halt a menacing depletion of the region's forest cover. This immediately rendered the entire population of elephants engaged in logging activities jobless. In absence of any substantive alternatives, this has created complex problems in sustained maintenance and management of this huge captive population but also a noticeable increase in the incidences of *musth*, fallout of forced rest and disruption of a normally strenuous work schedule. Observations have revealed certain significant factors that had directly or indirectly contributed to the development of *musth* in the captive elephants in this region.

Season: Incidence of *musth* in elephants in India's North East is noticeably higher during the months of February-March, which is early spring in the region and again during October-November, which is autumn. Of the 111 elephants in *musth* the author has handled so far, 44 had developed *musth* during February-March and 35 during October-November. Incidences of *musth* during the summer and rainy monsoon months, which are characterized by sweltering heat (38 degrees Celsius) and sapping humidity (95-99%), have been negligible. This is probably because hyperthermia caused by unbearable heat during that season does not provide conditions that are conducive for increase in Leydig cell activities responsible for synthesis of the male hormone, androgen in the intra-abdominal testicles of the bulls.

Table 11.1. Showing month wise occurrence of *musth* in elephants handled by the author between January, 1994 and December, 2011.

Month	Jan Sept	Feb Oct	Mar Nov	Apr Dec	May	Jun	Jul	Aug
Cases	*5* *5*	*23* *19*	*26* *16*	*17* *4*	*2*	*1*	*1*	*2*

Prime age: *Musth* is normally observed in male elephants in their prime. Stracey (1963) and Sukumar (1994) have mentioned of observing *musth* in elephants from 15 - 60 years of age. The youngest elephant this author has observed developing *musth* was 16 years old *makhna* named Indrajit in the Rajiv Gandhi National Park, Orang in Assam and the oldest was Bijulee Prasad of Borgang tea estate who was experiencing *musth* till 56-57 years of age. Another towering tusker named Lucky Bahadur in South Kamrup of Assam which was 53 years old experienced violent *musth* to meet a tragic end. But over 75 % of the cases of *musth* the author has observed occurred in elephants in the age group of 21 - 40 years.

Table 11.2: Showing age wise occurrence of *musth* in elephants handled by the author between January, 1994 and December, 2011

0-10yrs	11-20yrs	21-30yrs	31-40yrs	41-50yrs	51-60yrs	60yrs and above
0	5	38	46	23	4	0

Forced Rest: Forced rest due to disruptions in their normally strenuous work schedule has also been observed to make elephants prone to develop *musth*. In Assam and the North East where most domestic elephants were employed in logging, a particularly strenuous activity, sudden disruptions and forced rest due to rains etc., it was observed, often contributed to occurrence of *musth*. The 1996 ban on all logging activities in the North East by the Supreme Court of India compounded this problem and the impact became more visible.

Rich diet and sedentary life style: Another factor which enhances an elephant's chances of developing *musth* is continued consumption of highly nutritious concentrates provided to elephants even during periods of rest, forced or otherwise. A similar diet for an elephant not engaged in any physically taxing activity and having a sedentary life style also has the same effects. Sonbabu, a towering makhna belonging to a village school teacher of Bangsar village north of Guwahati city was once brought home after a two-year sojourn in the hills where he was engaged in logging activities. Incidentally, he was the only elephant in the entire area and the local people, predominantly Hindus considered his presence as an auspicious occasion and had taken the elephant to their respective villages and offered him with a lot of nutritious food. No wonder that after about a month he became violent in the frenzy of *musth* though apparently there was none other stimulant factor like a primed cow.

Social factors: The most important social factor contributing to the development of *musth* in a male elephant is the company of estrous females. It is a known fact that bulls in *musth* seeks out receptive females in estrous. It has also been observed that a female elephant in season has a stimulating effect on a male companion inevitably triggering him into *musth*. It is interesting to note that in heterogeneous social groups like in the camp elephants of Kaziranga and Manas National Parks, where a number of adult bulls live together in captive conditions, it was observed that only the master bull that is Gadapani of Kaziranga and Lachit of Manas developed *musth* and the other less dominant ones preferred to give them a wide berth. This observation is in agreement with that of Sukumar (1994) that the *musth* cycle in the dominant bull could subdue or suppress the same in the less dominant ones. When segregated into separate groups and kept further from each other, other less dominant bulls like Kartik, Rudra also expressed *musth* in subsequent years.

Physical and behavioral manifestations in the prodromal stage: The physiological activity that leads to the development of *musth*, primarily a gradual increase in testosterone levels, induces certain noticeable physical and behavioral changes in the elephant apparent to a keen observer. This stage when such premonitory physical and behavioral signs become noticeable prior to developing full-blown *musth* can be called the prodromal or pre-*musth* stage. Effective prevention and management of *musth* in captive elephants is to a large extent dependent on proper knowledge and recognition of these signs.

Physical changes noticeable during prodromal stage:

- There is always a noticeable weight gain in an elephant in prodromal stage. This is due to water retention in the body as a result of increased levels of testosterone along with other corticoids. Sometimes this is synchronous with consumption of high-quality grains and forage with higher nutritive values and in some cases probably steroid contents.
- There are layers of fat deposition beneath the skin, stretching it free of wrinkles and giving it an increased luster.
- Deposition of periorbital fats makes the eyes appear shallow and brighter.
- Due to fat deposition and functional hypertrophy of the temporal glands, the temporal fossae become shallower and, in some cases, even grossly swollen.
- The penile tissue increases noticeably in size with the enlargement of the perineal region because of a concomitant hypertrophy of the bulbo-urethral gland located at the base of the tail. When left alone, frequent protrusion of the erect penis is observed. This increases in frequency as the animal progresses towards full-blown *musth*.
- Frequent micturition of low volume of urine containing secretions of the accessory sex glands is also observed. Kaimal (1996) and Ananth (2000) have also recorded these noticeable changes.

Behavioral changes noticeable during prodromal stage:

- The most obvious change in a normally docile elephant's behavior during the prodromal stage is the noticeable air of arrogance it exhibits that almost borders on defiance. It is often observed that the animal stares with malevolence even at his mahout while approached.
- The animal prefers to go to water much more frequently and consumes large volumes of it.
- The animal exhibits a desire for female company. It is noticed that a male in this stage often sniffs the behind of prospective mates and exhibits Flehmen reaction.
- The bull would often extend his trunk up into the air apparently sniffing for female pheromones.
- The bull would examine the genitals of adult females to check them for oestrous.
- The bull expresses dominance at other bulls by touching their genitals and extends the trunk to sniff people in an unusual manner.

Physical and behavioral manifestations of full blown *Musth*. Crossing the threshold from the prodromal stage to full-blown *musth* is often sudden and explosive. The gentle giant explodes into a volatile emotional frenzy, breaking all bonds of loyalty and affection turning itself into a terrifying beast. It has often been noticed that any act or incident, which the animal may perceive to be a provocation or disturbance, can break the thin barrier of restraint the animal shows during prodromal stage and push it into full-blown *musth*. Although it is possible to recognize the premonitory signs mentioned earlier and anticipate an outburst, it is extremely difficult to predict whether the animal will actually cross the threshold and if it does, when it might do so or what destructive behaviour it might resort to. Such suddenness and unpredictability of the onset of *musth* has remained the most difficult and challenging aspect of managing male Asian elephants in captivity. This has naturally resulted in numerous tragedies as well.

Physical manifestations of *Musth*: The most noticeable manifestation of *musth* in Asian elephant is the bursting open of the temporal glands. Generally, the out flow of the temporal glands is synchronous with the first episode of the show of temper or just follows the first act of uncontrolled aggression. Temporin or (Temporal Gland Secretion) TGS, the terms by which the secretion of the *musth* glands is known is very rich in testosterone and various pheromones that sends appropriate signals to the different sexes. All the physical signs that are noticed during the prodromal stage get exaggerated during the *musth* phase. The penile tissue gets noticeably enlarged and the swelling at the base of the penis can be visualized from far away. There will be rather more frequent erection and throbbing of the penis in the lower belly and micturations. Sometimes the bull would often resort to masturbations. The initial blossom in the physical appearance is gradually lost as the animal spends more time and energy pacing up and down to the waterholes for cool bath and also probably looking for prospective mates. Moreover, it has been seen that they become anorexic by choice due to the psychological and physical disturbance. Interestingly, the Green-Penis syndrome as observed in the African elephants (Poole *et al.,* 1988) which is the result of algal growth in the continuously wet penis was never noticed in the elephants of the North-east even though they live in a much more humid climate. The author has seen greenish discoloration of preputial regions on a few elephants chained for a long duration for being in *musth* in the *Guruvayur* temple in Thrissur of Kerala.

Behavioural manifestations of *Musth*: Crossing of the threshold from the prodromal stage to that of full-blown *musth* is sudden and explosive. Although it is possible to recognize the premonitory signs and hence anticipate such an outburst, it is difficult to predict whether the animal will actually cross the threshold and if it does, when he might do so or what destructive form his behaviour might take. It appears that at the height of *musth*, the elephant experiences a lot of discomfort. When not distracted, he either keeps his head pressed against a big tree or clasp the tree between the lower lip and the raised trunk placed sideways as if to get rid of some agonizing pain somewhere deep within. When lonely, he occasionally raises his trunk high on air probably to sniff it for the smell of oestrous females and also keeps groaning at some intervals, a gesture indicative of an attempt to communicate with the receptive females that he desires to mate with. At some intervals, he would also touch the openings of the temporal glands with the tip of his trunk. If the observations of the keepers of Billy, the young elephant of Los Angeles zoo is to be believed, this behaviour might be due to the animals' attempt to evacuate the glands which is said to have relieved Billy from a lot of discomfiture.

A bull in *musth* asserts dominance over other adult males, which no other bulls, not in *musth* would challenge; nor even by the one which is physically bigger in size and stronger. They are mortally scared and would run away if attempts are made to drive them near the streaming bull. On the contrary, though he would always prefer a capitulating receptive cow, in absence of one he would be contended with the benign company of a female not even in oestrous. Very rarely, a bull, overwhelmed by the desire tries to force her which frightens the cow, keeps on crossing her hind legs and move forward whenever the maddened bull would try to keep her under restraint with his trunk. At this she would occasionally bellow in fright, her ears flat against her head and the mouth wide open.

Compared to any other living things, the *musth* bulls are exceptionally aggressive towards other adult bulls and human beings, chasing them from much greater distance with well-meant evil intentions. The author has noticed an interesting phenomenon in some of the *musth* bulls where they tolerated a few selected persons into much closer distances, but almost all of them were particularly aggressive against their own *mahouts*, probably the only way known to them to usurp in a dominant position for themselves in the relationship which is the most cherished desire harbored by any virile male.

Recurrences: Unlike in the wild elephants where the recurrence of *musth* is said to be so regular as to enable one to predict a date like that of a calendar looking at the onset of *musth* in a specific bull, the same was quite unpredictable in the logging elephants of Assam. Many of the elephants experienced *musth* only once in their entire life. Thirteen out of the 111 elephants (11.71%) exhibited regular annual *musth* but there were great variations in the date of recurrences. Two of them came to a second *musth* within nine months of the first, and in both the cases all the conditions were conducive including the company of receptive females. Two more elephants were experiencing *musth* thrice a year. A total of 22 elephants experienced *musth* at a gap of 2-4 years. The low rate of recurrence could be attributed to the horrendous experience that the owner had to undergo in the first instance, the sensitization and awakening, which led to careful handling of such bulls in future to preclude *musth* in these bulls in the subsequent years. However, though they might not have exhibited true violent *musth*, several instances of arrogant behaviour of these elephants were reported around the same time of the following year and subsequent years. Contrary to the logging elephants of Assam, 90% of the working elephants in Sri Lanka exhibited an annual cyclicity of *musth* in a study population (Jainudeen et al.1972a).

Some adverse effects of musth in a captive bull: An episode of *musth* in a captive bull affects the wellbeing of the animal on several accounts. If the imminent *musth* cannot be anticipated well in time, the bull might break loose and cause immense damages to life and properties and could even get killed if the chemical immobilization using the remote injection technique fails to restrain him safely as quickly as possible. The bull can losse weight and condition (Jainudeen *et al.,* 1972). Physically, a lot of injuries and abrasions take place in the legs caused by the tethering chains which the handlers are forced to use for long duration without any respite or change. Prolonged standing on muddy conditions and substrate contaminated by urine and dung also cause indolent foot infections. On the psychological front, the mahout who places unquestioned trust on his mount without any suspicion till the day he expressed that aggressive behaviour targeted towards him; loses his assertive confidence on the bull and this might also affect the quality of care the bull receives form the mahout in future.

Anatomy of the temporal glands: Temporal glands are unique modified apocrine sweat glands (Jainudeen et al. 1972a, 1972b, Rasmussen *et al.,* 1990), are paired organs located on either side of the head of the elephants. Each gland has an opening situated between the ear canal and the lateral cantus of the eye in the temporal fossa. At birth, both sexes of the elephant calf have the opening and a few bristle-like hairs are seen coming out from the depth of the aperture; which eventually fall off as the calf become adult. The adult females also have the temporal glands but not as well developed as that of the adult males. Glands dissected out from freshly killed *musth* bulls revealed that the glands are roughly ovoid in shape. Histological sections showed that the glands are covered with thick fibrous capsules consisting mostly of collagen fibers. Alveoli of *musth* gland showed that it was lined by tall cuboidal and columnar cells with distinct vesicular nuclei. The same in the non *musth* bull consisted of simple cuboidal cells. Myoepithelial cells were observed at the periphery of the alveoli. Scanning electron micrographs showed distinct glandular zone separated from the non-glandular zone and presence of abundance of fine connective tissue fibers around the secretory units. Transmission electron micrographs revealed a large number of mitochondria and smooth endoplasmic reticulum (Sarma *et al.,* 2009).

Composition of temporal gland secretions (TGS) and its role in elephant reproduction and chemical communication: Elaborate studies carried out on the status of physiological chemistry of *musth* bulls in pre-*musth*, full blown *musth* and post-*musth* phases in respect of their blood, urine and TGS revealed that extensive hormonal and metabolic changes take place in the system of the bull in relation to *musth* (Rasmussen and Perrin, 1999). The deviant behaviour of a *musth* bull is correlated with high or changing serum testosterone levels (Jainudeen *et al.,* 1972a, 1972b, Lincoln and Ratnasooriya, 1996, Schulte and Rasmussen, 1999). Serum testosterone level rises to up to 60 folds during *musth* compared to pre and post *musth* periods. The TGS is an important outlet for the testosterone as the rise in the serum testosterone accompanied a concomitant rise in the TGS levels of testosterone. A host of volatile substances have been detected in the TGS which were also elevated or dropped in their levels in relation to the rises and fall of the serum testosterone levels. At low serum concentration levels of testosterone (1ng/ml), compounds detected in the TGS were phenol, 4-methylphenol, farnesol, farnesol monohydrate, farnesol dihydrate, benzoic acid, phenylpropanoic acid, 2-n-propylphenol, 4-n-propylphenol and hexadecenoic acid. When serum testosterone level was 26ng/ml, several phenols increased and alcohol, 5-nonen-2-one were detected. When serum testosterone was 64ng/ml, 5-nonanol as well as hexadecenoic acid levels increased. Cyclohexanol was prominent and the farnesols were reduced. Several of these aromatic substances were also found in variable concentrations during different phases of *musth*.

Though the *musth* episode has been correlated with amplification in the levels of testosterone and an apparent increase in the libido of the bull, despite the fact that *musth* is not a precondition for a bull to be a successful sire. Bulls out of *musth* were seen to be mating successfully with estrous females to reproduce. This author has recorded several instances where an oestrous cow has actually triggered a *musth* episode in a bull. It is always the female who decides when to mate, but often she also decides with whom to mate; frequently showing a preference for a bull in *musth*. In the wild a *musth* bull advertises his readiness to mate to the prospective mates by rubbing his temporal secretions on the trees or spreading the same into the air and looking for them near the waterholes. The aroma of the TGS acts as an important chemical signal to appropriate groups of individuals; attracting the primed cows for mating and forcing the other lesser mortal bulls to give him a wide berth. So, it is through *musth* by which nature ensures passing of better genes down the generations in the elephant society.

The traditional ways of handling musth in the North-east: With the experience of handling elephants for thousands of years, the handlers of elephants in Assam were well familiar with the phenomenon of *musth* and therefore also naturally knew how to handle them. They rated an elephant that developed *musth* quite correctly, as an excellent one and as the prodromal signs were visible, the elephants were immediately hobbled and tethered securely till they became normal. To hasten the return to normalcy, various local herbal preparations were used. The practice of administration of herbal remedies is still in vogue and the author had the opportunity to appreciate some of these herbal agents and combinations' merit. Unfortunately, the traditional expertise is fast waning and the unsavory prospect of managing a rampaging bull in *musth* in the small fragmented forests, and frequently even inside thickly populated villages and towns demands expertise in the modern methods of understanding and handling them safely.

Present practice of prevention and handling of *musth*: The prospective candidates are identified from past history, physical conditions, age, workload and social standing and extra attention is focused on them. They are restrained by tethering or by hobbling the forelegs together and keeping a trail chain in one of the hind limbs during the vulnerable season. Grain feeding is withdrawn or at least restricted and they are put to heavy work and exercise to work off the extra energy. All adult females are removed to dispense off the stimulus and whenever possible, a more dominant bull is brought-in if he had not crossed the threshold already. It has been proved that the presence of a more dominant bull in the proximity can subdue the *musth* cycle in a less dominant one.

Xylazine, a commonly available alpha-2 adrenoceptor agonist sedative can be used at 100-150 mg daily intramuscularly to have a soothing effect. Haloperidol, a major tranquilizer at 100mg daily in divided doses has been found effective. Diazepam at 300-400mg daily also has good calming effect. Tranquilizers of phenothiazine origin should not be used repeatedly as they may cause photosensitizations. With the understanding that *musth* is nothing but the result of a heightened testosterone activity, researchers in the west (Fowler, 1973; Flanagon and Flanagon, 1983; Oslen *et al.,* 1993) attempted castration of young bulls which was considered to be a definite safeguard against *musth*. However, the necessities for opening of both the flanks to reach the intra-abdominal testes make the operation a tedious one and hence, can't be recommended as a general practice. Moreover, this practice would also stop their chances of procreation in captivity. Whatever the reason, castration of elephants to prevent *musth* has never been considered as a good idea.

The oral antiandrogenic preparations like 'Flutamide', a non-steroidal antiandrogen preparation as suggested by Chandrasekharan and Cheeran (1996) has been used effectively by the author. A dose of 7500 mg daily for three days effectively prevented *musth* in seven elephants that were experiencing the condition annually. The drug however, can't be widely prescribed yet for high prices and pending toxicity studies. Gonadotropic inhibitors (GNRH vaccine) have been used as injections in African elephants (*Loxodonta africana*) which have successfully inhibited the *musth* behaviour in bulls; the same has not been replicated in Asian elephants so far.

Diuretics like potassium iodide or potassium chloride at 20 gm daily orally can be used to prevent over hydration and resultant weight gain. Another common diuretic, Frusemide (Lasix-10mg) has been found useful. A dosing schedule of 20 tablets (10mg /tab) each time orally, morning and evening for first four days and 10 tablets for remaining four days along with Xylazine 100mg and Haloperidol 80mg daily was also found effective by this author. The continuous use of Frusemide in high doses is said to have a diminishing effect on testosterone level in serum. Prolonged use of Frusemide causes impotency in human beings. Yet again, the safety studies on the prolonged use of Frusemide in elephants is pending. The virile elephants in the hand of novices may still escape being noticed for the prodromal signs and a sizeable number of them break loose and go berserk in the frenzy of *musth* every year. Such rampaging bulls have to be immobilized using potent immobilizing agents through the remote injection technique and a few or all of the above cooling down methods employed after chaining and tethering him to robust trees or poles. The immobilization of a *musth* bull involves considerable risks and should be done by vets only with good knowledge of stupefying drugs, jungle craft, behaviour of elephants, remote injection technique and above all, previous experience. Safe approach protocol should be strictly adhered to while attempting to immobilize a free *musth* bull.

Musth does not turn an elephant into a compulsive killer. He would attack only when his solitude is disturbed. Unfortunately, with the exploding human population in the North-east India eating up every inch of the cultivable land, such huge tracks of forested lands for leaving a *musth* bull for such a considerable length of time has become increasingly impossible without confronting the human settlers. As the elephants have been deprived of the natural territory, they require to live during *musth*, such confrontations have started to occur far too frequently, conflicts in which the elephants are inevitably losing out.

Photo by: K.K. Sarma

Plate 12.1: (a) Temporal discharge, (b) Pereneal swelling, (c) Aggression during *musth*

Photo by: K.K. Sarma

Plate 12.2: Dominance behavior exhibited by *Makhana* in *musth*

Photo by: K.K. Sarma

Plate 12.2: Tying–up in standing sedation

CHAPTER XIII

HOWDAH (SADDLE) FITTING IN ELEPHANTS

- *Avadh B. Shrivastav*

Introduction

Elephants have been part of Indian culture since time immemorial. The earliest evidence of captive elephants dates to the Indus Valley Civilization about 4,500 years ago. Elephants have since then been used around the world in ancient warfare, royal processions and ceremonies, for construction of road and building, pulling wagons and boulders and more recently for tourist ride, logging and entertainment. Elephants are presently used for various activities by the forest department including patrolling, managing human wildlife conflict as *kumkies* and for forestry activities. Private owners have been using these animals for recreational and religious activities besides providing services to forest department in managing human elephant conflict. In South India, elephants especially the tuskers are maintained in temples for religious functions. Owing to major welfare concerns and availability of better technologies, their use has been reduced and presently limited to forestry activities and few ceremonial activities.

Elephant saddle/howdah

Elephant saddle/howdah is an integral component of the elephant gear and its proper position on the back of an elephant is important for animal to comfortably perform various types of work (Magda et. al., 2015). Different types of howdah have been in use. However, the design is based on nature of the activity for which it is required, carriage weight, size of the animal, regional resources/material available for constructing, maintenance and upkeep. Placing of howdah is an art as well as science. It essentially requires an understanding on animal's anatomical features, welfare concerns and knowledge of problems/injuries that may arise due to improper fitment. Every effort should be made to ensure that the howdah is placed in a manner that it causes minimal stress to the animal and the animal is able to perform normal functions comfortably without any pain or discomfort. The author has experienced that although the howdah has been used for long, the literature on howdah design and its fitting is limited. The article is not exhaustive but an attempt to highlight the problems that may arise due to improper fitment.

Information on saddlery of horse is available and the basic principles can be followed while using howdah on elephants. There are different types of saddles used in horses from general riding to those used for equestrian sports and carriage of load. These saddles are specifically designed as per individual event requirements for smooth, safe, comfortable seat to a rider and also for and ease to the animal to get best possible result.

In case of elephants, the howdah commonly used are designed primarily for the comfort of people sitting on it and with minimal consideration of comfort and ease of the animal. Improper saddle or howdah and its fitting on animal back is harmful, may reduce the working capacity and can cause sore back or saddle gall or howdah gall due to uneven and undesired pressure exerted on shoulder, back or loin regions. Lesions may be seen in neck, girth, back and tail and may range from rubbed/pink, raw, a full depth ulcer, an abscess (closed or draining), a healing lesion, or depigmented skin. The back region appears to be a high risk area for the presence of an active lesion relative to the other anatomical sites, followed by the girth region. Causal factors associated with development of active lesions include use of improper padding material that comes in contact with the skin, weight of the howdah. increasing age of the elephant, and longer working hours. Similarly, the loose rope used for tightening the howdah can cause friction related injury to the animal as manifested by rope burns around brisket and tail base. Various options are available for proper cushioning of areas coming in contact with ropes. A small injury can get severe if used for a long time.

For their own convenience, the mahout sometimes fit saddle while keeping elephants on sternal recumbency. This is an uncomfortable position for the animal. Animals maintained in sternal recumbency while fitment of howdah on hard ground may develop inflammation of the joint that may aggravate and result in hygroma, bursitis and severe arthritis in the long run. It is important that ride platforms should be used for howdah fitment instead of making animal sit on sternal recumbency. In case animal is made to sit, soft grounds should be used and animal maintained only for a short period.

Proper place for saddle on elephant back

Howdah or saddle should be placed on a right place on elephant approx. about 4-6" behind the scapular region. The saddle should not restrict the normal movement of the shoulder joint. Howdah used should be regularly checked to ensure that it does not hurt the animal. Adequate cushion should be provided to avoid friction especially where ropes are tied.

Precautions

1. The elephant saddle should be fitted to the individual animal, wellpadded, and in good repair.
2. The Howdah or saddle and its fittings should be maintained properly. Elephant gear like howdahs, etc. should be kept under proper care and supervision. Rusted or worn-out parts damage the skin of the animal by scratching, chafing and also will lead to serious injuries.
3. Elephant with minor thoracolumbar asymmetries is associated with ill-fitting saddles may lead to back pain, saddle gall, skin injuries due to rope burn. Therefore, each animal should have separate howdah with smooth ropes.
4. Saddle / howdah should have smooth fitting, soft mattress and ropes with padding material.
5. Mahout and experienced elephant's veterinarian should be involved in elephant care, maintenance of good quality howdah and its different components for better performance and to avoid complications of ill-fitted saddles and lameness.
6. Once the work has been completed, the howdah must be removed, animal visually inspected, and the bottom of its feet checked before returning the elephant to its holding. The howdah and all tack must be inspected, and any worn or damaged equipment must be replaced.

Looking at the seriousness of problem with respect to improper howdah design and its fitting in elephants, there is a need for research to design a suitable howdah based on the individual on which it has to be harnessed and based on nature of work.

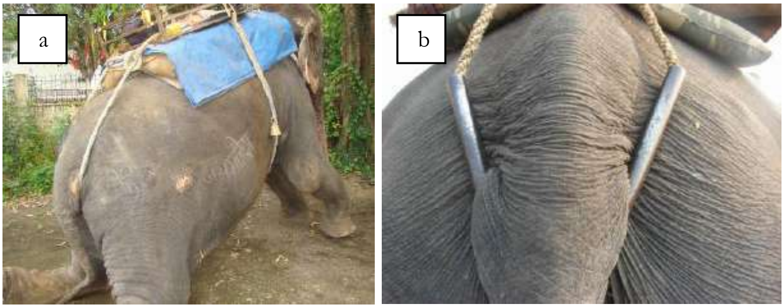

Plate 13.1: (a) Use of ropes without padding materials, (b)Tube used for passing the rope under the tail to avoid friction.

Plate13.2: Joint injuries in elephants maintained in sternal reciumbency on hard grounds.

Plate13.2: Saddle gall. Photo by: A.B. Shrivastav

CHAPTER XIV

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WELFARE CONCERNS IN MANAGING ELEPHANTS IN CAPTIVITY: A CASE STUDY

- *Baijuraj M. V. & Kartick Satyanarayan*

Introduction

Elephant conservation and care center (ECCC) situated in Mathura District of Uttar Pradesh was established as an elephant camp for providing treatment and care to elephants rescued from situations where animals were used for begging on roads, used in processions, temples, and tourism. Additionally, aged animals requiring rest and medical support following active service and those seized by the Forest department requiring shelter also find place for treatment and lifetime care at the centre. These animals are received in compromised health condition and show high degree of stereotypic behavior, have skeletal deformities/changes (ankylosis, lameness, sores), may be obese due altered and unnatural feeding practice (begging on the road), malnourished and even blind. These animals essentially require professional and humane support in management, taking due account of ensuring welfare concerns.

Systematic efforts are put in to ensure that the welfare of the elephants from the time of rescue, during transport, housing, treatment, and daily routine at the center are taken care off. With the help of international collaborations and knowledge exchange programs, positive conditioning to minimize any stress to the elephants and maximize the safety of the keepers have been integral part of management. Studies elsewhere have proved that these basic aspects if managed well, play a crucial role in ensuring welfare of animals in captivity (Greco *et al.,* 2016). Studies have demonstrated that the operant conditioning of an animal can be achieved through positive reinforcement and the primary operant conditioning method to train a captive animal is called shaping.

Captive management is aimed at ensuring that the principles of "Five Freedoms" developed by the Farm Animal Welfare Council in the UK in 1979 are addressed adequately. These include freedom from hunger and thirst, freedom from discomfort, freedom from pain, injury, or disease, freedom to express normal behavior, and freedom from fear or distress.

Besides providing treatment, the center also focusses on addressing the welfare concerns by providing adequate housing facility, chain free environment with innovative nutritional and environmental enrichment. Regular exercise walks and positive training are integral part of overall management.

Positive reinforcement training (PRT) has been adopted for the first time in India at the center and is aimed at facilitating the veterinary procedures besides supporting animal husbandry necessities without restraining or providing stress to the sick and injured elephants. This also contributes to a positive keeper–animal relationships which results in improved animal welfare. An enrichment-based positive reinforcement training has also shown additional benefits to animals under human care (Savastano et al. 2003). Environmental enrichment in captive animals helps to improve the welfare of the animals covering a wide variety of practices like foraging, playing, problem-solving, and exercise (Greco *et al.,* 2016; Meehan *et al.,* 2007; Young, 2003). The enrichments can be permanent or temporary like pools for play and food balls or rewards. There are several studies with different species of animals about the positive impact of enrichment, which reduce stereotypic behaviors and result in good welfare (Shyne, 2006).

The main objectives of environmental enrichment are to minimize stereotypic behavior of elephants under care, manage bull elephants in *musth* without chaining them throughout the *musth* period, unlike the traditional method of tying up and to minimize the stress levels during veterinary procedures and management. Female elephants are allowed to form herds of their choice and it gives them a good opportunity to express and practice their normal behaviors. Well-designed enrichments have also been extremely useful to manage *musth* in male elephants efficiently.

Methods to reduce stereotypies

Different methods to increase activity, avoid boredom and reduce the stereotype behaviors and also ensure maximum enclosure utilization by elephants are provided below.

- Scatter feeding in the enclosure
- Feeding enrichment using puzzle feeder (cages, barrel/cans, pipes)
- Green fodder feed enrichment with vegetation/browse on top of the shed inside, hay nets.
- A slight change in feeding set times for increasing temporal activities.

- Increasing the number of feeding times/day.
- Logs for the bull elephants inside the enclosure and logs outside for cow elephants.
- Tyres/ wheels for playing within the enclosures.
- Designing of a large enclosure with adequate precaution for *musth* elephants
- Introduction of enrichment tools to reduce stress levels and divert animals from charging, pacing, hurting himself.
- Temporary covering of the enclosure to avoid the distraction of people and vehicle movements.
- Water availability all the time. (Pond and troughs)
- Operant conditioning using positive reinforcement training can be introduced at different levels which make the treatment procedure stress free for both keepers as well for the elephant
- Long exercise walks for cow elephants daily and for bulls after *musth* period

Wildlife SOS Initiative to help captive elephants initially started with addressing the welfare of working elephants through a mobile clinic and onsite treatment in collaboration with Forest Department. In collaboration with Uttar Pradesh Forest Department, the organization assisted in microchipping the working elephants to keep track of the captive elephant population in Delhi NCR. The efforts further grew by setting up of the Elephant conservation and care center to provide treatment and care for the rescued elephants in various unfavorable conditions. Operant conditioning of elephants was introduced first time in India through positive reinforcement to reduce the stress level during treatment. Routine treatments are carried out with positive reinforcement and a reward mechanism. Feeding enrichments with minimal stable feeding was introduced to avoid boredom and also engage the elephants in various activities. The centre conducts in-house training for the mahouts and also for the mahouts working with elephants across the country. As India's first elephant hospital, the centre also provides outreach services in coordination with different state Forest Departments. The center today acts as a training and knowledge-sharing facility for managers, veterinary officers, biologists, and professionals from different disciplines

Conclusion

Ensuring animal welfare is of paramount importance while managing animals in captivity. Operant conditioning of elephants through positive reinforcement to reduce the stress level during treatment has proved as a good option for managing elephants in captivity. To avoid stereotypic behavior, large enclosures as per Central Zoo Authority guidelines with various types of enrichments have been critical in management of captive animals. Authors have experienced that elephants in *musth* can be managed in chain free environment and animals trained through positive reinforcement technique making interventions scientific, ethical and humane. It is prudent that adequately trained human resources and infrastructure are available for managing captive elephants.

Plate 14.1: (a) Elephants rescued from the circus exhibiting high degree of stereotypie behavior; (b) Severe ankylosis and lameness

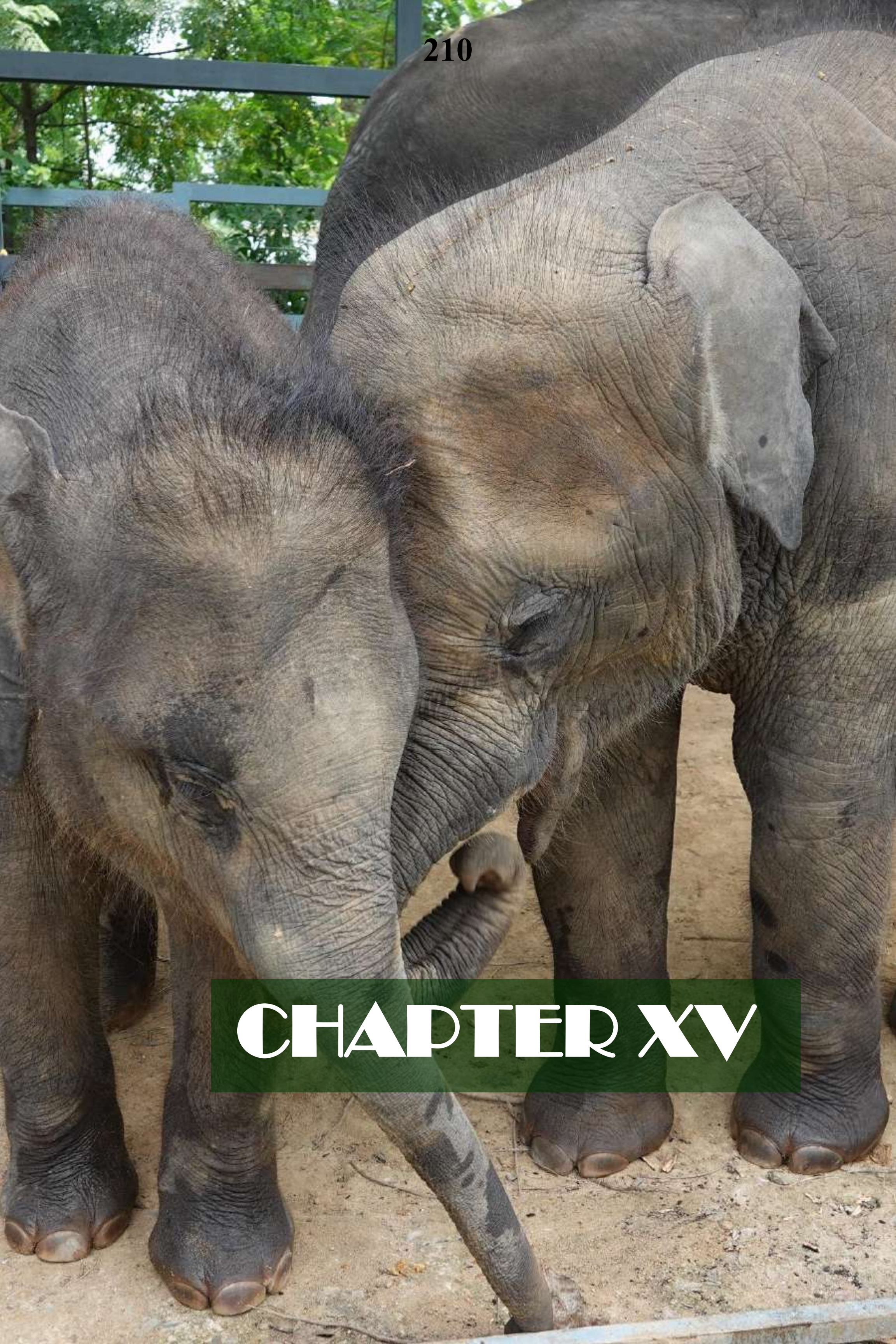
Plate 14.2: Long exercise walks as a part of daily routine

Plate 14.3: Large enclosure with adequate safety fitments for managing elephants in *musth* (a) Male *makhana* in *musth* in chain free enclosure and (b) Male tusker in *musth* engaged in feeding activity.

Plate 14.4: Nutritional enrichments (a) Pipe feeder and (b) Cage feeder; Provisioning of water in each enclosure (c) Pond, (d) shower facility

Plate 14.5: Operant conditions using PRT for Makhana in *musth* at ECCC

Plate 14.6: (a) Hydro-therapy (b) Foot Dips (c) Infrared theray as part of veterinary management



CHAPTER XV

BASICS OF NEONATAL CARE AND NURSING ORPHAN ASIAN ELEPHANT CALVES: A CASE STUDY

- *Bhaskar Choudhury*

Background

The article focuses on nursing and management of Asian elephant calves in the age group of 0-6 months of age, which is considered the most vulnerable period during nursing. Till the age of about 06 months, highest mortalities among such calves have been reported at Centre for Wildlife Rehabilitation and Conservation (CWRC) at Panbari RF under Kaziranga Tiger Reserve (Parera *et al.,* 2018).

Database on admitted distressed elephant calves at CWRC between Sep 2000 and Dec'2019 (total of 19 years, n=187) reveals around 9 calves between 0-6 months of age were found in distress every year requiring human intervention for survival (Assam Forest Department and WTI unpublished). The reasons of separation or distress are attributed into six major reasons that include trapped in bog 2.7% (n=5), fell in trench or slopes 24.1% (n= 44), debility or disease 3.8% (n=7), swept in flood or strong water current 13.1% (n=24), injured by people as a consequence of conflict including train hit 9.3% (n=17); interestingly majority of them 45% (n=82) are found to be without family/herd for reasons unknown. Among these calves; no physical evidence of congenital deformity or injury were noticed which could have indicated towards possible natural rejection. But in captivity, especially in zoos and rescue facilities; maternal rejection appears to be major reason for abandonment requiring nursing and management in mammals.

Nursing neonate and elephant calves is challenging and mortalities can go up to 45-50% depending on status of the animal upon admission. CWRC has successfully nursed 54 calves during July 2000-Oct 2020, from the age of approximately a week to 72 weeks of age with the objective of giving them an opportunity to return to the wild. After 42-48 months of nursing, the grown-up calves are translocated to release sites for attempting rehabilitation back to the wild, failing which they are transferred to Forest Department camps to be managed as departmental elephants.

Ageing and detailed physical/clinical examination of calves were usually carried out while attending on site/on admission. Wherever sexual dimorphism exists, the following table is followed as a guide for estimation of age for infant and neonates. The data is derived from handling cases at CWRC, handling captive born calves as well as references from Soshani et al. (1982); Schiffmann et al. (2019).

Shoulder height	Weight on admission (Kgs)	Molars	Age class
68-75 cm, naval intact	65-90 kgs	None	< 01 week
</=90	100 or less	None	6 weeks or below
90-110 cm	120 kgs-150 kgs	Hard or started appearing-appeared	06-12 weeks
110-140 cm	150-180 kgs or more	Two molars appeared	12-24 weeks.

Transportation and basic infrastructure required for nursing orphan elephant calves

At "0" day of admission, a rescued elephant calf would be terribly nervous, highly stressed due to separation from mother, confused and hence needed to be calmed down in a secure confinement guided by the animal keeper/surrogate mother 24x7. The calf needs both physiological and psychological stimulation to adapt to the new environment. This phase of "stress management" has probably the most bearing on the survival prospect of the calf. Natural mother is always the best option; hence in every case of elephant calf distress call, the team focuses primarily on stabilizing the calf on site and feasibility of reuniting with their mother/family if they are still around or in close vicinity. Hence transportation of the calf to stabilization and nursing facility is only undertaken when the possibility of such reunion attempt doesn't materialize due to absence of the herd/family in the area or the calf is seriously injured/sick which require intensive human care for survival. Light sedation of the calf while loading and transport is followed with 0.08mg/kg of Xylazine and 0.05 mg Ketamine injected intra-muscularly; which puts the calf in lateral recumbence for transportation in trucks accompanied by guards and nominated caretakers. Clinical examination, administration of fluid, collection of samples for disease screening especially for EEHV can be carried out during this period without stressing the calf. The elephant calf nursery (isolation facility for initial period of a maximum of 30 days) can typically have indoor cubicles (3.5 x 3 m) with adjoining mini paddocks of about 50-100 square meters each to permit restricted mobility. The facility is used for calves below six months of age to avoid struggle and self-injuries during the initial days of admission. The room should be well ventilated for use in summer and should have the provisions to insulate from cold weather in winter. It should also have provision for oil heaters and fans to maintain the ambient temperature, without compromising humidity. A thermo-hygrometer should be placed to monitor the temperature and humidity of the room regularly.

Milk formula and feeding regimen

Elephant milk is known to vary throughout the lactation period of the mother. Four phases of lactation can be identified in elephants and the composition varies during each: a) 1) Very early lactation (from birth to colostrum based milk); 2) Early lactation (up to 12 months); 3) Mid-lactation (12-18 months) when fat and protein content increases and carbohydrate decreases and 4) Late lactation (from 18 months to weaning age) then the nutritional components stabilize and protein levels remain high. (Dierenfeld *et al.,* 1994). Overall fat, protein and energy content (chiefly from fat) along with certain macro-minerals (Calcium and Phosphorous) increase throughout the lactation; while the sugar/carbohydrate concentrations reduce. The fat and protein content in elephant milk is comparatively lower than many other mammalian species and range from 0.63-19 g/100 g and 3.4-6.5 g/100 g respectively depending on the period of lactation. The fat and carbohydrates in Elephant milk have special composition with respect to the fatty acids and oligosaccharide units respectively. Capric and Lauric acid is especially higher in elephant milk as compared to bovine milk while the oligosaccharides have very unique structural properties that are not recorded in other mammals.

In the absence of artificial elephant milk formula (Grober Asian elephant milk replacer), a human infant milk formula "Lactogen 2" or freeze-dried skimmed milk powder have been used as base for feeding rescued elephant calves (table 1 and 2). The latter is more suited as it takes care of the fat content in artificial milk, which can be fortified with vegetable fat ingredients like coconut milk powder, and protein sources like crushed Soybean. CWRC is using the following formula currently to nurse the elephant calves with moderate to good success, in 2021-22, we have not recorded any mortality among the calves that are nursed with the formula for diarrhea/ formula intolerance/ septicemia triggered by indigestion. The weight gain is recorded daily for the initial 03 months of admission at the facility to monitor growth. Colour and consistency of stool and urine is observed daily for signs of indigestion, formula intolerance, dehydration etc. During the first 24 hours of admission, only electrolyte formula is used to train the calves suckle from feeding bottle. Once it starts suckling well, gradual introduction of the artificial milk is done with a much weaker concentration initially. Probiotics dominating *Lactobacillus* is introduced from 2nd day of offering artificial formula for better digestion and assimilation. Managing diarrhea is always better than treating it.

Breast milk is essential for optimal colonization and maturation of the infant microbiota; *Bifidobacterium* and *Lactobacillus* are dominant in humans and mice respectively and their growth is encouraged by milk compounds such as oligosaccharides and hydrogen peroxide. Large fluctuations in gut microbiota is seen in infant Asian elephants, but lactobacillus is the dominant (©2020 The Japanese Society of Veterinary Science).

Table 1: Feeding schedule with Lactogen 2 as base

App Age	B. wt. (Kgs)	BER required (Kcal) average	#Formula required to meet BER (Lt)	Fluid intake	Formula DM required	Supplement
0-1 months	110 kgs	9500	14.19 liters	14 liters	2029 gms	Lactobacillus 4.5 gms per day, Multivitamin and multimineral syrup
2-3 M	150 kgs	12000 kcal	17.91 liters	15-20% of B wt.	2561 gms	Coconut milk powder at 10 gms per day introduced increased up to 20 grams per day
3-6 months	180-220	20,000	21 liters	15-20% of body weight	3010 gms	Coconut milk powder at 50 gms per day

Table 2: Feeding schedule with Freeze dried skimmed milk as base

App Age	B. wt. (Kgs)	BER required (Kcal) average	Fluid intake	Formula DM required in Gms	Additives	Supplement
0-1 months	110 kgs	9500	14 litres	2660	Soybean crushed 20 grams per feed	Lactobacillus 2.5 gms per day , Multivitamin and multimineral syrup
2-3 M	150 kgs	12000 kcal	15-20% of B wt.	3300	Soybean 35 grams per feed	Coconut milk powder at 10 gms per day introduced
3-6 months	180-220	20,000	15-20% of body weight	3500	Soybean 50 grams per feed	Coconut milk powder at 20 gms per day

Keeping the milk formula to be same, introduction of concentrate mixture from the age of 12 months onwards is practiced till the age of 36 months. Short species of grass to nibble would be tried at the age of 6 months.

Recognizing intolerances in the early stage would help in managing digestive disturbances which invariably follow with watery diarrhea. With artificial milk feeding, the colour of stool should be pale yellow with semisolid pasty consistency under normal circumstances. Frequency of defecation is four-six times during 24 hours is observed in normal healthy individuals.

Husbandry

The social bonding is a critical part of the orphan elephant calf. While it would invariably bond with the two keepers feeding the animal in rotation, in a forest camp or rescue centre set up, it is always advisable to socialize the animal with other individuals/ family of various age group for interaction, security and comfort, and also encourage coprophagy to develop gut microflora at an early age. At CWRC all the calves from the age of 12 months onwards are taken to a daily forest walk for nearly 4-5 kilometers guided by the keepers to encourage natural foraging and interaction with the habitat. This is a great physiological stimulation for the calves which encourage growth and early weaning as well. This also encourages weaning off the keeper/ human intervention gradually. From the age of 12 months, stool samples are screened for parasite load and deworming drugs are provided appropriately. Introduction of cereal/ concentrate mixtures for cattle twice a day at 500-1000 grams is provided to all the calves. Provision of ad-libitum drinking water is kept in the enclosure, but the calves are encouraged to take water from the natural streams. Bathing / mud wallow also encourage social bonding apart from the natural benefits of thermoregulation, getting rid of ticks and sometimes hydrotherapy.

Records

While in isolation/quarantine, the animal should be weighed daily. Provision of a regular weighing should be made by installation of a digital weighbridge. As per the existing literature on hand-rearing of Asian elephant calves, they gain about 1-2 kg body mass daily in the first few months (Olson, 2002).

Diseases

80% of the calves that have died while nursing showed clinical symptoms of inappetence, lethargic, dehydration, watery diarrhea, followed by prostration coma and death. Stress plays a major role in developing neonatal diarrhea, which supports the commensal flare up in bacterial culture. Aggressive treatment with fluids, antibiotics (Ofloxacin + ornidazole), Metronidazole infusion in terminal stages and supportive therapy has showed results in few cases, but once the symptom appears, it is difficult to bring the calf back. We had used light sedation for mild symptoms to give intravenous fluid therapy. Oral thrush has been encountered in few cases, treated with Candid Oral application.

EEHV has been a recent threat and the centre witnessed two mortalities so though there were two survivors as well. Per-acute death was recorded. Treatment regimen as suggested by the EEHV Asia working group is critical. It is advisable to stockpile antivirals like Famciclovir (Inj.) at all zoos and rehabilitation facility that house elephants. Other non-infectious diseases include traumatic injury, podo-dermatitis, external parasites, colic.

Photo by: Dr. Bhaskar Choudhury

Plate 15.1: (a)Transporting the calf with sedatives to reduce transport stress (a) Allomothering at the Centre

Photo by: Dr. Bhaskar Choudhury

Plate 15.2: (a) Cleaning and sun drying of feeding bottles and nipples after every feeding, (b) Change over room for staff at CWRC, (c) Feeding a rescued calf inside nursery upon arrival (d) weighing the animal on daily basis day during initial periods for monitoring growth

Photo by: Dr. Bhaskar Choudhury

Plate 15.3: Feeding of calves at CWRC

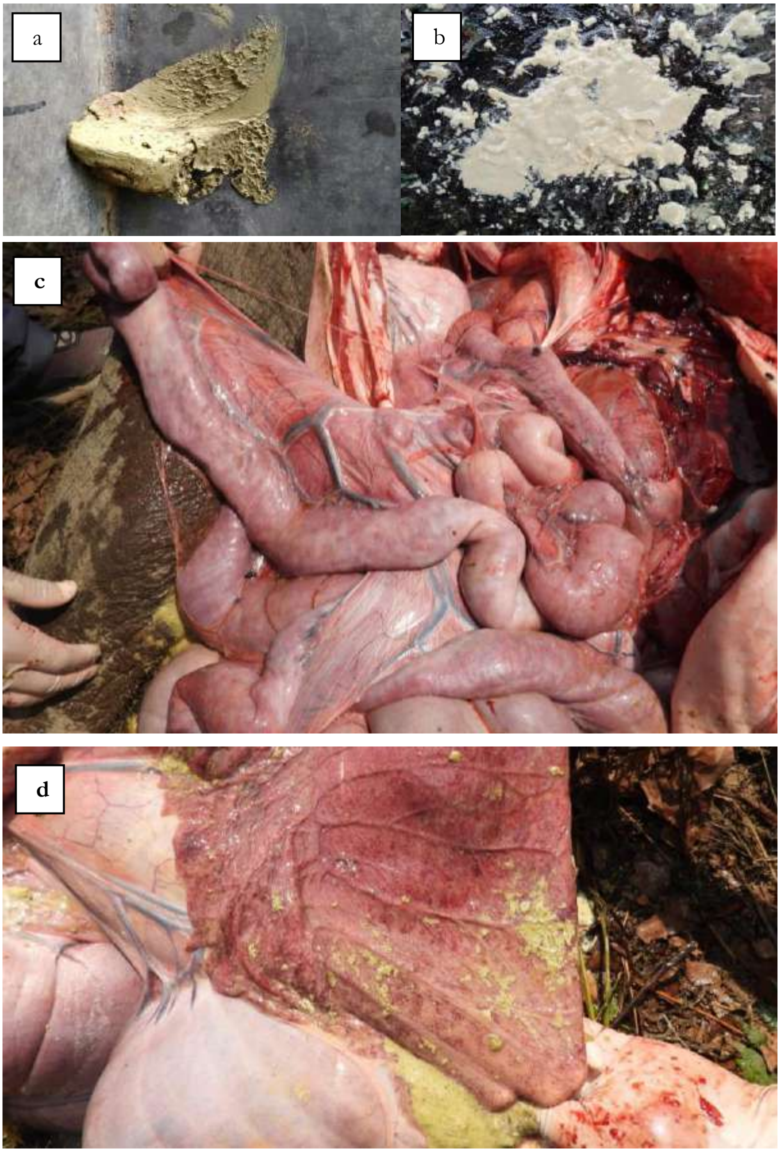


Photo by: Dr. Bhaskar Choudhury

Plate 15.4: (a) Normal stool with artificial milk, (b) Initial signs of diarrhea (c) Gross PM lesions indicating hemorrhagic gastro-enteritis (d) Submucosal hemorrhage.

CHAPTER XVI

ASSESSING GENETIC HEALTH OF ASIAN ELEPHANTS (*ELEPHAS MAXIMUS*) ACROSS INDIA: AN INTEGRATIVE APPROACH

- *Samrat Mondol*

Introduction

Recent assessments of the conservation status of many wildlife species indicate an alarming rate of population decline on a global scale (Ceballos *et al.,* 2005). Due to ongoing natural and anthropogenic processes such as climate change, land use practices, human persecution, habitat conversion and overexploitation, many species have faced severe declines in population sizes, range contractions and in some cases extinction (Ceballos *et al.,* 2005), thereby engendering significant efforts at their recovery. Such efforts require demographic, behavioural, genetic and life-history information of a species of interest at ecological time scales, over which various population processes, for example, demographic changes, migration, local extinction, colonization etc. occur (Carroll *et al.,* 2007). Acquiring this information in the wild can however be problematic for most species, and particularly challenging when endangered, rare, cryptic and elusive species are involved. Given that many biodiversity hotspots are subject to a multitude of pressures, including habitat degradation, conflict with agriculture, hunting, disease and commercial trade (Sillero-Zubiri and Laurenson, 2001) globally, it is very important to integrate ecological, demographic and genetic approaches to study rare, elusive species for their future survival.

Asian elephant (*Elephas maximus*) is a globally endangered megaherbivore (Williams *et al.,* 2020) and an umbrella species of the tropical and subtropical forests of Asia. Once widely distributed across different Asian countries, elephants are now confined to ~5% of their historical range in highly fragmented landscapes (Sukumar, 2006), mostly due to habitat fragmentation, rapid development of linear-infrastructures (railways, highways, electric transmission lines and irrigation canals), retaliatory killing, poaching and diseases. They have been accorded the highest level of protection under Wildlife Protection act, 1972 of the Government of India and Appendix – I of the CITES. However, human elephant conflict (HEC) is continuously increasing in recent times (Sukumar, 2006) due to their requirements of large areas and long-distance seasonal movements (Goswami and Vasudev, 2017). Elephants have a very strong cultural role in various Asian societies (Vasudev *et al.,* 2020) and are known to be an integral part of mythology and cultural in India and nearby countries in

Asia. According to Carrington, (1959) first records of elephant capture by the Indus valley people dates back to 4000 years, which later became a vital part of Asian culture. Tradition of elephant capturing, taming, keeping, handling and using for work has been retained in almost all Asian countries. India has a long history of taming and keeping elephants in captivity for a diversity of purposes that included use in wars, temples & religious places, and in zoological parks for conservation education and for various forest department activities such as wildlife tourism, patrolling, forestry operation and mitigation of conflict with wild elephants. Historically, logging was one of the most locally important economic use of captive elephants in Asia and the demand and trans-border movement of elephants started for this purpose in India. However, Supreme Court of India imposed a prohibition on green felling & logging operation in forests in 1994, and the use of captive elephants declined dramatically. Bist (2001) estimated that there were ~3500-3600 elephants in permanent captivity across many states in India. As per the latest information provided by different states, a total of ~2800 captive elephants remain in the country and this number keeps fluctuating due to natural death/ birth processes.

Effective conservation and management of wildlife, particularly for a species like elephant is a complex and challenging problem, requiring detailed knowledge at multidisciplinary levels. Genetic diversity is one facet of biological diversity for appropriate conservation strategies (Kaljund & Jaaska, 2010). It is well established that preserving the genetic diversity of endangered species can substantially affect their long-term survival and evolution in changing environments (Frankham *et al.,* 2002). The significant loss in elephant population from poaching and other anthropogenic impacts might have resulted in genetic erosion and a detailed genetic assessment of the existing elephant populations is critical in this regard. Unfortunately, illegal trade in live elephants still continues despite efforts by the Government of India. Sporadic cases of illegal capture of wild elephants and live elephant smuggling from Myanmar and Bangladesh to India have been reported in recent times. Therefore, in combination with the threats from illegal demands of ivory and other body parts, live captive elephants face a range of serious threats. In recent years, genetic analyses have emerged as an alternative option to solve some of the problems associated with the study of rare, endangered or cryptic species (Waits, 2004).

Molecular markers allow biologists to study species at the population level and even below in a myriad of contexts such as species identification, individual identification, relatedness and kinship patterns, dispersal patterns and individual movements, inferring population structure, population assignment, phylogeography, population size estimation, sex determination, dietary analysis and wildlife forensics. The success of these approaches has been instrumental in the emergence of conservation genetics as a recognized sub-discipline of conservation biology over the last decade. Here we present the current research that has been taken up by the MoEF&CC and the Elephant cell of the Wildlife Institute of India to understand the genetic makeup of the elephant populations (both wild as well as captive) across India.

Approach

The assessment of elephant genetic health involves biological sample collection, genetic data generation and a database development for long-term use towards appropriate management and animal welfare practices. Broadly the work involves collection of blood/swab/faecal samples across all the range states (with other morphological parameters) so genetic data at individual level can be generated. Along with this a uniform set of molecular markers need to be standardized as a forensic data panel for any future legal use. The approaches are described below.

Microsatellite marker selection and standardization

Existing elephant genetics research (both national as well as international) has used a large set of molecular markers (particularly STRs or microsatellites) to understand various genetic parameters of different elephant populations (De *et al.,* 2021; Wasser *et al.,* 2015), but till date no uniform set of markers are available to make a uniform database. The largest uniform dataset for African elephants is currently available at the Center for Conservation Biology, University of Washington where the data is being used to identify poaching hotspots across Africa (Ref.). Previously published research articles on elephant genetics were studied by us to select appropriate Asian and African elephant markers (STRs) for population genetic analysis. A total of 30 primers were shortlisted initially based on various characteristics (for example, polymorphism, amplification success rates etc.). The tissue DNA samples extracted were used to standardize the markers.

Table 16.1: Primers shortlisted based on various characteristics (for example, polymorphism, amplification success rates etc.)

SL	Marker	Dye	Ta (°C)	Size (bp)	Source
1	Lat18	NED	56	286-318	Archei et al. 2003
2	Lat25	VIC	52	298-318	Archei et al. 2003

SL	Marker	Dye	Ta (°C)	Size (bp)	Source
3	FH40	NED	57-60	243	Comstock et al. 2000; Okello et al. 2005
4	FH71	PET	58	69	Comstock et al. 2000; Okello et al. 2005
5	Lat13	PET	56	234-262	Archei et al. 2003
6	LaT08	PET	56	166-234	Archei et al. 2003
7	FH60	FAM	61	148	Comstock et al. 2000; Okello et al. 2005
8	FH39	FAM	60	242	Comstock et al. 2000; Okello et al. 2005
9	FH94	FAM	61	229	Comstock et al. 2000; Okello et al. 2005
10	LA5	FAM	52	142-144	Eggert et al. 2000
11	FH19	VIC	60	185	Comstock et al. 2000; Okello et al. 2005
12	LaT24	NED	56	211-231	Archei et al. 2003
13	FH67	NED	58	97	Comstock et al. 2000
14	LA6	VIC	57	155-159	Eggert et al. 2000
15	FH103	NED	58	154	Comstock et al. 2000
16	FH48	PET	58	178	Comstock et al. 2000
17	FH1	PET	55	81	Comstock et al. 2000
18	Lat06	NED	52	281-366	Archei et al. 2003
19	EMX-2	FAM	62	219-225	Chakraborty et al. 2014
20	FH60	FAM	65	148-162	Chakraborty et al. 2014
21	FH94	FAM	63	215-229	Chakraborty et al. 2014
22	EMU03	HEX	63	134-140	Chakraborty et al. 2014
23	EMU04	FAM	63	97-103	Chakraborty et al. 2014
24	EMU12	FAM	61	139-152	Chakraborty et al. 2014
25	EMU14	FAM	65	129-145	Chakraborty et al. 2014
26	EMU15	HEX	63	144-156	Chakraborty et al. 2014
27	EMU17	HEX	58	120-128	Chakraborty et al. 2014
28	LafMS02	HEX	62	135-141	Chakraborty et al. 2014
29	LafMS03	HEX	54	137-155	Chakraborty et al. 2014
30	LafMS05	FAM	58	144-156	Chakraborty et al. 2014

On the basis of their amplification success, 20 primers were finally selected for further testing. Primers with common annealing temperatures were grouped together and multiplex reactions were prepared (See Table16.2). PCR reactions were carried out for each multiplex set using the same tissue samples.

Table 16.2: Multiplex reactions

Marker	Dye	Size (bp)	Ta (in C^0)	Multiplex
Lat06	HEX	180	51	M1
EMX-2	FAM	219-225		
LA5	HEX	220		
LafMS03	HEX	137-155		
EMU03	HEX	134-140	54	M2
LafMS05	FAM	144-156		
LaT24	FAM	210		

Marker	Dye	Size (bp)	Ta (in C^0)	Multiplex
Lat18	FAM	120	56	M3
Lat25	FAM	140		
EMU04	FAM	97-103		
FH103	FAM	100	57	M4
FH94	FAM	215-229		
LafMS02	HEX	135-141		
LA6	HEX	150		
EMU17	HEX	120-128	58	M5
FH67	FAM	100		
FH19	HEX	220		
EMU15	HEX	144-156	59	M6
FH40	HEX	200		
FH60	FAM	148-162		

Sample collection

For biological sampling from captive elephants a tamper-proof sampling kit and an android mobile app have been developed and distributed to all elephant range states by WII. The sampling is being conducted by the respective state forest departments through their veterinary officers.

Biological samples for DNA database

Type of sample: Fresh Blood
Amount of sample: 5-6 ml blood from each individual collected in 2 EDTA vacutainers
Alternate type of sample: Dung swabs
Amount of sample: Two swabs per dung sample

Storage and transport

The sample vials must be properly placed in the container provided to prevent any mechanical damage during transport.

Conclusion

These genetic approaches, when combined with other non-invasive tools can be extremely critical in monitoring and studying elephant populations at large landscapes. Such genetic surveys, however, require substantial resources including laboratory facilities, reagents, and trained geneticists. Protocols for field sample collection, storage, DNA extraction, and individual identification have been well established and need to be followed very strictly—both in the field and in the laboratory—to minimize errors from various sources. Further, recent developments in the field of genomics allow biologists to identify a large panel of informative markers that could be used to study various elephant population parameters across their range to address biogeographic and evolutionary questions.

Gajah Suchana: a multidisciplinary approach towards developing captive elephant database in India

Asian elephant (*Elephas maximus*) is found across the tropical and subtropical forests of Asia and has played strong cultural roles in various Asian societies. Tradition of elephant capturing, taming, keeping, handling and using for work has been retained in almost all Asian countries. India has a long history of taming and keeping elephants in captivity for a diversity of purposes that included use in wars, temples & religious places, in zoological parks (for conservation education) and for various forest department activities such as wildlife tourism, patrolling, forestry operation and mitigation of conflict with wild elephants. With the decline in forest exploitation for timber the use of captive elephants for this purpose has declined dramatically in recent decades. Unfortunately, illegal trade in live elephants continues despite continuous efforts by the Government of India. Therefore, in combination with the threats from illegal demands of ivory and other body parts, the live captive elephants face a range of serious threats. The Wildlife Crime Control Bureau has also identified a number of irregularities with regard to the implementation of Wildlife Protection act (1972) towards captive elephants. Accordingly, The Project Elephant Division, MoEF&CC has decided to develop a comprehensive database (including DNA) for all the captive elephants regardless of their ownership in India to curb illegal wildlife practices and manage their population in a scientific manner. The database is expected to have individual-level genetic data along with pictures of these captive elephants, making it extremely useful to stop any illegal activities involving these animals.

WII has accordingly developed tamper-proof sample collection kits and an Android mobile application called 'Gajah Suchana' for this purpose. The combination of both of them is currently being employed across all elephant-bearing states to generate the most comprehensive database across the country. The information in this database would include:

a) Basic information: name, location, host facility details, microchip details, gender, age, origin, owner details and certificates etc.
b) Physical measures: shoulder height, body and tail length, foot circumferences, neck and chest girth, weight etc. with detailed photographs
c) Sample collector details
d) DNA profile data

CHAPTER XVII

ELEPHANT TRAINING IN CAPTIVITY: ASPECTS OF OPERANT CONDITIONING

- *N.S. Manoharan*

Introduction

Elephant husbandry practices have been around for millennia. Some level of training and conditioning of elephants is critical to maintain elephants in captivity. Such training is essential for both captive born and wild caught elephants. It may be noted that there are no domestic elephants, rather that elephants maintained in captivity are tamed version of wild elephants. Domestication involves process of selective breeding aimed at retaining "desirable traits" in animals for several generations.

Training of wild elephants would be one of the most stressful periods during their lives (Fowler & Mikota 2006). Wild caught elephants are at a high risk of mortality in captivity during the initial months, both due to injuries sustained during capture and the trauma experienced during the process of training (Lahdenpera *et al.,* 2018). There is evidence from Myanmar showing that elephants captured and tamed at relatively older ages showed a higher rate of mortality compared to young elephants (Lahdenpera *et al.,* 2018). Despite the aforementioned problems involved in capture and training of wild elephants, due to human–elephant conflict and other reasons, wild elephant capture seems to have become an inevitable option for management (Rangarajan *et al.,* 2010). Therefore, optimizing humane care is required to minimize the stress for the elephants and to ensure their wellbeing in the long run.

Although elephant capture and training are more than 4000 years old practice in the country, it is crucial to retrospect and advance methods that are in the best interest of elephants. Thus elucidates the aspects of elephant training in captivity, by drawing from the insights gained as a veterinarian managing elephants in Tamil Nadu for over three decades.

Introduction of wild elephants into captivity

Elephants with reported history of high incidences of human–elephant conflict involving crop raiding, causing damage to property and occasionally endangering human lives are oftentimes moved into permanent captivity. Further, when the efforts to rehabilitate the elephant in the wild through relocation or translocation fail, elephants are moved into elephant camps or rehabilitation center for lifetime care. Additionally, wild elephants that require lifetime medical care are also sometimes brought into captivity. Similarly, stranded elephant calves may be brought into captivity if attempts to reunite them with the herds fail. Thus, elephants of different age groups starting from infants to very old elephants can come into captivity from the wild. With regard to capture of elephants, several techniques have been historically used. This includes pit-method, *kheddah* (driving elephant herds into stockades), mela-shikar, and decoy methods (Stracey 1963). Modern day captures mostly involve chemical immobilization with elephant-specific drugs. The capture method can have profound influence on the training process.

Training of elephants in captivity

Training elephants is an art and is extremely challenging. However, as elephants are intelligent, they are capable of learning if handlers are knowledgeable and consistent in their commands (Fowler & Mikota 2006). The elephants that are born and raised in captivity are continually trained from a young age so that the process becomes simpler. In Tamil Nadu camps, elephants of the age class 18 – 24 months onwards are weaned and subjected to some-level of training so that the elephant starts listening to commands and can be handled with confidence. Without training the calves too cannot be reliably handled. It may be noted that even a 2-year-old calf that is untrained can cause serious injuries to handlers. Therefore, imparting basic training is critical. Learning on the part of elephants varies between individuals, background, age and ability of *mahouts*. Furthermore, training is not a one-off procedure, but a continuous process that may last the entire lifetime of the elephant in captivity. Therefore, continuous training of elephants is required for elephants of all age groups in the captivity.

The juveniles and sub-adults from wild usually settle quickly, rapidly learn to acclimatize to the new environment, accept the caretakers and obey the commands in a shorter span of time as compared to captive born animals. On the other hand, the adults – especially the older individuals often take a long time to get trained. Therefore, the trainers should patiently put in extra effort in handling older animals. Ideally, older animals require best of the *mahouts* and trainers.

Elephant – mahout relationship

Training of elephants relies completely on the effective communication between elephant and its trainer. Elephants do not listen to commands of a stranger. This includes all non-handlers (other than the elephants' *mahouts* and *kavadis*) such as veterinarians, and other staff of the elephant camp. The elephant trainer (*mahout* and *kavadi*) should be knowledgeable, experienced and dedicated to improve the wellbeing of elephants. Thus, selection of the right handlers holds the key to proper training. Amongst the many desirable characters of a good mahout, patience, dedication and emotional connection with elephant are foremost. Winning the elephant's trust is essential for a tenacious long-term relationship rather than breaking the spirit of the animal and trying to gain control over it.

Positive and negative reinforcement

Elephant training broadly falls into two strategies namely positive and negative reinforcement (Fowler & Mikota 2006). In either case, the objective is to make the elephant learn. The trainer in the first step tries to assess the elephant. The process of training would eventually involve gaining confidence, mutual trust, acceptance and recognition of each other on the part of both the mahout and the elephant. Upon successful completion of initial training process, the elephant starts obeying commands and allows the handlers to touch various parts of the body. A trained elephant allows the mahout to give a bath and scrub, changing the rope or chain on the legs, hand feeding, holding the tusk and mounting on the elephant. Positive reinforcement techniques involve appreciation by words (soft and gentle), patting, caressing and offering food rewards like sugarcane, jaggery, banana etc. The trainer has to repeatedly engage with the elephant, give commands and when the elephant satisfactorily responds, it is adequately encouraged and rewarded so that the behavior sets in. Negative reinforcement involves strong vocalization, showing the hand and use of stick with mild force to control or handle. Often the elephant movement during negative conditioning is restricted (such as confinement within the kraal).

Free and protected contact training methods

Wild caught elephants cannot be kept in captivity before they are trained.

Free/open contact training method involves tying down an elephant in the open and approaching it for training purposes. Usually, in free contact training method, the elephants are tied to large trees. The possibility of injuries as well as stress to elephants seems high in case of free contact method. In closed contact training of wild-caught elephants, a kraal (=wooden enclosure) is built and elephant is confined within the kraal during the period of training. Building a kraal that is reliable requires experience and care. Kraal site selection and the materials used are also paramount.

Protective Contact method

In this method the trainer and the caretaker will not have a direct social relationship with the animal but create an ambience to selective manipulations like medical intervention, foot care, sample collection etc. The elephants maintained in protective contact method may not be completely suitable for forestry operations.

Role of *Kumki* elephants in training

Kumki elephants are trained elephants that are typically used to deal with other elephants. A good *kumki* is the one that can perform multiple functions, as the situation warrants. The roles expected of a reliable *kumki* include that of a commando, friend, teacher, guide, companion, parent and confidant. It is wrongly assumed that *kumkis* are used only for fighting other elephants. The newly caught elephants in presence of *kumkis* that adequately care for them like friend and/or parent can bring down the stress levels of newly captive individuals reducing probability of capture myopathy. A good *kumki* would be over 9 feet in height (in case of bulls), 5 tonnes in weight, strong and well-built with a straight back, symmetric and strong tusks, good eye sight, good hearing, good gait, obedience, cordial relationship with mahout, willing to work with other elephants, confident in his moves, and also possess good comprehension, understanding, analysis and execution abilities. A good *kumki* allows other persons to sit on top (in presence of *mahouts*), work under their neck, abdomen, stand close to wild elephants, and possess an ability to overcome or overpower the wild individuals. The *kumkis* should not be perturbed by sound, light, smoke etc. and tolerate saddle (hadhi, namada). Both bull and cow elephants can be used as *kumkis*.

With ever increasing interface between wild animals, domesticated animals and humans the interactions, mostly negatively take place necessitating interventions including capture, rescue translocations and rehabilitations. The role of elephants as *kumkis* and great biological force become inevitable, as also the training.

Veterinary considerations

During the process of training, both in open and closed forms of contacts, injuries to elephants (particularly for wild caught elephants) on the forehead, trunk, legs, rump, back and tail are possible. When the wild-caught animal is within the kraal, treating injuries on forehead, trunk and legs is extremely difficult. More often than not, these injuries are avoidable if utmost care and patience are exercised during the capture, and enkraaling operations. Presence of experienced *mahouts* is a must during such operations to minimize chances of injuries and other risks. Similarly, the kraal design has to be well thought out and suit the individual elephant to minimize the injuries that could potentially arise out of elephant banging on the logs, trying to escape, clambering over the kraal etc. Any abnormality/injury to elephant during the process of capture and training is to be immediately attended to, so as to avoid long term treatment later on. Several instances have been recorded where wounds inflicted during capture and training process were treated for several months. The elephant's biology, behavior and psychology are to be understood and considered to advance the training techniques. The fundamental rule to be followed by veterinarians involved in case of training in captivity is "prevention is better than cure".

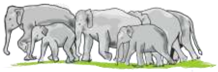
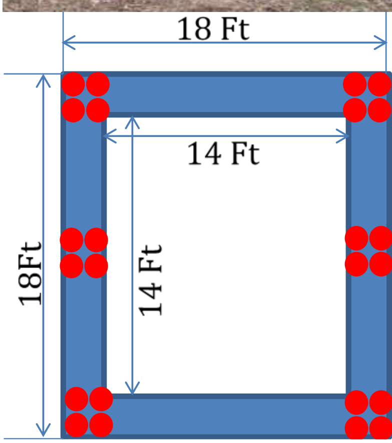



Photo by: Dr. N.S. Manoharan

Plate 17.1: Elephant calf stranded in a well (b) Calf being gently pulled out of well employing *Kumki*

Pillar Circumference -140Cm – 24Nos
Side Pole - 80Cm – 100Nos
Height of pole- 26Ft
Height of kraal – 20Ft

Photo by: Dr. N.S. Manoharan

Plate 17.2: Construction of Kraal

Photo by: Dr. N.S. Manoharan

Plate 17.3: Enkralling of tusker

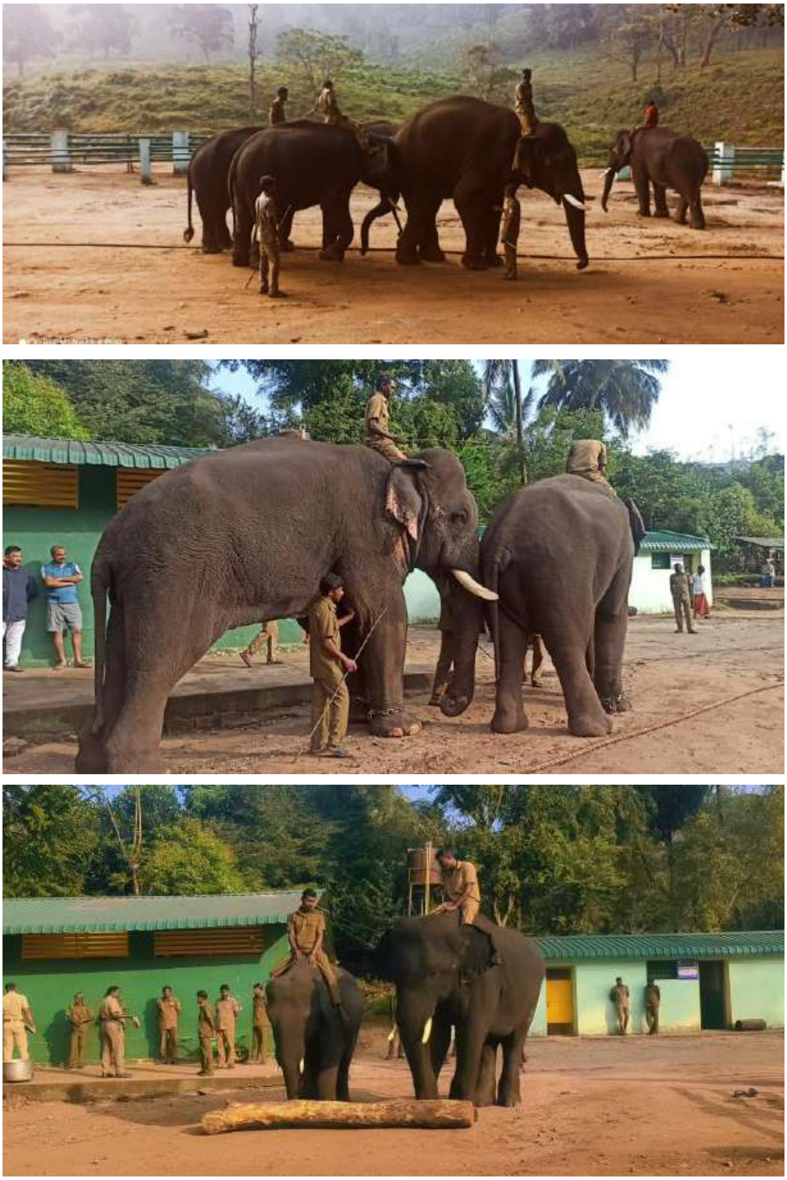
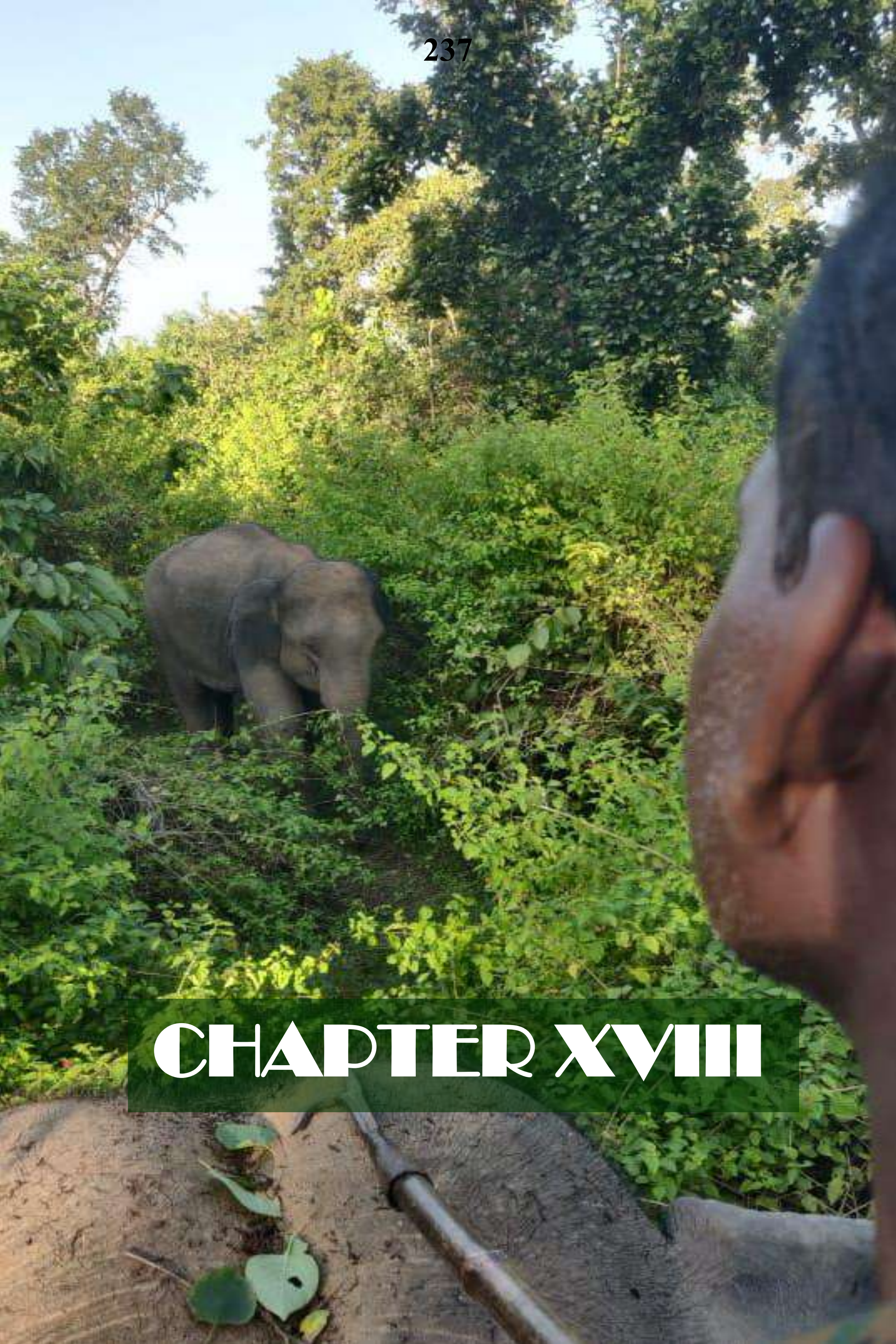


Photo by: Dr. N.S. Manoharan

Plate 17.3: Walking the elephant as part of training with the help of *Kumkis*



CHAPTER XVIII

OCCUPATIONAL HAZARDS AND WELFARE OF *MAHOUTS* AND ELEPHANT HANDLERS

- *N.S. Manoharan*

Introduction

Elephant *mahouts* and *kavadis* and occasionally their subordinates like the grass cutters form the "group" of elephant handlers Elephant handlers are integral part of captive elephant management, as elephants cannot be maintained in the captivity without trained and dedicated elephant handlers. The elephant handlers, in particular the *mahouts* act as caretakers, keepers, companions, confidants, food provider and guides (Phuangkum *et al.,* 2005). Overtime, with positive operant conditioning, strong bonds develop between the mahout and the elephant. Given this, the welfare of captive elephant is overbearingly dependent on elephant handlers. Captive elephants that are handled by incompetent and untrained handlers with deleterious attitudes suffer lifetime of misery. As elephants are extremely powerful and capable of causing serious injuries and deaths to human beings, handling elephants involves considerable risks, particularly when bonds between elephants and their handlers are volatile and weak. Every year, elephant handlers get killed by elephants due to variety of reasons and the trend seems to be particularly on the rise. Thus, in the long-run, minimizing risks to handlers, improving their welfare condition and inculcating scientific acumen are critical to infuse scientific management principles into captive elephant management with an overall aim of improving welfare conditions of the captive elephants.

Job demands of mahouts and elephant handlers

In the forest camps of Tamil Nadu working as a veterinarian for over three decades, it was noted that most of the elephant handlers are from tribal communities. These tribal communities live in natural elephant habitats encountering wild elephants frequently and historically, had worked as scouts in locating and capturing wild elephants. Lately, they have become expert elephant handlers carrying out a variety of forestry and wildlife activities using captive elephants. In such camps, there is often vertical transmission of traditional knowledge from father to son, sons-in-law, between cousins etc., in handling elephants across generations. In the Anamalai tiger reserve, the tribal communities of Malasars and Malai Malasars are engaged as *mahouts* and elephant handlers. In the Mudumalai tiger reserve, Betta Kurumba, Jenu Kurumba, and Kattunaickers are engaged as elephant handlers. In Central India, the tribal communities of

Gonds, Oraons and others have taken to elephant management. Elsewhere in India, several other communities, both tribes and non-tribes have been engaged as *mahouts*. There are physical demands for being a good mahout with qualities like physical prowess and stamina, mental balance and stability, patience, receptivity and keenness to learn, good comprehension, understanding, analytical and steadfast in execution of assigned tasks.

Human resource management of mahouts and elephant handlers

At the outset, it is imperative to define the job and activities of the *mahouts* and elephant handlers. As the job is demanding and elephant management is a 24 x 7 job, only individuals with the right temperament, commitment and dedication can be chosen as a mahout. Across India, it is high time to systematically evaluate the current status of *mahouts* collating details such as average age of *mahouts*, marital status, temperament assessment, and perceptions regarding their jobs along with aspirations. Equally important is to identify areas of continuous improvement for the elephants through specific capsule training programs on elephant behavior, ecology, conservation, and veterinary aspects. Assessing elephant handling as a profession from economic, social, personal, and futuristic points of view is important too. As elephant handlers live and work with elephants, usually their natural history knowledge and interpretation of elephant behavior is good. However, they need to be enriched from time-to-time by imparting training by involving senior and experienced *mahouts*.

Occupational hazards

Handling elephants is fraught with risks of mild to severe physical injuries, permanent disability, and even death. There are risks from handling one's own assigned elephant during feeding, bathing, grooming, tying chains and hobbles, walking, riding and moving along with elephants. These are in fact day-to-day risks. Further, there are specific risks when elephants are used for operations when there is a pressure to perform both for the elephant and its handler. Often during such operations there is lack of rest, disturbance of normal routine, improper diet and stress. Some elephants may also exhibit phobia towards crowd, livestock, other animals and even novel objects and may react abnormally jeopardizing the safety of handlers. The risks are usually high when both elephant and handler are new to each other. In addition to these risks from one's assigned elephant, there are also other risks particularly in the forest camps that include potential risks of encountering wild elephants, other potentially dangerous wild animals like tigers, sloth bear, snakes, gaur etc. There are also risks of accidents (in the roads while transporting elephants) and others.

Current state of affairs

The author notices break in learning with respect to knowledge transfer due to which, the overall art of elephant management is fading fast. There are profound changes in lifestyles of younger generation of *mahouts* with less affinity towards forest-based lifestyles. These have consequences on elephant management in the long run. Thus, the traditional knowledge, passion, the art and culture of *mahoutry* is increasingly vanishing and diminishing. The majority of the younger generation from traditional mahout families does not seem willing to continue the tradition.

Role of veterinarians

The veterinarian is part of all the teams with elephants and *mahouts*. Knowing the individual elephants and their *mahouts* will be very useful. Regular interactions with *mahouts* will strengthen the relationship and will be handy during demanding field operations. If a veterinarian understands the elephant and its mahout well, most of their problems could be comprehended well.

Future directions

1. Defining the job for *mahouts* and their elephants is of paramount importance.
2. Vertical transmission of knowledge from experienced *mahouts* to juniors should be nurtured.
3. Comprehensive life and medical insurance cover for handlers would be essential considering the risks involved in in the job.
4. Human-resource-related problems of elephant handlers (such as wage adn allowances, leave etc.) should be assessed and addressed regularly.
5. Vices like alcoholism and addiction to substances among the elephant handlers should be regulated through continuous positive engagement.
6. Health screening of elephant handlers at periodic intervals would be essential.
7. Often the tasks require the handlers to be outstation on duty away from their families. Therefore, it is appropriate to carry out stress management and counseling through yoga, meditation, interactions etc. should be considered.

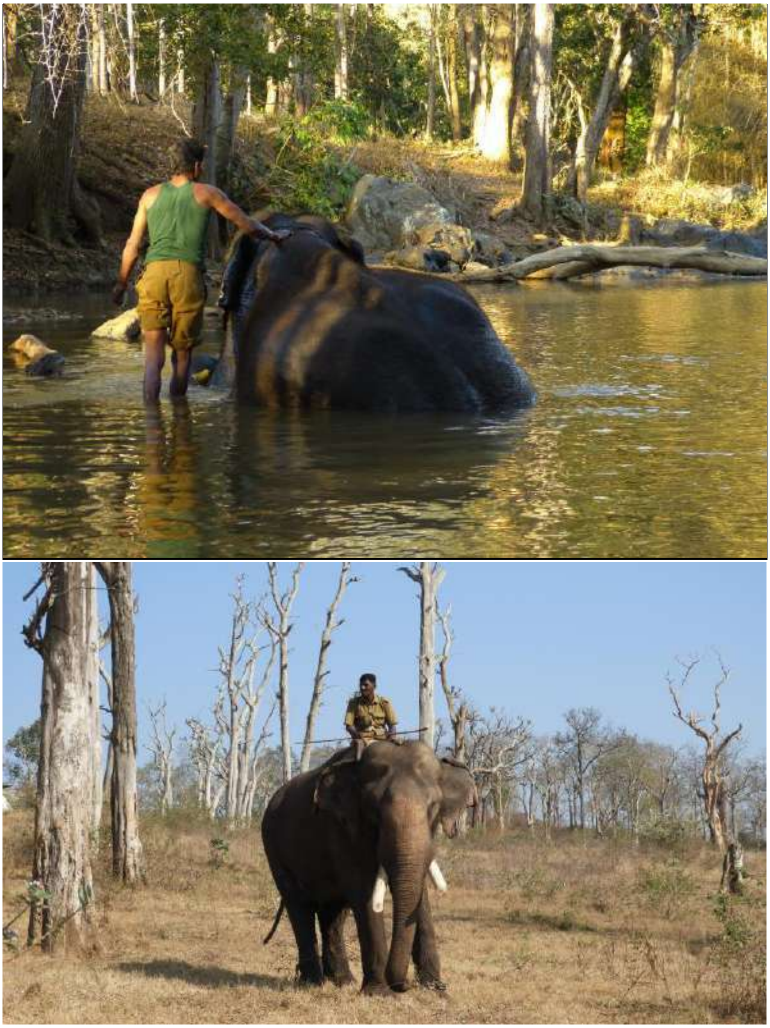


Photo by: Dr. N.S. Manoharan

Plate 17.3: Association building (a) Bathing elephant in stream (b) Walking through the forest

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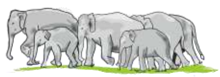

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Dr. Arun A Sha has a degree in Veterinary Science from Tamil Nadu Animal and Veterinary Science University during which he received the Governor's award for best Masters' student. He worked with wildlife SOS and served as the Director (Research and Veterinary operations). He has been involved in rescue rehabilitation and treatment of displaced and injured wildlife. He has been conferred with various titles overs the years owing to his outstanding services in the field

Kartick Satyanarayan is the Co-Founder and CEO of Wildlife SOS which he founded in 1995 with Geeta Seshamani. The organization works closely with Govt. of India and State Governments to rescue over 600 performing 'dancing bears' and brought an end to the centuries-old barbaric practice of dancing bears while providing alternative livelihoods to Kalandar communities previously dependant on bears. The organization has helped over 3000 families with alternative livelihoods, women empowerment & supported over 7600 children's education. The organization operates over 10 wildlife rescue and rehabilitation facilities for elephants, bears, tigers, leopards etc. Wildlife SOS spearheaded the establishment of India's first Elephant Hospital and Conservation Care Centre in Mathura in collaborating Uttar Pradesh Forest Department where medical facilities for blind, lame, crippled, injured, geriatric and handicapped elephants receive specialised medical treatment and care.

Dr. Bhaskar Choudhury heads the Wild Rescue Division of the Wildlife Trust of India. He has been involved in wildlife rescue, rehabilitation, conservation translocation and health management of wild animals for the past twenty-two years mostly in North East and also in states of Uttarakhand and Chhattisgarh. He is Member of task force on captive elephant healthcare constituted by Project Elephant, Government of India (2019-2023) and Member, Indian Rhino Vision 2020- Capture and Transport and Release committee (2008-2021). He is presently the consultant for training of forest officers and Veterinarians from Vietnam and Cambodia for WWF India on a project for chemical capture and radio telemetry study in Asian elephants. He is member of the IUCN SSC Asian elephant specialist group (2018-2024) and IUCN SSC Asian rhino specialist group (2017-2024)

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Dr Prajna Paramita Panda is a wildlife biologist and conservationist who has been working on wildlife conservation for nearly two decades. With her broad experience and interest, she has successfully planned, implemented, and monitored various conservation action projects in India. Her work largely focused on policy advocacy and liaison with national and international agencies. Working in the Project Elephant Division of MoEF&CC, Govt. of India since the last decade, she has been instrumental in framing advisories/ policies/ SOPs /guidelines for conservation and management of wild animals, including elephants. As the National Coordinator of Elephant Cell, she ideates, strategizes and helps develop long-term plans for the conservation of elephants in India. As a member of several Committees of the Ministry, her main areas of interest in Asian elephant issues are addressing human- elephant conflict, protection of Elephant Reserves and corridors and capacity building programmes to conserve elephants.

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Dr. Samrat Mondol is a molecular ecologist at the Wildlife Institute of India in the Department of Animal Ecology and Conservation Biology. He completed his PhD. from National Centre for Biological Sciences, TIFR on population and conservation genetics of Indian tigers. Following this, he was awarded prestigious Fulbright-Nehru fellowship for postdoctoral research on Wildlife physiology and forensics of small and large mammals. His broad research interests are of multidisciplinary nature combining the fields of conservation genetics, landscape genetics, wildlife endocrinology, wildlife disease dynamics and forensics. His current research focuses on quantifying the direction and degree of demographic changes and their health impacts from a myriad of anthropogenic causes. He is an Associate Fellow of the Indian Academy of Sciences, Bangalore and the South Asia sector in-charge of the IUCN Conservation Genetics Specialist Group.

Dr. Pradeep Malik served as a Senior Scientist at the Wildlife Institute of India for over 33 years and was responsible for building enhanced wildlife health capacity in India amongst the next generation of wildlife health professionals, wildlife biologists, wildlife managers and front line staff. He has been instrumental in developing effective wildlife health monitoring, disease surveillance programs, developing state of the art wildlife immobilization, and restraint techniques that are suitable for the South Asian context. He is recipient of the Carl Zeiss award in 2002 and received recognition as ICEID (International Conference on Emerging Infectious Diseases) Leaders Program, in 2010 for his contributions in enhancing prevention of infectious diseases globally, conferred by Centers for Disease Control and Prevention (CDC), United States Dept. of Health and Human Services. In association USGS-National Wildlife Health Center, USA, Dr. Malik developed a countrywide first ever One-Health initiative "Indian Wildlife Health Cooperative" (1995-2002) in five veterinary institutes in India. Dr. Malik is a member of International Wildlife Disease Association (WDA) and was Coordinator South-Asia, IUCN-VSG Species Survival Commission (2005-2019).

Capt (Dr.) Parag Nigam heads the Dept. of Wildlife Health Management at the Wildlife Institute of India and is responsible for developing and executing capacity development programs for wildlife professionals both nationally and internationally. He has played a key role in large carnivore and mega herbivore conservation in the country and steered the first ever tiger reintroduction program (Sariska Tiger Reserve) in the country in collaboration with the Rajasthan Forest Department and National Tiger Conservation Authority. Since last 10 years, he has been working towards establishing Indian Gaur population in Bandhavgarh along with the Madhya Pradesh Forest Department and &Beyond (CC Africa) that was the first ever large scale re-introduction of a mega-herbivore in the country. He contributes to various wildlife ecological research projects through his inputs on animal capture and radio collaring and has worked across different landscapes. He has been instrumental in establishing chemical capture protocols for variety of native species that have proved safe, effective and provide predictable responses. Presently, he is involved in capture of free ranging elephants in Chhattisgarh, tigers in Maharashtra, hangul in Jammu & Kashmir, swamp deer in Uttarakhand besides managing wild animals in distress.

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Wildlife Institute of India

Annexure-VII

F. No. 14-2/2019-PE(Part-1)
Government of India/ भारत सरकार
Ministry of Environment, Forest & Climate Change/ पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
(Project Tiger & Elephant Division / व्याघ्र एवं हाथी परियोजना प्रभाग)
****

Indira Paryavaran Bhawan,
Jor Bagh Road, New Delhi-110003

Dated: 09-08-2024

OFFICE MEMORANDUM

Sub: Standard Operating Procedure for Elephant Endotheliotropic Herpes Virus Hemorrhagic Disease-regd.

Madam/Sir,

As you may be aware that Elephant endotheliotropic herpesvirus (EEHV) is a moderately understood emerging disease which can cause a highly fatal hemorrhagic disease when transmitted to young Asian elephants. To address this dreaded disease the Central Zoo Authority during the year 2021 had issued a Standard Operating Procedure for dealing Elephant Endotheliotropic Herpesvirus (EEHV). The copy of the document is enclosed herewith for your perusal and implementation.

Signed by
Ramesh Kumar Pandey
Date: 09-08-2024 19:26:50

Encls: as above.

(Ramesh Kumar Pandey)
IGF (PT&E) & Director, Project Elephant
Email: ramesh.pandey@nic.in

The Principal Chief Conservator of Forests (WL) &
Chief Wildlife Warden,
All Elephant Range States/UTs

Copy for information:

- Principal Chief Conservator of Forests (HoFF), All Elephant Range States/ UTs.
- Member Secretary, Central Zoo Authority, MoEFCC, Govt of India, New Delhi.

True Copy

Standard Operating Procedure for Elephant Endotheliotropic Herpes Virus - Hemorrhagic Disease

CENTRAL ZOO AUTHORITY

Statutory body of the Ministry of Environment, Forest and Climate Change, Government of India

2021

Suggested citation:

Sharma.K.K., Mahato G.,Das.A.K., Zachariah A,.Karikalan.M., Mathur V.,Saini M., (2021) Standard Operating Procedure (SOP) to deal with Elephant Endotheliotropic Herpes Virus - Haemorrhagic Disease. Central Zoo Authority.

EEHV Case Photo Source: College of Veterinary Science, Khanapara and Nandankanan Zoological Park, Odisha
Design: Roopa, Sruthy Boopathy

Acknowledgements

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Contents

1 Background

"*Nature's great masterpiece, an elephant – the only harmless great thing*."

John Donne, 1572-1631

Elephants have fascinated people for time immemorial. They are integrally woven in our culture and mythology, portrayed in ancient art and often assume positions of reverence amongst people. Elephants inhabit mixed deciduous, evergreen forests, dense tropical rain forests, scrub and grass lands, plain and hilly forests with perennial water sources. In the wild, they are migratory in nature traveling for long distances in search of food and water.

The Asian elephant (*Elephas maximus*) is accorded the highest protection under Schedule I of the Indian Wildlife (Protection) Act of 1972 and categorised under CITES Appendix I. It is a quintessential flagship species, deployed to catalyse a range of conservation goals, including habitat conservation at landscape scales, generating public awareness on conservation issues, and mobilisation as a popular cultural icon both in India and the West. Elephant exhibits are popular in zoos globally and Indian zoos house 86 animals as on today.

Elephant endotheliotropic herpesvirus (EEHV) is a moderately understood emerging disease which can cause a highly fatal hemorrhagic disease when transmitted to young Asian elephants. Though treatable with an early diagnosis and with the rapid application of antiviral drugs, this has only been effective in around a third of cases.

The Central Zoo Authority (CZA), a statutory body of the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. As on today, CZA oversees the functioning of 152 zoos and rescue centres across the country. The ensuing Standard Operating Procedure document for Elephant Endotheliotropic Herpesvirus (EEHV) has been compiled by a process of detailed consultation with experts in the field. It is expected to serve as a guidance document to address this dreaded disease.

2 Description of disease

Elephant endotheliotropic herpesvirus (EEHV) is responsible for one of the most devastating viral infectious diseases in elephants worldwide, especially young Asian elephants. EEHV is classified in the family *Herpesviridae*, subfamily *Betaherpesvirinae*, genus *Proboscivirus*, and species *Elephantid betaherpes virus* (https://talk.ictvonline.org/taxonomy/) (Kochugal *et al* 2018). It is believed to affect the endothelial tissues found inside the blood vessels. The mortality rate is very high (70-85%) and death occurs within a short period of time (2-4 days).

The prevalence of EEHV in captive Asian elephants in North America and Europe has been well documented. In India, the incidence of EEHV-HD was first reported in 1997. 9 of 15 potential cases were confirmed from Southern India in wild free-ranging calves in Kerala, Karnataka, Tamil Nadu forest reserves, and Madras Zoo (Zhacharia *et al*, 2013). A positive case of EEHV1A infection has also been reported from captive Asiatic elephants of Assam (Barman et al, 2017). Within the last 10 years, 59 fatal cases of EEHV disease in Asian elephants have been identified within the eight range countries. Twelve of these deaths were wild elephants (Luz and Howard, 2016).

Fig.1. Lethargy and sternal recumbency

Fig.2. Open mouth breathing

3 Transmission of the disease

The elephants identified as carriers of EEHV need not be isolated from other Elephants. This is because of the fact that most elephants carry EEHV without showing symptoms. In addition, the majority of cases of EEHV-HD have been sporadic. Elephants are social animals and separating them from their herd is likely to increase their stress. However, direct transmission from another acute case cannot be ruled out completely. EEHV is mostly spread through mucosal secretions which include:

- Saliva
- Breast milk
- Nasal secretions
- Vaginal secretions
- Trunk to trunk contacts.

The disease can only affect elephants and is not infectious to humans or other animals. Epidemiology of the disease is still not clear and further research is required on this aspect. Incubation period of the virus is 7-14 days.

4 Clinical Symptoms

EEHV- HD always occurs either in per acute or acute forms and the elephant may exhibit any of the following symptoms:

- Lethargy
- Selective appetite to complete anorexia
- Pyrexia
- Edema of the head and trunk and limb
- Reduced trunk movement
- Lacrimation (sometimes)
- Vesicle formation on the tongue with salivation
- Cyanosis of the tongue, swollen tongue: starting at the tip and moving caudally
- Mild gastrointestinal signs viz distension of abdomen, colic pain, mild diarrhoea or constipation
- Lameness, stiffness of legs
- Nervous symptoms- Staggering gait, drowsiness, unresponsiveness to command, ataxia due to intracranial bleeding or cerebral hypoxia that may lead to death within 24-48 hours.

Fig.3. Edematous swelling of the trunk

Fig.4. Edematous swelling of the temporal region

Fig.5. Lateral recumbency

Fig.6. Cyanotic tongue (Blue discolouration of tongue)

5 Post mortem lesions

Post mortem reports generally mention 'Acute Haemorrhagic Disease' in elephants suspected for 'Elephant Endotheliotropic Herpes Virus (EEHV)' infection

Post Mortem findings may include:

- Extensive haemorrhages found in almost all visceral organs
- Purple or cyanotic discolouration of tongue

Histopathology may show: Intranuclear inclusion bodies in endothelial cell lining of visceral organs, particularly in liver sinusoid & spleen

6 Diagnosis

Most elephants carry EEHV latently and show no signs of disease. The disease may cause damage to the lining of small blood vessels, primarily capillaries. When this happens, blood starts to leak out from the vessels. The result is progressive blood and fluid loss. As the damage to the blood vessels worsens, the heart starts to pump less efficiently, and ultimately the elephant dies of shock. The disease can occur at any age group but the elephants that have highest risk are young elephants between the age group of 2-8years.

Confirmation of the disease can be correlated with following factors: -

- Clinical signs combined with the history of the herd,
- Gross post mortem and histopathology findings. Systematic examination of carcasses should be done and the gross lesions will be recorded during post mortem
- Clinical examination of suspected elephants and correlation with parameters like age, sex, temperature, body weight, respiratory rate, heart rate, general demeanour and gait. A detailed history may be collected from the respective forest authorities.
- Differential diagnosis with Encephalomyocarditis virus, Clostridial Enterotoxaemia, Anthrax, Pasteurellosis, Salmonellosis and Hypovitaminosis E.
- Result of Polymerase Chain Reaction (PCR) assays for the detection of EEHV and its subtypes.
- Quantitative real-time polymerase chain reaction (qPCR) assay for confirmation of disease.

Fig.7. Haemorrhage in tongue

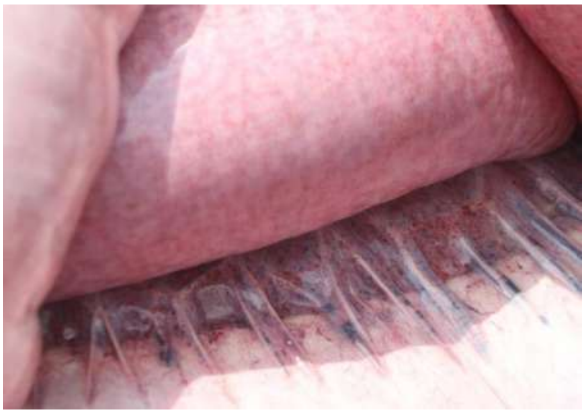

Fig. 8. Haemorrhage in the oral cavity

Fig. 9. Haemorrhage in mesentery

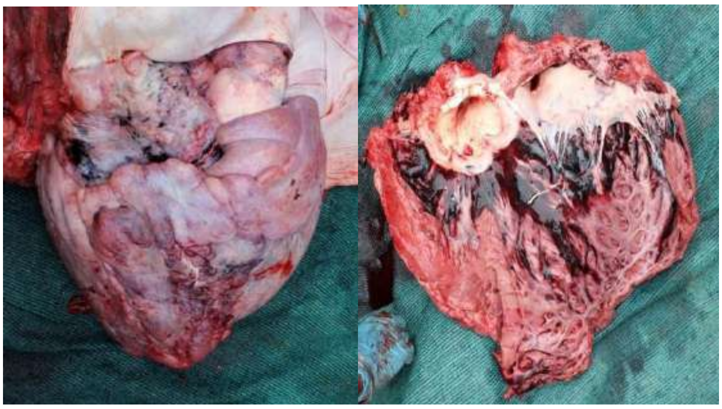

Fig.10. Haemorrhage in heart

Fig.11. Haemorrhage in brain

7 Sample collection

a) Samples like blood (whole blood and serum), trunk wash, ocular swabs and faecal swabs may be collected in viral transport media/ Phosphate Buffer Solution (PBS) and transported under cold chain. **Directions for trunk wash collection:** 60 ml sterile saline solution to be infused into trunk, have elephant raise trunk, then collect saline into clean zip-lock bag. Recover minimum of 30 ml of trunk wash fluid. Transfer trunk wash into clean 50 ml conical vials. Centrifuge conical tubes at 900 rpm x 5 min. Carefully remove supernatant without disturbing the pellet. Place equal volume of anti-DNase or anti-RNase solution over pellet. After properly mixing the tube, keep the tube in ice for transportation. Freeze the pellets at -80°C, for storage purpose and processing of sample for later references.

b) <u>Serum for biochemistry and antibody ELISA testing -</u> Collect blood in red top tube. Keep the tube upright for 5-10 minutes and allow clotting at room temperature. Centrifuge the tube at 1500 rpm for 10 min. gently aspirate out the serum, with the help of pipette. Place the serum (>2ml) into multiple storage tubes. Store the samples at -20°C as soon as possible.

c) <u>Tissue samples</u>: After post mortem tissue samples like liver, heart, kidney, blood, intestine, tongue, trachea, lung, trunk mucosa, brain, mammary gland, lymph node, oesophagus, urinary bladder, ovary/testis, spleen, uterus, aorta, pancreas, stomach should be collected in Viral Transport Media or in 10 % Neutral Buffered Formalin. The morbid samples submitted directly to the diagnostic centre in cold chain or 10% formalin can also be used.

d) For Histopathology

Samples from all organs that exhibit haemorrhagic lesions to be collected (Tissue size: 1 cm cube). They may be stored in 10% Neutral buffered formalin at room temperature.

e) PCR analysis (cPCR and qPCR)

Sample from all organs that exhibit haemorrhagic lesions to be collected. (Tissue size: 1 cm cube). The tissue may be placed in 50 ml conical tube.

f) <u>Transportation and storage</u>: Place tissue in conical tube with equal volume of 96- 99% alcohol (prefer molecular grade ethanol or HPLC grade ethanol). Transportation should be done in ice. Place -80°C (if not available, -20°C) until the analysis is under process. If 96-99% alcohol is not available, place tissue in regular ethanol and transport under ambient temperature. If alcohol is not available, ship the tissue in conical vial over ice.

8 Treatment

As no vaccines are available as on date, only the elephants identified early with the disease and treated in the early stages have the best chances of survival.

- Treatment should start immediately without waiting for laboratory confirmation.
- Treatment includes two major steps 1) management changes 2) Anti-viral and supportive therapy.
- Treatment should be targeted at causative agent i.e. Herpes virus, supportive care for the animal and controlling secondary bacterial and other infection.
- Sedation: Xylazine 0.04-0.08mg/kg Intramuscular (IM) (can be reversed with Yohimbine or Atipamezole) If insufficient sedation is obtained by Xylazine alone, an additional (low) dose of Ketamine (0.03 – 0.06 mg/kg) can be given IM or Intravenous (IV).

a) Management changes:

- The Elephant should be restrained in a comfortable area free from stress and should be provided with sufficient water, green fodder and concentrates.
- The body temperature should be regularly recorded to assess pyrexia due to viremia.

b) Antiviral drug

- Famciclovir @ 8-15 mg/ kg body weight QID (four times a day) on 1st day and then BID (two times a day) for 3 weeks orally or rectally (Famciclovir is the first drug of choice). In case Famciclovir is not available then Acyclovir can be used with same dose rate and route.
- Rectal administration of anti-viral drug: Generally rectal administration is considered when the elephant declines to accept oral medication because of oral lesion / ulcer and tongue cyanosis. In such cases the calculated doses of antiviral tablets are crushed into powdered form and mixed with ultrasound gel preferably for administration through the rectum.
- In case oral or rectal administration fails then Acyclovir @12.5 mg/kg or Ganciclovir @ 5mg/kg can be given IV in per acute form of sickness.

c) Fluid therapy

- Intravenous and rectal administration of fluid may be required to save the animal from shock.
- The volume of fluid for rectal administration may vary from 10-15 litres depending on the clinical status of the animal @ 20ml per kg body weight.
- Oral/per rectal rehydration or electrolyte (ORS).

- The fluid is usually deposited at the descending part of the colon slowly.
- In early stages, EEHV fluid therapy may be beneficial for cardiovascular support which is essential to prevent multi organ dysfunction. But in terminal stages of EEHV, fluid therapy is unlikely to have same impact under increasing leakage of capillary endothelium exacerbating peripheral and pulmonary edema. However, if no fluid support is given then it may result in shock leading to myocardial hypoxia and death in severe cases.

d) Diuretics:

- Management of peripheral edema has been achieved successfully with use of Furosemide 0.6 mg/ kg body weight route IV or IM QID.

e) Antibiotics:

- To manage secondary bacterial complication, antibiotic therapy should be started like Amoxicillin (11 mg), Ampicilin (8 mg), Ceftiofur (2 mg), Enrofloxacin (2.5-5 mg), Marbofloxacin (2 mg) per kg body weight.

f) Anti-inflammatory drug:

- In EEHV anti-inflammatory are indicated as a part of analgesic regime reducing secondary inflammation resulting from peripheral edema and haemorrhage. Hence, Non-steroidal Anti-inflammatory drug (NSAID) like Meloxicam or Flunixin meglumine @ 0.6 – 0.8mg/Kg body weight may be considered.

g) Other supportive therapy:

- Immuno-modulator like Levamisole-75 may be given S/C (single dose @ 1ml/50 kg). Besides that, administration of Vitamin-C, antioxidant is also considered as a potential supportive therapy.

9 Prevention and control

- Keep the Elephant in a healthy and near natural environment.
- Avoid all kinds of physical, emotional and other stresses to the animal.
- <u>Follow strict healthcare and management protocol</u>: Deworming, vaccination, regular exercise etc.
- Follow positive reinforcement methods to train the younger calves to accept being handled by the veterinary team. They should be trained to allow collection of blood samples, intravenous and intramuscular drug administration etc.
- The elephant handlers should be the responsible persons and they should be keeping constant vigilance on the elephants, particularly the vulnerable animals.

- Keep a ready stock of antiviral medicines in your facility, so that the medication could be started immediately on observing some of the clinical signs. It should be borne in mind that the medication does not cause any harm if the animal turns out to be negative to EEHV.
- Avoid exposure of Asian elephants to African elephants if both are available in your facility
- Separation of young elephant from the herd is not suggested.
- Regular deworming on the basis of faecal examination.
- Provide balanced diet and avoid transportation.
- Routine check-up of blood (CBC and Platelet) and trunk wash/ whole blood for PCR.
- Vitamin-C or Elephant apple or immunostimulant/immunomodulator.

10 Vaccination

- Vaccines are still not available in India. Vaccines developed in US are still under study. Since the virus has many strains and sub strains, the full spectrum of preventive vaccine needs to be developed.

11 Monitoring of disease

Under ideal circumstances, a healthy juvenile elephant should be monitored every week (checking for the presence of EEHV in the blood). This is based on the incubation period of the disease (7-14 days).

a. Regular close monitoring of animal with regard to visual inspection of different parts of the body mentioned earlier, vital signs and behavioural pattern.
b. Any subtle changes in the above parameters may immediately be brought to the notice of a veterinarian for prompt investigation and intervention.
c. Blood sample and trunk wash should be screened at weekly interval against virus through PCR to suspect/confirmed positive elephant.
d. Existence of carrier or shedder is not uncommon in EEHV infection. Hence such screening protocol should be in place for all zoo/private/camp having captive elephant to identify carrier/ shedder in herd for further bio-security measures.
e. Blood sample be regularly screened for Complete Blood Count (CBC), serum biochemical analysis to assess any abnormal haematological changes like leucocytosis, monocytosis, lymphopenia and thrombocytopenia along with elevated Blood Urea Nitrogen (BUN), creatinine and liver enzymes.
f. Manifestation of clinical signs corroborating with other abnormal changes in vital parameters almost confirms EEHV infection, if the animal is previously confirmed

as a carrier. Hence, it is prudent to initiate aggressive treatment as early as possible considering the severity and rapidly damaging effect of the disease course.

12 Risk period

Although the specific predisposing factors that make an elephant clinically sick are as yet not known, stress of different origin are thought to play an important role for EEHV infection. The main period of stress, where there is a potential risk of EEHV infection include;

1. Changes in immune status
2. Orphan calves which are devoid of colostrum and lack maternal antibodies
3. Weaning
4. Pregnancy
5. Translocation of elephants from old to new place
6. Social disharmony or direct introduction of new animal in the herd
7. Pre-pubertal hormonal changes
8. Period of sickness with other diseases

13 Introduction of new animal

- Animals arriving through exchange/ acquisition programme or rescued animal should be properly quarantined before mixing with an existing herd.
- Animal should be quarantined for a period of 6 months at a separate facility with periodical screening of blood sample and trunk wash by PCR besides regular monitoring of vital signs.

14 EEHV infection in pregnant Elephant

As per the current literature, no specific recommendation is available with regards to management of EEHV positive pregnant elephant. But the following points may be considered:

1) The pregnant female is outside the vulnerable age (1-10 yrs.) for clinical EEHV infection. Hence it can remain as carrier/ shedder without manifestation of clinical symptoms (Latent stage).
2) In such case only periodical monitoring of viral load through q-PCR from the samples like conjunctival swab/ trunk wash/ vaginal wash may be carried out at three-month intervals.
3) There is no report available about abortion/ still birth/ any congenital defect in calves with respect to EEHV infection in the mother. In the case of new born the maternal immunity should be kept in mind.

4) There's no confirmed report on transplacental transmission of EEHV infection from positive mother to offspring during pregnancy. So, new born calf may be screened on weekly basis for EEHV infection preferably through non-invasive method of sampling like conjunctival swab or trunk wash to assess the presence of infection along with viral load.
5) Regular monitoring through visual inspection of behaviour & vital signs in case of calf born from EEHV carrier mother may be carried out.
6) On the basis of lab test report & clinical sign antiviral therapy in such calf can be considered.

15 Diagnostic centres

- Till date PCR (cPCR or qPCR) is the main tool for confirmatory diagnosis of EEHV. Hence bio-samples from either clinical or healthy/suspected individual should be screened at nearby diagnostic centres. At present 5 centres in India are equipped for EEHV diagnosis.

  - IVRI, Izatnagar, Bareilly (www.ivri.nic.in)
  - Centre for EEHV project, Assam Veterinary College, Guwahati
  - Centre for Wildlife Health, OUAT, Surya Nagar, Bhubaneswar, Pin-751003, Ph.0674 239 7146 (Email: wildlifehealthodisha@gmail.com)
  - Centre for Wildlife Forensic & Health, Jabalpur (http://www.ndvsu.org/index.php/departments/school-for-wildlife-forensic-health)
  - EEHV Diagnostic laboratory, Kerala Forest Department, Wayanad

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EEHV Evaluation Form [OPD card]

OPD. No.______________ Date ____________________

Elephant's name ____________________________ Microchip No.__________________

Sex ☐ Male ☐ Female Age _______ (month/year) Birth Date ____________________

☐ Wild born ☐ Captive born ☐ Hand reared ☐ Parent reared

Type of work ☐ Zoo ☐ Tourism ☐ Logging ☐ Patrol ☐ other ______________________

Mahout's name ______________________________ Owner's name ____________________________

Address____

____ Tel.________________________

Weight ____________kg. ☐ True ☐ Calculated from BOD measurements ☐ Estimated

Nutrition status ☐ Obese ☐ Good ☐ Fair ☐ Poor

History

Is this elephant still parent-fed? ☐ Yes ☐ No ☐ Unknown Weaning age ______ year

Recent transport ☐ Yes ☐ No ☐ Unknown

When ___________________ From ___________________________ To ___________________

Unusual event

- Extreme environmental changes ☐ Yes, when_________ ☐ No ☐ Unknown
- Human-animal interaction ☐ Yes, when_________ ☐ No ☐ Unknown
- Management changes ☐ Yes, when_________ ☐ No ☐ Unknown
- Mahout changes ☐ Yes, when_________ ☐ No ☐ Unknown
- Training procedure changes ☐ Yes, when_______ ☐ No ☐ Unknown
- Herd status changes ☐ Yes, when_______ ☐ No ☐ Unknown
- Others____

Exposure history Has this elephant been exposed to the following?

- EEHV confirmed cases ☐ Yes, when___________ ☐ No ☐ Unknown
- Other ill animals ☐ Yes, when___________ ☐ No ☐ Unknown

- Wild elephant ☐ Yes, when__________ ☐ No ☐ Unknown

Medical record

- Vaccination history

  ____

- Deworming history

  ____

- Previous illness, testing and treatment history

  ____

Clinical observation

1. **Behaviour changes**

- Eating ☐ Normal ☐ Abnormal ☐ Not observed
- Drinking ☐ Normal ☐ Abnormal ☐ Not observed
- Defecation ☐ Normal ☐ Abnormal (constipation / diarrhea) ☐ Not observed
- Urination ☐ Normal ☐ Abnormal ☐ Not observed
- Sleeping ☐ Normal ☐ Abnormal ☐ Not observed
- Locomotion ☐ Normal ☐ Abnormal ☐ Not observed
- Activity / play behaviour ☐ Normal ☐ Abnormal ☐ Not observed

2. **EEHV related signs**

- Blood-shot eyes ☐ Normal ☐ Abnormal ☐ Not observed
- Oral mucosa – Lesion: ☐ Present ☐ Not present ☐ Not observed

  – Colour: ____

- Temporal gland swelling ☐ Present ☐ Not present ☐ Not observed
- Head, face or neck swelling ☐ Present ☐ Not present ☐ Not observed
- Mobility / lameness ☐ Present ☐ Not present ☐ Not observed
- Visible skin lesion ☐ Present ☐ Not present ☐ Not observed
- Tongue cyanosis ☐ Present ☐ Not present ☐ Not observed

3. Physical examination

Heart Rate ___________beat/min   Pulse ___________ time/min

Respiration Rate_________beat/min

Temp. ______________ ^{0}C/^{0}F   Mucous Membrane _______________________________

Capillary Refill Time ___________second

4. Lesions

Otherexamination____

____

____

____

____

Sample collection

☐ White blood ☐ Serum ☐ Faeces ☐ Trunk Wash ☐ Tissue ☐ Swab from ___________

☐ Other ____

Collected for____Date_______________________________

Recommended sample collection for EEHV diagnosis

Aims	Test method	Whole Blood	Serum	Swab	Trunk Wash	Tissue
Presence of virus**	PCR	X		X	X	X
Viral load	qPCR	X				
Haematology		X				
Chemistry			X			
Serology			X			

*** In active case of EEHV, blood samples (or tissue samples from dead elephants) are recommended. Swabs and trunk wash are not likely to be positive in an active case, but can be used for monitoring shedders in a herd.*

Camp Form

Current visit date ___________________________ Previous visit date _________________________

Camp's name ______________________________ Address _________________________________

____

Contact number _____________________________ E-mail: _________________________________

Type of management ☐ Zoo ☐ Tourism ☐ Logging ☐ Patrol ☐ Other ____________

Average work hours per day _______________________ hours

Number of elephants: Total ____ Babies ____ (newborn to 1 year old)

Young ___ (1-10 years old) Adult _____ (> 10 years old)

Changes in herd status from last visit; (please specify number of animals, location and date)

Birth _______ Death ________ Arrival ______ Departure _________

Feeding system (please specify type and amount of food) _____________________________________

Unusual events record (i.e. flooding, drought, disease outbreak) ______________________________

Frequency of your vet visit ______________ previous vet visit date ____________________________

Any concerns from your previous vet visit ____

NOTES

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Further reading

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Annexure-VIII

F.No. 8-60/2020 WL (Part-1)
Government of India
Ministry of Environment, Forest and Climate
Change Wildlife Division

1st Floor, Agni Wing,
Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj,
New Delhi – 110003.
Date: 6th February, 2021

To
Chief Wild Life Warden
All State/UTs

Sir/Madam,

Sub: Advisory to deal with Human Wildlife Conflicts – reg.

The Standing Committee of the National Board for Wild Life has recommended an Advisory to deal with the Human Wildlife Conflicts in the 60th meeting held on 5th January, 2021.

The Advisory to deal with the Human Wildlife Conflicts is enclosed herewith for information and necessary action.

Yours faithfully,

Enclosure: As above

Rakesh Kumar Jagenia,
Deputy inspector General of Forests (Wildlife)
Email: digwl-mefcc@gov.in

Copy to:
1. The Principal Secretary (Forest), All States/UTs
2. The Principal Chief Conservator of Forests & Head of Forest Force. All States/UTs

Copy also to
1. Sr. PPS to DGF & SS/PSO to ADGF (WL)/PPS to IGF (WL)/PS to JD (WL

Signature Not Verified

Digitally signed by RAKESH KUMAR JAGENIA
Date: 2021.02.06 06:17:15 IST

F. No. 8-60/2020 WL

Government of India

Ministry of Environment, Forests and Climate Change

(Wildlife Division)

***

New Delhi, Dated 6th February, 2021

Background

As per the Constitution of India, it is the duty of every citizen to protect wildlife. The Government is fully committed to protection of wildlife and has put in place institutional and organizational measures to strengthen the protection regime. Yet, incidences of negative interaction have been reported from time to time where wild animals including large mammals such as Nilgai (blue–bull), wild pig, elephant, tiger, leopard, bear etc. that are protected under the schedules of Wild Life (Protection) Act 1972, are involved. Human wildlife negative interaction many a time results in death/injury/permanent incapacitation of human beings/domestic animals/livestock due to attack by wild animals or loss of crops and property.

Therefore, the need for a separate advisory in this regard**.** The advisory has been recommended by the Standing Committee of the National Board for Wild Life in its 60th meeting held on 5.1.2021 as per Section 5C(2)(a) of the Wild Life (Protection) Act 1972.

The Advisory

Preamble

Recognising that the factors leading to Human Wildlife Conflict and associated death/injury to humans lives and or crops/scheduled animals, and their remedial measures often concern several departments of the State Governments/ UT Administration, this Advisory seeks expedited inter-departmental coordinated and effective action by State Governments/ UT Administrations on preventing and dealing with Human Wildlife Conflict (HWC) and associated death/injury/permanent incapacitation of human beings/domestic animals/livestock due to attack by wild animals or loss of crops and property and also accidental deaths of wild animals listed in Schedule I to IV of Wild Life (Protection) Act 1972..

Objectives

The following objectives are sought to be achieved:

i. Improvement in wildlife habitat of such wild animals under Schedule I to IV of Wild Life (Protection) Act 1972 (hereinafter referred to as wild animals) that are commonly involved in HWC by leveraging resources from different departments of the government, so as to provide adequate food and water inside forests and minimise venturing of those wild animals outside forests;

ii. Ensuring safe passage of wild animals along their scientifically-identified movement routes or corridors outside forests, including improvement of habitat conditions in and along those routes;

iii. Creation of locally suitable biological barriers on and along the forest-fringe farms, including alteration of crop patterns, under schemes of different departments to deter wild animals from raiding private farms/ villages;

iv. Ensuring adequate and timely payment of ex-gratia to the persons affected by HWC; and

v. Creating an intelligent and effective system based on local intelligence and people's participation for preventing wildlife crimes, including killings of wild animals outside forests and trade/ consumption of animal parts, and prosecution of offenders.

Measures

In order to prevent and manage Human Wildlife Conflict, and mitigate the risks and adverse impacts associated with it, including killing of wild animals, the States/UTs should adopt the following measures:

A. **MANAGEMENT MEASURES:**

1. **Inter-departmental Coordination Committees:**

Prevention and management of HWC and associated death/ killing of wild animals concerns several government departments, and, therefore, close coordination is required for timely and adequate action. Coordination committees at the State/ UT and district levels should be constituted as follows within three months of issue of this Advisory:

a. *Co-ordination committee at the State/UTs level (SLCC):*

i. State Governments/ UT Administrations of the affected States/ UTs should constitute a State Co-ordination Committee (SLCC) headed by the Chief Secretary with membership of Secretary in-charge of finance, natural resources, infrastructure, home and forest departments of State/ UT, Director General of Police, PCCF-HoFF and representatives of concerned Central Government departments (Railways, Revenue Intelligence, Customs, etc.). The Chief Wild Life Warden is to act as the member secretary of this committee.

ii. The committee would meet as many times as necessary, but no later than six months of the previous meeting.

iii. Functions of the SLCC:

- In furtherance of the objectives of this Advisory, review the required infrastructure, manpower and monitoring systems in the State/ UT, and take necessary measures to strengthen the same;
- Monitor the number of HWC cases and their geographical spread, and provide guidance/ instructions to different departments for action to be taken by each one of them in order to minimise/ prevent HWC in those areas;
- Review the quantum of ex-gratia relief, issue guidance/ instructions for expedited payments, and work towards providing adequate funds for the same;

- Review the cases of revenge killings of wild animals and other wildlife related crime, and issue necessary guidance/ instructions to the concerned departments/ agencies as appropriate; and
- Recommend to State Wildlife Board and / or the Government, policy and programmatic measures, including for capacity building, required for fulfilling the objectives of this Advisory.

b. *District Co-ordination Committee (DLCC):*

i. On the recommendation of Chief Wild Life Warden (CWLW), the State Government/ UT Administration should constitute an inter-departmental coordination committee in all or identified district(s) of the State/ UT that are vulnerable to HWC to be chaired by District Collector, and comprising of district-level officers of departments/ organisations included in the SLCC. The Wild Life Warden of the District headquarter is to act as Member Secretary.

ii. The Committee may also include an Honorary Wild Life Warden residing in the district and up to two non-official expert members on the recommendation of the Member Secretary.

iii. The Committee may invite an official from any other department/ organisation or an expert from a reputed State/ national level institute as special or standing invitee to meetings of the Committee.

iv. The Committee should meet as often as required but no later than three months of the last meeting.

v. Functions of the DLCC:

- The DLCC would ensure coordinated action by different departments of the government to prevent killing/ injuring/ illegal capturing of wild animals by snaring, use of explosives, poisoning, electrocution, etc. in areas outside forests, and if requested so by the Wild Life Warden, in forest areas also.
- The DLCC would also ensure coordinated action by different Departments for expeditious payment of ex-gratia to persons affected by HWC.
- The DLCC may seek assistance of Wildlife Crime Control Bureau (WCCB) or other expert organisations in capacity building for intelligence gathering, investigation and prosecution for prevention and dealing with wildlife crime.

2. **Identification of Hotspots**

i. The hotspots where human death/ injury or damage to property by wild animals is occurring on a regular basis or death/ injury to wild animals is being caused by use of explosives, snares, traps, poisoning, electrocution or by any other means, may be identified and record of the same should be continuously updated by the concerned Wild Life Warden. A State level inventory of such Hotspots will be maintained, updated and used for planning for reducing Human Wildlife Conflict. The inventory should preferably be hosted on a secure GIS-based MIS platform under the direct supervision of Chief Wild Life Warden, and nodes of the platform may be available to the Wild Life Wardens.

ii. For the purpose of identification of hotspots, simple mobile-based applications may be developed/used to for collation of geo-referenced HWC data.

3. **Joint Patrolling of Hotspots:**

Whenever solicited by the Wild Life Warden (Divisional Forest Officer) assistance from departments like Police, Revenue, Electricity, Irrigation, PWD, local community representatives etc. shall be provided for joint patrolling and combing operations in and around the hotspot areas or any other area where such operation is deemed necessary.

4. **Adherence to Standard Operating Procedures (SOP) and Guidelines**

The Ministry of Environment Forest and Climate Change, Govt. of India and authorities under it have been issuing SOPs and guidelines to deal with various aspects of HWC which have to be followed while dealing with HWC incidences.

5. **Establishment of Rapid Response Teams (RRT):**

i. States should establish Rapid Response Teams (RRT) for quick action and management of conflict situations, especially in the hotspot areas. The RRTs should include trained staff with technical knowledge, be well equipped with materials as per local needs. The DLCC should facilitate the involvement and contribution of related departments in the district for establishment of RRTs. The Chief Wild Life Warden will make assessment of RRTs at regular intervals, including men and materials to be made available to RRTs, and take necessary steps for their timely procurement with the help of DLCC.

ii. Depending up on the severity of HWC, States may establish dedicated circle wise Control Rooms with Public helpline/Toll **free hotline numbers** which could operate on a 24x7 basis.

6. **Provision of financial resources for HWC**

It is to underline that HWC, if not attended properly, may acquire serious proportions, endangering both human life/property and the wildlife. Therefore, each State Government shall endeavour to provide adequate budgetary resources for dealing with HWC, and in particular for Early Warning Systems (EWS), RRT, ex-gratia payment and awareness generation. Measures like establishment of Revolving Fund at the level of Divisional Forest Officer help in timely availability of financial resources for dealing with HWC and expedited payment of ex-gratia.

7. **People's participation in managing HWC**

Local people should be involved in dealing with HWC particularly in the hotspot areas, by formation of teams at village or a group of village level comprising of members of Joint Forest Management Committee (JFMC), Eco-development Committee (EDC), Watershed Committee (WC), etc. to ensure timely communication, coordination and immediate management of HWC. Basic equipment, communication tools and training should be provided to these teams. The State/ UT may also consider providing 'contingency funds' to JFMCs/ EDCs for dealing with contingent expenses in cases of emergency.

8. **Dealing with Law and order situation in HWC cases**

It is often seen that in HWC situations, dealing with a large number of people who quickly gather at one place to view wild animals or to prevent them from entering their farms/ habitation, becomes a challenging task that hampers safe passage of wild animals or rescue work. State Governments/ UT Administrations may review the situation devise administrative mechanisms to ensure efficient coordination and cooperation of the law enforcing agencies at such situations to ensure smooth handling of such situations.

9. **Adoption of Early Warning Systems (EWS):**

The States should endeavour to develop and establish Early Warning Systems (EWS) to manage HWC. This may include:

i. Seismic waves/IOS Mobile Technology, infrared technology, temperature and movement sensors, in alerting the movement of large herbivores like elephants in and around most vulnerable villages;

ii. Drones and other systems for tracking movement of wildlife herd in and around Hot-Spot areas such as radio/satellite collars.

iii. Warning alerts to local leaders /officials/villagers through SMS or through FM Radio/community radio/local TV, etc.

10. **Developing ecologically sustainable linear infrastructure:**

The guidelines issued by Ministry of Environment, Forest and Climate Change on “Eco-friendly measures to mitigate impacts of linear infrastructure on wildlife” should be followed, and timely creation of Underpasses, overpasses, etc. that facilitate the movement of wildlife in a timely manner by the infrastructure agencies should be monitored and ensured at highest level.

11. **Adoption of traditional/common management practices:**

i. Creation of barriers:

Barriers that prevents easy movement of wildlife from forest area to human habitations may be considered in certain cases after thorough evaluation about their necessity and effectiveness. These could in the form of:

- Trenches (especially for Elephants)
- Solar-powered electric fences
- Rubble walls
- Other types of fences made from steel channels, rail, wire guide ropes, bars etc

ii. *Promotion of appropriate agri-horticulture/ agroforestry around wildlife rich areas that repel wild animal:*

It is well known that wild animals get attracted to palatable and nutritious crops grown on crop fields around forest areas. This leads to damage of crops and financial loss and hardship to the farmers who are often poor people from the tribal communities. The concerned departments should promote crops in these fringe areas which are unpalatable to wild animals. Farming or agroforestry models may include cash crops like chillies, lemon grass, *khus* grass etc. suitably mixed with appropriate tree/ shrub species. A comprehensive long-term plan for alternate cropping should be prepared and implemented by the State Agriculture/ Horticulture department under different schemes in such vulnerable areas.

iii. Augmenting fodder and drinking water in forest areas:

Improving wildlife habitat by management of invasive species, augmenting fodder species and provisioning water for wild animals in lean periods is the key to minimizing HWC, and, therefore, this should be undertaken extensively. Desilting of existing water holes should also be taken on priority basis. All wildlife rich areas and wildlife corridors in and around the Hotspots should be treated on priority. The SLCC and DLCC should review the progress and facilitate mobilisation of necessary resources available in different departments/ organisations for this purpose.

iv Improvement of local livestock

Free ranging livestock becomes more vulnerable to killing by wild animals. The Animal Husbandry department should formulate and implement special plans for improved stall-fed farm animal stock and practices, especially in the Hotspot areas. This will also reduce grazing pressure on native wildlife habitats and improve local economy.

12. Dealing with Wildlife Crime:

i. Each State/UT should establish a State-level forest and wildlife crime intelligence units/ cells to facilitate collection of information from locals and other informers regarding forest and wildlife crime, including with the help of the existing Police Intelligence network. The Cell should regularly coordinate with WCCB and other neighbouring states.

ii. The States/UTs should develop a mechanism of rewarding informers for intelligence gathering regarding wildlife crimes. The States/UTs may also issue necessary guidelines/notifications as per the provisions contained in the Wild Life (Protection) Act, 1972 to reward persons who render assistance in detection of offences and apprehension and trial of the offenders, and may also consider establishing Secret Fund at the disposal of Wild Life authorities of the State/UT at the appropriate level on the lines of Secret Fund operated by the State Police Department.

iii. DLCC should oversee that regular patrolling of vulnerable local markets and food joints is being organised and effective action is being taken against the offenders.

iv. Capacity building of frontline staff for investigation, forensics and successful prosecution of wildlife cases should be organised at regular interval.

v. Sensitization and awareness drives involving JFMCs/ EDCs/ WCs through print & visual media in local language should be organised regularly. The DLCC and SLCC may oversee that the Public Relation Dept of the Govt. remains actively involved.

13. Dealing with problem animals

Providing safe passage to the wild animals involved in HWC in human habitations should be the topmost priority, and local administration should ensure better crowd management. If everything else fails, capture and translocation using scientific methods may be resorted with the approval of Chief Wild Life Warden.

14. Involving Gram Panchayats:

Considering the role Gram Panchayats play in community development and conservation of natural resources, the State Chief Wild Life Wardens may utilise the Panchayati Raj Institutions and authorize the *Sarpanch* or any other representative of Gram Panchayat for dealing with problematic wild animals under Section 11(1) (b) of Wild Life (Protection) Act, 1972 .

B. FINANCIAL MEASURES:

1. **Ex-gratia relief:**

   i. SLCC should review the rate of *ex-gratia* relief at regular intervals with a view to ensure that it is effective both in providing necessary support to the victim and to prevent revengeful action by vulnerable/ affected population. The rates of adjoining States and that of Central Government under various Centrally Sponsored Schemes, whichever is higher, should guide the review.

   ii. A suitable portion of ex-gratia relief should be paid within 24 hours to the affected persons in the case of death and injury to persons.

   iii. SLCC and DLCC should regularly review that ex-gratia, including immediate relief within 24 hours, is being paid in a timely manner, and for this purpose necessary reports/ documents are being made available by police, revenue and medical authorities to the local Range Officer of Forests expeditiously on priority. State Governments may establish a robust procedure with specific timelines for this purpose. Revolving Fund may be established with local Divisional Forest officer for quick payment of ex-gratia and other expenses in dealing with HWC.

2. **Crop Insurance:**

   The State/UT Governments may also utilise the *Pradhan Mantri Fasal Bima Yojana* which provides add-on coverage. With a view to provide an add-on welfare to the farmers, the Ministry of Agriculture and Farmers Welfare has included insurance coverage for crop loss due to attack by wild animals, under the *Pradham Mantri fasal Bima Yojana*. This insurance programme would help farmers as means of compensation for their crops that have been damaged due to wild animal attacks.

   The Operational Guidelines of the *Pradahan Mantri Fasal Bima Yojana* may kindly be seen at the following link:

   https://pmfby.gov.in/pdf/Revised_Operational_Guidelines.pdf

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Annexure-IX

Government of India

Ministry of Environment, Forest and Climate Change, Government of India

Guidelines for Human–Elephant Conflict Mitigation

Taking a Harmonious-Coexistence Approach

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Acknowledgments

The Ministry of Environment, Forest and Climate Change, Government of India gratefully acknowledges the contributions of the experts and field practitioners who developed the guidelines, with support from innumerable contributors, using a participatory approach in workshops and consultations organised under the Indo-German Project on Human–Wildlife Conflict Mitigation in India.

The Ministry acknowledges the technical support extended by *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), in the preparation and pilot implementation of these guidelines.

The Ministry acknowledges the support provided by the Wildlife Institute of India and the state forest departments of Karnataka, Uttarakhand and West Bengal for pilot implementation of the key elements of the guidelines during 2018– 22 and the valuable feedback provided by them for updating the drafts.

Ministry of Environment, Forest and Climate Change

Government of India

Ministry of Environment,
Forest and Climate Change,
Government of India

Guidelines for Human–Elephant Conflict Mitigation

Taking a Harmonious-Coexistence Approach

Abbreviations

BMZ	German Federal Ministry for Economic Cooperation and Development
CCTV	Closed-circuit television
CWLW	Chief Wildlife Warden
CZA	Central Zoo Authority
DBT	Direct Benefit Transfer
DFO	Divisional Forest Officer
DLCC	District-Level Coordination Committee
EDC	Eco-development Committee
EIA	Environmental impact assessment
EWRR	Early Warning and Rapid Response
GIS	Geographical information system
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoI	Government of India
HEC	Human–Elephant conflict
HOFF	Head of Forest Force (in a state)
HWC	Human–wildlife conflict
HWC-MAP	Human–Wildlife Conflict Management Action Plan
HWC-NAP	National Human–Wildlife Conflict Mitigation Strategy and Action Plan
HWC-SAP	State-Level HWC Mitigation Strategy and Action Plan
IFS	Indian Forest Service
IUCN	International Union for Conservation of Nature
JFM	Joint Forest Management
MoEF&CC	Ministry of Environment, Forest and Climate Change, Government of India
NDRF	National Disaster Response Force
NGO	Non-governmental organisation
NTCA	National Tiger Conservation Authority
NTG	National Technical Group
NWAP	National Wildlife Action Plan
OPs	Operating procedures
PA	Protected area
PCCF	Principal Chief Conservator of Forest
PPE	Personal protective equipment
PRT	Primary Response Team
RFID	Radio frequency identification
RRT	Rapid Response Team
SDRF	State Disaster Response Force
SFD	State forest department
SHG	Self-help group
SLCC	State-Level Coordination Committee
SOPs	Standard operating procedures
WII	Wildlife Institute of India
WLPA	Wild Life (Protection) Act, 1972

Contents

1. ABOUT THE GUIDELINES

1.1 THE OVERALL CONTEXT

- The Guidelines on Human–Elephant Conflict (HEC) Mitigation get the overall context from the Wild Life (Protection) Act 1972, National Wildlife Action Plan (2017) [1], Human–Elephant Conflict Guidelines (2017), Advisory to deal with human wildlife conflicts (MoEFCC 2021) and National Human–Wildlife Conflict Mitigation Strategy and Action Plan (HWC-NAP) [2]. HWC-NAP provides the overall conceptual and institutional framework for implementing the guidelines.
- This document takes into consideration the existing guidelines,[3] advisories and good practices on HEC mitigation [4] issued by Project Elephant and various state forest departments and builds on them to bring about a more holistic approach to HEC mitigation.

1.2 PURPOSE AND SCOPE

- These guidelines aim to facilitate a common understanding among key stakeholders on what constitutes effective and efficient mitigation of HEC in India, leading to co-existence, and to ensure standardisation in performing mitigation operations in the most effective and efficient manner, with minimum damage to humans and Elephants.
- These guidelines provide advice on mitigation measures to address HEC in the long term, as well as facilitate the development, assessment, customisation and evaluation of site-specific HEC mitigation measures that are effective and wildlife-friendly.
- These guidelines serve as a basis for overall long-term planning and coordination of HEC mitigation measures at the national, state and division levels.
- In general, these guidelines apply to all stakeholders involved in HEC mitigation and are not only limited to state forest departments (SFDs).

1.3 APPROACH

- The development and implementation of these guidelines is driven by a harmonious-coexistence[5] approach to ensure that both humans and Elephants are protected from the negative impacts of HEC.
- The guidelines address the issue of HEC, adopting a holistic approach. The holistic approach of the guidelines entails not only addressing the emergency situations arising due to immediate conflict situations but also addressing the drivers and pressures that lead to HEC; providing guidance on establishing and managing prevention methods; and reducing the impact of the conflict on both humans and Elephants.
- The development of these guidelines and the intended implementation are driven by a participatory approach. These guidelines are intended to facilitate participatory planning, development and implementation of HEC mitigation measures with key sectors and stakeholders at national, state and local levels.
- The guidelines reflect on the need for a landscape approach while formulating measures for mitigating HEC to ensure sustainable solutions as unless comprehensive and integrated HEC mitigation measures are implemented across the landscape, the problem is likely to only shift from one place to another.
- Efforts have been made to forge linkages with plans and guidelines of key relevant sectors for enhancing synergies and eliminating trade-offs at the field level.
- Taking a capacity development approach, the guidelines facilitate the implementation through provision of *Implementer's Toolkit,* which includes operating procedures (OPs), formats, checklists and other field implementation aids.

1.4 LEGAL AND POLICY FRAMEWORK FOR IMPLEMENTING THE GUIDELINES

- These guidelines should be read in conjunction with the existing relevant legal and regulatory frameworks, especially the Wild Life (Protection) Act 1972.
- The following laws are considered directly relevant for conservation when dealing with HEC:
  - Wild Life (Protection) Act,1972
  - Prevention of Cruelty to Animals Act, 1960
- Sections 9, 11(1)(a) (2) (3), 12(bb), 29, 35(6) and 39(1)(a) of the WLPA 1972 are especially relevant when dealing with HEC.
- The Supplementary Framework to HWC-NAP on Legislative Framework [6] for HWC Mitigation in India is to be referred to for more details on the specific legal provisions related to HWC mitigation.
- Other important legislations that facilitate conservation when dealing with HEC include the Environment Protection Act, 1986; Indian Penal Code, 1860; Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; Electricity Act, 2003; Railways Act, 1989; National Highways Act, 1956; and Disaster Management Act, 2005.

1.5 INSTITUTIONAL MECHANISM FOR IMPLEMENTATION OF THESE GUIDELINES

- The institutional mechanism outlined in HWC-NAP will be followed for implementing these guidelines.

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1 MoEFCC (2017). National Wildlife Action Plan (2017-35)

2 National HWC Mitigation Strategy and Action Plan of India (2021-26), available from https://moef.gov.in/wp-content/uploads/2022/01/National-Human-Wildlife-Conflict-Mitigation-Strategy-and-Action-Plan-of-India-2.pdf

3 MoEFCC (2008). Guidelines for care and management of captive elephants. 8 January 2008. Project Elephant Division, Ministry of Environment, Forests and Climate Change, New Delhi.http://moef.gov.in/division/forest-divisions-2/project-elephant-pe/new-guidelines/
MoEFCC (2017). Guidelines for Management of HECs. 2017. Project Elephant Division, Ministry of Environment, Forests and Climate Change, New Delhi. http://moef.gov.in/wp-content/uploads/2019/08/01-HEC-guidelines.pdf
Standards/ Norms for Recognition of Elephant Rehabilitation/ Rescue Centres under Section 42 of Wildlife Protection Act, 1972 (F.No. 2-5/ 2006-PE [Vol. II], Government of India, Ministry of Environment, Forest and Climate Change, Project Elephant Division. 29 Sept 2017.<http://moef.gov.in/wp-content/uploads/2019/08/02-Standards-Norms-for-Elephant-Rehab.-2_compressed.pdf>

4 MoEFCC (2020). Best Practices of HEC Management in India. 2020. Project Elephant Division, Ministry of Environment, Forests and Climate Change, New Delhi. http://moef.gov.in/wp-content/uploads/2020/08/Best-Practice-Man-Animal-Conflict.pdf

5 'Harmonious coexistence' is defined as a dynamic but sustainable state in which humans and wildlife adapt to living in shared landscapes, with minimum negative impacts of human-wildlife interaction on humans or on their resources and on the wildlife or on their habitats. The mitigation measures designed using this approach maintain a balance between the welfare of animals and that of humans in which both are given equal importance. Overlap in space and resource use is managed in a manner that minimises conflict.

6 Supplementary frameworks to the HWC-NAP: https://moef.gov.in/wp-content/uploads/2022/01/National-Human-Wildlife-Conflict-Mitigation-Strategy-and-Action-Plan-of-India-2.pdf

2. CONTEXT AND SITUATION

- The Indian Elephant *(Elephas maximus)* is a keystone species affecting habitats and ecosystems in significant ways, ensuring ecological balance and resulting ecosystem services for human well-being. Elephants are referred to as ecosystem engineers due to their transformative role in the ecosystems where they create water holes that are also used by other wildlife for their survival during dry season, clear understories to promote new plant growth in forests, and facilitate seed dispersal of several important tree species, due to their highly mobile nature.
- The Elephant is recognised as a National Heritage animal and is deeply rooted in our culture. India holds by far the largest number of wild Asian Elephants, estimated at about 29,964 [7], this is nearly 60% of the population of the species. The Elephant is placed under Schedule I and Part I of the Indian Wild Life Protection Act (1972), which confers it the highest level of protection. However, Elephants and humans are now often in conflict in our country because of varied reasons.
- HEC refers to the negative interaction between humans and Elephants, leading to adverse impacts such as injury or loss of human lives, crop, livestock and other properties, or even their emotional well-being, and equally negative impacts on the Elephant or its habitats.
- The general drivers of HEC include a human population increase, changing lifestyle and economic aspirations, reduced appreciation of wildlife, climate change, disasters, land use change, policies in linear infrastructure, mining, urban development, habitat fragmentation, loss and degradation including local overabundance of Elephants. Among these, the increase in human population, land use change, changing lifestyle and economic aspirations, policies in linear infrastructure, mining, habitat fragmentation, loss and degradation have the greatest impact.
- The intensity of HEC is highly variable, ranging from very occasional to chronic, and depends on the density of Elephant populations; the nature of the interface between human areas and Elephant habitats; an irregular and diffuse boundary with a long perimeter; highly fragmented Elephant habitats interspersed with human-use areas; dispersing herds; railway tracks passing through forests with sizeable Elephant populations; etc.
- HEC is prevalent in many states and is particularly high, relative to the number of Elephants involved, in areas where Elephants have dispersed and areas that Elephants have colonised. It is estimated that approximately 500 persons and more than 100 Elephants are killed annually. Nearly 0.8 to 1 million ha of agriculture land may be impacted by crop damage due to Elephants, and nearly a million families are adversely affected due to HEC. The challenge extends to the transboundary Elephant populations of Bhutan, Nepal and Bangladesh.
- HEC mitigation so far has largely focused on the use of barriers, short-distance drives, and ex gratia payments or compensation for loss and damages. While these efforts have helped contain HEC, the problem continues to grow as a holistic approach has not been incorporated into the mitigation effort.

7 MoEFCC (2017). Synchronized Elephant Population Estimation India 2017. Project Elephant Division, Ministry of Environment, Forests and Climate Change, New Delhi

3. AADDRESSING THE DRIVERS AND PRESSURES OF HEC

3.1 OVERVIEW

A major gap involves effective problem analysis to identify drivers and pressures of conflict which would allow appropriate selection of mitigation measures.

- An assessment of long-term outcomes and implications of all mitigation methods is needed to identify effective and Elephant -friendly mitigation measures to address HEC. For this, a systematic analysis of HEC mitigation methods should be done to assess their effectiveness and wildlife-friendliness in different types of conflict situations.
- This will facilitate the necessary customisation and adaption of the mitigation measures/combining two mitigation measures to achieve the best possible impacts in the field.

The HWC-NAP recommends a holistic approach to HWC mitigation by considering and addressing the thematic triangle of drivers–prevention–damage mitigation, these guidelines are prepared in line with the recommended holistic approach to bridge the current gap.

- The need to identify Elephant range areas and corridors in a state is the first step. Thereafter, in and around all such areas the drivers as aforementioned should be identified and addressing these drivers should be a priority in the state-level planning in order to avoid future impacts. Similarly, at the district-level planning, the impact of these drivers to be ascertained to avoid escalating HEC in the area.

Addressing the drivers and pressures includes responses that are directed towards:

- Management-relevant response for addressing the drivers and pressures
- Institutional capacity development for addressing the drivers and pressures

3.2 MANAGEMENT-RELEVANT RESPONSE FOR ADDRESSING THE DRIVERS AND PRESSURES

3.2.1 ZONATION IN ELEPHANT RESERVES

- The current land use and land cover and inherited land use changes have caused Elephant habitats to become habitat islands of various sizes within a sea of human-use areas, thus creating areas where Elephants and humans compete for space and resources inside Elephant reserves.
- Elephants, because of their adaptability, have also exploited opportunities to occupy plantation crops such as tea and coffee and thus overlap with humans in human use areas. Elephants have also adapted to fragmented landscapes by transiting through human-use areas to use spatially separated habitat patches. Some have adapted to using small habitat patches, a few hectares in extent, as daytime refuges to forage on the agricultural crops in the surrounding areas at night.
- All these factors have created different types of conflict situations between humans and Elephants; such situations have varying degrees of management feasibility, viz, sometimes these are easily manageable, sometimes situations require significant intervention and sometimes there are situations where keeping Elephants in unviable habitat patches is not possible for various reasons.
- Zonation, a management entity, takes into consideration the fact that resources available are limited and if these are not prioritised and optimally used, the conflict will intensify and the overall conservation benefits will be minimised. Zonation will allow a science-based and pragmatic approach to landscape level planning for conservation and HEC mitigation. Zonation should be based on Elephant population viability analysis in each prescribed zone. The zonation suggested in these guidelines reinforces the recommendations made by the Karnataka Elephant Task Force (appointed by the Karnataka High Court) and can be as follows:
  - **Elephant Conservation Zones**, where primarily Elephant conservation takes priority over competing livelihood goals (a smaller sub-section of our forests where human presence and resource extraction are absent): Areas where there is adequate habitat to support a viable Elephant population with no human settlements, and communities have no rights or dependencies on the forest. If any minor dependencies exist along the interface area, they should be such that they can be easily settled through negotiations.
  - **Elephant–Human Coexistence Zones**, where Elephant conservation and human livelihoods have to be balanced and reconciled (which would constitute the bulk of the forests): Areas where there is adequate habitat to support a viable elephant population where the movement of the Elephants is restricted to the interface area. There may or may not be human settlements inside the

forest, but communities have rights to resource extraction from the forests. The extraction of resources from the forests should be sustainable so that it does not degrade the Elephant habitat and escalate HEC.

- **Elephant Exclusion Zones**, areas where Elephants do not have adequate natural habitats and are dependent on crops for survival, and hence effective conflict mitigation would not allow Elephants to survive in such areas. In such areas concerns of human safety and livelihood take precedence over competing conservation concerns about Elephants, as Elephant populations in such areas may not be viable in the long term. Elephants in such areas need to be translocated, and after translocation, further colonisation of such areas should be stopped through proper HEC mitigation strategies.

3.2.2 MONITORING AND MANAGING HABITAT-RELATED DRIVERS AND PRESSURES

- There is a clear need to have a more holistic understanding of HEC and its implications for humans and Elephants. Monitoring and addressing habitat loss, fragmentation and degradation may play an important role in understanding and mitigating HEC. Therefore, the following measures should be envisaged:
- Mapping of existing drivers and pressures of conflict such as linear infrastructure, mining, encroachments, settlements within forests, and resource use by local communities.
- Ensuring that all forest boundaries are clearly demarcated and patrolled on regular basis including monitoring deemed forest areas, forests on revenue land and private forest areas that form part of the Elephant range.
- Managing Elephant habitats in regions where the bulk of the forests are under the management of district councils and local bodies (where the SFDs have restricted control) requires active participation of communities and proper land use planning by:
  - Mapping the Elephant distribution and numbers in community forest areas with a population and habitat viability analysis to determine where and what can be conserved
  - Mapping land tenure and identification of communities who are stakeholders in the land
  - Consultation with local communities to facilitate Elephant conservation
  - Engaging various line departments who can facilitate in enhancing or improving livelihood options that reduce the extent and intensity of slash and burn agriculture and thus bring about Elephant-compatible land use
  - Facilitating capacity development of the forest department, line departments, local communities and all key stakeholders
  - Preparing, implementing and periodically updating long-term perspective plans such as state-level human–wildlife conflict mitigation strategies and action plans (HWC-SAP) and division-level HWC management action plans. A common framework for developing these plans is provided in the supplementary frameworks to the HWC-NAP [8].
- Developing synergies and facilitating integrated land-use planning for effective implementation of planned measures, through the State-level Coordination Committees (SLCC), Multi-stakeholder Fora at the state level, Joint Working Groups with key departments and agencies at the landscape level, and the District-level Coordination Committees (DLCC).
- Developing innovative firefighting strategies and equipment, using RS technology, etc. and engaging the local community, especially the community-level Primary Response Teams (Community PRTs).
- Facilitating long-term studies to understand the impact of these measures in addressing the drivers in the landscapes

3.2.3 HABITAT RESTORATION AND RECLAMATION OF DIVERTED FOREST LAND

- Habitat restoration requires that the driver of habitat degradation be first addressed so that the process of degradation does not continue. The following measures are envisaged:
- SFDs should prioritise restoration in and around vulnerable areas and HWC hotspots.
- In highly degraded habitats the process of regeneration may be accelerated by interventions such as gap planting with native species, controlling soil erosion, ground water recharging, restoring grasslands and tree cover, etc.
- Many Elephant ranges have large monoculture plantations. They may not be optimal habitats for wildlife, and therefore the native vegetation needs to be restored by preparing ecologically sound plans in the interest of habitat improvement and HEC mitigation.

8 Supplementary frameworks to the HWC-NAP https://moef.gov.in/wp-content/uploads/2022/01/National-Human-Wildlife-Conflict-Mitigation-Strategy-and-Action-Plan-of-India-2.pdf

- SFDs may work with mining project proponents to reclaim and restore old mining sites.
- In many regions across India, tea, coffee, rubber and cardamom estates within Elephant landscapes are unutilised; such areas can be restored/reclaimed for Elephant conservation.

3.2.4 REMOVAL OF INVASIVE PLANT SPECIES IN AND AROUND HEC HOTSPOTS INCLUDING VISTA CLEARANCE

There may be suppression and reduction of indigenous plants due to the presence of invasive alien species in the area resulting in decreased habitat quality, leading to increased movement of Elephants outside the forested landscapes, subsequently leading to increased HEC. The following measures may be implemented:

- Mapping invasive species cover and abundance in the landscape and the herbivore use of the landscape and accordingly implementing habitat management plans.
- Exploring the use of remote sensing data for mapping and managing invasive species.
- Prioritising sites for intervention based on hotspots of invasive species spread, areas critical for the Elephant (and other herbivores) and conflict hotspots, to ensure efficient mitigation, given the scale of the problem, and the challenges involved in containing and eliminating invasive species over large landscapes.
- Clearing vistas along the boundaries of forests in close proximity of the habitations for avoiding accidental encounters.
- SFDs may facilitate Panchayats in making the HEC hotspots adequately lit, by installing street/solar lights.

3.2.5 SECURING ELEPHANT CORRIDORS

Elephants have large home ranges, often with clear seasonal ranges and migration paths and fragmentation or blockage in their movement path will result in disruption causing conflict. In the document titled “Right of Passage – Elephant Corridors in India”, 101 corridors have been listed; however, there are likely to be additional corridors that need to be identified.

Hence, SFDs may start planning corridor conservation by taking into consideration the following:

- Initiate landscape level assessment of all constrictions in habitat and obstructions caused by linear infrastructure, using GIS and remote sensing tools to identify any new corridors. This should be supported by verification on the ground using the field staff.
- Corridor management strategies should be developed and incorporated into the working/management plans and into the HWC Management Action Plans at division levels.
- Threats to the physical integrity (land use changes) of the corridor and to the free movement of Elephants (disturbances, degradation, etc) within the corridor should be identified and addressed.
- Corridors through tea/coffee estates which connect two or more large habitat patches should be secured.
- Restoration of habitats within the corridors, where possible, should be carried out.
- Support should be provided to PRTs and RRTs during the migration season.
- The feasibility of establishing community reserve or private conservancies should also be explored, with greater participation from community-based institutions and key stakeholders.
- In the case of private lands, the villagers may be incentivised to allow movement of Elephants.
- Awareness about Elephant ecology, behaviour and suitable mitigation measures to humans living in and around the corridor areas may be imparted, regularly.
- Address the issues of land tenure and land use in the corridor and existing linear infrastructure within the corridor area in order to secure its legal status and physical integrity.

3.2.6 REDUCE LIVELIHOOD DEPENDENCE OF HUMANS ON FORESTS

Communities living in proximity to the forest are dependent on forest biomass (fuel wood, NTFP. livestock grazing, etc), which is the primary reason for them to enter the forest. Accidental encounters of humans with Elephants inside forest areas can be prevented to a large extent by reducing the dependence of humans on forests. The following indicative measures may be implemented:

- Facilitate management interventions for better livelihood opportunities through community-participatory approaches including various eco-development measures and livelihood improvement programmes.
- Reduce the dependency of fringe forest communities on forests (e.g., cattle grazing, fodder collection, fuelwood collection, non-timber forest produce (NTFP) collection, right of way) by participatory forest management.
- Improve animal husbandry practices (promoting stall-feeding practices or incentivising improved livestock breeds)
- Address livelihood needs of communities by skill development, poverty alleviation and alternate income generation schemes of the government.

- Facilitate cross-sector linkages for community development (coordination and cooperation with line departments).
- Facilitate cooperation to integrate HWC mitigation planning at the district level, through measures including, but not limited to, dovetailing HWC mitigation measures with schemes relevant to community development.

3.2.7 SCIENTIFIC POPULATION MANAGEMENT AT INTERFACE AREAS OR CONFLICT HOTSPOTS

A local overabundance [9] of wildlife including Elephants could be due to various factors including habitat loss, degradation and fragmentation, and an increase in population. The Elephant population in fringe forest areas have become habituated to humans and therefore there may be a proper understanding of the spatio-temporal distribution, foraging and ranging patterns and use of human-dominated landscape. The following measures are envisaged:

- Implementation of a robust population monitoring protocol at HEC hotspots, using trained field staff or in collaboration with research institutes or local universities/colleges.
- The dispersing Elephant population that has colonised new areas may be assessed for impacts on the well-being of the people and the Elephants.
- Understand the population dynamics of Elephant herds in the tea estates and coffee plantations, which continue to remain there as resident populations, and changes in their behavioural attributes.

3.2.8 MANAGING TRANSBOUNDARY AND INTERSTATE ELEPHANT MOVEMENT

- Some Elephant populations are known to regularly cross international and state boundaries. This occurs regularly on the international boundary with Nepal, Bangladesh, Bhutan and Myanmar. Elephant populations regularly cross interstate boundaries in many Elephant states such as Goa, Maharashtra, Northern Andhra Pradesh, Madhya Pradesh, Chhattisgarh, Bihar, Himachal Pradesh, Haryana, Manipur and Mizoram and within southern states. The following measures are envisaged:
- Within India, states sharing the Elephant landscape should meet at least annually and share information and plan for management of Elephants under the aegis of the National HWC Mitigation Forum using a common framework/approach to implement a coordinated strategy.
- As to the transnational management and conservation of Elephants between neighbouring countries, the states sharing international boundaries should follow the protocol as agreed between the nations and communicated by the MoEF&CC.

3.2.9 EFFECTIVE GARBAGE MANAGEMENT AND SAFE SANITATION AROUND ELEPHANT HABITATS

Garbage is known to attract Elephants, and when garbage dumps are on the periphery or inside a village/town they create potential for accidental encounters between humans and Elephants. Unmanaged garbage may also habituate Elephants to moving and foraging in human-use areas, and as a consequence there may be high levels of conflict.

The vegetable and food waste generated in weekly markets in rural India and garbage thrown along roads and railway lines passing through forests attract Elephants. With a large number of humans moving around on foot or on two-wheelers, particularly in the evening after the rural markets, and Elephants also moving into the same area in the evening, accidental encounters happen. Accidental encounters also take place when truck drivers pass through forests, and also when they (truck drivers), and local people go into the forest for defecation, especially at dawn and dusk.

9 Local overabundance refers to occurrence, in a habitat, excessive number of individuals of a species beyond the normal population density, due to a variety of factors.

The following are indicative measures to address the situation:

- Ensure sustainable and ecologically sound waste- and garbage disposal by town municipalities and village panchayats bordering Elephant habitats
- Undertake periodic inspection of the forest perimeter near villages/towns to ensure that poor disposal of waste and garbage is detected early and brought to the notice of relevant local authorities. Volunteers can be engaged for this.
- Aversion conditioning measures may be implemented, in areas where Elephants have started foraging inside the boundary of villages and towns in search of forage and have grown accustomed to feeding on garbage.
- Community awareness including signages etc should be implemented to facilitate effective participation from local communities in garbage management.
- SFDs may also coordinate with municipalities/ panchayats on garbage management and explore the possibility of building toilets under the Swachh Bharat Mission to prevent accidental encounters at HEC hotspots.

3.3 INSTITUTIONAL CAPACITY DEVELOPMENT FOR ADDRESSING THE DRIVERS AND PRESSURES

3.3.1 STRENGTHENING THE ROLE OF KEY STAKEHOLDERS

Local communities bear the direct brunt of loss of crops and human lives and other economic losses as a direct or indirect result of HEC. This has a direct impact on the wildlife and its habitat. The long-term engagement with local communities and other key stakeholders can be institutionalised and continued by adopting the following measures:

- Facilitate the establishment and effective steering of State-Level Coordination Committees (SLCC), a landscape-level multi-stakeholder forum, and District-Level Coordination Committees (DLCCs) to strengthen the inter-agency and cross-sector coordination and engagement of key stakeholders required for HEC.
- SFDs may support the community-level (village/ward) Primary Response Teams (PRTs) as the entry point for all community engagement work. Establishment and developing the capacity of PRTs should be in line with the Supplementary Framework to HWC-NAP on Establishment and Capacity Development of HWC Mitigation Response Teams.
- Establish a platform where all community members, people's representatives and government agencies can interact and find solutions to mitigate conflict.
- Briefing of forest user groups, workers of tea and coffee plantations before every work season about Elephant risk and safety issues
- A campaign for creating awareness of Elephant may be instituted and communities also need to be educated to take responsibility in managing HEC. There is also a need to extend educational and awareness programmes for the development agencies, railways, power, irrigation, highways, mining companies, tourism industry, district administration, etc
- Plan and implement training programmes and other capacity development measures, extension programmes with school and college students, engage with women's self-help groups, Village Forest Committees (VFCs), Eco-development Committees (EDCs), Large Area Multipurpose Society (LAMPs), forest user groups, etc The EDCs/VFCs formed by the SFD in villages abutting the forest area in the periphery and zone of influence may be made functional and their sustainability ensured by accrual of benefits and incentives.
- Carrying capacity studies may be conducted to assess the tourism potential in the HEC hotspots.
- HEC mitigation measures should be developed with an inclusive and participatory approach.
- Ensure the participation of key stakeholders to ensure integration of traditional and local knowledge and experiences into the development of division-level HWC Management Action Plans (HWC-MAPs).

Tools for stakeholder engagement may be developed.

3.3.2 COMMUNITY AWARENESS AND COMMUNICATION MEASURES TO REDUCE THE RISK OF ACCIDENTAL ENCOUNTERS AND RETALIATION

Encounters with Elephants often take place in low light conditions, early in the morning or late in the evening, or when people enter the forests for NTFP or firewood collection, or Elephants enter the crop fields or get attracted by country liquor stored in houses. Knowledge of these factors can help prevent such encounters.

To facilitate effective engagement of local communities and various stakeholders in mitigation of HEC, it is extremely important to plan and implement awareness and sensitisations measures, taking a participatory approach.

- Appropriate community awareness and communication measures may be implemented at HEC hotspots, and their impacts may be assessed periodically to ensure that the awareness and communication measures are locally customised.
- The local communities at HEC hotspots may be advised to store grains in the granaries in pucca or underground structures. If necessary, communal granaries can be opted for.
- The local communities at HEC hotspots may be advised to avoid brewing indigenous liquor, which attracts wild Elephants to villages. Appropriate measures may be devised, together with the local administration, to implement this measure.
- Tools for developing, implementing and customising community awareness and communication measures may be developed.

3.3.3 SYSTEMATIC RESEARCH AND MONITORING ADDRESSING HEC

HEC mitigation is a challenging issue, especially when adequate data on Elephant population density, Elephant demography, social and ranging behaviour of Elephants and its ecology are not available. Currently the data for assessing the impact of HEC are limited to the number of compensation claims paid, number of humans killed or injured, and the number of Elephants killed. There is, therefore, a need to constantly develop a knowledge base of subjects such as habitat usage, habitat connectivity, corridors, preferred or suitable habitat, home range, behaviour, attractions along the habitat and their movement paths.

Therefore, the following research topics are prioritised, which are expected to answer the existing management questions:

- Data on indirect costs of HEC (for example, abandoning agriculture due to HEC or human well-being, including stress, fear and restrictions on normal daily activities) may be gathered.
- Recording and analysing the data on long-term adverse impacts of HEC on Elephants (in terms of stress, reduction in reproductive fitness, loss of genetic diversity, etc.) and socio-economic impacts on families and communities may be done.
- SFDs may involve research institutions, non-governmental organisations (NGOs) and experts in carrying out result-oriented research on HEC status and mitigation measures besides undertaking in-house research.
- A standardised criterion for assessing the effectiveness and wildlife-friendliness of mitigation measures should be developed and used.
- The following research areas may be given higher priority for research and monitoring at HEC hotspots and the results from such studies may be consolidated at the national level to support further revision of these guidelines and strengthen the HEC mitigation measures:
  - Elephant responses to land use changes (mining, linear infrastructure) inside the forest
  - Elephant responses to changing cropping patterns and land use changes outside the forest
  - Differences between crop-foraging and non-crop foraging Elephants to understand what factors influence crop foraging behaviour
  - Status of Elephant populations along with demographic parameters
  - Impact of local overabundance on the habitat, population and HEC and impacts on other species
  - Efficacy of HWC mitigation tools and Elephants' responses to different methods (RRT/PRT interventions, barriers/deterrents, habitat interventions, etc)
  - How different mitigation measures impact Elephants (change in resource use, health and HEC)
  - Monitoring the efficacy of community capacity building exercises and how the threat perception has changed.

3.3.4 FACILITATING CAPACITY DEVELOPMENT MEASURES TO DEVELOP THE REQUIRED COMPETENCIES FOR ADDRESSING HEC IN THE MOST EFFECTIVE AND EFFICIENT MANNER

Facilitating capacity development of SFDs, other line departments, local communities and all key stakeholders to ensure that a holistic approach can be followed.

Training of the field staff and response teams

- The SFDs should ensure that all response team personnel from forest and other line departments and agencies are brought under a systematic approach to capacity development, in line with the *Supplementary Framework to HWC-NAP on Establishment and Capacity Development of HWC Mitigation Response Teams*[10]

10 Supplementary Framework to HWC-NAP on Establishment and Capacity Development of HWC Mitigation Response Teams available from https://moef.

- Arrangement for deployment of personnel and quick action on cognizance of conflict cases may be strengthened in each division
- The SFDs may sensitise all response teams and relevant personnel from forest and other line departments and agencies to the One Health approach, which can be used for planning and implementing measures related to occupational health and safety and humane treatment of animals in conflict.
- Regular and systematic training programes on critical operations such as rescue, capture and translocation should be conducted jointly with other key relevant departments, in the form of mock-drills and simulation trainings.
- Advanced trainings on animal welfare issues should be conducted for all personnel of the RRTs.
- Competencies of members of RRTs to be reviewed on a regular basis and the curriculum for their training to be fine-tuned and updated regularly, in line with the Supplementary Framework to HWC-NAP on Establishment and Capacity Development of HWC Mitigation Response Teams.
- The arrangement for deployment of personnel and quick action on cognizance of conflict cases may be strengthened in each division.

Training and support to *mahouts* and assistants

- SFDs may build the capacity of mahouts, incorporating learnings from Elephant behavioural studies for guiding *koonkie* Elephants in dealing with conflict mitigation.
- Trainings for mahouts from different states may be conducted, preferably in local languages, and developing trainers.
- States conducting regular trainings can act as regional hubs for imparting training to the other states in training the mahouts of *koonkie* Elephants.
- A database of experienced mahouts of *koonkie* Elephants may be developed and linked to the National HWC Mitigation Database.
- Steps may be envisaged for improving the service conditions of mahouts.

Training and support for daily wage workers/anti-poaching watchers

- SFDs may provide appropriate support and systematic training to daily wage workers and anti-poaching watchers on key HEC operations handled by them.
- Steps may be taken to improve their service conditions.

Support the local population in human safety by preventing accidental encounters with Elephants

- SFDs may facilitate, encourage and seek support from local NGOs, volunteers, schools, etc to implement safety measures, aiming at preventing human–Elephant encounters. These measures may include guiding people to watch for signs of Elephant presence during crepuscular period (around dawn and dusk), and how to respond when they encounter an Elephant. Regular trainings in local schools and colleges, and also possibly during village meetings at HEC hotspots, can be organised to train people on such safety measures.
- Tools for such safety measures may be elaborated.

3.3.5 MEASURES TO STRENGTHEN CROSS-SECTOR AND INTER-AGENCY COOPERATION FOR HEC MITIGATION

Cross-sectoral cooperation for HEC mitigation entails that multiple stakeholders from different sectors and domains be engaged, at national, state, landscape and district/forest division-levels. Key stakeholders for HEC mitigation may include State Forest Department, and other line departments, viz., Agriculture, Revenue, Animal Husbandry, Police, Public Works, Health and Family Welfare, Education, Electricity Boards; private sector (tea or coffee plantations), and agencies viz., Railways, National Highway Authority of India, as well as wildlife conservation and development NGOs, farmers' cooperatives and agricultural research institutions are relevant when dealing with conflict and conflict mitigation

Following measures are envisaged:

- State-level Coordination Committees (SLCC), landscape-level multi-stakeholder fora, and District-level Coordination Committees (DLCC), may be used to strengthen inter-agency coordination required for HEC, and district specific operational mechanism may be developed to address specific needs for HEC mitigation.

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- Safety audits may be conducted each year, if feasible, to ensure that all members of the community act responsibly in case of HEC, and to facilitate inter-agency cooperation.
- Maintaining information and data on HEC cases with reference to the developments in the area that may have bearing on conflict cases, may be used for discussions in the DLCC.

3.3.6 MEASURES TO STRENGTHEN THE SYSTEM OF KNOWLEDGE MANAGEMENT ON HEC MITIGATION

To ensure effective and sustainable HEC mitigation measures, it is essential that field experiences, learnings, field-evidence and conceptual advances are not only shared across key stakeholders and landscapes, but such knowledge is also documented to be utilised for future strategies and plans on HEC mitigation.

- National HWC Mitigation Forum, Landscape-level multi-stakeholder forum, and appropriate Working Groups may be used to share field experiences, learnings, evidence and conceptual advances, within the forest department, across stakeholders, and across landscapes.
- Measures may be put in place to systematically document field experiences, learnings, field-evidence and conceptual advances on HEC mitigation, to inform the future strategies and plans on HEC mitigation.

4. DEPLOYING MEASURES TO PREVENT HUMAN–ELEPHANT CONFLICTS

4.1 DIFFERENTIAL MITIGATION APPROACH FOR DIFFERENT HEC LOCATION SCENARIOS

HEC can be effectively addressed by understanding the type of conflict, the site of occurrence, and its overall impact on humans and Elephants.

4.2 IDENTIFICATION OF HEC HOTSPOTS

"HWC Hotspots" are areas with actual or predicted repeated occurrence of HWC incidents resulting in crop-loss, livestock death, human death and injury, wildlife death and injury over temporal and spatial scales. It can be static (repeated in the same place or time) or dynamic (shift in space and time over years). In addition to count statistics, the magnitude of the incidents is subjected to interpolation or extrapolation techniques to define the hotspots in space and time.

Identifying conflict hotspots that could also provide a direction towards the drivers of conflict, is critical to provide site-specific solutions to mitigate human–Elephant conflict. Conflict hotspots of HEC can be mapped through geo-spatial assessments, by using both primary data and secondary data including time-series data. The hotspots can be identified and mapped as follows:

- **Incident hotspot:** Frequency of occurrence of incidences over past specific years such as previous five or ten years, mapped over the target area. The data include number of incident of injury and death, attack/ killing of domestic animals.
- **Vulnerability Hotspot:** Cumulative index by overlaying past incidents, vulnerability of local community and potential risk of the area.

The following assessment are envisaged:

- Database to be created by involving frontline SFD staff, researchers, research institutions, veterinary professionals and others for the identification and assessment of the hotspot.
- Predictive modelling based on the field data and Geographic Information System (GIS) analysis, may be carried out by trained personnel.

4.3 EFFECTIVE USE OF EARLY WARNING AND RAPID RESPONSE SYSTEM AT HEC HOTSPOTS

Since it is inevitable to prevent the wildlife and humans from using the same space in many situations, early warning systems and rapid response teams are important for timely action to prevent the conflicts and to reduce the impacts due to such incidents. However, with Elephants, some conflict situations require high intensity interventions.

A system of "Early Warning and Rapid Response (EWRR)" should be established and used to enhance the overall efficiency of mitigation efforts in the field. EWRR is a set of tools, processes and personnel competencies needed for the timely and meaningful generation and dissemination of alert information to individuals, communities and establishments at risk, for optimal preparedness and response and at the appropriate time to reduce the likelihood of injury, death or crop damage.

EWRR would structurally include an HWC Mitigation Hub/ Control Room, and a system of three-tiered response teams, viz, Division-level Rapid Response teams (Division RRT), range-level Rapid Response Teams (Range RRT) and village/ward level Primary Response Teams of local community (Community PRT). The following steps should be taken up under the EWRR system, in line with the *Supplementary Framework to HWC-NAP on Establishment and Capacity development of HWC Mitigation response Teams*[11].

The system of early warning and rapid response can be used for detecting early conflict case with Elephants and for ensuring appropriate response in cases of HEC.

4.4 MONITOR AND DOCUMENT 'POTENTIAL ELEPHANTS-IN-CONFLICT' IN THE LANDSCAPE

Potential Elephant-in-conflict is/are individuals/ herds that are likely to enter in a HEC situation, owing to their movement pattern/ other behaviour.

Monitoring of potential Elephants-in-conflict in the forest-agriculture interface area can be carried out, as a preparedness and prevention measure, to ensure that their movement in the human-dominated landscape does not lead to an emergency situation. Following are some examples of such monitoring methods:

- Monitoring the movement of potential Elephants/ herds-in-conflict in the landscape, by recording direct observations, indirect evidence such as hoof prints and dung (to generate presence-absence data), and foraging signs in crop fields. Interviewing local villagers can reveal Elephant presence and movement patterns.
- Spatial and temporal movements, and behaviour of straying individuals from known Elephant herds monitored using camera traps and radio collars.
- Updates on the status of Elephants in potential conflict areas, especially on migration/ movement patterns, collected.
- SFDs may develop an identification database of identified individual and known herds of Elephants, their movement pattern within human-dominated landscapes, and the conflict that is thereby generated; this will help identify aggressive and individual Elephants with high potential for conflict

4.5 AN INTEGRATED APPROACH TO MANAGING POTENTIAL ELEPHANTS-IN-CONFLICT

There are three key elements in most HEC situations: the Elephant, humans (settlement) and the attractant for the Elephant (such a palatable crop). Sometimes removal of one of these elements in the conflict is required to resolve an intractable situation.

- Addressing high conflict Elephant/s: Male Elephants in particular are prone to higher levels of conflict and some of them become habituated to humans and the different methods they use to protect crop. The following measures are envisaged:
    - SFDs may develop an identification database of identified individual and known herds of Elephants, their movement pattern within human-dominated landscapes, and the conflict that is thereby generated; this will help identify aggressive and individual Elephants with high potential for conflict. SFDs should identify the high conflict individual/s from this database.
    - SFDs should test aversion conditioning to train habituated males who have the ability to breach barriers to avoid human use areas through radio collaring of such males so that systematic intervention is possible.
    - Necessary capture, translocation (if required) to be carried out as per the Guidelines and OP with related monitoring protocols. Translocation is one of the tools available for addressing high conflict individual or even pocketed populations. Animals which are captured may be rehabilitated in a suitable habitat or to be brought into captivity depending upon the situation.
- Addressing settlements inside the forest in HEC hotspots: When settlements inside the forests face very severe HEC and also have other problems based on the remoteness of their location, they may be willing to be resettled outside the forest in order to avoid HEC and to have access to a better livelihood and living conditions. In such situations the SFDs should facilitate voluntary resettlement, as per the protocols of the Government of India.
- Addressing the attractant for Elephants:
    - Identification of non-palatable crops by the farmers / agriculture department with due consideration to their socio-economic-cultural aspects

11 Supplementary frameworks to the HWC-NAP https://moef.gov.in/wp-content/uploads/2022/01/National-Human-Wildlife-Conflict-Mitigation-Strategy-and-Action-Plan-of-India-2.pdf

– The low economic return from non-palatable crop may be addressed by facilitating assured pricing mechanism, value addition and marketing linkages.

4.6 MANAGING DISPERSING ELEPHANTS

Elephants which have strayed out of the forest and have been driven back to their natural habitat and also Elephants which colonise new areas, pose a very significant challenge to the managers. The following measures may be envisaged:

- Such Elephants should be monitored based on individual identification and tracking through radio-telemetry.
- Population-habitat viability analysis should be conducted for long-term scientific population management and HEC mitigation.
- Evaluation of the outcome of past dispersals is necessary to determine the effectiveness of the mitigation measures.
- Ensure regular monitoring and review by the Chief Wild Life Warden of the situation in all potential HEC conflict hotspots.

4.7 JUDICIOUS USE OF BARRIERS, TAKING A LANDSCAPE APPROACH

Barriers are primarily used to regulate the movement of Elephants, and poorly designed barrier can have adverse impact on conservation. Barriers are not fool-proof, so there may be breaches and occasionally some Elephant may be able to overcome them and enter human use areas.

Following principal types of barriers are currently used to prevent Elephant entering human-dominated areas:

- Elephant Proof Trench (EPT)
- Solar powered electric fences
- Rubble walls
- Other types – railway girders / tracks, steel channels / ropes / bars etc

When planning and establishing barriers, following to be considered

- Adopting a landscape approach during planning and execution so as not to disrupt natural movement of the Elephants in the landscape. This may be applicable to the following situations
  – Construction of barriers around forest areas to keep Elephants inside the forest. Such barriers are not advisable around small forest blocks (few sq. km in size) because such forests cannot provide all the space and food requirements and confines the Elephant population, compromising their long-term genetic viability. It may be moderately useful around large forest blocks but extremely difficult to completely encircle forest blocks.
  – Barriers constructed across the landscape between two states / districts / countries. It is rather impossible to create effective barriers at landscape-level ensuring movement of the Elephants across ecological landscapes and not be confined to administrative units.
  – Barriers constructed around the settlement to be protected such as village / enclave. This would be most effective for protection of crops but it can be used only in specific situations wherever there is a compact area but not so around large enclaves.
- Creation of site-specific quality barriers using a participatory approach from designing monitoring and maintenance by systematic engagement of communities is essential.
- Barrier should only be used at the interface between human use areas and forests.
- Barriers with sharp spikes that have potential to injure Elephants, wildlife, livestock and humans should be avoided.
- When barriers are to be developed, a map should be prepared showing location of Elephant groups, seasonal migration patterns of Elephants and locations of Elephant corridors including location of proposed Elephant barriers.
- Barriers may be created only if the boundary is "hard" (clear and sharp demarcation between forest and human landscape), fairly straight without much convolution and not broken by roads, river or large stream for making them more effective.

4.8 JUDICIOUS USE OF OTHER EXCLUSIONARY MEASURES, TAKING A HARMONIOUS-COEXISTENCE APPROACH

Beating of drums or tin can, kerosene torch (mashal), swinging fireball and shouting are the most common repellent measures, but their effectiveness is low in most situations. The following measures may be envisaged:

- Innovative local repellent techniques like honey-bee boxes, chilly ropes etc may be piloted, and customised to enhance their effectiveness, while ensuring their wildlife-friendliness.
- New repellent methods may also include sound of bees and carnivores, use of drones etc besides deterrents like trip / sensor-based alarm system.
- Community-based institutions may be engaged by the SFDs together with wildlife experts / organisations, in motivating, training and hand-holding the community in use of exclusionary measures.

4.9 SUPPORT LOCAL POPULATION IN CROP-GUARDING METHODS

Guarding crops at night from any safe structure is one of the most effective early warning and deterrent method. Crop-guarding involves deterring Elephants by chasing and driving them using noise (i.e., shouting, beating drums or tins or using firecrackers/torches). Guarding crops at night is suitable in low-conflict areas. The following measures may be envisaged:

- Developing Community-based-conflict-management (CBCM) measures, especially in North Eastern Region, as a means of empowering the community to share the responsibility of HEC mitigation with the Forest Department through JFMC / EDC / Gram Sabha considering their vital stake and for eliciting more rapid response.
- Community PRTs and farmer groups may be engaged to ensure that besides preventive measures, traditional crop-guarding methods are encouraged, with the involvement of the local community/farmers.
- Awareness-building and training should be carried out on the proper usage of firecrackers and fire torches such that do not harm the Elephants, nor become fire hazards and on various aspects of the crop-guarding techniques.
- Early warning bulk SMS Alerts along with pulsating warning lights on towers, that warns of Elephant presence in the area may be developed.
- Farmers can be supported in developing effective and sustainable crop-guarding practices by various incentive mechanisms and subsidised funding under district-level government schemes such as Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS).
- A compendium on good practices on crop guarding techniques may be developed for use by the local community.

4.10 ADDRESSING ZOONOTIC AND OTHER EMERGING DISEASES, ADOPTING A ONE HEALTH [12] APPROACH

The response teams and other stakeholders, at HWC hotspots, are vulnerable to a variety of Zoonotic disease that can be transmitted from different animals, apart from the risk that exists for disease transmission domestic animals and wildlife; and between human-domestic animals:

- Veterinary capacities and infrastructure may be upgraded, to facilitate disease monitoring in Elephant populations (e.g., for anthrax, rinderpest, foot-and-mouth disease), both from an Elephant conservation point of view, and from zoonotic diseases spreading to livestock and human populations.
- To reduce biotic pressure on forests and prevent the spread of zoonotic diseases, it is encouraged to keep high yielding cattle and stall-feed them
- A well formulated Wildlife Health Management and Disease Surveillance Plan may be developed at every division/Protected Area (PA).
- All personnel involved with capture operations may be trained, vaccinated and equipped.
- The basic approach should be to integrate the concept of 'One Health', which links human and animal health in a shared environment, into all the operations and HEC mitigation measures in the field.

12 One Health is a collaborative, multi-sectoral and trans-disciplinary approach—working at the local, regional, national and global levels—with the goal of achieving optimal health outcomes, recognising the interconnection between people, animals, plants and their shared environment.

5. ADDRESSING THE EMERGENCY SITUATIONS ARISING DUE TO HEC

Emergency or Crisis situations can be defined as situations that are sudden, unexpected, have the potential to be serious/are serious in nature and therefore require immediate intervention in time and space, from concerned stakeholders, to minimise loss of lives and assets. The response to such emergencies involves prompt handling of situations, ensuring reduced vulnerabilities of humans and Elephants.

An indicative list of the potential emergency situations on a priority basis is as follows:

i. A human is killed/injured

ii. Elephant/abandoned calves are injured and need rescue

iii. Property is damaged

iv. Elephant has entered human use areas (agriculture field or settlement areas)

v. Livestock is injured/ dead

vi. Elephant death due to retaliatory action by humans / train collision

vii. Crop damage

viii. Sighting of Elephant in the vicinity of agricultural land or settlement

Key response procedures should be established, and actions promptly implemented/ undertaken for addressing emergency situations. Detailed step-by-step guidance should be developed as "Operating Procedures for Addressing Emergency Response Situations"

The key emergency response procedures may be elaborated, and should include the following:

5.1 PREPAREDNESS MEASURES — BEFORE AN EMERGENCY SITUATION ARISES

5.1.1 ESTABLISHMENT OF EMERGENCY RESPONSE MECHANISM

A strong institutional mechanism is required, to respond to emergency situation arising due to HEC. This starts with detection of incident, communication to Control Room and information dissemination to the officials and staff in the command-and-control hierarchy, including forest and civil administration, for initiation of appropriate response actions. The divisional forest office coordinates action by rushing RRTs to the incident site. The field support operations to be structured around the following key operational stages, for synchronisation of activities to meet the emergency:

- Monitoring and situational awareness.
- Mitigation Hubs/Control Room/helplines to receive and disseminate information.
- RRT/ PRT personnel, veterinary team, drug and equipment, mobility and communication to address the emergency situation, effectively and efficiently.

5.1.2 INTRA- AND INTER-AGENCY COORDINATION AND COOPERATION

- Procedures may be laid down in each forest division/ district, in line with these guidelines, and in line with the institutional framework suggested under the HWC-NAP, to ensure timely coordination amongst the various response teams from forest department and other agencies, under the DLCC consisting of District Magistrate/District Collector; Police, Fire Services, Animal Husbandry Department, Health Department, SDRF, NDRF, Paramilitary Forces, etc and local community, especially local Panchayat leaders and village Community PRTs.

5.1.3 PREPAREDNESS OF RESPONSE TEAMS

- Operating Procedures may be laid down in detail to ensure that the capacities and capabilities of the various response teams (Community PRTs, RRTs) are established and facilitated in their capacity development through trainings and other measures, including trainings on occupational health and safety.
- Operating Procedures may be laid down with specifications to ensure that each response team is sensitised and equipped with appropriate and adequate response equipment and personal protective equipment (PPE kits), in view of effective zoonotic diseases and pandemic prevention, management and control.

5.2 MEASURES DURING AN EMERGENCY SITUATION

5.2.1 IDENTIFICATION OF THE ELEPHANT-IN-CONFLICT

Identification of individual or group of Elephants-in-conflict to be characterised into casual (opportunistic) or repeated (obligatory) crop foraging individuals/groups, which may result from Elephants with their natural movement adjoining the periphery of the forest, or Elephants which exclusively move within the crop lands due to the attractions, resulting in their localisation. The following steps may be taken for identifying the Elephant that causes conflict:

- The movement area of the Elephant in conflict may be demarcated or mapped.
- Follow the track marks and other distinct signs to confirm and track the presence and absence of Elephants.
- Investigate all conflict-related incidents within the region.
- Deploy a number of cameras at strategic locations depending on their predictable movement.
- Investigate the existing camera trap database if available and identify the individual based on the distinct morphological identification features.

5.2.2 OTHER KEY RESPONSE ACTIONS DURING AN EMERGENCY

- Operating Procedures may be laid down to receive, channelise and disseminate information at the onset of any emergency, from site of the incident, to related forest officials, HWC Mitigation Hub and further information dissemination, to requisition related response action at the emergency site.
- Specifications may be detailed for mobilisation, activation and deployment of response teams on ground to respond to the emergency situation.
- Adequate arrangements may be made to provide first aid to the person facing a health emergency condition, and then his/her quick transfer to the nearest available equipped hospital should be facilitated. It is also critical to ensure occupational safety and health of the forest department personnel before, during and after any response operation.
- During an HEC situation, it is very essential to maintain public order and tranquillity through effective crowd management. SOPs indicating the specific roles and responsibilities of the forest department officials, District Magistrate/administration, police department, fire department, emergency services (NDRF, SDRF, paramilitary forces), health department, animal husbandry department, relief/revenue Department; first responders, specialised responders and other volunteers in crowd management should be laid down clearly, and these should be agreed to by all the stakeholders.
- The role of the media, before, during and after HEC situations should be discussed to ensure they participate effectively in crowd management and other mitigation measures.

5.3 MEASURES AFTER AN EMERGENCY SITUATION

- Operating Procedures may be laid down for reporting and process documentation of the response operation, including detailed on step-wise response actions taken and challenges faced, further Insights into the conflict and its future management, key follow up actions that need to be taken, if any, to resolve the issue (incident), management of animal if a capture was required, and assessment of the need to monitor the location for a few days to discourage any retaliatory actions

6. REDUCING THE IMPACT OF HEC ON HEALTH AND OVERALL WELL-BEING OF THE AFFECTED HUMANS

Humans living in Elephant range areas are familiar with its habits and behaviour and are accustomed to Elephant presence in the area. Although they are aware of how to react to the situations, many a times, things go beyond control and marginal farmers face losses due to HEC. Moreover, due to dispersal and colonisation of Elephants in new areas, people are not familiar with Elephants and are less tolerant of the damage caused in conflict.

A major response to HEC has been compensation for losses, but little evidence exists to support the claims that these schemes have an impact on people's attitude or the impact on the conservation of wildlife. Moral hazard, optimisation and leveraging of compensation schemes are a challenge.

Measures, which may encourage people to work towards harmonious co-existence, include participatory planning, awareness and communication for change the threat perceptions, integrating HEC mitigation into poverty alleviation programs and community-based natural resource management, and other site-appropriate stakeholder engagement measures, such as.

- Compensation for economic loss from damage to crops by Elephant activities, or personal injury or risk from Elephant encounters, is meant to increase community tolerance towards Elephants
- Insurance schemes require participants to pay a premium, for insurance against economic loss. This premium is determined based on the risk associated with HWC/HEC. The challenges of high premiums charged (due to high risk) have been addressed in some areas, by supplementing premiums with government or non-governmental funding support, community financing (e.g., through ecotourism), or better risk evaluation. Dialogue with insurance sector may be initiated for providing insurance cover for damages due to HEC. Modalities may vary for such programme from place to place based on assessment of risk by the Insurance companies. Feasibility may be explored at the state level
- Performance payments for community support for conservation may also be explored as an instrument, where the EDCs / VFCs can be provided funds for conservation-linked performance payments, and experiences and learnings can be shared back, for further refinement of these guidelines
- Conservation Easement may be a good instrument for mitigation of conflict, which could be explored by incentivising conservation for mitigation of conflict and as an innovative mechanism, where farmers can be compensated for keeping these areas fallow for part of the year for wild animals or no/reduced gain from the farming income. Experiences and learnings can be shared back, for further refinement of these guidelines.

6.1 ADDRESSING THE SITUATION OF LOSS OF HUMAN LIFE

The dimensions of human death are many folds. It's not simple to fathom the loss of human life to the family of the victim. The primary assumption behind ex gratia is that the loss of life of any individual cannot be compensated. Therefore, any amount paid to the family of the victim is mere consolation or a kind of solatium.

The following measures may be implemented to effectively address the situation:

- Part of the *ex gratia* payment may be made immediately to the victim's family/heirs and the balance payment may be made at the earliest.
- The payments to the victim's family should be made into their bank accounts.
- In the HEC hotspots, a revolving fund may also be established, at the division-level, to ensure availability of funds for providing immediate relief to the victim/ family.
- Possibility of setting up of foundations in the territorial divisions, for extending sustainable support to the victim, can also be explored. The minimum *ex gratia* payment may be kept in conformity with the Gajah (Elephant Task Force) [13] recommendation by various states.

6.2 ADDRESSING THE HEALTH AND OVERALL WELL-BEING OF THE AFFECTED HUMANS

- In the case of injury, as a result of encounter with Elephant, the victim needs to be immediately hospitalised and *ex gratia* should be paid, as per the state government norms.
- Professional counselling through qualified psychiatrists/ health workers will be useful to check the effects of such traumatic incidents.

13 Rangarajan, Mahesh, Ajay Desai, R Sukumar, PS Easa, Vivek Menon, S Vincent, Suparna Ganguly, BK Talukdar, Brijendra Singh, Divya Mudappa, Sushant Chowdhary and AN Prasad. Gajah. Securing the Future for Elephants in India. The Report of the Elephant Task Force,

- The SFDs and other government agencies/ institutions may organise some counselling sessions for such victims and support them in coming out of this psychological impact.

6.3 ADDRESSING THE SITUATION OF PROPERTY DAMAGE

Ex gratia for property damage does not generally consider the cost of repairing and the costs of temporary fixes that are needed prior to repairs. The poor are affected more as their houses are of low value and damages do not consider the fact that the main costs is actually labour that the family provides in reconstruction and not the cost of materials themselves.

- Property insurance should be the ultimate goal. Awareness and adoption of options regarding property insurance should be given priority. However, till the system is fully established, present system of payment of compensation should be continued and enhanced by factoring in the hidden costs and losses. Compensation for damage to property (including buildings) should be in accordance with the state government rules, and may be made at the earliest.
- Mobile application-based system may be developed, to evaluate the loss of property and *ex gratia* paid to the property owner.
- Elephant may enter urban areas and semi-urban area close to the forest, which may create panic amongst residents. The following measures may provide relief and assistance to the community. SFDs may coordinate with the respective resident welfare associations for *ex gratia* payment in the event of loss of property and human injury

6.4 ADDRESSING THE SITUATION OF CROP DAMAGE AND LIVESTOCK INJURY/LOSS

The long-term impacts of assessment of crop compensation amount are complex. While payment of inadequate compensation to farmers will lead to resentment among humans, leading to adverse impact on wildlife conversation due to retaliatory killings. Payment of compensation is equally challenging as it might also lead to laxity in crop protection by the farmers, and inhibit possible innovations for crop guarding.

- Ministry of Agriculture and Farmers Welfare have included the crop loss by activities of wild animals under its flagship scheme *Pradhan Mantri Fasal Bima Yojana* (PMFBY), which can be used as an important HWC mitigation instrument. However, till the system is formally established in remote forest areas, the existing system of direct payment of compensation to farmers should be continued.
- The process of settling crop or property loss compensation should be transparent and simplified. Mobile apps may be used for collecting the information and processing of claims of farmers, after crop losses from Elephant activities, to ensure efficiency and transparency in the system. Experiences and success-story sharing across states can facilitate further improvements in the system.
- Farmers may be encouraged, facilitated through community-based institutions, to explore solutions such as change in cropping pattern, use of non-palatable crops etc.
- Collaborative efforts can be made to promote market-based arrangements for alternate crops, wherever feasible. Community Primary Response Teams (PRTs) may be engaged to facilitate this process in their respective villages/ areas of operations.
- Site-specific studies may be conducted to find out appropriate crops that are non-palatable to Elephants, in collaboration with agricultural institutions.
- Ensure sufficient delegation at field-level for deciding and disbursing *ex gratia*/compensation for its effective use for addressing possible trauma due to HEC
- Livestock loss or injury, as a result of encounter with Elephant, are not common. However, cattle tethered near or in Elephant movement paths may be at risk. SFDs may coordinate with Animal Husbandry Department for providing livestock insurance coverage in HWC hotspots. To reduce conflict and risk of loss of livestock inside the forest areas, it is encouraged to stall feed the livestock in HWC hotspots.

6.5 ADDRESSING THE SITUATION OF LOST LIVELIHOOD OPPORTUNITIES

- HEC may deprive humans of their jobs, or reduce their ability to raise income, and thus diminish their capacity to make a living. *Ex gratia* and compensation in an important coping mechanism, but specific measures may be required to ensure long-term sustainability of livelihoods at the HWC hotspots. Following measures may be planned and implemented, with cross-sector cooperation:
- Systematic assessments of the extent and scale of lost livelihood opportunities and other indirect impacts, due to HEC, may be conducted
- Development of skills for alternative non-land/non-farming-based income generation opportunities
- Creation of self-help groups (SHG) for facilitating small businesses that adopt alternative non-land / non-farming based livelihoods.

7. REDUCING THE IMPACT OF HEC ON THE HEALTH AND WELL-BEING OF ELEPHANTS

Indian laws take a very strong stand on animal welfare. There are enough provisions in national and state laws to avoid and prevent cruelty and harm to animals.

- All the care should be taken to address the issues of Animal Welfare and Animal Rights as enshrined in the Constitution (Article 48A and 51A(g)), and as per the statutory provisions made under the Indian Penal Code (Sections 428 and 429), Prevention of Cruelty to Animals Act of 1960 (Section 11(1)(h) and Section 11(1)(d)), Motor Vehicles Act 1978 (Transport of Animal) Rules, 2001) and guidelines issued by the MoEF&CC.

7.1 ADDRESSING THE HEALTH OF ELEPHANTS DURING CAPTURE AND POST-CAPTURE OPERATIONS

Capturing of Elephants can be for different purposes, for example capture can be for radio-collaring to be used for research purposes, or for early warning and rapid response treatment of injured Elephants or rescuing abandoned calves, or removal of Elephant from conflict space for the purpose of translocation or bringing it into captivity.

Operating procedure (OP), providing step-by-step procedure and approach for tracking and capturing Elephant/s as a mitigation measure, may be developed. Separate Operating Procedures for radio-collaring, treatment and transport to be developed to ensure animal health and safety during such operations.

Post-capture management of Elephants includes knowing the position of the captured animal (captured through immobilisation), monitoring physiological parameters and transportation of the animal. Currently, most of the capture of Elephants is done through immobilisation.

- The first & foremost thing after immobilisation of the Elephant is to restrain it securely in a comfortable position to maintain airway.
- Following drug induction, the Elephant should be approached (from the rear) keeping safety in mind.
- Post capture health examination and monitoring of the immobilised Elephant is mandatory.
- The physiological parameters (temperature, respiration, pulse and colour of mucous membrane) need constant monitoring, as these are likely to be compromised during chemical capture.
- Any significant deviation in normal physiological parameters should be dealt with appropriately.

Health Examination post capture & Critical monitoring of the immobilised Elephant:

- Once the Elephant is properly positioned, the Veterinarian should examine its health status and monitor its vital signs (pulse, respiration rate, temperature, blood oxygen level etc). Accordingly, it may be decided whether the radio collaring or capture operation will continue or the animal needs to be revived due to some complication/health emergency and released.
- A checklist of parameters may be elaborated.

Transportation post capture:

- The animals should be transported in specially designed vehicles or large containers (for long distance) or on foot (for short distance).
- The vehicle should be designed considering the animal's weight, adequate ventilation options (containers), sound non-slippery floor, provision of drainage to facilitate disposal of waste etc.
- The animal needs to be appropriately secured in the vehicle and necessary transport considerations should be in place during transit.
- Alternatively, the animal can be hoisted on the vehicle using slings/ropes/belts taking due anatomical and physiological considerations strictly under veterinary supervision and using a skilled crane operator.
- Stops en-route should be pre-planned and identified well in advance aimed at achieving the shortest journey time possible and ensuring safety and wellbeing of the animal.
- The animal needs to be regularly monitored for signs of discomfort or stress during the entire journey period by veterinary professional, and the Elephant maintained in a sedated state.
- Koonkies, if available, should be used in moving / pushing the animal into the vehicle/ container.

Food and water during transportation

- It is better to avoid provisioning of feed and water during overnight transport and efforts should be made to reach the destination (release site/ Elephant camp/ designated facility) as early as possible taking due care of vehicle speed and halting destinations.
- Water should be made available to the animal during transportation especially on hot journeys exceeding 6

hr. Water should also be at hand to control possible hyperthermia of recumbent animals.

7.2 RELEASE ESSENTIALS

- Relocated Elephants should be fitted with GPS-based collars to monitor their movement with the option of recapturing them in case they again come into conflict.
- The site of release should be at sufficient distance (typically of the order of 200-300 km or greater) such that it is unlikely that the Elephant would be familiar with the new site and attempt to go back to the place of capture.
- "Soft release" options can also be experimented with; this would involve keeping the animal in a stockade for some limited time period at the proposed site of release before letting it free.
- The animals should be monitored for any transport injuries or any other health-related issues following release.
- The release sites should have proper off-loading facility and release should be done with the least possible stress on the Elephants.
- Following release in native habitats, it is necessary to monitor the behaviour of the animal/s and its interaction with the other herbivores
- The animal should be monitored post-release, for injuries, wounds, ill-health and disease such as nervous, locomotive or digestive disturbance by team of veterinary professionals, biologist and manager during the initial period.
- There is also a need for long-term monitoring of the health of the released individual/ population.
- In some instances, the best option or the only option may be to retain the captured Elephant or Elephants in captivity, especially if the animal has killed people or the risks of release into the wild are too high. If Elephants are retained in captivity, it is essential to consider their proper welfare and utilisation.
- In case destined for captivity, the animal should be held in fenced enclosure/ Kraal. This would provide chances for animal to recover from anaesthetics, in getting acclimatised to their surroundings at new destination and provide opportunities for intensive monitoring and veterinary management.
- In case the Elephant is required to be kept in captivity, the space provided to the Elephant should be as per the guidelines issued by the Project Elephant division, MoEFCC.
- Proper sanitation and hygiene should be maintained to avoid chances of infection
- Adequate balanced food and water should be made available along with mineral and vitamins supplements as per the health status of the Elephant.
- Health Screening: A general health screening once a week should be done and a thorough health examination should be done at least once in a month. Bi-monthly foot dip, foot care and nail trimming should be carried out to prevent foot problems. In case of suspicion of some serious health condition, samples should be collected and sent to institutes like Indian Veterinary Research Institute (IVRI) etc. for more advanced investigations.

7.3 REHABILITATION OF THE CAPTURED ELEPHANT

- In the case of Elephant brought into captivity temporarily for treatment, their release post treatment should take into consideration their past record in conflict.
- Elephants that have a record of high conflict cannot be released back as they are more habituated to humans when compared to the Elephants not causing serious conflict, which can be released back with adequate monitoring.
- States having wild Elephant population may envisage at least one Elephant rescue and rehabilitation centre and should follow CZA guidelines for their management.
- Chief Wildlife Wardens should ensure that Rescue and Rehabilitation Centres for Elephants as well as housing facilities for captive Elephants are maintained properly to avoid complaints about cruelty/ ill treatment of Elephants.

7.4 MANAGING ORPHANED/STRAY ELEPHANT CALVES-IN-CONFLICT

An Elephant calf, in the wild, is orphaned due to several reasons and special care is required to handle it, as follows

- The rescued calf should be raised under guidance of a veterinarian by an experienced senior/dedicated mahout. It should be handled only by one mahout with full precautions about hand hygiene and hygiene of the room/enclosure in which the calf is housed.
- For young calves below the age of 1 year, the constant presence (24 x 7) of the mahout is critical as stress of separation can very adversely affect its survival. If there are adult female Elephants in the facility and one of them is tolerant to the calf, then the calf should be raised in its presence as the female will acts as a foster mother.
- The calves should not be exposed to humans as they have a weak immunity and may contract the diseases quickly.

7.5 RADIO COLLARING OR TAGGING (RFID-MICROCHIP) AN ELEPHANT

Elephants may be radio collared before release. Radio collars are important for HEC mitigation with the objective of understanding ranging behaviour and other information.

- Ranging behaviour studies will help to better understand how and why certain Elephants come into conflict and help the development of customised conflict mitigation measures including RRT deployment, aversion conditioning, barriers, community awareness about preventive behaviours/actions, etc. These studies will also help to ascertain the effectiveness of mitigation methods and also in understanding how Elephants respond to these methods and how these methods impact Elephants.
- Radio collaring may also facilitate enhancing the effectiveness and efficiency of the response teams, as using real-time location information from satellite collars can help RRTs to intervene early and stop Elephants from coming into conflict.
- It is useful to radio collar an injured Elephant to monitor it systematically for medical intervention over an extended period of time.
- Radio Frequency Identification Device (RFID) may be used for tagging captured wild Elephants brought to captivity

7.6 HEALTH AND WELL-BEING OF PRIVATE AND TEMPLE ELEPHANTS

- There are several instances of private Elephants and temple Elephants not being managed properly and going out of control, often during processions, due to loud music, crackers and presence of large crowd etc. The captive Elephants need to be managed as under:
- As far as possible, Elephants may be kept away from the congested places and large crowds. Assembly of Elephants in temples or other public places should not be permitted unless the organisers have taken adequate measures to deal with any emergency. It should be ensured that the Elephants, particularly bulls, participating in public functions are manned only by trained and experienced mahouts.
- A dossier should be maintained of all Elephants including their behaviour in the crowd and public functions. Operating Procedures (OPs) should be drafted for tackling such situations. Rapid response teams should be formed by the Forest Department in big cities to tackle such situations.
- Captive Elephant welfare committees should be constituted at State and District levels to ensure welfare and humane treatment of captive Elephants, particularly in private custody.
- Chief Wildlife Wardens should periodically monitor ownership certificates/ microchips of Elephants.
- Guidelines for care and management of captive Elephants issued by the MoEF No. 9-5/2003 PE dated 8.1.2008 for transportation, housing, care, feeding, work etc should be strictly followed including maintenance of necessary records and registers.

8. USE OF LEARNINGS FROM THE GUIDELINES TO FURTHER STRENGTHEN INSTITUTIONAL AND POLICY FRAMEWORK ON HEC MITIGATION IN INDIA

These guidelines are expected to serve as a capacity development instrument, given that a robust and structured feedback mechanism will be put in place, to document the feedback coming from implementation of them.

- The feedback from use of these guidelines may, therefore, be consolidated, to form the basis for fine-tuning these mitigation measures, and also understanding capacity needs for effectively implementing the mitigation measures.
- In the long term, the consolidated feedback may also be used in further reviewing the capacity development strategies, HWC-MAPs, HWC-SAPs, and HWC-NAP.

9. PROCESS OF DEVELOPMENT, PILOT TESTING OF THESE GUIDELINES AND CONSULTATION PROCESS

- A dedicated framework of experts (Annexe 1) was formed, consisting of representatives from Government agencies, SFDs, research institutions, civil society institutions, International organisations and independent wildlife policy experts as members of the core team. The experts were a mix of scientists, wildlife managers, policy experts, and capacity development experts.
- A common understanding was developed on the overall purpose, scope, approach and methodology.[14] The experts implemented different roles in the drafting and editing process, viz. Coordinating Lead Authors, Lead Authors, Contributing Authors, and Review Editors. The Author Group worked on developing these Guidelines during July 2019- August 2021, while consulting a larger group of experts and stakeholders via workshops, meetings and consultations. The authors reviewed the existing documents and guidelines available from the MoEF&CC and different states, and relevant information and recommendations were brought into this new document. A National Technical Group (NTG), consisting of experts from MoEF&CC, Wildlife Institute of India (WII), *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ), and independent wildlife and policy experts, was formed for overall steering and facilitation of the process. A 'Working Group on Pilot Implementation of Guidelines and HWC-NAP' was formed to facilitate planning and implementation of pilot testing, consultations and final editing of draft guidelines and HWC-NAP. Detailed terms of reference of each of this category was provided and meetings and workshops of the author groups were facilitated under the Indo-German Cooperation Project on Human-Wildlife Conflict Mitigation.
- The draft guidelines and HWC-NAP were pilot tested at selected HWC hotspots in India, to test and receive feedback on the feasibility and acceptability of the recommendations expressed in the Guidelines, using structured process and tools. Based on the feedback received during fortnightly meetings and one to one consultations with managers, the draft of the guidelines was revised.
- A Committee was constituted by MoEFCC in December 2022, consisting of officials from MoEFCC, and the state forest departments of Bihar, Haryana, Karnataka, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal to review and finalize the guidelines.

10. MONITORING AND EVALUATION OF GUIDELINES

- This set of guidelines is not a static document; rather, it is a living document. It will keep abreast of the various developments in field implementation methods and wildlife research. For this, the feedback from field practitioners and other wildlife experts may be analysed to assess the specific elements and sections that need to undergo changes. A review of the guidelines is planned to take place every 5 years from 2023 onwards. However, a mid-term review process in 2024 may be desirable. In the long term, the review cycle of these guidelines can be aligned with the review cycle of HWC-NAP.
- Detailed mechanism, templates and guidance used for collating information and feedback on the use of these guidelines may be developed.

14 Approach paper: https://indo-germanbiodiversity.com/pdf/publication/publication19-04-2021-1618808050.pdf

ANNEXE 1

NATIONAL TECHNICAL GROUP (NTG)

Shri Bivash Ranjan, *IFS*, Additional Director General of Forest (Wildlife), Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India (GoI) Dr S P Yadav, *IFS*, Former Additional Director General General of Forest (WL), MoEF&CC, GoI (December 2021 to March 1, 2022) Shri Soumitra Dasgupta, *IFS*, Former Additional Director General of Forest (WL), MoEF&CC, GoI (June 2019 to November 2021)	Chairperson
Shri Rohit Tiwari, Inspector General of Forest (WL), MoEF&CC, GoI	Member
Shri Rakesh Kumar Jagenia, Deputy Inspector General of Forest (WL), MoEF&CC, GoI	Member
Dr Sunil Sharma, IFS, Joint Director (WL), MoEF&CC, GoI Dr R. Gopinath, IFS, Former Joint Director (WL), MoEF&CC, GoI (June 2019 to December 2020)	Member
Director, Wildlife Institute of India (WII)	Member
Shri P C Tyagi, *IFS* (Retd.), Former Principle Chief Conservator of Forests-Head of Forest Force, Tamil Nadu	Member
Late Shri Ajay Desai, Wildlife Expert (June 2019 to November 20, 2020)	Member
Dr Sanjay Gubbi, Wildlife Expert, Nature Conservation Foundation (June 2019 to November 20, 2020)	Member
Dr Neeraj Khera, Team Leader, Indo-German Project on HWC Mitigation, GIZ India	Member Convenor

WORKING GROUP ON PILOT IMPLEMENTATION OF GUIDELINES AND HWC-NAP

Dr. Neeraj Khera, Team Leader, Indo-German Project on HWC Mitigation, GIZ India (Member Facilitator)
Dr. Bhaskar Acharya, Independent Wildlife and Documentation Expert
Ms Naghma Firdaus, Disaster Management Specialist
Shri Ramesh Menon, Media Expert
Shri C. Sasi Kumar, Technical Officer, MoEF&CC
Shri Aditya Bisht, Project Elephant-MoEF&CC
Shri Siddhanta Das, *IFS* (Retd.), Former DGF&SS, MoEF&CC
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Shri Sanjay Srivastava, *IFS* (Retd.), Former PCCF- HOFF, Tamil Nadu
Shri P C Tyagi, *IFS* (Retd.), Former PCCF–HOFF, Tamil Nadu
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Shri Surendra Varma, Asian Nature Conservation Foundation
Dr. Nayanika Singh, M&E and Policy Expert

AUTHOR GROUP FOR DRAFTING THE GUIDELINES

Late Sh. Ajay A Desai, Wildlife Expert Sh Surendra Varma, Asia Nature Conservation Foundation Sh Ramesh Pandey, *IFS*, IGF (Project Elephant), MoEFCC, GoI	Coordinating Lead Authors
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Shri P. C. Tyagi, *IFS* (Retd.), Former PCCF–HOFF, Tamil Nadu Shri Sanjay K. Srivastava, *IFS* (Retd.), Former PCCF–HOFF, Tamil Nadu	Review Editors

Ministry of Environment, Forest and Climate Change
Government of India
2023

Designed by Aspire Design, New Delhi

Annexure-X

F. No. 3-8/2022-PE
Government of India/ भारत सरकार
Ministry of Environment, Forests & Climate Change/ पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
(Project Tiger & Elephant Division/व्याघ्र एवं हाथी परियोजना प्रभाग)
****

3rd Floor, Prithvi Wing,
Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj,
New Delhi-110003

Dated: 25th **January, 2024**

To,

The Chief Wildlife Warden,
All Tiger & Elephant Range States/Union Territory

Sub: Enhancement of Ex-gratia for loss of human life due to Elephant attack-reg.

Sir/Madam,

As you may be aware that recognizing the importance of preserving biodiversity and ensuring the safety and well-being of both human and wildlife communities, the Ministry of Environment, Forest and Climate Change, Government of India has been prioritizing various comprehensive measures to address the issue of human-wildlife conflict mitigation.

2. The Ministry has recently reviewed the rate of *Ex-gratia,* payable under the Centrally Sponsored Scheme "Integrated Development of Wildlife Habitat" which also includes Project Tiger & Elephant, in case of human-wildlife conflict and has increased the *Ex-gratia* amount from Rs. 5 Lakh to Rs. 10 Lakh (Copy of O.M. enclosed for ready reference). It is expected that this decision of the government will further buttress the consistent efforts being made to mitigate human-wildlife conflicts specially related to elephants and tigers.

3. In this regard, it is requested to kindly disseminate this information to all field formations and stakeholders for the needful. It is also requested to align the State's *Ex-gratia* rates with the Ministry's revised rates to contribute towards a cohesive and standardized approach for human-elephant conflict management across the country.

Yours faithfully,

25/1/24
(Ramesh Kumar Pandey)
Inspector General of Forest (PT & E) and
Director, Project Elephant

Encl: as above

Copy to: i. Principal Chief Conservator of Forests & HoFF of all Tiger & Elephant Range States
ii. PPS to ADG (PT&E) & MS-NTCA, MoEF&CC

True Copy

F. No. WL-21/4/2023-WL
Government of India
Ministry of Environment Forest and Climate Change
(Wildlife Division)

A.208, Indira Paryavaan Bhawan,
Jor Bagh Road,
New Delhi-110003.

Dated: 22nd December, 2023

Office Memorandum

Sub: Enhancement of compensation for loss of life and damage to crops /property by Wild Animals-reg.

In super session to the Ministry letter No. 14-2/2011-WL-I (Pt.II) dated 09th February, 2018 on above cited subject ; rate of *Ex- gratia* payable under the Centrally sponsored scheme 'Integrated development of Wildlife habitats' in case of Human – wildlife conflict has been revised. The revised rate of relief under ex- gratia are as follows:

S. No.	Nature of damage caused by wild animals	Amount of ex-gratia relief
(a)	Death or permanent incapacitation to human beings	₹10.00 Lakh
(b)	Grievous injury	₹2.00 Lakh
(c)	Minor injury	Cost of treatment up to ₹25000/- per person
(d)	Loss of property/crops	State/UT Government may adhere to the cost norms prescribed them.

2. It is clarified that the amount of ex- gratia relief payable under Centrally sponsored scheme 'Integrated development of Wildlife habitats 'supported by this Ministry may be made only by DBT as per revised rates, subject to availability of funds.

3. This is issued with the approval of Hon'ble Minister of Environment, Forest and Climate Change.

Yours faithfully,

(Dr. Rajendra Kumar)
Scientist 'C'

To,

The Secretary,
Forest Department,
All States/UTs

Copy to:
1. PCCF/CWLW, All States/UTs
2. PS to HMEF&CC.
3. PS to HMOS, MOEF&CC
4. PPS to DGF&SS/ PPS ADG(WL)/PPS IGF(WL)/PPS to IGF(PT&PE)

Annexure-XI

F.No. 12-1/2019-PE-Part(1)
Government of India/ भारत सरकार
Ministry of Environment, Forests & Climate Change/ पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय
(Project Elephant Division/हाथी परियोजना विभाग)
****

6th Floor, Vayu Wing,
Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj,
New Delhi-110003

Dated 16th September, 2022

To,
The Principal Chief Conservator of Forests (WL) &
Chief Wildlife Warden,
All Elephant Range States/UTs.

Sub:- Advisory on implementation of measures to mitigate the impact of power transmission lines and other power infrastructure on elephant and other wildlife– reg.

Sir,

As you aware the death of elephant due to power transmission lines and other power infrastructure is a major concern in the country. This issue was also discussed during the 17th meeting of the Steering Committee of Project Elephant, held on 12th August, 2022 at Peiryar Tiger Reserve under the Chairmanship of Hon'ble Minister, EFCC with the officials of Ministry of Power.

In this regard, I am directed to inform you that, in compliance of the discussion held during the 17th Steering Committee meeting of Project Elephant the Central Electricity Authority, Ministry of Power on 31st August, 2022 has issued and advisory to all DISCOMs and TRANSCOs regarding implementation of measures to mitigate the impact of power transmission lines and other power infrastructure on elephant and other wildlife. A copy of the advisory issued is enclosed for your kind reference and needful action please.

Yours faithfully,

Encls: as above.

(Dr. K. Muthamizh Selvan)
Scientist 'E' (Project Elephant)
Email id: km.selvan@gov.in
Telephone No. 011-24695067

Copy to: For information and necessary action.

- PCCF&HoFF, All Elephant Range States/UTs.
- PPS to IGF (Wildlife), MoEF&CC.
- PS to IGF& Director (Project Elephant), MoEF&CC.

True Copy

सत्यमेव जयते

भारत सरकार/Govt. of India
विद्युत मंत्रालय/Ministry of Power
केन्द्रीय विद्युत प्राधिकरण/Central Electricity Authority
मुख्य विद्युत निरीक्षणालय प्रभाग/Chief Electrical Inspectorate Division
****

CEI/1/2/2022/522 Dated: 31.08.2022

To,

1. Chairman & Managing Director of all DISCOMs
2. Chairman & Managing Director of all TRANSCOs

Sub: Advisory regrading implementation of measures to mitigate the impact of power transmission lines and other power infrastructure on elephant and other wildlife.

विषय: हाथी और अन्य वन्यजीवों पर बिजली पारेषण लाइनों और अन्य बिजली के बुनियादी ढांचे के प्रभाव को कम करने के उपायों के कार्यान्वयन की सलाह।

महोदय/ महोदया,

In the 17th Steering Committee of Project Elephant held on 12.08.2022 at Periyar Elephant Reserve, Hon'ble Minister of Environment, Forest & Climate Change emphasized the need for continuous monitoring of the condition of the lines/conductors so as to avoid sagging/ loose ends, etc. and for undertaking other suitable protective measures for the lines passing through elephant reserves and wildlife sanctuaries with special attention in monsoon months, so that any untoward incidents are avoided and deaths caused by electrocution may be minimized/eliminated.

It is also informed that MOEF&CC vide their letter No. 6-104/2019 WL dated 29/08/2019 (copy enclosed) had requested the concerned stakeholders for implementation of the recommendations of the task force constituted by the MOEF&CC. All stakeholder are advised to take necessary measures as mentioned below:

1) **Rectification of sagging** transmission lines and cable of existing transmission line in the protected areas by the Electricity Supply Utilities, DISCOMs, Transmission companies, and State Electricity Boards. Minimum required clearances as specified in the CEA (Measures Relating to Safety and Electric Supply) regulation, 2010 (as amended) shall be maintained.

2) **Joint inspection** of every transmission / distribution line passing through the protected areas or passing through the vicinity of protected Areas (which are frequented by wild animals) by officials of DISCOMs/TRANSCOs and Forest Department regularly, at least thrice a year, once before onset of monsoon and once after monsoon so as to identify potential problem stretches.

Contd/..

18–ए, शहीद जीत सिंह मार्ग, कटवारिया सराय110016-नई दिल्ली - टेलीफैक्स: 011-26565183 ईमेल:cea-eidivision@nic.in वेबसाइट: http://www.cea.nic.in/cei.html
18-A, Shaheed Jeet Singh Marg, Katwaria Sarai, New Delhi-110016– Telefax-011-26565183 Email: cea-eidivision@nic.in Website:http://www.cea.nic.in/cei.html

3) The distribution companies shall preferably **use ABC (aerial bunched cables) or underground cable** to prevent electrocution of animals in the forest areas. In case of the overhead lines, the clearance above ground of the lower conductor of 11 kV / 33 kV overhead lines should be as per CEA (Measures Relating to Safety and Electric Supply) regulation, 2010 (as amended).

4) **Setting up of reinforced electric poles** fitted with spikes to prevent elephants rubbing against them. Also, **insulate overhead wires** across all elephant habitat and elephant movement zones and remove / dismantle all defunct solar powered fences.

5) Forest Department shall **inform the concerned power supplier about electrocution** occurring in and around forest area. All electrical accidents are to be investigated by Electrical Inspector and suitable measures shall be taken up.

It is also requested to ensure strict compliance of the recommendations of the task force as mentioned above to mitigate the impact of power transmission lines and other power infrastructure on wildlife with special attention to the monsoon season.

भवदीय,

(रमेश कुमार)
मुख्य अभियंता (सीईआई)

Annexure-XII

Elephant Reserves in India

Sl. No.	Elephant Reserve (ER)	State	Total Area (Sq. Km)
1.	Mayurjharna ER	West Bengal	414
2.	Singhbhum ER	Jharkhand	13440
3.	Mayurbhanj ER	Odisha	3214
4.	Mahanadi ER	Odisha	1038
5.	Sambalpur ER	Odisha	427
6.	Badalkhol-Tamorpingla	Chhattisgarh	1143.34
7.	Lemru Elephant Reserve	Chhattisgarh	1995.48
8.	Kameng ER	Arunachal Pradesh	1892
9.	Sonitpur ER	Assam	1420
10.	Dihing-Patkai ER	Assam	937
11.	South Arunachal ER	Arunachal Pradesh	1957.50
12.	Kaziranga – Karbi Anglong ER	Assam	3270
13.	Dhansiri-Lungding ER	Assam	2740
14.	Intanki ER	Nagaland	202
15.	Singphan ER	Nagaland	23.57
16.	Chirang-Ripu ER	Assam	2600
17.	Eastern Dooars ER	West Bengal	978
18.	Garo Hills ER	Meghalaya	3,500
19.	Mysore ER	Karnataka	8055.94
20.	Dandeli ER	Karnataka	2321.11
21.	Wayanad ER	Kerala	1200
22.	Nilgiri ER	Tamil Nadu	4663
23.	Rayala ER	Andhra Pradesh	766
24.	Nilambur ER	Kerala	1419
25.	Coimbatore ER	Tamil Nadu	566
26.	Anamalai ER	Tamil Nadu	1457
27.	Anamudi ER	Kerala	3728
28.	Agasthyamalai ER	Tamil Nadu	1197.48
29.	Periyar	Kerala	3742
30.	Srivilliputtur ER	Tamil Nadu	1249
31.	Shivalik ER	Uttarakhand	5405
32.	Uttar Pradesh ER	Uttar Pradesh	744
33.	Terai ER	Uttar Pradesh	3072.358
	TOTAL		**80,777.778**

True Copy

Annexure-XIII

F.No. 7-1/2021-PE

Government of India/ भारत सरकार

Ministry of Environment, Forests & Climate Change/ पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय

(Project Tiger & Elephant Division / व्याघ्र एवं हाथी परियोजना प्रभाग)

****

6th Floor, Jal Wing,
Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj,
New Delhi-110003
Dated 22nd August, 2023

To

The Principal Chief Conservator of Forests (WL) &
Chief Wildlife Warden,
All States/UTs.

Sub: Report on Elephant Corridors of India -reg.

Madam/Sir,

Elephant is long ranging landscape species which moves from one habitat to another through corridors. Long- term conservation of elephants can be ensured only by maintaining viable population within suitable habitats, which could be well connected, with other habitats by protecting and strengthening the existing corridors.

The Elephant Task Force Report, 2010 'Gajah' had listed 88 elephant corridors in the country. The Ministry had been communicating to the States/UTs to assess the feasibility of protecting and conserving these corridors and take appropriate measures.

In continuation of the efforts being made by the States/UTs, the Ministry along with the support of State Forest Departments initiated the ground validation of elephant corridors across the country in August 2021 and completed the task in July, 2023.

As a result, 150 elephant corridors have been identified with their significance and conservation needs. A report titled **"Elephant Corridors of India (2023)"** comprising information pertaining to all the identified elephant corridors was released by the Hon'ble Minister, EFCC during the World Elephant Day 2023 held on 12th August, 2023 at Bhubaneswar, Odisha (copy enclosed). The report was deliberated in the 19th Steering Committee meeting of Project Elephant wherein Chief Wildlife Wardens or their representatives were present.

As reiterated in the report, the number of elephant corridors presented is best considered minimum, and can be subject to modification based on the field data and inputs. The Sates/UTs are requested to take necessary steps to protect and conserve the elephant corridors and keep updating the Ministry with their field inputs and actions taken for further updating the report in future.

A copy of the report is enclosed herewith for consideration and necessary actions.

Yours faithfully,

Encls: As above

22.8.23
(Ramesh Kumar Pandey)
Inspector General of Forests (PT&E) & Director (PE)

True Copy

Elephant Corridors ground-validated

Sl. No.	Corridors	State
1	Tri-Junction Corridor	Andhra Pradesh
2	Rayala ER	Andhra Pradesh
3	Pakke-doimara at dedzelling	Arunachal Pradesh
4	Dulung- subansiri	Arunachal Pradesh
5	Dering- mebo (sigar nalla)	Arunachal Pradesh
6	Pakke- papum longka nalla	Arunachal Pradesh
7	Pakke- papum seijosa nalla	Arunachal Pradesh
8	Pakke doimara at tippi	Arunachal Pradesh
9	Durpong-Doimukh at Khundakhuwa	Arunachal Pradesh
10	D'ering - Mebo at Kongkul	Arunachal Pradesh
11	Deosur Corridor	Assam
12	Bogapani Corridor- Upper Dihing East- Upper Dihing West Block	Assam
13	Panbari Corridor	Assam
14	Kotha Buridehing Corridor	Assam
15	Kanchanjuri Corridor	Assam
16	Hatidandi Corridor	Assam
17	Haldhibari Corridor	Assam
18	Golai- Pawai corridor- Upper Dihing East- Upper Dihing West Block Corridor	Assam
19	Kukurakata-Bagser at Amguri	Assam
20	Charduar-Singri Hill	Assam
21	D’ering- Dibru Saikhowa Corridor	Assam and Arunachal Pradesh

True Copy

22	Kalapahar- Doigrung Corridor	Assam and Arunachal Pradesh
23	Jamui- Jhajha- Chakayi	Bihar
24	Charmar- jingol	Chhattisgarh
25	Nagdhara-Baraud	Chhattisgarh
26	Hati-Kudmura	Chhattisgarh
27	Chaal - Kartala	Chhattisgarh
28	Korondha - Rupunga	Chhattisgarh
29	Balco-Etma Nagar	Chhattisgarh
30	Balco-Katghora	Chhattisgarh
31	Khod-Rihand	Chhattisgarh
32	Ghat Pendari-Pakni	Chhattisgarh
33	Bhagabilla- Ratnasai Corridor	Jharkhand
34	Jampani- Bhagabilla Corridor	Jharkhand
35	Sangajata- Haldipokhar Corridor	Jharkhand
36	Lepang- Dumuria Corridor	Jharkhand
37	Ankua- Ambia Corridor	Jharkhand
38	Raibera- Pulbaburu Corridor	Jharkhand
39	Dalapani - Suklara Corridor	Jharkhand
40	Dalma – Chandil Corridor	Jharkhand
41	Dumariya - Nayagram Corridor	Jharkhand
42	Silli - Angara	Jharkhand
43	Bharno – Bero - Kara / Sisai- Karra	Jharkhand
44	Dalma- asanbani	Jharkhand
45	Dalma - rugai	Jharkhand
46	Siyaljora - Dhobadhobin Corridor	Jharkhand

True Copy

47	Dalapani - Kankrajhor Corridor	Jharkhand and West Bengal
48	Anjadbera-Bichaburu	Jharkhand
49	Dumriya-Kundaluka and Murakanjia	Jharkhand
50	Kaniyanpura - Moyar	Karnataka
51	Begur - Brahmagiri	Karnataka and Kerala
52	Edayarahalli - Doddasampige	Karnataka
53	Edayarahalli - Guthiyalathur	Karnataka
54	Talamalai - Chamrajnagar (Pununjur)	Karnataka
55	Karadikkal - Madeshwara	Karnataka
56	Talamalai - Chamrajnagar (Muddahalli) (Talavadi- mudahalli)	Karnataka and Tamil Nadu
57	Kudrakote- Thirunelly	Kerala
58	Kottiyur- Peria	Kerala
59	Peria- Pannippad (Peria at Pakranthalam)	Kerala
60	Nilambur- Appankappu	Kerala
61	Nilambur Kovilakam- New Amarambalam	Kerala and Tamil Nadu
62	Rewak- Emangre Corridor	Meghalaya
63	Nokrek- Emangre Corridor	Meghalaya
64	Siju- Rewak Corridor	Meghalaya
65	Balpakram- Baghmara	Meghalaya
66	Ranggira- Nokrek Corridor	Meghalaya
67	Saipung- Narpuh Corridor	Meghalaya
68	Geleki- Sitap corridor	Nagaland
69	Abhaypur- Singphan corridor	Nagaland
70	Hollongapar- Longtho corridor	Nagaland

True Copy

71	Daldali- Dimapur corridor	Nagaland
72	Geleki- Tuli corridor	Nagaland
73	Desoi- Changdang corridor	Nagaland
74	Tirutilip- Longchem corridor	Nagaland
75	Telkoi - Pallahada corridor	Odisha
76	Karo - Karampada corridor	Odisha
77	Deuli - Suliapada	Odisha and West Bengal
78	Similipal - Hadagarh - Kuldiha (Simlipal- Satkosia) (Baula-kuldiha)	Odisha
79	Maulabhanja - Jiridamali - Anantapur	Odisha
80	Kanheijena - Anantapur	Odisha
81	Nuagaon - Baruni	Odisha
82	Buguda - Central RF	Odisha
83	Tal - Kholgarh	Odisha
84	Barapahad - Tarva - Kantamal	Odisha
85	Kotagarh - Chandrapur (Kotagarh – Pankhalgudi)	Odisha
86	Karlapat - Urlandi	Odisha
87	Badampahar - Dhobadhobin	Odisha and Jharkhand
88	Badampahar - Karida East	Odisha and Jharkhand
89	Srivilliputur-Saptur	Tamil Nadu
90	Kallhatti – Sigur at Glencorin	Tamil Nadu
91	Avarahalla at sigur	Tamil Nadu
92	Kalmalai – Singara and Avarahalla,	Tamil Nadu
93	Moyar – Avarahalla	Tamil Nadu
94	Siluvaimedu - Kadamparai Corridor	Tamil Nadu

True Copy

95	Anamalai at Waterfalls estate	Tamil Nadu
96	SHOLAYAR DAM (Vazhachal – Anaimalai via sholayur)	Tamil Nadu
97	Topslip to Navamalai	Tamil Nadu
98	TANTEA (Vazhachal – Anaimalai via Ryan)	Tamil Nadu
99	Talamalai – Guttiyalattur	Tamil Nadu
100	Mukurthi – Mudumalai Corridor	Tamil Nadu
101	Anaikatti North – Anaikatti South	Tamil Nadu
102	Anamalai at punachi	Tamil Nadu
103	Kallar at Gandhapalllayam (Jaccanaire Slope - Hulikal Durgam)	Tamil Nadu
104	Thalli- bilikal	Tamil Nadu and Karnataka
105	Bilikal- jawalagiri	Tamil Nadu and Karnataka
106	Mudumalai – Nilambur via O' Valley	Tamil Nadu and Kerala
107	Basanta Corridor	Uttar Pradesh
108	Laljhadi corridor	Uttar Pradesh
109	Chhedia corridor	Uttar Pradesh
110	Dudhwa-Katarniaghat corridor	Uttar Pradesh
111	Khata corridor	Uttar Pradesh
112	Laggabagga-Tatarganj-Shukhlaphanta Corridor	Uttar Pradesh
113	Shiwalik	Uttar Pradesh
114	Rawasan-Sonanadi corridor ie Rajaji- Corbett Corridor	Uttar Pradesh
115	Kansrau – Barkote	Uttarakhand
116	Motichur – Barkote (Teenpani)	Uttarakhand
117	Motichur – Gohri	Uttarakhand
118	Chilla – Motichur	Uttarakhand

119	Rawasan – Sonanadhi (Upper arm)	Uttarakhand
120	Malani – Kota: Kosi corridor	Uttarakhand
121	Chilkiya – Kota: Kosi corridor near Sundarkhal	Uttarakhand
122	Fatehpur – Gadgadia (Nihal – Bhakra)	Uttarakhand
123	Kilpura – Khatima	Uttarakhand
124	Gorai Tanda (Gola)	Uttarakhand
125	Titi- Dumchi - Reti Corridor	West Bengal
126	Titi- Reti Corridor	West Bengal
127	Kalikunda-Chandra through Manikpara Corridor	West Bengal
128	Nayagram-- Jamboni through keshorrekha Corridor	West Bengal
129	Chandabila Tapoban- Dhumsi through Keshorrekha Corridor	West Bengal
130	Kalaikunda- Chandra through Satpadi ghat Corridor	West Bengal
131	Gidhni- Jamboni Corridor	West Bengal
132	Chandua- Joka Corridor	West Bengal
133	Kankrajhore- Lalgarh Corridor	West Bengal
134	Apalchand- Mahananda Corridor	West Bengal
135	Apalchand- Gorumara Corridor	West Bengal
136	Apalchand- Klimpong at Mal block (via Meenglass) Corridor	West Bengal
137	Apalchand- Klimpong at Mal block (via Sylee) Corridor	West Bengal
138	Nimati- Chilpata (Buxa- Chilpata) Corridor	West Bengal
139	Buxa- Titi (via Beech and Bharnobari Tea Garden) Corridor	West Bengal
140	Buxa- Titi (via Torsha) Corridor	West Bengal
141	Buxa- Ripu at Sankosh Corridor	West Bengal
142	Mahananda- Kolabari- Tukriajhar Corridor	West Bengal
143	Mahilong- Kalimati Corridor	West Bengal
144	Jhalda- Baghmundi Corridor	West Bengal
145	Chapramari - Kalimpong Corridor	West Bengal

True Copy

146	Moraghat–Central Daina Corridor	West Bengal
147	Reti–Central Daina Corridor	West Bengal
148	Chandil- Matha Corridor	West Bengal and Jharkhand
149	Gobarghusi- Jhunjhaka- Banduan Corridor	West Bengal and Jharkhand
150	Moraghat- Reti Corridor	West Bengal

True Copy

Annexure-XIV(Colly)

F. No. 6-7/2024-PE
Government of India/ भारत सरकार
Ministry of Environment, Forest & Climate Change/ पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
(Project Tiger & Elephant Division / व्याघ्र एवं हाथी परियोजना प्रभाग)
****

Indira Paryavaran Bhawan,
Jor Bagh Road, New Delhi-110003

Dated: 12th September, 2024

To,

The Principal Chief Conservator of Forests
& Chief Wildlife Warden,
Government of Kerala.
Forest Headquarters, Trivandrum-695014,
Kerala.

Sub: O.A. No. 1043 of 2024 before Hon'ble NGT (SZ), Chennai-Suo Motu matter initiated on a news item appearing in the Hindu dated 19.07.2024 titled "845 elephant deaths recorded in Kerala in 8 years" - reg.

Sir,

The undersigned is directed to forward to you a news report published in the Hindu Newspaper dated 19.07.2024 titled as **"845 elephant deaths recorded in Kerala in eight years"** and a copy of Order dated 05.08.2024 passed by the Hon'ble NGT, Principal Bench, New Delhi.

2. In the aforesaid context, Hon'ble NGT, Principal Bench, New Delhi has taken *suo-motu* cognizance on news item. The MoEF&CC through Regional Office, Bangalore and PCCF & CWLW, Kerala have been impleaded as Respondents in the captioned O.A.

3. In view of the above, it is requested to look into the above-captioned matter and submit a detailed report. The information may kindly be provided to this Ministry through email at the earliest please, as the next date of hearing is on **30.09.2024** listed before the Hon'ble NGT (SZ), Chennai (*transferred by Principal Bench*).

(Encls. as above)

Signed by
Dheeraj Mittal
Date: 12-09-2024 19:14:01

Yours faithfully,

(Dr. Dheeraj Mittal)
Asst. Inspector General of Forests

True Copy

Copy to:
1. Principal Secretary, Forest and Wildlife Department, Govt. of Kerala for information.
2. PCCF & HoFF, Forest Department, Govt. of Kerala for information.

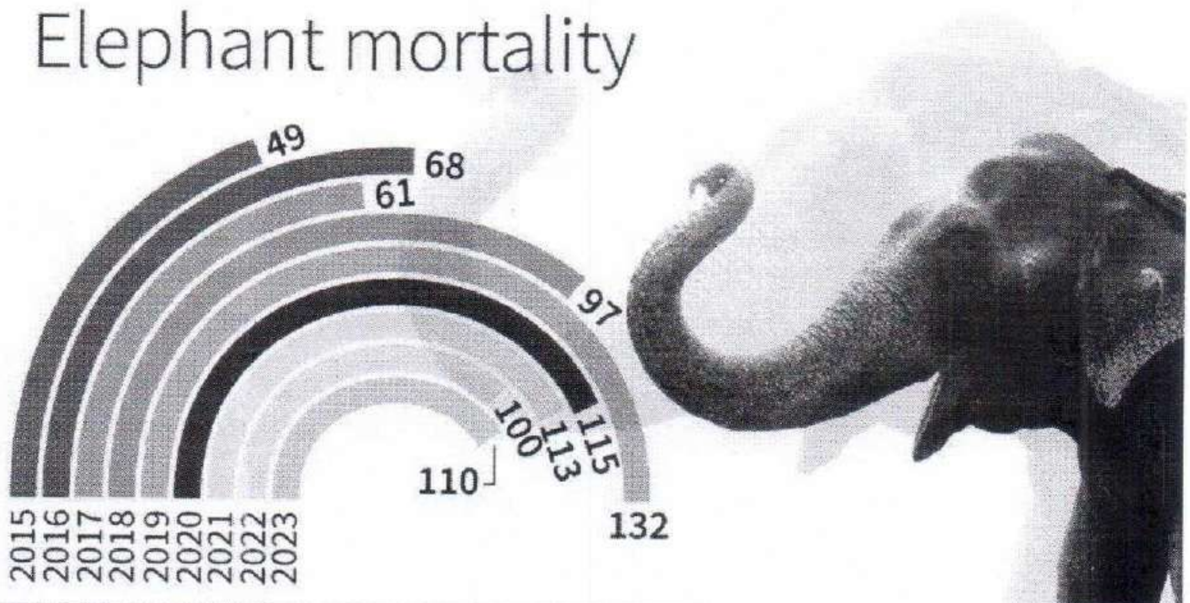
845 elephant deaths recorded in Kerala in eight years

Younger elephants, particularly those under 10 years of age, face the highest risk of mortality, according to an elephant population estimation undertaken in the State's four elephant reserves

Updated - July 19, 2024 06:18 pm IST

Published - July 18, 2024 06:47 pm IST - THIRUVANANTHAPURAM

SARATH BABU GEORGE



Kerala's forests have recorded 845 elephant deaths between 2015 and 2023 with studies indicating an increasing trend in death rate over time.

The findings were given in the report of an elephant population estimation undertaken in the State's four elephant reserves.

An analysis also highlights a stark trend: younger elephants, particularly those under 10 years of age, face the highest risk of mortality, with an alarming rate of approximately 40%. This increase in deaths among calves has been attributed to Elephant Endotheliotropic Herpesviruses – Haemorrhagic Disease (EEHV-HD) that coexist with elephants.

The Forest department has cited a recent study in Sri Lanka that shed light on the potential mitigating factors against the herpesvirus. It has been observed that calves in larger herds exhibit better survival rates due to shared immunity. Exposure to various strains within larger herds enables calves to develop antibodies that effectively combat EEHV-HD, thus enhancing their chances of survival.

The population estimation report underscores the need to restore natural habitats and prevent fragmentation of elephant herds to prevent EEHV-HD from becoming a major threat to the survival of Asian elephants in the region. Elephant herd sizes are found to shrink significantly in sub-optimal habitats where fodder availability is severely constrained.

Current threats

The document also observes that elephants have been facing increasing vulnerability due to shrinking habitats and rising fragmentation exacerbated by climate change. Key factors contributing to their susceptibility include declining population sizes, sensitivity to high temperatures, competition from invasive plant species disrupting their food sources, and heightened susceptibility to diseases.

It also reports several critical variables influencing elephant distribution patterns, including land-use changes, water balance in the climate, temperature fluctuations, and disturbances are induced by human activities.

Recognising the need for a systematic approach to understand and mitigate elephant deaths, the study has recommended a structured protocol akin to Tamil Nadu's Elephant Death Audit Framework (EDAF). The proposed framework would facilitate comprehensive investigations into the causes of elephant deaths, helping to identify patterns, assess threats, and implement targeted conservation measures effectively.

Item No. 04 Court No. 1

BEFORE THE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI

Original Application No. 1043/2024

News Item appearing in The Hindu dated 19.07.2024 Titled "845 elephant death recorded in Kerala in 8 years"

Date of hearing: 05.08.2024

CORAM: **HON'BLE MR. JUSTICE PRAKASH SHRIVASTAVA, CHAIRPERSON**
HON'BLE MR. JUSTICE ARUN KUMAR TYAGI, JUDICIAL MEMBER
HON'BLE DR. A. SENTHIL VEL, EXPERT MEMBER

Respondent: Mr. Alim Anvar & Mr. Nishe Rajen Shonker, Advs. for R - 2 & 3

ORDER

1. This original application is registered *suo motu* on the basis of the news item titled "845 elephant death recorded in Kerala in eight years" appearing in The Hindu dated 19.07.2024.

2. The news item relates to the 845 elephant deaths in Kerala in the past few years. As per the article, between 2015 and 2023, Kerala's forests recorded 845 elephant deaths, with studies indicating an increasing death rate, particularly among elephants under 10 years old. Approximately 40% of these young elephants die due to Elephant Endotheliotropic Herpesvirus-Haemorrhagic Disease (EEHV-HD). Research shows that calves in larger herds, which share immunity, have better survival rates against EEHV-HD, suggesting that maintaining large herds can mitigate the disease's impact. The Forest Department emphasizes the need to restore natural habitats and prevent fragmentation to combat this threat.

3. The news item highlights current threats to elephants include habitat shrinkage, fragmentation, climate change, and competition from

invasive plant species, all are exacerbating their vulnerability. These factors contribute to declining population sizes, increased sensitivity to high temperatures, and heightened disease susceptibility. Elephants' distribution is also affected by land-use changes, water balance, temperature fluctuations, and human-induced disturbances. The study recommends adopting a protocol similar to Tamil Nadu's Elephant Death Audit Framework (EDAF) for Kerala to systematically investigate elephant deaths. This framework would help identify patterns, assess threats, and implement targeted conservation measures.

4. The news item raises substantial issue relating to compliance of the environmental norms, especially compliance of Environment Protection Act of 1986 and the Biological Diversity Act, 2002.

5. Power of the Tribunal to take up the matter *suo-motu* has been recognized by the Hon'ble Supreme Court in the matter of *"Municipal Corporation of Greater Mumbai vs. Ankita Sinha & Ors." reported in 2021 SCC Online SC 897.*

6. Hence, we implead the following as respondents in the matter:

(1). Ministry of Environment, Forest & Climate Change, through its Regional office, Kendriya Sadan, 4th Floor, E&F Wings, 17th Main Road, Koramangala II Block, Bangalore – 560034

(2). Principal Chief Conservator of Forest, Kerala, Van Laxmi Forest Headquarters, Trivandrum – 695014, Kerala

(3). Chief Wildlife Warden, Kerala, Vanalakshmi, Forest Headquarters, Vazhuthacaud, Thiruvananthapuram - 695014, Kerala

7. Mr. Alim Anvar & Mr. Nishe Rajen Shonker, Advocates accept notice on behalf of Respondent No. 2 & 3 and seeks four week's time to file the reply. Let Notice be issued to Respondent No. 1 for filing the response before the appropriate Bench of the Tribunal at least one week before the next date of hearing.

8. Since the matter falls within the jurisdiction of Southern Zonal Bench of the Tribunal, therefore, the OA is transferred to the Southern Zonal Bench, Chennai for appropriate further action. Let the original record of the OA be transferred to Southern Zonal Bench, Chennai.

9. List before Southern Zonal Bench at Chennai on 30.09.2024.

Prakash Shrivastava, CP

Arun Kumar Tyagi, JM

Dr. A. Senthil Vel, EM

August 05, 2024
Original Application No. 1043/2024
SN

PRAMOD G. KRISHNAN IFS
Additional Principal Chief Conservator of Forests (Administration) &
Chief Wildlife Warden, Kerala

Forest Headquarters
'Vanalakshmi', Vazhuthacaud
Thiruvananthapuram - 695 014,
Keralam
Phone: +91-471-232 1610
Mobile: +91-9447 979 003
Email: cww.for@kerala.gov.in

KFDHQ/6967/2024-CWW/WL8 Dated: .11.2024

To

The Assistant Inspector General of Forests,
Ministry of Environment, Forest & Climate Change,
Project Tiger & Elephant Division
Indira Paryavaran Bhawan, Jor Bagh Road,
New Delhi-110003.

Sir,

Sub : Kerala Forest Department – OA No.1043 of 2024 before Hon'ble NGT(SZ), Chennai - OA.No. 1043 of 2024 (PB) and renumbered as OA.No. 259 of 2024(SZ) – Suo Motu matter initiated on a news item appearing in the Hindu dated 19.07.2024 titled "845 elephant deaths recorded in Kerala in 8 years" - reg.

Ref : That Office Letter No. F.No.6-7/2024-PE dated 12.09.2024.

Attention is invited to the above subject and reference cited. Kerala is part of a larger landscape in the Western Ghats which is one of the prominent elephant conservation areas in the world. The management of elephant population in its all complexity (eg., conservation, mitigating human-elephant conflicts etc.) is one of the crucial management imperatives of the Kerala Forest Department.

Kerala Forest Department has always striven to look into various aspects of elephant population including natality, mortality and changes in demography. It may please be noted that the news report itself is based on the wild elephant population estimation report published by the Kerala Forest Department.

However, in the above circumstances, the Government of Kerala vide GO(RT) No.451/2024/F&WLD dated 15.10.2024 has constituted an Expert Committee (copy enclosed) comprising of five members to critically look into the mortality of wild elephants in Kerala during the last ten years. The Expert Committee in consultation with the experts in the field shall examine the details of the mortality of wild elephants in Kerala and shall also submit detailed report within three months to the Government. The first meeting of the Committee was held on 30.10.2024. It is expected that the findings of this Committee would reveal whether these mortality patterns are normal as expected in nature or are there any unnatural patterns involved that require closer examination and action.

Besides, in future, in order to conduct a detailed and systematic analysis of death of wild elephants, an Elephant Death Audit Framework (a software driven protocol) is also being developed for application in the field.

Yours faithfully,

Signed by
Pramod G Krishnan
Date: 07-11-2024 09:29:37

Additional Principal Chief Conservator of Forests (Administration) &
Chief Wildlife Warden, Kerala

GOVERNMENT OF KERALA

Abstract

Forest & Wildlife Department - Expert Committee for the study on Elephant Mortality in Kerala - Constituted - Orders issued.

FOREST & WILDLIFE(D) DEPARTMENT

G.O.(Rt)No.451/2024/F&WLD Dated,Thiruvananthapuram, 15-10-2024

Read Letter No. KFDHQ/6233/2024-CWW/WL8 dated 10.09.2024 from the Principal Chief Conservator of Forests(Wildlife) & Chief Wildlife Warden, Kerala

ORDER

Elephant being a flagship species, play a vital role in maintaining the ecological balance of ecosystems. Kerala is part of a larger landscape in the Western Ghats which is one of the prominent elephant conservation areas in the world. The management of elephant population in its all complexity (eg., conservation, mitigating human-elephant conflicts etc.) is one of the crucial management imperatives of the Kerala Forest Department these days. In this background, in the interests of science and management, it is desirable to look at the figures of elephant mortality in Kerala during the last one decade to understand the nature, reasons, pattern, etc.

2. As per the letter read above, the Principal Chief Conservator of Forests(Wildlife) & Chief Wildlife Warden, submitted a proposal for constituting an Expert Committee with respect to the mortality of wild elephants in Kerala.

3. Government have examined the matter in detail and are pleased to constitute the Expert Committee, with the following members, for criticality looking at the mortality of wild elephants in Kerala during the last ten years,

Structure of the Expert Committee

1. Shri. Pramod.G.Krishnan IFS, Additional Principal Chief Conservator of Forests (Administration)holding full additional charge of the

Principal Chief Conservator of Forests (WL) & Chief Wildlife Warden - Chairman

2. Dr. Arun Zachariah, Forest Veterinary Officer - Member
3. Shri. Radhakrishnan S.R., Deputy Conservator of Forests (Project Elephant), O/o the PCCF(WL) & CWW, Kerala - Convenor
4. Shri. Manu Sathyan, Divisional Forest Officer, Flying Squad, Ernakulam and Nodal Officer, HAWK - Member
5. Dr. Balasubramanyam, Lead Wildlife Expert, Parambikulam Tiger Conservation Foundation - Member

4. The committee can seek advise or opinion of experts in the field , if required. If scientific tests are required in the matter, the report or opinion of such experts shall be obtained. The committee shall submit a detailed report, on the mortality of wild elephants in Kerala during the last ten years, within three months to Government.

Necessary expenditure in this regard shall be met from the allotment in the existing Budget Head of Wildlife Wing.

(By order of the Governor)
PRAMOD V R
JOINT SECRETARY

To:

The Principal Chief Conservator of Forests & Head of Forest Force, Thiruvananthapuram

Shri. Pramod.G.Krishnan IFS, Additional Principal Chief Conservator of Forests (Administration) holding full additional charge of the Principal Chief Conservator of Forests (WL) & Chief Wildlife Warden
Dr. Arun Zachariah, Forest Veterinary Officer
Shri. Radhakrishnan S.R., Deputy Conservator of Forests (Project Elephant)
Shri. Manu Sathyan, Divisional Forest Officer, Flying Squad, Ernakulam and Nodal Officer, HAWK
Dr. Balasubramanyam, Lead Wildlife Expert, Parambikulam Tiger Conservation Foundation
The Principal Accountant General(Audit/A&E), Thiruvananthapuram
Stock File/Office Copy

Forwarded /By order

Signed by
Suja S K
Date: 16-10-2024 12:20:10

Section Officer

Copy to- PS to the Hon. Minister, Forest & Wildlife Department
PA to ACS, Forest & Wildlife Department

The Action points derived at the first meeting of the Expert Committee held on 30/10/2024 (formed vide GO(Rt.) No. 451/2024/F&WLD dated 15/10/2024)

1. Decided to create a mobile application for Elephant Death Analysis Framework (EDAF) by 1st December 2024.
2. Develop a long-term Monitoring Protocol.
3. The first draft report of the Committee will be prepared by 25th November 2024.

Chief Wildlife Warden

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL SOUTHERN ZONE, CHENNAI

O.A. No. 259 of 2024 (SZ)

Suo Moto matter in respect of news item appearing in the Hindu dated 19.07.2024 titled "845 elephant deaths recorded in Kerala in eight years".

Versus

MOEF & CC,
Through its Regional Office,
Bengaluru and Ors.

...Respondents

REPLY AFFIDAVIT FILED BY THE 1st RESPONDENT

M/s. Y. KAVITHA

Counsel for the 1st Respondent

Mob. 98415 86629