OPTIONS FOR WILD ANIMAL CAPTURE AND RESTRAINT

Parag Nigam, Pradeep K Malik and Sushant Chowdhury

Wildlife Institute of India, Post Office-Chandrabani,
Dehra Dun – 248 001, Uttarakhand.
Email: nigamp@wii.gov.in, malikpk@wii.gov.in

Introduction

With increasing urbanization of wildlife habitats and interactions with wildlife resulting in conflict, the need for efficient capture and handling of wild animals as a management tool has becomes quite relevant. Further, sometimes animals need to be captured for providing treatment, in conservation projects involving translocation or in research studies requiring sampling and telemetry.

Proper selection of the capture and restraint procedures relevant to the species and situation forms the basis of successful management. This article provides information on various options available for efficient capture and restraint of wild animals.

General Considerations

Wild animals can be captured employing physical methods, chemical methods or a combination of both. The selection of a procedure primarily depends on the species involved, size of the animal, number of animals to be managed, physiological and emotional status of the animal, length of the procedure and level of invasiveness, the environmental conditions, terrain/escape cover, availability of equipment, appropriateness and availability of drugs and most importantly the safety of the investigator.

Physical Restraint Methods

These methods include various systems and devices that aid in physically restraining wild animals. Physical methods are well suited for capturing small animals as these animals pose limitations to darting (have small darting areas on the body), are shy, maintain a large distance on approach and are often hidden in thickets/bushes.

It is important to understand the individual animal's temperament and behavior, strength and retrieval capabilities and the handler's safety when choosing a physical restraint procedure. The terrain and topography of the area must be understood thoroughly before a procedure is put into practice. Details of various physical restraint procedures are summarized in Table1.

Supplemental chemical restraint may be necessary to prevent injury to an animal and/or to personnel. Any kind of restraint without sedation is acceptable only for short term procedures with minimal pain. The use of suitable sedatives shortly before or during restraint is desirable.

Chemical Restraint

Chemical immobilization has become an important and popular tool in wildlife management over the last few decades. The advances and developments in this field have resulted in the use of newer and safer drugs for immobilization; better, efficient and reliable systems of drug delivery; and the extensive information available on scientific handling. Chemical immobilization involves the use of drugs to restrict animals' movements by inducing a state of insensibility and preventing deliberate and coherent mobility. The technique is well suited for medium and large sized animals. It allows the capture of selected individuals and enables selection of the time of capture, the equipment is easy to carry, and it causes minimum disturbance to the animals. The drugs used for chemical immobilization are broadly classified into peripherally acting drugs and centrally acting drugs.

Peripherally acting drugs

These are the drugs that act on the peripheral nervous system and block the transmission of impulses. These drugs are referred to as paralytic agents/neuro-muscular (NM) blockers and induce immobilization through paralysis of voluntary muscles. Animal may be paralyzed and unable to move; however, since the drugs have no sedative or analgesic properties, the animal remains fully conscious and sensitive to fear, pain, stress or stimulation. This magnifies the stress on the animal. NM blockers, e.g. gallamine and succinylcholine, have a narrow safety margin, interfere with respiration, do not have antidotes and may cause high mortalities; hence their use has been discontinued.

Centrally acting drugs

Peripherally acting drugs have been replaced by drugs acting on the central nervous system (CNS). These drugs alter certain CNS functions without compromising the vital functions and produce a state of anesthesia either by diminution of the excitability of the CNS, leading to depression (e.g. thiopentone, halothane, diazepam, xylazine), or by increasing the irritability of the CNS, leading to hyper-excitability (e.g. ketamine, phencyclidine, tiletamine, nitrous oxide and other dissociative anesthetics). These are briefly discussed in the following.

Table 1 : Physical restraint procedures

S. No.	Physical Restraint Procedure		Examples Remarks
Mass Capture Techniques			
A. Involving Physical Handling			
1.	Nets	Linear Drive-Nets-Deers and antelopes, Drop-Nets-deers and antelopes, Cannon or Rocket-Nets-Birds, Popup and Drop down nets, net guns etc.	Nets can be used in open areas, are easy to set and remove and considered for the species that cannot be captured with plastic boma. Taking out netted animals may often be quite stressful for certain species resulting in injuries. Net capture involves increased handling.
B. Without Physical Handling			
1.	Plastic bomas	Animals are driven into a large plastic funnel and the plastic sheeting acts as a visual barrier that animals respect and do not challenge. The animals are trapped by closing the entrance plastic curtains and chased up the funnel by assistants working inside directly into solid-sided crush and then up a loading ramp into transport vehicle.	Method is very versatile and can be used for variety of forest dwelling animals, does not require immobilization and physical handling. The equipment is expensive and has limitation of use in dense vegetation.
Individual Captures			
1.	Snares	Aldrich foot snares-black bears Foot snares-ungulates	Designing of the snares, traps and cages should ensure that animal
2.	Traps	Foot hold traps, padded traps-carnivores and bears, Culvert traps-bears, Corral traps-deers and antelopes, Clover traps-deers, Panel traps-wild pigs, Box traps-pigs, Bow (Bailey) trap-Rodents, civets and mongoose	does not sustain any injury once trapped. The period following trapping should be minimal and animal should be attended at the earliest. Trap should be monitored
3.	Cages	Cage traps-Carnivores and primates	frequently. It may be necessary to supplement the the procedure with chemical restraint to prevent injury to an animal and/or to personal.
4.	Other equipments	Ropes, gloves, tape, hobbles	Ensure safety of animal and personnel.

Neuroleptics/Anxiolytics/Tranquilizers

This category includes phenothiazine and benzodiazapine derivatives. These drugs reduce anxiety and produce a relaxed state of mind. They do not produce immobility and have no analgesic effect. As a result the animal can be aroused by pain. These drugs are usually used in combination with either narcotics or dissociative anesthetics so as to smoothen the effect of the anesthetic agent. These have also been used effectively in decreasing aggression and excitement in animals and find use during transport of animals and in acclimatizing animals to new habitats/areas.

Examples acetylpromazine, azaperone, chlorpromazine, droperidol, diazepam, zolazepam, midazolam.

Alpha-2 adrenergic agonists/Sedatives

These drugs are CNS depressants with good sedative, muscle relaxant and analgesic properties. These drugs need to be used with caution in animals as they produce hypertension initially, followed by severe hypotension, bradycardia, hyperglycemia and glucosuria. They disrupt thermoregulation and may lead to regurgitation in carnivores. Repeated doses are reported to cause drug tolerance. These have the advantage of being non-controlled, inexpensive and reversible. These drugs have been extensively used in wild animals either alone or in combination with dissociatives. A mixture of xylazine and ketamine makes a very popular balanced anesthetic called the Hellabrunn mixture that is used with a variety of animals. The effect of alpha-2 adrenergic agonists can be specifically negated by antidotes.

- *Examples* xylazine, detomidine, medetomidine. Antidotes include yohimbine hydrochloride, atipamezole and tolazoline hydrochloride.

Dissociatives

These include psychotomimetic drugs that are cyclohexamine derivatives. The drugs act by separating the conscious mind from the sensory and motor or control mechanisms in the brain, (dissociative) producing rapid analgesia and a trance-like state (psychosis) which may be a result of over-stimulation of the CNS. Under the influence of one of these drugs, an animal appears to be unaware of human presence. Dissociatives have the advantage of being rapidly absorbed following IM or IV application, having a good safety margin and causing little depression of the respiratory and circulatory systems. Pronounced muscle rigidity, hyperthermia, hypersalivation, convulsions and a rough recovery are common side effects. These effects can be considerably reduced by combining these drugs with a tranquilizer or sedative. Their effects cannot be reversed, and the animal has to be monitored till complete recovery takes place, which may take a long time. These drugs lack specific antidotes.

Examples phencyclidine, ketamine hydrochloride, tiletamine hydrochloride.

Opioids/Narcotics

These drugs are the commonly used for immobilization of free ranging wild animals, especially the mega-herbivores. These drugs are primarily morphine and morphine derivatives and produce immobilization through CNS depression. They have the advantage of being powerful pain killers (good analgesia), showing rapid induction (immobilization effects) and having a good safety margin. At higher doses, the drugs cause depression of respiratory and cardiac functions. Hence they should be used with caution in sick, stressed and excited animals. Their effects can be specifically negated by antidotes. All these drugs are scheduled, controlled substances and are subjected to strict regulation by the drug controlling authorities. In addition, narcotics are extremely toxic and hazardous. Even a minute dose, accidentally administered, can cause death through CNS depression, resulting in respiratory failure, coma and cardiovascular collapse. These drugs require safe and professional handling. These drugs have been used alone or in combination with neuroleptics.

Examples etorphine HCl, fentanyl, carfentanil. Antidotes include diprenorphine HCl, naloxone and naltrexone. Inhalant / Gaseous anesthetics

Gaseous anesthetics have proved to be effective in maintaining animals in an immobilized state. These have been effectively used in controlled settings such as zoological parks and research laboratories because of the ease of titration of anesthetic depth and rapidity of recovery. Their use under field conditions is limited owing to the need for specialized delivery devices and a supply of delivery gas (*e.g.*, oxygen). Although inhalant anesthetics are relatively safe, their low therapeutic index mandates frequent and careful monitoring of depth of anesthetic. The commonly used anesthetic gases include halothane, sevoflurane and isoflurane. These gases produce rapid & smooth induction and emergence from anesthesia. Tables 2 gives the details of various classes of drugs.

Table 2 : Various classes of drugs and examples

Class of Drug	Examples	Antidote
Phenothiazine derivatives/	Acepromazine - ACEPRIL Chlorpromazine - LARGACTIL, THORAZINE Azaperone - STRESNIL	None
Butyrophenone derivatives/	Droperidol (part of INNOVAR-VET) Haloperidol - SERENACE, TALENDOL	None
Benzodiazapine derivatives/ Tranquilizers	Diazepam - VALIUM Midazolam - MEZOLAM Zolazepam - (part of TELAZOL, ZOLETIL)	Flumazenil
Alpha2 adrenergic agonist/ Sedatives	Xylazine - XYLAZIL100, ROMPUN Detomidine - DOMITOR, DOMOSEDAN Medetomidine - ZALOPINE	Yohimbine-ANTAGONIL Tolazoline HCl - TOLAZINE Atipamezole ANTISEDAN
Cyclohexylamine derivatives/ Dissociatives	Phencyclidine Ketamine HCl - KETAMIL-100, KETASET, VETALAR Tiletamine HCL (available in combination with zolazepam as TELAZOL, ZOLETIL)	None
Opioids/ Narcotics	Etorphine HCL-M-99, CAPTIVION and in combination with acepromazine as IMMOBILON Carfentanil citrate - WILDNIL Fentanil citrate in combination with Droperidol as INNOVAR - VET Thiafentanil - A3080	Diprenorphine - M50-50, REVIVON Naltrexone - TREXONIL Naloxone HCL - NARCAN Nalorphine HCL

Drug Delivery Methods

Due to the difficulty of directly approaching and handling wild animals, it is necessary to have safe and effective methods by which drugs can be administered. The history of remote injection ranges back to the ancient hunters and warriors, who used arrows and spears with plant or animal poisons for hunting, and warfare in different parts of the world. However, with the changing times and needs, a range of systems have been developed that ensure safe and effective drug delivery. There are a number of options available for effective drug delivery. The choice of method is based on the following:

(a) Species of animal involved.

(b) Area of use (captive/free ranging)

(c) Characteristics of equipment, i.e. the impact, volume of drug to be delivered, projection capabilities, range potential, accuracy, versatility, portability and compactness, availability of spares and service and maintenance.

(d) Feasibility and practicability of administration.

(e) Post-delivery retrieval capabilities.

(f) Capabilities, expertise and skills of personnel.

(g) Budget available.

Whatever system is selected, it should ensure safe and effective drug delivery. Various procedures are briefly discussed in the following.

Oral administration

The drugs can be mixed with food or water (waiting) and presented to an animal. The induction time and degree of immobilization are unpredictable. A number of factors affect the drug intake and responses, viz. palatability; whether the animal has an empty stomach or full stomach; the drug dilution; and the level of absorption and interference in the gut. Though the technique has been used in captivity in cervids, it has led to varied results.

Parenteral administration

a. Hand-held syringes

The use of hand-held syringes is generally limited to animals that have already been physically restrained, be it in a cage, enclosure or room. The drug can be either directly injected when the animal is restrained in a squeeze cage or injecting using a pole syringe or "jab stick" that ensures safe drug delivery. Drugs can be effectively administered up to a distance of 2-3 m using a jab stick, and this method has been effectively used in primates. The major disadvantage of its use is the tendency of needles to break or bend when trying to administer the drug and injuring the animal if too much force is used when jabbing.

b. Projected darts

This is the most commonly used means of delivering drugs to wild animals. The dart is projected using projecting equipment and discharges the contents upon impact. Darts are available in different sizes and weights and are specific to the type of equipment used to propel them. Upon impact on the target, the drug is expelled through the needle, the plunger pushed forward by an explosive, air-activated or spring-activated discharge mechanisms.

The blow pipe is the most basic of all remote drug delivery systems and has been effectively used in captivity. The dart can be effectively propelled up to a distance of up to 10 m; however, using a blow pipe requires practice. Different power projection systems have also been used for projecting the darts. These systems employ compressed gas/CO_2 or explosive/gunpowder charges to propel the dart and are in the form of a pistol or rifle. Commercially available projection systems include Cap-Chur, Dist-Inject, Dan-Inject, Telinject, Paxarms, Pneu-Dart, Simmons and Vari-Range equipment. They can be effectively used for ranges from 30 to 70 m, depending on the air pressurization and the strength of cartridge.

Post-Immobilization Emergencies

The post-capture period represents the most critical stage in the course of chemical capture. Injected chemical agents, especially CNS depressants, cause physiological changes in wild animals. These changes should be monitored frequently till an animal regain normalcy after the influence of the drug has worn off. Sometimes, the existing and induced imbalance in the physiological conditions and an undesired position of recumbency may lead to complications. In such instances, emergency treatment of the captured animal may be required. Major emergencies that may be encountered include the following:

(a) Trauma (capture wounds, contusions, abrasions, lacerations, fractures or even abortions) due to underdosage or the use of drugs with longer induction times.

(b) Tympanism/bloat/asphyxiation resulting from malpositioning.

(c) Cardio-pulmonary depression or failure due to overdosage or exhaustion.

(d) Capture myopathy due to excessive musclar activity prior to capture coupled with vitamin and mineral deficiencies.

(e) Hyperthermia/hypothermia which may be drug induced, as a result of extreme environmental conditions or excitement or exhaustion of an animal.

(f) Others—renarcotization, seizures, acidosis.

Conclusions

Managing wild animals is becoming a critical and demanding task for both veterinarians and wildlife managers. Safe and effective capture techniques can provide aid for professional, scientific, ethical and humane management of wild sentient beings. This article presents different options available for wild animal restraint and immobilization.

Bibliography

Chowdhury, S. and P. Malik 1992. A Guide to the Chemical Restraint of Wild Animal, Wildlife Institute of India. Rohini Printers and publishers, Dehradun

Clark, R. K. and D. A. Jessup (Eds.). 1992. Wildlife Restraint Series. International Wildlife Veterinary Services, Inc., Salinas, California.

Fowler, M.E. 1982 Devivery systems for chemical immobilization In: L.Nielsen, J.C. Haigh, and M.E. Fowler (eds), Chemical Immobiilzation of North American Wildlife, The Wisconsin Humane- Society, Inc., Milwaukee, Wisconsin. pp 18-45.

Fowler, M.F. (Ed.). 1986. Zoo and Wild Animal Medicine, 2nd ed. W.B. Saunders Co., Philedelphia.

Harthoorn, A.M. 1982. Mechanical capture as a preliminary to chemical immobilization and the use of taming and training to prevent post capture stress. In Nielsen, L., J.C. Haigh, and M.F. Fowler (Eds). Chemical Immobilization of North American Wildlife. The Wisconsin Humane- Society, Inc., Milwaukee, Wisconsin.

Jones, D.M. 1984. Physical and chemical methods of capturing deer Vet. Rec. 114:109-112.

Karesh, W.B. 1995. Wildlife Rehabilitation : Additional considerations for developing countries. J. Zoo Wildl. Med. 26(1):2-9.

Kreeger, Terry J. 1996 Handbook of Wildlife Chemical Immobilization. International Wildlife Veterinary Services.

Nigam, P. 2006 Wild animal immobilization and restraint. ICAR Summer Institute on Recent trends in wildlife Health Management and Forensics, 8-28September 2006IVRI Izatnagar, (UP). Pp286-293

Porter, S.L. 1992 Role of the veterinarian in wildlife rehabilitation. J.Am. Vet. Med. Assoc. 200:634-640

Sarma, K.K. 2002 Remote injection and chemical immobilization of large animals. In: Ranvir Singh (Ed.) Healthcare and management of Zoo animals, Society for conservation of flora and fauna, Patna, India. pp18-27

Swan G.E. 1993 Drugs used for the immobilization, capture and translocation of wild animals. In : Andrew A. McKenzie (Ed.) The Capture and Care Manual : capture, care, accommodation and transportation of wild African animals. Wildlife Decision Support Services and South African Veterinary Foundation, South Africa pp. 7-59.