
HUMAN - LEOPARD CONFLICT MANAGEMENT GUIDELINES



VIDYA ATHREYA & ANIRUDDHA BELSARE

2007

MAHARASHTRA STATE FOREST DEPARTMENT

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FOREWORD

The Maharashtra Forest Department has been facing the serious problem of depredation by leopards, which has unfortunately led to death of a large number of persons in the last few years. While all efforts are being made to ensure that steps are taken to mitigate the situation and ensure that such conflicts are minimised, these were purely on an empirical footing since the problem had not been earlier studied in its totality. We are now fortunate to have such a study done by the Kaati Trust, Pune, under Vidya Athreya and Aniruddha Belsare, and it has been our endeavour to use the findings of the study to handle the problem from an ecological perspective. One of our top priorities has been to formulate practical guidelines for our staff to handle the problem.

I am therefore very happy that the Kaati Trust has now come out with the field manual for our staff and I am confident that this will help empower them to deal with the problem. This booklet, the first step towards better management of the conflict at the field level, will hopefully be found equally useful by the Forest Departments in other states where the problem unfortunately persists.

We are grateful to the Kaati Trust, in particular Vidya and Aniruddha, for this remarkable initiative and also to The Rufford Maurice Laing Foundation, U.K for funding the production of this manual.

B MAJUMDAR

**PRINCIPAL CHIEF CONSERVATOR OF FORESTS (WILDLIFE)
& CHIEF WILDLIFE WARDEN, MAHARASHTRA**

PREFACE

We have been involved in research and capacity building projects related to human-leopard conflict in Maharashtra since 2003. Our experience is that the Forest Department and the local veterinary officers often use antiquated methods to deal with conflict primarily due to lack of training and/or exposure to the conflict situation.

In 2006 VRA obtained a grant from the Rufford Maurice Laing Foundation (U.K) to publish a management manual for managers across India to better handle human-leopard conflict. The aim is to provide basic scientific information along with the legal aspects, related to conflict, so that better management practices are implemented.

The production of this booklet, is entirely due to the efforts of the Chief Wildlife Warden, Maharashtra (Mr B. Majumdar) who wanted it to be distributed as soon as possible to all the field level offices.

Our strategy over the last three years has been to

1. Obtain and share basic scientific information with Forest Department personnel.
2. Provide hands-on assistance to the Department on leopard related problems, both in the field and as scientific recommendations.

We hope this booklet is of practical use and we welcome feedback (critical and/or informative) so that this version can be improved.

Vidya R. Athreya

Aniruddha V. Belsare

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¹ from *An introduction to dealing with wildlife emergencies. Vol I Leopards*
by Dr Aniruddha Belsare

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I. INTRODUCTION

Human-leopard conflict is a complex issue influenced by political and social attitudes, the biology of the species, and management action. Effective management of conflict will have to strike a balance between minimizing serious conflict (attacks on people) and the long-term conservation of the leopard species. Although the leopard is commoner and more resilient than other large cat species that occur in India, it is poached in the largest numbers to meet the demand of the illegal wildlife trade (Athreya et al. 2004). The leopard is very adaptable, and can live close to human habitations.

The presence of a species like the leopard in a human dominated landscape will invariably lead to some predation on domestic animals. Carnivore density is known to be dependant on prey density (Carbone & Gittleman 2002, Karanth et al. 2004) and the leopard is no exception (Bothma et al. 1997, Marker & Dickman 2005, Mizutani & Jewell, 1998, Stander et al. 1997). Various studies across India have confirmed the important role of domestic dog* in

* Dogs, pigs, goats form an important part of leopards diet across many sites (Sanjay Gandhi National Park, Himachal Pradesh, Uttaranchal, Gujarat, Maharashtra (Mukherjee and Mishra, 2001; Edgaonkar and Ravi Chellam, 2002). Furthermore, studies from Junnar, Maharashtra show number of tended livestock taken by leopards is lower than expected indicating that the feral/untended animals probably constitute the most important prey of leopards living outside Protected Areas in India (Athreya et al. 2004).

the leopard's diet. It is likely that the abundance of feral animal populations helps sustain leopard populations in human dominated areas (example, in sugarcane fields and surrounding villages) in India.

Leopards can live near humans with low levels of conflict (McDougal 1991, Seidensticker 1990) and this has also been seen in India (Also see Athreya & Belsare 2006).

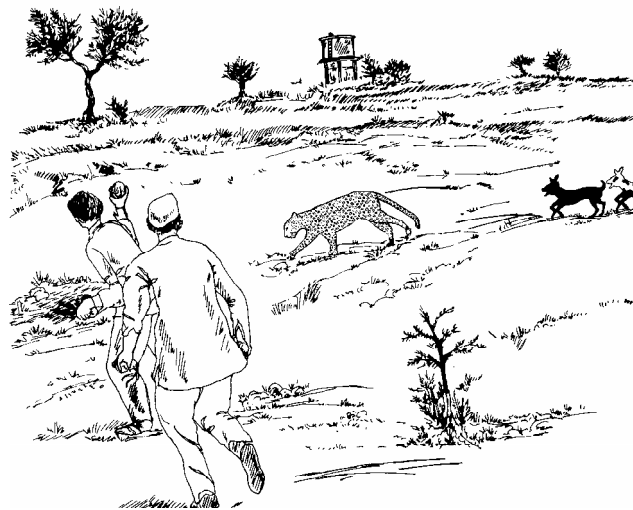
Examples of low conflict levels

a) Ahmednagar Forest Division, Nashik Forest Circle.

The landscape consists of rural habitations and crop fields with a population density of 258 people per km² (<http://ahmednagar.nic.in>). More than 60 leopards are estimated to inhabit the croplands of the 1717 sq. km Ahmednagar Forest Division. Sixty nine leopards were trapped in this region between 1999 and 2005 (Maharashtra Forest Department records).

Between December 2004 and October 2006, 19 leopards were trapped from the agricultural fields although no attacks on people were reported during this time indicating that these 19 adult animals lived in a human dominated area without attacking people (See Athreya & Belsare 2006).

-
- On 25 February 2005, a leopard fell into a well near the town of Sangamner in the Ahmednagar Forest Division but escaped via a ladder - no human attacks in the area before or after the incident.
 - On November 2005, a 75 kg male with chip 00-0658-D1AA escaped from a cage in the crowded town of Sangamner (Ahmednagar Division), after two weeks in captivity. No attacks on people after his escape.
 - The following picture illustrates the case of a leopard in Shevgaon, Nashik district. When first seen near a village, people chased it and in the confusion, the leopard injured few people before escaping. Trapping attempts were unsuccessful. No other attacks on people were reported following the incident.



b) Junnar Forest Division, Pune Forest Circle.

For an entire year prior to February 2001 no attacks on people were reported in the Junnar Forest Division. More than 60 leopards were removed in the following two years from croplands in a large scale trapping exercise that coincided with a large number of leopard releases in the adjoining Western Ghat forests. The same 60 leopards had lived in a human dominated landscape without serious conflict for an entire year (Athreya et al. 2004).

c) Example from a radio collared leopard in Nepal.

A radio-collared leopard in Nepal entered a cattle shed undetected at night. It spent the entire day in the cattle shed while people's activity continued around the shed and finally escaped the following night. The situation would have become a law and order problem if anybody had noticed its presence.

Information on attacks on people by leopards in some states of India.

States	Site of conflict	Habitat of conflict	No. people attacked (period)	Reference
Maharashtra	Junnar Forest Division	Sugarcane fields	51 (2001 – 2003)	Athreya et al 2004
	Sanjay Gandhi National Park	In and around Protected Area	13 (June 2004) 84 (2002 – 2004)	Maharashtra Forest Department records
	Ahmednagar Forest Division	Sugarcane fields	106 (1997 – 2005)	Maharashtra Forest Department records
W. Bengal	W & E. Duars	Tea gardens	121 (1990 – 1997)	WWF-India 1997 and Field Director, Buxa Tiger Reserve, personal communication.
Gujarat	Outside Gir National Park	Sugarcane fields and mango orchards	27 (1990 – 1999)	Vijayan and Pati 2001; Pati et al. 2004.
	Vadodara Forest Circle	Tall crops	850 (1992 – 2002)	Chaudhuri 2004
Uttaranchal	Garhwal	Near villages	352 (1991-2003)	UA Forest Department records

2 - 2.2

2. COMMON MANAGEMENT ACTION

Trap and release

2.1. THE LAW REQUIRES STRINGENT CONDITIONS TO BE FULFILLED BEFORE 'TRAPPING' A SCHEDULE I SPECIES.

The legal interpretation of Section 11 of the Wild Life (Protection) Act (1972) has been provided by Supreme Court Advocate on environment issues - Mr Ritwick Dutta (Dutta et al. 2004) as

'Attacks on livestock (categorised as property) or sighting of a leopard do not justify the trapping of a Schedule I species as per the Section 11 of the Wild Life (Protection) Act 1972'.

A careful interpretation of this section shows that the Chief Wildlife Warden is required to exercise care in permitting trapping.

2.2. TRAPPING PERMITTED AS PER SECTION 11 (WILD LIFE PROTECTION ACT 1972)?

Leopard fallen in a well*	NO
Leopard sighted near a village	NO
Leopard inside a chicken coop	NO

* See section 2.3.iv.(a)

2.3. i

Leopard attacked a goat outside a house	NO
Leopard pugmarks in village	NO
Leopard attacks people chasing it	NO
Attacks on people in one area	YES

IT IS IMPORTANT THAT THE FOREST DEPARTMENT'S FIELD STAFF, PUBLIC AND THE MEDIA ARE MADE AWARE OF THE COMPLEXITIES OF THE CONFLICT ISSUE SO THAT SPONTANEOUS AND OFTEN ARBITRARY DEMAND FOR TRAPPING OF LEOPARDS IS REDUCED.

2.3. RESCUE IN AN EMERGENCY SITUATION

General considerations when a leopard has to be rescued (e.g. from a well, snare, inside a house)

2.3.i. Safety of the people has to be kept in mind

- a. Assistance of the Police has to be sought to tackle the public. The Fire Department and volunteers can also aid the Forest Department in an emergency situation - It is important to control curious onlookers from crowding around the leopard to prevent agitating the animal further. Besides, the Emergency Response Team requires sufficient space to operate effectively. Most importantly if the leopard makes an

2.3.ii, iii

attempt to escape the chances of people getting hurt are reduced.

- A barrier (bamboo, fluorescent tape, brightly coloured tape) is necessary to cordon the area
- Heroics (example - trying to tackle the animal without any training or equipment) on the part of Forest Department personnel, volunteers and onlookers to be strictly prohibited.

b. Regular training of an Emergency Team has to be carried out - This is best done in advance and at regular intervals to reinforce the capacities of the staff and also to train new staff who might have joined since the last training and also enable the incorporation of fresh knowledge and experience.

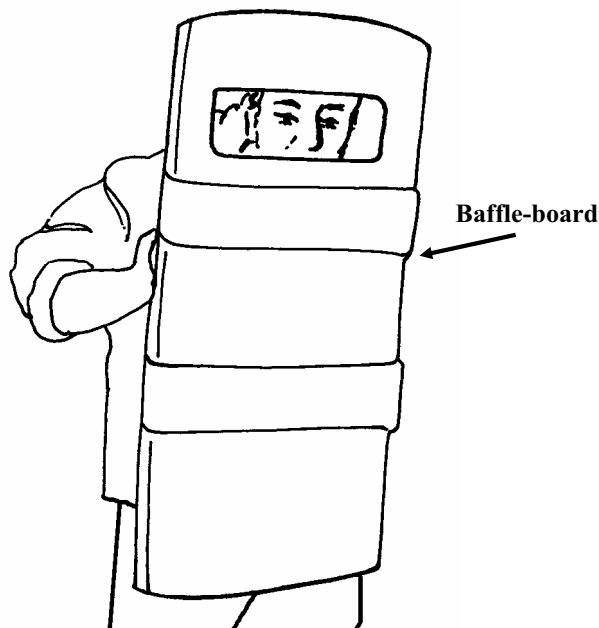
2.3.ii. Safety of the animal has to be kept in mind

- A veterinary doctor's services have to be availed of
- Prompt action will increase the success of the operation

2.3.iii. The Forest Department has to be prepared

- Appropriate remote drug delivery equipments (Blowpipe, gas pistol, rifle) and drugs should be available. Equipment should be in working condition, accessories and drugs should be in stock and not past their expiry date.

-
- Ensure that the veterinarians assisting in the procedure are trained for wildlife emergencies and have the emergency drugs (dexamethasone, adrenaline, diazepam, doxapram, sodium bicarbonate, nikethamide) on hand.
 - Inventory of miscellaneous items that could be useful in an emergency (like ropes, ladder, tarpaulin sheet, nets, baffle-boards¹) should be maintained.



¹ These can be made from fibre glass, a curved shield about 2.5 feet in width and 4 feet in length, and should be used only while approaching trapped/tranquilised leopards.

2.3.iv

- All equipment, stock of drugs and other materials need to be checked every month to ensure they are in good working condition and ready for use in an emergency.
- Contact details of personnel, veterinarians and volunteers to be summoned during emergencies have to be displayed at a prominent place in the Forest Office. This information needs to be regularly updated and shared with the concerned government agencies in advance.

2.3.iv. Specific considerations

The situation has to be gauged. If the area has not reported any attacks on people in the past and **if only the presence of a crowd is preventing the leopard from escaping then the crowd has to be dispersed and the animal allowed to escape** - preferably at night. Trapping of a leopard detailed in the following situations should not be resorted to unless the animal requires medical treatment (*See* Section 2.1 and 3 in this document).

If trapping of such an animal is necessary (because it is injured) it should be released in the vicinity of the site where found within a week after appropriate veterinary treatment. Care HAS to be taken that the said animal has minimal contact with people (**under no condition should the animal be displayed to the public**) when in captivity.

2.3.iv.(a), (b)

2.3.iv.(a) Rescuing from a well

- **Do not** attempt immobilization when the animal is in a well since it can fall into the water and drown.
- If the well has water, as an immediate measure lower a wooden plank (or a wooden charpai) for the animal to rest on.
- A ladder can be lowered into the well after clearing the area of people so that the animal can climb up and escape. To make sure that the animal obtains a firm grip, coir rope can be wound around the ladder.

If the animal is in a well and not injured seriously, it should be allowed to escape at night. Trapping as per Section 11 of the Wild Life Protection Act is not applicable to such animals (Ritwick Dutta, Advocate Supreme Court, personal communication). Apart from the legal issues, leopard conflict is likely to increase when these territorial animals are taken out of their territories and released elsewhere.

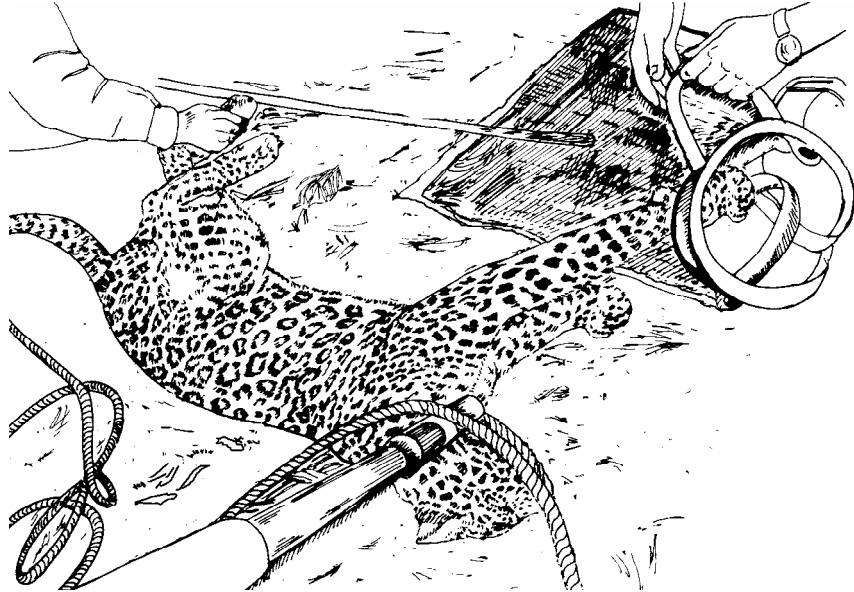
2.3.iv.(b) Rescuing from a house or a similar structure

- Seal all outlets securely and promptly after ensuring no person is inside.
- Use any local materials for sealing the site.
- Attempt immobilizing the animal from some opening (example, window, roof)

2.3.iv.(c), (d)

2.3.iv.(c). Rescuing from a foothold snare/trap

- Keep people out of the animal's sight to reduce stress and self inflicted injuries.
- Immobilize the animal from a safe distance and then attempt approaching the animal using any safety device like a baffle board.



2.3.iv.(d). Rescuing from a tree

- If the leopard to be immobilized is up on a tree, be prepared with strong nets of sufficient size and adequate number of volunteers (decided by official in charge) to catch the animal if it falls after immobilization.

Note: It is important that rescued leopards are released as soon as possible. In Maharashtra it is common for the Forest Department to be called to rescue leopards that have fallen into open wells and, in some instances, leopards ensnared in cable traps (about 30 each year based on information from Forest Department personnel). If the area has not reported attacks on people, if the leopard is not a cub and if the animal is healthy with only minor injuries, then it should be allowed to escape or be released as soon as possible in a nearby area not frequented by people and where the animal can be left undisturbed.

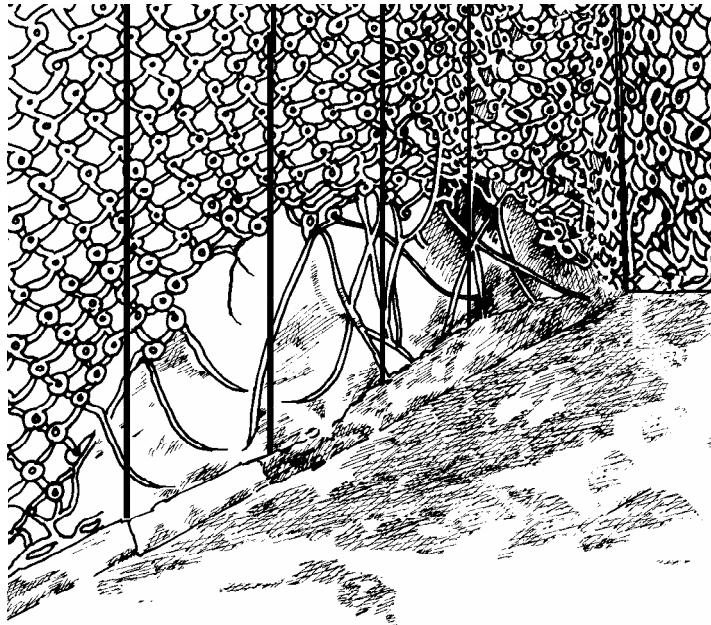
2.4. TRAP CAGES - IMPORTANT POINTS TO CONSIDER

In case trapping becomes a necessity, the following points should be kept in mind.....

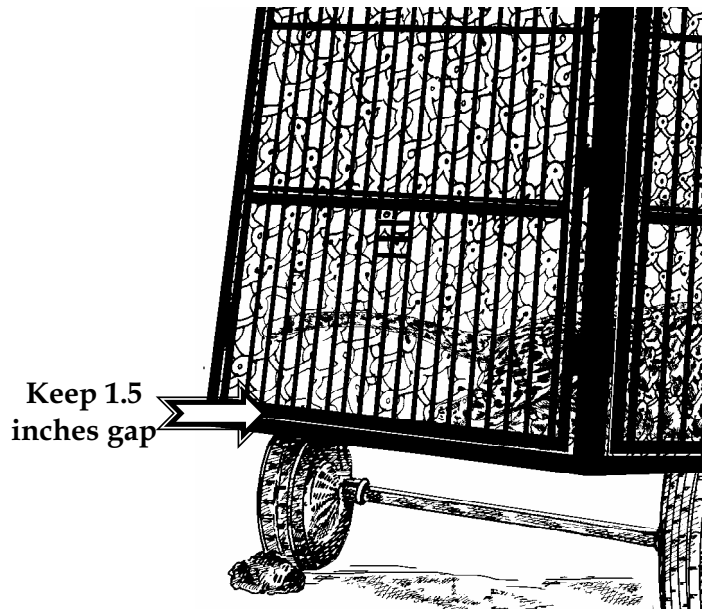
TRAP CAGES SHOULD

- ...be in good condition, with no sharp edges or wires and no rusting points (as shown below), and should be escape proof (especially the flooring)

(Reason - trapped leopards tend to bang against the cage and any sharp protruding objects will cause injury which could result in death of the animal)



-
-be inspected by the RFO periodically to make sure they are in working condition
 -have a gap of 1.5 inches between the cage floor and lower edge of the trap door
(Reason - to avoid the leopard's tail getting cut during trapping - a common occurrence)



-have 8 cm distance between the bars of the cage
(Reason - to prevent the canines from breaking when the leopard tries to bite the bars of the cage)

-
- **....should be well ventilated**

(Reason – to prevent the animal from dying due to overheating, especially in summer)

- **....be at least 6 feet in length [body length of the leopards of Maharashtra is on average 48" (4 feet) and tail length is 33" (about 3 feet) - data from 19 leopards] with the trap door activation region being at the extreme end, in the opposite direction to the trap door.**

(Reason – so that the trap door does not fall on the animal's back)

- **....be securely anchored during trapping procedure**

(Reason – the trap cage should not roll down or topple when placed on a slope).

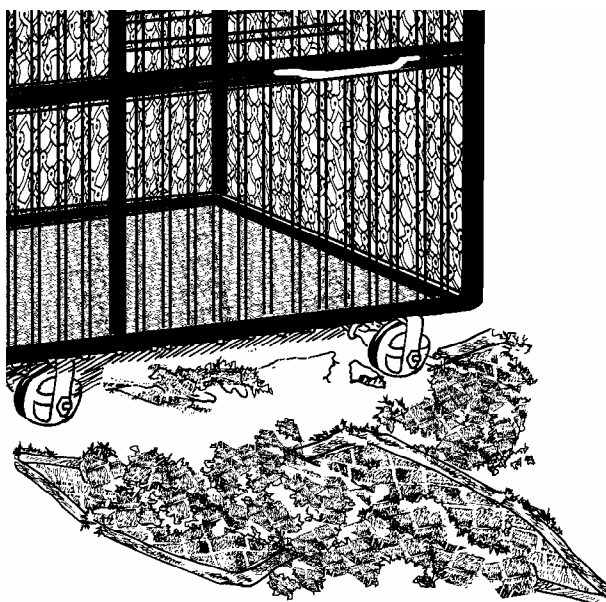
- **....never house a leopard. Each trap cage should have its associated housing cage. The Wild Life Protection Act (Appendix I in the Recognition of Zoos section) prescribes a minimum area of 2 x 1.5 x 2 metres for a feeding/retiring enclosure for a leopard.**

(Reason – long term maintenance of leopards in small trap cages makes it impossible for the staff to maintain hygienic conditions which in turn adversely affects the health of the animal).

-
-not have any padding

(Reason – leopards in their frenzy will bite any material in the cage and ingestion of the padding has led to their death)

The rubber mat placed at bottom of cage was shredded by the leopard



MORE THAN ONE LEOPARD SHOULD NOT BE KEPT IN A TRAP CAGE/TRANSPORT CAGE/HOUSING CAGE

(REASON – INFIGHTING CAN LEAD TO DEATH AND SERIOUS INJURIES). It is common to see many leopards in a single enclosure in India, possibly due to constraints of resources and

space. Infighting does not always occur, however we should be aware of their basic biology (they are solitary animals by nature) and the stress that they undergo in such situations may not be perceptible to humans.

2.5 POST - CAPTURE MANAGEMENT

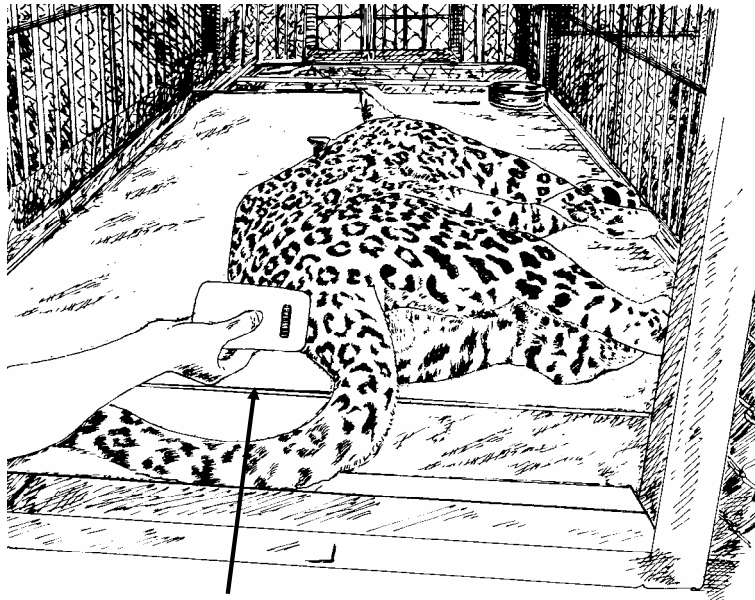
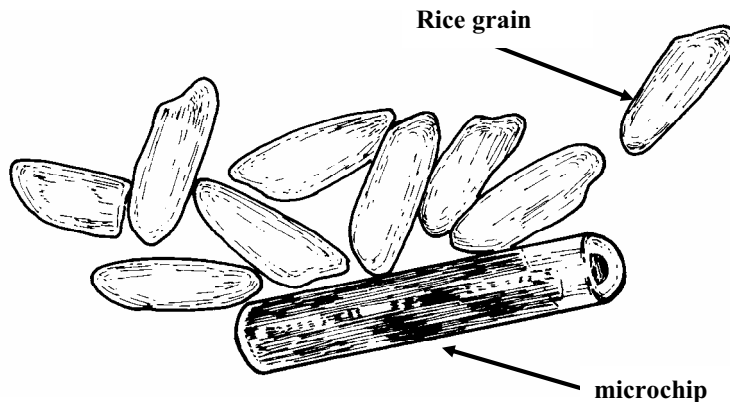
2.5.a. Immediately after trapping

- Cover the cage (greenhouse material/gunny sack material is recommended) and cordon off at least a 20 m radius around the cage.
- **No** person should be allowed to break the cordon.
- Media should not be allowed within the cordoned area, old file pictures and video recordings can be provided for their use
- If the crowd is unmanageable, then the covered trap cage should be immediately moved to a nearby Forest Department Nursery or Rescue Center or any place where the public can be kept out.

(Reason - leopards are HIGHLY stressed in the close proximity of people and in their attempt to flee, they will repeatedly bang against the cage leading to serious head injuries and death).

- **Check for microchip in the animal and if not found then mark the animal with a microchip (or radio collar if possible).**

(Reason - to identify the individual leopard following its release or if maintained in captivity).



Microchip being read

2.5.b

2.5.b. Feeding - weekly schedule

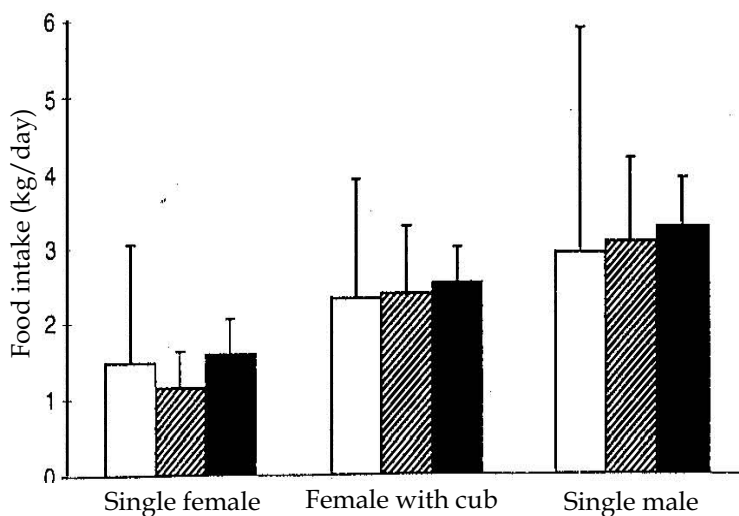
Day	Food item and amount to be fed	Other tasks related to feeding
Day 1	2 - 2.5 kg meat with bones per leopard	<ul style="list-style-type: none"> - Clean meat – see Section 2.5.b.(i). - Provide supplement – see Section 2.5.b.(v). - Change drinking water.
Day 2	2 - 2.5 kg meat with bones per leopard	<ul style="list-style-type: none"> - Clean meat – see Section 2.5.b.(i). - Provide supplement – see Section 2.5.b.(v). - Change drinking water.
Day 3	No food	<ul style="list-style-type: none"> - Change drinking water.
Day 4	2 - 2.5 kg meat with bones per leopard	<ul style="list-style-type: none"> - Clean meat – see Section 2.5.b.(i). - Provide supplement – see Section 2.5.b.(v). - Change drinking water.
Day 5	2 - 2.5 kg meat with bones per leopard	<ul style="list-style-type: none"> - Clean meat – see Section 2.5.b.(i). - Provide supplement – see Section 2.5.b.(v). - Change drinking water.
Day 6	2 - 2.5 kg meat with bones per leopard	<ul style="list-style-type: none"> - Clean meat – see Section 2.5.b.(i). - Provide supplement – see Section 2.5.b.(v). - Change drinking water.
Day 7	Full chicken (with feathers)	<ul style="list-style-type: none"> - Change drinking water.

2.5.b.(i) – (ii)

2.5.b. (i). Animal to be fasted on one day of the week

2.5.b.(ii). Each leopard to be fed no more than 2 – 2.5 kg meat with bones per day for five days in the week.

(Reason - Generally any felid species requires about 5 % of its body weight in food per day, fasting them one day is beneficial to their health. Supplements are a must for animals that are fed only muscle and bone (Shoemaker et al. 1997). It has to be remembered that animals in captivity are sedentary and will require less quantum of food than those in the wild. Stander (1997) has provided estimates of leopard diet based on radio telemetry and daily tracking of 18 wild leopards (see following figure)).



2.5.b.(iii) – (v)

2.5.b.(iii). The meat should be rinsed in a solution of potassium permanganate (One pinch of potassium permanganate in one litre of water) or can be rinsed in boiling water.

2.5.b.(iv). A full chicken (not dressed) should be provided on one day of the week.

(Reason – the leopards need roughage and crucial supplements that are present in the non-meaty parts [skin, feathers, viscera] of their prey).

2.5.b.(v). Two teaspoons of Calcium carbonate (REMEMBER NOT TO USE PREPARATIONS WITH PHOSPHOROUS!!!) and one teaspoon of vitamin A supplement (eg. *Brivita* powder or 10 gm raw liver) per kg of meat/beef should be provided daily² for leopards in long-term captivity.

(Reason – wild felids require a specific proportion of calcium to phosphorous ratio in their diet. In captivity phosphorous intake is high due to the pure muscle diet. Therefore calcium supplementation is necessary. If not carried out, the animal will eventually suffer from metabolic bone disease (deterioration of their bones and eventually paralysis).

² The powder should be inserted in a cut made into the meat which is then pressed close prior to feeding the animal.

2.5.c. Housing requirements

- **All leopards in long-term captivity have to be micro-chipped, meticulous records maintained and provided at the end of the financial year to the office of the Chief Wildlife Warden**
- **Males and females should not be allowed to meet even for brief periods of time**
(Reason – it will lead to reproduction and production of cubs which is unwanted in an overcrowded captive facility)
- **The females should not be kept near males**
(Reason – the presence of a male causes the female to come into heat frequently and can lead to medical problems such as false pregnancies).
- **The drinking water trough should be built at a height of about 3 feet into the side of the enclosure**
(Reason – leopards invariably defecate in the drinking water present if placed on the floor of their enclosure)
- **The enclosures should be provided furniture (logs, planks) for the animal to rest on**

2.5.d

(Reason – the presence of a lattice of large logs allows the animal to move in an otherwise confined space and also to rest on the logs which are warmer and more comfortable than concrete floors).

- **The housing facility should allow the animal access to early morning (preferably) or late evening sunlight.**

(Reason – as with humans, sunlight is essential for their good health).

- **There should be a small place within each enclosure where the leopard can retire to.**

2.5.d. Cleaning enclosures

- **Phenyl and phenylic compounds should NEVER be used. A 5% solution of bleach (50 gm bleach in one litre of water) is recommended for cleaning the enclosure.**

(Reason – cats groom themselves with their tongues. If phenyl is used for cleaning, residues present on their coat will be ingested when they clean themselves. Phenyl is contraindicated for felids and can be toxic for the cat family)

-
- **The people working at the enclosure should undergo periodic health tests. Spitting and smoking in the captive centre should be prohibited. No dogs or domestic animals should be allowed in the vicinity of the leopards.**

(Reason - Tuberculosis can be transmitted to leopards by man).

3. BIOLOGY OF THE SPECIES AND ITS RELATION TO CONFLICT

- **LEOPARDS ARE SOLITARY**

- **LEOPARDS ARE TERRITORIAL**

- **LEOPARDS ARE VERY ADAPTABLE AND CAN LIVE NEAR HUMAN INHABITATIONS**

- **LEOPARDS ARE KNOWN TO FEED ON DOMESTIC DOGS AND LIVESTOCK**

Dogs, pigs, goats form an important part of leopards diet across many sites (Sanjay Gandhi National Park, Himachal Pradesh, Uttaranchal, Gujarat, Maharashtra (Mukherjee and Mishra, 2001; Edgaonkar and Chellam, 2002) indicating that the feral animals and untended livestock are probably important prey of leopards living outside Protected Areas in India. Furthermore, studies from Junnar have shown that tended livestock are killed in much smaller numbers than expected in a human dominated landscape (Athreya et al 2004).

3.1.(a) – (b)

3.1. TRANSLOCATION IS NOT RECOMMENDED BY SCIENTISTS TO DEAL WITH LEOPARD CONFLICT BECAUSE

3.1.(a). Leopards could transfer or introduce conflict near the new site of release

- *A female leopard released in Radhanagari WLS from Junnar attacked a boy near the new site of release. She was recaptured and is now in permanent captivity.*
- *A female leopard trapped in Junnar Forest Division was released more than 200 km away in Yaval WLS. When she was captured in Chalisgaon, she had traveled ~90 km in the direction of Junnar. She was responsible for many attacks on people in areas which had never reported human-leopard conflict.*
- *A leopard released in Sanjay Gandhi National Park (SGNP) from Sangamner was found in a marriage hall and had to be re-trapped.*

3.1.(b). Leopards, especially older individuals, attempt to head back to their territories following translocation.

- *Eight leopards involved in livestock depredation were released into a 2000 km² National Park in Kenya. All the individuals traveled at least 25 km from the release area and some resumed killing livestock (In Linnell et al. 1997).*
- *In South Africa, a translocated leopard traversed more than 500 km to reach its territory (In Jewell 1982).*

3.1.(c)

3.1.(c). Sustained translocation into a given forest could lead to increased leopard populations in the adjacent human dominated areas.

All high density leopard areas in Maharashtra contain or are adjacent to release site of leopards trapped elsewhere because they were a problem (Also see Athreya et al. In Press).

Affected area	Sites of release
Junnar Forest Division	Malshej Ghats, Bhimashankar WLS
Ahmadnagar FD	Igatpuri, Kalsubai WLS
Nashik FD	Jawhar Mokhda
SGNP	Bhootbangla Parisar, Nagla block

4. LONG TERM MANAGEMENT OF HUMAN-LEOPARD CONFLICT

In our experience, the best form of conflict management is to deal with it before the problem gets out of hand. There are many areas in Maharashtra where leopards live in croplands outside Protected Areas. Our work in Junnar and Nashik Forest Circle indicates that leopard populations in croplands can be managed without serious conflict as long as the biology of the species is considered. The following outlines our experience and the recommendations.

4.1. EXPERIENCES FROM MAHARASHTRA

- Attacks on people increase following releases of leopards in nearby forests
- Removal of a few leopards each year from conflict area does not reduce livestock depredation nor number of leopards trapped the following year in the conflict area
- Removal may in fact increase populations at site of capture due to younger animals colonizing vacant territories.
- Large scale trapping can decrease leopard population in an area but the mere presence of a carnivore cannot justify its trapping. Being a Schedule I species, danger to property cannot be used as a reason to trap leopards (Section 11, a. Wild Life Protection Act 1972).

4.2

- Leopards can live in high human density areas (> 250 people km⁻²) with low levels of conflict and effective management will have to deal with their presence.

4.2. HOW TO DECREASE CONFLICT

- It is likely that releases worsen conflict and therefore releases should be minimized. Information from many sites in Maharashtra indicate that a decrease in releases will result in an immediate reduction in conflict.
- Trapping should be minimized and followed as per the Wild Life Protection Act (Section 11) (1972).
- People who live in leopard dominated areas have to be made aware of the problems that are associated with indiscriminate trapping of leopards.
- For leopards that have to be rescued, trapping should not be resorted to unless it is necessary for treating an injured animal.
- It is advisable that local health and municipal authorities are made aware that dogs and other feral animals form an important prey base for leopards and that feral animal population control will reduce the attractiveness of such areas to leopards.

5. EDUCATION AND AWARENESS

Points for awareness programmes

Recommended behaviour in leopard areas	Reason
Children must be supervised.	Small children are especially vulnerable
Take a companion when answering the call of nature	A crouching person might be mistaken for prey
Announce ones presence in leopard areas by talking, singing, shouting, taking a transistor if moving alone in leopard areas.	It is likely that a quiet movement could be mistaken for a dog or a livestock by the leopard, especially in human dominated areas.
Do not chase or surround a leopard	High chances leopard will be stressed and attack in its attempt to escape
Reduce feral animals in areas adjacent to forests with leopard populations	Feral animals especially domestic dogs could be "attractors" for leopards
Strengthen existing cattle shed and do not tether livestock outside	Better protection of livestock is seen to reduce livestock predation by carnivores
Educate local groups/village level communities.	The public will be more co-operative in case of leopard situations in the area.

- Awareness campaigns to be organized in leopard areas even in the absence of conflict
- Target audience for awareness campaign = local schools and local administrative areas (gram sabha and/or panchayat meetings).

In case of attack on a person –

-
- 1. Provide immediate assistance by taking the person to a medical facility (Department vehicle can be used).**
 - 2. Affected family to be accompanied by Department personnel.**



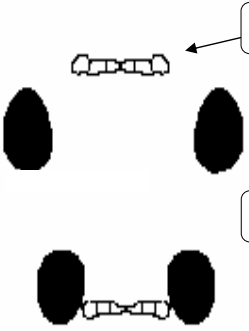
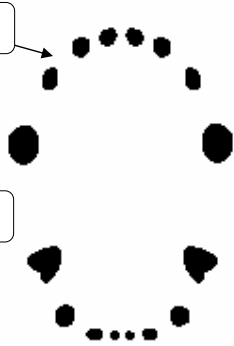
The importance of awareness

The easiest option for the field officer in the face of public pressure is to assure the public that trap cages will be set. However, the seriousness of the procedure of setting up of cages has to be communicated to the public. In most instances, they are not aware of the seriousness of this request at an administrative level. This awareness has to be carried out even in the absence of any serious conflict.

6. A GUIDE TO IDENTIFYING LEOPARD ATTACKS

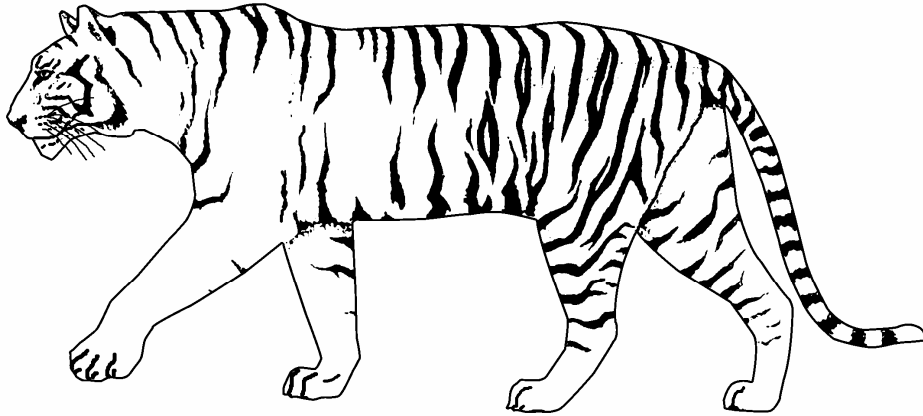
Wild carnivores that live in and around densely populated human habitations are wolves, leopards and hyaenas. Following an attack on a livestock or a person it is necessary that the species responsible is correctly identified. For instance, if a wolf is responsible then trap cages should not be set up. Wolves do not enter trap cages. Setting up of a trap cage however, is likely to trap a leopard leading to an unnecessary capture.

A few pointers to assist in identifying the family (dog or cat) responsible for the attack are provided below. Information on the species can be obtained from pugmarks, information on mode of killing/attack and information from reliable eye-witnesses. It must be kept in mind that the following are only guidelines and it is often difficult to obtain accurate information from the signs in the field.

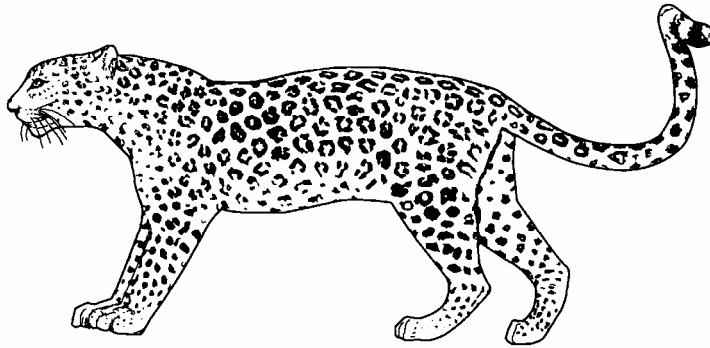
<u>Leopard</u>	<u>Wolf, Hyaena</u>
<p>1. Pugmarks squarish</p> <p>2. Pugmarks usually without claw marks</p> 	<p>1. Pugmark elongate</p> <p>2. Pugmarks with claw marks</p> 
<p>3. Bite marks of cat family (From Murmann et al. 2006)</p> 	<p>3. Bite marks of dog family</p> 
<p>3. Carcass up in a tree</p>	<p>3. Carcass never taken up a tree</p>

Large carnivore species that could come into conflict with people.

Tiger

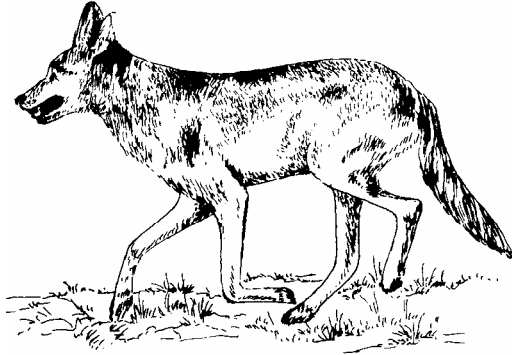


Leopard

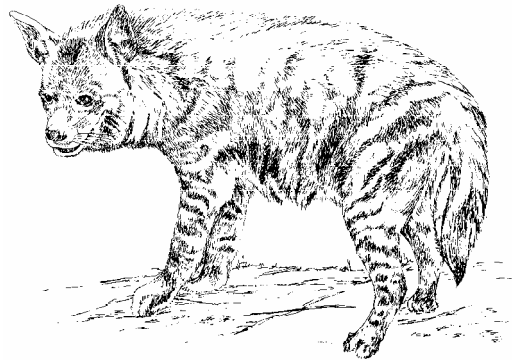


Point to note Territories of different leopard individuals overlap. Furthermore, transient animals move through the territories of others. Therefore a trapped individual need not necessarily be the culprit. Also, the number of trap cages deployed is likely to be proportional to the number of leopards trapped. It is important to identify the situation and make sure that trapping is necessary prior to setting up the traps.

Wolf



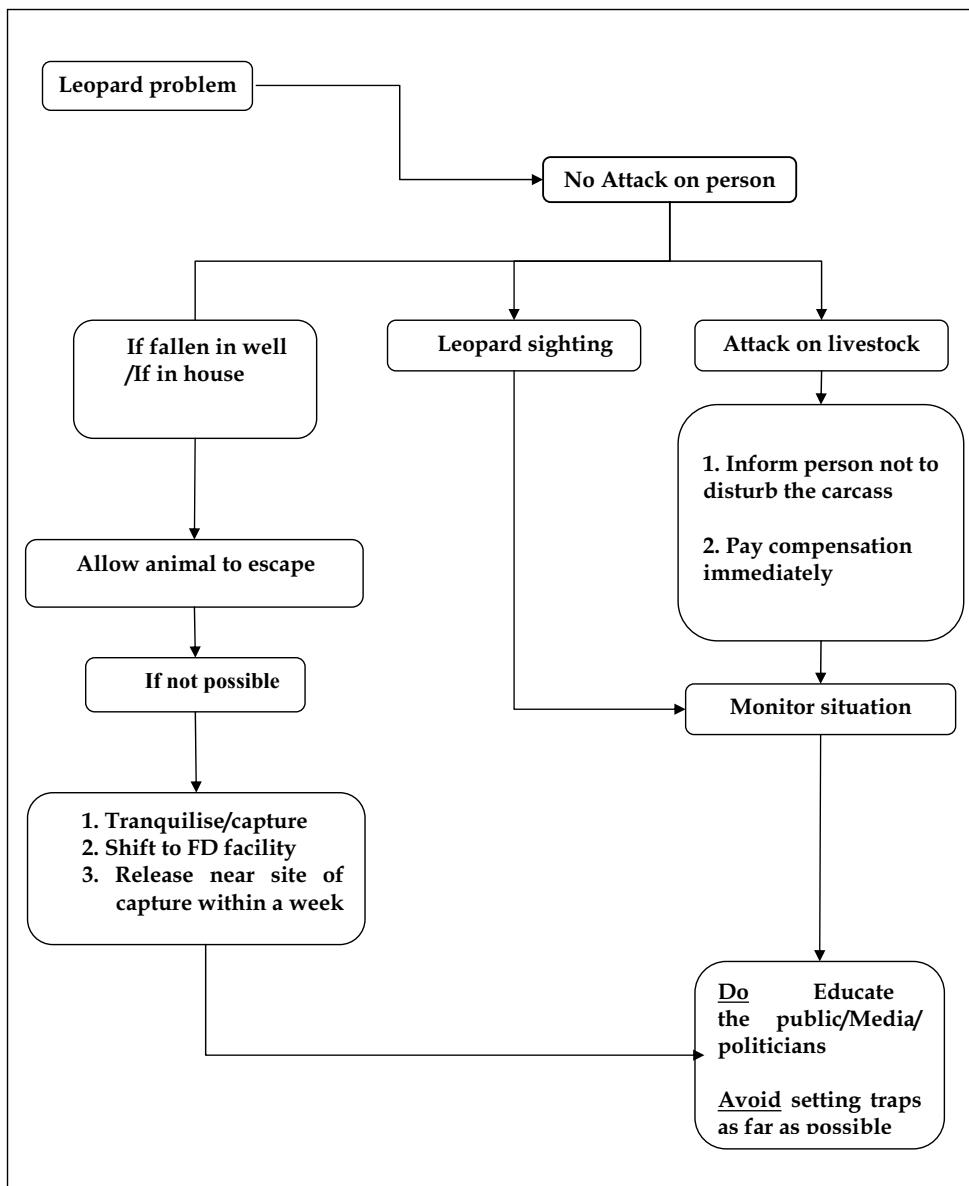
Hyaena



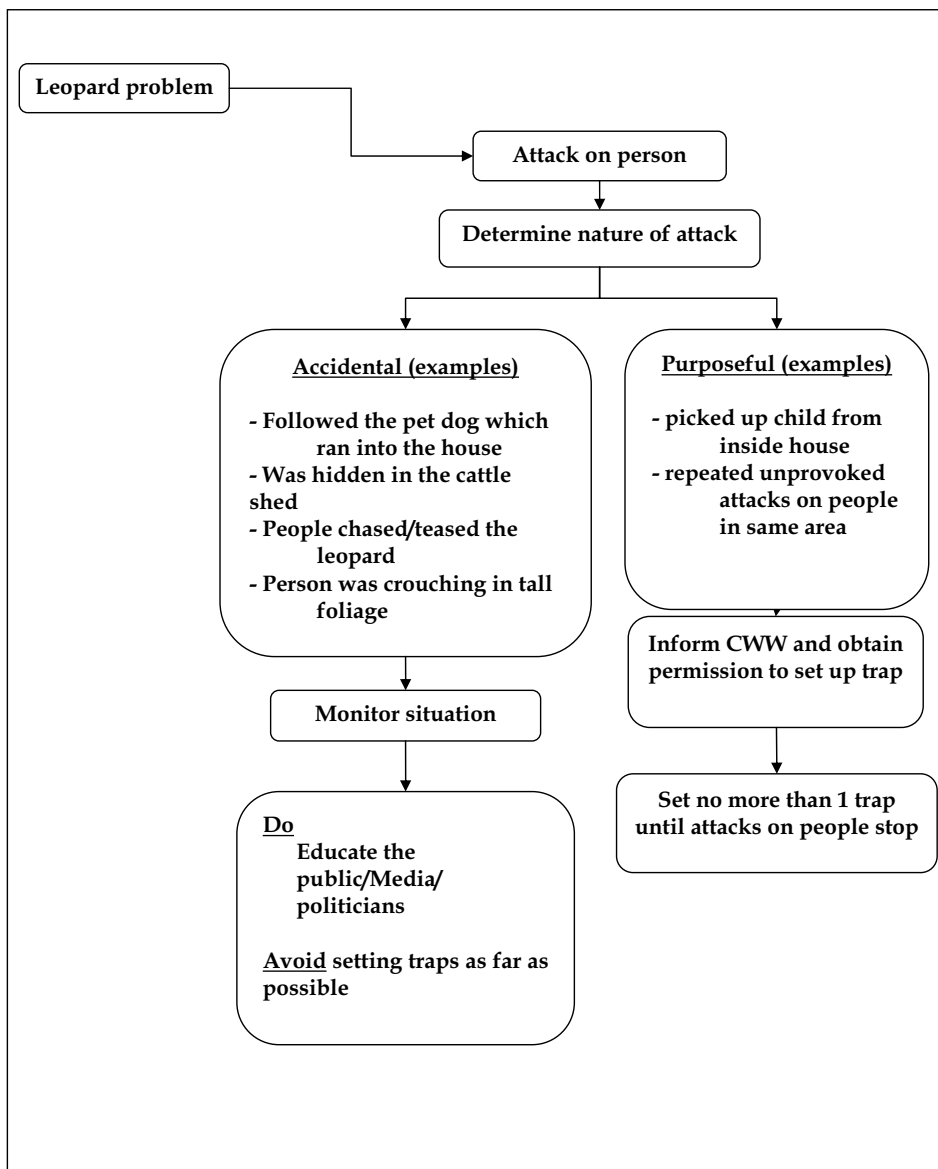
7, 7.1

7. EFFECTIVE MANAGEMENT ACTION – A FLOW CHART

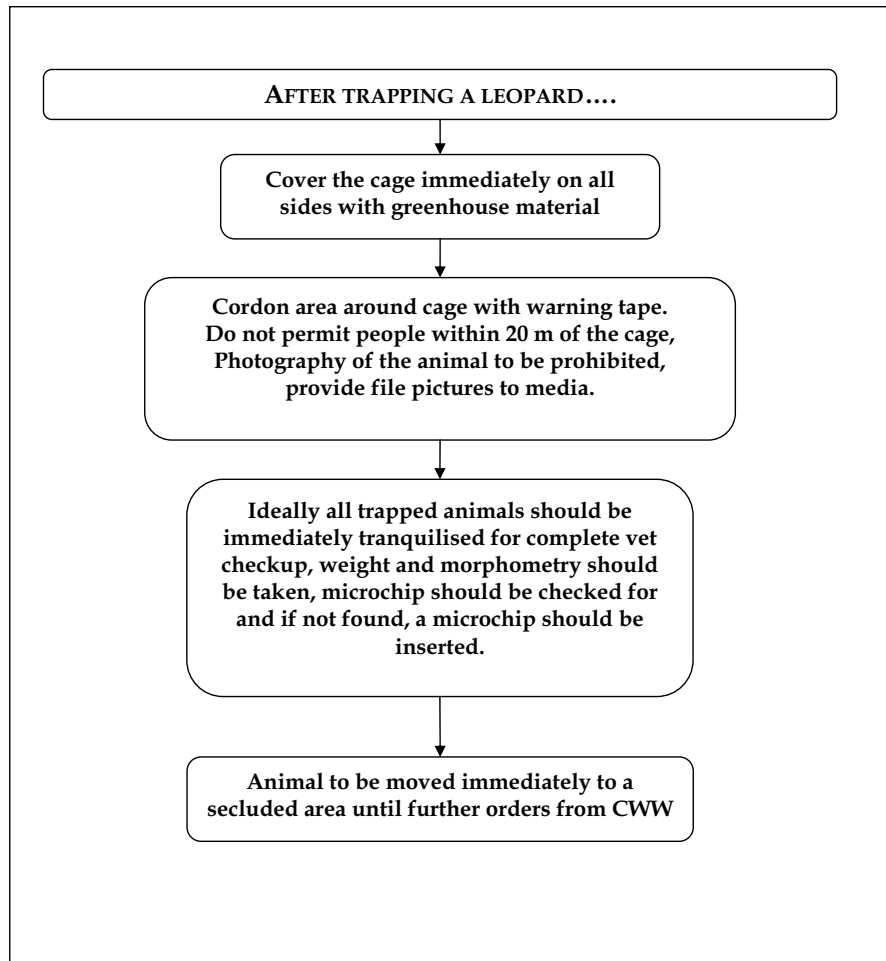
7.1 IN CASE OF A LEOPARD SIGHTING OR LIVESTOCK ATTACKS



7.2 IN CASE OF ATTACKS ON PEOPLE



7.3 AFTER TRAPPING A LEOPARD....



8.8.1

8.1. DATA TO BE SENT TO THE OFFICE OF THE CHIEF WILDLIFE WARDEN FOLLOWING A CONFLICT INCIDENT.

SHEET I (PAGE1)

Name of Officer _____

Designation _____

Date _____

Site of incident

Compartment # _____

Range _____

Division _____

Territorial Wildlife

Habitat

Cropfield _____

Near house _____

Cattle shed _____

In Malki _____

In Forest _____

Other _____

Nature of attack

Attack on livestock

Species of livestock _____ Age _____ Sex _____

Injured _____ Killed _____

Carcass/ animal rescued by people? Yes _____ No _____

Taken away by leopard? Yes _____ No _____

Time of attack _____

Details of attack _____

SHEET I (PAGE2)

Attack on person

Name of affected person_____Age_____

Sex_____Address_____

Activity of person at time of attack_____

Time of attack_____

Accidental attack Yes_____ No_____

Purposeful attack Yes_____ No_____

Details of attack_____

Name of family member interviewed_____

Family members Phone number_____

Mobile number_____

Leopard identified by_____

People sighted it_____

Pugmarks_____

Other methods - (Describe)_____

8.2

8.2. Details of past attacks on people in the region

S. No.	Dates of last attack on people	Distance of attack site from previous attack site	Age of person attacked	Phone numbers of interviewed relative	Amount of compensation paid
1.					
2.					
3.					
4.					
5.					

Since when have leopards been reported in the region (obtain information from FD records or interviews with village headman).

Information on past trapping and releases in region

1. Number of trap cages in Division _____

2. Number of leopards trapped in Division (please provide chip numbers if available)

Present year _____

Last year _____

Past five years _____

3. Number of leopards released in forests < 100 km from Division

Present year _____

Last year _____

Past five years _____

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10. APPENDICES

10.1 BASIC TREATMENT



1. Tranquilisation is strongly recommended prior to any medical treatment to reduce the stress to the wild animal.
2. Preparations like long acting penicillin (@40,000 IU/kg body weight) and **doramectin** (Dectomax) should be used so that frequent intervention with the wild felid is avoided. The effect of these drugs lasts for about a week.
3. Do not use NSAIDs (Non steriod anti-inflammatory drugs like **diclofenac**, **ibuprofen**). Even **paracetamol** should not be used. They are strictly contraindicated in felids.

4. In cases when the animal is beyond recovery (Example: a wild leopard hit by a vehicle and has a broken spine, or a broken skull, or a paralysed leopard) then an application to euthanize the said animal along with a certificate by the veterinarian in charge is to be sent by FAX by the concerned Deputy Conservator of Forests to the Chief Wildlife Warden requesting for permission to humanely put down the said animal.

Drug to be used: **Thiopentone (Intraval Sodium)**

Method: **intravenous/intraperitoneal/intracardiac.**

Available as 500mg or 1g vial. For a leopard use 2-3 (even 4 sometimes) 1g vials until heart beats stop. 10 ml water should be used to dissolve 1g powder. If leopard is awake and alert but severely injured then first tranquilise leopard using **Xylazine** and **Ketamine** mixture IM (See Section 10.2) prior to giving **Thiopentone (Intraval Sodium)**.

Following the procedure a report should be faxed by Deputy Conservator of Forests to the Chief Wildlife Warden.

10.2 DRUGS USED IN CHEMICAL RESTRAINT

Safety, effectivity, ease of procurement and use are the crucial factors to be considered while deciding the chemical restraint agent. A wide safety margin is essential because weight estimation is extremely difficult in field conditions and significant errors are possible (especially chances of overdose). Furthermore, inadvertent intravenous/intraperitoneal/intrathoracic injection is equivalent to a large overdose.

A mixture of Xylaxine hydrochloride 10% (XYLAZIL-100) and Ketamine hydrochloride 10% (KETAMIL HCl) is used in chemical restraint[∅]. Helpro Health Products & Services market these two drug preparations in India.

Ketamine hydrochloride is a *dissociative anaesthetic*, resulting in a condition where the animal is largely aware of its surroundings, but is insensitive to pain and other stimuli. The animal cannot walk and appears to suffer neither fear nor rage. Xylaxine hydrochloride is a non-narcotic sedative-hypnotic with analgesic and muscle relaxant properties.

[∅] In case XYLAZIL-100 is unavailable, Xylaxine HCl 2% is often available at a veterinary chemist. If KETAMIL HCl is unavailable, Ketamine HCl 5% is available at most chemists.

The mixture of Xylaxine and Ketamine has a marked synergistic effect *i.e.*, the combined effect is greater than the sum of their individual effects. The addition of Xylaxine reduces the quantity of Ketamine required, thus minimizing the antagonistic reactions and other hazards involved in Ketamine usage. In sufficiently large doses, the combination produces actual anaesthesia.

WARNING : Oral ingestion or injection of Ketamine or Xylazine can produce anaesthesia in man and hospitalisation is required in such cases.

CALCULATING DOSAGE

1. Recommended dose is in milligrams per kilogram (mg/kg). *For leopards, a mixture of Xylazine HCl @ 0.5 to 1 mg/kg and Ketamine HCl @3 to 4 mg/kg is to be used.*

2. Estimate the weight of the leopard to be darted.
A male wild leopard may weigh up to 50kg (the maximum recorded by the author 83kg) and a female upto 35kg. It is safer to consider an overestimate so as not to under dose the animal.

3. Calculate the dose needed in milligrams.
Dosage (mg) = recommended dose (mg/kg) X estimated weight (kg).

4. Finally calculate the dose in milliliters.
Dosage (ml) = Dose (mg) divided by drug concentration^N.

^N Drug concentrations are usually expressed in milligrams per milliliter (mg/ml). Remember that XYLAZIL-100 has 100mg of Xylazine hydrochloride per milliliter and KETAMIL has 100 mg of Ketamine hydrochloride per milliliter.

5. Add the required quantities of XYLAZIL-100 and KETAMIL HCl together.

Example:

Estimated weight = 50 kg

XYLAZIL-100 required @ 1mg/kg = $1 \times 50 = 50\text{mg}$

KETAMIL HCl 10% required @ 4mg/kg = $4 \times 50 = 200\text{mg}$

ml of XYLAZIL-100 required = $50 / 100 = 0.5\text{ml}$

ml of KETAMIL HCl 10% required = $200 / 100 = 2\text{ml}$

DOSAGE: 0.5 ml of XYLAZIL-100 and 2ml of KETAMIL HCl 10%.

Administrating chemical restraint agents strictly adhering to a mg/kg body weight formula is impractical because:

(i) *Wild animals cannot be weighed before anaesthesia.*

Estimations are very subjective which leaves room for significant error.

(ii) *The success of remote drug delivery cannot be guaranteed.* It is difficult to know how much of the drug mixture has been injected (none/partial/complete).

(iii) *Routes of administration may vary.* The intention of projectile injection delivery is intramuscular injection so that vascular tissue rapidly absorbs the drugs. Drugs may inadvertently be delivered by other routes *i.e.* subcutaneous or intraperitoneal affecting consistency of the results.

Chemical restraint agents must be given carefully to achieve a certain desired levels of anaesthesia.

Disturbances during the induction phase may prolong the onset and depth of anaesthesia. Approaching/handling the leopard before it is completely under the effect of drugs can be dangerous. Accidents of this nature have occurred as recently as 2004 in Mumbai and caution in dealing with anaesthetized animals is emphasized. Excessive struggling or excitement before the induction of anaesthesia may lead to capture myopathy and death.

When the animal is down it should be approached quietly. To confirm the depth of anaesthesia, a long pole/stick can be used to touch the inside of the leopard's ear. If there is twitch the leopard may not be completely under the effect of the drugs and caution is required.

UNDERDOSING

If the quantum of the original drug/s injected successfully is not known, then wait for at least 10 minutes before re-administering any drugs. Underdosing may occur in the event that:

- (a) The projectile syringe bounces off the animal.
- (b) The projectile syringe falls before the entire content is injected.
- (c) Poor targetting (drug deposited subcutaneously).
- (d) Failure of the projectile syringe to discharge the drug.

If no effect of the drugs is observed for 30 minutes then entire dose is repeated. If some effects are observed but the leopard is not satisfactorily anaesthetized within 15 minutes of initial dose injection, then half of the initial dose should be administered again.

If the leopard starts to awaken when under anaesthesia and additional time is required then supplemental dose of **ONLY** Ketamine should be given intramuscular at half the initial dose (1 to 2 mg/kg). Supplemental Ketamine can also be given @1mg/kg intravenous. Xylaxine should *never* be given as the supplemental drug. It should only be administered in combination with Ketamine for induction of anaesthesia.

After confirming that the leopard is sufficiently anaesthetized, the projectile syringe should be recovered, *without handling the needle* and kept in a safe place. Ensure that the needle is not broken. Wear latex gloves while carrying out this procedure.

Treat the dart wound (see Text Box below).

Once anaesthetized, the leopard should be placed so that it is lying on one side (lateral recumbency). Its mouth is to be kept lower than the back of the throat so that saliva flows out of the mouth. Protect the leopard from direct sunlight. The eyes remain open throughout the anaesthetic phase, so they need to be covered and

periodically moistened using sterile saline solution. Periodically check for vital signs and monitor rectal temperature, respiration, and heart rate every 10 minutes until recovery. Examine for wounds, ectoparasites, and general conditions and treat accordingly.

The leopard should not be left unattended until it has completely recovered. Leopards may have seizures during anaesthesia, but the seizures are generally self-limiting. Let one or two seizures pass before using anti-convulsants. Administer Diazepam @ 5 to 10mg/leopard by slow intravenous injection. Repeat after 5 minutes if no effect is observed. If a vein cannot be located, diazepam can be given intramuscularly or per rectal.

TREATING WOUNDS

Clean the wound with normal saline. Use 2% chlorhexidine solution.

Apply pressure for sometime using a gauze pad if bleeding.

Suture only fresh wounds, if necessary.

Apply topical antibiotic ointment like *Gentamicin cream* or *Soframycin cream* and also fly repellants like *Himax* or *Topicure spray*.

Administer long-acting antibiotic (such as Penicillin G Benzathine @ 40,000IU/kg body weight, IM).

Administer Doramectin (Dectomax) @ 200mcg/kg body weight SC.

10.3 MICROCHIPPING LEOPARDS

A passive transponder microchip should be implanted below the skin at the base of tail (dorsally, where the tail joins the body) as this site can be relatively easily accessed with the handheld reader for reading the microchip without anaesthetizing the leopard (using a squeeze cage).

Reading transponder microchips

When evaluating for the presence of a microchip, scanning with a reader should begin at the standardized site of microchip implantation *i.e.* dorsally at the base of the tail. If a microchip is not immediately identified, scanning should encompass a larger area and be done in slowly expanding concentric circles or a figure-of-eight pattern. Scanning should be done with the reader touching, or brushing, the animal's fur. Although one cannot visualize the actual position of the implanted microchip relative to the reader during scanning, we can take advantage of this principle by slightly rocking the reader from side to side during the scanning process if the reader design so allows.

To ensure that an implanted animal is identified, the scanning procedure should be done for a minimum of *10 seconds* (longer if possible) and on two consecutive occasions before an animal is declared negative for the presence of a microchip. If possible,

repeat the scanning process using a different reader. Fortunately this is rarely necessary, being the exception rather than the norm.

Battery charge is important for portable, hand-held reader function. Ensure that batteries are always fully charged and that the manufacturer's directions for battery care are followed closely.

Readers emit and receive electromagnetic energy and therefore can be affected by other electronic equipment or metallic objects. Try to maintain a distance of at least one meter (three feet) from electronic equipment.

All implanted animals should be scanned annually to ensure proper function and location of the microchip.

Distributors provide support services for their products. Check the reader's performance frequently for read rate and range using a microchip that has not been implanted. Don't risk the use of a reader if its performance is in doubt. Instead, call the manufacturer or distributor for hardware support.

10.4 MORPHOMETRY

There is a paucity of basic biological information on the leopard in India.

The basic information that could be collected is

1. the weight of the individual,
2. the length of its body (from the tip of the nose, over its back till the end of the body), length of hind and fore leg, length of the tail (from the start of the tail to its tip).
3. Condition of teeth. If any of the canines damaged, extent of damage need to be reported.
4. The colour and sharpness of canines should also be noted. Photographs of the dental characteristics we use are provided below (Athreya & Belsare 2006).
5. Any wounds, injuries, scars (old or recent) should also be noted

Aging leopard using dental characteristics

Old Adults: Teeth yellow, canines and incisors usually well worn and sometimes missing.



Prime Adults: Teeth yellowish, incisors and canines slightly worn.



Young Adults/subadults: It is not possible to distinguish the transition age between prime adults and young adults. However, we have considered all individuals with whitish perfect set of teeth and large body sizes (opposed to large cubs) as young adults.



Large cubs: With deciduous canines, incisors and smaller body size.



Ten Commandments of Wildlife Interventions

1. Safety of the people involved in such interventions, including the Forest Department personnel, Veterinarians, Volunteers and other persons assisting in the procedure(s) as well as that of the unwanted onlooker. Safety of the animal(s) is also to be considered. **Example:** people running after a leopard should be avoided

2. Justify need for intervention No wildlife intervention is to be undertaken unless and until it is rationally justified. Every intervention is potentially dangerous, especially so for the wild animal. Interventions for demonstrating one's skills, for personal reasons (e.g photography, practice of catching snakes, etc) or for anthropomorphic reasons ('because one feels that the animal is suffering') are to be avoided.

3. Legality of the situation should be considered especially the Wild Life (Protection) Act, 1972. The provisions of the act should be properly considered before trapping, immobilizing, shooting or translocating a wild animal. The required permissions should be obtained in writing from a competent authority. E.g. a Range Forest Officer is not entitled to give permission for the custody of a Schedule I animal; the permissions have to be obtained from Chief Wildlife Warden. **Example:** A wild python cannot be even touched without permission (Section 11 and 12 of the Wild Life Protection

Act). Touching it is equivalent to “hunting” and therefore a serious offence.

4. Respect and understand the wild animal. One has to keep in mind that a wild animal will never ‘co-operate’ and this is due to the survival instinct or the fight or flight mechanism. The animal has to be approached/ handled firmly with confidence and patiently with due respect.

5. Prognosis or the outcome of the intervention has to be seriously considered before deciding on the course of action. An ‘orphaned’ deer fawn is many a time brought to rescue centers but it dies within a few days or lives the rest of its life in captivity. Remember that death is an integral part of nature. We are not to go against nature and save weak and unfit wild animals and keep them in captivity for the rest of their lives.

6. Practicality of the planned intervention is of paramount importance. **Example:** A professor of surgery (with no wildlife experience) was consulted to treat a captive rhinoceros which had not passed stools for about a month. The professor advised surgical removal of the fecolith! Cutting through the thick skin of the rhino is a Herculean task and stitching the skin back will be a near impossible maneuver. The Rhino was later successfully treated using a medication regime used for constipated elephants.

7. Planning the intervention to the minutest detail is a must because an apparently simple procedure in case of a wild animal can turn out to be a nightmare. **Example:** An otherwise successful immobilization episode in a chital turned out to be a complete failure because the animal sat on the same side where the dart was injected as a result of which the needle broke and was retained in the thigh musculature. Attempts to find the tip of the needle were unsuccessful. The chital recovered from the anaesthesia but died within two days. Postmortem examination revealed swollen and gangrenous leg and lesions suggestive of Capture Myopathy. Before undertaking such interventions, one should be prepared to deal with contingencies and emergencies.

8. Minimize Stress to the wild animal. Excessive stress and the subsequent exhaustion are responsible for the high mortality in most of the interventions. It is manifested as Capture Myopathy, especially in herbivores. Chasing the animal before or after chemical immobilization, underdosing, excessive and improper handling, resorting to physical restraint rather than chemical restraint, crowding around the cage, etc leads to excessive stress. Also planning an appropriate treatment regime like using long acting antibiotics and preparations like Doramectin so the animal has to be restrained once a week only for treatment can significantly reduce stress.

9. Understand and Accept limitations. While undertaking interventions like hand rearing of wildlife orphans, treating wildlife casualties or rehabilitating wild animals, one has to come to terms with high mortality and failure rates. Natural mothers are the best mothers and in spite of this fact there is a significantly high neonatal mortality. Similarly treating wildlife casualties is a challenging task because the wild animals are inherently stressed by our attempts to treat them, besides the stress caused by injury/ disability and the stress of captivity, which worsens the situation by lowering the immunity.

10. Create, update and share database. This will ensure that the same mistakes will not be repeated. Consult experts or literature in case of doubt. Ignorance might lead to the death of the animal. We know of the death of a leopard caused by the use of NSAID (Non Steroid Anti Inflammatory Drug) while treating the animal. NSAIDs are contraindicated in Felids.