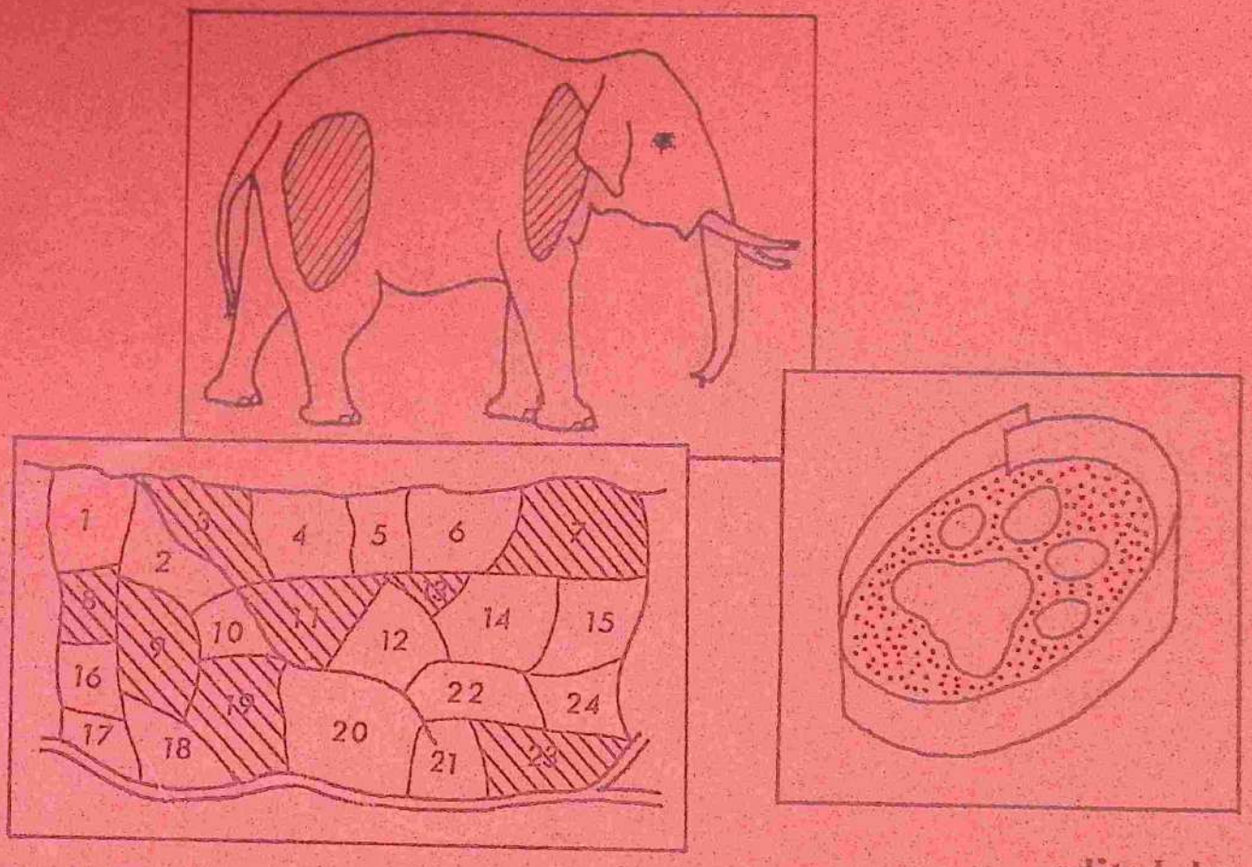
Field Document No. 11

FO: IND/82/003
July, 1988

MANUAL OF WILDLIFE TECHNIQUES FOR INDIA



edited by

J. B. SALE and K. BERKMÜLLER

India: Establishment of the Wildlife Institute of India
FOOD & AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Dehra Dun, 1988

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TWO : WILDLIFE

1. Animal Abundance & Movements

2. Wildlife Damage Control

3. Capture

THREE - THE PUBLIC

INTRODUCTION

USE OF THE MANUAL

This manual contains practical techniques for wildlife managers, not highly sophisticated methodology aimed at obtaining research quality data. In many cases the work can be carried out by staff with a minimum of technical training, provided planning and supervision is carried out by a competent wildlife officer, who has read and interpreted the relevant instructions. In some cases, such as analysing data from census based on sample counts, a little knowledge of sampling statistics is required but here the manual itself offers assistance at a level which should suffice for most management purposes.

Each of the three chapters is divided into several numbered sections in which techniques are grouped according to a general theme. Each technique is described in approximately two to five pages of text and illustrations. The box of text which heads each technique states its objective, major considerations and content.

The first "technique" in each section (e.g. Habitat 2.0) provides an overview of that section by way of introduction, pointing out its general significance to the overall management context.

In some cases more than one method is given for obtaining a particular type of information and guidence offered on how to select the most appropriate one.

Because there was a conscious aim to keep techniques as brief as possible, there are a few instances where a subject spans two adjacent techniques - the first, for example, describing the planning and field operations and the second the analysis and interpretation of the data obtained. It may therefore be advisable to read through a whole section before selecting and embarking on a particular technique.

The high proportion of material in the manual on human aspects (Chapter 3 - The Public) represents an acknowledgement that much of wildlife management in India is involved with management of people, either as visitors to wildlife areas or as local residents living in and around sanctuaries and national parks. The flora and fauna largely care for themselves, given adequate protection from the impacts and pressures imposed on them by the ever expanding human population.

ACKNOWLEDGEMENTS

Many of our WII colleagues have contributed to the production of this manual. Some have drafted descriptions of techniques or even entire sections; others have read through and commented on portions of the draft, while yet others have given themselves to the task of production, which has been done entirely within the Institute.

We are greatly indebted to all of these colleagues and in particular wish to thank the Director, WII Mr. H.S. Panwar for professional advice on many aspects; Dr. W.A. Rodgers, FAO Expert, who drafted many of the original Habitat and Wildlife Techniques; Mr. A.J.F.M. Dekker, FAO Associate Expert, who has refined the large sections on sampling and censuses, as well as assisting in production; Mr. Kishore Rao, Joint Director, who made extensive editorial comment. Dr. D.K. Sujan, Assistant Director, and his team of willing helpers ably assisted with the final phase of production.

We also wish to record our deep gratitude and thanks to Mrs. J.A. Sale who has been responsible for drawing the illustrations and extensive proof reading and Miss. P.S. Dawson who has contributed her skills to many aspects of production, including layout and word-processing. Both have worked voluntarily, often under heavy pressure and against totally unrealistic deadlines.

As editors, we hope what we present will be a useful contribution to the development of the scientific conservation of India's diverse wildlife heritage.

J.B. SALE
FAO Chief Technical Adviser

and K. BERKMULLER
FAO Expert

PREFACE

For long there has been felt a need of a manual of simple techniques of wildlife management developed for or adapted to Indian habitats, animals and social situations - one that managers can refer to for straight - forward use in the field. This need has been expected to be supplied by our young Institute.

Technique development is an evolving process at any stage in any scientific field. In the case of wildlife science this is a particularly challenging proposition because the field itself is in an early stage of development in the country. There is, as would be expected, shortage of good reference literature, especially on techniques aspects. Our new Institute, involved intensively in training managers and in research of current field relevance, has had largely to develop its own teaching materials and methodologies for field studies. In the process we have tested our techniques through our faculty, trainees and research fellows. We have benefited immensely from the study and analysis of numerous examples of census work, habitat management and treatment of human-wildlife interface conflicts, as practised by field managers in different parts of the country.

We are delighted to have been able to compile this manual and put it in the hands of our field personnel. This is a compilation by the faculty of our relatively new Institute in close collaboration with international experts based at the Institute under the FAO Project. The contribution of FAO experts is invaluable because this stems from their prolonged experience within the country which has enabled them to relate the basic techniques to Indian situations.

We have deliberately avoided inclusion of theory as text books are available. Material included is intended to be of direct application in the field. This first edition has three chapters dealing with habitat, wildlife and the people's aspects. Each chapter has a number of sections. More sections and more material in each section will hopefully be added progressively. For example, we are already planning new sections on wildlife managment in commercial forestry and on animal health and veterinary caree. The chapter on People will doubtless need augumenting on management of interface conflicts, ecodevelopment and the like.

Lastly, we acknowledge that in an initial attempt like this there are bound to be shortcomings and deficiency in coverage. We do not pretend to have presented the final answer in every case. We would greatly welcome suggestions from users on how to correct, improve and augment the contents and on additions of more subjects.

H.S. PANWAR
Director
Wildlife Institute of India

HABITAT

WATER RESOURCES

INTRODUCTION TO THE SECTION

Water is a crucial factor in wildlife management. For example it is a key aspect when evaluating habitat suitability for water-dependent species. By creating or closing water sources one can regulate animal use of habitats and thus manipulate the condition of the habitat itself. A knowledge of local rainfall patterns enables a better understanding of the water resources of an area.

In many Indian reserves, water management mainly involves locating areas without surface water during the "pinch period" and providing a water supply. This is best done by conserving and facilitating access to natural water sources. Otherwise one has to create an artificial water source.

By providing additional sources of water you may achieve any of the following objectives:

- *Allow the dry season use of habitats which could not otherwise be used by water-dependent species, thus removing a limiting factor.*
- *Draw animals away from water near human settlements, thus reducing conflict and risk of disease transmission from domestic stock.*
- *Draw animals closer to tourist or observation points, thus assisting research, monitoring, capture, identification etc.*
- *Achieve a form of rotational grazing by opening and closing artificial sources.*

Caution: Creation and maintenance of water sources is expensive and should only be undertaken with a specific objective in mind, for instance to benefit the population of an endangered species by one of the above means.

The opening up of new habitat should not be allowed to lead to the deterioration of that habitat by overuse. Proper distribution of water sources is critical in this regard.

SECTION CONTENTS

Surveying and Mapping of Water Sources

TO SHOW TYPE, LOCATION AND AVAILABILITY OF WATER SOURCES ON MAPS FOR MANAGEMENT PLANNING.

For the manager it is useful to know how water sources are distributed and whether or not they dry up. With this information on a map in front of you it is easier to a) identify seasonal gaps in water availability, and b) to decide where the provision of additional water sources might be needed.

The precise objectives of a water survey and the degree of detail of information sought should be clarified before designing the survey

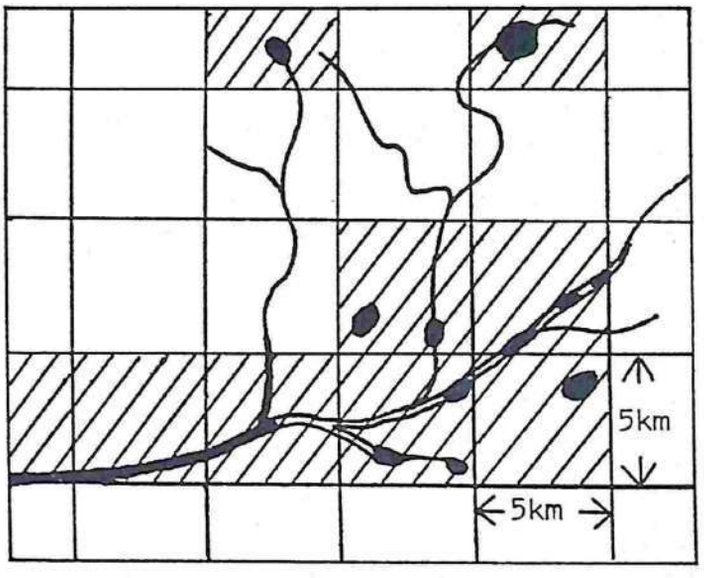
Mapping usually begins with a survey to locate the perennial sources. accessible to wildlife. If these are inadequate for wildife needs, a survey of the non-perennial sources will be necessary to provide a basis for a water development plan. Ultimately, all water sources may be located and classified by type and seasonal availability.

How to survey, classify and map water sources is described below.

SURVEYING

Survey for Perennial Sources

Local staff/residents usually know existing perennial sources of water. After enquiry, locate them on a map on which you have superimposed a 5 km x 5 km grid. Lightly shade all squares containing perennial water. Since, as a rule of thumb, a water dependent species should have no further than 2.5 km to walk to water, any grid square without a perennial source represents a "gap". A decision then has to be made whether additional water should be made available. If the answer is yes, a survey for non-perennial sources should be made.



Perennial water source

Grid square with perennial water

Grid square representing water "gap"

Survey for Non-perennial Sources

In practice, preliminary information about non-perennial sources can be taken down along with that about perennial sources. However, it is necessary to find out how long these sources last into the dry season, in an average year. To do this choose one or more non-perennial sources in each respective "gap" grid for inspection at regular intervals, commencing with the post-monsoon period. Inspection intervals should be shortened prior to the final drying up. Relate the duration of water to the total rainfall in that year and compare this with high and low annual totals, as seen in records for the area. Ideally, one should repeat the survey in several subsequent years, examining permanence of water in relation to variations in annual rainfall.

At the end of the survey, one is able to tell for what period in an average year, no water is available in a specific grid cell and it is for that period that additional supplies need to be provided.

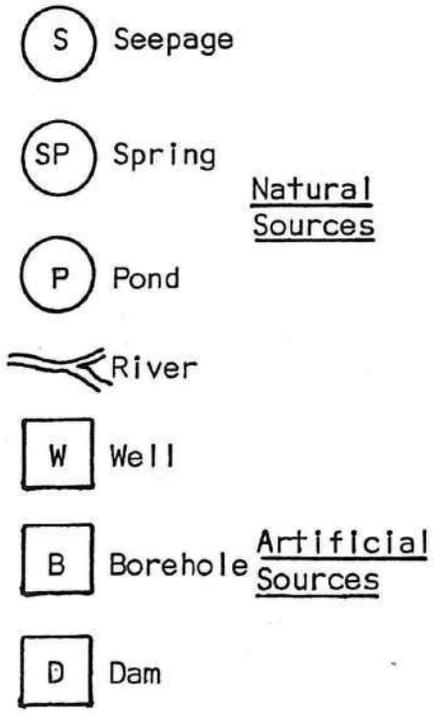
CLASSIFYING

In the long term it may be useful to produce a comprehensive record of water sources according to permanence, type and access.

- Permanence: Periods during which the source normally contains water, e.g. July to September; July to December; July to March; July to June (perennial).
- Type: Natural sources - river, lake, pond, spring, seepage, etc. Artificial sources - check dam, reservoirs, well, borehole with tank, artificially deepened seepage, etc.
- Access: Times and reasons of difficult access, e.g. reservoir or canal embankments too steep, competition from livestock, disturbance by noise and traffic, lack of cover, etc. (Perhaps note that access is difficult for some species, but not for others.)

MAPPING

Design symbols for permanence, type and access.



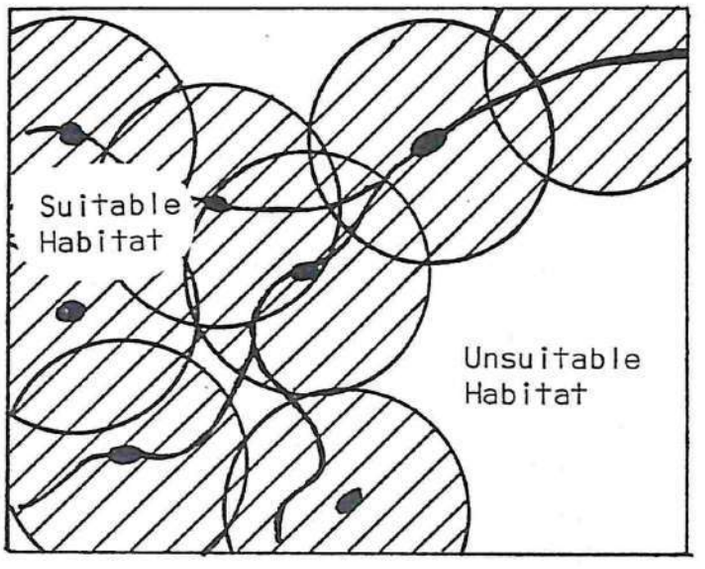
Above symbols may be colour-coded to indicate permanence
e.g. Green = July-September
Blue = July-December
Yellow= July-March
Red = July-June

Enter these on a map in any appropriate combination. For instance natural sources available during the pinch period, artificial sources to be serviced during the pinch period, water sources with a high degree of disturbance, etc.

This way you can see at a glance the general distribution and types of water sources with an indication of availability.

HABITAT ANALYSIS BASED ON WATER RESOURCES

A useful refinement shows the availability of water for a particular species or group of species. Some species may move several kilometers away from the nearest water source, while others stay within a few hundred meters. If the maximum range from water is 2 km for the species under consideration, draw circles with the appropriate radius around each source. The space outside the circles represents unsuitable habitat for that species.



Setting up Rain Gauges

TO OBTAIN ACCURATE RAINFALL DATA FROM KEY LOCATIONS

Long term rainfall data (means, distribution and intensity) are valuable in water resources management and for understanding many biological phenomena important to wildlife management, such as vegetation phenology and animal migrations.

Rainfall measured at a meteorological station 50 km away, may not be representative for the intensity and amount of rain falling in your protected area. Even within the area you may experience considerable local variation, for example, between distinct catchment areas.

The meteorological service in your state might be interested in data from your area and might even be prepared to assist with the setting up of a base climatic station which measures humidity and temperatures as well as rainfall. Continuity and accuracy of recording are vital. Staff charged with reading the gauge must be reliable.

You have a choice between daily rainfall gauges and the slightly more expensive storage gauges.

Methods of choosing the location, setting up and making the gauges and analysing and presenting the data are shown below.

CHOOSING A SITE

- Locate gauges in the catchment areas of important streams.
- Locate gauges on opposite sides of ridge tops which separate catchments and form a cloud barrier.
- Install gauges next to a guard post where they are safe from tampering and convenient to read.
- Mount gauges at least 1 m high and 10 m away from trees or buildings.

DAILY RAINFALL GAUGES

These gauges are read and emptied daily at a specified time. To record intensity take readings at shorter intervals, e.g. hourly during actual rainfall.

The funnel gauge, described here, is suitable for hot climates because it prevents evaporation losses. It consists of three parts: an outer casing, a funnel and a calibrated collection jar or measuring cylinder. The funnel rim should have a perfect circle with a sharp edge to avoid measuring errors. The casing should be just big enough to prevent the funnel from slipping through.

Order the funnel and the casing from a local tinsmith. Purchase the measuring cylinder or substitute a glass jar which must have parallel sides.

Calibrating the Measuring Cylinder

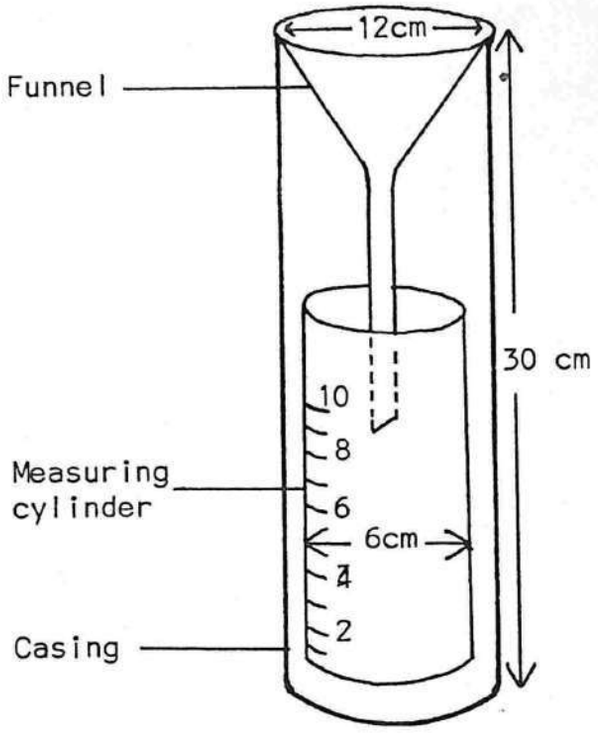
Calculate area of funnel opening.
Formula for circle area: πr^2

$$3.4 \times 6^2 = 122.4 \text{ sq cm}$$

Calculate area of cylinder opening:

$$3.4 \times 3^2 = 30.6 \text{ sq cm}$$

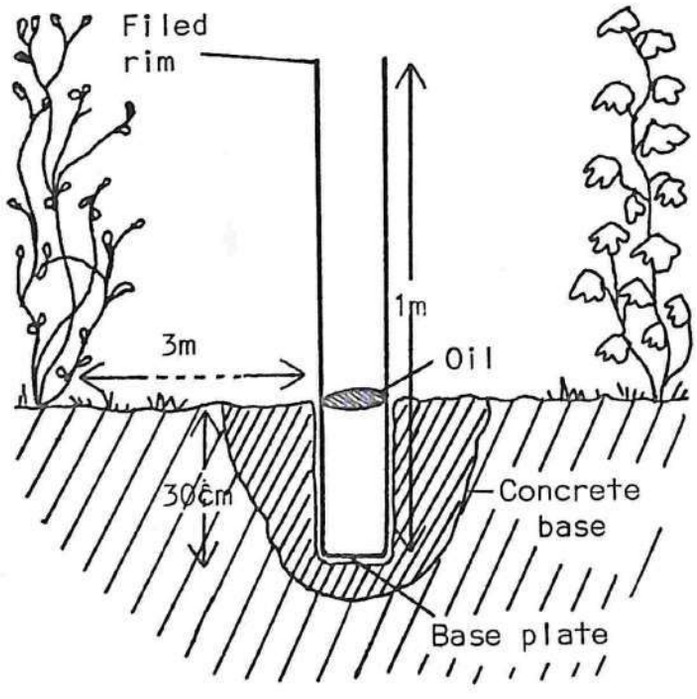
The opening of the funnel is thus 4 times as large as that of the measuring cylinder. A water column in the cylinder 4 mm high corresponds to 1 mm of rainfall; 8 mm corresponds to 2 mm rainfall, and so on. For convenience, mark the cylinder in mm of rainfall.



STORAGE GAUGES

A simple storage gauge is inexpensively made from a 8 to 10cm metal pipe. Weld a 1 m length of pipe to a base plate and file the upper rim from the outside to prevent splash errors. Anchor the pipe securely in a vertical position by burying it in the ground. In wet climates a pipe partly inserted into a hole in a concerte base makes it easier to empty it at more frequent intervals. Clear the vegetation 3 m around the site. Pour in a spoonful of engine oil to prevent evaporation.

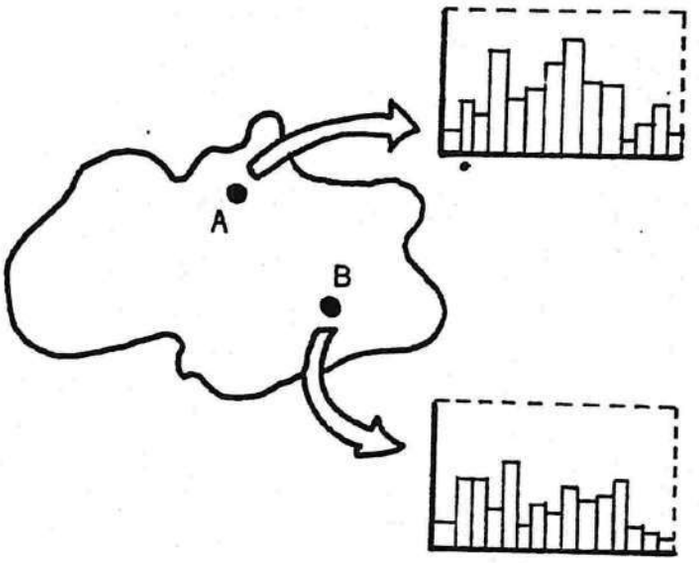
At the end of each month measure the contents with a graduated ruler as a dipstick. In areas with over 1000 mm rainfall discard the water and add fresh oil.



DATA RECORDING AND ANALYSIS

Keep a separate book for each gauge and have senior staff examine the records for errors periodically. Tally for monthly and annual precipitation, for days of rain, and for high intensity if hourly readings were taken.

Display monthly rainfall as histograms, annual rainfall by line graphs. Small histograms can be superimposed onto a map, allowing ready comparison of rainfall patterns at various locations.



Development of Supplementary Water Sources

TO DRAW ATTENTION TO CONSIDERATIONS WHICH SHOULD PRECEDE THE PROVISION OF SUPPLEMENTARY WATER SOURCES.

All forms of human intervention in nature have their attendent risks and should only be undertaken after careful consideration. Water development in a wilderness area is no exception and should only be undertaken if its necessity and objectives have been firmly established.

Purpose, location and quality of the site, type of construction and potential constraints are factors to consider in the planning stage.

A checklist of constraints and guidelines is given below.

SOME GENERAL RULES

- A gap in water supply is not in itself sufficient reason to establish an additional water source. Clear objectives must be established - See Habitat 1.0.
- An unreliable supplementary supply is worse than no supply.
- Providing access to natural water sources is preferable to constructing artificial ones.
- A large number of small and widely scattered sources are better than a few large sources, which may lead to over-concentration of animals around them.
- A water source per every 25 sq km is adequate for most protected areas. Animals would thus have a maximum distance of 2.5 km to travel for water.
- All water bodies should be regularly checked for pathogens which can cause epidemics among animals.

CONSTRAINTS

In certain conditions, developing new water sources may involve some risk. For instance:

- Withdrawal of water, particularly ground water, may alter natural processes of water cycling and lead to significant changes in ecosystems.
- Water sources in buffer zones may bring domestic stock into contact with wildlife, increasing the chance of disease transmission.
- Excessive water development in arid zones can raise animal populations to levels incompatible with food availability, leading to habitat degradation.
- Endemic and rare plant species may be adversely affected, therefore avoid water development in areas where these are present.
- Water development might trigger erosion on steep lands and fragile soils.

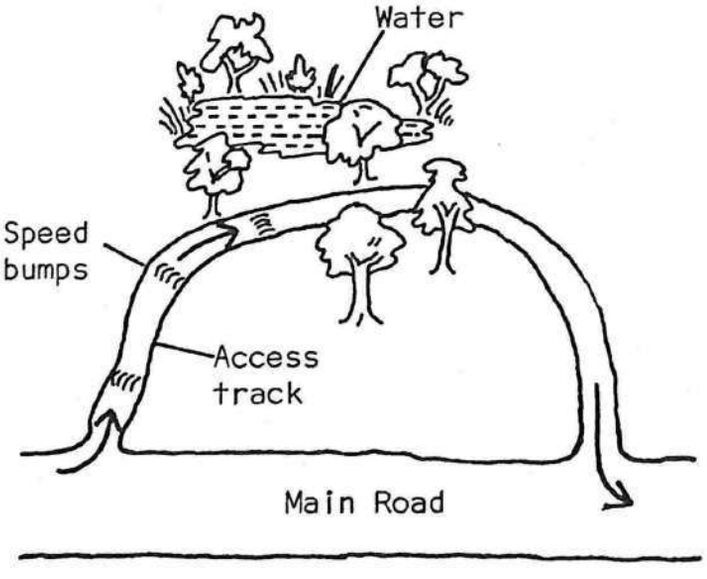
GUIDELINES FOR CHOOSING A SITE

As far as possible:

- Choose sites near habitat edges (ecotones) where species from different habitats congregate.
- Choose a site which has shade trees and tall shrub or grass escape cover nearby.
- Avoid sites which are likely to be disturbed frequently,e.g. by livestock, local people or traffic.
- In buffer zones, ensure that wildlife has adequate access to water sources, e.g. it should be sited at least 500m away from a cattle camp. Camp residents should be instructed to avoid disturbance and limit cattle watering to the hours from 9am to 3pm.
- If you develop a site for the benefit of tourists observing wildlife from a vehicle track, keep it far enough away to prevent speeding vehicles from scaring the animals (25 m). Consider building an access track.
- If timid species are involved consider building an earth bank between the track and water hole to shield approaching vehicles from drinking animals. Tourists can view animals by peeping over the top of the bank. A hide or machan overlooking the water may be a better alternative (see Public 2.3).

GUIDELINES FOR SITE DEVELOPMENT

- Where a water source is within cultivated land, a corridor or gap with shrub or forest cover should be maintained for wildlife access to the water.
- In wildlife viewing areas make the waterhole look <u>natural</u>.Give it an irregular shape and slightly sloping edges. Use locally available stone. Put storage tanks, pumps and pipes underground or at least hide them from view.



Providing Access to Natural Water Sources

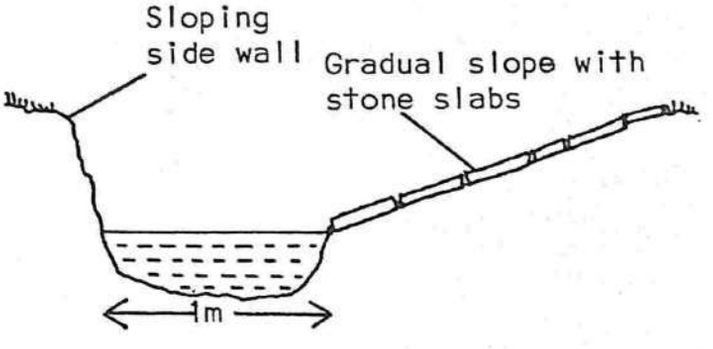
TO SHOW HOW ACCESS CAN BE PROVIDED TO INACCESSIBLE NATURAL WATER SOURCES.

Where additional water is needed, it is often easier and cheaper to facilitate access to natural sourses, like, a high ground water table, a spring emerging from a sheer rock face, or a source which is normally occupied by livestock, than to install a totally artificial water supply. Natural sources are also aesthetically more acceptable than artificial constructions which are visually intrusive.

How to tap shallow ground water, divert a water source and enhance replenishment of ground water by digging percolation trenches, is described below.

TAPPING SHALLOW GROUNDWATER OR SEEPAGES

An impermeable layer of rock sometimes brings groundwater close to the surface. You can detect such places from local congregations of butterflies, by a lush growth of grass, and the presence of moisture-loving tree species. Digging 1 to 2 m down should expose water. Level the edge to give it a gradual approach from at least one side. A water depth of 30 cm is sufficient but, depending on the condition of the soil, it may have to be scooped out often if the animals tread down the edges. Alternatively, the immediate approach may be paved with slabs or concrete to prevent erosion. To avoid evaporation losses, keep the source below 1 m diameter.

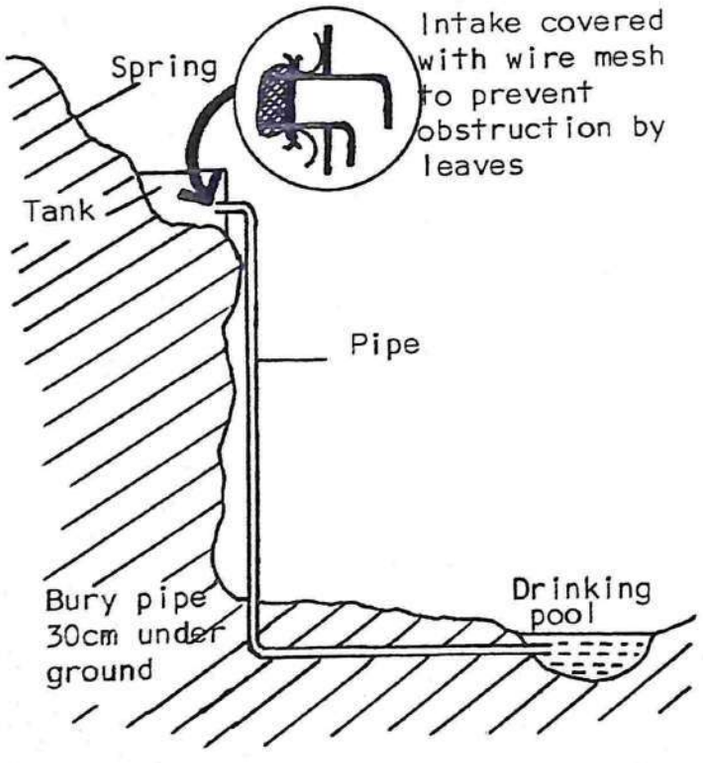


During the dry season, water is sometimes present not far below the surface in dry riverbeds or nullahs, beneath damp depressions in the mud or sand. (Elephants sometimes exploit such water by digging a narrow hole down to it with their tusks and then inserting their trunk to suck it out.)

A temporary water source for wildlife may be made, during the pinch period, by digging out a hole 1 to 2 m in diameter and deep enough to allow at least 30 cm of water to percolate into it. Again, at least one edge should have a gradual drinking animals from pushing in the soil and possibly obliterating the waterhole.

DIVERTING NATURAL WATER SUPPLIES

Water from springs or seepages emerging from the ground in places not readily accessible to wildlife such as sheer cliffs can be collected in a settling tank and channelled by gravity feed through pipes or an open channel to a place where animals can easily reach it. Fine examples of this can be seen at Bhandavgarh National Park in Madhya Pradesh.



For a reliable, low maintenance system without air valves, one should avoid humps above the fall line and the pipe should be buried a foot or so underground, especially if it is made from polythene.

Similar distribution systems to the above can be developed from a disturbed water source such as a village tank, to divert water to places with less disturbance to wildlife.

PERCOLATION TRENCHES

The amount of rainwater percolating into the ground and replenishing ground water supplies can sometimes be increased by digging percolation trenches on the slope above a seepage. This is most likely to work in dry areas where rainfall may be heavy but of short duration. Surface runoff which would otherwise go to waste, is collected in the trenches and subsequently has time to seep into the ground. The method has been applied at Palamau Tiger Reserve where it has resulted in a considerable saving of money for the tanker supply for a series of waterholes.

Providing Artificial Water Sources

TO DESCRIBE INEXPENSIVE METHODS OF CONSTRUCTING ARTIFICIAL WATER SOURCES

If gaps revealed by a water survey cannot be remedied by providing access to natural sources you will need to consider artificial water sources such as check dams, reservoirs, anicuts tube wells or tanker supply. Whichever option you choose, it should be economical, easy to build and maintain, and not be an eyesore in the landscape. Two general rules apply: a) An unreliable supply can be worse than none; b) Many small dispersed sources are better than a few large sources.

Tube wells and anicuts (a weir across a streambed) are usually elaborate and costly. Obtain construction manuals and professional assistance for building them. Tube wells will give a reliable high quality supply and may greatly facilitate tanker supply in large areas.

Guidance on construction of check dams, small reservoirs and tanker supplied troughs is given below.

CHECK DAMS

Check dams, in seasonally flowing streambeds, are relatively inexpensive, but they may not hold water throughout the dry season and sediments will have to be removed periodically.

Choose a number of dispersed sites in a river/stream system. Depressions in a riverbed which normally hold water for a time after flow has ceased provide suitable sites, the check dams thus increasing the amount of water held back and prolonging the supply further into the dry season.

Check dam walls are usually curved away from the direction of flow and should be constructed of natural materials at the site, such as boulders cemented together.Concrete dam walls which are expensive and unsightly, should be avoided as far as possible.

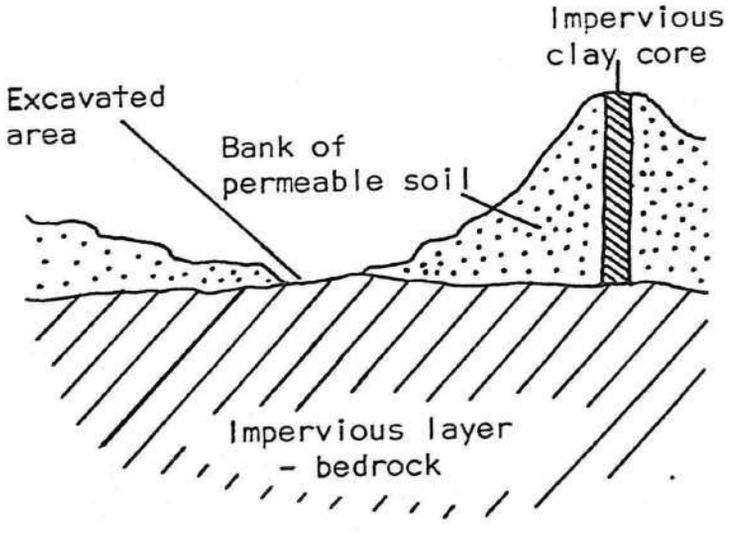
SMALL RESERVOIRS

Among the most common artificial water sources are shallow reservoirs which retain surface runoff behind earth dams. Choose the site by judging catchment area, drainage, and soil condition. Runoff from a small catchment area may never fill the tank.

Surplus runoff from a large catchment area can be diverted if there is a natural drainage channel. Seepage can be prevented by constructing the tank on impervious soil or bedrock.

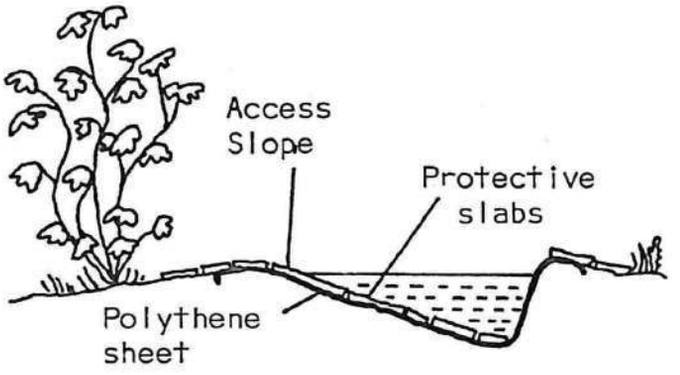
Construction

Begin by digging a saucer shaped depression, using the excavated material to heap up a dam perpendicular to the direction of flow. Excavating the tank in steps allows you to continue work at a higher level even after rains. While the lower part of the pit is flooded, the higher steps remain dry. If the excavated soil is sandy and permeable, the dam will require a core of clay rising directly from bedrock or an impervious layer of soil.



TANKER SUPPLIED TROUGHS

A tractor drawn tanker is often an emergency measure during severe drought. If large areas are to be covered, strategically located boreholes reduce the hauling distances considerably.



Construct temporary troughs to hold the water delivered by the tanker. It is best to construct these on impervious clay. If the soil will not hold water, use cement or thick polythene sheets, weighted with stone slabs, as a lining. Allow for an overflow into a mud pool for birds and for wallowing. Troughs which are very shallow will suffer heavy evaporation losses but one side should have a gradual gradient to provide as easy approach. Two or three meters diameter and a depth of 50 cm usually suffice if the water hole is filled daily.

VEGETATION

INTRODUCTION TO THE SECTION

Vegetation is a major component of wildlife habitat. It is made up of a number of plant communities, which can be distinct entities or more diffuse, merging slowly into each other. The value of the habitat for wildlife species is directly linked to the type and variety of plant communities and their condition. Changes will have a positive or negative effect on the overall quality of a habitat for a particular wildlife species.

Plant communities evolve from low diversity and simple structure to diverse and complex systems, in a process called succession. Communities at an early stage of succession, and their typical wildlife, may require management intervention in order to survive. In other cases, one may wish to encourage rapid succession as, for instance, after degradation due to overuse.

Often, as a result of encroachment, commercial exploitation or overgrazing, vegetation becomes degraded, losing diversity and productivity. Active management to restore such degraded land often requires, apart from protection, the eradication of weeds and restoration of tree cover.

Protected area managers must be able to assess and monitor vegetation as a basis for manipulating it in tune with management objectives. This involves qualitative processes such as floristic inventory, community description and photographic recording, as well as quantification of factors such as vegatation cover. Information from both types of recording can be portrayed on a vegetation map.

Apart from manipulation of water supplies and ungulate usage of areas (see section Habitat 1), fire is an important manipulative tool, especially in grassland management. Conversely, the prevention of unwanted fires is a vital part of habitat management, as is the control of weeds.

The above aspects of vegetation management are covered in this section.

SECTION CONTENTS

Floristic Inventory

TO COMPILE A RECORD OF PLANT SPECIES AND THEIR DISTRIBUTION IN TIME AND SPACE

In order to understand healthy vegetation as well as recognize habitat degradation, and the associated loss of species, one must first make an inventory of the plant species present. Much information about the flora exists in working plans and other publications, among local people and junior staff. This knowledge needs to be recorded and collated.

This technique describes how to compile and collate records of plant species occurrence.

FILE CARD RECORD

A simple checklist of plant names constitutes the first step in information gathering (but in itself it has little use). Entering each name and additional relevant information on a 5" x 3" file card enables useful knowledge about species to be built up, as well as facilitating the efficient extraction of information.

Copy the species from existing checklists onto the file cards. List scientific, English, and local names. Organise the cards alphabetically by genus. Trees and browse level shrubs and herbs are important, but so are grasses, and these are poorly represented in foresters' lists. With this in mind, let the list grow.

ECOLOGICAL INFORMATION

Add additional ecological information as it becomes available.

- Type of plant: e.g. canopy tree, small tree, shrub, climber, herb, grass.
- Distribution in terms of community and abundance:

  a) community in which the plant is found e.g. Sal forest, alkali flat, riverine thicket, rocky cliff, deciduous forest; (use abbreviations like, SF, AK, etc.)

  b) How abundant is the plant within the community? : e.g. dominant, frequent, occasional or rare (D, F, O, R), local or widespread (l, w).
- Other information: importance to wild animals, livestock, humans; the time of flowering, leaf or fruit production.

Capparis horrida L. Capparaceae

Vernacular(s): _____

Shrub
R, DF, T.
F, W
Leaf eaten by ungulates
New leaf - March

Later the data can be brought together in report form as an annotated check list, using two lines as shown below:

C. horrida L. Vernacular:_____ Shrub

R, D F, T; F,W; Leaf eaten; March.

Describing Major Plant Communities

TO PROVIDE GUIDELINES FOR DESCRIBING PLANT COMMUNITIES

Describing major plant communities is a pre-requisite to scientific protected area management. Examples of major plant communities in Indian wildlife reserves are teak, bamboo or sal forests and terai grasslands.

Unfortunately, descriptions in existing working plans are frequently too generalised, cover too large an area, and often ignore the ground layer.

The file card record or annotated checklist are the major data sources for the description (see Habitat 2.1). The need to be analyzed and additional information may have to be gathered.

This technique shows how to sort, group, and interpret information for a community description.

SORTING THE DATA

Make a list of the major communities in your area. With the help of the file cards prepared during the floristic inventory, make a list of plant species found in each community.

DESCRIBING THE STRUCTURE

Structure can be described in terms of vegetation layers and by adding simple height measurements, e.g."tall grasses up to 3 m and scattered trees to 8 m".

Example:

- Canopy Emergents: higher than 25 m, are widely scattered, usually Terminalia tomentosa
- Continuous Canopy: at 25 m, dominated by Shorea robusta. Lianas scarce. Canopy is bare in March and fierce fires in May-June may cause a second leaf fall.
- Understorey: frequent trees to 12 m,crowns not touching, Mallotus, Litsea, Ehretia, Kydia are common, Lianas, like Millettia, Clematis are frequent.
- Shrub Layer: dense to 4 m, diverse, many Mallotus and Murraya. Taller herbs reaching 2 m in the gaps. Dominated by Clerodendron and Callicarpa with some Jasminum. This layer opens up in the dry season due to leaf-fall.
- Ground Layer: sparse, grasses infrequent, Oplisenus occasional, ferns Adiantum occasional, several species of herb appear at low density in monsoon.

VALUE FOR WILDLIFE

Note if a community is of particular value to wildlife, e.g. "The tall Saccharum grass habitat of the river flood plain provides essential shelter and food for the Indian One-Horned Rhinoceros"; "Ficus trees attract frugivores for several months of the year"; "Fallen Butea flowers and leaf attract ungulates in April/May".

VARIANTS

Note variations in the prevailing pattern.

e.g. "A dense tangle of Lantana often found where tree fall has taken place" Patches of Syzygium are common in low lying areas".

DESCRIBING DISTRIBUTION AND ABUNDANCE

At the end of this process you will be able to make statements like the following:

- The ..... community is the richest with a total of __ species, _____ of which are frequent to abundant.
- Within the protected area, the.... community is found only along the lower reaches of its three perennial streams.

Point Sampling for Ground Cover

TO DESCRIBE A SAMPLING METHOD FOR GROUND COVER MEASUREMENT IN LESS DENSE VEGETATION

"Basal cover" - the proportion of ground covered by vegetation at ground level - is a good indicator of habitat condition. Excessive use of a habitat usually leads to a loss of perennial plant cover and loss of wildlife dependent on it. Fire and cutting causes sudden and drastic changes in ground cover.

Even if plant cover as a whole remains constant, the proportion of components may change; for instance, annual grasses replaced by perennials or weeds. Sampling determines the frequency at which each component occurs and enables rapid evaluation of cover over large areas. Repeated sampling at intervals reveals changes and monitors trends.

This sampling method is suitable for less dense or sparse ground vegetation, whilst Habitat 2.4 describes a method for use in dense vegetation.

Point (also called "Two-step") sampling gives a randomised sample of points or individual plants and indicates the percentage of ground covered by vegetation and the composition of that vegetation in terms of frequency of plant types or species, e.g. out of 10 plants sampled, 4 are grasses, 2 are sedges and 4 are herbs. No complicated mathematical treatment is required. Details of the method are given below.

Details of the method are given below.

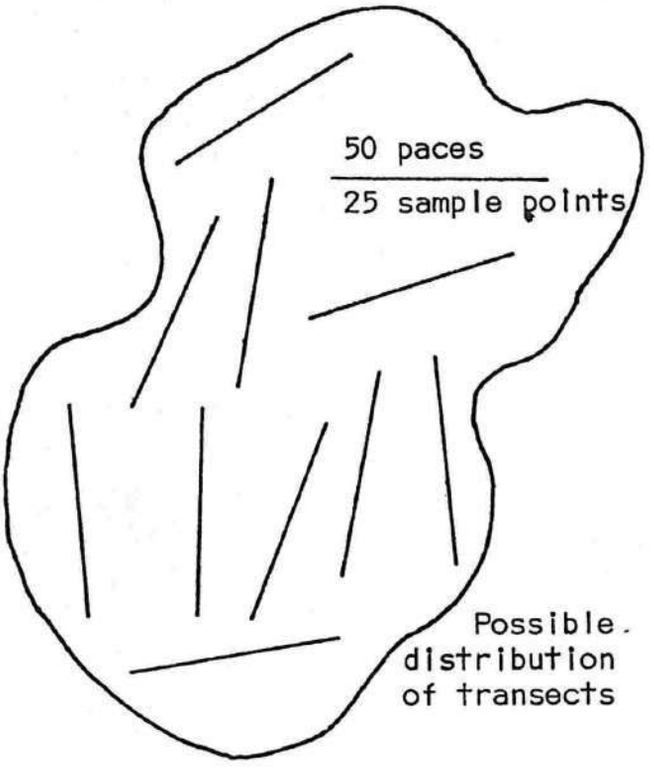
WHAT CAN BE SAMPLED?

Anything which is identifiable and of importance to understanding ground cover can be sampled, including absence of cover. Categories may, for example, include bare ground, leaf litter, dung, dead plants, green plants. The latter may be divided into grasses and herbs, annuals or perennials, size classes or palatable and unpalatable species etc. Categories of this kind enable more rapid sampling than if species are recorded by name, unless those present are all readily identifiable by the recorder.

Sampling costs time and money - maximize the information gathered but gather only that which is likely to yield useful results.

SAMPLING PROCEDURE

- Devise appropriate categories of cover (or absence of cover), e.g. grass, herb, bare soil, rock.
- With pin, chalk, or notch, mark a point at the toe of one of your shoes.



- Traverse the study area in a series of walked transects. Ten transects of 50 paces give an adequate sample in a relatively homogeneous area.

- As you walk along the transect, every second step record the cover immediately under the mark on your shoe. A grass leaf pushed down by a descending shoe is not ground cover. A Cynodon leaf hugging the ground counts as ground cover. One transect of 50 paces will contain 25 sampling points.

- Record data in manner shown on accompanying sample sheet.

- Add the figures for each category of all transects and divide by the number of sample points to arrive at the mean. (For transects of unequal length, weighted averages must be used).

  e.g. if out of 250 sample points 100 are categorized as grass, then grass cover is $\frac{100}{250}$ x100 = 40%

- In sparse vegetation with, let's say, 2% cover, point sampling along transects may yield inadequate data on plants. Adjust your sampling method to, for example, identify the nearest 5 plants at every tenth step.

- The 2-step method is not suitable when it becomes impossible to walk in dense vegetation.

Date: Recorder:

Location/habitat:

Point No.	G=grass D=dung S=soil TRANSECTS						
	1	2	3	4	5	6	
1	G						
2	G						
3	S						
4	G						
5	G						
6	S						
7	D						
24	D						
25	S						
TOTAL G	12						
TOTAL D	8						
TOTAL S	5						

Area Sampling for Ground Cover

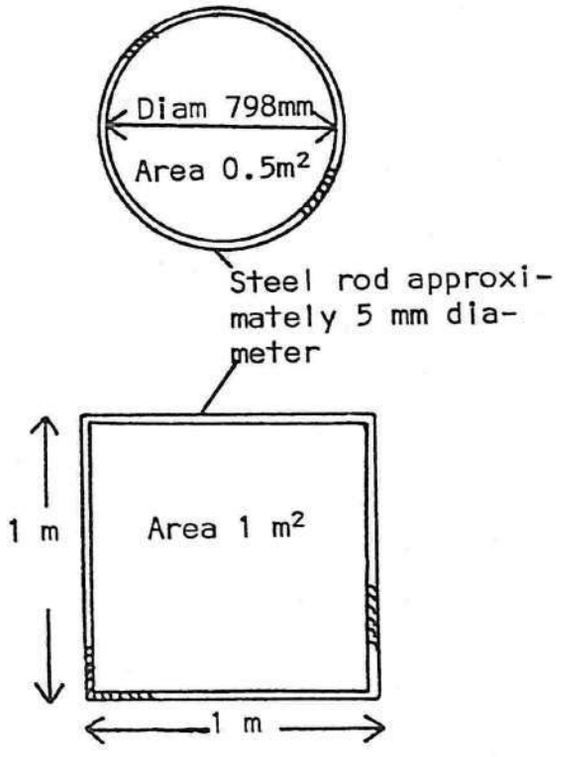
TO DESCRIBE A SAMPLING METHOD FOR GROUND COVER MEASUREMENTS IN DENSE VEGETATION

The importance of measuring ground cover is indicated in the previous technique, Habitat 2.3, which describes a method for making measurements in sparse vegetation. This method, which is suitable for use in dense or tall vegetation, is based on sample plots or areas and records the frequency with which each cover category occurs within a number of plots. For example, if out of 10 sample plots, 8 contained grasses, 5 contained sedges and all 10 contained herbs, the frequency of occurence of these categories is 80%, 50% and 100% respectively, showing how widely each is distributed. Note the result may add up to over 100%.

Details of the method are given below.

EQUIPMENT

The sample plot is the area enclosed by a circular or square frame which is thrown to the ground. This should be made, to exact dimensions, from steel rod, welded at the joint and is usually 0.25 to 1 sq m in area - smaller if the number of species per area is high.



SAMPLING PROCEDURE

- Devise suitable categories of cover, e.g. lantana, grass, herbs, woody vegetation, leaf litter, dead wood.
- Throw the frame to the ground in a random manner.
- Record whether or not each of your sampling categories are present within the frame. (Note only presence or absence of each category is recorded, not the number of individuals of each category.)

- Repeat random throws until requisite number of samples, e.g. 50, have been obtained.
- Analyse the data to determine in how many of the sample plots each category of cover was present.

Date: Recorder:

Location/habitat:

Lantana = L Grass = G
Leaf litter = L/L Dead Wood = D/W
✓ = Present X = Absent

Frame No.	L	G	L/L	D/W
1	✓	✓	X	X
2	X	✓	X	✓
3	X	X	✓	X
50	X	✓	✓	✓
✓	15	40	10	6
X	35	10	40	44

ALTERNATIVE PROCEDURE

Alternatively, you can estimate proportion of cover in small sample frame. Tall growth may have to be cut away to see the stem bases easily. Suggested classes are 0-20%, 21-40%, 41-60%, 61-80%, over 80%

Measurements of Shrub and Tree Layer

TO DESCRIBE A SAMPLING METHOD TO DETERMINE DENSITY AND SPECIES COMPOSITION OF THE SHRUB AND TREE LAYER

The Point Centred Quarter (P.C.Q.) method described here is a transect-based point sampling method for investigating the density and species composition of woody plants of importance to wildlife. An example might be shrubs or young trees up to 1.5 m high providing cover for chital. Alternatively, the density of, say, a particular fodder species may be determined.

The method thus enables the manager to quantify and analyse key habitat factors provided by the shrub/tree layer and to compare different wildlife ranges with respect to these factors.

The P.C.Q. method, which is described below, is best used by two persons.

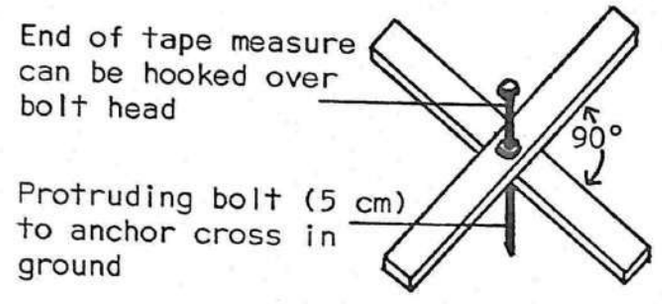
WHAT CAN BE SAMPLED?

Any woody plants which occur as isolated individuals and do not form continuous cover, as does much ground vegetation. The method is best suited to shrubs and trees and can sample the density of either a single species or group of species which have some common property (size class providing cover at a particular level; constitutes available browse for a particular herbivore; provide high canopy for an arboreal primate etc). If a group of species is being studied, the frequency of occurence of the individual species in the group can be determined in addition to group (cumulative) and species-specific densities.

Note that, in practice, it is possible to sample two different categories of plant simultaneously e.g. species x and group y.

EQUIPMENT

- Measuring tape (20 or 30 m length)
- Hardwood cross, consisting of two strips (2 x 4 x 60 cm) bolted together at the centre.
- A pocket compass



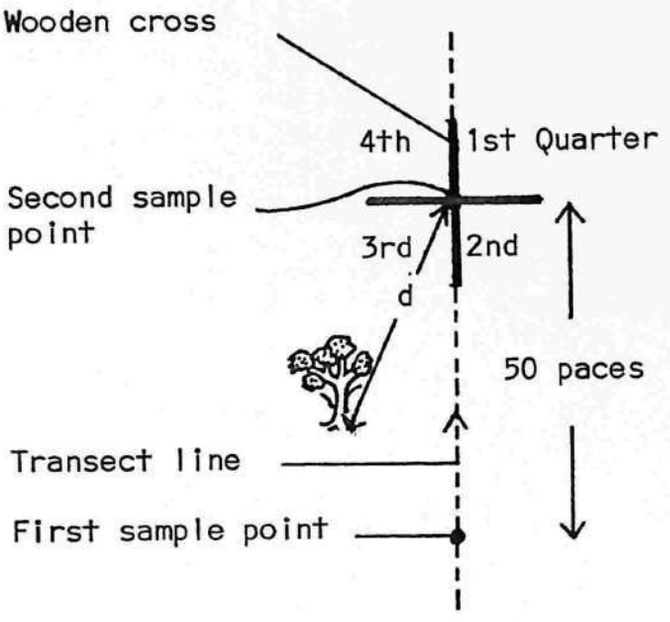
METHOD

1. Precisely define the species or categories of plants to be sampled.

2. Locate a number of line transects in the study area with aid of a large scale map (e.g. 1 : 50,000), ensuring representativeness of sampling with respect to any known variations in vegetation. Transects of 0.5 to 1.0 km length are adequate for most situations. The start of each transect must be easy to locate in the field. Transect direction is maintained with the aid of a compass.

3. Sampling points are regularly spaced along the transects, e.g. every 50 paces - the appropriate interval being determined according to the vegetation density. At each sampling point place the cross on the ground and with the tape, measure the distance (d) from the centre point to the nearest plant in the category being sampled in the first quarter. Do this separately for all four quarters, thus obtaining a set of four measurements for each sampling point. (Record a blank if no appropriate plant is available within 30 m). If the sampling category contains various species, the species of each plant measured should be recorded in order to determine species composition.

   A transect of 500 m would yield data from approximately 10 sample points. A minimum of 25 sample points (100 measurements of d) should be obtained.



Example of record

Sample point	Quarter	d (in m)	Plant species
1	1st	3.6	C. spinarum
	2nd	5.1	Ziziphus sp.
	3rd	2.0	C. elastica
	4th	15.7	Z. xylocarpa
2	1st	4.5	
	2nd		
	3rd		
	4th		

CALCULATIONS

Density

Mean point-to-plant distance (D) is obtained from the sum of d's in the record. The density of the plant type investigated is the reciprocal of D^2. Thus if a sum of 328 was obtained from a transect containing 20 sample points (20 x 4 = 80 d) the density would be:

$D = \frac{328}{80} = 4.1$; $\frac{1}{D^2} = 0.06$ plants/m^2 or

600 plants/hectare.

Species frequency

Frequency of a particular species among the plants recorded is obtained by dividing the sum of records for that species by the total number of records obtained. Thus if Carissa spinarum was recorded 22 times in the above example, the conclusion would be that in the area under investigation

$\frac{22}{80} = 0.28$ or 28% of plants are of the species C. spinarum.

Photographic Monitoring of Habitat Condition

TO SHOW HOW TO TAKE PHOTOGRAPHS WHICH PROVIDE A RECORD OF HABITAT CHANGE OVER TIME.

Photographs, even simple black and white, are well suited to provide a record of habitat condition at a given point in time. Periodic repetition of an initial photographic survey documents habitat change at little expenditure of time and funds. However, a long term commitment must be made to take the required pictures periodically and to properly store negatives and prints. The commitment ought to be noted in the working plan or management plan. Initial efforts would be in vain if subsequent managers fail to continue the records at suitable intervals.

Detailed notes must be kept with each set of photographs to facilitate their interpretation.

This technique describes how to choose subject, vantage point, and how to impart structure and scale to the photographic record.

SUBJECTS

The photographic record provides a time series of habitat factors undergoing change. Often it will document changes in a "before" and "after" situation. Examples:

- What is the nature and pace of succession after gregarious flowering and die off of bamboo?
- How quickly and in what ways does an area recover after fire or fencing?
- How fast do illegal clearings proceed in a particularly vulnerable area of the reserve?
- What is the visible impact of overgrazing?

INTERVAL

The time interval between successive series of photographs will depend on the expected rate of change of the factors under investigation. For recording succession a set of photos every 2 or 3 years may be sufficient. For illegal clearing, if the pressure is particularly great it may be necessary to photograph the area at 6-monthly intervals.

VANTAGE POINT

Decide about the type of change to be recorded. Make that feature the focal point of the picture. If you need a sweeping view, maybe a firetower is the best place from which to take it. A series of overlapping pictures taken from the same place can later be assembled into a panoramic view.

Whatever the place, it is important to be able to locate exactly the same spot again, when the subsequent series of photographs are being taken. Use an existing landmark, e.g. kilometer stone, or a special permanent marker and note the compass bearing of the direction in which the picture was taken. Note the appropriate information down after taking the pictures, e.g. pictures 3, 4, and 5 (on the roll), at kilometer stone 7, Haridwar Road, bearing 022 degrees.

STRUCTURE AND SCALE

To lend structure and scale to the photograph, position a man holding a graduated 2 m pole at a set distance, e.g. 15 m. Additional data can allow more detailed analysis in the years to come, so describe the photo scene accurately in the accompanying notes, e.g. tree on left, 32 m from the camera is Anogeissus pendula, 14 m high, 23 cm dbh. Foreground cover is Heteropogon to 1.2 m etc.

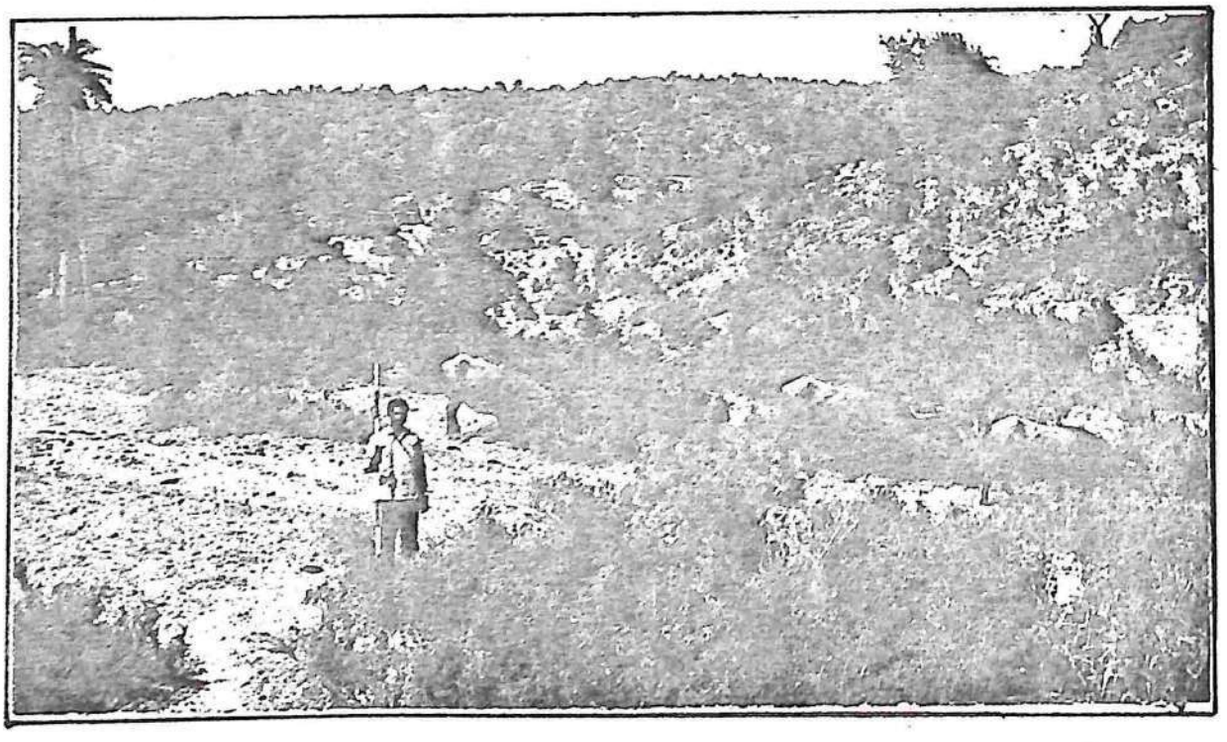
NOTES ACCOMPANYING PHOTOGRAPHS

Maintain notes on a file card record, using one card for each location.

Record Number :
Location :
Condition to be recorded :
Interval between pictures :
Date of first picture :
Additional information :

STORAGE

Store negatives in tightly sealed containers. File prints in photo albums or mount them on cardboard stock. Photographs in a stack will often stick to each other. Long exposure to sunlight causes them to fade.



Vegetation Mapping

TO SHOW HABITAT FEATURES ON MANAGEMENT MAPS.

Protected area managers generally deal with two kinds of maps, topographic maps and thematic maps. Maps are essential for most reports and it pays to prepare them carefully.

Topographic maps which require a high degree of accuracy are best made by professional cartographers. Thematic maps, on the other hand, often require less precision and can be prepared by the non-professional.

Themes, in this context, refer mainly to vegetation types and dominant plant species, but generally apply to other features as well, e.g. slope, management zones. (For mapping of water resources see Habitat 1.1)

This technique describes a simple mapping procedure.

DATA SOURCES

Information collected in previous surveys (e.g. Floristic inventory - Habitat 2.1) and from other sources such as topo maps and aerial photographs, forms the basis of the map. From information on the file cards, for instance, you know where a particular species occurs, at which elevation, degree of slope, type of soil.

MAKING A BASE MAP

Use a large scale base map to enter the data. At a scale of 1:50,000 an area 22 km long and 15 km wide will nicely fit on a working map measuring 30 cm x 50 cm. Direct tracing from existing topo-maps is the preferred method for producing an outline work map. Boundaries of the protected area, river systems, main roads and the grid network should all be lightly traced to assist in orientation.

For most report purposes, the completed map will have to be reduced to regular paper size (e.g. A4).

INFORMATION

- As a rule of thumb, avoid overloading the map and confusing the viewer. This is especially important when a large working map is reduced to a much smaller map to fit into a report.
- Carefully draw in the boundaries of the various zones, forest types etc, making full use of all your data sources and using the features already on your base map for orientation. Reference to the original topo sheet may be required to clarify some orientations.

- If only a few copies need to be produced coloured pencils are best to distinguish different zones. Use widely accepted colour symbols, e.g. dark green for forest. If reproduction is in black and white use various types of cross-hatching and other symbols. Logic suggests darker shading for greater densities.

- Always indicate the scale. Note that it changes when the working map is reduced. Indicate real distance with a distance bar.

- The map should show the direction of North with an arrow, usually pointing towards the top of the map.

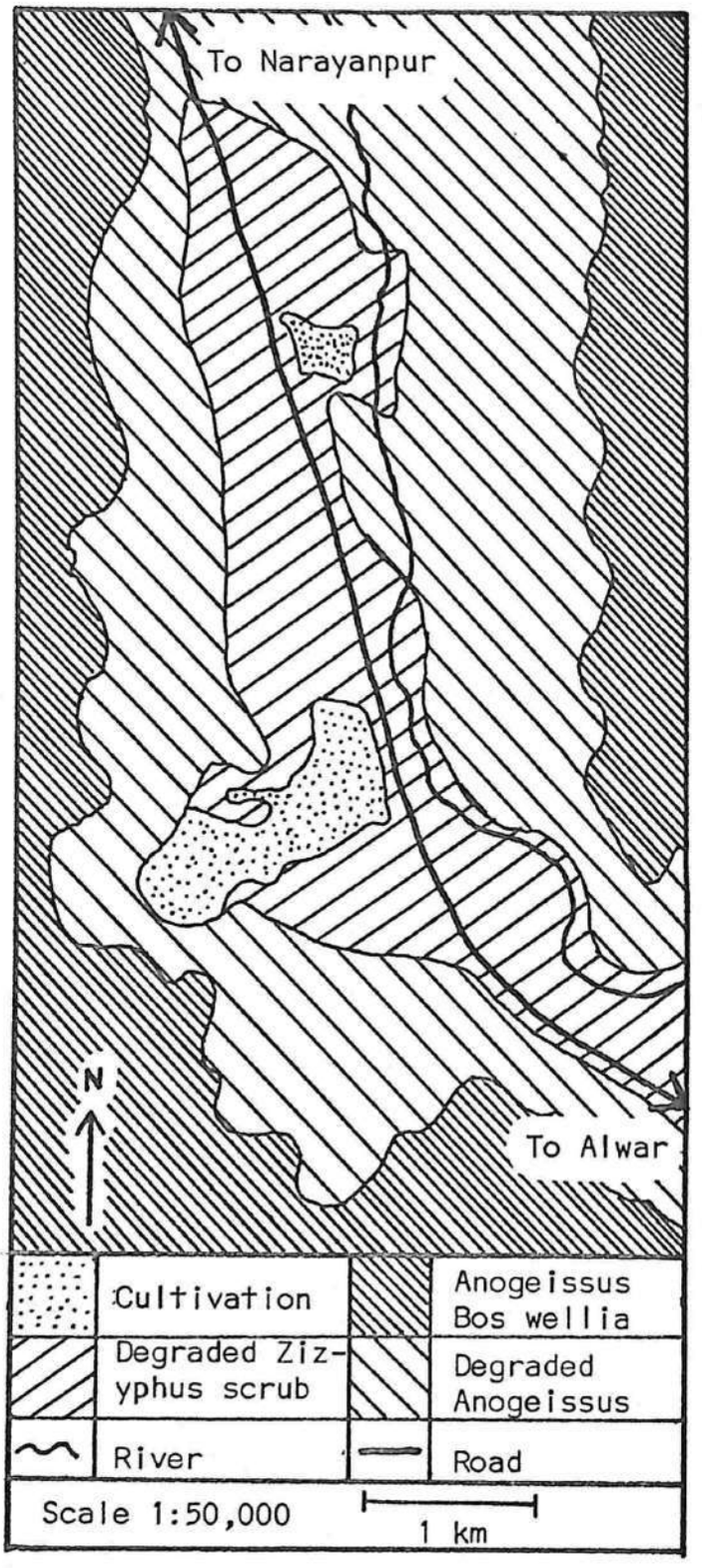
- For proper reference, also note the title of the map, name of the author (or institution) and the date of production.

LARGE SCALE/small scale

There is often confusion about them.

1 : 5 million is small scale

1 : 5000 is large scale



Fire as a Management Tool

TO IMPROVE HABITAT CONDITIONS OF PARTICULAR SPECIES BY BURNING SELECTED AREAS OF VEGETATION.

Fire can have two main effects. The immediate result is to remove coarse, dry and often fibrous and unpalatable plant material and produce a flush of young, nutritious green shoots of perennial grasses and woody plants provided there is enough moisture. The second, long-term, effect is to reverse the natural trend of plant community succession away from the normal grassland-shrubland-woodland-forest sequence. Fire kills or partly destroys young seedlings, saplings, shrubs and small trees and thus "opens up" habitat. Fire resistant grasses and herbs are thus "preferred" over the less fire resistant woody plants.

Caution : Fires can quickly destroy species and whole communities. Fire should only be used on the basis of prescriptions in approved management plans. Great care should be taken to ensure fires do not spread beyond the target area.

The technique provides guidelines for the use of fire in habitat manipulation.

APPLICATIONS OF FIRE

1. Where the objective of management is to maintain open grassland or woodland conditions but woody species are naturally invading, fires set every three years at the end of the dry season will reduce woody plant density. A different third of the total area should be burnt every year.

   Example: Maintaining meadows in moist deciduous forest.

2. Fire can help to create open feeding glades for the grazing community (rhino, buffalo, swamp deer and hog deer) where soil and moisture conditions produce a very tall alluvial flood plain grassland. Only part of the area should be burned and within the burnt areas some tall grass patches should be left as cover.

   Example: Grasslands in West Bengal and Assam.

3. Fire can remove a ground layer which is 'choked' with litter and unpalatable herbs, and where grass is coarse, with inaccessible green growth. An occasional early season fire can create conditions more conducive to herbivore populations by removing litter and coarse growth.

4. Silvicultural considerations some times dictate the need for burning, irrespective of wildlife requirements. For example to create conditions for bamboo germination, or enhanced sal regeneration.

Hot Burns and Cool Burns

Hot burns (dry fuel) are set when ground and vegetation are dry after a long spell without rain at the end of the dry season. Hot fires easily burn out of control particularly when it is windy. A dry fire burns at a temperature of 600 degrees C and consumes almost everything in its path.

Cool burns are set before the ground and vegetation have completely dried up, early in the dry season. They move more slowly, are less hot (300 degrees C) and leave patches of greener vegetation.

SITUATIONS WHERE FIRE SHOULD BE AVOIDED

- Avoid fire where the maintenance of fire vulnerable evergreen communities is a major objective. e.g. riverine forests or on key watersheds.
- Avoid fires in very arid situations (rainfall below 600 mm per annum). In these cases dry season growth is not stimulated due to absence of soil moisture and presence of many annual species. Grasses typically are less coarse and fire is not needed for forage improvement.

GENERAL RULES FOR BURNING

- All burning blocks should be small, certainly not bigger than a compartment and preferably below 100 ha.
- Burn many small patches rather than one large block.
- Carefully consider weather conditions, e.g. avoid very windy days.
- Ensure adequate fire line precautions.
- Have fire-fighting equipment and staff to hand, in case fire gets out of control.
- Monitor fire effectiveness and record all details of your burning programme.

Managing Weeds

TO HELP THE MANAGER DECIDE ON THE BEST WEED MANAGEMENT STRATEGY.

What is a Weed?

Weeds are aggressive colonizers which spread rapidly, outcompeting other plant species. They are usually not very palatable to either wild herbivores or domestic stock. A plant species gets the label "weed" if it is unwanted and crowds out other, more wanted, species. In a national park, a plant species is certainly unwanted if it is an exotic (not naturally occurring in the area). Indigenous plants become weeds if they "take over" large areas and reduce natural species diversity in the process.

Some of the most common weeds in India: Lantana camera (exotic shrub), Eupatorium adenophorum (exotic herb), Mikania micrantha (exotic climber) and the indigenous species Adhatoda vasica, Tiliacora acuminata, Ageratum conyzoides and Cassia tora.

Causes of Weed Infestations

The proliferation of weeds in a protected area is the result of disturbance: heavy grazing by domestic stock, heavy forest working (planting, thinning, clear-cutting), or abandoned cultivation. Any form of weed control is ultimately only successful if the cause of the weed infestation is brought under control. Even then, weed eradication is seldom practical or economically feasible over large areas. Weeds have very effective mechanisms for seed dispersal and often regrow vigorously from root cuttings.

Weed Control

Eradication methods suitable for use in protected areas are expensive and the gain in improvement of wildlife habitat is slow. Usually weed eradication will concentrate on small pockets of weed infestation in order to prevent further spread or, in the case of woody weeds, attempt to speed up their replacement through natural succession.

The elements of a weed control programme are presented below.

ADVANTAGES OF WEEDS

On a degraded slope where nothing else will grow weeds are better than no vegetation cover. Lantana thickets sometimes offer the only sufficiently dense cover for wildlife and it may act as a barrier which prevents the passage of cattle and other livestock. Jungle fowl and bulbuls eat Lantana fruits.

WEED CONTROL STRATEGY

1. Remove the cause of the weed infestation.

2. Encourage the growth of non-weed species.

Most weeds love light. Other plants eventually shade out the weeds and replace them, but this may take a long time. Examination of the ground cover will show woody plant seedlings and saplings (e.g. Mallotus, Trema, Ehretia). Removing weeds from around these plants speeds up natural succession towards a more diverse flora. Care should be taken when large patches of weed are cleared, not to clear the weed competitors at the same time. In forestry operations one should leave trees of the desired species as seed source for the future.

3. Eradication

Consider weed eradication only for relatively small (several hectares) and isolated patches for a specific reason, e.g. to prevent its spread to valuable wildlife habitat (water sources, alluvial valleys with good grazing, meadows); to encourage the regeneration of canopy species (e.g. nesting or fruit bearing trees); to maintain open view lines from hides or machans. Start at the edges of the weedy patch and work inward because clearings inside the patch are quickly reseeded from all sides.

Cost Effectiveness of Weed Control

Eradicating Lantana may cost up to Rs.5,000 per hectare,or Rs.500,000 per square kilometer and could soar to over Rs. 1,000,000. Therefore, focus efforts on small key areas and experiment with different methods of weed control. Find out about the best way to plant local weed competitors. Monitor the results of completed operations. Do the weeds come back? If yes, how fast?

Little is known about the practical aspects of weed control in India's protected areas and there is much scope for applied research. Pass your findings on to others.

Chemical Weed Control

Chemical weed control is widespread in agriculture and comparatively inexpensive. The chemicals used are not selective for broad leaved plants nor specific enough to rule out undesirable effects on the natural fauna and flora. In a national park or sanctuary, chemical weed control should not even be contemplated.

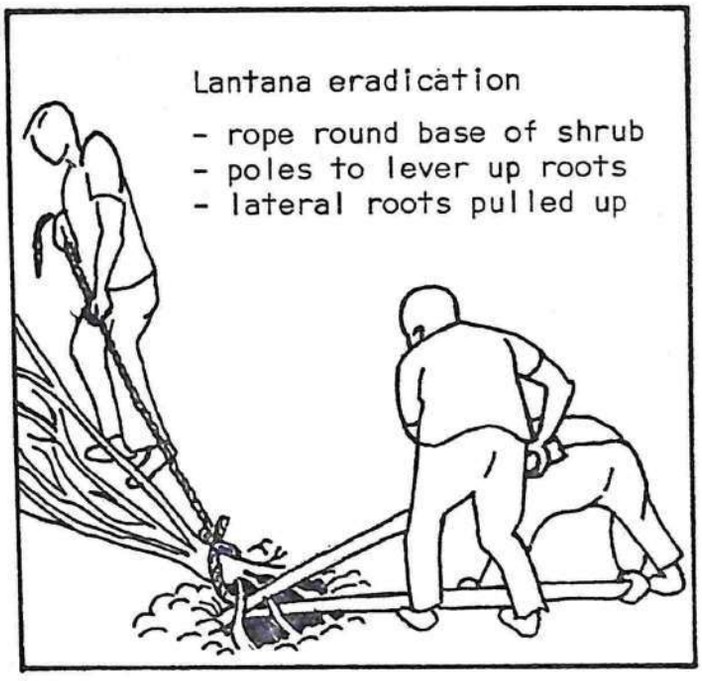
ERADICATION METHODS

Eradication of annual weeds

Two things need to be done: eliminating the seed source by cutting growth before the seeds mature and removing the weed plant to give other plants (mostly grasses) room to grow. Experience in some parks suggests that three years of intensive weeding is required before non-weed species once again dominate. Grass seed broadcasting may be beneficial in some instances.

Eradication of Woody Weeds

Woody weeds (e.g. Lantana, Prosopis, Eupatorium) must be uprooted to avoid an even denser growth from root coppice. Plan the extraction for the monsoon time when the soil is moist and soft. A team of four to five labourers has been employed in Kanha National Park. The management of Corbett has used labour and elephants. For handling thorny weeds the employees should be provided with protective gloves.



Extracted material should be collected and burned. If the fire is hot enough it will kill any remaining weed stumps underneath. In some areas, three successive removal operations are considered necessary.

PLANTING AFTER ERADICATION

Selected species should be planted soon after the eradication and before the weed has time to re-establish itself. Bamboo has been planted successfully in some cases. If highly palatable species are to be planted, they may have to be protected from wild and domestic ungulates. Good alluvial soils can often support a tall and dense grass growth of species like Arundo donax. Arundo can out-compete Lantana within three years after just one cycle of clearing, if the grass rhizomes are planted on a 1 m x 1 m spacing immediately after eradication.

WILDLIFE

ANIMAL ABUNDANCE & MOVEMENTS

INTRODUCTION TO THE SECTION

Understanding animal abundance, distribution and movement patterns is a very important aspect of wildlife management. Measuring abundance of animal populations essentially means census. Some census methods may require complex statistical treatment of the data which perhaps deters managers from trying to improve their knowledge of census techniques. Yet, the simple techniques, with a minimum of statistical treatment, in this section will also yield useful results if undertaken with a clear understanding of assumptions and limitations.

A census technique yields numerical information like population estimates per area, information about relative abundance, or trends. The adjectives "absent, rare, occasional, common, abundant" denote measures of relative abundance, but even this basic information is lacking for most species in Indian protected areas. If one can determine the relative abundance of a species over time it may be possible to recognize trends of population change or stability. Discovering such trends is one of the most useful outcomes of a census and is the essence of monitoring wildlife populations.

Census techniques are based on direct sightings (e.g. waterhole census technique, or animal counts on transects) or indirect evidence (pugmark or dung counts). Population sizes can be ascertained on the basis of total counts or estimated from sample counts.

The techniques in this section are designed for use in Indian parks and sanctuaries. Some, like the waterhole, the pugmark and the block count census techniques have been widely used in India. However, their implementation in the field is not always as it should be. Limitations and necessary preparations are therefore stressed. Hints are given on interpreting population trends and presentation of data. Because an understanding of basic statistics is essential for sampling, a brief treatment of this is also included.

Some aspects of wildlife management such as understanding dispersal patterns or social organization require the identification of a number of individuals in a population. This can be achieved by either recording naturally occurring markings which differ for each individual or by placing an artificial mark, such as a brand or ear tag, on a small sample of the population.

This section presents a variety of techniques for censusing wildlife populations, as well as methods of individual identification.

SECTION CONTENTS

Planning a Census

TO HELP THE MANAGER DEFINE THE PURPOSE OF A CENSUS AND CHOOSE AN APPROPRIATE CENSUS TECHNIQUE.

No census should be conducted for the reason that "I have been instructed to do so" or "we have always done an annual census". Defining why a census is to be conducted and how to use its results are the first prerequisites for a meaningful census.

For biological and management needs, in most cases it is not necessary to know the total population size. For example, many censuses are to determine trends (indices of population change with time) or to make comparisons between different areas, seasons or different treatments.

For the manager, to know whether the populations of certain species are increasing or not, repeating the same census technique covering only a part of the total area may yield the desired information. A mean number of 5.2 chital seen per km of forest road in 1984 and 8.1 in 1986, probably indicates an increase in population size.

However, in practice, the desire of the public and administrators to talk total numbers, means that in most cases a census operation will have to produce a total population size. Nevertheless, it is often preferable to express population size in relative rather than absolute figures. Stating that 16,000 chital live in Kanha National Park and 3,000 in Ranthambore tells us less than stating "density of chital in Kanha is 18 per sq km and in Ranthambore 7 per sq km".

Other planning considerations concern the most appropriate census technique and the timing of the census operation. Do I need qualitative (none, few, many) or quantitative data (0, 10, 52)? Should it be based on actual sightings or on indirect evidence such as droppings, nests or burrows? What resources are at my disposal? What is the appropriate season for the particular census I have in mind?

Important census planning considerations are highlighted below.

CENSUS OBJECTIVES

Most reasons for undertaking a census fall into the following categories:

- To determine whether a population of a species is increasing, stable or decreasing, i.e. the trend.
- To determine how well introduced stock is doing.
- To compare densities of wildlife in an area before and after management intervention, like burning.
- To compare densities in different areas e.g. core and buffer, or habitats e.g. plantation and natural forest.

MAIN CONSIDERATIONS

Which Species to Census

For management purposes it is obviously impossible to census all species in the area concerned. The manager has to make a choice such as one of the following:

- Species which may require management intervention (over-grazing, competition).
- Internationally or locally endangered species.
- Species of national or local importance.
- Species of economic significance, e.g. causing crop damage.
- Species which are tourist attractions.
- Important prey species.

Direct or Indirect Census Technique

Species occurring in relatively high densities, in habitat in which they are visible when searched for, can be counted by direct sighting methods. This applies to most populations of medium to large ungulates, rhino, and elephant.

Species occurring in very low densities, or which are difficult to see because of poor habitat visibility or cryptic behaviour, should be censused either by carefully planned, intensive samples, or by indirect methods, such as dung or pugmark counts.This applies to most carnivores and small or nocturnal mammals, as well as to some large mammal populations in particularly dense habitat types.

It should be noted that most indirect methods (pellet counts, pugmarks) are only suitable for obtaining relative indices of population size and only rarely yield a good estimate of actual population numbers.

Total or Sample Counts

For a total count the entire area under consideration is searched. A disadvantage of total counts is that one cannot account for unavoidable errors (especially when the count is spread over more than one day) or treat the data statistically. Area size, species, terrain, cover and available resources decide when a total count becomes prohibitively expensive or simply impossible.

The alternative is to count a part of the area only. This is accomplished by conducting a number of sample counts. The cumulative area covered by these sample counts is a known (calculated) proportion of the total area, hence the total population size can be estimated by extrapolating the outcome of the sample count to the entire area. This population estimate can be subjected to statistical treatment, as the data are based on a number of independent counts. This way, the manager will have a range of maximum and minimum numbers within which the actual population size will fall. He will also be able to assess the level of confidence he can have in the final population size estimate.

In most cases sample counts, if skillfully planned and conducted, are more efficient than total counts and hence will allow repetition, which is the basis of monitoring. It is this factor, combined with the advantage of statistical analysis, that normally makes sample counts the preferred choice.

Timing of the Census

The optimal time depends on the type of census and the reason for which it is being conducted. For example, for the waterhole census the height of the dry season is best, as animals are concentrated around limited water sources. But do not wait too long, as flush of green after pre-monsoon rains may reduce dependence on surface water.

Visibility, which shows marked seasonal variations in many habitat types, e.g. deciduous forest or grassland, also has to be taken into account.

If you want to monitor the changes in density over an area through the dry season, then that sets the time frame within which a number of censuses have to be done.

In general, avoid periods of extensive disturbance, like timber working, fire, height of the tourist season.

Staffing and Resource Requirements

All techniques require sufficient trained and dependable staff. The actual number of people needed for a census, however, varies according to the technique adopted. A total count requires, in general, many more people and resources than a well planned sample count. The manager should select the census technique for which he knows staff and resources are readily available. Once a method is selected, stick to it. The same method repeated by the same team will give the best basis for comparing results from different areas or habitats, or for assessing population trends over consecutive sample intervals.

Understading Sample Counts

TO ACQUAINT THE MANAGER WITH THE MAJOR CONSIDERATIONS FOR SAMPLE COUNTS.

In a sample count, you concentrate the counting effort within "sampling units" which constitute a known proportion (the "sample fraction") of the whole area being censused. Limiting the counting effort to these units requires a smaller commitment in terms of staff and budget than total counts, but they require careful planning, especially in respect to size, number and distribution of sample units.

The ability to statisitically define precision and establish confidence limits is an important aspect of sampling

Sampling assumptions, variability, confidence limits and sample size are explained in this technique.

SAMPLING AREAS AND SAMPLING UNITS

The sampling area, often called the "sampling universe" is the area for which a population estimate is to be made. It is often identical with the protected area or a sub-section of it. Such sub-sections can be defined as habitat types or land forms (grassland, riverine forest, wooded valley, grassy plateau), but may also be management units (compartments, blocks, buffer zone).

Sampling units are the individual portions of the sampling area which may be counted. In theory all of the sample area could be counted, but in practice only a fraction of the potential units will actually be counted. These units should be chosen at random and are usually scattered throughout the sampling area. More often than not the shape of a unit will be irregular. The only regularly shaped sampling unit mentioned in this section is the strip transect of the roadside count which has a known width and length.

ASSUMPTIONS

The basic assumption in sampling is that the sample(s) should be representative of the entire sampling area. Obviously, selecting sample areas from only the core zone or along cut roadsides will not give a representative sample for the whole area.

When undertaking sample counts one makes three additional major assumptions.

a. The sighting of one animal does not influence the chances of sighting another.

b. The conditions affecting observer/object encounter do not change during the sampling operation.

c. The objects to be sampled are distributed at random (uniformly) in the area being sampled.

Assumption (a) is true for more or less solitary animals. A herd of animals is more easily spotted than the individuals in it. In this case, from theoretical considerations, one should base population estimates on mean group size and herd density estimates, rather than on individual animals. However, explanation of the mathematics involved is beyond the scope of this manual.

Assumption (b) is generally met if the observations are taken during the same period, e.g. late dry season or post-monsoon, and at the appropriate time(s) of the day or night. Also, animal reaction to the observer should not change, e.g. animals should not become more shy as a result of disturbance during the census operation.

Assumption (c) is more difficult to understand and know whether it holds. The individual trees in a plantation are uniformly distributed, because they had no "choice" of rooting elsewhere. Animals and animal herds are never as uniformly distributed as this. Depending on species, they prefer certain areas, often according to season or time of day. However, within a homogeneous environment, say a floodplain grassland, they come closer to being uniformly distributed at random and not further aggregated around specific features.

SAMPLING

There is considerable variation in all attributes of natural populations. For example, the weights of chital males are not exactly the same; the ages of male sexual maturity vary from place to place. The density of chital from place to place will also vary. In a particular location density will also vary. If we have a 100 sq km sanctuary with exactly 1000 chital there will be a density of 10 chital per sq km. This does not mean every sq km has 10 chital - some will have none, some may have 50! An area with no chital today may have 50 tomorrow, so notice that density distributions continuously vary in space and time.It is this variation which makes sampling a little complex to understand and implement.

In order to understand the basic principles of sample counts and some of the mathematics involved, consider examples (a) and (b) in Box I. The sampling area is a rectangular area of 10 by 5 km, and it has a chital population of 100 animals. Example (a) shows a random distribution, (b) shows a non-random, patchy distribution pattern. This sampling area is divided into 10 strips, each of 1 km width, the sampling units. One or more strips may be selected and counted, and the total population estimated from this sample count.

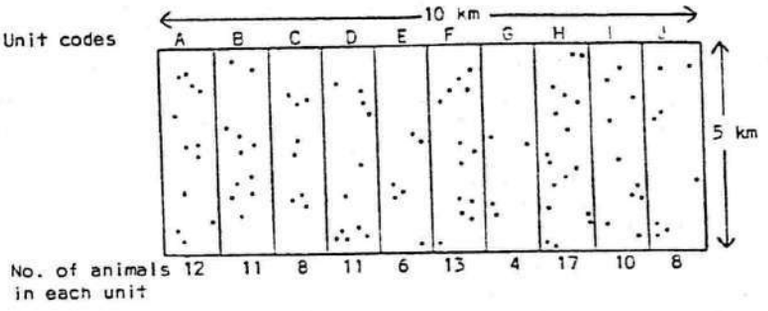
However, taking one sample only would give plenty of opportunity for a large error in the population estimate. If in (a) it happens to be sampling unit 7, total population would be estimated as 10x4 = 40 chital, in case of sampling unit 8 it would be 10x17 = 170 chital. This error would be reduced dramatically by counting more than one unit, and using the mean of all counts to estimate the total population size. Examples of this are worked out in Box I. We can see that there is inherent variation in the population itself and there is also variation due to our level of sampling. A small sample will give more variable results than a large sample, no matter how the animals are distributed. In case of a non-random distribution you need a much larger sample to get a better estimate

I

EXAMPLES OF ANIMAL DISTRIBUTION AND POPULATION ESTIMATES AS A FUNCTION OF THE SIZE OF THE SAMPLE TAKEN

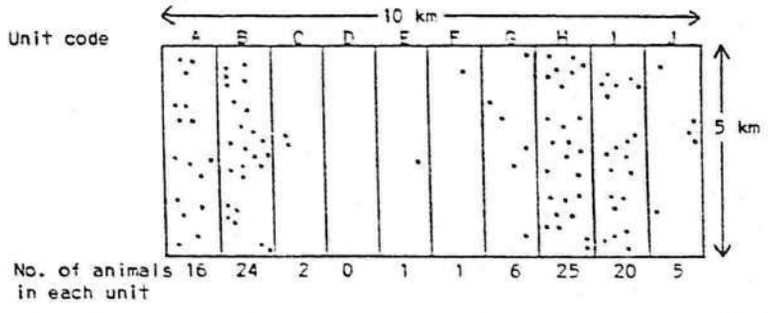
a) random, b) non-random (patchy) distribution. Sampling area = 50 sq km. Each sampling unit = 5 sq km (1/10th). Population size = 100. Each dot represents one animal.

a)



Unit counts	Sample size (% of total area)	Mean number of animals/unit	Total population estimate (mean number/unit x 10)
A E F I J			
12	10%	12/1 = 12	12 x 10 = 120
12 6	20%	18/2 = 9	9 x 10 = 90
12 6 13	30%	31/3 = 10.3	10.3 x 10 = 103
12 6 13 10	40%	41/4 = 10.2	10.2 x 10 = 102
12 6 13 10 8	50%	49/5 = 9.8	9.8 x 10 = 98

b)



Unit counts	Sample size (% of total area)	Mean number of animals/unit	Total population estimate (mean number/unit x 10)
B C E G I J			
24	10%	24/1 = 24	24 x 10 = 240
24 2	20%	26/2 = 13	13 x 10 = 130
24 2 1	30%	27/3 = 9	9 x 10 = 90
24 2 1 6	40%	33/4 = 8.2	8.2 x 10 = 82
24 2 1 6 20	50%	53/5 = 10.6	10.6 x 10 = 106
24 2 1 6 20 5	60%	58/6 = 9.7	9.7 X 10 = 97

From these examples several questions arise:

- Can I gain knowledge about the level of variation?
- How can this help me in making the estimated results more reliable?
- How many sampling units do I need to count so as to get an acceptable amount of possible error in my final estimation?

To answer these questions we will have to discuss some statistical method and terminology.

The Standard Deviation

Every population can be described by two things, the mean and a measure of variation around that mean. We estimate these by sampling, hence we have an estimated mean and estimated so called variance. The variance is a measure of how far the individual counts are from the mean. Obviously they are much farther apart in the second example (Box Ib). For the sample, the variance is calculated as the cumulative sum of the mean minus the value for each count. Finally this sum is divided by the number of sampling units counted minus 1. Some are bigger and some are smaller than the mean, so to prevent negative values from cancelling out positive values, we use the squared values of the measurements for the variance. The square root of this is called the Standard Deviation of the distribution around the mean, and is often referred to as "s". This is the beginning of many statistical calculations. The latter Box (II) gives an example of how to calculate the standard deviation, but many pocket calculators give this value directly.

The Standard Error

We now have to combine the variability in the population with the variability due to our sampling.As we saw earlier, the population estimate varies greatly due to changes in sample intensity, i.e. the number of units counted.

Combining these two variabilities into one value of variability for our estimated mean gives the Standard Error. This is simply the standard deviation divided by the square root of the sample size (n = number of samples counted) or $s/\sqrt{n}$. The standard error around a mean tells you how close the estimated mean comes to the real value in the population. Obviously the standard error will get smaller as your sample size gets bigger. See box II for examples of standard errors.

Confidence Limits

The standard error gives a statistical assessment of the probable range of values for the real mean. How confident are we that this is correct? Remember we are taking samples; there is always a chance that our samples fell in mainly high or low values and so the estimate could still be much worse than expected. We get over this by setting ourselves "limits of confidence". In biology, the lowest level of confidence that is in wide use is the "95% confidence limit", which means that "I am confident that in 95 out of 100 occasions the true mean will lie between so much....of the estimated mean". There is still a 5% chance left that the true mean lies outside the given range! A 99% confidence limit would therefore have a larger range, as we are confident it could be wrong only 1 in 100 times. The calculations of confidence limits uses three things:

II

CALCULATION OF STANDARD DEVIATION, STANDARD ERROR AND CONFIDENCE LIMITS FOR ESTIMATING POPULATION SIZES.

a) data from Box Ia (5 samples), b) data from Box Ib (6 samples)

a) No. counted in sampling units : 12, 6, 13, 10, 8

No. of samples (n) = 5. Total No. of samples possible (N) = 10

Mean/sampling unit = (12+6+13+10+8)/n = 49/5 = 9.8

Variance (s^2) = $[(9.8-12)^2 + (9.8-6)^2 + (9.8-13)^2 + (9.8-10)^2 + (9.8-8)^2]/(n-1)$
= [4.84+14.44+10.24+0.04+3.24]/(5-1)
= 32.8/4 = 8.2

Standard Deviation (S) = $\sqrt{s^2}$ = $\sqrt{8.2}$ = 2.2864

Standard Error (SE) = $s/\sqrt{n}$ = $2.864/\sqrt{5}$ = 1.28

Confidence Limits (L), 95% level, n = 5, hence (from t-values) t = 2.57
L = t x SE = 2.57 x 1.28 = 3.29

Population estimate = N x (mean $\pm$L) = 10 x (9.8 $\pm$ 3.29)
= 98 $\pm$ 32.9

b) No. counted in sampling units = 24, 2, 1, 6, 20, 5.

No. of samples (n) = 6. Total number of samples possible (N) = 10

Mean/sampling unit = (24+2+1+6+20+5)/n = 58/6 = 9.7

Variance (s^2) = $[(9.7-24)^2 + (9.7-2)^2 + (9.7-1)^2 + (9.7-6)^2 + (9.7-20)^2 + (9.7-5)^2]/(n-1)$
= [204.49+59.29+75.69+13.69+106.09+22.09]/(6-1)
= 481.34/5 = 96.27

Standard Deviation (s) = $\sqrt{s^2}$ = $\sqrt{96.27}$ = 9.812

Standard Error (SE) = $s/\sqrt{n}$ = 9.812/ 6 = 4.01

Confidence Limits (L), 95% level, N = 6, hence (from t-values) t = 2.57
L = t x SE = 2.57 x 4.01 = 10.31

Population estimate = N x (mean $\pm$L) = 10 x (9.7 $\pm$ 10.31)
= 97 $\pm$ 103.1

- The standard error around the estimated mean.
- The sample size (as again we have more confidence in bigger samples).
- The level of confidence required, e.g. 95, 99, 99.9%.

Confidence limits are expressed as: Estimated Mean Value ± Confidence Limit. They are calculated as the Standard Error (SE) times a constant (Z), which is dependent on the sample size and confidence level required. For large samples (30 or more units counted) the constant is:

95%	99%	99.9%
Z = 1.96	Z = 2.58	Z = 3.29

For sample sizes smaller than 30, the sample size has much more influence. For these cases a different factor is needed, which is taken from "t" tables in statistical handbooks, For our purposes the relevant t-values are given in the table below. Select the one that comes closest to your sample size and use that as value for Z.

Fully worked out examples of these statistical procedures are given in Box II.

Why Do We Need Confidence Limits?

Confidence limits give a measure of precision (see box) to the sample estimate and are <u>essential</u> to the <u>interpretation</u> of census data. If a density of 10 chital per sq km is found in year 1 and 12 in year 2, is this then an increase or is it merely due to sample variation? If the confidence limits around the respective means do not overlap, you have a given measure of certainty (95, 99%) that the estimated densities indicate a <u>real</u> difference.

Sample Size

How large a sample (how many units) do I need to take? This question is not easy to answer, and depends largely on the level of precision desired (see box). Basically, the manager has two methods which he could apply.

The first one involves the use of some of the statistics described above. First, we must set a limit (L) within which we want our estimated mean to be. Next we select the probability that our estimate will lie within the range of mean ± L, say 95%.

t-values for Different Sample Sizes and Confidence Levels.

Sample size	*5*	*10*	*15*	*20*	*25*
t-value, 95%	*2.57*	*2.23*	*2.13*	*2.09*	*2.06*
t-value, 99%	*4.03*	*3.17*	*2.95*	*2.85*	*2.79*
t-value, 99.9%	*6.87*	*4.59*	*4.07*	*3.85*	*3.73*

ACCURACY AND PRECISION

An estimate of population size is characterised by two attributes: accuracy and precision.

Accuracy depends mostly on minimizing human errors. For example: counting animals in tall grass means young will be missed, hence a negative bias (of unknown magnitude.); a careless census team sights only 50 out of 100 animals present in a sampling unit, a negative bias of 50%.

Precision means minimizing the confidence limits around the estimated mean population size. It is thus a measure of repeatability: if I repeat the census in the same way I will get a similar figure, i.e. the results are precise.

Example: Real population size = 2300 animals
Estimated population size = 1400 ± 70 animals

This result has a bias of -40%, hence is inaccurate, but it has a high precision, with confidence limits of only 5%.

A high accuracy may be needed for estimating total population size. Accuracy can be improved through training of census staff, by choosing the best method for the particular purpose of the census, and by applying correction factors obtained through careful testing, to allow for known, constant levels of bias. A high precision is needed when monitoring the trend of a population, as I want to be sure to detect changes. Precision will improve by increasing the sample size, and consistently repeating the same technique.

From the 95% confidence limits we know that there is a 95% chance that our estimate lies within the range for the estimated mean. This range is set by the Standard Error (SE) times a factor Z = 1.96, and a factor r indicating the ratio of the size of the sampling unit to the sampling area. This gives the equation:

$$1.96 \times s/\sqrt{N} = r \times L$$

which is solved for n.

This equation requires some knowledge of s, which we will have to get from previous work on this or similar populations. As this is a bit of a guess, the formula use the rounded off value of Z = 2, so it becomes:

$$n = 4 \times s^2/L^2$$

A second simpler, but less precise method requires that we keep a record of the amount of variation around the mean from samples as they are counted, while the sampling process is in progress. With this method we determine whether further samples will increase the precision of the estimation of the unit mean by calculating successive means (also referred to as "running mean"). The mean of, say, the first 5, 10, 15 etc counts is calculated and plotted against the sample size.This mean will at first oscillate violently, but oscillation will gradually fade out as the sample size increases. This allows us, once the curve has smoothed out, to decide that we have reached a large enough sample size. Otherwise sampling should continue.

Examples of both methods are given in Box III. From these examples it is clear that a randomly distributed population requires far less intensive sampling than a population with a non-random distribution. Hence, in the latter case, stratified sampling, meaning sampling sub-areas with different animal densities separately, is highly recommended. Details of this technique are further discussed in Wildlife 1.3. The "running mean" method would indicate a much less intensive sampling, but remember that the result here is very imprecise indeed. This is shown by the Confidence Limits of + 33 and + 103 respectively (see Box II). Hence,the manager should refrain from using this method, unless absolutely necessary.

Methods and examples given here are simplified, but will suit most manager's needs. For more complicated sample census operations it is recommended that the manager seeks the advice of a trained statistician.

III

HOW TO CALCULATE THE SAMPLE SIZE REQUIRED

A1 : using desired confidence limits, data from Box Ia; A2 : "running mean" method, same data; B1 and B2, same as A1 and A2 respectively, but data from Box Ib.

A1. 1. Set the limit for L, say L = ± 10 animals.
2. Select the desired Confidence level, say 95%, hence Z = 1.96.
3 Select the Standard Deviation (literature, previous work), here s = 2.864.
4. Determine the ratio of the sampling unit size to the sampling area, here r = 0.1 (each sampling unit is 1/10 th of the sampling area).

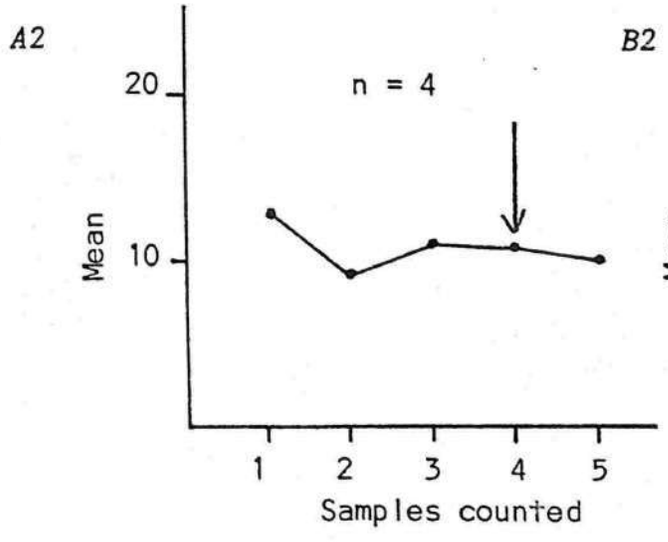
The number of sampling units needed is now calculated as:

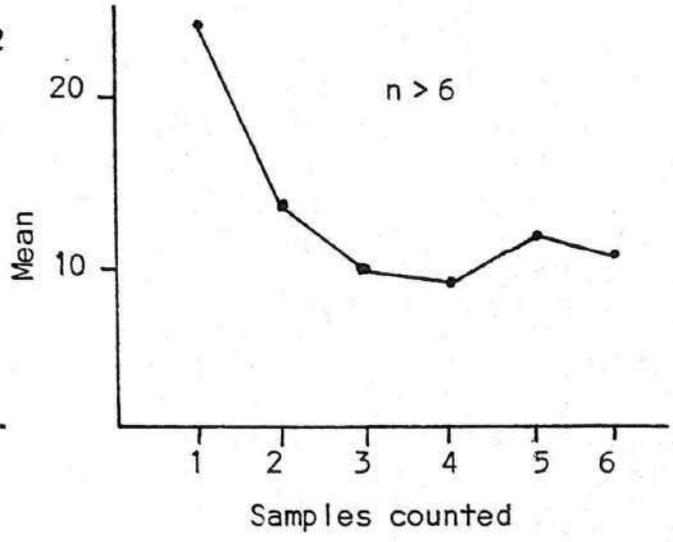
$$n = Z^2 \times S^2/(r \times L)^2$$
$$= (1.96)^2 \times (2.864)^2/(0.1 \times 10)^2$$
$$= 31.5/1 = 32$$

B1. 1. Set the limit for L, say L = ± 10 animals.
2. Select the desired Confidence level, say 95%, hence Z = 1.96.
3. Select the Standard Deviation (literature, previous work), here s = 9.9812.
4. Determine the ratio of the sampling unit size to the sampling area, here r = 0.1 (each sampling unit is 1/10 th of the sampling area).

The number of sampling units needed is now calculated as:

$$n = Z^2 \times s^2/(r \times L)^2$$
$$= (1.96)^2 \times (9.812)^2/(0.1 \times 10)^2$$
$$= 369.8/1 = 370$$





Block Counts

TO EXPLAIN THE PLANNING AND IMPLEMENTATION OF BLOCK COUNTS.

In a block count observers move through an area in a predetermined pattern. The main assumptions are that they see all the animals of the target species and that double counting can be avoided.

The term "block" in this context refers to a small area with natural and/or artificial boundaries which can be easily identified on maps as well as in the field. This area must be small enough so that, if a reasonable investment of time and resources is used, a total count in it can be conducted.

The term "block" as used here does not refer to forest blocks which typically cover an area of between 15 and 30 sq km. However, it may fit a forest compartment or part of a compartment.

To conduct a census based on block counts, the entire protected area is first divided up into counting blocks. The total numbers of animals in this protected area may then be ascertained either by counting all the blocks and adding up the figures thus obtained, i.e. a total count; or, the preferred method, estimated from figures obtained by counting a certain proportion of the blocks only, i.e. a sample count.

This technique discusses design and implementation of block counts, including stratification and problems encountered.

PREPARATIONS

Prior to conducting a block count, the following must be done.

- Determine which species (target animals) are to be sampled.
- Select the census method (see below).
- Using a map of the area to be counted, divide this area into blocks. Block size will be different depending on the habitat features (very small in dense forest, larger in open meadows), and the size and habits of the target animal(s) (in general larger if target animal is bigger, and smaller the more elusive it is).
- Boundary choice may depend on the type of count conducted (see below). If stratification is desired (see Wildlife 1.2 Box) then that sets secondary limits to the boundaries.

THE OPTIONS

Line Drive Count

In a line drive count a large number of observers proceed in an extended line abreast along a given compass bearing at a steady pace, from a well defined and reasonably straight baseline to the far edge of the block to be counted. Do <u>not</u> conduct a line drive if you cannot start it from such a baseline. Fire-lines or roads can frequently be used as a baseline. The finishing line should be easily identifiable in the field, e.g. a river or cliff edge.

The count works on the asusmption that no target animals remain undetected between neighbouring observers.

The observers must <u>start and finish together</u>, and neighbouring observers should see each other or be within earshot from one another. These prerequisites determine the size of the individual blocks. As they depend largely on habitat features (e.g. density of vegetation, ruggedness of terrain), block size will vary accordingly. The line of observers tends to break up with increasing distance from the baseline. In dense forest this usually happens after only 1 km! Similarly, lateral distances between observers are set according to the habitat features of the block.

Criss-cross Pattern Count

This method employs a small team (1 to 4 observers), that searches in a criss-cross pattern through the entire block.

The assumption is that no target animal remains undetected in between the lines of the search pattern. Furthermore, the target animals are assumed to be stationary, so as not to be encountered twice.

The size of the block is again determined by the habitat features. It should be small enough to enable the searching team to rapidly execute their search pattern. Hence in dense forest or tall grass the block must be small e.g. 1 sq km, whereas short grassland allows for a bigger block size, e.g. 5 sq km.

FIELD OPERATIONS

Observer Training

Care in preparation of all participants in a census can eliminate many misunderstandings and sources of error.

- Thoroughly brief and train all observers in the tasks expected from them on the day(s) prior to commencement of the census.
- Define the census area clearly with the help of maps, pointing out boundary features such as roads, tracks or rivers.
- Identify the transects to be walked or the stations to be occupied (when and for what period) and allocate individuals or teams to each.
- Explain carefully how the record sheet is to be filled in, leaving no possibility of ambiguity.

- Emphasise the importance of accuracy - a nil return is as important as one showing a large number of animals!
- Have a brief trial run before the census proper begins to further eliminate any misunderstandings.

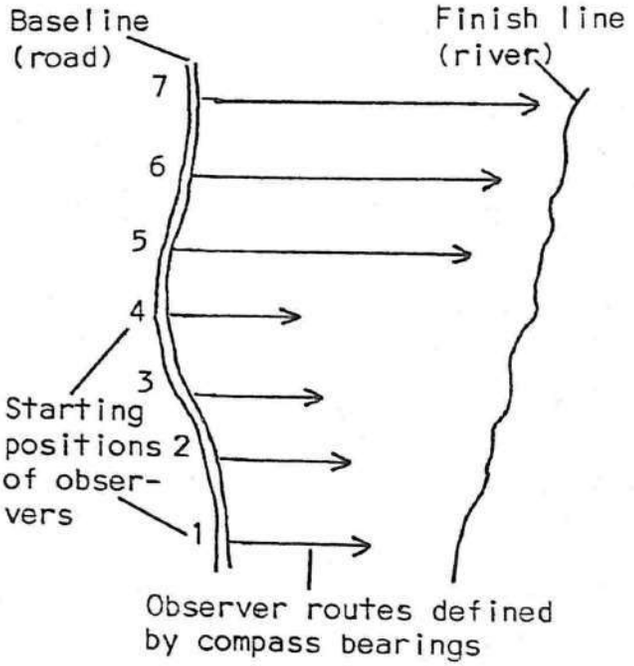
Equipment and Supplies

Make sure that all items essential for the operation are available, in required quantities, in advance of the starting date. Examples:

- Vehicle(s) to carry personnel to starting points.
- Riding elephants, if census to be carried out from elephant back.
- Food - as appropriate.
- Bedding if census to occupy more than one day in field.
- Firearms and ammunition if census team likely to encounter dangerous species.
- Map for each team showing boundaries of census area and counting blocks,
- Binoculars (if possible) - one per team.
- Compasses (if possible) - one per team.
- Watches - one per team.
- Recording sheets (proforma) and pencils.

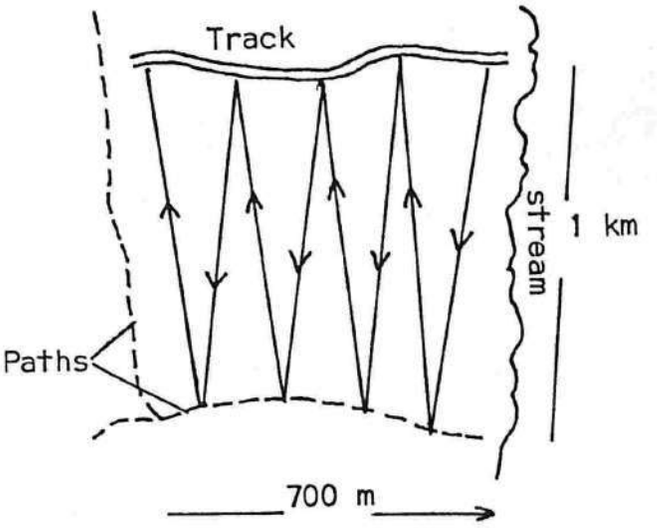
Line Drive Count

A total of twenty observers (or observer groups) is about the most that can be managed in the field. They should be lined up, at the proper lateral distance along the baseline. The observers should all start at the same time and proceed at the same speed. Maintaining the given compass bearing is very important. They finish, again all at the same time, whenever the landmark which marks the end of the block is reached. Note, observers at the beginning and end of the line count only inwards from the line.



Criss-cross Pattern Count

With the help of a good, preferably topographic map and their knowledge of the area, the team member(s) should carefully plot out the search pattern which covers the whole block without missing sections of it. At least one member must be thoroughly familar with the block to ensure that no important place where wildlife is likely to be found is missed.



Data Recording

On sighting an animal of the target species, observers should stop and record the details as in the proforma.

Noting time of observation and direction of movement may help during data analysis to detect possible double counting. An example of a proforma is given below.

Sampling Area _____ *Block No.* _____ *Station No.*_____

Date _____ *Starting Time* _____ *Finishing Time* _____

Observer(s) _____

Sl No.	*Time*	*Species*	*Total No.*	*Age/Sex Composition*	*Direction of movement*
1					
2					
3					
etc					

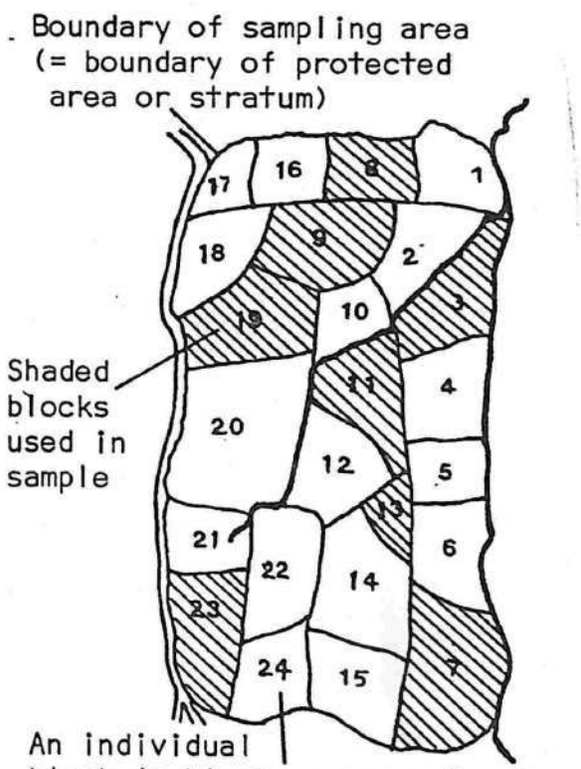
ALL THE BLOCKS OR A SAMPLE?

It is of course possible to count all the blocks, and then to calculate the total population size in the area concerned by adding up all the individual block counts. As is pointed out earlier (see Wildlife 1.2) this approach is usually not recommended.

It is much better, both time-wise and for data analysis, to use each block as a sampling unit and count only a proportion of them. The total population size is then estimated from this sample.

RANDOM SELECTION OF SAMPLING UNITS

Identify all the blocks on a map and number each of them. Mark a piece of paper for each number and put these papers in a box or hat. Subsequently papers are drawn from this box up to the required number of samples, thus identifying the blocks in the sample. Alternatively, a table of random numbers could be used.



A total of 8 out of a potential number of 25 blocks have been randomly chosen.

Considerations for sample size and data analysis, as discussed in Wildlife 1.2, are fully applicable.

The use of stratification is highly recommended to improve precision. As a guide, choose the initial number of blocks to be counted in each stratum, so that they cover the stratum in the same proportion as the stratum bears to the total sampling area. For example, if the grassland stratum covers 30% of a 100 sq km sampling area, then the sample size would be set as 0.3 x 30 sq km = 9 sq km. With a block size of, say, 1 sq km, this means 9 blocks must be counted. This process is repeated for each stratum.

PROBLEMS

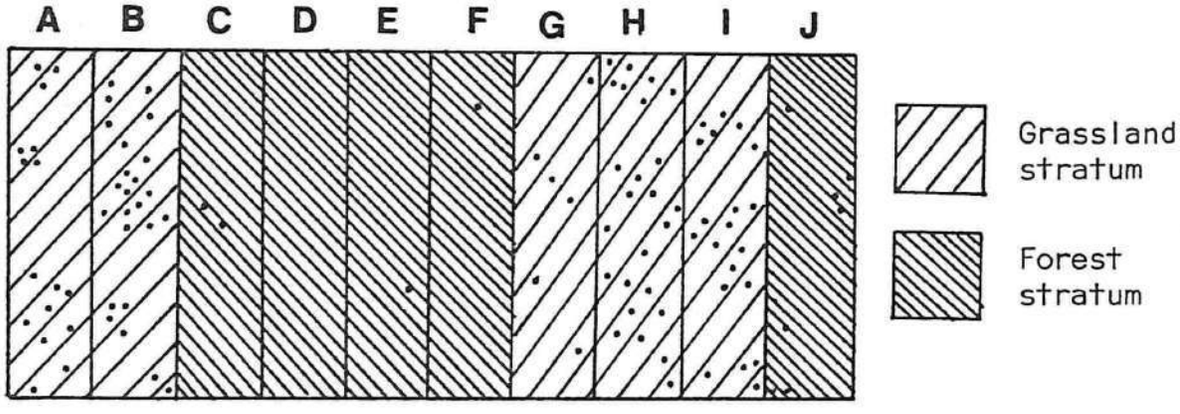
Probably the biggest problem with block counts is to avoid double counting of animals. The most common source of this is animal movement during the census operation. With the line count method a startled animal could be sent "down the line", and thus be recorded by several observers. In the cRIss-cross method animals could move to within sighting distance from an adjacent search line in the pattern. Some of this error can be removed by carefully comparing times of observation and direction of movement entered in the data sheets for each sighting.

STRATIFICATION

The distribution of animals is expected to be random within an area with a homogeneous habitat, like Anogeissus forest, alpine meadow, evergreen rain forest, riverine forest or tall grassland. A sampling area, for example, a National Park, will usually have more than one habitat type but ideally sampling units should contain only a single (homogeneous) type. This is achieved by dividing the sampling area into sub areas ("strata") of relat- ively homogeneous habitat characteristics - and is known as stratification.

Subsequently, sampling and data analysis is done for each stratum separately. This is called stratified sampling.

Stratified sampling can also include sampling in different management units, like core and buffer zone.



N.B. Dots represent animals; in this case densities are obviously different between strata.

In general, the sampling effort in each stratum should be proportionate to the area covered by this stratum in relation to the total area. In the example above, the "forest" stratum and the "grassland" stratum each cover 50% of the total area. Hence half of the total sample effort would normally be allotted to the sampling of each stratum separately.

A second problem concerns the assumption that all individuals of the target species are counted. This assumption may be violated if, for example:

- Observers in a line count veer off the track assigned to them, hence sections remain uncounted.
- The line in a line count "breaks", giving animals the opportunity to escape between observers.
- The search pattern in a criss-cross count is not laid out properly, hence animals are missed.
- Animals move out of a section covered by the search pattern in a criss-cross count to a section already counted,hence they are missed.

Taking everything into consideration, it is recommended to use the following combination of methods.

Use the criss-cross count whenever possible, but test for accuracy and possible correction factors to counter inaccuracy by conducting a few carefully designed and meticulously carried out line counts in some of the blocks counted by the previous method.

Road Side Counts

TO ESTIMATE WILDLIFE POPULATION DENSITIES FROM VEHICLE BASED TRANSECTS.

Roadside counts may merely be used to detect population trends from season to season or year to year. However, in some areas where specific conditions are met, and with certain precautions and proper sampling design, they may yield a reasonable estimate of overall population size.

If a good road network is present, roadside counts can cover a large area in a short time, especially when using motorized vehicles.

A roadside census is a sample count. The sampling unit is a transect: a strip-like area with a narrow width and the road running down the long axis. The width of a transect is, in principle, variable, depending on the visibility of the target animal(s).

Two types of transect are proposed: the open width transect and the closed or fixed width transect. In the former all the target animals are counted, at whatever distance they may be sighted. In the latter only those individuals of a target species are counted, which are sighted within a predetermined distance from the observer. Applicability of each method is discussed.

How to collect and analyze data from roadside counts is explained below.

PREREQUISITES

Road Network

Especially when information is sought for the entire (protected) area, an adequate road or track system is a necessity. For example, the road network must cover all the major habitats or management units, e.g.core, buffer. Furthermore, there should be at least 50 km of road for every 100 sq km of sampling area. Why?, Assuming a sighting distance of 25 m on each side of the road, the area of the transect is 2.5 sq km or 2.5% of the sampling area. The proportion of sample size to sample area should definitely not be below that.

Representativeness and Bias

As with all samples, the transect counted must be representative for the stratum (area, e.g. core, buffer, or habitat, e.g. forest, grassland) being sampled. More often than not, roadside conditions violate this principle. For example:

- Roads tend to avoid steep, rugged or swampy terrain. Animals may have a similar preference, but the opposite could be true as well, hence the densities counted may be biased.

- Artificial waterholes and salt licks may be placed close to roads for easy management. Animal densities are bound to be unusually high, at least at certain times (dry season).

- Animals may stay away from areas where roads have a heavy traffic load (e.g. tourists, state highway).

- Many animals have higher densities near habitat edges. This would give a biased result if a road serving as a boundary between, say, forest and grassland were to be used.

- In many protected areas roadsides are purposely cut back as fire breaks and view lines. Regenerating vegetation attracts many animals such as chital, wild boar and gaur. This may result in significantly high densities along roadsides than elsewhere in the stratum sampled.

Extreme care must be taken in selecting suitable roads or tracks in order to avoid these sources of bias as much as possible. Wherever possible, choose straight roads with little traffic.

Vehicle and Sampling Team

Preferably an open jeep with driver should be assigned for the census. The sampling team, apart from the driver, ideally consists of two observers standing in the back, who concentrate on spotting and counting of target animals on their side of the vehicle only, and a recorder who takes down information as it is called out by the observers.

SAMPLING CONSIDERATIONS

Sampling Units and Sample Size

Each individual transect is one sampling unit. Rather than treating each road or track to be censused as one single transect, the road is divided into stretches of standard length (e.g. 1 km, 5 km). Each stretch can then be used as a transect, thus increasing the sample size.

Sampling

Carry out all counts at a standard time of day, e.g. 0600 to 0900 hours, with a slow speed (c. 20 km per hour). Each transect should preferably be counted several times during the sampling period. This may allow for reduction of some inevitable bias, through averaging of the data for each transect.

Sampling Procedures

Identify the beginning, end and length of each transect on the map, and on the ground. Decide when and in which sequence they are to be travelled. Number the transects consecutively for easy identification.

Prepare a recording proforma and have sufficient copies made.

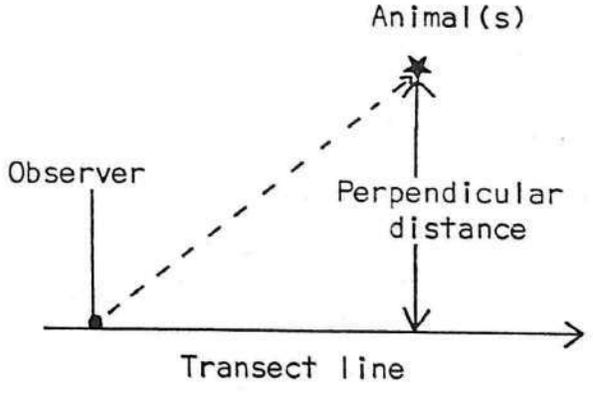
Observers should practice the procedures and should be thoroughly familiar with the transect routes.

Do not exceed a speed of about 20 km/ hour. With stops for observing and recording, between 10 and 12 km can be covered in one hour.

Sighting distances where applicable should ideally be measured at right angles to the transect line. As actual measuring is rather impractical, observers should be trained to adequately estimate distances. Occasionally, these can be checked by pacing out the distance. Distances should be taken from the edge of the road, not from the centre.

If there is a ditch on the roadside measure from the far side of the ditch. The road itself and the embankment are not included as part of the sampling unit.

With each sighting,the perpendicular distance from the transect line to the animal (when first sighted) is estimated and recorded where applicable In the case of a group, distance should be to the approximate centre of the group.

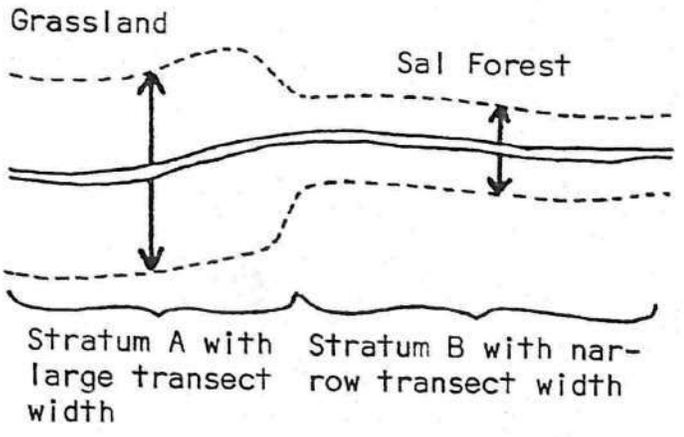


TRANSECT WIDTH

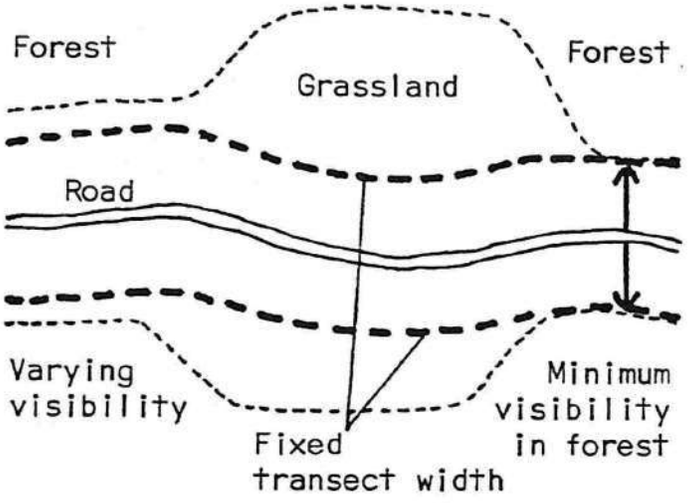
How far you can see on each side of the road depends on the habitat type, terrain features and vegatation. Whether you can detect and positively identify an animal depends on its size, colour and habits. For density estimates it is necessary to accurately determine transect width. For monitorring trends, however, this is usually not necessary, as the aim is merely to establish an index of density.

Fixed Width Transect

In absolutely open and flat country you can detect animals as far away as normal eyesight allows. However, the chances of missing animals increase with distance. A fixed width transect has a predetermined width, depending on habitat type of the stratum and target species, within which the observers are sure to detect <u>all</u> the target animals present. This width, once chosen, remains constant for all the transects in that particular sampling area (or stratum), and all sightings outside of it <u>have</u> to be ignored.



If a sampling area has transects, parts of which have variable visibility, then the smallest width has to be chosen for the whole transect, and all the transects in the sampling area will use that width.

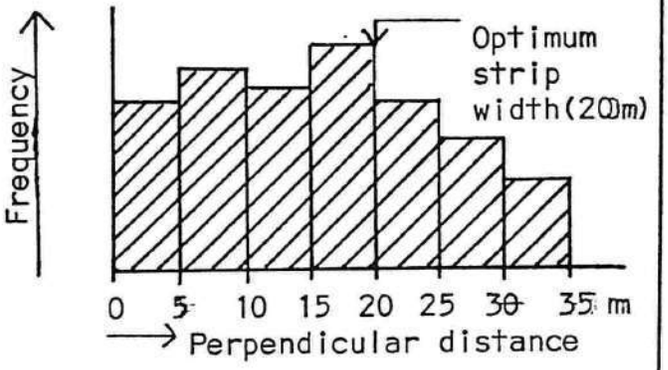


Open Width Transect

Fixed width transects are inefficient in the case of species occurring in low densities, as some sightings have to be rejected because they are outside the predetermined sightings of target animals and distances at which these are made. However, calculations for estimating animal densities from these data are rather lengthy and complicated. Hence, simplifications have been developed, which overcome some of the inefficiencies of the fixed width while retaining ease of calculation. This is done by establishing, upon completion of the census, an "optimum strip width" on the basis of the actual sighting distances. The Kelker Belt Transect method (see box) is the most useful for vehicle based transects.

KELKER BELT TRANSECT

After the census the frequencies of sighting distances recorded are plotted in a histogram, in 5 m classes (a minimum of 50 separate distance measurements is essential). The point on the histogram where class levels begin to drop off indicates the "optimum strip width". All sightings made beyond this distance are rejected for the census calculations.



MONITORING TRENDS

For management purposes, what is often needed is information on population trends (increasing, stable, decreassing), rather than on actual numbers. It is far easier to monitor trends than absolute or total numbers. Also it should be noted that while prerequisites for transects designed to yield density information are rarely fully met, those rigorous conditions are not required for gathering valid trend information. A simplified roadside census can be used for this purpose.

ANIMAL MONITORING

Date _____ *Recorder* _____

From _____ *To* _____ *Time out* _____ *Time in* _____

No.	*Km.*	*Species*	*No.*	*M*	*F*	*Imm*	*Notes*
1	*2-3*	*Chital*	*27*				*Eating ber fruit*
2	*4-5*	*Nilgai*	*8*	*0*	*5*	*3*	*One F in poor condition*
3	*4-5*	*Boar*	*6*	-	-	-	

Within the area concerned (e.g. sanctuary, core, habitat type) a number of roads or tracks are chosen which can be regularly covered over a given time, e.g. 5 times per month. Each road is divided into 1 km segments, the transects, using the vehicle mileometer or marks on trees or the road itself. All target animals are carefully searched for as in the methods discussed above, but no distances are recorded. An example for a monitoring proforma is given above.

ANALYZING AND PRESENTING THE DATA

Density Calculation Per Transect

Calculate the mean number of individuals per species counted on all transects e.g. Chital 58, 32, 46, 44 mean = 45.

Calculate the area of the transect (exclude the area of the road), e.g. fixed (or optimal, if Kelker method) width one side = 40 m.

Length of transect = 5 km.

Area of transect = 40 m x 2 x 5000 m = 400,000 sq km (or 0.4 sq km)

Density is 45 chital per 0.4 sq km or 112 chital per sq km.

Total Population Estimate

For a total population estimte calculate the density for each stratum from the data of all the transects in the stratum. Treat each transect as a separate sampling unit, hence the statistics discussed in Wildlife 1.2 apply. Total population size is then determined by the proportions of the different strata to the whole area.

Dung Counts

TO RECOGNIZE POPULATION TRENDS FROM THE INDIRECT EVIDENCE OF DUNG.

Wildlife dung is an indicator of animal presence which can be used to establish trends and examine relative abundance. If a count shows a pellet group density of let's say, 120/ha and one year later 240/ha we could infer that the population size has doubled. According to the same principle, counting cattle dung in two different areas can give an indication of relative grazing pressure.

In theory one can make population estimates from dung counts if we know the defaecation rates and the rate of decomposition of the dung but in practice, this is not easy to find out reliably and the method is not recommended if total numbers are required.

The method has additional problems which limit its application:identification of pellet groups and observer error.

This technique explains how to plan, implement and interpret a pellet group count.

POTENTIAL PROBLEMS

Identification of Pellet Groups

In principle it is possible to distinguish pellets of nilgai,sambar,chital, barking deer, chinkara, domestic goats etc by size and shape and make a species specific dung count. However, even with experience there is a great deal of variation and, hence, uncertainty in attributing pellets to species. Nilgai have the habit of defaecating repeatedly on the same heaps, on which individual pellet groups cannot be distinguished. A small sambar may produce pellets of similar size to that of a large chital. A big goat drops pellets the size of chital pellets and there is a possibility of inferring an increase in wildlife populations when in actual fact,more goats were browsing in the area.

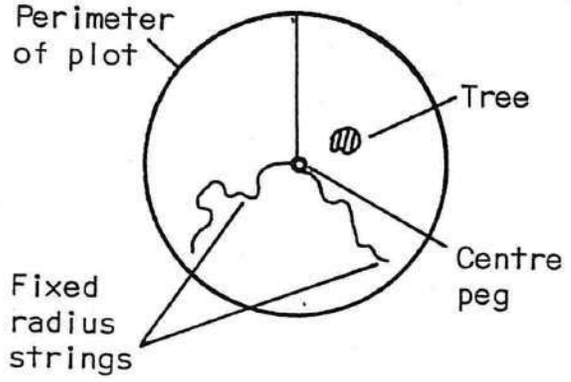
The error due to misidentification can be reduced, but this requires more time for the count which might render the method inefficient. For example, observers can carry a selection of dung samples with them, taken from absolutely identified pellets (e.g. when the animal has been seen defaecating), with which they can compare dubious pellets in the count. Also consider lumping several species, e.g. sambar, chital, barking deer, together to represent general ungulate abundance instead of species specific abundance.

Counting of Pellet Groups

What should be counted are distinct pellet groups. In the field these come in a myriad of shapes, sizes, degree of scatter, age and decomposition. It is impossible to remove all ambiguity in what is to be counted as a separate pellet group or not and, in practice, each observer forms his own mental image of pellet groups which should be counted. Because individual judgement is involved there is likely to be a considerable difference between observers counting dung in the same plot. There is generally less variation within the counts by the same observer. Hence, it is preferable for obtaining data on trends, that the same areas be repeatedly sampled by the same observer.

Circular Plots

A string attached to a central peg (length = desired radius) defines the perimeter of the plot. If several such strings are attached to a central peg it becomes easier to move around obstacles.



SAMPLING CONSIDERATIONS

Timing of the Count

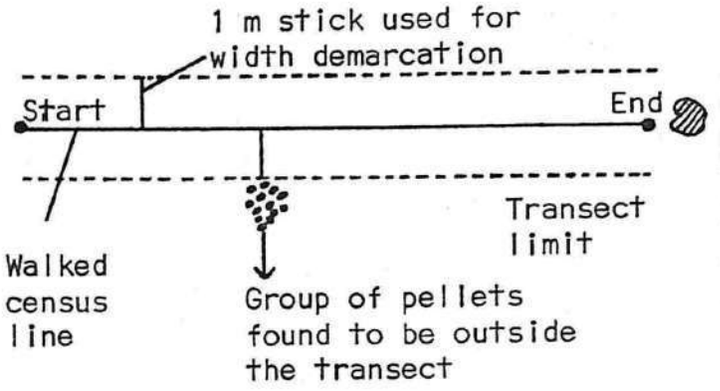
It is necessary to conduct the count under similar conditions each time. For instance, the amount of litter may vary through the seasons, affecting the number of pellets readily visible, or heavy rains may have dissolved or washed away more dung now than on the previous count.

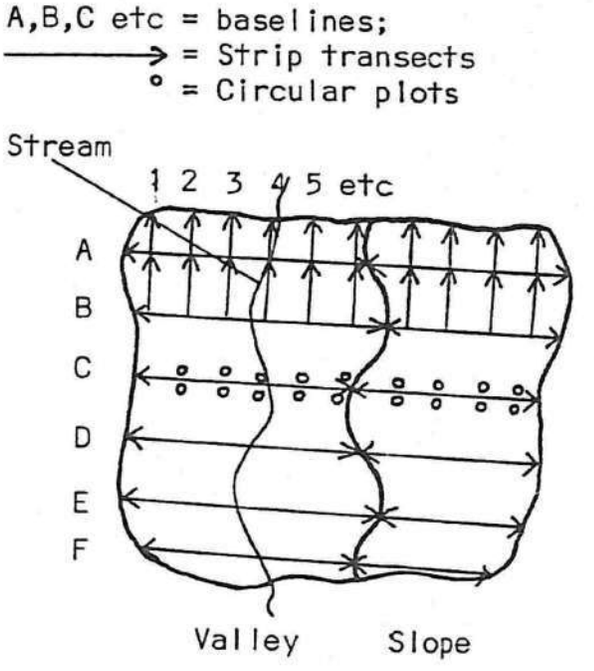
Shape and Size of Sample Plots

Sample plot size and shape must be designed for easy searching. Too large a plot will take excessive time to count. If plots are too small, one will too often waste time setting it up while getting no dung to count.

Strip Transects

Here the sampling unit is a narrow, elongated strip. Strip transects have the advantage that they equalize micro-habitat variation better than circular plots. It can easily happen that a circular plot is entirely in the shade where dung is often concentrated. Strip transects stretch over a longer area,hence are more likely to include shaded as well as non-shaded areas. Transects 2 m wide and 30 m long have been found convenient in a number of different areas. With experience, the size can be chosen so that at least 6 out of 10 units searched contain pellet groups.



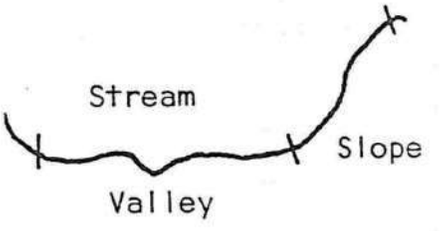


Sample Design

Let us assume you want to compare use of two different habitat types, e.g. valley grassland and wooded slope. Select two sampling areas (size 0.25 - 0.5 sq km) which are representative of these habitat types. These areas may be adjacent, as long as they are distinct.

Sampling should cover the entire sampling area. Sampling is done from parallel baselines. The distance between baselines depends on the size of the sampling unit, overlap is not allowed. For 30 m transect strips, this distance would be set to, say, 50 m. Each baseline cuts across the main habitat features of each area (see cross section of sampling area), hence each baseline is expected to have similar dung densities. This may not be true for the individual samples along it. Sample plots near the stream or habitat edges may have different densities.

Either circular sample plots or strip transects are placed at regular intervals (e.g.50 m) along each of the baselines.



Topographic cross section

SAMPLING PROCESS

Two observers with the necessary proformas and equipment are ideal.

Sample along the baseline as shown. Maintain direction, ideally by compass bearing. Pace out distances between individual sampling units.

Record dung counts for each plot or transect separately per baseline and per habitat type.

DATA ANALYSIS

Work out the data statistically as explained in Wildlife 1.2. This can be done per baseline separately, or for all the baselines together in each habitat type.

*Baseline :*_____ *Sampling Area :*_____ *Date :*_____

Plot/Transect	*Sambar*	*Chital*	*Other*	*Nilgai*	*Habitat*
1					
2					
3					

Pugmark Census

TO PROVIDE A METHOD FOR IDENTIFYING AND COUNTING TIGERS AND LEOPARDS BASED ON A RECORD OF THEIR TRACKS.

The use of pugmarks as a census technique has been developed in India. The technique requires a "pugmark tracer" which can easily be manufactured locally. Even more important it requires an experienced and skilled observer (director, research officer or other wildlife officers) to interpret pugmark tracings in relation to space and time as well as other important clues. Staff must be trained to provide accurate and continuous records. Both the accuracy in tracing of pugmarks and the ability to interpret, require practice and experience. One will then be able to identify individual animals and, if the survey covers all suitable habitat, arrive at a total population of the species within the park or sanctuary. In addition, the data will allow one to determine sex ratio and age structure of the population. If the survey covers large areas and if it is done continuously, one may even be able to determine the boundaries of home ranges and detect variations in them over a given time period.

The technique described here is an adapted version of an article by H.S. Panwar, "A note on Tiger Census Technique", Tiger Paper 6: 16-18.

How to collect and interpret a pugmark track record is described in this technique.

EQUIPMENT

For the pugmark tracer;

- 1 pane of colourless glass (20 cm x 25 cm x 3 mm) with holes drilled in the corner.
- Four metal screws, about 5 cm long, with wingnuts, nuts and washers to fit; (these become the "legs" of the tracer.
- Thin paper to transfer the tracing from the glass.
- Rubber bands to hold the tracing paper onto the glass pane.
- A felt pen which can write on glass (and be erased).
- A measuring tape (100 cm).

CHOOSING A TRACK FOR TRACING

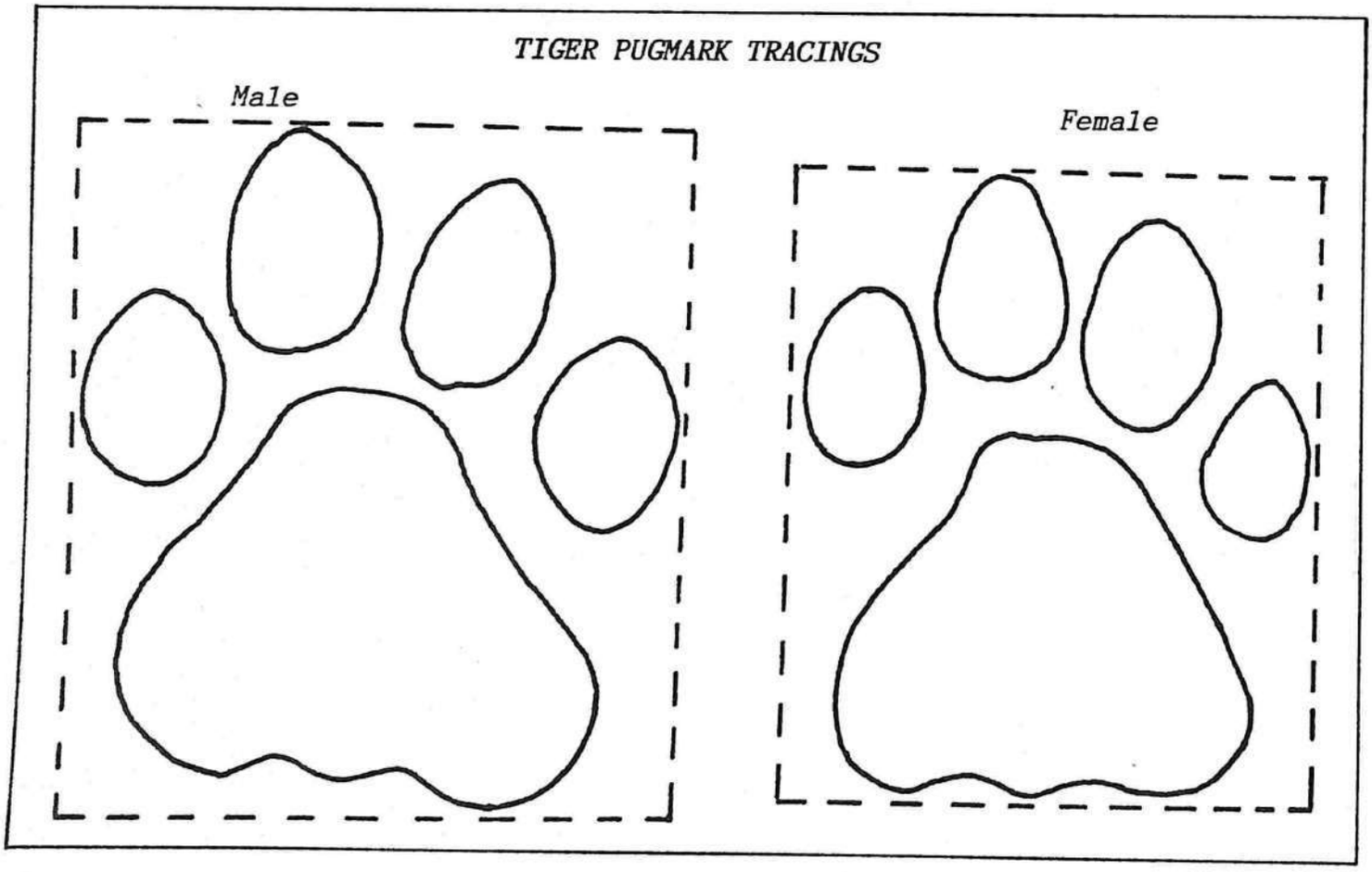
Select a well formed impression of the rear pug, preferably from a series of tracks along a road, sandy stream bed etc. If no perfect impression can be found, make a composite tracing using two or three pugmarks of the same animal. Left and right pugs should be identical mirror images, but if one shows a deformity, that side should be taken, because it can always be easily identified.

However, when conducting a tiger census a decision should be made in advance and rigorously followed to make tracings of either the left rear or the right rear pugmarks. In such a case an additional pugmark - left or right, front or rear - should be recorded as extra evidence of an individual's identification.

A walking tiger (or leopard) in normal gait places the rear foot on top of the impression made of the front foot. The positioning, however, changes with the speed of walking, but rear pugmarks always remain undisturbed because the rear pug either superimposes the front pugmark or overshoots it. This is one reason for choosing pugmarks made by the rear pug. Rear pugs are invariably smaller than front pugs. Of the superimposed pugs, the inner outline is the outline of the rear pug.

Another reason is that only the rear pugmark is different between males and females. The distinction is one of size (male pugs are larger) and shape (see box). A "box" drawn around the pugmark of the male is almost a square. A box drawn around the pugmark of the female, on the other hand, is clearly rectangular.

TIGER PUGMARK TRACINGS



Caution with Multiple Tracks

Tigers lead solitary lives except mothers and their offspring.However, there are times when males join the "family" for short periods. Because of simultaneous movements distortion of tracks occurs as marks of one individual get superimposed by anothers. Great care must be taken in identifying pugmaks of an individual in the series of multiple tracks and only then should tracing be attempted.

Can you tell the difference between a tiger and a leopard track?

Yes and No. It is impossible to tell a leopard track from that of a young tiger six months of age or less. However, tiger cubs of that age are always accompanied by their mother and a solitary track of suitable size is bound to have been made by a leopard.

TRACING THE TRACK

Place the tracer directly above a clear track. Push the legs of the tracer into the soil until the glass pane is just above the track surface. If the ground is hard, lower the glass pane by adjusting the wing nuts which hold it in place. With both knees on the ground left and right of the tracer and looking straight down,start tracing. By moving your head while drawing, so as to keep your eyes vertically above the tip of the pen and the portion of the mark under tracing, you will be able to avoid the error of parallax and make an accurate tracing. As with all skills, proficiency comes with practice.

To transfer the pugmark from the glass to paper, attach the tracing paper to the glass by means of the rubber bands and, holding it up against the light, draw the pugmark outline, again taking care to avoid the error of parallax.

DISTINCTIVE FEATURES OF THE TRACK

It is important to draw the following distinctive features of the track correctly:

- Shape of the three lobes at the base of the main pad (and the two small "indents" formed by them) because this is one characteristic of individual variation. The shape and size of the three lobes, the extent of sag of the right or left leg and the direction of the two "indents" vary with individuals.
- The apex of the pad as this is also an important individual characteristic. This apex line varies in length, curve and inclination from individual to individual.
- Abnormalities which allow easy recognition.
- Stride measurement from track to track when rear pugmark is exactly superimposed onto front pugmark.

OTHER INFORMATION TO RECORD

Additional information should be recorded on the tracing sheet or on a separate proforma attached to it.

- o Name of the recorder.
- o Date and time of tracking.
- o Location, e.g. section of road, ravine or nala.
- o Direction of movement.
- o Surface type (sand/earth) and condition (dry, wet, muddy, slushy)
- o Freshness of the track (fresh, probably last night, yesterday, old etc).

Note that the size of the pugmark of the same individual may vary depending upon the texture and consistency of the ground surface. In mud, deep dust or sand, the track size will be larger but all the characteristics will remain unchanged.

TIMING OF THE SURVEY

If an estimate of population size and structure is the only purpose of the survey, it should be carried out over a period of several weeks during the time when tiger tracks can be most conveniently located.

Records to determine home range and utilization of different habitats within a given area, require the survey to be extended through a full seasonal cycle. In the course of a pugmark based count of tigers within a given area, intensive survey for tiger tracks and their tracings have to be made. The pugmark records obtained are compared every day and individual locations entered on a map. In a few weeks these will lead to identification of all individuals using the area.

AGEING AND SEXING

Reasonably accurate sexing of adults can be made from the overall comparative shape of the pugmarks as explained earlier. Pugmarks of the young are smaller. Cubs less than three months old are seldom taken out and cubs upto a year old do not move except with the mother. Sexing and ageing is thus possible from pugmark records.

INTERPRETING THE TRACK RECORD DATA

Once the pugmark of an individual animal has been positively identified it should be given a number so it is easily remembered and referred to. The number can be pinned to a map to indicate locations where its track has been recorded. This will show the general whereabouts of the animal at different dates during the survey.

Waterhole Census

TO DETERMINE WILDLIFE POPULATION TRENDS IN DRY AREAS WITH LIMITED WATER SOURCES.

A census technique where large animals are counted from a hide as they visit waterholes is in widespread use in the drier parts of India, e.g. Sariska, Gir, Melghat. The technique is useful where all dry season water sources are known and are not too numerous.

The technique may yield a reasonably valid index to determine population trends. However, because of a large number of untested assumptions involved, it has no validity as a method to estimate actual population size.

How to plan and implement a waterhole count and interpret the results is described in this technique.

ASSSUMPTIONS

Four main assumptions are involved:

a. There is a linear correlation between the number of animals seen drinking per time period and the total number of animals in the area.

b. The frequency with which a certain species drinks is known.

c. Field staff record an accurate count of the animals seen drinking.

d. The presence of field staff does not deter the animals.

The first assumption is probably true, but the actual correlation is rarely known as it differs from species to species, and between age and sex classes. As for assumption b), many people support the tacit assumption that each animal drinks once a day. There is no biological basis for this.

Assumptions c) and d) require, among other things, that staff remain awake, stay at their post for the entire counting period, do not make up figures, remember figures correctly if they are illiterate, do not smoke or otherwise frighten animals away. Supervision and training can eliminate some, but probably not all of these uncertainties.

PREPARATIONS

Hide Construction

Locate and map all water sources in the area (Habitat 1.1). Open access to the water sources and, at each, construct a machan or hide. These should be large enough to accommodate at least two people. They should be between 20 to 35 m away from the water. Construction should be finished several days ahead of the census. Let the census staff check the machans or hides.

Staff and Equipment

- Select at least one literate person and one helper for each water hole, well ahead of the census time.
- Explain objectives and importance of the census.
- Explain the recording process and use of the proforma.
- Species and total numbers usually are the most important data. For example, it is not realistic to expect staff without binoculars to determine sex and age classes.
- Give staff several hours of practice sitting at a waterhole and using the proforma.
- Issue binoculars, if a limited number is available, to staff at the most important sites.
- Advise them to take sufficient food, water and clothes for the entire census period.
- Consider issuing cheap alarm clocks which, continuously being set for an hour ahead, reduce the risk of long sleeping periods. In addition entries into the records can be timed.

PROFORMA FOR WATERHOLE CENSUS

Range _____ *Block* _____ *Waterhole* _____

Name of Observer _____ *Date* _____

Time started _____ *Time finished* _____ *Signature of RO* _____

Sl.No.	*Time*	*Species*	*Number*	*Adult Male*	*Adult Female*	*Immature*	*Others*

THE CENSUS

- Undertake the census during full moon at some time late in the dry season.
- Start the census in the evening of day because people are less likely to fall asleep at the beginning.
- Start counting one hour after arrival at the machan or hide to eliminate the disturbance period and continue the census through a complete 24 hour cycle.
- Repeat the count at selected places a few days after the census.

INTERPRETING THE RESULTS

The result is an index of animal presence. More animals are expected to be counted at high population density and data from successive years may be compared to indicate possible trends in population density and size. However, because of the many uncertainties involved, it is useful to examine data for consistency.

CHECKING FOR CONSISTENCY

This can be done at selected places shortly after the main census. If 282 nilgai were counted the first time and 171 or 369 two days later, the data are clearly inconsistent and of little value. If you counted 350 nilgai next year, you could not infer a population increase.

- Select about 20% of all waterholes for repeat counts soon after the main census count.
- Choose waterholes or groups of adjacent waterholes, frequented by large numbers of animals.
- Repeat the count for three 24 hour periods at 2-day intervals.

Presentation of Data

TO HELP THE MANAGER PRESENT CENSUS DATA IN A CLEAR AND CONVINCING MANNER.

A census is usually conducted to produce a combination of total population estimates, densities, trends, or measures of relative abundance.

Censuses are basically meant to detect change or to show that populations are stable. Changes or stability must come out clearly when presenting sequential census data. Is it possible to deduce rates of increase or decrease? Can trends or population slumps be related to cataclysmic events, e.g. an epidemic or to slower changes in habitat condition (persistent grazing pressure by village livestock)? Do the data allow you to make comparisons either between areas or in time?

Convincingly presented census data do not only enhance the census taker's own understanding of the situation, but can also be used to support arguments for political decision making, to gain moral or financial support, or form interesting displays in a visitor centre.

This technique explains how to express results in tables, graphs and maps.

CATEGORIES OF INFORMATION

Examine the data to see whether they allow you to extract information about any of the following:

Population Totals

- For the whole area
- For part of it (an ecological subunit, a management unit).

Densities

- Overall density.
- Density variation according to strata (e.g. core, buffer, habitats).
- Seasonal variations of density.

Distribution (as indicated by densities or trend monitoring)

- Distribution of a single species or a group of similar species.
- Seasonal distributions.
- Distribution in response to disturbance or burning.
- Distribution in relation to different habitats.

Trends

- Do populations remain stable?
- Do they fluctuate?
- Do you notice a consistent trend?

Proportions

The percentage of animals of a species in poor condition, in specified age classes, or different habitat types.

Rate of Increase or Decrease

Census Year One : 1280 chital
Census Year Two : 1590 chital
Census Year Three : 1640 chital
Census Year Four : 1880 chital
Census Year Five : 1910 chital

$$rate = \frac{\text{number last year}}{\text{numbers 1st year}} = \frac{1910}{1280} = 1.5$$

rate > 1.0 would indicate a possible increase in population size.
rate = 1.0 would indicate a possible stable population size.
rate < 1.0 would indicate a possible decrease in population size.

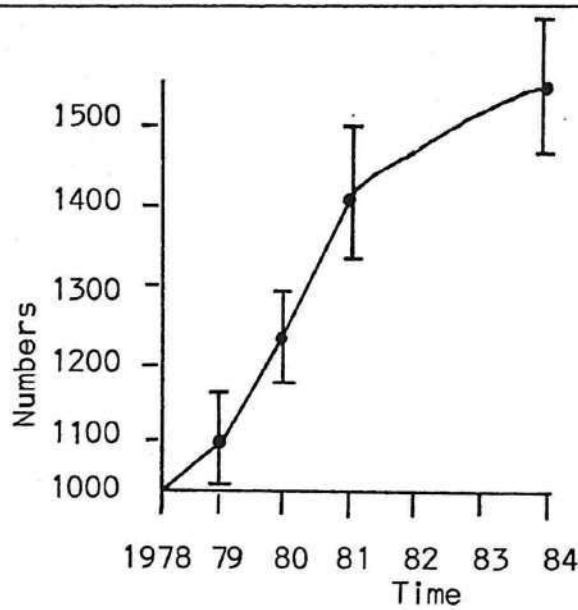
However, only confidence limits can tell us if the rate calculated is real or just an illusion.

For example: If confidence limits from one year's total with the next overlap, one cannot infer an increase.

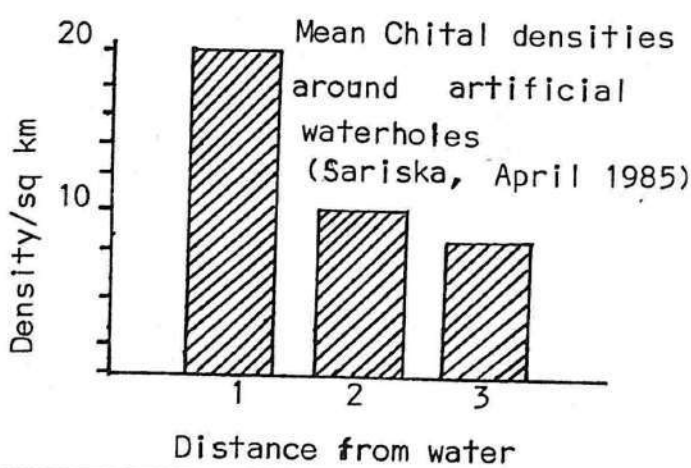
METHODS OF PRESENTATION

The extracted information can be presented in graphs, tables and maps. These can, of course, be used in various combinations. All need to be clearly labelled and provided with the information necessary to understand them.

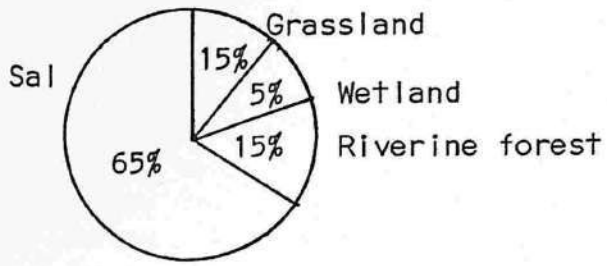
Graphs: Graphs visualize information and make it easier to understand. Line graphs are good to portray long term trends, with time on the horizontal axis, population estimates on the vertical axis. It is easy to grasp the inevitable uncertainty associated with census data if confidence limits are shown in the same graph.



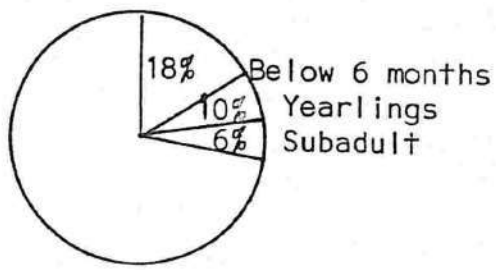
Histograms: Histograms are well suited to protray discrete variables. For instance, the density of chital against the distance from water in discrete steps.



Pie-Charts: Usually best to depict proportions or relative population size.

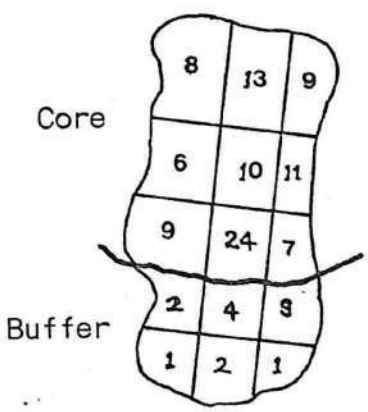


Distribution of habitats

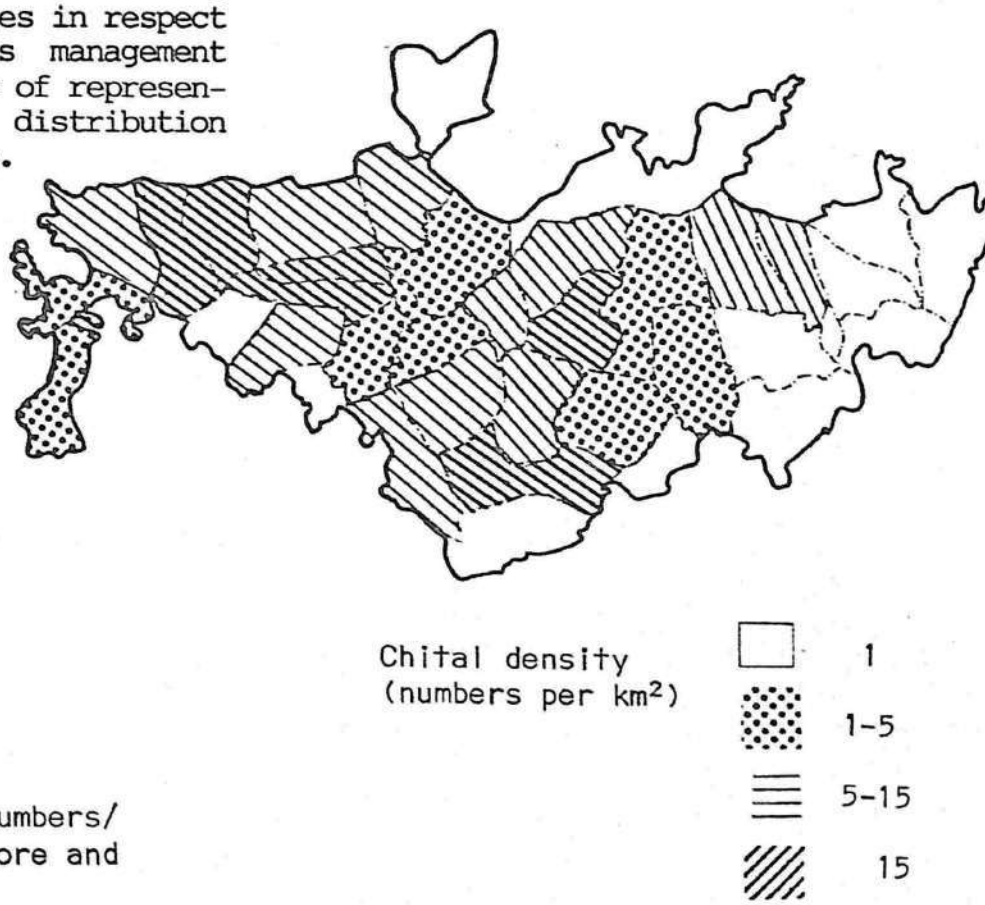


Proportion of young

Maps: Maps are useful for explaining methodology, e.g. location of sample plots, distribution of strata etc. They are indispensable for showing distribution and densities in respect to ecological as well as management units. Two different ways of representing information on the distribution of density are shown here.



Total wildlife density (numbers/ km^2) by compartments in core and buffer.



Identifying Individual Animals

TO INTRODUCE METHODS OF POSITIVELY IDENTIFYING INDIVIDUAL ANIMALS IN THE FIELD.

There are a number of situations in wildlife management where it is advantageous to be able to positively identify some individuals in a population. In tracing migration routes, for example, one must be able to state with certainty, that a herd formerly seen in location A was later in locations B, (or C, D etc). This can only be done on the basis of known herd members. A proper understanding of the social organization and group dynamics of many species can only be attained if at least key individuals can be repeatedly recognized e.g. territorial males. In controlling nuisance animals, it is sometimes necessary to know whether particular individuals are repeatedly crop raiding, cattle lifting or even man-eating. Following the fate of released individuals in a rehabilitation programme also demands that these animals be readily distinguishable.

For efficiency, identifying features should be susceptable to ready and accurate recognition, permanent and cause no interference in the individual's normal life or behaviour.

A surprising number of species possess natural features, such as coat stripes or spot patterns, which provide a basis for individual identification, as do accidentally acquired deformities. In the absence of natural distinguishing characteristics, a variety of artificial marking techniques are available but the great majority of these require the capture of individuals to allow the device to be fixed - an operation which is not without risks.

Both natural identifying features and artificial marking methods are considered in this technique.

NATURAL IDENTIFYING FEATURES

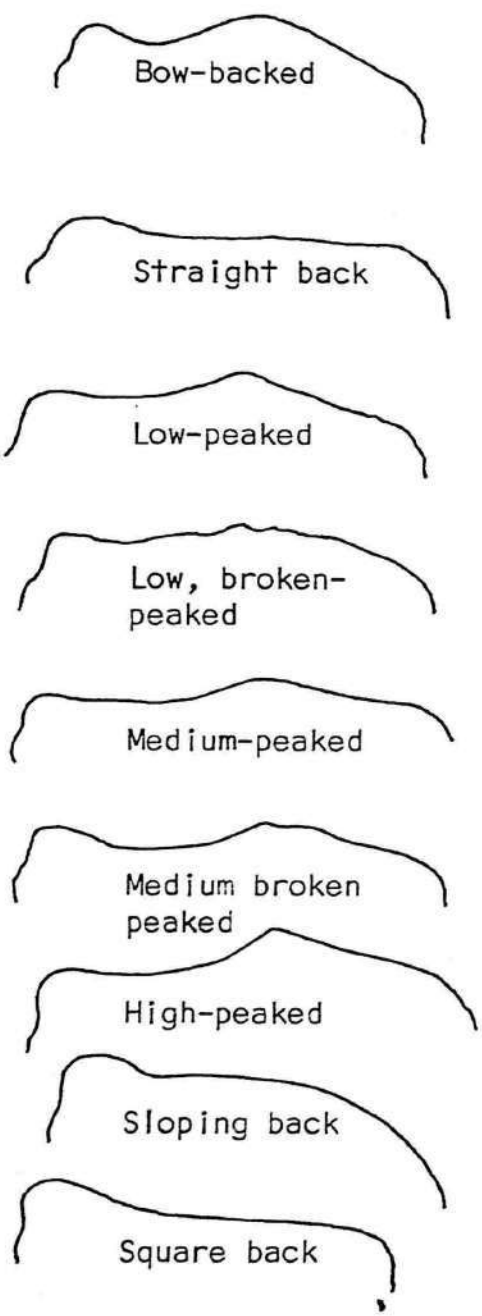
Whenever possible, recognition should be achieved by using naturally occurring individual differences, rather than opting automatically for a method requiring artificial intervention in the animal's life. Useful characteristics:

- Stripe patterns e.g. tiger.
- Spot patterns e.g. chital.
- Horn or antler configuration e.g. male antelope or deer.
- Horn or tusk shape and wear pattern e.g. rhino, elephant.
- Vibrissae (facial whiskers) arrangement e.g. lions.
- Colour differences e.g. male blackbuck, male macaque, albinos.
- Permanent deformities - wound scars (rhino); ear tear (elephant, lion); broken tails (langur).
- Unusual behaviour traits - unduly aggressive individuals (rhino,lion)

NATURAL IDENTIFYING FEATURES OF AN ELEPHANT

(after Lahiri Choudhury & Barua)

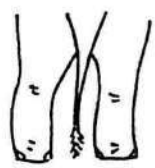
BACK PROFILES



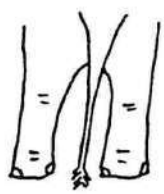
TAIL TYPES

A. According to length

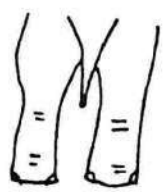
"Knee" length



"Ankle" length



Touching the ground



Cut tail

B. According to brush

No tail brush

Full brush

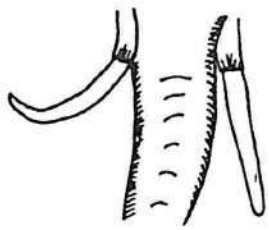
"Fish-tail"

"Half-fish"

TUSK TYPES

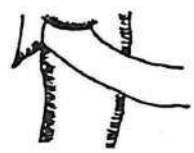
A. According to plane

Unbalanced - either tusk higher than the other

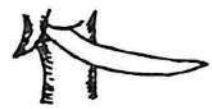


Totally opposite to each other

B. According to thickness

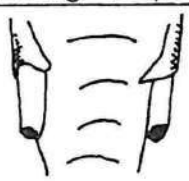


Thick and massive tusks



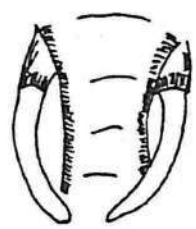
Thin tube-like tusks

C. According to parallelness



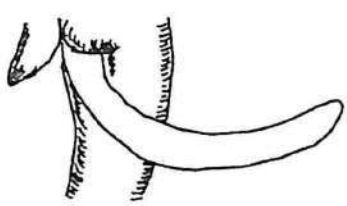
Parallel

Divergent



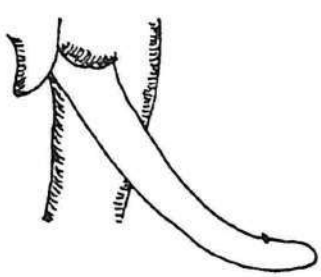
Convergent

D. According to angle to the ground

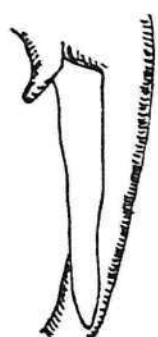


Sufficiently recurved to enable carrying of a log

Short, thick, no recurving



Sloping towards ground, slight recurve



Straight towards the ground

Short, straight tusks of no particular distinction

Recording Methods

- Aim to record one main and two subsidiary identifying features for each individual e.g. main: stripe: pattern, subsidiary: tail length, gait.

- With coat patterns only record a particular area of the body e.g. stripes on face or left flank. Use the same 'key' area for all identified individuals.

- Keep a separate record (5 x 3 card or notebook page) for each individual, consisting of precise notes on identifying features, accompanied by a close-up photograph and/or sketch. For the latter a standard outline of the key area (tiger's face, elephant's ear) can be printed onto blank record cards and details filled in when a new individual is being recorded. Date and location of re-sightings can be recorded on the back of the card.

- For large numbers of identified individuals, a punch card or similar sorting system aids rapid retrieval of a particular record. In any case, orderly storage of record cards and portability in the field is essential.

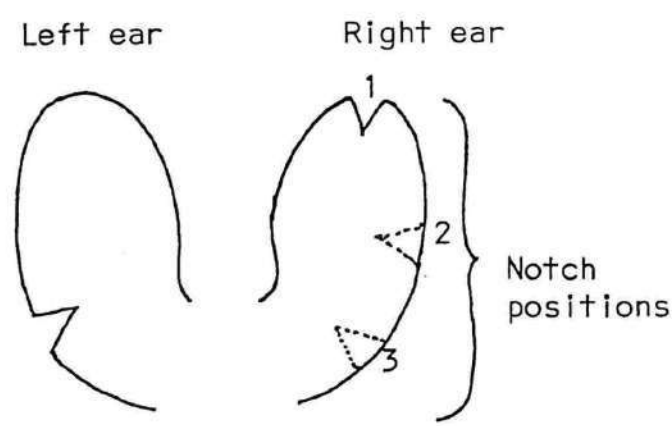
ARTIFICIAL MARKING METHODS

Artificial marking should only be considered in species where it proves impossible to identify an adequate number of individuals using natural features of the type mentioned above.

Basically there are two types of artificial marking. Mutilation methods involve surgically removing a small part of an animal to impart a permanent, visible disfigurement. Other methods entail the attachment of a marking device (collar, tag) to the animal. Both approaches usually necessitate capture of the animal (Wildlife 3).

Marking by Mutilation

- Ear clipping can be used in species such as ungulates or large carnivores which have relatively large erect ears, which are visible from a distance. A V-shaped notch is removed from the outer ear rim with a sterilised sharp knife or scissors. An antiseptic or pvc aersol spray should be applied to the wound. By using varying combinations of right and left ears and different positions on the ear (top, middle, bottom) a good number of animals can be individually marked in a systematic manner.

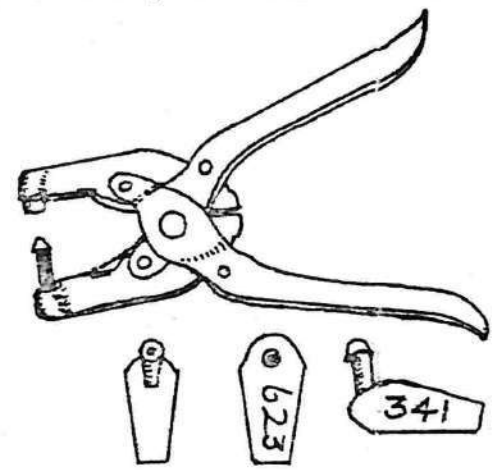


- Scute clipping has been widely used in India for marking crocodiles bred in captivity before release into the wild. These triangular projections on the dorsal surface of the tail are readily removed with a sterilised sharp knife. The large number of scutes available makes possible identification of animals be sex, year and locality of release and serial number, by clipping in various combinations.

Attached Marking Devices

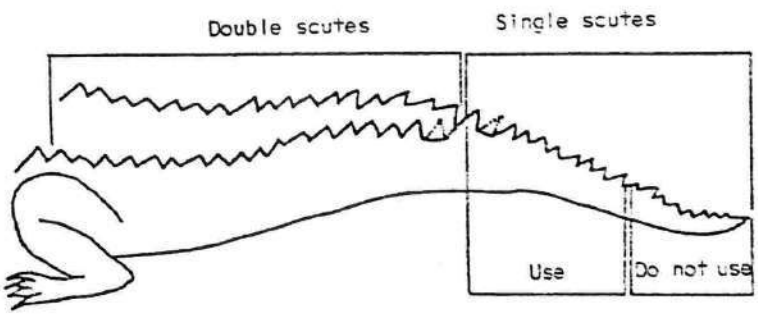
- Serially numbered aluminium leg rings have been used for many years in the study of bird migrations. These small markers require the recapture or death of the bird in order to be read however.

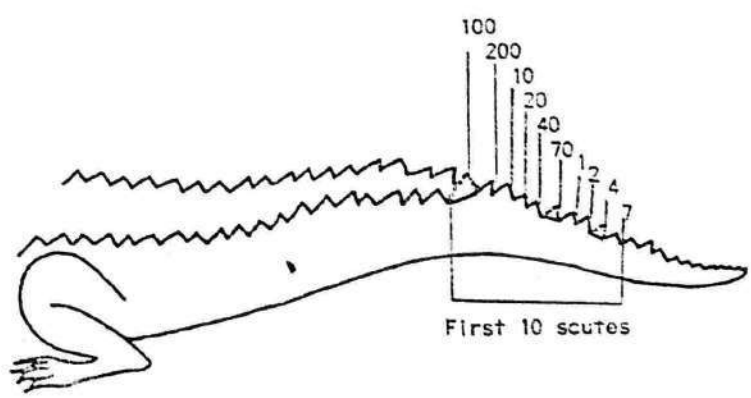
- Colour coded, serially numbered plastic ear tags are available, enabling a large number of ungulates to be individually marked. The tags, which are in two identical halves, are fixed to the ear using special pliers. Whilst tag colours can be distinguished from a distance, the numbers on this kind of tag can only be read, using binoculars, from 30m or less.



SCUTE REMOVAL IN CROCODILES

(after Bustard & Choudhury, 1981)



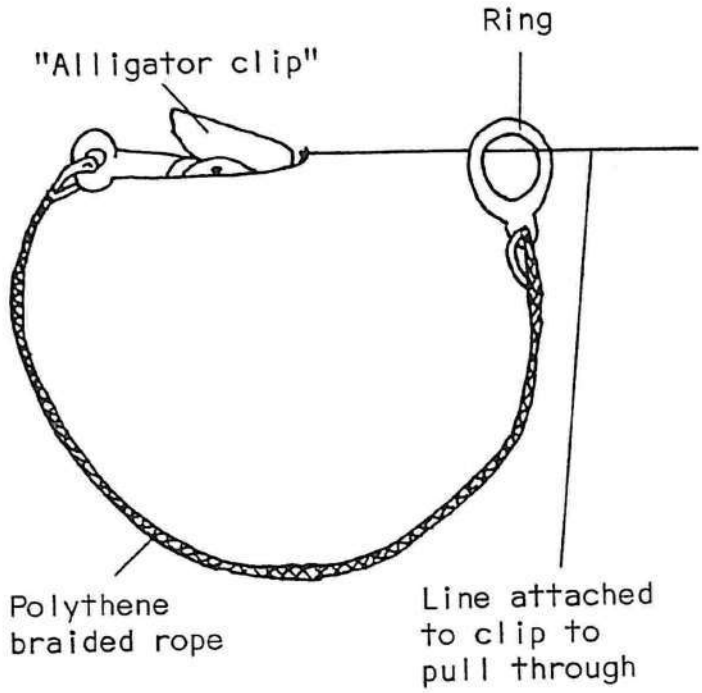


Example of simple code: Last scute of double row on left removed to indicate sex. Second scute of single row removed to indicate second year of release.

Example of numerical codes allocated to first ten scutes, enabling individual numbering of up to 399 individuals by removing various combinations of scutes. The three scutes removed from this animal indicate it is individual no. 174.

- Rust-proof alloy tags, with serial numbers stamped on them, are attached with stainless steel wire to turtles via a hole drilled in the posterior edge of the carapace.

- A variety of collars in coloured woven nylon or stout canvas material are available for placing on the necks of ungulates. A self-locking collar which could be fitted without catching the animal was used in a study on Nilgiri Tahr. The collars consisted of a length of braided polythene rope with a ring attached at one end and a clip similar to an "alligator clip" at the other. The size of the ring just allowed the clip to slip through when compressed on its spring. The tahr were baited with salt and while they were feeding the collar was looped over the head using a 2 m bamboo pole. When this was accomplished a line attached to the clip end of the collar was pulled in gently to complete the process of collaring. The animal moved off trailing a small length of the thin cotton line, which soon disappeared due to rotting. Collars of this type can sometimes be fitted to animals "automatically" by incorporating them into a flimsy snare through which the animal puts its head as it passes through a gap in a fence or between bushes. The snare line is fixed at one end and breaks, after locking the clip as the animal pulls it while running off.



- Radio-collars, details of which are beyond the scope of this section, are an ultimate form of artificial "marker" in that they permit remote location of an animal via radio signals, a considerable distance (up to 10 km) from the observer. Radio tracking is largely a research tool but is useful in management, for example, when keeping track of newly introduced animals and ensuring they do not wander from their designated area.

WILDLIFE DAMAGE CONTROL

INTRODUCTION TO THE SECTION.

Wildlife damage takes many forms including damage to cultivated crops, domestic stock and even injury to man himself. In addition, animals sometimes take to damaging their habitat particularly if their numbers have been compressed by loss of traditional range in areas surrounding a national park or sanctuary.

In trying to devise solutions to wildlife damage problems it is first necessary to attempt to understand the exact nature of the problem, its dimensions and, if possible, the underlying cause. Only when such an analysis has been made will it be possible to devise a really appropriate solution.

In the meantime it is possible to be testing out methods of controlling wildlife damage, including the design of effective barriers which prevent animals from straying into areas where they come into conflict with human activities and property.

Much work remains to be done on both aspects of management of wildlife damage. However, a start has been made and this brief section describes one method of monitoring a particular type of wildlife impact, viz that of elephants on trees and shrubs. It also introduces one approach to damage control in the form of several different types of wildlife barrier, viz electric fencing, trenches and rubble walls.

SECTION CONTENTS

Elephant Impact on Woody Vegetation

TO DETERMINE THE RATE AT WHICH WOODY VEGETATION DETERIORATES AS A RESULT OF ELEPHANT DAMAGE.

Elephants, particularly when confined in reduced ranges or during periods of prolonged drought, can have a profound impact on the vegetation. In particular woody vegetation, including large trees, is often severely damaged by debarking, breaking off of major portions or even total destruction.

Elephant damage is easy enough to detect by casual observation. However, systematic observation is necessary to determine the rate of deterioration or recovery. When large trees are involved, observations should extend over several years. The commitment to such long term studies must be recorded in working plans or management plans.

This technique describes how to assess damage along a transect line by marking and periodic inspection of individual trees.

SELECTING THE TRANSECT

Select areas heavily used by elephants. Within each area mark out a transect belt (about 5 m wide). In each transect mark approximately 100 trees each of species which are (a) much favoured, (b) less frequently eaten and (c) rarely eaten by elephant.

MARKING THE TREES

Mark each tree with a number (paint or tin tag) and identify its location by compass bearing from the previously marked one. Measure height, diameter at breast height, and number of stems.

RECORDING THE DATA

Record the original condition of bark, stems, and branches on a five point scale.

Visit the transect every other year and record changes in the condition of individual trees (see box).

Elephant Use of Woody Vegetation

Species Mallotus philippensis Transect No. 3

Tree No.	Distance	Bearing	DBH	Stems	Height	Bark loss	Stem loss	Notes
18	12 paces	120°	16,12	2	7 m	0	1	1 stem pushed over.
19	19 paces	175°	21,9,8	3	9 m	0	0	No damage.
20	8 paces	140°	18		2 m	0	0	Prone and Coppice

ANALYZING THE DATA

From visit to visit some of the trees will show damage which may eventually lead to their death. There may be an appearance of devastation, but records may reveal that rates of pushing over are low and that trees remain alive in a prone position for a long time, e.g. Mallotus philippensis. Such prostrate and coppice Mallotus shoots provide browse which would otherwise be unavailable to other wildlife species. The role of fire in allowing or repressing regeneration is equally important when trying to determine elephant impact. Transects should be visited several months after having been burned over to distinguish between elephant and fire damage.

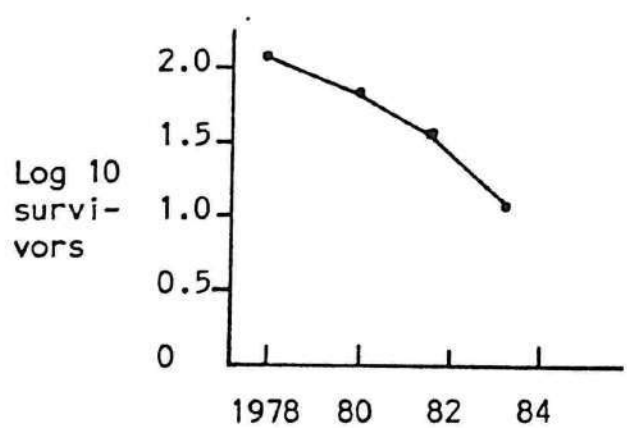
The mortality rate per species can be determined as an index of impact. It is best visualised by plotting the number of survivors against time (see box).

Decline in 100 marked *Mallotus* trees

Transect No. 3. 1978 - 1984

Year	1978	1980	1982	1984
Trees alive	100	76	52	22

Hence 78/100 trees damaged in 6 years, or 13% mortality per year. Rate has increased over study period.



Electric Fences for Damage Control

TO HELP THE MANAGER ASSESS FEASIBILITY AND USEFULNESS OF INSTALLING AN ELECTRIC FENCE, TO CONTROL WILDLIFE MOVEMENTS.

An animal which touches the wires of an electric fence receives a frightening shock so that, in most cases, it will not go near it a second time. Although the shock is painful, it does not injure or disable the animal.

The principle is essentially one of learning to avoid the fence and hence the structure itself does not require great mechanical strength - this makes for cheapness, rapidity of erection and minimum visual impact in the vicinity of scenic wilderness areas.

Over twenty trials of various designs of electric fences have been carried out, with WII collaboration, in different parts of India over the last 6 years. These trials have shown electric fences to be particularly effective against rhino, elephants, wild boar, sambar and other herbivores. Trials continue, including fences against tiger. A variety of designs against either single species or a group of species have emerged which are explained in detail in the recently published manual "Construction and Maintenance of Power Fencing for Indian Wildlife", available from WII. In this general Wildlife Techniques manual we merely introduce some of the main points to consider for those who are not already familiar with electric fencing as a wildlife barrier.

This technique describes the advantages and principles of an electric fence, some applications, additional planning considerations and preparation for construction.

ADVANTAGES

- Electric fences are inexpensive (between Rs. 5 and 10 per running meter).
- Materials are light and easily transported, even to remote areas.
- Fence life is long because it is not subject to physical abuse.
- If necessary, the fence can be easily dismantled and shifted.
- Maintenance requirements are low if properly installed.

They also have some slight disadvantages:

- Energisers cannot be purchased locally (although Indian made equipment is available).
- Installation and maintenance requires the experience and skill of a specially trained person.
- Involvement and support by local people is necessary to achieve objectives for which a fence is erected.

HOW DOES AN ELECTRIC FENCE WORK?

A so called energizer sends out electric pulses (one per second) along the wires of the fence. An animal which touches the wire makes a connection between wire and ground and through the soil to the earth wire of the energizer. The animal has, in effect, closed an electric circuit and the current pulse passing through it causes the shock.

Whether the shock is sufficient as a repellant depends on:

- The energy output of the energizer.
- Insulation of the wire (no current is lost due to wires touching fence posts, trees, or grass).
- Moisture content of the soil (dry surfaces conduct electricity poorly, wet surfaces conduct it well).

APPLICATIONS OF AN ELECTRIC FENCE

Protected area managers might consider electric fencing for any of the following,often overlapping, applications:

- Protecting field crops and property in enclaves and communities adjacent to the area.
- Protecting specific localized installations.
- Protecting plantations and wasteland reclamation.
- Keeping wildlife inside dispersal corridors and away from roads, railway lines etc.
- Keep livestock out of protected areas.
- Use in conjuction with trenches and stone walls.
- Rotational grazing.

PLANNING CONSIDERATIONS

The first question to answer is this: "Is a wildlife barrier required?" it probably is if:

- There is considerable cost in terms of damage to crops, property and public relations if no fence is installed.
- It is for a well defined purpose (specific purpose, location, species).

The second question concerns the type of fence. "Is an electric fence feasible?" It probably is if:

- A firm commitment to proper installation and maintenance is made.
- The distance to be covered by a single system does not exceed 10 km.
- It is supported by the local people.

The third question concerns the type, cost and construction of the fence.

- Only build the fence for the species doing the damage, letting others pass. Use the minimum amount of wire, considering height above ground and spacing.
- Can cost be reduced by upgrading/ incorporating existing barriers (e.g. single electrified wire strand on top of a stone wall)?
- Is the problem acute all year round? Is a temporary structure sufficient?

PREPARING FOR CONSTRUCTION

Although the construction of an electric fence is not complicated as such, experience and appropriate tools ensure a quality job at little waste of effort and money. It is recommended to call in a specialist to help draw up plans, and train personnel. Alternatively, one might inspect existing fences and obtain the WII construction manual. Some very basic design and construction principles are however given in the following section (Wildlife 2.3).

Electric Fence Design

TO HELP THE MANAGER TO UNDERSTAND THE BASIC DESIGN FEATURES OF AN ELECTRIC FENCE AGAINST WILDLIFE.

While it is not within the scope of this general manual on wildlife techniques to show many detailed fence designs, a brief indication of the main considerations and design features may help the manager contemplating using electric fencing to understand more clearly what is needed.

As pointed out in the previous section (Wildlife 2.2), there are some important points to be considered before deciding on an electric fence. Once that decision has been taken, design can commence and a search for suitable materials at a resonable price can begin. Only commence fence erection when all materials, including an energiser, are to hand on the site, as the fence must be energised, section by section, as it is put up. If this is not done animals will abuse it and much of the psychological effect of the initial shock will be lost.

General considerations and basic design features of an electric fence are dealt with in this technique.

GENERAL CONSIDERATIONS

- Design of a fence (number of strands, height, post spacing etc) will depend mainly on the target species and the type of behaviour it is likely to exhibit in response to the barrier, e.g. will it attempt to jump over, crawl under of push through.
- Location, terrain and length are also important considerations. Long, straight sections on flat ground make for economic erection and maintenance.
- If the energiser can be sited near mains electricity supply a mains energiser can be employed, otherwise a battery or solar-powered model will be needed. Batteries require frequent re-charging.
- Soil type will influence the type of earthing system required and effectiveness of the fence in producing a large shock on contact. Damp soils produce better results than very dry ones which provide poor electrical conductivity.

DESIGN

The box below illustrates the main design features of an electric fence.

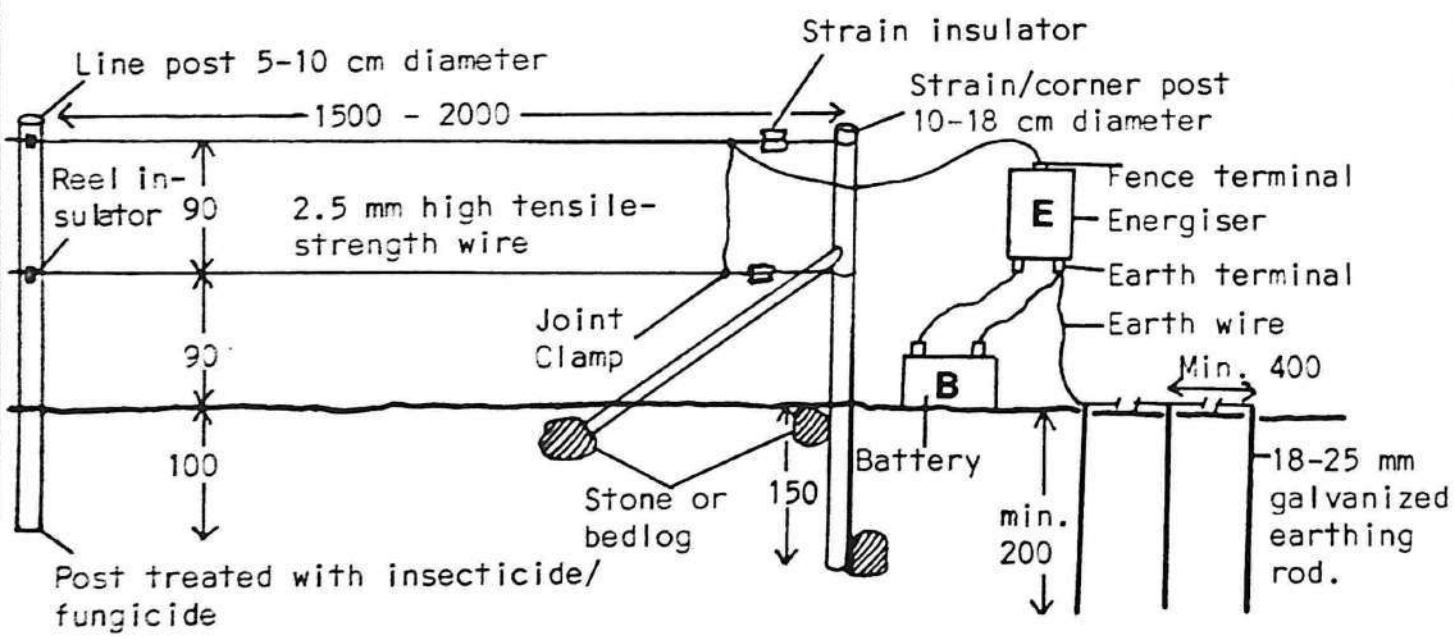
- Posts, which may be of any durable timber, are of two kinds (a) heavier strain posts between which up to 500 m lengths of wire are stretched tightly and (b) regular line posts which merely keep the wires in place at intervals of 15 to 20 m within strained sections. One third of a line post should be embedded in the ground, rather more with a strain post.

- There are also two types of insulators. "Guy" insulators attach the long length of wire to the strain posts, while "button" or "reel" insulators, through which the wire runs freely, are fixed at the appropriate height on the line posts.

- High tensile galvanised steel wire of 12 or 13 gauge (or 2.5 mm) should be used, the best being "cable makers core", which is more durable and elastic than ordinary GI wire.

- Good earthing is vital and is provided by three or more 18-25 mm galvanised water pipes approximately 2 m long and set (in damp soil) more than twice this distance apart. The earthing system should be connected up to the energiser by heavy 8 gauge wire, firmly clamped to the earthing rods.

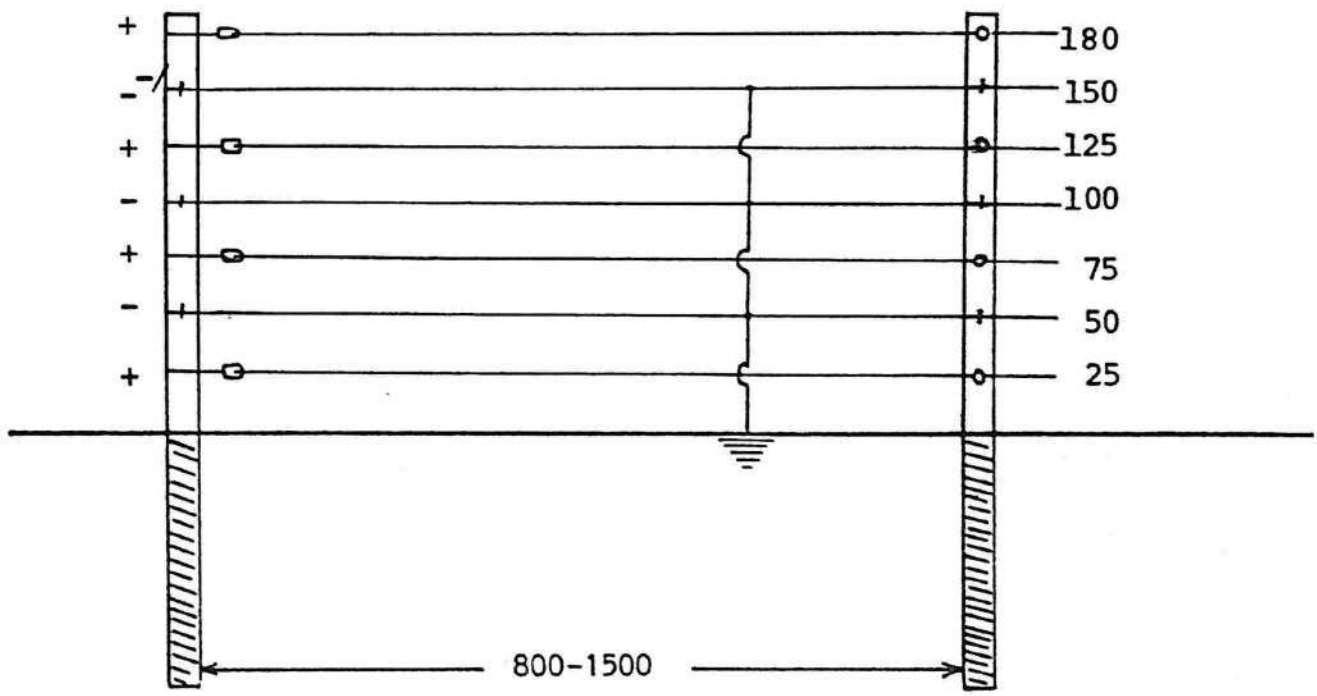
Design Features of a Two-strand Electric Fence against Elephant.



All measurements in cm

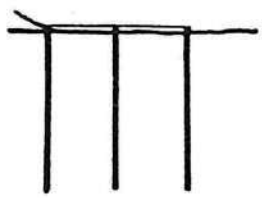
- A mains or battery powered energiser is normally housed under cover but a solar powered energiser can be fixed to the post bearing the panel (in a south-facing direction). The energizer has a single insulated electrical wire connecting it to the fence wires.
- Number and height of strands will depend on the target species. A 2-strand elephant fence and a 7-strand chital fence are illustrated but many other designs for particular species or species combinations are available.

7-strand Fence against Chital

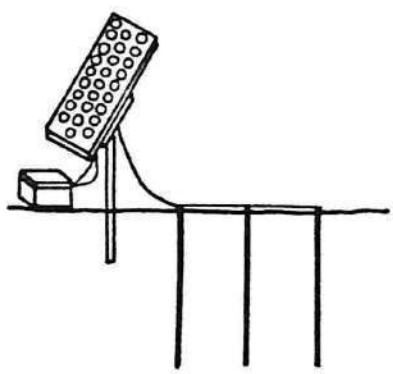


Note three wires are earthed

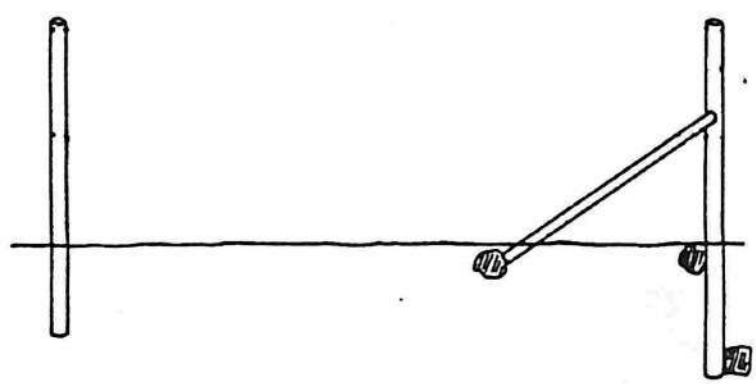
STAGES IN FENCE ERECTION



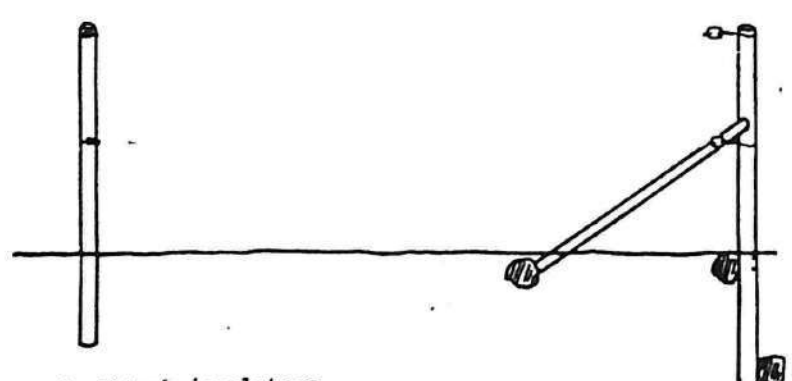
1. Construct earthing system.



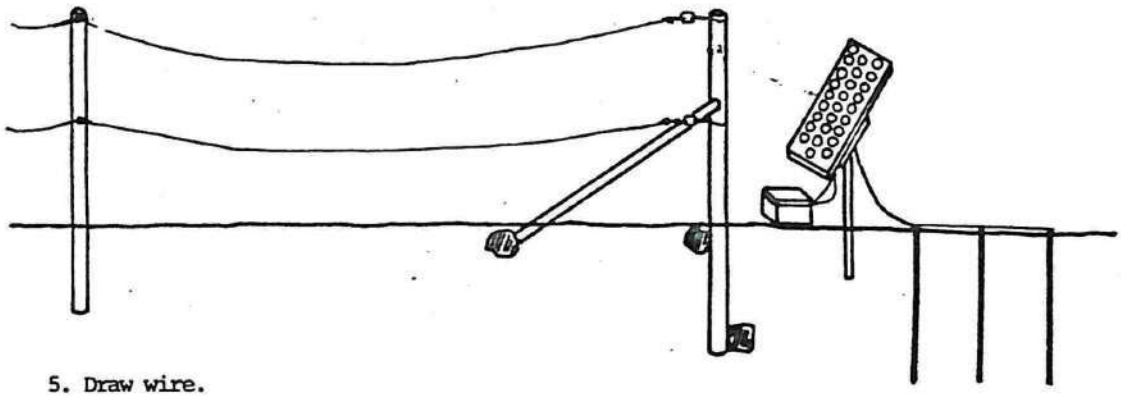
2. Install energiser and power supply.



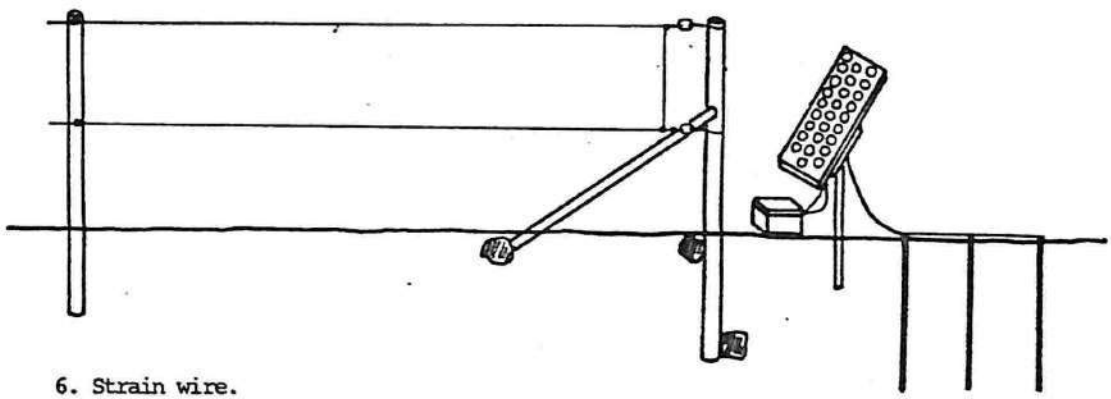
3. Erect posts.



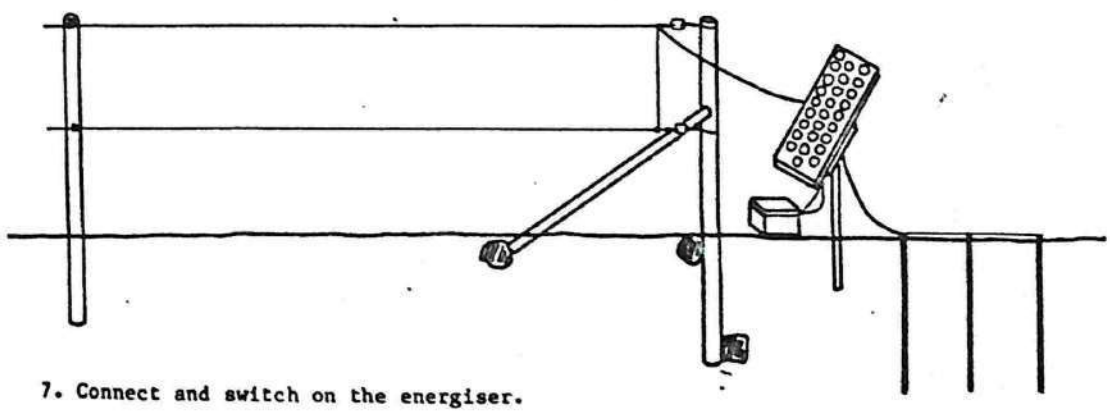
4. Attach insulators.



5. Draw wire.



6. Strain wire.



7. Connect and switch on the energiser.

Trench Designs

TO DESCRIBE LIMITATIONS, APPLICATIONS AND DESIGN CONSIDERATIONS FOR TRENCHES.

Apart from electric fences, trenches are the only effective method to keep out elephants and rhinoceros. They will also deter wild boar and porcupine, but not deer and antelope. Compared to an electric fence, trenches are simple to construct, needing no special tools, materials, or skills. Ninety percent of its cost is for labour which benefits the local people. On account of the high labour cost, trenches are rather expensive at Rs. 25 per running meter, not considering extras, like, planting of the trench mound or blasting on rocky ground. Particularly on loose soils and in high rainfall, much maintenance is required. Wages however, can sometimes be covered by rural development funds.

As a rule of thumb, trenches are suitable only if they protect particularly valuable property or meet multiple objectives, e.g. boundary demarcation, crop protection, and livestock barrier.

This technique explains three types of trench design and their applications.

IS TRENCHING THE MOST SUITABLE METHOD?

Unless it is required as a barrier against elephant or rhino, it is unsuitable as a wildlife barrier. Stonewalls are preferred as boundary demarcation and livestock barriers. Only if suitable stone is unavailable locally and electric fencing not feasible, should trenching be considered. A shallow trench can sometimes supplement a stone wall.

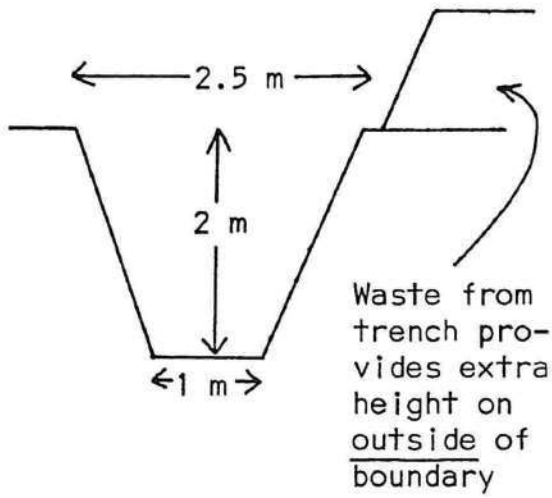
On loose and sandy soils, trenches are almost a waste of time, unless expensive lining with brick or rock is undertaken.

Trenches sometimes disturb local drainage patterns. Furthermore, they occasionally result in injury or death to animals which accidentally fall into them and struggle to get out.

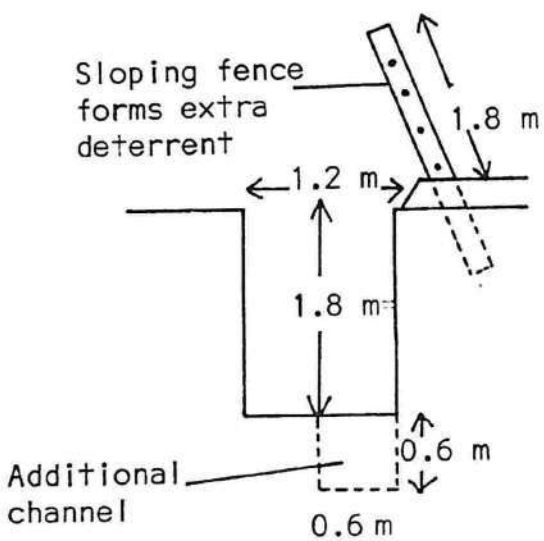
TRENCH DESIGNS

The effectiveness of a trench depends not only on actual width and depth, but also on the perception of depth.

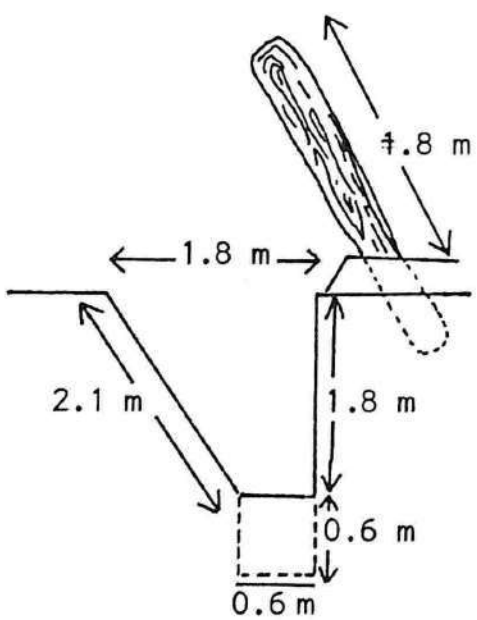
The trench with sloping sides requires the least maintenance but is also the least effective as a barrier.



Most effective as a barrier is the trench with vertical sides, the perception of which can be enhanced by an additional narrow channel dug in the bottom of the trench. However, this method only works in stable soils.



The version which has one vertical and one sloping side is an effective adaptation of both. Heavy round wood barriers (at least 10 cm diameter and 2.4 m long) sunk into the ground side by side, act as an additional deterrent for elephants and rhino.



Rubble Wall Designs

TO PRESENT THE DESIGN OF RUBBLE WALLS AGAINST WILDLIFE.

Rubble walls have been used as effective wildlife barriers in a number of places in India such as Gir National Park and Panna in Madhya Pradesh. In addition to containing some wildlife species, walls are often effective in keeping domestic stock from straying into wildlife areas, such as National Parks and core areas of sanctuaries, from which they are legally excluded.

Stone walls require mainly labour costs for their erection, providing suitable material is locally available and heavy transport costs are not involved. They do require some maintenance but generally much less than trenches and, unlike the latter, they do not affect local drainage systems.

Both trenches and rubble walls are, however, unsightly modifications of natural landscapes and cannot be readily dismantled if no longer required.

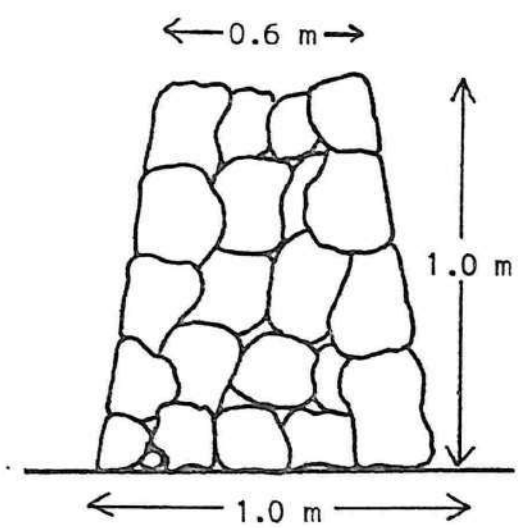
This technique briefly describes the design of two types of rubble wall in use in wildlife areas.

DESIGNS

Depending on abundance of suitable local rubble/stones for building wall, two basic designs are possible.

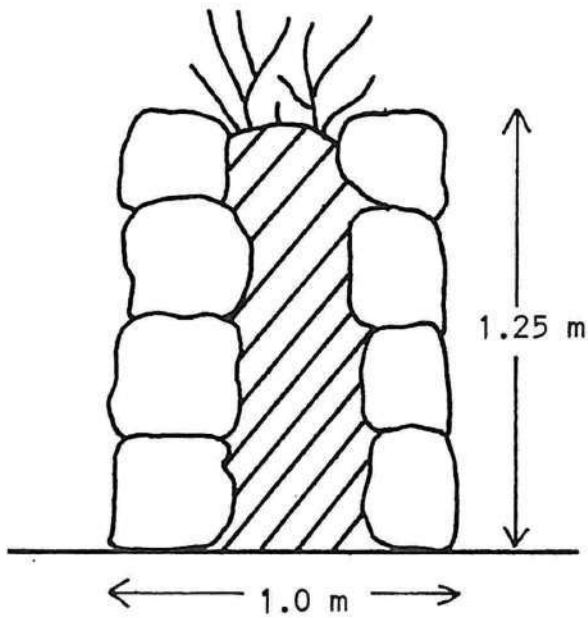
Solid Wall

If material is abundant a solid wall, consisting of stone throughout, can be designed, along the lines of the one in Gir National Park. This wall is 1 m high and 1 m wide at the base, tapering to 0.6 m at the top. The sloping sides of the wall assist stability, as the base is broader than the upper portion. The cost of this type of wall is around Rs. 75,000 per running km. Maintenance costs, involving repairing breached sections and replacing loose stones, are not very high at Rs. 275 per km per annum. Whilst lions and other wildlife can climb or jump over this wall it constitutes an effective barrier against cattle.



Earth Filled Wall

This design requires far less stone for its construction as it consists of two parallel outer stone walls, the space between which is filled in with earth. This allows planting of a live hedge on the wall itself, which with maturity covers up much of the stonework, producing a more natural appearance. Local plant species and not exotics must, of course, be used for such planting.



CAPTURE AND HANDLING

INTRODUCTION TO THE SECTION

In both wildlife management and research it is often necessary to capture wild animals, including birds, alive. Reasons for capture and handling include treatment of a sick animal; removal of a displaced nuisance animal such as a maneater; translocation to a new area (reintroduction/restocking) or a zoo; research such as fixing of an identification tag or radio transmitter, and collection of samples (blood, hair, stomach contents).

Planning of a capture operation must be based on a knowledge of the species' ecology and behaviour e.g. favoured habitat within the range, diurnal pattern of activity, sensitivity to disturbance and handling. Minimize physical and psychological trauma and plan to restore the animal back to normal conditions as soon as possible.

Costs in terms of time, manpower and money should be considered but the cheapest method is not always the best one from other points of view, e.g. the animal's safety. Availability of equipment and expertise may influence the choice of method. With dangerous or delicate operations in particular, proper equipment is essential and previous experience greatly reduces the possibility of disaster.

The capture of various species of wild animal has a long history in India and many traditional methods are available, including netting of birds, snares, pits (elephant and rhinoceros), stockade (khedda) and chase/noose (mela shikar) for elephants. Such methods are well known and therefore not described here but they may be appropriate for the wildlife manager under certain circumstances.

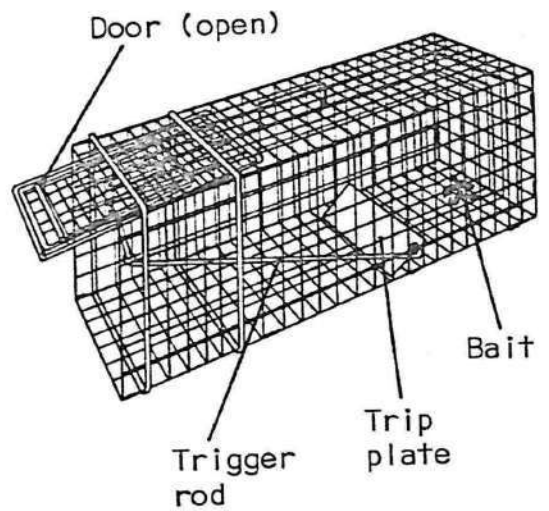
SECTION CONTENTS

Live Trapping

TO CAPTURE SMALL MAMMALS OR CARNIVORES ALIVE

Live trapping, with box or cage traps, is used for the capture of small mammals e.g. rodents and carnivores for study purposes. Nuisance carnivores such as stock lifters may also be caught for removal to another area. Well designed live traps cause little or no physical harm to the captives, provided that they are not left unattended for long periods.

Equipment and live trapping procedure are described in this technique.



EQUIPMENT

The type of trap depends on the target species. For very small mammals such as shrews or mice, a "Sherman" trap made of thin G.I. sheet is best.

For larger rodents, lagomorphs and carnivores up to jackal size, steel mesh traps are most suitable and may be of rigid construction or collapsible on the lines of American "Havahart" or "Tomahawk" traps respectively. They consist of a long "box" with a spring-loaded door at one end, connected to a treadle plate which triggers off the closure of the door behind the animal. These traps vary in size from 25 x 8 x 8 cm to 178 x 76 x 76 cm and can be made by any competent metal workshop. Models can be inspected at W.I.I. if desired.

MANUFACTURERS OF LIVE TRAPS

- *TOMAHAWK LIVE TRAP COMPANY*
  PO Box 323, Tomahawk
  Wisconsin 54487, U.S.A.

  (Collapsible traps supplied)

- *HAVAHART TRAPS*
  Woodstream Corporation
  Lititz
  Pennsylvania 17543, U.S.A.

  (Rigid traps supplied)

Large carnivores such as leopard or tiger require a much more robust trap, consisting of a wooden or iron frame covered with heavy weld-mesh or closely spaced steel rods. Such traps normally have a vertical sliding door, which closes under gravity, when the catch holding it up is triggered by the carnivore tugging at bait attached to a wire hook. A latch to prevent the door being pushed up after closure is essential. Most zoos and sanctuary managers' offices possess a trap of this kind.

TRAPPING PROCEDURE

Trap Site

Traps should be placed inconspicuously (camouflaged by twigs or grass) in shade near to but not on a well used trail or den site. A strange, highly visible object or unfamiliar odours such as human sweat may frighten the animal away. Hence rub your hands in faecal material of the species or use gloves when setting the trap.

Bait

Select a bait which is attractive to the target species and scatter very small portions of it in the area, forming a trail leading to the trap. Place a good quantity of bait in the trap itself, tying it securely to prevent hasty removal (meat). Some carnivores will only go for live prey, in which case use a trap with a special compartment for a live chicken or rabbit at one end.

With a particularly shy species, it may be advisable to familiarise the animal with the trap for some days by scattering bait around but not setting the trigger mechanism and tying the trap door in the open position - so-called "pre-baiting".

BAITS

Squirrels, small rodents - *peanuts, grains.*
Hare - *Cabbage, carrot, fresh vegetable.*
Porcupine - *Salt, carrots, other vegetables.*
Civet, mongoose - *Fish, chicken entrails.*
Otter - *Fish.*
Jungle cat - *Fish, meat.*
Jackal, fox - *Chicken necks and entrails, meat.*
Leopard - *Live chicken, rabbit.*
Birds - *Grains, rice, seeds.*

Handling a Captive

Do not leave set traps unattended for long periods. With nocturnal species, traps should be inspected at dawn. With diurnal species traps should be checked several times during the day, particularly during very hot or very cold weather. In the absence of attendants traps should be left closed.

Once an animal is captured, approach the trap gently and cover with cloth or a gunny bag - darkness quietens animals down. Handling of a highly excited or dangerous animal may be facilitated by manual injection of a mild tranquillizer, such as diazepam (Wildlife 3.5), into the tail or a limb projecting through the mesh of the trap.

Release animals as soon as possible once research procedures or translocation are accomplished.

Mist Netting

TO CAPTURE SMALLER BIRDS OR BATS ALIVE

Mist netting is used for the live capture of small birds and bats for study purposes, such as species determination or ringing for individual identification in migration studies. Animals are caught in flight by becoming entangled in the fine, relatively invisible black nylon net.

This technique describes the use of mist nets.

EQUIPMENT

Mist nets are available in rectangular sizes ranging from 2.1 x 10 m to 2.7 x 18 m. Filament thickness and mesh size depend on the size of birds or bats being trapped. An average mesh would be 3 cm.

MANUFACTURER

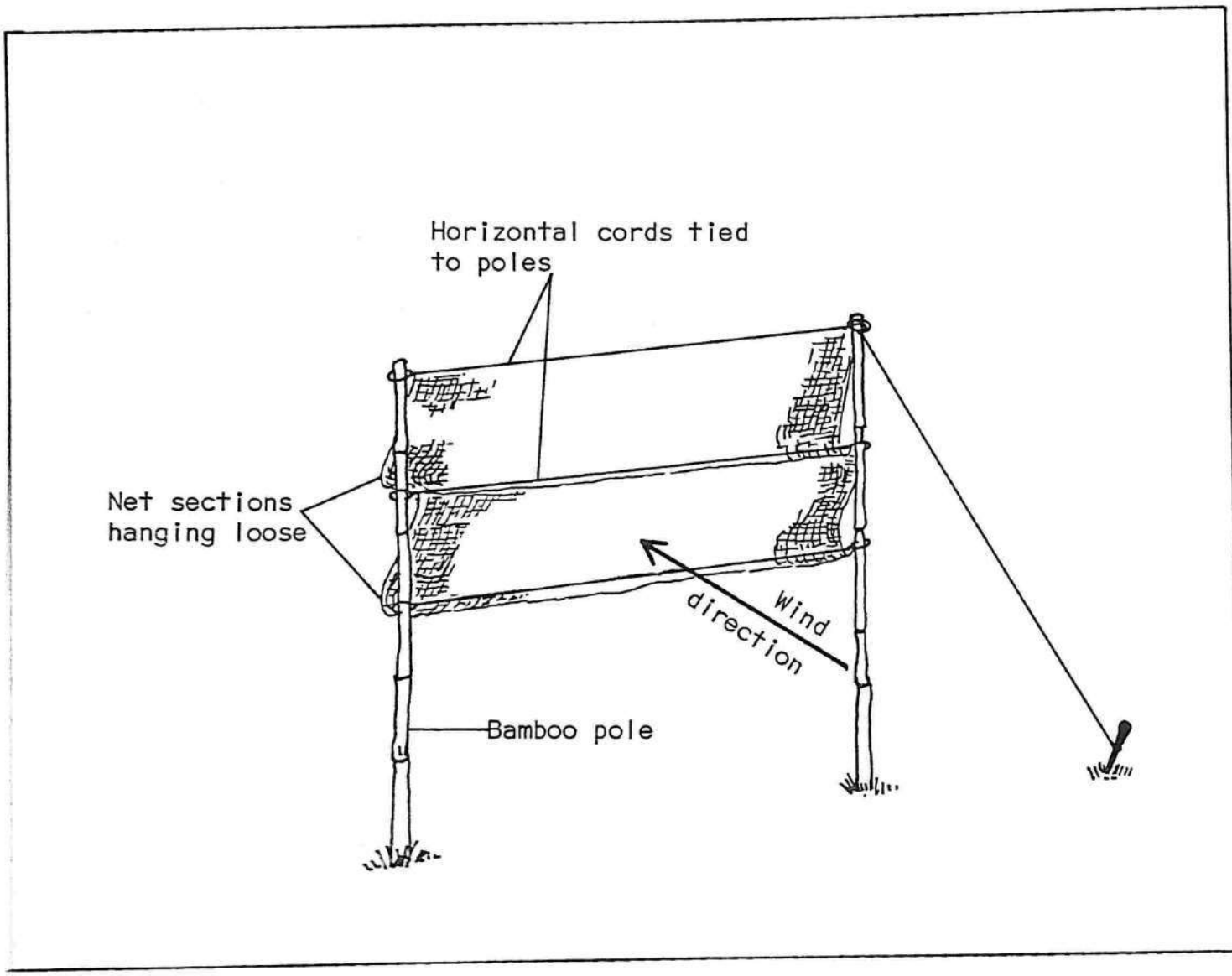
Mist nets are available from:

Yamada Trading Co. Ltd
Mochifukucho 31-26
Yoddaichi
MIE PREF. 512
JAPAN

SETTING THE NET

The net is suspended vertically between two bamboo poles in a known flight path of the target species, at an appropriate height.

- In order to reduce the possibility of the net being seen, mist nets should not be set against open sky but against a background of broken vegetation.
- The poles should be firmly fixed in the ground, about 45 cm deep and may be steadied with guy ropes if necessary.
- They should be slightly further apart than the length of the net.
- The height of the poles depends on the depth of the net and how far above ground it is being set.
- The horizontal cords which pass through the net (between 3 and 5 in number, depending on net size) are held taut by being tied tightly to the poles.
- The horizontal section of the net between the cords should not be taut but should hang loosely, allowing a bird to get well entangled on collision with the net.
- Once set up, nets should be inspected frequently, preferably every hour, to minimize distress and injury to captives. They should not be left for long periods unattended, particularly in extreme climatic conditions.



REMOVING CAPTIVES FROM NET

Hold the bird firmly in one hand, with the wings folded in the natural position onto the back, while feet and neck are carefully extricated from the net. Excessive struggling must be avoided as this may result in shock and physical injury.

After ringing, weighing or other procedures are completed, release the captive well away from the net to avoid immediate re-capture.

STORAGE

After use, all twigs and other material entangled in the net should be removed and the net folded and stored in a dry dark area (nylon is de-natured by excessive light).

Rocket Netting

TO CAPTURE GROUPS OF LARGE GROUND BIRDS, OR SMALL TO MEDIUM SIZED UNGULATES.

Rocket or cannon netting is used for the simultaneous capture of group of 4 to 10 individuals. The animals are trapped under a rectangular net propelled by powder-charged "rockets". The method is suitable for any species that can be physically handled by a team of assistants, immediately after being trapped under the net. It has been successfully tried in Nepal and India (e.g. chital), using imported equipment. However, the components can easily be manufactured in a local metal workshop from instructions based on information contained in this technique.

Information on equipment and conduct of a rocket netting operation is given in this technique.

EQUIPMENT

Nets

The nylon net is rectangular with three (larger sizes have four) ropes fixed to its front edge for attachment to the rocket.The rear edge has a similar number of ropes to anchor the net to the ground. Net dimensions, weight and mesh size depend on the target species.For large birds (waterfowl, peafowl, bustard) a lightweight 10 x 15 m net, made of 2-3 mm nylon cord, with a 5 cm mesh is used. For ungulates, such as chital or blackbuck, a heavier 13 x 20 m net, of 5 mm nylon, with a 15 cm mesh is recommended.

- *Manufacturer of Rocket Netting Equipment.*

  Wildlife Materials Inc.
  R.R. No. 1, Giant City Road,
  Carbondale, Illinois 62901
  U.S.A.

- *Useful References*

Dill, H.H. 1969. A field guide to cannon net trapping. US Dept. of the Interior. Bureau of Sport, Fisheries and Wildlife, 18 pp.

Hawkins, R.E., Martoglio, L.D. & Montgomery, G.G. 1968. Cannon netting deer. J. Wildl. Mgmt. 32 (1): 191-195.

Rocket Launchers

Launchers consist of a stout angle iron post, with a 10 cm length of steel pipe (2 cm diameter) welded at right angles (horizontally) near the top. This holds the stem of the rocket. For a lightweight net three launchers about 1 m high are used. Ungulate nets require four launchers 1.7 m high.

Rockets

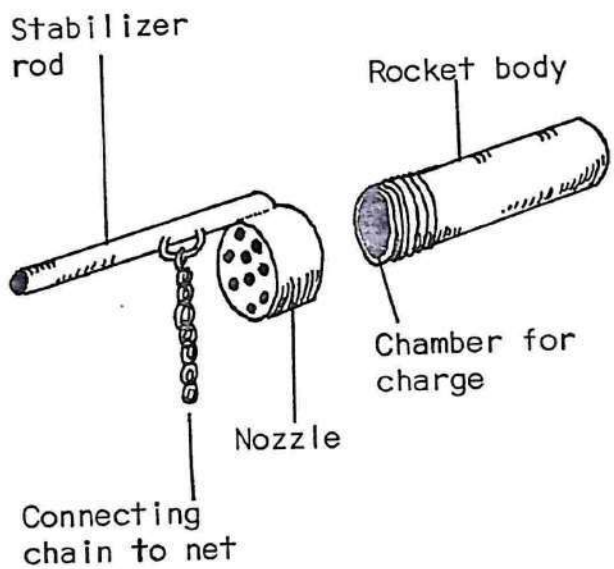
Rockets are of the impulse type and weigh about 5 kg. The rocket body consists of a stout steel cylinder, aproximately 5 cm in diameter and 20 cm long, one end of which is closed. A steel "nozzle" cap screws onto the open end of the body and bears a number of holes through which the explosive gases escape while propelling the rocket. A steel stabilizer rod, which holds the rocket in the launcher, is welded to the outside of the cap. A chain which connects the rocket to a net rope is fixed to the stabilizer rod.

The propulsive charge cosists of an electric firing squib, black powder and larger pellets of explosive, encased in a waterproof plastic. A pair of insulated wires, for linking the charge to the main firing line, protrude from the plastic covering.

Firing Line and Power Supply

This connects the explosive charges to the power supply and consists of good quality, well insulated solid copper wire. In addition to the length of the net, the firing line should be long enough to enable the operator, with the power supply, to hide 30-40 m away from the net.

The power supply, which ignites the squibs in the explosive charges can be either a fully charged 12 volt car battery or a crank- operated impulse generator, such as the "blasting" machine used in quarrying operations.



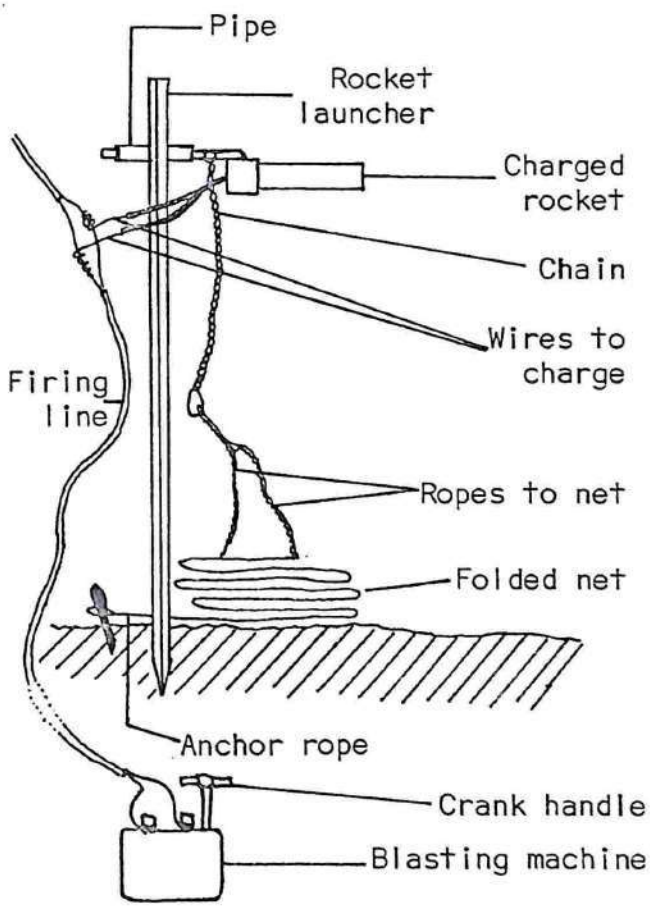
THE CAPTURE OPERATION

Site

This should be flat, devoid of shrubs, long grass etc. A rectangle the size of the net should be demarcated by a few stones and baited for several days prior to placing the equipment, to encourage animals to visit the site.

Setting the Net

With the net spread over the target area, hammer rocket launchers into ground behind its rear edge, appropriately spaced, i.e. one at each corner and centre for smaller net. Pipe on launcher holding the rocket must be horizontal. Secure rear anchor ropes to boulders or stakes and then fold net neatly in front of launchers so that front edge is on top. Place rockets in launchers and tie net connecting ropes securely to rocket chain. Lay out the firing line behind launchers.



SAFETY RULES

- *Clear all personnel from site, except those charging the rocket.*
- *Keep power supply well away from firing line, the two ends of which should be shunted (twisted together) to prevent accidental firing.*
- *Lead wires of propellant charges should also be shunted until firmly secured to the firing line.*
- *Persons doing the charging should not stand or work in front of a rocket or immediately behind it.*
- *Rocket nets should not be erected in vicinity of high voltage transmission lines or radio transmitters*
- *In the event of an undetermined misfire, at least 15 minutes should be allowed before attempting to disarm the rocket.*
- *Do not carry explosive charges inside a vehicle.*
- *Charges should be stored in a secure locked container, not exposed to excessive heat or damp, and only taken out when required for placing directly into the rocket.*

Charging the Rockets

Strict safety rules must be observed during this procedure. (See box.)

To load rocket unscrew main body, insert charge and pass lead wires, (still shunted by ends being twisted together) through a nozzle hole in rear cap which is then screwed firmly onto body. Replace rocket in launcher.

Untwist lead wires, clean terminal portions if necessary and firmly wind each round an exposed section of the copper firing line, making a parallel connection.

Carefully check all connections and remove charging personnel from net area. Ends of firing line can be unshunted and connected to power supply ready for firing. If blasting machine is being used connect each copper wire firmly to one of the terminals. Retain the firing key (crank) until actual firing takes place. If battery is used as power supply, connect only ONE of the copper wires to one of the terminals.The free wire is touched onto the other terminal to effect firing and great care is needed to ensure this does not happen accidently.

Firing the Net

Wait until the entire group of animals to be captured is well within limits of net area (previously marked with visible objects such as several large stones). Make sure sufficient personnel are present in hiding to handle netted individuals immediately after firing (minimum one person per animal, plus several extras).

Post-netting Procedure

Physically restrain each individual to minimize struggling by covering the eyes and holding close to ground. Pull over if still standing. Particularly excited animals may be quietened by an injection of tranquiliser, such as valium.

Release animals by "peeling" net over the top of them, while still restrained, starting with those nearest to edges of net. Legs or antlers may need to be carefully released if entangled in net.

Chemical Capture-Equipment

TO INTRODUCE CHEMICAL CAPTURE AND THE EQUIPMENT REQUIRED FOR IT.

Drug immobilisation or 'darting' is now a widely used capture method, particularly appropriate for large or dangerous species. Although most of the drugs and equipment currently have to be imported, it is being increasingly used in India.

Prior training and the presence of an experienced person, preferably with veterinary knowledge, are essential. WII organises occasional workshops on capture which provide a useful introduction to 'darting' but there is no substitute for building up field experience over a number of years.

As with all forms of capture, occasional animal fatalities (up to 10%) are experienced but can largely be avoided by careful observance of precautions.

This technique summarises information generally applicable to chemical capture and gives details of darting equipment.

ADVANTAGES

- Compared to mechanical capture methods, immobilisation causes little disturbance to the animal - fear, shock and physical damage are practically eliminated.
- It enables the capture of carefully selected individuals.
- Time of capture can also be selected.
- Equipment is very portable, enabling rapid shifts of field location

DISADVANTAGES

- As with all drug use, undesirable side-effects are possible.
- Due to drug induction delay, darted animal is occasionally lost.
- Procurement of drugs and equipment from overseas can be tedious and expensive.
- Danger to human operator if certain drugs used carelessly.

Reference books on immobilisation

- *Young, E. (Ed.). 1973. The Capture and Care of Wild Animals. Human & Rousseau, Capetown.*
- *Harthoorn, A.M. 1976. The Chemical Capture of Animals. Bailliere Tindall, London.*
- *Fowler, M.E. 1978. Restraint and Handling of Wild and Domestic Animals. Iowa State University, Ames, Iowa.*

EQUIPMENT

There are two essential items of immobilisation equipment: the projector - blowpipe, rifle, pistol - and the projectile - 'dart' or 'flying syringe', of which the needle is a vital component. For successful capture, selection of appropriate equipment and familarity with its use are essential. Target practice, involving anticipated dart sizes and shooting range, are a must before embarking on any capture operation.

Blowpipe

This is the simplest type of dart projector, consisting of a straight pvc or aluminium pipe 1 to 2 m in length and 8.0 to 10.0 mm in diameter. It propels a small plastic dart over distances of up to 10 m and is mainly used for thin-skinned animals in enclosures. After placing the loaded dart inside its near end, the blowpipe is held to the mouth and pointed steadily toward the target area of the animal's anatomy. After taking a deep breath, a rapid 'blow' is made to propel the dart.

The blowpipe is entirely silent in operation, causing minimum disturbance to non-target members of a group of animals. It has no operating costs, apart from occasional replacement of dart components.

"Blow-gun" rifle

This equipment ("Teleinject") consists of a blowpipe fitted onto a gun stock which has a compression chamber pressurised via rubber tubing connected to a tyre foot pump (inflator). Compressed air is released into the barrel to propel the dart by pulling a trigger - a mechanism similar to an air-gun. The instrument is fitted with a sight and propels a lightweight plastic dart with fair accuracy up to about 30 m. Air pressure imparted may be varied according to syringe size and target distance and is read on a pressure gauge attached to the inflator.

This simple, lightweight propulsion system has greater range and accuracy than the blowpipe and is ideal for zoo animals or thin-skinned species in the wild, providing one can get within the desired range. However, the small syringe capacity is a serious limitation, added to which their lightness makes these darts subject to cross winds.

Manufacturers of immobilisation equipment

1. *Teleinject GmbH*
   PO Box 210750
   D-6700 Ludwigshafen
   West Germany

2. *"Dist-inject"*
   Peter Ott Limited
   PO Box 16
   CH 4007 Basel
   Switzerland

3. *"Cap-chur"*
   Palmer Chemical & Equipment Co. Inc.
   PO Box 867,
   Palmer Village
   Douglasville,
   Georgia 30134
   U.S.A.

Powder charged rifles

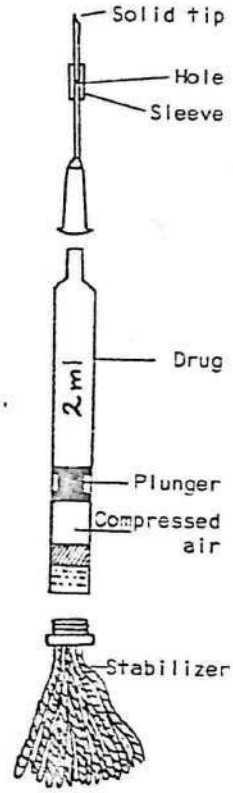
This lightweight 32 calibre (13 mm) rifle ("Dist-Inject" or "Cap-chur") propels darts up to 15 ml capacity to a range of over 50 m by means of an explosive charge, similar to a .22 blank cartridge. Charges are available in a variety of strengths depending on dart weight and target distance. Some brands of rifle ("Dist-Inject") also have an adjustable rear sight which enables very accurate shooting. An aluminium dart is assembled according to requirements (drug volume and needle size) and may be re-used many times. Ready prepared disposable plastic darts are also available. A pistol is available for short ranges (up to 20 m) with the same kind of dart and is useful for zoo enclosures or administering a 'top-up' to an underdosed but approachable animal in the wild.

Its accuracy, shooting range and variety of dart types and sizes impart great flexability to the powder rifle and it is the most widely used darting system in India at the present time, the Swiss made "Dist-Inject" equipment being particularly popular.

Reuseable plastic darts

The blowpipe and blow-gun fire a reuseable lightweight plastic dart, available in sizes between 1 and 3.5 ml capacity. The drug is loaded into the front chamber of the dart from a hyperdermic syringe and an appropriate needle then attached. The needle opening is at the side and covered with a tight fitting plastic sleeve which prevents loss of the drug when the dart is pressurised. This is achieved by introducing compressed air or an inert gas into the rear chamber of the dart, behind the plunger. The flight or stabilizer is then attached.

After firing, as the needle penetrates the animal's skin the sleeve is pushed backwards, allowing the drug to exit from the side hole into the subdermal tissues.



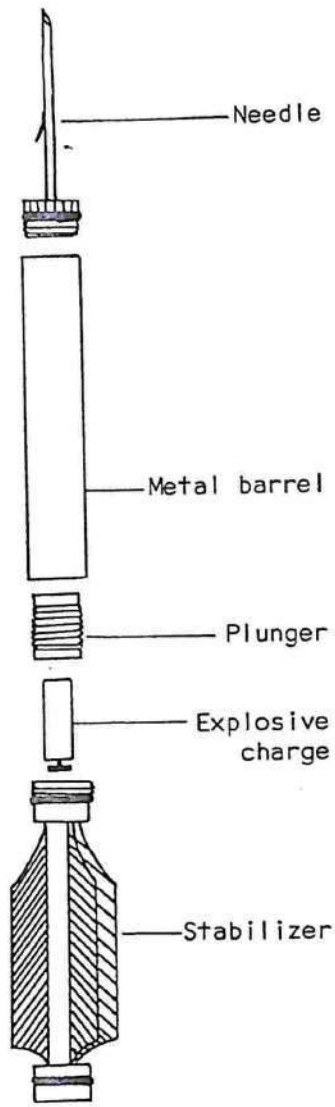
Disposable plastic darts

Ready prepared plastic darts with a fixed needle and explosive cap to activate the plunger are available for powder charged rifles, in sizes varying between 1 and 3.5 ml. These convenient, lightweight darts have to be loaded via the needle using a narrow canula attached to a hyperdermic syringe. They cannot be re-used. Due to their lightness these darts are less liable to cause tissue injury on impact but are more subject to wind deflection than heavier metal darts. A maximum volume of only 3.5 ml is a further limitation in many operations.

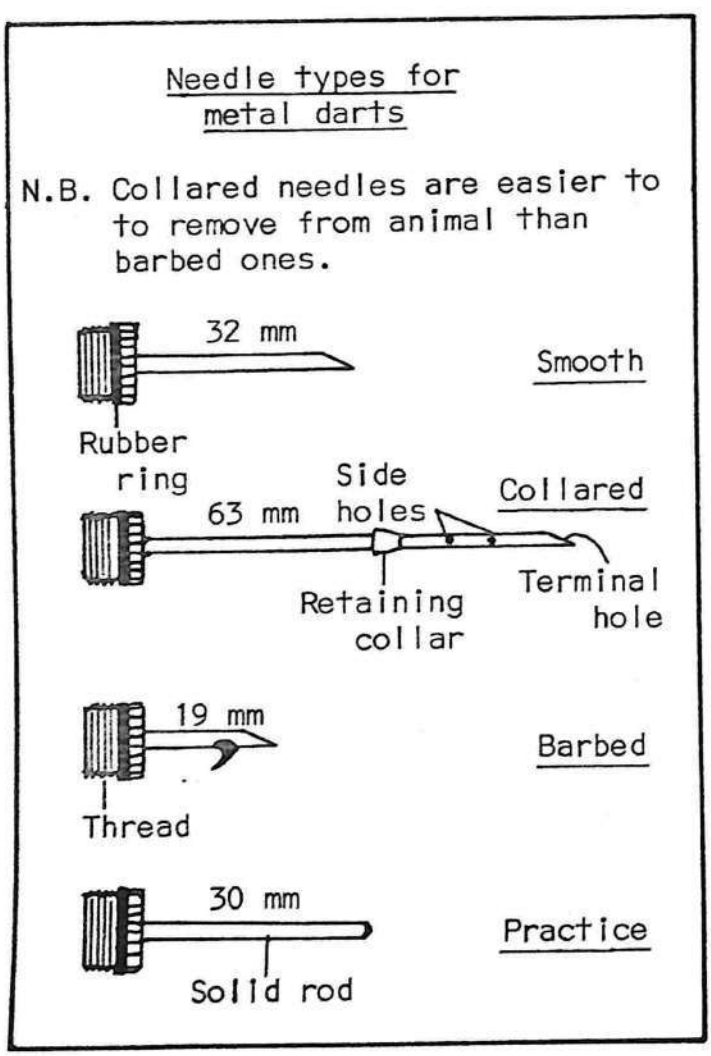
Metal darts

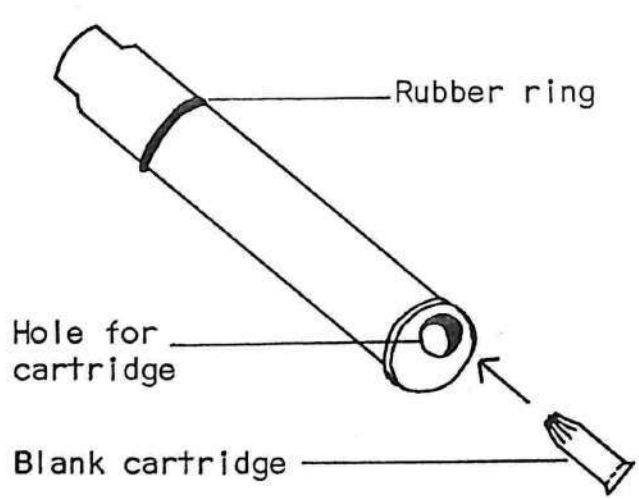
To assemble one of these darts an aluminium syringe barrel is selected in accordance with required drug volume (ranging from 1 to 15 ml). A greased rubber plunger, fitted with an impact sensitive explosive charge, is placed inside the barrel towards the rear end. A flight stabilizer is screwed in behind it. After loading the drug, a needle (see box) is screwed into the front of the barrel. A little vaseline smeared over the needle hole(s) prevents accidental seepage of the drug.

After loading the prepared dart into the rifle a cylindrical steel cartridge holder is placed in the breech behind it.



Cartridge holder





Chemical Capture-Drugs

TO INTRODUCE SOME OF THE DRUGS COMMONLY USED IN IMMOBILISATION OF WILDLIFE

For a full discussion of drug choice consult one of the strandard reference books. Most of the immobilising drugs used today are central nervous system depressants, which have a relatively wide rafety margin and permit some degree of control of the state of the animal by careful adjustment of dosage and use of antagonists. For example, a small dose may merely tranquillise (sedate) an animal, reducing fear or aggression, enabling safe transportation. A larger dose of the same drug will induce immobilisation, in which locomotion ceases and the animal is generally recumbant, allowing handling, taking of blood samples or radio-collaring.

Some of these drugs are highly dangerous to the human operator and should not be handled by inexperienced or junior staff. Familiarisation with accident procedure is essential before such drugs are used. All drugs should be kept under lock and key.

Characterstics of a few of the most frequently used drugs in India are indicated below (dosages for particular species are given in Wildlife 3.7 to 3.9).

THE IDEAL CAPTURE DRUG

- *Only requires a small dose (1-5 ml).*
- *Is readily soluble in water.*
- *Has a wide dosage margin.*
- *Absorption and onset of action is rapid.*
- *Does not interfere with respiration or temperature control.*
- *Allows the 'righting reflex' - animal can sit up.*
- *Allows coughing and swallowing reflexes.*
- *Has a specific antagonist, allowing rapid reversal of immobilisation.*
- *Is not dangerous to human operator.*
- *Has no side effects - drug and antidote.*
- *Is not subject to restrictive legislation.*
- *Is readily available at reasonable cost.*

Xylazine hydrochloride

Marketed as "Rompun" by Bayer, this drug achieves effects ranging from tranquillisation to anaesthesia, combined with muscular relaxation and general elimination of pain (analgesia). It is generally a very safe drug and can be used in a great variety of species particularly ungulates, in dosages varying from 1 to 10 mg per kg body weight. Full effect is normally achieved within 15 minutes of darting.

Rompun is available as a dry powder in 500 mg vials, which can be made up into desired solutions by addition of the solvent provided: 500 mg + 10 ml solvent = 5% solution; 500 mg + 5 ml solvent = 10% solution etc. A slight disadvantage for use with darts is that xylazine is not as readily soluble as some drugs and therefore larger volumes are required. It is often used in combination with other immobilising drugs such as ketamine (see box) or etorphine which provides a synergistic effect, greater than using either drug on its own.

A recently developed antidote for xylazine is yohimbine which is available in India and 100 mg xylazine is ordinarily reversed by 100 mg yohimbine. Use of the antidote reduces recovery time from several hours to approximately 5 minutes.

Ketamine hydrochloride

Marketed in a 100 mg/ml solution as 'Ketamine', 'Ketaset' or 'Vetalar', this is the drug of choice for primates, carnivores and birds and is now available in India. An advantage of ketamine is that protective reflexes such as coughing and swallowing are maintained in animals under the drug. In dosages of approximately 10 mg per kg body weight, it may be used alone or in a mixture with xylazine (see box)

"Hellabrunn" mixture

100 mg/ml Ketamine solution

500 mg Xylazine powder

Etorphine hydrochloride ("M.99")

Etorphine is a very potent morphine derivative which is particularly useful in immobilisation of large herbivores, as only small quantities are necessary. It must never be used in felids. The specific antagonist, diprenorphine, provides rapid reversal.

Because etorphine is extremely toxic in man and a narcotic, it is subject to stringent legislation and can only be imported into India with a permit from the Narcotics Commissioner, Gwalior, M.P. It should never be handled unless the specific human antidote nalaxone is to hand, in case of a human accident (see box). Special care (rubber gloves, spectacles) should be exercised when loading darts and in cleaning contaminated components after use.

M.99 is marketed in Europe by C-Vet under the name "Immobilon", the large animal formulation of which contains 2.45 mg of etorphine hydrochloride per ml, as well as 10 mg acepromazine maleate, which reduces any initial excitation from the M.99 and acts as a residual tranquilliser after reversal of the latter. The antidote, containing 3 mg/ml diprenorphine hydrochloride, is marketed as "Revivon", 1 ml of which is required to reverse 1 ml of Immobilon.

In USA etorphine is available as a 1mg/ml solution, which is not so convenient due to the larger volumes and dart sizes necessitated. The antidote diprenorphine is known as "M.50-50."

SEE NEXT PAGE FOR ACCIDENT PROCEDURE WITH M.99.

Acepromazine maleate

Available in a 10 mg/ml solution Acetylpromazine (acepromazine maleate) can either be used alone as a tranquilliser or mild sedative, e.g. in transportation, or in conjunction with immobilising drugs such as etorphine. It has useful anticonvulsant, antispasmodic and antiemetic properties. In some species acepromazine causes hyperthermia and should be used with caution in conditions of extreme ambient temperatures. There is some danger of heart block if acepromazine is given to animals already in an excited state.

Diazepam

Available in 5 mg/ml solution as "Valium", diazepam is used alone as a tranquilliser to reduce excitement when handling or transporting animals and, unlike acepromazine, can safely be given to an already excited animal. A dose of 10 mg i/m was found useful to quieten chital captured with a rocket net (Wildlife 3.3).

ACCIDENT PROCEDURE WITH M.99

A 'Human Kit' containing 1 ml vials of the human antidote "Narcan" (0.4 mg/ml naloxone), file - for breaking open vials, small sterile syringe and needles (2 cm) should be carried at all times when M.99 is being used. At least two people present should be familar with the following procedure.

Symptoms

Etorphine is highly toxic in man, causing dizziness, nausea, pinpoint pupils, followed by respiratory depression, cyanosis (blue membranes - eyelids, mouth etc) and, in extreme cases, loss of consciousness and cardiac arrest.

Use of antidote

In case of (a) accidental injection (including a needle scratch), (b) spillage on the skin, or (c) splashing into eyes, nose or mouth, before calling medical assistance, inject an antidote. In the case of (b) or (c) immediate washing with plenty of water may prevent absorption but this should never be assumed - if symptoms begin to develop inject antidote.

- Inject 2-3 ml Narcan, preferably intravenously or alternatively intramuscularly and repeat at 2 to 3 minute intervals until symptoms are reversed.

  Easiest vein is the one on back of the hand. Convenient muscle is triceps at top of arm, at the back. If difficult to get needle into vein, give half dose into muscle first, then other half into vein.

- If Narcan not available, an alternative human antidote is nalorphine, (human formulation 10mg/ml) marketed as "Lethidrone" in 1 ml vials. Dose is 1 ml, repeated at 5 min intervals if necessary, up to a total of 4 ml.

- In the event of a human antidote being unavailable, or in an extreme emergency, Large Animal Revivon (diprenorphine) may be used in a dose of 0.1 ml, repeated after 2 to 3 minutes if necessary.

ADEQUATE RESPIRATION AND HEARTBEAT MUST BE MAINTAINED, IF NECESSARY BY MEANS OF ARTIFICIAL RESPIRATION AND EXTERNAL HEART MASSAGE, UNTIL UNTIL MEDICAL HELP ARRIVES.

Chemical Capture–Plan of Operation

TO INTRODUCE THE MANAGER TO THE BASIC PLAN OF ANY CHEMICAL CAPTURE OPERATION.

All darting operations, for whatever target species, should only be undertaken after careful planning. Operations which are mounted on the spur of the moment often fail because some key element has been overlooked or some vital precaution not followed.

Before proceeding to sections 3.7 to 3.9 on immobilization of particular species groups, this section should be carefully studied and all points noted in making the specific plan.

Basic planning and precautions to be followed when undertaking immobilization of any wildlife species are outlined below.

- Study Sections Wildlife 3.4 & 3.5 and select correct darting equipment and drug or drug mixture for the species you plan to capture. Ensure the human antidote is available if you plan to use M.99. If it is not, the operation should be abandoned.

- Even an experienced operator would be wise to have a number of practice shots at a target (gunny bag or cardboard carton filled with straw) placed at a similar range to that anticipated in the planned darting operation and using the same size of dart, filled with water in place of the drug. Solid practice needles are provided in most types of dart kit.

- Time of day is an important factor. No capture operation should be undertaken in the middle of the day when the ambient temperature is high as this increases the risk of the animal suffering from hyperthermia, which can be fatal. Early morning is the optimal time for most capture operations. You have the maximum number of daylight hours ahead of you.

- A well organised search party should be on hand to assist in finding the darted animal after the drug is administered. It is important to ensure that the animal is found quickly so that in case it has gone down in a bad position immediate measures may be taken to put this right. If "walkie-talkie" communication is available, radios should be issued to all search parties.

- Animals should not be darted close to deep water or precipitous terrain. In the semi-immobilised state preceding and following recumbancy they may drown or fall down a steep slope or cliff, inflicting serious injury.

- Capture candidates should be chosen with care, ensuring that at least externally they look healthy. The internal condition, of course, cannot be ascertained but poor liver or heart conditions may cause fatalities, resulting from the added stress of immobilization.

- Pregnant and obviously lactating mothers should not be selected for immobilization. The chemical or mechanical stress of immobilization can cause a pregnant female to abort. Remains of the drug, even after reversal, can be absorbed by young through feeding if a lactating mother is immobilized, thus jeopardising the life of the offspring.

- The target animal should be stalked cautiously and not chased or otherwise excited prior to darting. Patience may be needed to allow the animal to move into a suitable position for the shot. Never fire unless there is a clear line between you and the target site on the animal. Grass blades or leaves of a bush can deflect the dart and result in a "miss".

- Once the animal is darted remain quiet, keeping it in sight as far as possible without disturbing it - a long flight will make the animal difficult to locate, especially after it has gone down. Induction time (between darting and the animal going down) varies considerably, even when using a standard drug dosage with a particular species. Anything between 5 and 20 minutes may be expected with most combinations.

- Do not approach the animal immediately it goes down but allow a few minutes for it to settle and the drug effect to deepen. Premature handling or noise may frighten the animal, causing it to struggle against the effect of the drug in an attempt to escape. When you do approach, test reaction of recumbant animal by lightly proding with a stick from the rear.

- Make sure the immobilized animal is not in the direct sun by lifting it into shade or constructing artificial shade over it, e.g. tarpaulin.

- Check on the position of recumbancy, according to the species.

- Eyes, if open should be covered (cloth, clean gunny bag) to prevent damage by dust or direct sunlight. Moisten with boiled water, saliva or opthalmic ointment.

- If species is very sensitive to noise disturbance, block ear openings with plugs of soft rag or cotton wool.

- The dart should be carefully removed and antiseptic ointment (e.g. an antibiotic) applied to the wound. In the case of barbed darts, a sharp scalpel may be needed to ease the exit of the barb from the skin.

EMERGENCY MEASURES

Respiration

- Rate of respiration drops considerably with most CNS depressant drugs. However, depth and regularity of breathing is as important as frequency. Shallow, irregular breathing is a cause for concern. In the event of failing respiration or circulation, a small amount of antidote should be immediately given intravenously if the immobilising drug has an antagonist.

- Failing respiration may be stimulated by .880 Ammonia dabbed onto back of the tongue. Alternatively, an intravenous injection of doxapram hydrochloride ('Dopram', A.H. Robins Co. Ltd - manufactured in India) is a very powerful stimulant.

- If respiration stops totally, artificial respiration may be attempted in smaller ungulates but is not feasible in larger animals. Put the animal on its side and expel air from the lungs by pressing downwards with both hands on the thorax in a sudden, jerky manner. Release pressure quickly. Alternate this with blowing into the animal's nostrils, while the mouth is held closed by your hands, in order to fill the lungs with air. Continue until breathing is restored.

Heart Beat

- Shock or acute acidosis may cause cardiac arrest. Circulatory failure may be treated by intramuscular injection of a cortizone preparation such as dexamethasone ("Dexafort") which is long- acting - up to 8 days. Note this drug may cause abortion after approximately 48 hours, if administered to pregnant females.

Dosages of Dexafort

(each ml contains Dexamethasone as phenylpropionate 2 mg
and Dexamethasone as sodium phosphate 1 mg)

Ungulates	1 - 3 ml depending on size
Rhino/elephant	15 - 20 ml
Cats	1 - 4 ml

- Body temperature and respiratory rate should be monitored at approximately 10 minute intervals. Temperatures over 104 degrees F (40 degrees C) are dangerous and should be immediately counteracted by dousing with water or covering the body with gunny bags soaked in water.

- In the absence of an antidote, the immobilising effect of the drug may take several hours to wear off and even after the animal regains its feet it may be unstable and drowzy for a further period. If necessary provide protection from predation until full normality and alertness are restored.

- If an antidote is available (as in the case of diprenorphine used to reverse etorphine) administer it as soon as the purpose of capture has been accomplished. Intravenous injection provides the most rapid response but some operators prefer to give half the dose via this route and the other half into muscle, which provides a slower antaonistic effect for a longer period. Remember drowziness often persists even after reversal of immobilisation with a specific antidote.

Chemical Capture of Ungulates

TO CAPTURE MEDIUM TO LARGE UNGULATES BY DRUG IMMOBILISATION.

Drug capture is ideal for large ungulates such as gaur, sambar and nilgai but may be used, in the absence of more appropriate methods, for species down to the size of chital or blackbuck. The operation is more difficult and risky with the smaller species - they are often harder to approach, present a smaller target and succumb more readily to psychological and other forms of shock.

Choice of drug or drug mixture and dosage for a particular species is, to some extent, a matter of experience. In this and the two subsequent techniques (Wildlife 3.8 and 3.9) drug choice and dosages given are as far as possible those which have been tested out by WII personnel but with occasional reference to information from the literature on Indian species in the wild. Where a dosage range is given, the lower figure is recommended for females and young adult males and the higher figure for fully adult males.

Sections 3.4 to 3.6 should be consulted for background information re equipment, drugs, procedure in case of human accident and basic operational planning.

This technique deals with equipment, drugs and operation planning for chemical capture of ungulates.

EQUIPMENT

In the wild, a powder charged rifle which is more accurate over the longer ranges usually involved with these species, is the best choice. The Dist-Inject 60N rifle, with adjustable rear sight, assists accurate placement of the dart. A blow-pipe or blow-gun may be used in small captive enclosures. With heavier species such as gaur, buffalo, nilgai or sambar use a metal dart of appropriate volume with a 30-40 mm length collared or barbed needle. For smaller species like chital a pre-assembled plastic dart would be preferable to a metal one, provided conditions are not windy. A needle length of 15-20 mm should be used.

DRUGS

The most suitable drug for large ungulates such as gaur, buffalo, nilgai and sambar is etorphine and the 'Immobilon' formulation is the most convenient for darting purposes because of the greater concentration per unit volume (2.45 mg/ml). Whilst etorphine can be used for smaller species such as barasingha and chital, Hellabrunn mixture or Rompun alone is generally safer for the inexperienced operator. For dosages see box.

DRUG DOSAGES FOR UNGULATES

Species	Drug	Dosage		
		Volume	Composition	
Gaur	*Immobilon*	*3 - 4 ml*	*Etorphine* *+ Acepromazine*	*7.35 - 9.80 mg* *30 - 40 mg*
Nilgai	*Immobilon*	*2 - 3 ml*	*Etorphine* *+ Acepromazine*	*4.90 - 7.35 mg* *20 - 30 mg*
Sambar	*Immobilon*	*2 ml*	*Etorphine* *+ Acepromazine*	*4.90 mg* *20 mg*
Barasingha	*Hellabrunn Mixture*	*2 - 3 ml*	*Ketamine* *+ Xylazine*	*200 - 300 mg* *250 - 375 mg*
Chital 1.	*Hellabrunn Mixture*	*1.25 - 1.5 ml*	*Ketamine* *+ Xylazine*	*125 - 150 mg* *156 - 188 mg*
or 2.	*Rompun 10% solution*	*2.0 - 2.5 ml*	*Xylazine*	*200 - 250 mg*
Blackbuck	*Rompun 5 % solution*	*1.25 - 2.0 ml*	*Xylazine*	*63 - 100 mg*

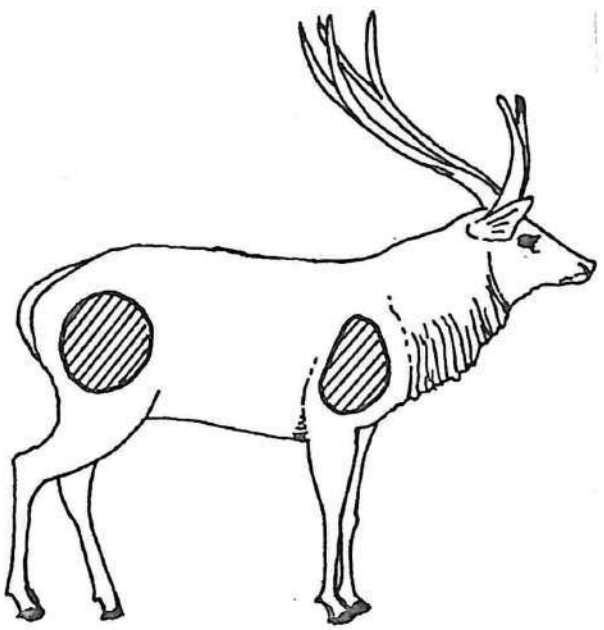
THE DARTING OPERATION

Approach

Observe carefully all precautions indicated in Wildlife 3.6. A maximum range of 35 m for larger ungulates and 25 m for the smaller species is reasonable, unless one is a very experienced marksman with a dart gun and condi- tions are ideal (no wind,clear line of site without intervening vegetation).

Smaller ungulates such as chital or blackbuck should always be taken from the side, as an attempted shot from the rear can easily stray into the delicate organs in the mid-line (anus, genitalia) in so small a target, causing serious injury. See box for target sites for dart.

TARGET SITES FOR DARTING LARGE UNGULATES



N.B. With smaller species (chital, blackbuck) only rump site should be used.

Care of Immobilised Ruminant

Ruminants should never be left for long in lateral recumbancy (lying on their side) as this is conducive to bloat, which can be fatal. Make sure the animal is in sternal recumbancy, with the legs tucked under the body in the natural position. The neck should be positioned forward and slightly raised from the body, with the mouth pointing downwards to allow any saliva or vomit to drain out - inhalation of these into the lungs must be avoided. If necessary clear the airway by pulling the tongue forwards and removing any obstructive material with the fingers.

Recovery

The most convenient vein for intravenous administration of an antidote in a ruminant is the jugular. To locate it hold neck upwards and turn head to one side; the vein is in a furrow to the side of the trachea. Clip off excess hair if necessary and clean area with water or alcohol. The vein can be engorged with blood by pressing on it spot with the thumb below the proposed injection site.

Remember most ungulates will be particularly vulnerable to predation during the recovery period, whether an antidote is used or not. Proper monitoring and protection should be provided until full mobility and alertness are restored.

Chemical Capture of Elephant and Rhinoceros

TO CAPTURE ELEPHANT OR RHINOCEROS BY DRUG IMMOBILISATION.

Drugs provide a very appropriate capture method for these very large herbivores, which is gradually replacing traditional methods when elephants or rhinos are being captured for management purposes. Valuable experience with elephants has been gained with a radio-collaring programme in Rajaji National Park, U.P. and translocation operations recently carried out by the Karnataka Forest Department. Similarly, the Dudhwa rhino reintroduction programme has provided experience with rhino capture and transportation, to both Indian and Nepali wildlife personnel.

Immobilisation allows selection and removal of particular individuals with minimum disturbance to other members of the population and greater safety for management staff. It also simplifies much of the difficult procedure in handling infuriated freshly caught captives of these heavy and dangerous species, particularly if tranquillisation (drug sedation) is used during the transport operations which may follow actual capture.

Sections 3.4 to 3.6 should be consulted for background information re equipment, drugs, procedure in case of a human accident and basic operational planning.

Choice of drugs and equipment, planning of capture operations and care of immobilised elephant and rhino are dealt with in this technique.

EQUIPMENT

With thick-skinned species such as elephants and rhinos a powder charged rifle and metal darts should always be used (see Wildlife 3.4), as a blow-gun may not provide adequate penetrating power to the dart. Size of dart assembled will depend on the required drug volume. A long (minimum 63 mm) collared or barbed needle should be used, preferably with side holes which permit explusion of the drug, even if the terminal hole is blocked by 'coring' with tissue as the needle passes through the skin.

Contrary to frequent opinion, it is not necessary to use a heavier charge on thick-skinned species than the normal one indicated by considerations of range and dart weight.

References on Elephant & Rhino Immobilisation.

Sale, J.B., Rishi, V., Singh, K.N. & Verma, V.K. 1986. Drug immobilisation of Indian elephant. Journal of the Bombay Natural History Society 83 (1) : 49-56.

Sale, J.B. & Woodford, M.H. 1981. Preliminary report on drug immobilisation and transport of the Great Indian rhinoceros. Field Document No. 7, FO:IND/74/046, FAO, Rome.

DRUGS

The most satisfactory drug for immobilisation of these very large animals is etorphine (M.99). Other drugs/drug mixtures require too large a volume for administration by a single dart syringe. Due to its greater concentration of etorphine, Immobilon is the preferred formulation and the additional presence of acepromazine in this preparation reduces initial excitability, as well as imparting a residual tranquillising effect after reversal of the M.99. This is especially valuable in the case of transportation subsequent to capture.

DRUG DOSAGES FOR IMMOBILISING ELEPHANT AND RHINO

Elephant	*Immobilon*	*3.0 - 3.5 ml*	*Etorphine*	*7.35 - 8.60 mg*
			+ Acepromazine	*30 - 35 mg*
Great Indian rhinoceros	*Immobilon*	*1.0 - 2.0 ml*	*Etorphine*	*2.45 - 4.90 mg*
			+ Acepromazine	*10 - 20 mg*

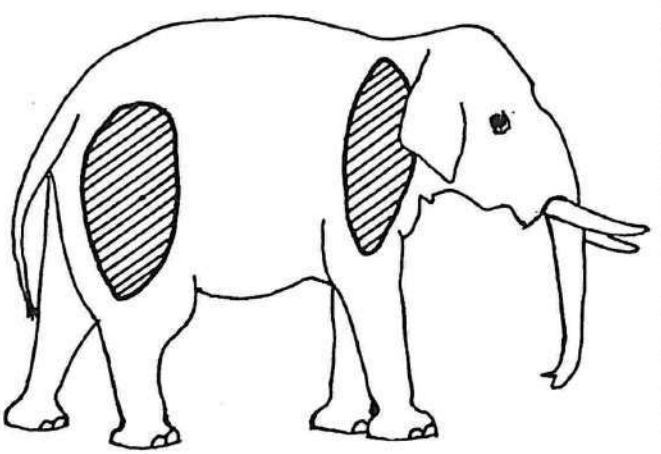
N.B. Lower doses for sub-adult or female; higher dose for adult males.

DARTING OPERATION

Approach

Both species should be approached with great caution, particularly if darting is being undertaken on foot. Approach on riding elephant is preferred if a reliable animal and mahout are available and the terrain and vegetation allow access without disturbing the target animal or its companions. A shooting range of 30-45 m is reasonable and should permit the placing of the dart in the preferred site (see box). On account of the thickness of the skin, it is important that the needle enters perpendicularly to the body surface. An oblique shot may result in the needle tip delivering the drug in the inner dermal layer of the skin where there are few blood vessels to assist its rapid dispersal throughout the animal's body.

TARGET SITES FOR DARTING ELEPHANT

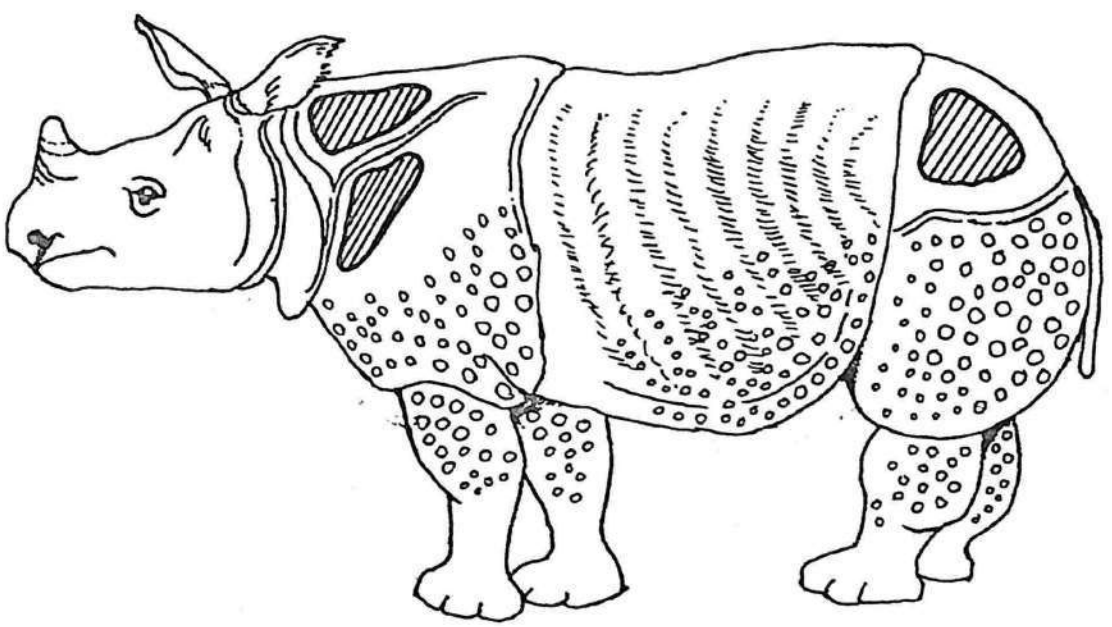


Follow-up

Both species may charge or run a considerable distance in response to being hit by a dart, particularly if they see or hear the darter and his assistants. It is therefore preferable to keep hidden from the target animal when making the shot.

Induction times of from 10 to 25 minutes are normal, during which time the darted animal should be kept under observation from a distance, if at all possible. If it runs out of sight, it may be better to delay searching,which may disturb the animal and push it further away, until 10 minutes have elapsed allowing the drug to at least initiate immobilisation. Search with great caution as a partially immobilised elephant or rhino can still effect a charge if suddenly alarmed.

TARGET SITES FOR DARTING RHINO



Areas with hardened tubercles should be avoided as dart will bounce off or needle break. Neck target site is best (soft skin overlaying muscle) but should be avoided by inexperienced marksmen as danger of stray dart damaging spine, ear or eye. Rump site sloping, hence perpendicular shot only possible from elevated position e.g. elephant back.

Care of Immobilised Animals

Elephants generally fall onto to their side when immobilised and may safely be left in such lateral recumbancy for a number of hours. However, it should be noted that, unlike ruminants, elephants should not be allowed to stay in sternal recumbancy for more than 20-25 minutes, as proper ventilation of the lungs is impeded in this posture, leading to build up of fluid which can rapidly cause death. If it is essential to keep an elephant immobilised for more than 20 minutes lateral recumbancy must be ensured, if necessary by rolling it over onto its side - not an easy task with an adult animal. In any event, the trunk should be laid out and freed from any obstruction.

Rhinos are the opposite of elephants and should be kept in the sternal position when immobilised. Prolonged lateral recumbancy is not advisable.

Hyperthermia is fairly uncommon in these large-bodied species. Respiration rate should be checked frequently but can go as low as 3 or 4 per minute in elephants and 6 in rhinos without causing undue concern.

Revival

Revivon is a rapid acting antidote and all personnel except the one giving the injection should be cleared from the site prior to its injection. If a portion of the antidote is being given intramuscularly (to ensure slower long-term completion of reversal) do this before giving the rapidly acting intravenous portion of the dose.

Both elephant and rhino have large veins on the underside of the ear which are convenient for intravenous injection of the antidote. Clean the area with water or alcohol on a swab and depress the selected vein with your thumb on the side of the proposed injection site proximal to the heart (towards the base of the ear). This causes the vein to become engorged with blood which assists entry of the hypodermic needle (always use a stout veterinary needle). Draw the plunger back a little until blood appears in the syringe, indicating the needle is in the vein. After slow injection of the antidote, rub the site vigorously to assist absorption. Sudden revival and rising of the animal onto its feet, can occur any time after 3 minutes so be prepared.

HANDLING, TRANSPORTATION

Large intramuscular doses (up to 500 mg) of Rompun (Xylazine) are reported to be effective in inducing a tranquil state in elephants which are to be walked from the capture site or loaded onto a truck, after capture and revival by Immobilon/Revivon. If necessary, the dose may be topped up 200 mg at a time, up to a total of 1000 mg.

A mixture of xylazine and ketamine has also been used for post-revival tranquillisation of elephants.

Rhinos may be tranquillised with xylazine or acepromazine for transport, after loading into crates which is normally done when the animal is still immobilised (See Sale and Woodford, 1981).

ELEPHANT IMMOBILIZATION OPERATION - A STEP-BY-STEP GUIDE

1. With the help of several search parties (in radio contact) a suitable capture candidate should be located. The animal should preferably be in habitat where vegetation is not too dense as this increases the chances of missing the target animal by deflection of the dart when fired and impedes easy location after recumbancy.

2. Location and watch over the candidate should be conducted with minimum of disturbance to the animal and as far as possible the animal must be kept from being aware of human presence.

3. Capture team should be notified (radio) and on the basis of the description of the potential target (size, sex etc) they should prepare and load two or three appropriate darts, e.g. 3 ml Immobilon for adult female, One dart should be loaded into the rifle <u>without</u> the .22 blank and the safety catch in place. Several spare charges of different strengths for the rifle should be carried.

4. In case the first shot misses the animal, one or two extra prepared darts should be carried in a small <u>metal</u> box. The box will stop accidental application to the person carrying it. In no event should prepared or used darts be carried in a pocket.

5. Human kit with several vials of antidote should always be carried and marked clearly. One member of the team other than the darter should be familar with the procedure for administering the antidote in the event of a human accident.

6. As far as possible the target animal should be approached from downwind to avoid detection and this may sometimes mean walking around it. The elephant should also be approached from behind if possible so that the darting party is not seen. Elephants are extremely sensitive to smell and sound so great care needs to be taken in this regard - no heavy aftershave° Light, carefully placed footsteps, avoiding twigs or dry leaves on the ground.

7. *The dart should ideally be fired fairly high into the hind quarters from a distance of 30-45 m, ensuring that the target area is perpendicular to the line of flight of the dart. Darts in other regions e.g.shoulders, can be removed by the animal with its trunk, or get dislodged when brushing past vegetation while moving away.*

8. *During the induction period (10-25 minutes) the animal should be carefully monitored, visually if possible, until recumbancy is attained, with minimum disturbance to avoid exciting it. If the animal is lost wait 10 minutes before cautiously conducting a thorough search of the area with teams radiating out from the darting area.*

9. *Wait for 5 minutes after recumbancy before approaching the animal. Ensure that it is completely immobilized and test its reactions by throwing a stick or some other object at it.*

10. *Once it is ascertained that complete immobilization is attained, approach the animal from behind. If the eyes are open cover them with a damp cloth to keep them moist and dust-free.*

11. *Remove dart and dress dart site with antiseptic cream.*

12. *Monitor body temperature and respiration rate at regular intervals (10-15 minutes). If body temperature is high (÷ 104 degrees F or 40 degrees C) place wet gunny sacking over the body to help cooling. Add more water to sacking as necessary.*

13. *The animal should be kept down for as short a period as possible. Once the objective of immobilization is completed, all equipment should be cleared away and all except one member of the capture team should move to a safe distance behind the animal before the reversal drug is injected.*

14. *After cleaning an area on the back of the ear above a vein, inject antidote and observe revival from a safe distance.*

15. *The animal should be monitored for a few hours after revival to ensure that it does not go down again due to recycling of the immobilizing drug (an extremely rare occurance in elephants). It may be left once fully normal behaviour and alertness are restored.*

Chemical Capture of Large Carnivores.

TO CAPTURE LARGE CARNIVORES BY DRUG IMMOBILISATION.

Whilst many carnivores can be readily captured using baited live traps (Wildlife 3.1), the larger felids such as tiger and leopard present a number of problems, partly deriving from their great strength and ferocity. They frequently injure themselves while trying to escape from traps and nuisance animals such as cattle lifters, sometimes become wary of traps, particularly if repeated attempts are made to capture them by this means. Chemical capture has altered this scene to some extent, although the wariness and cryptic habits of tiger and leopard still means that they often elude the dart gun.

A good deal of experience in chemical capture of tigers and leopards is now available in India, however, and the method has also recently been used successfully by WII in the Asiatic Lion research programme in Gir.

The recent availability of effective reversing agents for the preferred immobilising drugs for large cats, further enhances the usefulness of the chemical capture method in relation to them. However, it is too early to report on trial useage of reversing agents such as Yohimbine with felids in India.

Sections 3.4 to 3.6 should be consulted for background information re equipment, drugs and basic operations.

This technique considers equipment, drugs and operation planning for chemical capture of large felids.

EQUIPMENT

Being thin-skinned animals, the large cats can be satisfactorily darted using "blow-gun" equipment, provided that (a) the drug dose required does not call for a dart capacity greater than that available (3.5 ml) and (b) it is possible to find a target animal within the rather limited range of this equipment. Darting of tigers often takes place from elephant back which usually brings the darter within a suitable range for the blow-gun. Many prides of the Gir lions are relatively approachable by man which also facilitates use of this simple and silent method. However, providing the shooting range and strength of the propellent cartridge are correctly matched, the powder charged gun gives satisfactory results and does not cause dart injury to the soft skin. It has the advantage of large dart volume (up to 15 ml) if one is forced to use drugs at great dilutions. Even with the powder charged rifle, a prepared, disposable plastic dart (Wildlife 3.4) may be used (provided capacity is adequate) and due to its light construction, will cause minimal trauma at the point of impact.

A medium length needle (30-40 mm) should be selected for tiger or lion and a rather shorter one (20-25 mm) for leopard.

DRUGS

Hellabrunn mixture with additional ketamine or some other varient of a ketamine/xylazine combination is mostly used for felids. Some workers recommend a very large dose of ketamine (1,800-3,400 mg) plus 10-20 mg diazepam for tigers but this mixture has not been tried out in India.

The diazepam prevents excitability and convulsions to which cats are prone. Acepromazine should not be used for cats which are susceptible to hyperthermia - a condition sometimes induced by this drug. Etorphine or M.99 should NEVER be used for felids, where it has fatal results. A small animal formulation of Immobilon, containing 0.074 mg/ml etorphine together with 18 mg/ml methotrimeprazine, is however available for canids (dog family).

DRUG DOSAGES FOR LARGE FELIDS

Species	*Drug*	*Dosage*	
		Volume	*Composition*
Tiger	*Hellabrunn + Ketamine*	*2 ml + 3.0 - 5.0 ml*	*Ketamine + Xylazine* *500 - 700 mg 250 mg*
Leopard	*1. Hellabrunn + Ketamine*	*0.3 - 1.0 ml + 1.5 ml*	*Ketamine + Xylazine* *180 - 250 mg 37.5 - 125 mg*
	or 2. Ketamine	*4 ml*	*Ketamine* *400 mg*
Lion	*Ketamine + Xylazine*	*10 - 13 ml*	*Ketamine + Xylazine* *1000 - 1300 mg 100 - 150 mg*

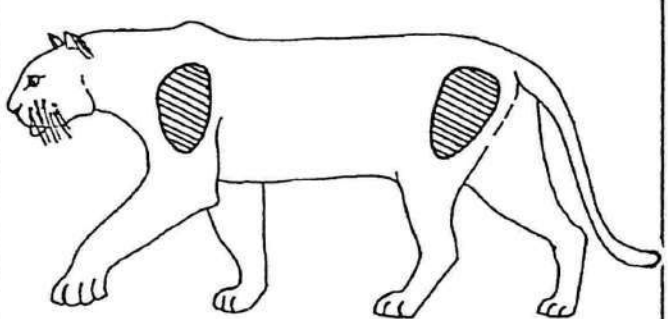
THE DARTING OPERATION

It is best to avoid darting cats which have recently eaten a meal because of the possibility of regurgitation, under the influence of the immobilizing drug, which may result in choking.

Approach

This is not easy or safe on foot with tiger or leopard and elephant back is the preferred mode of approach, particularly for tiger. If baits are used to localise target animals, try and immobilise before the animal has filled his stomach from the bait. Otherwise the general principle of cautiousness and care not to disturb or harass the animal during the induction period apply.

TARGET SITES FOR DARTING LARGE CATS



N.B. With smaller animals only rump site should be used.

Care of Immobilized Animal

Cats are prone to hyperthermia when under drugs so always move into shade as soon as immobilisation is complete. Lateral recumbancy is normal and safe in felids.

Monitor temperature frequently and douse with water at first signs of temperature rise. Respiration should not go below 8 to 10 per minute in cats, which have a higher metabolic rate than herbivores.

Recovery

If using a non reversible drug mixture, a long period of slow recovery should be planned for (up to four or five hours). Watch should be kept over the animal throughout this time bearing in mind that other members of the species may try and take advantage of the defenceless state of the recovering animal to attack it (territorial and other behavioural reasons?).

Once the animal starts to stagger around on its feet, keep it away from deep water (drowning) or precipices where it could fall over and seriously injure itself.

THE PUBLIC

TOURISM MANAGEMENT

INTRODUCTION TO THE SECTION

In India, the term "recreation" sometimes has connotations which are incompatible with the objectives of a national park or wildlife sanctuary. Managers speak of "wildlife tourism" instead of "forest recreation" or "outdoor recreation" which are the more commonly used terms internationally. Accordingly we use the term "tourism management" to head this section. Tourism in this context does not necessarily mean "commercial tourism".

Tourism management in national parks and other protected areas has the following objectives:

- *Maximize people's enjoyment of their stay, through education and recreation.*
- *Minimize the impact on habitat and wildlife.*
- *Increase the visitor's concern for nature conservation.*

All protected areas where recreation is an objective should have a tourism management plan within the overall management plan. This will usually entail establishment of a tourism zone. Both zonation and the tourism management plan should be part of a comprehensive management planning process and are not discussed here. Where management also intends to provide a variety of educational services, an interpretive plan (Public 1.6) should complement the tourism management plan.

Sub division of a tourism zone, regulation of access and development is discussed first, together with the range of activities which might be offered (Public 1.1).A systematic inventory of resources for recreation and interpretation (Public 1.2) is necessary for tourism planning.

Visitor carrying capacity (Public 1.3) is an elusive concept and is often arbitrarily fixed at a certain number of visitors per time period. Alternatively, one may opt to spread recreational use in time and space, concentrate it in certain areas or attempt to reduce tourism impact through other means.

One prerequisite of tourism management is an understanding of the visitor. The manager must recognize trends and patterns of recreational activities (Public 1.4) and find out about visitors' preferences and dislikes (Public 1.5). He can then begin to regulate visitor behaviour and movement. This can be done by regulating access, specifying types of development and transport permitted and by providing information and enforcing regulations.

SECTION CONTENTS

Tourism Zone Management

TO HELP THE MANAGER SET GUIDELINES FOR TOURISM ZONE MANAGEMENT.

In national parks and sanctuaries, tourism is usually an objective applied to only part of the total area, the "tourism zone". It is assumed that such a zone has already been set up within the framework of a comprehensive management plan, which takes all management objectives into account. Each tourism zone has its own unique set of resources for recreation and education. From the range of possible activities the manager must choose those which are desirable to promote and then decide where and under which regulations the respective activity can be permitted.

The tourism zone usually requires sub-zonation into low intensity use area, development areas and development sites to better enable the manager to guide and control its recreational use.

This technique explains (a) how to compile a list of activities and (b) what to consider when establishing development sites and areas.

RECREATION RESOURCES AND ACTIVITIES

Considering the set of questions listed below, select those activities which your area is well suited to support.

1. Is the activity among those to be encouraged?
2. Is it fully compatible with the other objectives of the protected area?
3. Is there likely to be a demand for the activity?
4. What are the budget and manpower implications?

Activity List

The list (see box) covers the most common types of activities but is not exhaustive. It is also indicated where, within the areas open to visitors, the activity can be permitted. Activities marked with a single asterisk (*) are permissible in some protected areas, but not in others e.g. walking and trekking. Activities marked with a double asterisk (**) are generally inappropriate in national parks and comparable areas.

ACTIVITY LIST	Areas A	B	C	D
Wildlife Viewing				
on foot*	X	X		X
by bicycle*/rickshaw/horse cart		X		X
on elephant/camel/horse	X	X		
from car/minibus/jeep		X		
from machan or hide	X	X		
captive animals**, safari park**			X	X
Walking and Trekking				
short trail		X		
long trail	X	X		X
trek	X	X		X
Education/Information/Entertainment				
guided tours	X	X		X
interpretive talk			X	
meet the park director/range officer		X	X	
films or AV presentations			X	
library			X	
exhibition at visitor centre			X	
Cultural Activities/Sight Seeing				
visits to Historic buildings		X	X	X
visits to religious shrines/temples		X		X
observing village craftsmen at work			X	X
tribal dance			X	X
visit local fairs and festivals				X
interesting development works (dams)				X
Social Gathering				
picnic*			X	X
campfire*			X	X
camping*		X	X	X
Sporting Activities				
mountaineering*	X	X		
orienteering*		X		
rafting/boating*		X		
swimming*			X	
diving		X		
fishing/hunting**				X
Games and Play				
playground**			X	X
joy rides**			X	X

A=low intensity area; B=development areas; C=Development sites; D=outside park

SUB-ZONATION OF THE TOURISM ZONE

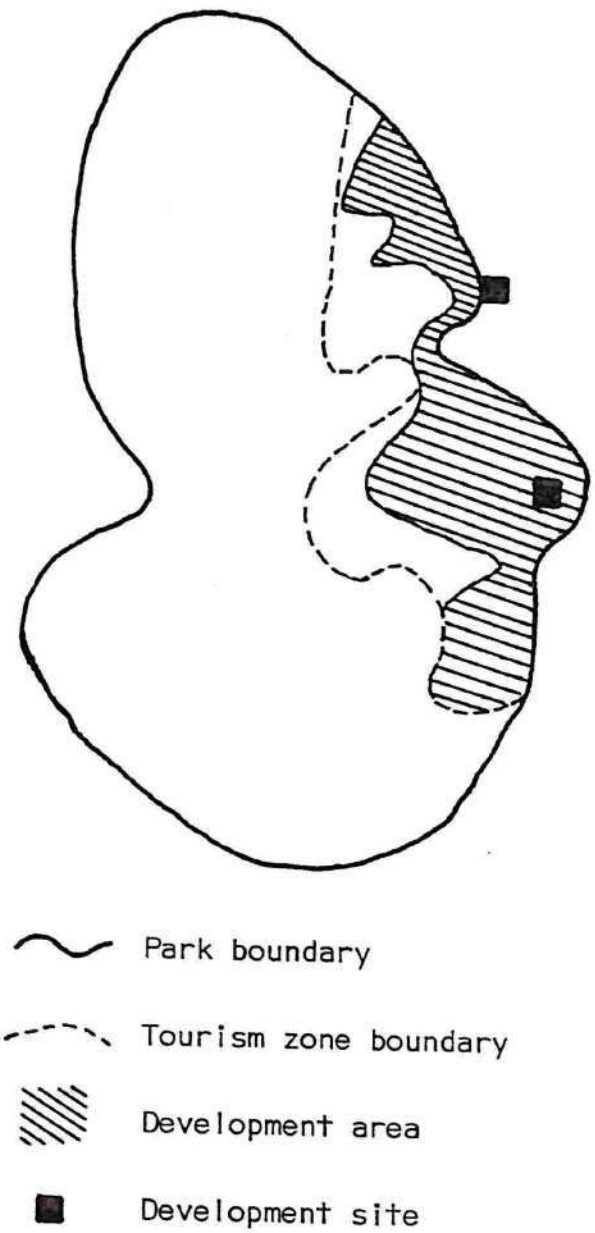
Within the tourism zone there will be low, medium and high intensity use. Use intensity depends on the nature of the activity and on the number of people engaging in the activity (see activity list above).

By definition, the entire tourism zone is fit for low intensity use. Medium intensity use is limited to development areas. High intensity use is confined to development sites within development areas. Tourism zone, development area, development sites and the road or trail network for reaching various places within should be clearly shown on an area map at the park entrance (Public 2.2).

For each sub-zone a set of rules should be set up which cover permitted mode of transport, permitted activities, permitted construction (including design criteria), access restrictions.

High intensity Use in Development Sites

Development sites should be located near the periphery of the park or preferably outside the park, usually near the entrance gates. It is only here that large scale construction of facilities or amenities is permitted (accommodation, visitor centre, restaurant, parking lots, nature camp, picnic sites). Most parks in India have inherited de facto development sites in the form of forest rest houses which are often widely scattered. Only rest houses within the recreation zone and within development areas should be considered for public use and no expansion should generally be considered unless they are located at the periphery.



Medium Intensity Use in Development Areas

The regular visitor traffic to established viewing areas and other major attractions takes place in the development areas. The size of the development areas is determined by the availability of suitable places within the tourism zone and the demand. No special permission or guide is normally required. Signs and other information are needed so people know where to go and how to find the way.

Forest recreation sites may be established in suitable locations e.g. streamside cove, waterfall, view point to engage visitors during mid-day.

Limited construction and infrastructure development is permitted (nature trails, viewing tracks, wayside displays, signs, machans and hides).

Low Intensity Use

Only occasional visits by individuals or small groups are allowed in this area. Special permission or a guard may be required. No construction or development is permitted except that which is necessary to provide access on trails or tracks. Special destinations (a bat cave, a pristine rock pool, an old fort) within this zone should be identified and the conditions under which they can be visited made known to the public. Foot trails to these destinations should be marked as closed to the general public unless accompanied by a guide. Spur roads for vehicular traffic should be padlocked. No signs (except perhaps at the trail or roadhead) are necessary or desirable.

Development Sites: inside or outside the park?

The inevitable disturbance caused by tourist accommodation complexes and the like is a strong argument for keeping these sites away from the interior of a protected area.

Some advocate location of development sites outside the boundaries as a matter of principle, on the grounds that many Indian protected areas are very small to begin with and that some managers may otherwise permit the continued existence of development sites close to vulnerable areas and core zone.

Others favour the more flexible term "near the periphery" which leaves the manager with more freedom of choice in selecting suitable sites. They argue that managers may have less influence over sites set up outside the boundary and that the disturbance caused by a site just inside the boundary is not likely to be greater than that of a site just outside.

Tourism Resource Inventory

TO HELP THE MANAGER MAKE A SYSTEMATIC INVENTORY OF NATURAL AND MAN-MADE ATTRACTIONS OF INTEREST TO VISITORS

Detailed knowledge of what one's area has to offer to the visitor is essential for the management of a tourism zone (Public 1.1), for locating suitable nature trail terrain (Public 2.4), and for offering a varied and interesting visitor programme.

The tourism resources determine which activities are possible. A reservoir or lake is a resource which can be used for bird watching, swimming, boating, fishing or walking along its shore. The predictable presence of wildlife permits the activities "wildlife viewing" and "wildlife photography". Of course, not all of the activities are necessarily desirable and permissible from a management point of view and the inventory of these resources does not mean they will necessarily be accessible to the public. That decision will be made taking into consideration all management objectives.

Many tourism resources are also resources for education and interpretation. River rapids and waterfalls are recreation resources because they offer the opportunity of a scenic hike, a drive or rafting. They are an education resource when, for instance, they serve as an example of the role of streams and rivers in shaping the land.

This technique describes how to categorize, describe and inventory recreation and interpretive resources.

AREAS AND POINTS OF INTEREST

The resources fall into two broad categories: a) areas and b) points of interest. Area resources must be well defined and exceptional in some way in order to be useful. "Riverine Forest in the whole reserve" is not useful whereas "a particularly diverse and interesting patch of riverine forest at location XYZ" is suitable for inclusion as a resource. A machan overlooking a waterhole or a hill-top offering an excellent view, on the other hand, is a point of interest.

MAN-MADE RESOURCES

Most resources in national parks and wildlife sanctuaries are natural, but historic buildings and temples are not uncommon and add variety to the programme.

Evidence of human impact can become an interpretive resource, such as erosion as a result of mining or weed invasion as a result of grazing pressure. As with the other resources, one should limit the list to truly outstanding examples which serve to illustrate certain points.

Areas of Interest

These are identified by type, the wildlife generally seen, notes on access. One can rank them on a scale of 1 to 3 or suitably describe them as interesting, pleasant, spectacular, outstanding.

- Wildlife viewing areas: a patch of swampy grassland at the edge of an oxbow lake; accessible by elephant or on foot only; excellent for observing barasingha, mugger and water fowl.

- Interesting landforms: cliffs,rock outcrops, ravines, a series of clear perennial rock pools; tiger lair; access for small groups up to 4 in presence of guide;

- Unusual vegetation: rare forest type, exceptionally old stand of trees, old burn, accessible edge of a swamp, a particularly rich patch of riverine forest next to the park road.

- Rivers, streams, lakes: scenic stretches of river or stream, accessible portions of lake or reservoir shore, section of gently sloping lake shoreline with excellent potential for development of picnic sites and swimming.

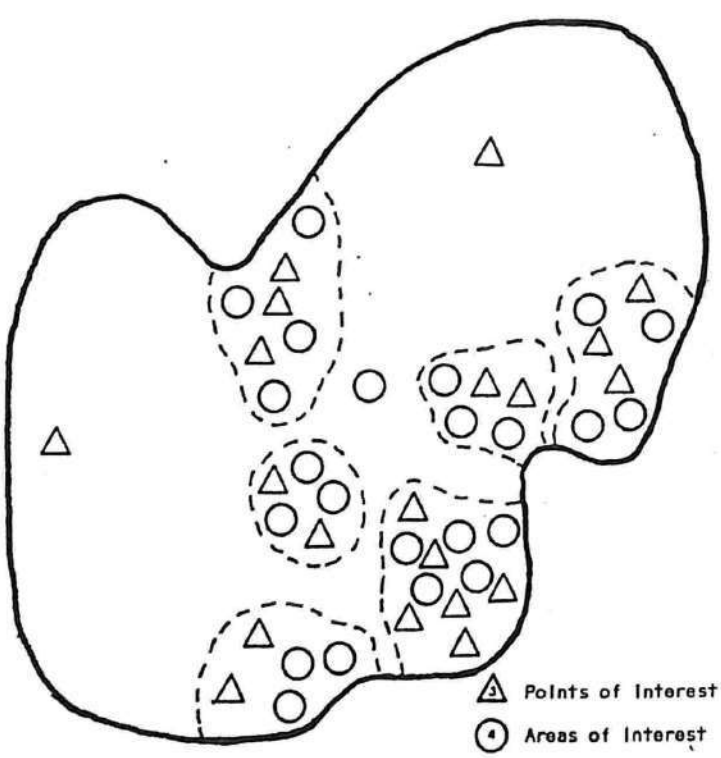
- Areas affected by human influence: encroachments, weed infestation, tribal hamlets/old encroachment occupying 5 sq km of park land; good potential for interpretation because situated on approach to park gate.

Points of Interest

- Scenic look-outs/viewpoints
- Waterfalls
- Historic buildings and temples
- Man-made structures (machan,dam, abandoned villages)
- Waterholes and saltlicks
- Caves

RESOURCE CLUSTERS

Enter the resources on a map and draw a line around resource clusters. The clusters should be proposed for inclusion in the recreation zone. They can become the focal point of a development area within the zone and for the setting up of nature trails.



Visitor Carrying Capacity

TO HELP DETERMINE CARRYING CAPACITY OF A PROTECTED AREA IN RESPECT TO ITS RECREATIONAL USE BY THE PUBLIC.

In regard to visitors, "carrying capacity" can actually refer to: (a) the capacity of accommodation, facilities and amenities (facility carrying capacity); (b) the level of recreational use beyond which wildlife and habitat are seriously damaged (physical carrying capacity); (c) the degree to which people can tolerate each other's presence (social carrying capacity).

All three types of carrying capacities are inter-linked but nevertheless useful to look at separately. Establishing carrying capacity in terms of visitor numbers is readily possible for the capacity of the facilities. The other types of carrying capacity can normally only be estimated after specific impacts have been observed, preferably measured, and described.

Research can, in some cases, furnish clear management prescriptions but generally managers will have to use judgement based on systematic observation to determine carrying capacity in respect to the public.

How to approximate the different types of carrying capacity on the basis of systematic observations, is described below.

MANAGEMENT OPTIONS

Carrying capacity depends very much on the impact on wildlife and its habitat which can be tolerated. What can be tolerated depends in turn on the relative importance of the recreation objective. Management options range from minimizing the impact of recreation to mitigating its worst effects. In national parks and sanctuaries, where conservation objectives are paramount, heavy impact cannot be tolerated even in restricted zones. In deer parks, on the other hand, the recreation objective may dominate and heavy impact may be tolerated.

FACILITY CARRYING CAPACITY (FCC)

The number of visitors staying overnight in a park is limited by the number of beds available. The number of visitors to a safari park by the number of seats, number and frequency of buses running. In a day with many visitors it is easy to find out whether carrying capacity in any of these is approached (Public 1.4, 1.5). By (not) providing facilities one can regulate visitor use of an area. Lack of or inadequate facilities keep people away. Selective improvement may attract a specific clientele (e.g. offering nature camps) or attract visitors to selected places.

PHYSICAL CARRYING CAPACITY (PCC)

Monitoring wildlife abundance and health as well as habitat factors can yeild measures of impact resulting from recreational use. However, scientific proof of impact will be available in exceptional cases only. The next best thing to a study is judgement based on systematic observation and sound reasoning. For this it is useful to spend some time and effort in finding the answers to the set of questions listed below. First, determine in general terms the nature, urgency and cause of the problem.

1. What exactly is the nature of the problem? (see examples).

2. What is the worst possible consequence if the impact is not mitigated? When is this situation likely to arise?

3. What are the indications that the problem is the result of recreational use?

Next, collect detailed information which may help you cope with the problem.

4. Where has the impact been observed, in which season, at what time of the day?

5. In which situations has the problem usually been observed to arise? Can visitors causing the problem be characterized?

6. Is it possible to monitor the rate or degree of deterioration?

Frequently Observed Impacts

- *Habitat: Routine use of a few small areas by riding elephants can leave visible marks. Off trail movement and trampling of fragile plants may be a problem in high altitude parks. Tour guides drive off the road leaving visible track marks, destroying some of the vegetation on the ground. Dust stirred up by fast moving vehicles covers plants.*

- *Wildlife: Repeated attempts to get close by overly keen wildlife photographers may cause sensitive species to abandon brood or litter. Visitors may cause birds to take flight several times daily at a time when the animal can ill afford to expend energy. Disturbance by people sometimes makes it more difficult for predators to catch their prey. Frequent interruption of feeding or drinking may result in animals leaving an area. Others may become irritable as a result of harrassment or learn to scavenge from refuse dumps.*

Possible Action

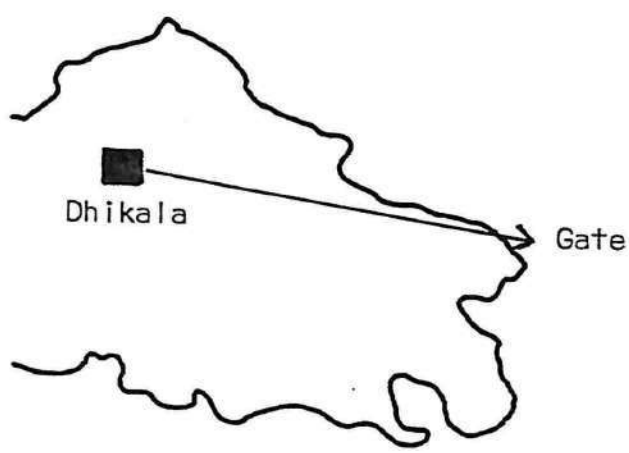
If impacts are measurable, one can decide on a threshold level at which carrying capacity is considered as exceeded. Unles such thresholds are established through research, they are based on the manager's judgement and objectives. If PCC appears to have been reached anywhere, one can:

- Disperse visitors to less sensitive areas through improvement of roads or other means. (This is appropriate when the impact is clearly the result of too many people in the same place at the same time)
- Give clear instructions to visitors about park rules and increase supervision and law enforcement.
- Allow access only to a limited number of people/vehicles.
- Allow access only at certain times and/or only in the presence of an official guide.
- Close the affected area.

Facility Carrying Capacity: Should we increase it?

Most of the accommodation available at Corbett National Park is at Dhikala in the centre of the park. Many more people would like to visit and stay overnight at the park. Should Dhikala expand to accommodate more?

No, because the noise, litter and traffic in the heart of the park conflict with the park's conservation objectives. Relocating the accommodation to outside or periphery of the park is a better solution - now being undertaken.



'Corbett National Park'

SOCIAL CARRYING CAPACITY (SCC)

Social carrying capacity is exceeded when people begin to feel crowded. The densities at which this happens vary widely with the type of use, culture and place. One practical, if arbitrary threshold is the proportion of people who feel inconvenienced by crowding, noise or litter as determined by questionnaire (Public 1.5).

Possible Action

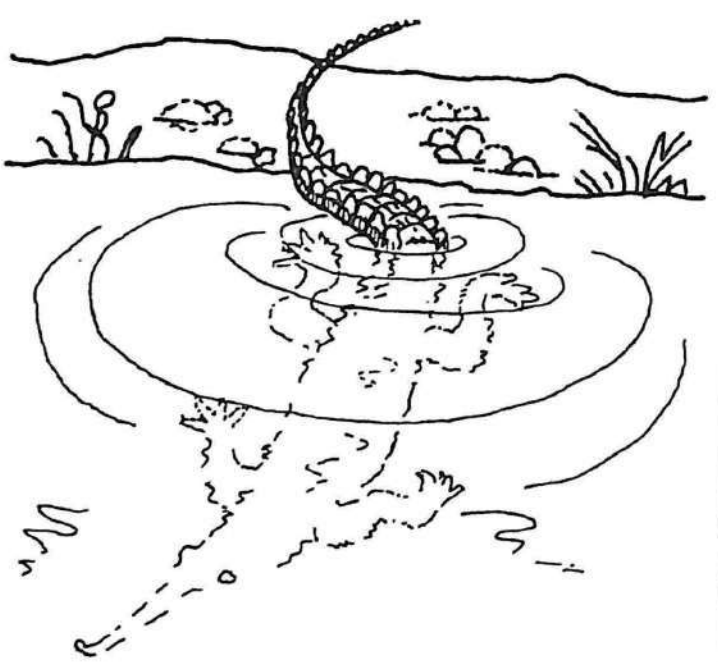
The effects and perception of crowding can be reduced by careful planning of recreational use patterns and by supervision.

- Ask people if they feel crowded or otherwise inconvenienced by other visitors.
- Identify places and situations in which this happens.
- Separate conflicting uses (e.g. sightseeing and wildlife observation) and clearly designate places for specific uses (e.g. picnic only at place X).
- Plan and regulate the use of roads, trails and machans.
- Set up and enforce rules to prevent unnecessary noise in the field as well as accommodation complexes.

Physical Carrying Capacity: Has it been reached?

One might observe that visitors go too close to gharial basking sites and that the animals escape into the water nearly every time somebody comes. This happens 4-8 times daily at all of the best basking sites but we have no definite proof that this does more than bother the gharials a little every time. What should the manager do?

With endangered species it is better not to take any chances and assume that PCC has been reached. Devise suitable action.



Collecting Visitor Statistics

TO HELP WITH THE COLLECTION OF DATA REQUIRED FOR VISITOR MANAGEMENT.

Visitor statistics are helpful in recreation management and facility planning. Rising trends may draw attention to the need for zoning or provide clues about the type and size of facilties required. Duration of visits is one factor to be considered when planning programmes and activities. Knowing the peak visitor periods allows one to prepare for them. Finally, visitor statistics can provide solid support for budget requests.

This technique is concerned with how to obtain visitor records, what information to collect and how to analyze and present the data.

VISITOR NUMBERS, DURATION OF STAY, VISITOR DAYS

Visitor numbers and duration of stay are at the core of visitor records. Because of the time factor "visitor-days" (individual visitors x number of days they stay) are a better indicator of the potential impact of recreational use than merely total visitor numbers.

Permits issued at the begining of the visit and collected at departure provide a clear record of these important factors. Permits issued daily, regardless of how many days a visitor stays, will furnish a record of visitor-days but to add up visitor numbers and determine cate- gories of duration of stay from them is laborious and usually not done.

The most satisfactory procedure is generally to issue a permit to the leader of a visiting group for the anticipated duration of stay and enter the relevant information about the group into the logbook.

CAUTION!

- *Do all people pass the gate and ticket counter?*
- *Are all the people counted?*
- *If people pass through the gate several times a day, are they counted every time?*
- *Are permits issued on a daily basis so that the same person is counted three times if he stays three days?*
- *Are the visitors mainly interested in nature and wildlife or are a significant number of them pilgrims or travelling through on a right of way?*

INFORMATION TO COLLECT ON THE WAY IN

In general, avoid turning the registration of visits into a lengthy and irritating procedure. Collect only that information which is likely to be useful. The full address and passport details may be appropriate at a hotel but not at a national park reception. (Except in the case of foreigners.)

- Date/time of entry.
- Group size and composition (adults/children/youth: define by age).
- Private organized trip or commercial tour.
- Nationality/domicile.
- First/second/third/fourth visits during last three years.
- Accommodation (if overnight stay, government/private, price class).

INFORMATION TO COLLECT ON THE WAY OUT

Visitors should be required to return the permit when leaving and give additional information on the back of the form. If visitors leave through a different gate from entry, used permits may have to be periodically returned to the gate where they were issued.

- Date/time of departure (for duration of stay).
- Wildlife seen (sighting of tiger/leopard and other rare sightings).
- Complaints/suggestions/comments.

VISITOR NUMBERS, AVERAGE DURATION OF STAY, VISITOR DAYS 1983-1988

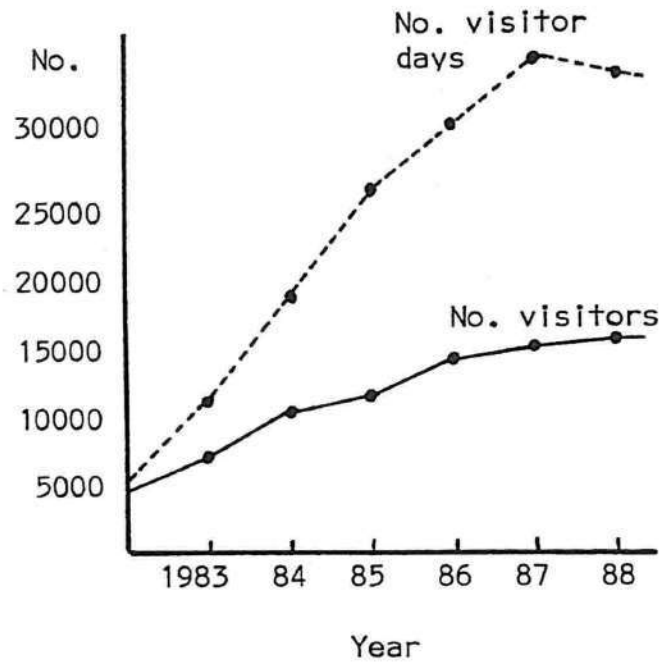
Year	No.of Visitors	Average Duration (days)	Visitor Days
1983	5,940	1.6	9,504
1984	8,800	1.8	15,840
1985	9,950	2.3	22,885
1986	12,000	2.2	26,400
1987	12,600	2.4	30,240
1988	13,240	2.2	29,128

ANALYSING THE DATA

- Number of visitors: daily,monthly, yearly totals.
- Peaks: months, days, hours of the day with minimum number of visitors.
- Duration of stay: percentage of visitors staying one, two, three, four days or longer, percentage of day visitors.
- Visitor days: total number of visitor-days,percentage of total visitor-days by sub-group (e.g. foreigners).
- Group size: in classes (1-2, 3-5, over 5, large tour groups 15-40).
- Nationality/domicile: local, regional, distant, foreigners.
- Repeat visits: proportion of first visits and repeat visits.
- Accommodation: proportion of visitors staying overnight outside/inside the park; occupancy for different places and price classes

PRESENTATION OF THE DATA

Present the data as totals, sub-totals, or percentages (proportions). Present them in the form of tables, line graphs, histograms, or pie-charts as shown.

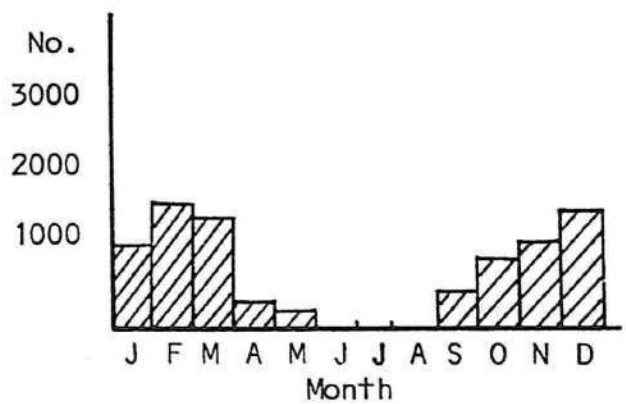


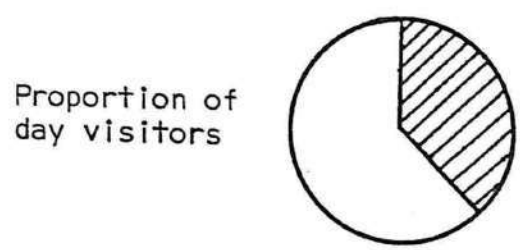
SAMPLING

Where continuous records are not maintained, as in some deerparks or sanctuaries, one can approximate visitor numbers by sampling. List the days on which, judging from past experience, there is peak, high, medium, low visitation.

Do a count on all the days with peak visitation. Decide on the number of samples to take in the other periods, let's say 5% (of 365 days) which amounts to 18 sampling days. The number of samples in each period should be in proportion to the number of days each period occupies. In the example one should spend 7 sample days on the medium, 6 on the high, and 5 on the low visitation period.

If the first sampling cycle reveals that an overwhelming majority of visitors come in a certain period, limit future sampling to that period.





Visitor Feedback & its Evaluation

TO HELP THE MANAGER EVALUATE VISITOR OPINION

Many factors which determine a person's enjoyment of a visit to a park are under the manager's control;courteousness and efficiency of staff, provision of information, quality and safety of amenities. To find out more about the visitors and their opinion in respect to facilities, programmes and services offered, devise a questionnaire as outlined.

Expensive but little used facilities and unnecessary restrictions may result from failure to observe and interpret visitor activity patterns. These can be deduced from direct observation. Recorded observation yields data about where people go and how long they stay in any one place or whether they actually use the facilities provided as intended. This may help decide where to encourage and where to discourage access and where to place additional facilities or improve existing ones. Data should be collected at intervals of 2-4 years.

This technique deals with questionnaire design and systematic observation of facility use.

PREPARING A QUESTIONNAIRE

Objectives

Be clear about overall ojectives, e.g. to measure "Visitor Satisfaction" (see box) or to evaluate "Visitor Expectations" (see sample questionnaire).

Setting up and Testing

To determine the variety of opinions and feelings on a topic for the questionnaire survey, discuss it first informally with visitors and staff. The questions should then be phrased so as to elicit the answers relevant to the objectives. This is more difficult than it sounds and a questionnaire may have to be revised several times. Conduct a few trial runs. Delete or rephrase questions which are too time-consuming or ambiguous.

Maintain the focus on the objectives. If the questionnaire threatens to become too long, eliminate questions which will yield the least information in respect to the stated objective.

General Guidelines

1. Recording personal data like name and address is time consuming and irrelevant.

2. Multiple choice questions are difficult to write but easier to evaluate than "what" and "why" questions.

MEASURES OF VISITOR SATISFACTION

Below are some measures of visitor satisfaction, together with an example of a relevant question:

- ***Attractiveness of the area***
  (How many time have you come here in the last 2 years?)
- ***Helpfulness of staff***
  (How would you judge the services of staff at the gate? Would you like to comment on a specific incident?)
- ***Quality of Wildlife Viewing***
  (What was the quality of wildlife viewing in your opinion? If it did not meet your expectations, please explain how.)
- ***Activity Opportunities***
  (What was the purpose of your visit? Was it achieved?)
- ***Quality of Facilities***
  (Which of the following facilities did you use? Were they in good condition, adequate, or poorly maintained. Can you suggest improvements?)
- ***Crowding***
  (Did you generally feel there were too many people? Did you feel inconvenienced by other visitors in any way? If yes, where and why?)

3. Keep the questionnaire short. The majority of visitors should need no more than ten minutes to fill it in.

4. Give people an opportunity to come up with unprompted comments.

5. Do not ask questions which beg a certain answer, like "Did you come here for education?"

6. Date and time of administering the questionnaire are important in relating satisfaction to crowdedness during peak visitation.

Types of Answers

1. <u>"Yes" or "No"</u> lead to one or more additional questions. e.g. Did you attend the film show? If yes,how interesting was it? If no, what was the reason?

2. <u>Ranking</u> e.g How interesting was the film show? Very interesting/ interesting/not very interesting/ boring.

3. <u>Multiple choice</u> e.g. Why did you not attend the film show?
   ( ) Did not see an announcement
   ( ) Timing was inconvenient
   ( ) Could not get in, too crowded
   ( ) Title did not look interesting

4. <u>Suggestions or complaints</u> Do you have any suggestions for improvement? Such open ended questions give people an opportunity to air their grievances and make suggestions.

Questionnaire on visitors' activity preferences and expectations re seeing tiger

QUESTIONNAIRE *Date:_____* *Time:_____*

DEAR VISITOR: TO HELP US LEARN MORE ABOUT OUR VISITORS AND THEIR EXPECTATIONS WOULD YOU PLEASE SPARE A FEW MINUTES FOR FILLING IN THIS QUESTIONNAIRE? THANK YOU. The Manager.

Please tick off the appropriate answer.

1. *What is your home town?* _____

2. *Did you come alone or with a group? Including yourself, how many people are in your group? alone _____ ; group of family/friends _____ ; commercial tour group _____.*

3. *Have you been to this park before? (no) (yes) _____ time(s)*

4. *What do you look forward to doing in the park? (Please tick off only four activities which are most important to you)*

( ) *wildlife viewing from car*	( ) *see everything there is to see*
( ) *wildlife viewing from machan/hide*	( ) *picnic with friends or family*
( ) *wildlife viewing from elephant*	( ) *hiking or walking*
( ) *see a tiger or leopard*	( ) *play cricket/volleyball/badmin.*
( ) *bird watching*	( ) *visit a temple (_____)*
( ) *wildlife photography*	( ) *relax in natural surroundings*
( ) *idenfity and study plants/animals*	( ) _____
( ) *enjoy peace and solitude*	( ) _____

5. *How long do you intend to stay this time?* _____ *hours* _____*days.*

6. *Have you seen a tiger or leopard in the wild before? (yes) (no)*

7. *Please mark the statement which best reflects your own feelings in respect to the sighting of tiger.*
   ( ) *This is a tiger reserve, naturally I expect to see a tiger.*
   ( ) *To see a tiger would be exciting but I did not come here mainly to see a tiger.*

8. *In case you leave without having seen a tiger, how would you feel?*
   ( ) *cheated* ( ) *very disappointed*
   ( ) *slightly disappointed* ( ) *not disappointed at all*

9. *What do you think is your chance of actually seeing a tiger in this Park?*
   ( ) *90%* ( ) *70%* ( ) *50%* ( ) *30%* ( ) *10%*

10. *If you do not see a tiger, you can often tell whether it is or was around. Can you list some of the signs?* _____ _____ _____ _____

ADMINISTERING THE QUESTIONNAIRE

A questionnaire filled in by the visitor himself is the most convenient but one must ensure that the questions are well understood and easy to answer. Such self-administered questionnaires require little extra work and all groups visiting in a season can, in theory, be interviewed this way. However, to save paper and work when interpreting the results, sample size should be limited to about 1,000 as additional samples will not greatly improve the results.

When and where to hand out the questionnaire depends partly on the objective. If the main aim is to find out about visitors' expectations, then people ought to fill it in as they enter the park. Questions about satisfaction with services, programme and facilities must, of course, be asked at the end of the visit.

The person handling the entry formalities for a group will generally be the one to fill in a questionnaire on behalf of a group. Because of this, the opinion of women and children may be somewhat under-represented.

Alternatively, a questionnaire can be given to every tenth party passing through the gate. It may be addressed to specific age groups. Leaving the choice to the recorder might introduce a bias in the selection of samples.

EVALUATION BY OBSERVATION

Sometimes it is better to infer visitor satisfaction from direct observation. Especially the routes and areas which visitors prefer can be well determined through observation.

It is possible to classify areas according to use intensity. Useful data about the time visitors actually spend in potentially sensitive areas can thus be obtained. Conclusions can be drawn as to how recreational use is distributed within the area.

Two questions need to be answered.

On a busy day how many user units reach or enter area X?

What proportion of all user units enter areas X, Y, Z?

What is a User-unit?

A "user-unit" can refer to a vehicle, to a riding elephant, to an individual or to a group of visitors.

When trying to find out about the use of a particular network of tracks for wildlife viewing from car, it is better - and easier - to count the number of cars within a given period of time and not the number of people sitting in them. The "user-unit" in this case is vehicles entering the area.

Collecting the Data

On a map, identify distinct activity areas, such as wildlife viewing loops or trail locations, which are to be examined. Locate the bottlenecks which control access.

For the count of user-units entering the area, choose five or more days when many visitors are expected. Post an observer at each entry point to record entries and exits either all day or during the main visiting hours.

Note time and other features as considered relevant (vehicle, group size, foreigners). For comparability, conduct the counts for all areas simultaneously. According to the results classify areas as low, medium or heavy use area.

Time	People		Remarks
	In	Out	

Visitor Distribution at Bharatpur

Concern about visitor impact on bird nesting was voiced in the Keoladeo Ghana National Park (Bharatpur). The concern was based mainly only the increasing numbers of tourists entering the park but was at first not substantiated by observations.

Two counts from 6 a.m. to 7 p.m. showed that (a) 90% of all visitors stayed on the 4 km long main road connecting the gate with the temple in the middle of the park, (b) over 20% visited the temple, (c) fewer than 3% walked more than one kilometer along the dyke bunds away from the road.

Conclusions: Only observation of the activities of the minority who venture close to the nesting sites can yield evidence of impact on nesting success. Total visitor numbers entering the park or walking along the main bund is not a good indicator because most nesting sites are well away from the main bund.

Analyzing the Data

The results of observation will often, as in the example, bring suspected problems into sharper focus and lead to additional observation and studies. If an area appears underused, try to find out the cause and eliminate it if possible.

If there is reason to believe that visitor carrying capacity has been reached in a heavy use area, one may regulate entry by issuing tokens which permit use in a specified area perhaps during a specified time.

Interpretive Planning

TO HELP THE MANAGER WRITE AN INTERPRETIVE PLAN.

Education and interpretation of park resources is part of the overall tourism management effort and has the same objectives, with an emphasis on increasing public support for wildlife conservation by creating understanding and fostering awareness and concern in respect to conservation needs.

If a budget and staff are assigned to meet the objectives in a variety of ways, one should also have an interpretive plan. It is assumed that a tourism management plan exists which describes the resources and major facilities required to support an existing or planned interpretation programme. The interpretive plan specifies what will be interpreted where, when and how.

Ideally, an interpretive plan is prepared by a team consisting of a designated education officer and specialists (architect, historian, designer, writer) who bring in their professional expertise when needed. The planning process starts by defining the themes one is likely to deal with under each interpretation objective. Messages are then developed under each theme for which the planners select the most effective and practical media.

How to develop and write the components of an interpretive plan is described below.

WHAT IS INTERPRETATION

"An educational activity which aims to reveal meaning and relationships through the use of original objects, by firsthand experience, and by illustrative media, rather than simply to communicate factual information".

Freeman Tilden

- *Informs about*
  - *the most significant features which need to be protected (animal species, habitat, historic sites);*
  - *why they need protection;*
  - *management problems;*
  - *research.*
- *Provides orientation.*
- *Creates concern for*
  - *endangered species; and*
  - *ecosystems.*
- *Satisfies people's curiosity.*
- *Publisizes the available activities and attractions.*
- *Warns and guides.*

PLAN COMPONENTS

Note: A collection of reference materials (working plans, species lists, historic accounts, research reports) about the area should be available to the planning team.

1. Objectives

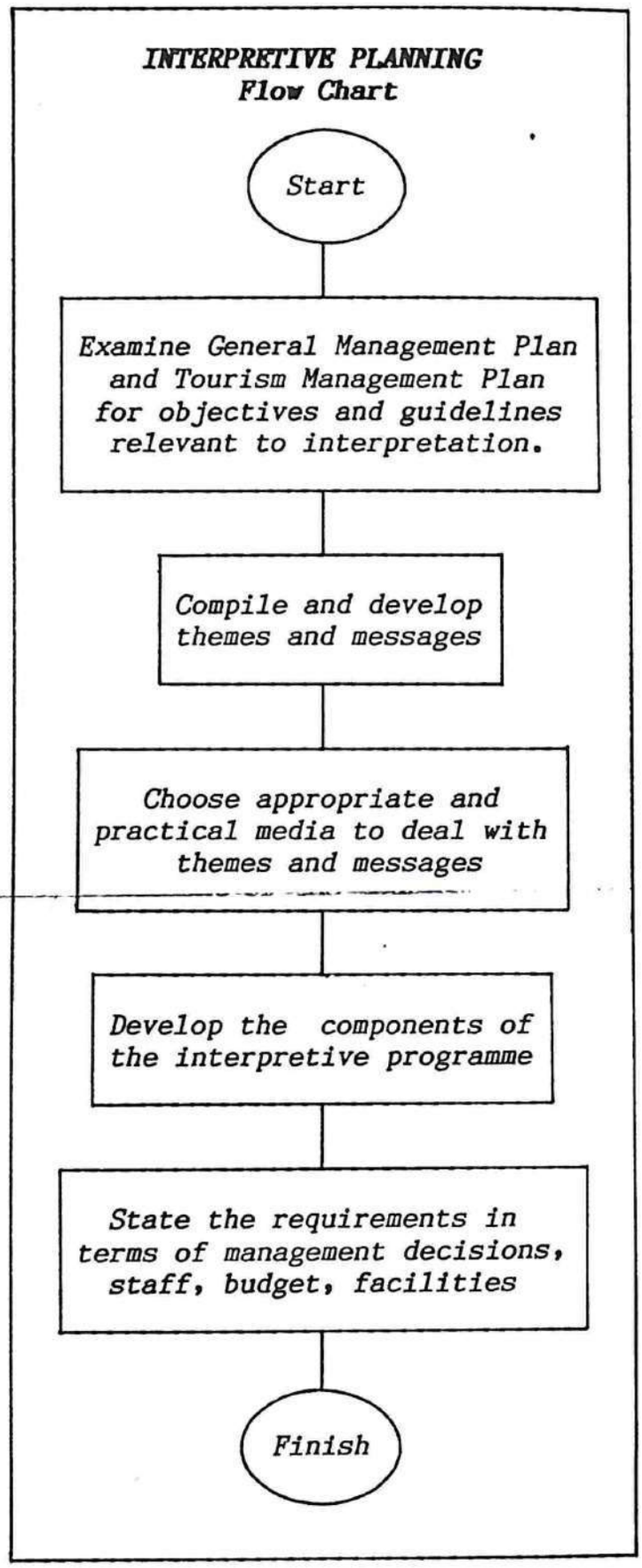
In this section clarify the kind of action required to attain the objectives noted above. Elaborate on the proposed action so that the major themes and focal points of an interpretive programme become apparent.

2. Factors influencing the Choice of Interpretive Services and Facilities.

In this section, summarize relevant material from the tourism management plan and draw conclusions in respect to interpretation. The conclusions should follow from what has been said in the policy statement of the tourism management plan.

- Visitor expectations

  How well do the existing services and facilities meet the visitor's expectations?
  Should special facilities, services, activities be offered for specific groups, e.g day-visitors, children, groups on organized visits?
  How much time does the average visitor have to take advantage of interpretive programmes or activities?
  What do we know about preferred activities? How suitable are they as vehicles for education and interpretation?



THEMES, MESSAGES, MEDIA

When preparing an interpretive programme one needs to be clear about its components, especially the following

1. *What are the main topics one should deal with? (Themes)*
2. *What are the "bits" of information you want to convey under each theme? (Messages)*
3. *What are the most suitable means to present the theme and convey the messages? (Media)*

It may help to first choose from the list of media (right) those which can be comfortably handled with the available expertise and resources.

Formulating themes and messages requires some practice. The difficulty lies in phrasing them so they are neither too general nor overly detailed.

Media

Attended Services
- *Information desk*
- *Interpretive talk*
- *Guided tour*
- *Guided activities*
- *Demonstration*

Unattended Services
- *Publications*
- *Audio-visual programmes*
- *Notice board*
- *Signboard*

Facilities
- *Area map*
- *Nature trail*
- *Wildlife viewing circuit*
- *Wayside display*
- *Nature camp*
- *Visitor centre*
- *Indoor exhibits/models*
- *Live animal exhibits*

EXAMPLE

Visit to the Elephant Stable

Objective: *Show advantages and cost of maintaining riding elephants. Satisfy people's curiosity and give them something to do in the afternoon.*

Theme: *Usefulness and care of domestic elephants.*

Messages: *Domestic elephants are trained to do a variety of tasks.*
They understand and follow two dozen commands.
They need a daily bath.
They require substantial amounts of supplementary food.
Their toe nails need to be cut periodically.

Media: *Conducted tour and demonstration.*

N.B. Programme for visit is developed in later box.

- Activity areas
  Which development areas and sites are best suited for interpretation? Now or in the future? What are the main interpretive resources in each area and site and how may they be used to full advantage?
  What are the most suitable area or site specific interpretive themes?

- Major facilities an services.
  Based on known trends in visitor numbers and projections for the future as well as management priorities, what is the required capacity of services and facilities? Should they be planned to cope with peak demand or not?

- Management concerns
  Which management concerns should be covered by interpretation?

3. The Interpretive Programme

The programme consists of attended or unattended services which are supported or complemented by facilities. Plans for each service and facility have to be developed in sufficient detail to know what needs to be done for what purpose, where and when.

Compile the essential information for each on a separate sheet using the outline given below.

1. Descriptive title
2. Functions/purpose
3. Themes/messages
4. Description of the service/facility
5. Location
6. Bookings/schedule/duration
7. Supervision/implementing staff
8. Announcement details
9. Anticipated problems

Some programme components, like the "visit to the elephant stable" do not need a great deal of preparation. Once the implementing staff has been identified, the programme contents need to be sketched out and practiced for a few afternoons.

Other programme components may be very complex. A visitor centre and the associated services for example. For these, detailed plans will have to be developed with the help of subject specialists.

In this section, do not include technical details about facilities and equipment or layout and text. These go either into the following section or into an appendix for detail plans.

Whether or not detail plans are required, the essential information about each programme component should be condensed into a single page if at all possible.

*Title: **Visit to the Elephant Stables***

Purpose: Visitors learn to appreciate the advantages as well as the effort and cost of maintaining riding elephants.

Themes/messages: as noted previously

Description: Conducted Tour - Visitors observe food preparation and feeding. They accompany elephants and their caretakers to the river to see bathing and may be invited to help. They watch a demonstration of what elephants have been trained to do. The visit ends with a question and answer session.

Location: Elephant stables and bathing sites.

Bookings/Schedule: Bookings should be made in the reception office in the evening or morning before. Up to eight participants. The activity is conducted daily during the tourist season depending on demand. Timing is such that it conflicts least with elephant management. Participants meet in front of the lodge entrance. Duration is about 20 min.,or 45 min. if elephant bathing is included.

Staff: Two designated Hindi and English speaking guides will be trained to conduct the tour. Mahouts and cutters will also participte in the training.

Announcements: The activity is advertised in the information brochures, on a notice board at the entrance gate and in flatwork displays at the tourist accommodation complexes

4. Requirements

In this section, describe the requirements in respect to facilities, equipment and staff to operate and maintain it.

- Existing facilities
  Function, condition, maintenance, renovation, expansion.

- New facilities
  Function, major specifications, location, additional requirements, e.g. access road

- Staff
  Description of duties, experience and education, training required, time when required.

- Management decisions
  Sometimes certain management decisions have to be taken before plans can be implemented, e.g. adjustment of the tourism zone, approval to start off-site school extension, institution of an impact monitoring programme.

FACILITIES FOR EDUCATION & TOURISM

INTRODUCTION TO THE SECTION

A facility should always be set up because it is ***needed*** *- whether it is a directional sign or a sophisticated visitor centre. Needs are obviously different in places like Borivili National Park at the outskirts of Bombay, with over a million visitors, and a park with a few thousand visitors per year. Deer parks and zoos have different requirements from national parks.*

Recreational activities must be ***compatible with the conservation objectives*** *of a protected area which should determine whether a particular facility can even be considered. No argument could justify opening a golf course in a national park!*

Cost *should be proportionate to the anticipated use. Costly projects, such as safari parks, in remote places with few visitors often amount to a state subsidy of recreation by a small group of users.*

Facilities must be ***functional.*** *An unread sign does not serve its purpose and is a waste of effort and money. No facility can remain functional indefinitely if it is not maintained, updated, improved. Most facilities are meant to support specific services, e.g. an auditorium supports regular talks and audiovisual programmes. Good facilities are* ***appealing*** *as well as functional. Aesthetic aspects of design should not be underestimated. Indigenous designs and natural materials, such as wood, stone, brick and thatch are more in harmony with the surroundings than concrete or corrugated iron.*

Aim for simplicity, with minimum of cost and construction for a maximum of use, and least disturbance of the environment.A well maintained lawn under a big shade tree is far superior as a picnic site to a concrete platform shaded by a tin sheet umbrella. Give priority to planting, maintenance and cleanliness. New facilities should not even be considered if maintenance of the old ones is a problem.

This section presents the planning and design of basic facilities.

SECTION CONTENTS

Signage

TO HELP THE MANAGER WITH THE DESIGN, POSTING AND MAINTENANCE OF SIGNAGE.

Signs are the most widely used method to direct visitors. Good signs help people find their way and prevent tedious inquiries. They can furnish interesting information at the wayside and warn where necessary.

A great proliferation of signs dotting the wayside in some parks and sanctuaries suggests that managers place too much trust in the usefulness of signs. Rule number one of signposting: ***"Keep the number of signs to the absolute minimum".***

To avoid putting up superfluous signs one must know where they are truly needed and of what kind. Signs (a) show the way to a place ***(directional signs);*** *(b) help the visitor orient himself or give instructions* ***(orientation signs)*** *and (c) convey a conservation message* ***(interpretative signs).***

All areas with visitors need some directional and orientation signs. Interpretive signs are somewhat more difficult to design, construct and maintain.

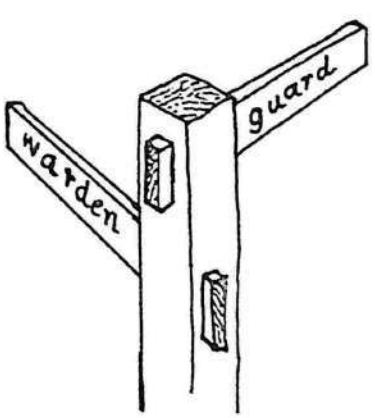
As highly visible products of management efforts, signs deserve more care than they commonly receive. Well desgined, functional and sparingly placed signs reflect well on management but they cannot be made and maintained without skilled craftsmen. A standardized design can enhance recognition and appearance. Tattered, rusty, faded and illegible signs indicate poor management. Therefore, ***never put up a sign you cannot maintain***

This technique deals with the planning and design of signage.

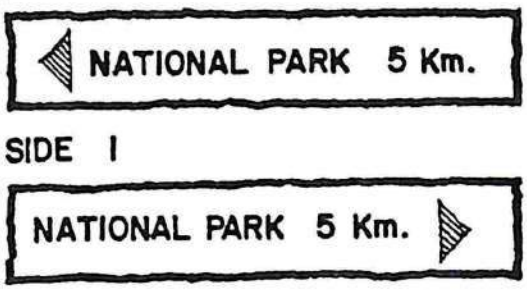
TYPES OF SIGNS

Directional Signs

These signs show the way to the entraance gates of your area, beginning at the nearest town of importance. Past the gate they help people find destinations and attractions inside the park.



Directional signs should be put up at all places where people may conceivably go in the wrong direction. They are necessary at all road forks and intersections, but they should only be put up after traffic flow has been decided. The indicated direction should be unmistakable (use conspicuous arrows). If the sign has to be read from both sides, ensure that the direction arrow is on the left of the lettering on one side and to the right of the lettering on the other. Indicate distances in km or in terms of time needed to cover it.

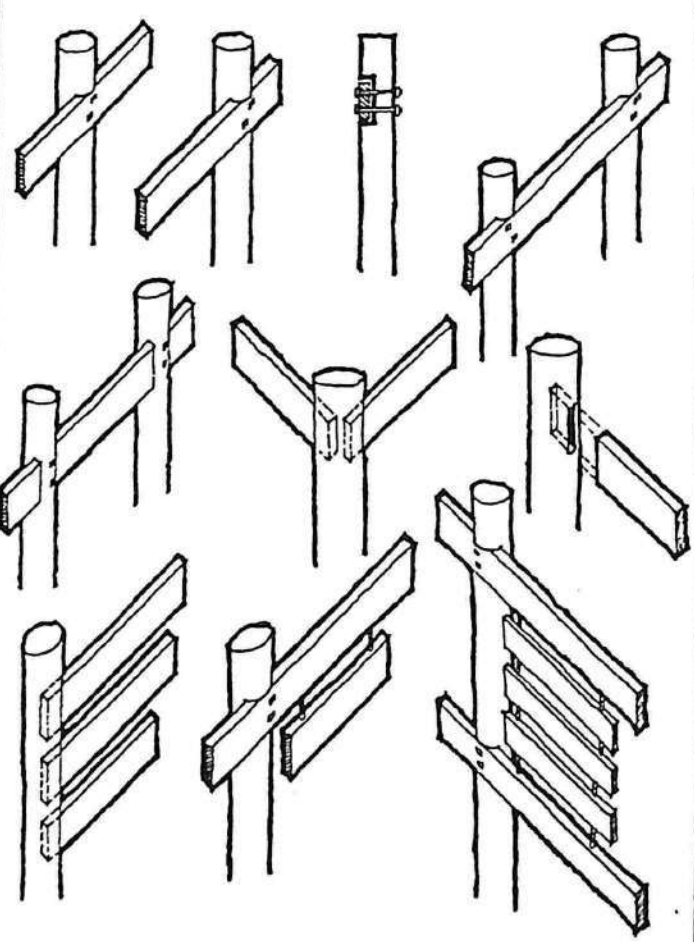


Orientation Signs

These are signs of the "you are here" type and comprise the entrance signs, area maps and building labels.

- Entrance signs should be large and conspicuous, interesting but not over-elaborate or ostentatious.
- Area maps are essential in places with many visitors. One must be placed near the entrance and more might be required elsewhere. (Public 2.2).
- Building labels are required in the development sites to identify places like restaurant, administrative offices, ticket booth etc. If necessary they may also carry additional information, e.g. opening hours. Longer texts like tariff charts or programme schedules are better presented on a separate board.
- Building labels can be mounted flat against the building wall or on posts in front of it.

Different methods for mounting signs



Interpretive Signs

These signs are put up along trails or at scenic viewpoints to draw attention to and explain interesting features. The simplest type of interpretive sign is a number sign which refers to text in a guide booklet. The design of text and layout, as well as construction, of other interpretive signs requires professional skills. A budget for these is normally justified only in places with high visitor numbers.

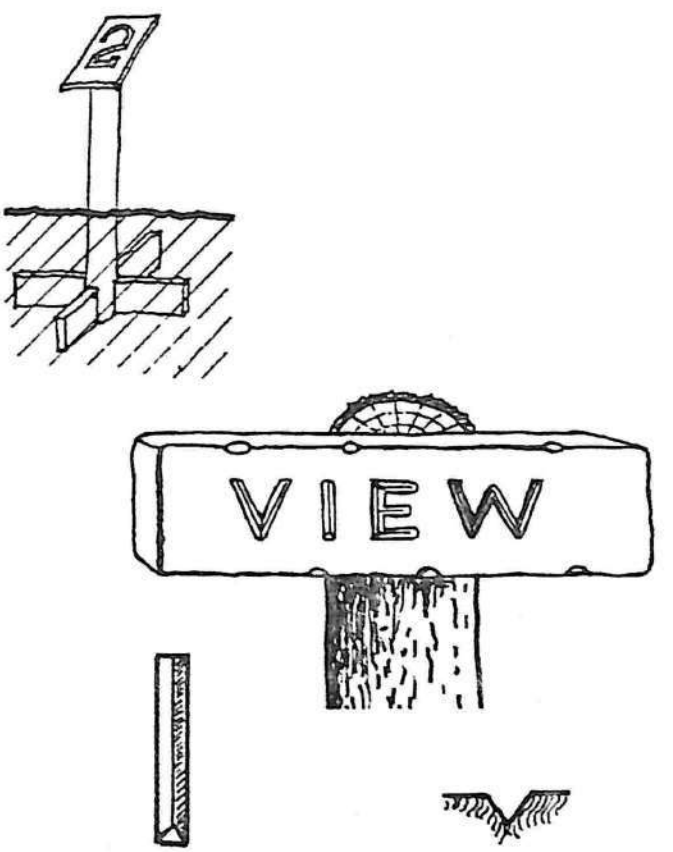
When wooden signposts are frequently damaged by wild elephants, a stone or wooden slab set into a pile of stones cemented together forms an "elephant proof" alternative.

SIGN MATERIALS AND CONSTRUCTION

Cost, appeal, ease of construction and durability should be considered when choosing materials. Wood and natural stone are the preferred materials, but tin sheets or plywood may be necessary when large surfaces are needed. In many parts of India much more use could be made of carved sandstone which is very durable. Parks in forested areas could salvage fallen trees and driftwood to build signs which are attractive as well as durable. The heartwood of some species is very resistant to moisture and termites, even without treatment.

The base of signposts should be buried at least 50 cm deep and should either be fitted with a wooden crosspiece to anchor the post firmly in the ground or grouted in concrete.

Lettering can be painted on or carved into the signboard surface. Carving is slower than painting and mistakes cannot be erased, but it is well worth the additional effort because the lettering is much more durable.



DESIGN

Standardized Design

A standardized design facilitates message recognition and maintenance. Consider standardizing the following:

- Lettering style and size: Choose a simple and easily readable style. Select a set of three letter sizes to fit various purposes.
- Language: Decide which langauge is most appropriate. Are bi-lingual signs required?
- Materials: Specify the signboard and post material (type of wood, thickness of board, size and height of posts).
- Symbols: Symbols can make signage easier to read, but choose only symbols which are easily understood by most people and which are not too difficult to reproduce.
- Colour: Choose a contrasting colour for the lettering. Consider colour-coding of some information.

Lettering

Upper and lower case lettering is easier to read than all capitals.

A letter height of 5 cm is sufficient for most signs. For longer messages use letters 3 cm high. This is also the smallest size which can be conveniently carved into wood.

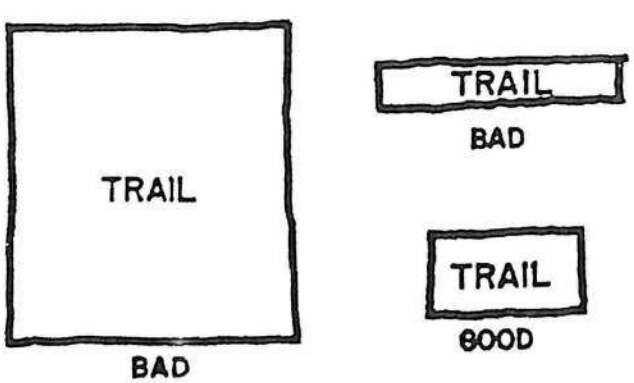
Lettering which must be read from passing vehicles should be 7.5-10 cm high.

Letters on large entrance signs may have a height of 10 cm or more.

Layout

The text should be placed on the board in such a way that it is easy to read and "visually balanced".

For readability it is important to have margins, and proper spacing between words and lines. Centring the text on the board is the most common method to achieve visual balance, but size of board and text must also be considered.



Colour

Bright colours are not in keeping with the objectives of a national park or sanctuary. The colour contrast of signs with red/green background widely used in some parts of India detracts from the text they carry. White lettering on a dark (brown or black) background should be chosen as a rule. Wood can also be stained, while sandstone should be allowed to retain its original colour. If this is reddish or ochre, lettering has to be black in order to contrast.

SIGN LOCATION AND MAINTENANCE RECORD

To ensure systematic inspection and maintenance set up a signage record which and describes all signs and shows their locations on a map. Each sign should be given a serial number under which it is entered on the map. The description includes text, sign material, and date of first posting. An inspection schedule should be set up to ensure that all signs are periodically checked and these checks should be entered in the record.

Designing an Area Map

TO HELP THE MANAGER WITH THE CHOICE OF LOCATION, INFORMATION CONTENT AND CONSTRUCTION OF AN AREA MAP.

Visitors, having arrived at the entrance gate to the park are keen to find out what there is to do and where they can go from there. An area map provides that information at a glance.

In order for people to remember the information, it must be kept to a minimum which must be as clearly presented as posible.

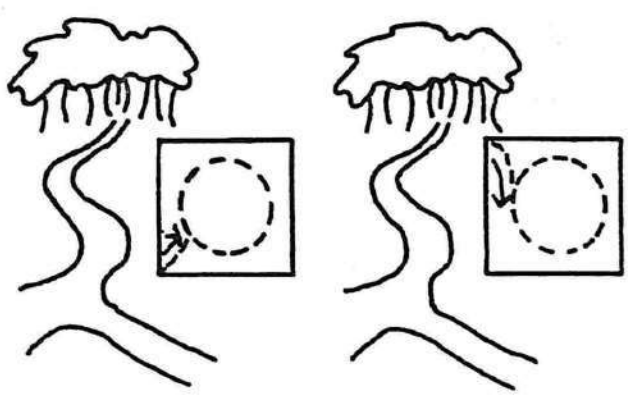
A single area map is enough where activities are limited to a single scenic or wildlife viewing drive. If there are a number of distinct activity areas (e.g. wildlife viewing routes 1/2/3 trails, or picnic sites), additional area maps of these sub-units may be required.

Guidance on the location, content and presentation of area maps is given below.

LOCATION OF AREA MAPS

An area map should be placed prominently near ticket office or car park at the gate (or gates). The map should be so oriented that for the observer the entry road on the ground is in the same direction as on the map.

Additional area maps may be necessary at trail heads or other distinct sub-units of the recreation zone. If area maps are not set up in these places because of cost and difficulty of maintenance, the maps can be shown as insets on printed maps of the park.



Correct Incorrect

INFORMATION CONTENT

Information is shown on the map itself and contained in brief text written on the same board. The map should orientate the visitor towards the location and access to activity areas. To do

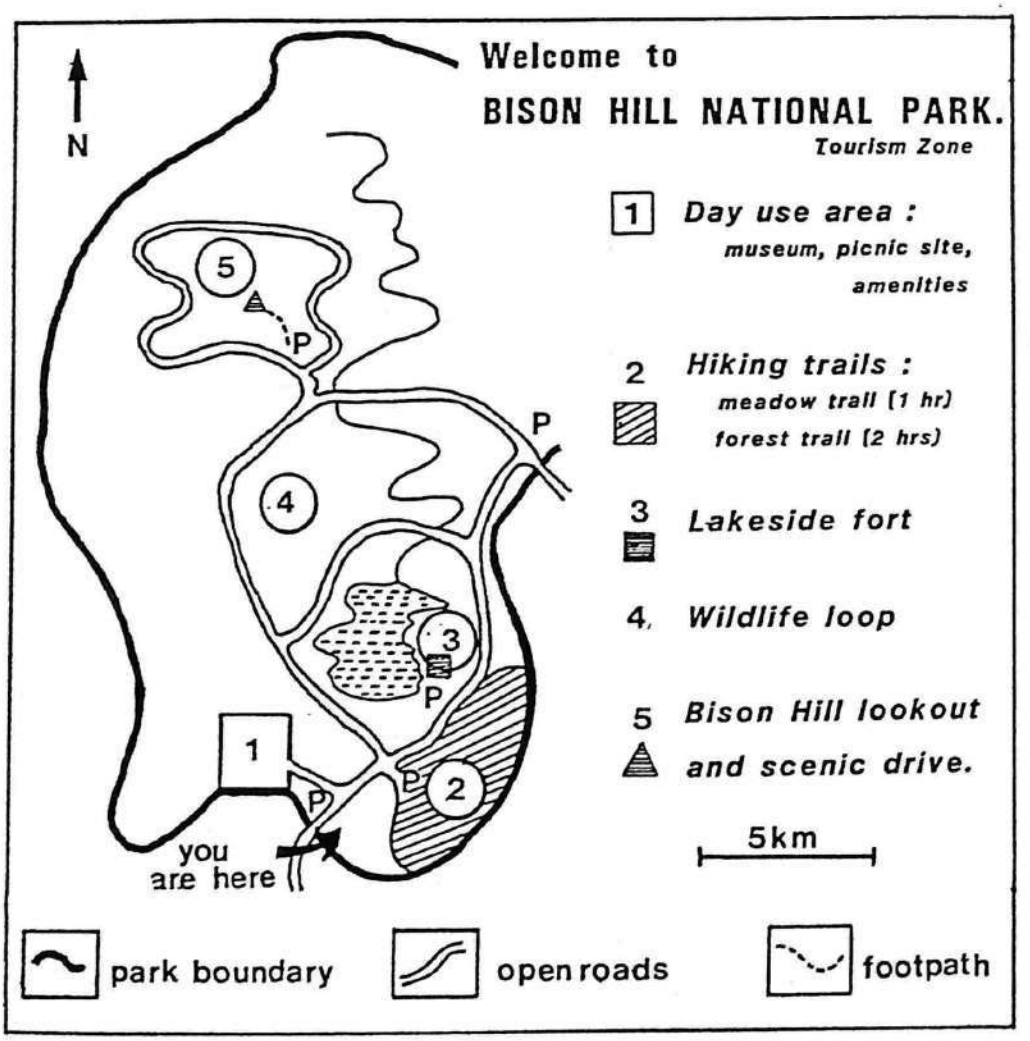
this well, it cannot be cluttered with detail. The various individual attractions within an activity area are often too numerous for an area map to accommodate comfortably. The attractions offered in these areas are thus best noted not on the map itself, but in the legend.

The pictorial part of the map should show the following:

- Position of the map (you are here)
- Boundary of the area
- Entry point or points
- Parking lots
- Open roads (closed roads are irrelevant)
- Major attractions (or activity areas)
- Major bodies of water/rivers/ streams
- Major amenities (day use area, toilets)
- Scale/distance

The text part of the map may contain all or some of the following:

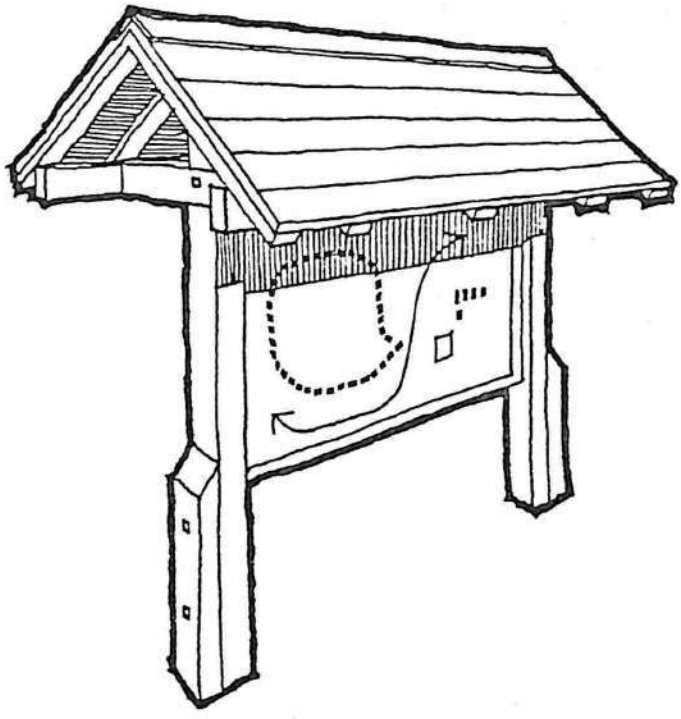
- Welcome and/or name of the area
- Legend
- Description of major attractions and activities
- Rules for access (e.g. areas open for walking)
- Text should be brief and to the point.



CONSTRUCTION MATERIALS

The choice of materials offering a smooth large surface is limited. Plywood, readily available in most places, must be protected from rain and well finished by paint. Acrylic plastic which is not susceptible to weathering and which comes in many colours is expensive and not readily available. Tin sheet can be used if nailed to a sturdy frame, or backed by timber boarding.

The support structure is best made from timber although natural stone may be used where timber is difficult to get. The roof cover can be made of tiles, shingle, thatch, clap-board or bamboo.



Setting up Hides and Machans

TO FAMILIARIZE THE MANAGER WITH THE CONSIDERATIONS INVOLVED IN LOCATION, USE AND DESIGN OF MACHANS AND HIDES.

Machan: An elevated platform to faciliate wildlife observation.

Hide: A structure to facilitate wildlife observation by hiding the observer - normally at ground level.

Many Indian parks and sanctuaries still have machans used in the old days by the hunter. These structures now help the wildlife photographer shoot good pictures and the visitor to enjoy observing wild animals. They increase the visitor's chance of seeing wildlife and they reduce disturbance because people quietly sit and wait for animals to come instead of moving around and looking for them.

Hides and machans hide movement and muffle sounds thus allowing one to approach wildlife more closely, safely and in relative comfort. Hides and machans are not the same as look-outs and observation towers which are built especially for appreciation of a scenic view or as fire-watch towers.

Location, types and design of hides and machans are discussed in this technique.

LOCATION

Hides and machans should be built in the tourism zone. To ensure regular use by visitors, as well as inspection and maintenance, they should not be set up in remote areas.

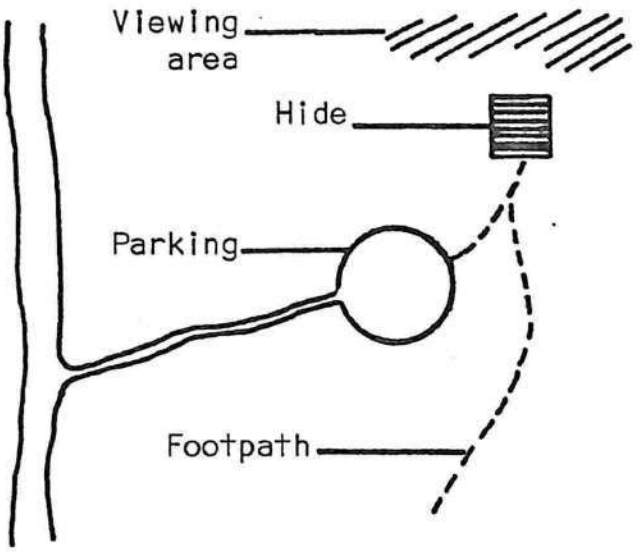
Hides and machans should overlook places which attract wildlife e.g. wallows, waterholes, saltlicks, meadows. One can also attract wildlife to the machan by installing artificial saltlicks or waterholes (see Habitat 1.3).

Hides and machans should be built inside cover, but with a clear view into an open area. It may be necessary to plant cover or to judiciously remove trees or shrubs which obstruct the view.

ACCESS

If access is allowed on foot, the path should be routed so as not to disturb wildlife in the area overlooked by the hide or machan. Occasionally, it may be desirable to surface the path with rice husk, saw dust or similar materials to allow a silent approach.

If access is by car,the final approach should be on foot from a small parking lot 100 m away. Safety should be considered and visitors should be duly warned or accompanied by a guard if the approach on foot may be dangerous.



REGULATION OF USE

The majority of visitors do not have the patience to sit up in a machan for a long time. Only a minority are prepared to spend as long as an hour or possibly the night. For them, nothing could be more annoying than a group of noisy newcomers who frighten away some animals and leave again after ten minutes. Regulations should be designed to prevent such situations.

If the approach road is padlocked, visitors can pick up a key at the entry gate against a deposit and while they occupy the machan no other party would be allowed to use it. Similiarly tokens which authorize use of a particular machan could be handed out against a small fee.

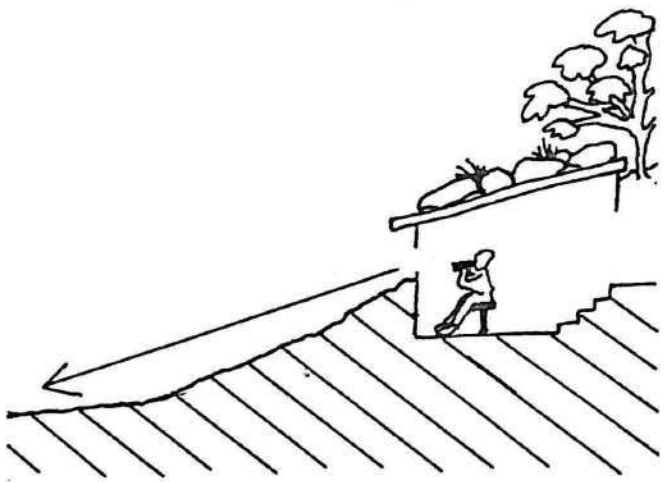
In case this is not a practical solution or if there is much demand for short term use by groups, people should be reminded to be silent, not to smoke, eat or drink and be considerate of others. Do not rely on the effectiveness of signs in ensuring compliance but instruct staff to enforce such rules.

Other points to consider: capacity, night stay permitted or not, hours during which it can be approached, permit required or not, safety.

STRUCTURE TYPES

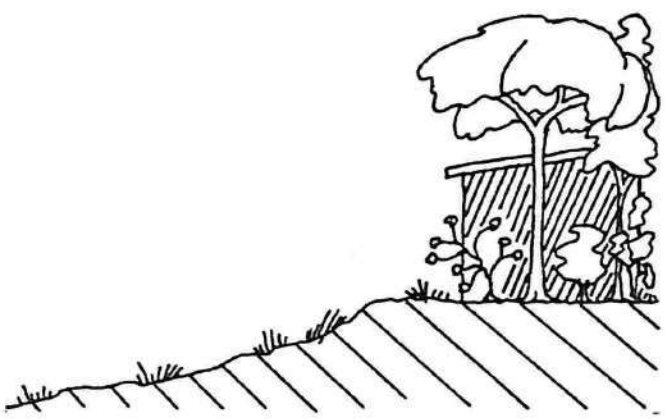
Bunker Type

In this type the hide is excavated and covered by a solid roof. The viewing slot is just above ground level. This is the preferred design in open terrain because there is no obtrusive structure and the roof is readily camouflaged.



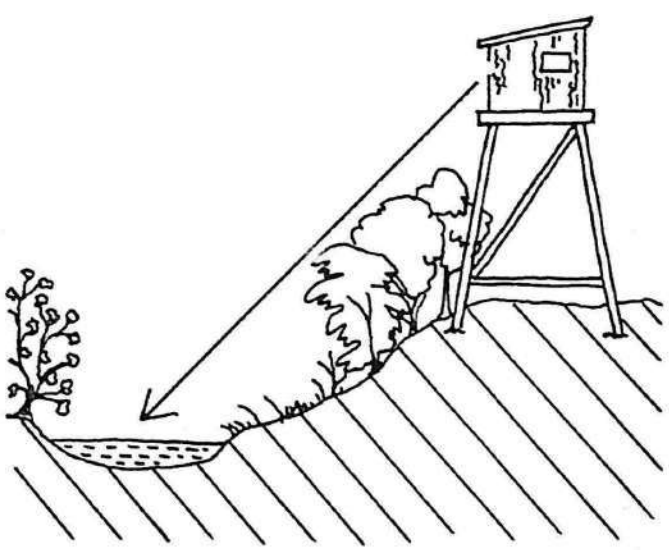
Ground Level Structures

Constructions at or near ground level are suitable on slopes or if overlooking a depression from a forest edge.



Elevated Structures

Best suited where a broad view is required of a relatively level area or of a place hidden by low but dense cover (e.g. a wallow). This can be a self- supporting structure or - aesthetically more pleasing - built into a tree.



DESIGN AND MATERIALS

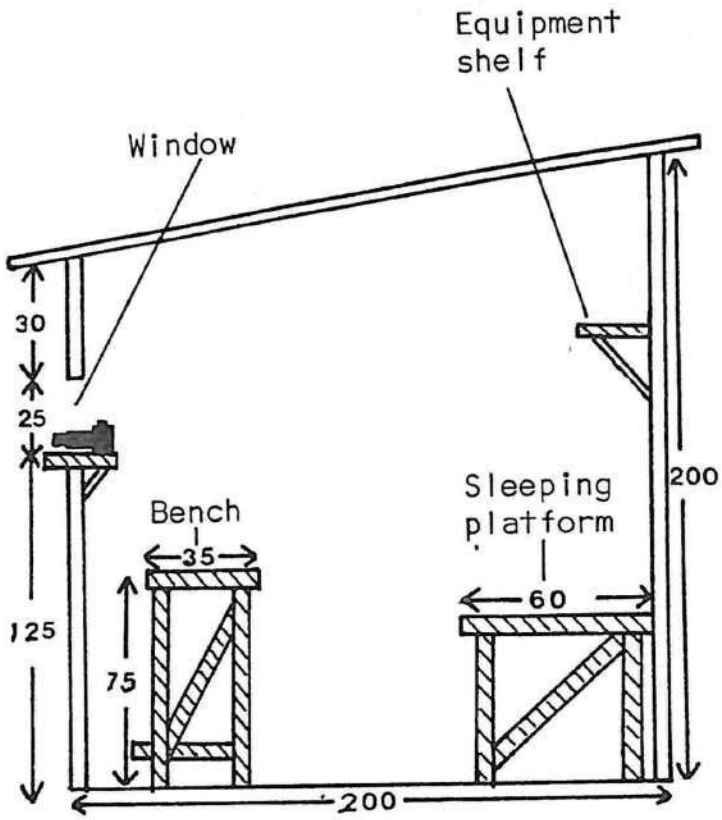
The Interior

A windowsill for resting elbows and placing cameras and binoculars, a bench and foot rest are all that is required, unless, of course overnight stays are permitted, in which case sleeping platforms must be provided.

The size of the hide depends on how many people it needs to accommodate at one time. A floor space of about 12 sq m will provide enough room for small groups of 3-4 people for overnight stays.

The windows should be long and narrow (about 25 cm high) and at eye level when the user is sitting on the bench. Several windows at angles to each other, are better than one as they make it possible to view a much wider area. The ceiling of closed hides should be high enough to allow the use of movie-cameras.

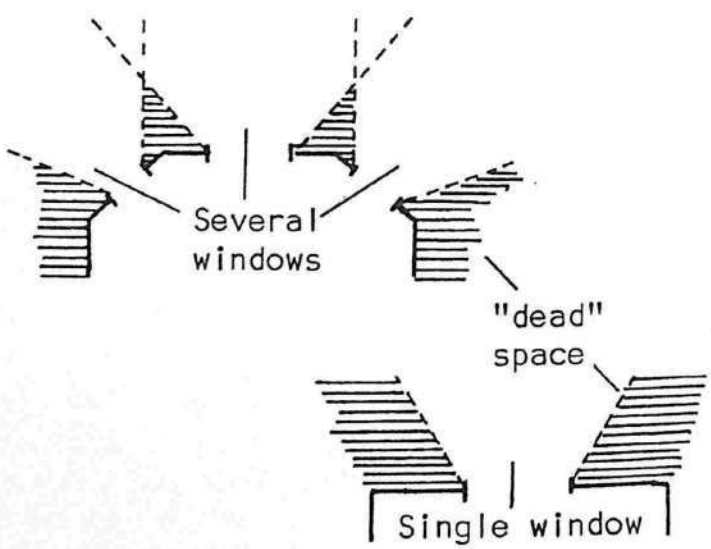
The windows should not be fitted with glass or mosquito screen. Both impede the view and tend to break or rust.



N.B. Measurements in cm.

Materials

Brick, concrete, natural stone and wood or bamboo and thatch are materials from which machans and hides can be built. Which is chosen depends on the requirements of strength and size. Those in elephant country and suitable for overnight stay must be very strong. Generally speaking, steel and concrete should be avoided in favour of natural stone and wood. Temporary designs set up for a single season may consist of no more than wooden posts and thatching grass.



Planning a Nature Trail

TO ACQUAINT THE MANAGER WITH THE MAIN PLANNING CONSIDERATIONS.

With the exception of the high altitude parks, travel on foot is justifably prohibited in most of India's protected areas. The reasons are the high adverse impacts, the difficulty in controlling such movement and the inherent hazard to human life in wildlife areas.

Some parks offer elephant rides but generally park visitors enjoy wildlife and scenery from inside a vehicle. They are often with a large group and never able to experience wilderness as one can when walking alone or in a small group away from the trappings of civilization. Wildlife viewing from a car or machan are sometimes the only permitted activities.

It is always desirable and often possible to establish trekking routes or shorter nature trails to scenic view points or similar attractions. Trails add variety to the visitor programme and bring visitors into closer contact with nature. If provided with interpretation (Public 3.2) they have considerable educational value.

Theoretically one has the choice between opening a whole area for walking or to limit travel on foot to specific routes or trails. In national parks and sanctuaries it will usually be the latter.

Short (up to 1 hour) and easy trails in the vicinity of day use areas or overnight accommodation can be established as self-guided trails.

Trekking trails may require several hours of strenuous walking or even overnight stops. On such trails visitors may have to be accopmanied by an official guide.

What to consider when planning and constructing a self-guided trail is is explained below.

CHARACTERISTICS OF A GOOD TRAIL

- A good trail leads past pleasant or spectacular scenery, e.g. forest glades, panoramic views, cliffs and gorges.
- Points of interest e.g. exceptionally old stands of trees , animal burrows, large termite hills, old clearings, caves, nesting sites, oxbow lakes, waterfalls, maintain interest and lend themselves for interpretation.
- One hour may be a long time for people unaccustomed to walking in the forest. A graded series of trails (30 mins, 1 hr, 2 hrs) should be considered.

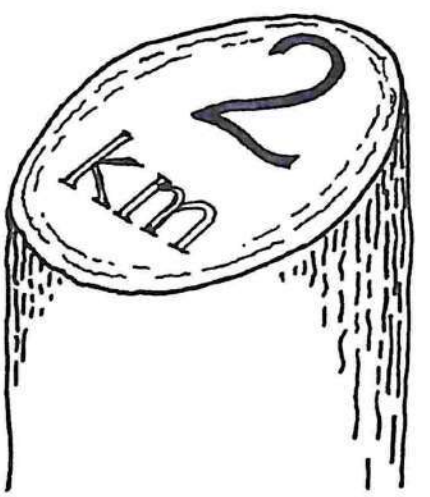
- Avoid steep and slippery ascents, mud and swamps or difficult stream crossings. These can be negotiated by building steps, boardwalks and bridges, but they can be costly and substantially increase the maintenance burden.

- People must be able to easily find the starting point of a trail by a prominent sign.

- Once on a trail, people must be reassured by direction and distance markers at intervals of 50 to 100 m. Paint markings on rocks or sheet metal disks nailed to trees are the most expedient solution. Wooden posts sunk in the ground are better.

TRAIL ROUTE

The trail route is determined after management has decided about the general area where it can be permitted without safety hazards and in accordance with other management objectives (Public 1.1). If an inventory of interpretive resources has been made for this area (Public 1.2) a trail route can be quickly chosen, bearing in mind the above characteristics.



TRAIL CONSTRUCTION

- Avoid firelines or long straight stretches. Leave everything as it is unless it has to be removed in the interest of comfortable trail use. Trails can easily lead around obstacles.

- On reasonably dry and level ground it is not necessary to give special treatment to the trail surface. The trail edges may be marked with rocks but grass, moss, or fallen leaf need not and should not be removed.

- Close supervision of the workcrew is essential. Tell the crew to remove anything within a width of 1.5 m which is or will soon become an obstacle to comfortable walking.

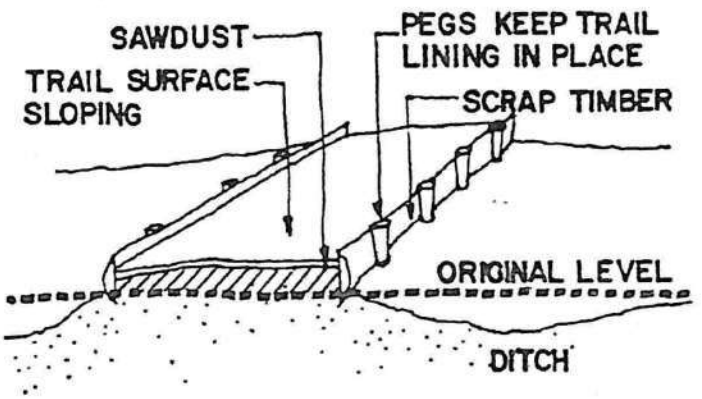
- Impress upon the workmen not, under any circumstances to cut timber or saplings right next to the trail.

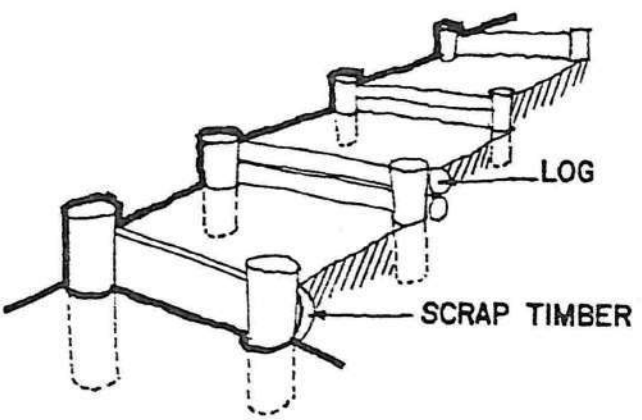
- If a short stretch of waterlogged ground cannot be avoided, raise the trail surface by filling with soil or gravel. Note that the material must be kept in place by low retaining walls made of rock or scrap timber. Over short distances, the more expensive boardwalks can be considered.

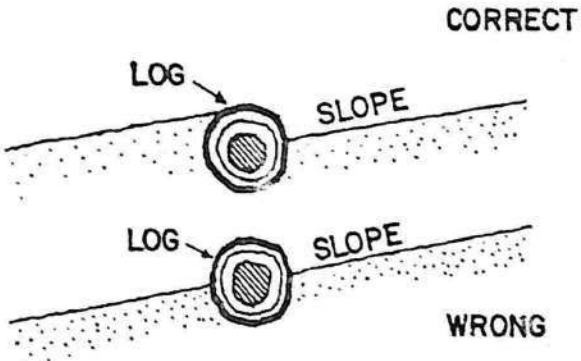
- Avoid building the trail where it will obviously become an artificial stream bed. Anticipate waterflow and divert it off the trail before enough can accumulate to do serious damage.

- Steep slopes have to be negotiated by building steps using wood or preferably stone.

- Sturdy and safe bridges are expensive and difficult to build. Choose a trail route so as to skirt steep ravines or cross streams at shallow places where stepping stones are sufficient.







Planning a Visitor Centre

TO FAMILIARISE THE MANAGER WITH VISITOR CENTRE PLANNING.

Discussions in regard to information and education of visitors tend to focus on the visitor centre. Should you build such a centre or not? This cannot be solely decided by the availablity of funds. Instead, managers should carefully examine the need for and purpose of such a centre.

A visitor centre has objectives under the general heading of "information and education of visitors". If a sustained effort has already been made to meet these objectives through talks, guided tours or nature trails, small exhibitions, literature, camp-fire discussions one may feel that a visitor centre is necessary to further improve services which are already offered. If that is the case, a visitor centre will probably be useful and necessary. How big and how well equipped it should be is a different matter.

Anybody can order a visitor centre "off the shelf" from architects with relevant expertise but run the risk of getting a grandiose design half of which will lie unused. Being clear about the purpose of the centre enables a park manager to meaningfully interact with the designer. How many visitors can we expect to have in the building at any one time? Do we have enough literature for sale to warrant a sales desk? Such questions need to be answered before and during the design stage.

A visitor centre is one of the most expensive facilities in a protected area. If operated and maintained properly there is a high annual recurring cost. Both capital and recurring cost need to be related to expected use. If it turns out that, over a period of five years, the cost of a single use hour is Rs. 15 or more, one may consider a more moderate design or a more cost effective facility.

The fundamental steps in planning a visitor centre are described below.

OBJECTIVES

The visitor centre will have all or some of the objectives listed below. Examine each objective in turn. Has it been addressed by different methods? Will the visitor centre lead to a significant improvement in attaining the objective?

- Increase public concern over nature conservation in general and regional conservation issues in particular.
- Inform arriving visitors about what they can see and do.

- Increase people's interest in and understanding of the area's values by providing information about its history, ecology, habitats, wildlife, research and management problems.
- Entertain and educate visitors in the evenings or the hot hours of the day.
- Provide a focal point for activities and services related to the public.
- Provide an outlet for the sale of local arts and handicrafts.
- Accommodate the office of education officer and his staff.
- House a workshop for display making and maintenance.

CENTRE COMPONENTS

Depending on the objectives chosen, some or all of the components listed below will be incorporated into the design. Only a few are essential for all visitor centres. Sometimes it is possible to convert existing buildings or rooms into temporary or makeshift centres.

Essential components for all centres:

- An orientation/activity section where displays and maps inform visitors about the area and available activities.
- A space where visiting groups can meet for talks or discussions. This can be on a verandah or in the open under a tree.
- An exhibition room where visitors can learn about ecology, habitats, wildlife and management problems of the area through displays and exhibits.
- A small workshop for display, manufacture and maintenance work. This can be housed in a different building and may be part of a sign-making workshop established previously.

Optional components

- Information (and sales?) desk
- Auditorium
- AV equipment and store
- Library cum reading corner
- Discovery room for children
- Education staff office
- Public toilets
- Large covered porch for rest and enjoyment of scenic view
- Amphitheatre

Only the most sophisticated centre would have all of the above. To reduce expense some functions can be combined, e.g. staff office and AV equipment store. Each centre requires staff ranging from cleaners and attendents to skilled craftsmen and trained communication experts to use and develop the facilities.

DESIGN

The designer must be informed about which essential components are to be incorporated. Expected visitor numbers per time period, with emphasis on visitation peaks have to be supplied for proper planning of room size and capacity amenities.

The visitor building is a highly visible structure which, nevertheless, should blend in with its natural surroundings. A good architect will adjust the design to land contour and vegetation, that is plan around standing trees or rock outcrops instead of removing them or levelling the building site.

Design is also influenced by climatic conditions, the type of equipment to be used as well as the nature and size of exhibits if any. Airflow, lighting, wall space and ceiling height have to be considered. An adaptation of local architectural style often yields the most pleasing and cost effective designs.

Designs should minimize the use of "cold" materials; e.g. steel and concrete, corrugated iron and plastic. "Warm" materials, like brick, clay roof-tiles, sand-stone or slate, natural rock, bamboo, timber, thatch, even cowdung plaster, are preferred. Designs should be such that artificial lighting and air conditioning are not required.

SITE SELECTION

Park management should pre-select several sites which can be inspected together with the architect. The site for the visitor centre should be within a development area of the tourism zone. Suitable sites may also be found outside the park as long as they are situated so that visitors have to pass it on the way. Most visitor centres will be near the main gate or a day use area or tourist accommodation complex if there is one.

The potential site should also be chosen for its scenic qualities. A centre build on a bluff overlooking a meandering river, in a grove with stately old trees, or next to a waterfall will be much more attractive than one built in nondescript surroundings.

Planting Up

Judicious planting can - in time - cover up some of the blemishes of an imperfect site. However, the possibility of improvement through planting up should not be used as an argument to justify the choice of an inadequate site.

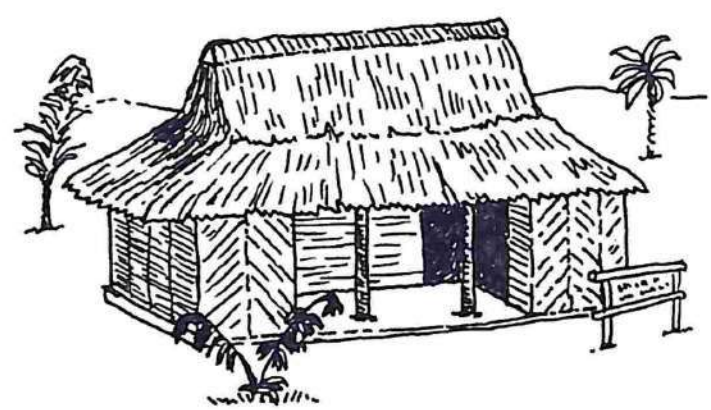
COST/BENEFIT

The cost of a visitor centre easily amounts to Rs. 500,000 for the building alone. Add to this the cost of exhibits and equipment, capital investment will come to Rs. 800,000 if not more. Recurring cost for staff, maintenance, improvement can be put at Rs. 100,000 per annum. Total (undiscounted) cost would then come to Rs. 1.3 million for a five year period.

Assume that the park receives 25,000 visitors per year and that each visitor spends an average of one hour in the centre. This would amount to a total of 125,000 user hours. Each user hour would then, in effect, cost about Rs. 10. A park with a visitation of 10,000 should probably not build this visitor centre and find a less expensive solution.

MAKESHIFT OR TEMPORARY VISITOR CENTRES

A full fledged visitor centre requires a substantial budget and staff to operate it. If the expense of labour and money does not seem quite justified at the moment, consider alternatives, e.g. an annex to the ticket office with information about the attractions and activities offered, a temporary exhibition set up in native style buildings or the conversion of an unused park building. Occasionally rooms in a historic building can be converted.



Picnic Sites

TO HELP THE MANAGER WITH THE PLANNING OF PICNIC SITES.

A picnic with family and friends is probably the most popular outdoor leisure activity in India. The demand for picnic sites is greatest among day users of protected areas and the question arises to what extent the manager should try to satisfy the demand. The answer is a resounding "yes" when it comes to deer parks which are predominantly for local recreation. Short picnic visits to national parks and sanctuaries, on the other hand, should be discouraged but cannot always be avoided entirely. In such cases attracting visitors to an activity area at the periphery of the park can relieve some of the pressure on the important conservation areas, including the core area.

Intensive use areas must be chosen carefully and attended to so as to prevent the problems often associated with heavy recreational use; soil erosion, loss of vegetation cover and diversity, litter and scavenging of foodscraps by wildlife and, sometimes, fire.

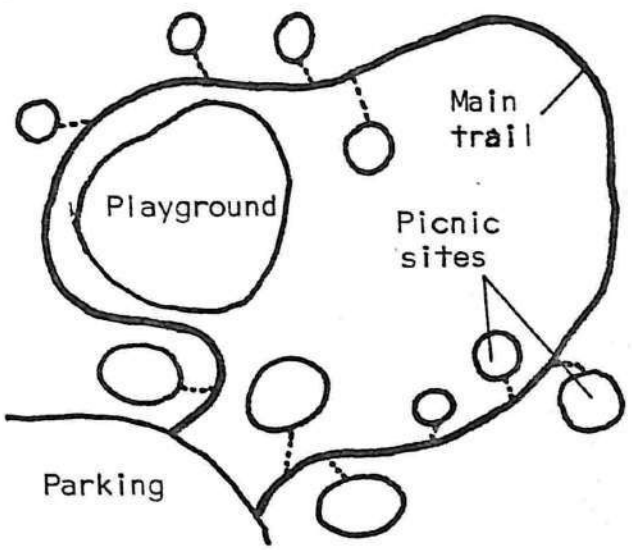
This technique discusses how to select a picnic site and determine additional requirements.

LOCATION CONSIDERATIONS

Picnic sites are placed within development sites or forest recreation areas of the tourism zone. Flat to undulating open ground with good cover by large shade trees is ideal. Deep soils with good drainage, not susceptible to erosion are preferred. Pleasant scenery and a stream or lake nearby enhances the quality of the site.

The number of individual picnic sites required can perhaps be inferred from visitor statistics and visitor satisfaction surveys (Public 1.3, 1.4). A number of sites equal to the number of groups of day users on a moderately busy day suffices for average use.

Access should be by short walk from one central parking lot. In places with heavy visitation several satellite picnic grounds can prevent the impression of crowding in a single site.



INDIVIDUAL SITE REQUIREMENTS

Most sites should be planned to accommodate 4-8 people (20-30 sq m). A few sites should be developed for large groups of more than 15 people. These should be located closest to the parking lot and the available amenities.

Individual sites should be recognizable by separate entry from the main connecting trail. Sites should be shielded from one another by shrubs and trees. Judicious planting of hardy (and thorny) shrubs may be required.

Sites must be shaded, preferably by good shade trees, If suitable shade trees are rare, then shade roofs may be constructed from wood, thatch, bamboo or other natural materials. Vines can often provide good shade within a few years of planting.

Sites should be fairly level. On sloping ground sites can be created by building low retaining walls and earth fill.

Short grass is the preferred cover. Under intensive use, sites may have to be closed periodically for the grass to recover. Sometimes paving is inevitable. In this case, natural stone like shale or sandstone is preferred to concrete.

Tables and benches are generally not required as long as the site otherwise (pleasant surroundings, shade) meets people's expectations.

MAINTENANCE

Litter and Waste Disposal

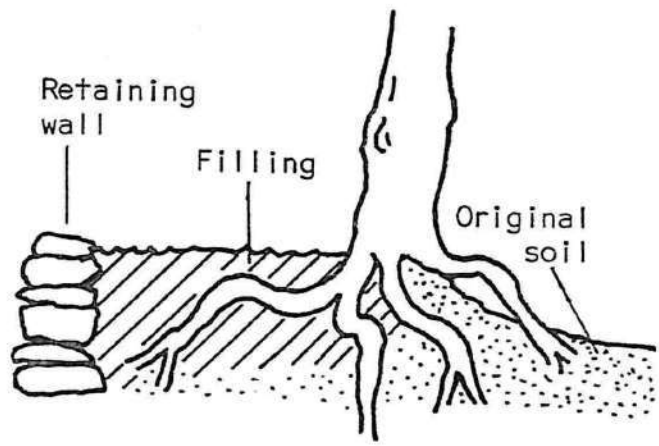
To overcome the everpresent litter problem each site should be equipped with a closed litter bin. Refuse collection and disposal has to be tightly supervised. If this is not done, intensive use areas quickly lose their aesthetic appeal.

Signs are not very effective in overcoming litter problems. Supervision and presence of staff are better. Ask individual groups politely to pick up their trash. This must be done by sufficiently senior staff - sweepers are likely to be ignored. Litter should never accumulate anywhere. If it does, it implies that litter is tolerated.

The collected waste must be properly disposed of by placing and burning in a pit on dry ground. The pit should be covered with a lid to prevent scavenging by wild animals. Dumping the refuse at the side of the road or down a ravine a little away from the picnic area should not be tolerated.

Preventing Erosion

Signs of erosion need to be recognised early. Periodic closure is necessary when bare patches appear in the grass cover and the soil is compacted. Where tree roots are becoming exposed, retaining walls and filling may be the answer. Gully formation along trails should be stopped by realigning the trails and improving drainage.



AMENITIES

A public toilet should be available near the picnic area.

Water taps should be provided in several places conveniently located in relation to individual sites.

EDUCATION METHODS & MATERIALS

INTRODUCTION TO THE SECTION

Tourism management and visitor education/information in Indian protected areas tends to be discussed in terms of hardware (facilities). The software (the ideas, activities, programmes) necessary to use the facilities is often sadly neglected.

Every protected area should have a brochure to introduce its salient features and attractions to the public. However, only one out of three parks and sanctuaries in India have one,and many of those could easily be improved.

Nature camps for youth groups are supported by a number of protected areas. Advice contained in this section may persuade some managers to offer nature camps on a continuous basis and professionalize camp organization and programme.

Nature trails or wildlife viewing circuits will be more interesting for a majority of the visitors if they are "interpreted". The simple interpretation methods described in this section can be implemented without a large budget.

Park managers generally do not realize that over time they can easily collect, at no expense, a great variety of interesting materials and objects from their protected areas. Such objects may be used for demonstration in talks or suitably labelled and displayed in a makeshift exhibit room which might become the precursor of a full fledged exhibition in a visitor centre.

This section presents techniques to improve visitor information and education.

SECTION CONTENT

Preparing a Brochure

TO ACQUAINT THE MANAGER WITH THE PREPARATION OF A BROCHURE INTRODUCING THE PARK AND ITS ATTRACTIONS TO THE PUBLIC.

Brochures and pamphlets advertise the attractions of a national park or sanctuary by pictures, maps and text containing highly condensed information. With increasing popularity of visits to parks and reserves, more managers will need to produce professionally executed brochures which reflect well on the issuing agency.

Quality is decided not so much by the printing budget as by the layout and text. Some very attractive and readable brochures have been printed in simple black and white.

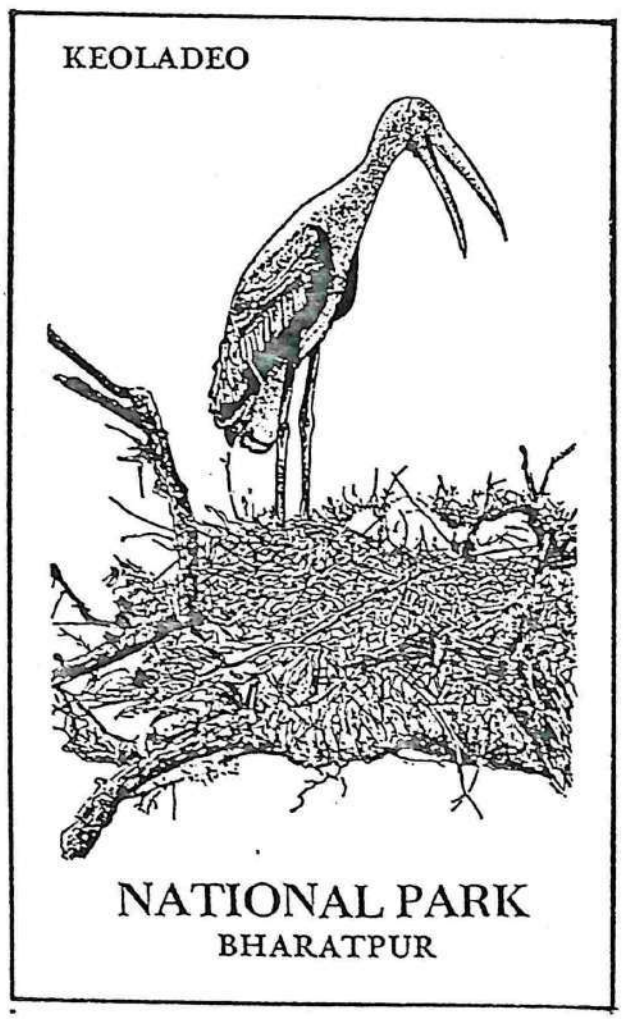
Brochure design and a checklist of points to consider are discussed below.

DEFINE THE OBJECTIVES

Space is very limited in a fold-out brochure of A4 paper size. In order to chose the text which goes in it, we need to know the objective of the brochure. For example:

1. **Brochures which promote visits to an area and help people plan the visit**

   These introduce the major attractions of the area. Information about type and location of access, best season to visit, opening times, accommodation and booking procedures is given. An overview map shows the wider region around the park and the main roads, nearest railway stations and airport. Existing brochures of this type may be brought out by tourism departments or tour operators. Park managers should try to exert their influence so that an area is not "oversold".



2. Brochures which provide information about attractions and activities and help the visitor find their way around in the park.

Brochures of this type give a more detailed description of points and areas of interest and list the available types of activities. Rules and timings are given. A map shows entry points, accommodation, trails and roads, and attractions. It happens frequently that brochures of this and the former type are combined into one with the result that maps are difficult to read, that text becomes very crowded and information is incomplete.

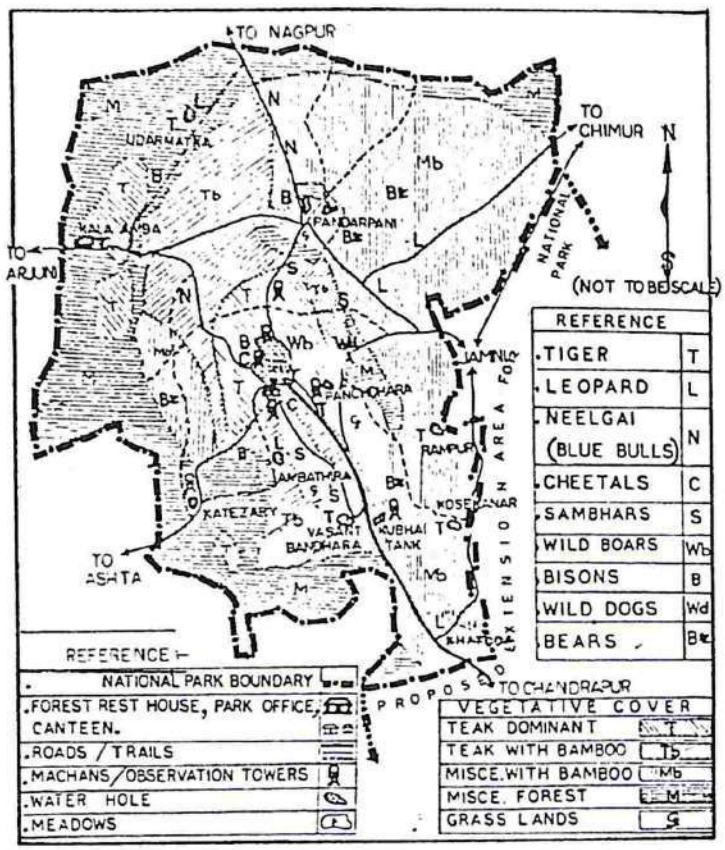
3. Brochures which inform about specific activities or attractions in more detail.

These brochures may become necessary when visitors want to find out more about certain species and habitats, about historic buildings, or if certain activities are to be highlighted and promoted e.g. nature camp. Since these will be booklet rather than pamphlet size, they should be sold in order to discourage wastage by distribution to visitors who are not really interested in reading them.

TEXT AND PRINTING INSTRUCTIONS

Resist the temptation to pack a brochure with all the information it can possibly contain. The secret of a good brochure is leaving out that which is less relevant and appropriate. Species lists are not appropriate except in the detailed type of brochure (3, above). Make a conscious choice about text which has to be included and which might be included.

Map overloaded with information



Text should be written in a straightforward personal style. Inappropriate lyrical embellishments or dry bookish phrases (.....the species is known to occur) and longwinded passages should be avoided. Make sure a contact address is included.

A do-it-yourself production is advisable only if no budget is available. Ordinarily one consults professional writers, designers and artists. Supply them with the information and the specific messages to convey, maps and pictures and a description of the people the pamphlet is meant to reach.

Determine how many copies will be required for one season, how they will be issued, sold or handed out free of charge. Note the approximate budget appropriations to be made. Consult the printer to determine cost for different size runs.

PROOF CHECKING

Thoroughly examine the proof copy returned from the printer using the list of guidelines below.

- Text complete; mis-spellings; last minute insertions.
- Information presented in logical sequence and as easily understood "chunks of information".
- Major points emphasized by titles, type style, layout, boxes, background colour.
- Rules/recommendations/requests are explicit and unambiguous.
- Maps readable at a glance, not overloaded with confusing detail; legend clear; symbols appropriate.
- Text interspersed with graphics, line drawings or photographs.
- Visuals correct, descriptive, interesting cover design.
- Enough white space between paragraphs.

Sample of brochure with pleasing design and use of illustration.

HISTORY The islets are surrounded by water of a reservoir which was formed by the construction of a weir across the River Cauvery. It was built between 1645 & 1648, when Kantirava Narasaraja Wodeyar was the ruler of Mysore.

The sanctuary is just 3 Kms. from the historic town of Srirangapatna, where Tippu Sultan made his last stand against the British in 1799 and was slain in the battle.

TERRAIN

The soil along the river is soft and loamy—ideal for aquatic insects. Abundance of these insects attracts numerous birds to the Sanctuary. The surface is rocky with shrubs and trees.

CLIMATE

Ranganathittu has a moderate climate with 3 seasons.

Summer—March to May—36°C (max)

Monsoon—June to October

Winter—November to February—14°C (min)

WATER SOURCES

The Cauvery is the main source of water, inundating the fields all around.

Darter

WILDLIFE

Ranganathittu Bird Sanctuary has a colourful variety of birds (See the chart on following pages). A few animals are also seen.

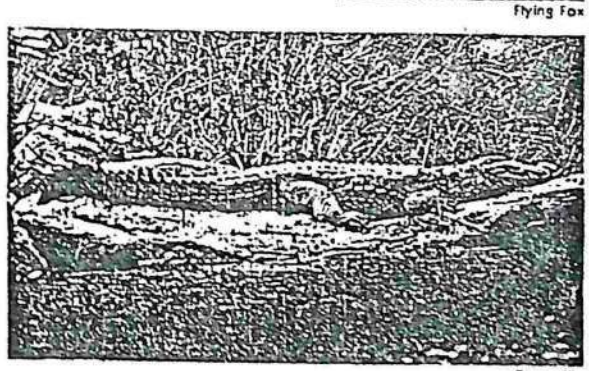
MAMMALS

Flying Fox and Otter.

REPTILES

Marsh Crocodiles are common and can be seen sunbathing on the rocks.

Flying Fox



Crocodile

Organizing a Nature Camp

TO FAMILIARIZE THE MANAGER WITH THE REQUIREMENTS FOR A PERMANENT NATURE CAMP.

Nature camps provide outdoor recreation and conservation education for urban or local students from upper primary to college level. They offer a unique opportunity to instill love and concern for nature at a young and impressionable age. Young people do not expect much comfort and enjoy the wilderness experience.

Nature camps are a cost effective method for reaching people. Compared to the visitor centre where people passively view exhibits, participants in a nature camp become actively involved and receive personal attention by trained staff. Nature camps should only be established in locations where movement on foot can be permitted.

Unfortunately, nature camps normally last a few weeks, benefitting a few hundred young people at the most. A permanent camp, on the other hand, accommodating some 30 youngsters on 3-day visits, can cater to well over 2,000 people per 8 month season. Staff of a permanent camp are better able to professionalize their approach over time and develop teaching aids and activities. Parks close to urban centres are particularly suited for permanent camps.

Nature camps offer an ideal opportunity for non-government organisations and protected area authorities to work together. For instance, the park authority can supply the camp supervisor and logistic support, while the NGO organizes visits, transport and employs camp councillors and teaching staff.

This technique discusses nature camp planning and organization.

OBJECTIVES

- Introduce basic ecological principles in ways which are conducive to learning by personal experience.
- Motivate participants to gather information on aspects of the biotic and abiotic environment.
- Encourage participants to analyze and discuss conservation issues in a constructive and problem-solving manner.
- Foster admiration and respect for the complexities of relationships between species and within natural communities.
- Dispel unfounded fear of wild animals and help participants feel comfortable in wilderness.

ACTIVITIES

A camp is successful if it is fun for the participants and the objectives as stated above have at least partially been met. Choosing activities which allow a maximum of personal involvement is the key to success.

The programme should be planned in three phases. Activities (see box) are selected to fit the objectives of each phase and to be appropriate for the respective age group.

In the discovery phase participants are allowed to discover nature on their own. At this stage it is important not to lead a group from place to place and explain everything so that they become passive bystanders but to encourage observation, questions, speculation and phantasy. The camp instructor introduces the programme, answers questions and puts participants at ease.

In the directed investigation phase the participants are entrusted with certain tasks to complete by themselves or in small groups; collect, record, measure, discuss, simple experiments. Allow only collection of non-living materials. Explain the use of field guides. The instructor makes suggestions, gives advice, issues materials and equipment, helps analyze collected data.

In the small project phase, the youngsters get an opportunity to put experiences into perspective, depending on age and interest, e.g. write a report on the findings of an examination of water quality on a stretch of river. The instructor facilitates discussion, draws experiences together, discusses follow-up with teachers/group leaders.

Activities for the three phases of a Nature Camp.

The activities are listed in ascending order for young (about 10) to older age groups (18). However, suitably adapted, most activities can be used with all age groups.

Discovery phase

Check list/treasure hunt: collect items, display and discuss
Blind walk - walk blindfolded along a rope or with a companion; explore surroundings through sense of touch and smell;
Bird watching: record of species identified, describe characteristics.
Trail walking, swimming, boating
Waterhole/machan watch: quiet observation
Orienteering: finding way with help of compass and map)
Evening campfire

Directed investigation phase

Collect rocks, shells, discarded antlers, dung pellets
Systematic observations of animal behaviour
Painting/sketches
Guided tours on selected topics
Identification/plaster casting of tracks
Interviews with local people about history of the area
Simple mapping exercise
Examination of water quality
Plant species identification
Investigating a management problem

Small project phase

Competition, exhibition of collected items, posters, draft resolution or letter to a minister, pledges, recommendations, documentations on the basis of experiences and discussions at the camp, tree planting.

STAFF AND STAFF TRAINING

For a camp with a capacity of about 30 participants camp staff should consist of a camp supervisor, two instructors and support staff ranging from cook to driver.

Camp supervisor and instructors are responsible for organizing the camp and developing and conducting activities. Although camps might only operate seasonally, staff should be permanently assigned. During the off-season they can prepare for next year's camp or offer programmes at local schools. Especially in the beginning, the time between camp seasons should allow staff to acquire additional expertise via internships and workshops.If staff are permanently assigned, the experience thus gained will not be wasted and eventually the team will become "nature camp specialists", able to train others.

SITES AND ACCOMMODATION

Ideally, several sites should be identified as it may become necessary to shift the site in order to avoid excessive impact in the camp vicinity.

A suitable location for a nature camp has the following characteristics:

- Away from other tourist accommodation and facilities.
- Away from sensitive and vulnerable habitats.
- Near open water bodies suitable for nature study and - perhaps - swimming or boating.
- Near areas and points of attraction.
- Safe for walking or trekking.
- Accessible by public transport or hired bus to avoid having to provide transport from the terminal to the camp.

Accommodation will normally be in tents, but do not overlook the possibility of building native huts at less cost.

CAMP ORGANIZATION

Day camps can sometimes be organized where travel time is short enough that visits are worthwhile. However, a nature camp of at least three days duration is recommended because it leaves sufficient time for the phased activities. With increased experience, one may consider even longer camps or camps which specialize in catering for a particular age group.

Three-day visits by groups of 30 students together with their teachers can be comfortably handled by a staff of one supervisor and two instructors. Visits should be arranged well ahead of time so that camp staff and facilities are fully utilized.

The camp supervisor should either stay at the camp site or live within reasonable travel time of it. Instructors must live at the camp while it is in session. Permanent residence and family should be located elsewhere.

EQUIPMENT/MATERIALS

A film projector with suitable films and slide projection equipment are usually assumed to be the most essential pieces of equipment. They are, no doubt useful tools for providing entertainment and education particularly in the evenings but not essential. Camp fires, song, dance and discussion easily take their place. Necessary equipment includes binoculars, magnifying glasses, haversacks, storage bins, etc.

Good food contributes greatly to the success of a nature camp. A vehicle with trailer is required to procure fresh supplies for the camp kitchen and for staff transport. Cots, hurricane lanterns, buckets, cooking utensils, stove, etc. are necessary for minimum comfort at the camp.

A CAMP BUDGET

A simple budget for a camp catering to a group of 30 might look like this.

Capital Investment

Vehicle with trailer	*100,000*
Camp furniture/utensils	*15,000*
Accommdation (tents or local style huts/tments for staff and visitors)	*30,000*
Equipment for office/ activities	*25,000*
Total	***170,000***

Annual Recurring Costs

Staff (camp supervisor, 2 instructors, 2 cooks, 1 chowkidar, 1 driver, 1 steno)	*80,000*
Office/activity materials	*10,000*
Vehicle fuel and maintenance	*25,000*
Camp essentials (other than food)	*10,000*
Contingency	*15,000*
Total	***140,000***

Cost per Visitor Hour

If capital investment is spread over 5 years, total annual cost amounts to Rs. 174,000 (170,000/5 + 140,000). At 2,000 participants, the cost per participant comes to Rs. 87 or just under Rs. 30 per participant day.

Trail Interpretation

TO FAMILIARISE THE MANAGER WITH METHODS TO INTERPRET FEATURES ALONG TRAILS OR WILDLIFE VIEWING ROUTES.

Many visitors appreciate it if we draw their attention to features along trails or viewing routes and explain them. Managers frequently complain that the majority of visitors to parks and sanctuaries are seeking thrills; that they are only satisfied by close encounters with large wildlife species. This attitude stems partly from a lack of suitable interpretation which can maintain interest even if animals are not seen.

Encourage people to look for and see the seemingly insignificant detail. Help them discover amazing examples of mimicry and other adaptations. Highlight interdependence and relationships between plants, animals and abiotic ecosystem components so the visitor learns about the inherent resilience as well as the fragility of natural systems.

Interpretation for self-guided trails and viewing routes.

WHAT IS TRAIL INTERPRETATION?

One often finds labels with local and scientific name stuck to trees. This, it must be stressed, is not interpretation. The interpretation of a tree might say something about its wood, how much water it evaporates, about its seeds or about the animals that live and feed on it. Interpretation should satisfy people's natural curiosity. Therefore interpret the conspicuous, that which people would ask about if they had a guide. But draw attention also to the inconspicuous; how ants and termites are important links in the cycling and recycling of organic matter. (see Public 1.1 for definition).

TYPES OF INTERPRETATION

General Subject Trail

You interpret whatever seems worthwhile. The interpreted features are not linked by an underlying theme.

Special Theme Trail

On this type of trail all the interpreted features are linked by a theme.

- Life in a stream
- Forests protect soil and watersheds
- Birds of the seashore
- Past and present misuse of the land
- Habitats, vegetation types of XYZ
- Seeds and their adaptations
- Fig trees in a rainforest ecosystem

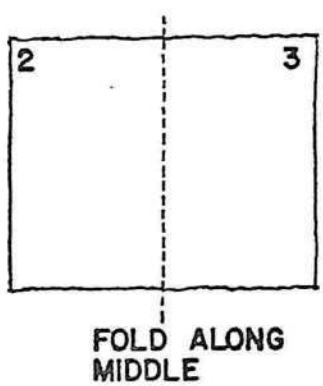
METHODS OF TRAIL INTERPRETATION

Trails can be interpreted by:

- Printed handout. The text of the handout refers to easily recognizable features along the trail or to station numbers (Public 2.4).
- Wayside exhibits and text. Waysides are expensive, difficult to make and maintain.
- Trained guides. Even if trained guides exist, they cannot be made available for every group.

PREPARING A TRAIL HANDOUT

A trail handout can be a simple paper sheet folded once in the middle or a printed fold out brochure in colour. The content is the most important.



Page 1

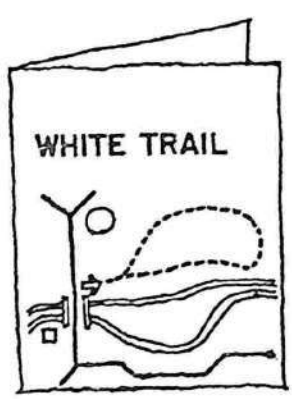
Trail name and map possibly introduction.

Page 2,3 and/or 4

Trail interpretation

Page 4

Optional information on relevant issues



GENERAL SUBJECT TRAIL
(Sample material)

- *Fallen trees provide shelter for many animals. A monitor lizard uses this one. Others may be inhabited by porcupines or cover the entrance to a hogbadger burrow.*
- *Porcupine signs are often noticed on the following 100 m of the trail. Look for footprints and drag marks caused by the tail quills. The cigar-shaped droppings are about 5-6 cm long and pointed at the ends.*
- *What do you notice comparing both river banks? This side, within the national park is covered with vegetation and therefore stable. The other bank is caving in and washed away by the river because people and livestock have removed the vegetation.*
- *Fig trees provide food and shelter for a lot of animals; monkeys, gibbons, civets, birds, bears, pigs and deer. When the fruit is ripe, animals congregate in large numbers and it becomes an excellent place to watch wild animals. This is why the trail is open only on special permit for about 4 weeks in April/May for people who want to use the hide.*

About 100 m past this station you will come out at a forest road. Turn left on this road and after a short 5 minute walk you will again reach the starting point of the trail.

We hope you enjoyed the walk. Please come again.

1. Find a suitable name for the trail or viewing tour. The name is often associated with a prominent feature of the trail e.g. Look-out Trail.If If a series of trails are planned, consider colour coding the trail, facilitating its recognition on maps and directional signs.

2. Introduce the trail. Briefly describe the location and what to expect.

3. Draw a sketch map of the trail area. This map should enable one to find the trail head and, especially on long trails, help the visitor orient himself and show shortcuts if they exist.

4. Make the handout visually attractive with illustrations and good layout. If at all possible one should seek professional help for this, even if the handout is copied on a Xerox machine.

5. In order to make the text interesting observe the following points:

   - Dramatize! Instead of explaining protective cover properties of the canopy layers in the rain forest, describe what happens to a rain drop which falls on it.

   - Ask people to do things! Look up! Walk quietly!

   - Appeal to the competitive spirit! Can you find and identify six different types of seeds? A casual observer can easily identify ten items on the checklist. Try to identify more!

   - Appeal to use the senses! Feel how cold the water is. Close your eyes and listen to bird sounds.

SPECIAL THEME TRAIL
(sample material)

Acquatic Life in Tanda Pani Nullah

Introduction: The trail starts at the small bridge near the information centre. Follow the arrows up on one side of Tanda Pani Nullah and back on the other. About 30 min. leisurely walk.

Attached to this handout is an illustrated checklist which will help you identify some of the animals found in the stream. Glass bottom boxes for underwater viewing are available against a deposit.

Stream Environment

Where the stream is narrow, the water flows fast and the sand cannot settle. Where it becomes wide, the current slows and allows suspended sand to settle. Sand contains no nutrients and is not very stable. The sandy areas you see support very little life. Most of the small creatures in the stream live in or near water weeds, dead leaves, wood or among the pebbles and rocks washed by the swift currents.

Walk slowly and try to find the fish, amphibians and insects on the checklist. Note which environment they prefer. You can easily discover 7 different species and 10 or more if you are a good observer.

Please do not attempt to catch animals. Help us keep the stream banks clean. Throw any paper, cans and plastic bags into the rubbish bin at the trail head. Thank you.

Objects for Display / Demonstration

TO MOTIVATE STAFF TO COLLECT OBJECTS WHICH CAN BE INCORPORATED INTO DISPLAYS OR USED AS TEACHING AIDS.

Anybody who seriously undertakes information and education in a protected area will use objects, like plaster casts of animal tracks, preserved dung pellets, antlers, skulls, as well as plant materials, such as seeds and wood samples.

Deer antlers locked in fatal contest, a cross section of a giant papery wasp nest, tree bark deeply scratched by the claws of a bear; all these can be woven into a story told in an interpretive talk or through exhibits. These objects have the advantage that they cost nothing except the effort to recognize, to collect and to keep them.

Collections as suggested here are not scientific reference collections but items which can be used for demonstration in interpretive talks or be incorporated into displays and exhibits.

What items to collect and how to preserve them are described in this technique.

PREREQUISITES

Little is needed except a dry room with open shelf space where items are stored and easily retrieved. Each object needs to be labelled as to what it is, where it came from, and supplementary information. Guards should be insructed to report the death even of the lesser species and shown how to salvage, clean and label skulls, bones and skins.

OBJECTS TO COLLECT

Skulls

Skulls can be saved by burying the head of the dead animal in relatively dry ground. In wet soil, skulls will turn black. Mark the burial place, so that it is easy to find again.

Teeth tend to drop out, therefore put a plastic bag underneath big skulls. Smaller ones are best put in an open tin can or plastic container. They can later he held in place with a light glue.

Check small skulls (squirrel size) after 4-5 days. If left longer, lower jaws tend to come apart. Big skulls may require several weeks. Check every five days, after the first ten days.

A skull has been long enough in the ground if skin and flesh rub off easily,but the lower jaw bones still hold together. Remaining pieces of flesh should be cleaned off with a toothbrush. If thoroughly washed in warm water and detergent and dried in the sun it will lose any unpleasant odour.

To obtain really white specimens, degrease the skull (or other bones) by soaking in a solvent such as benzene or tetrachloride overnight. Then bleach in hydrogen peroxide.

Label with a soft pencil or Indian ink on the upper palate where it cannot be seen.

Specimens Preserved in Alcohol/ Formalin

Smaller reptiles, amphibians, and fish can be collected in glass containers filled either with formalin solution (1 part of commercial formalin to 15 parts of water) or alcohol (commercial alcohol 80-85%). Formalin is cheaper than alcohol, but anything soaked in it becomes stiff as a board and has an irritating odour.

Body juices can lower the concentration of the preserving liquid. Inject preserving liquid directly into the soft parts with a hypodermic syringe to ensure preservation of the internal organs. Add large quantities of sugar to formalin solutions in order to retain the natural skin colour of amphibians and fish.

Insects

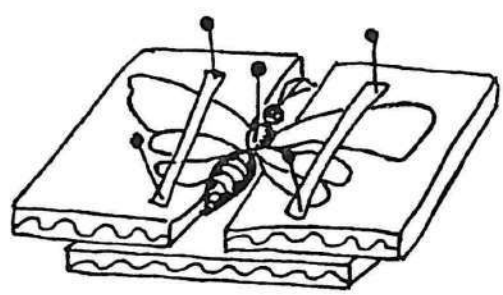
The many interesting adaptations, (mimicry, camouflage, mandibles etc) among the insects can be demonstrated using mounts of some of the larger ones. Their mounting requires skill and patience.

1. Kill the specimen painlessly in a killing jar (see box).

2. Before wings and legs become stiff, fix the specimen in the required position on a piece of styrofoam or corrugated cardboard base.

3. Butterflies and moths are mounted on softwood or styrofoam boards which have a narrow groove running along the centre. While the body rests in the groove, the wings are carefully spread out by pushing behind a major vein with the point of a mounting pin. Dried, the wings and antennae will remain in the fixed position.

   Without protection, such collections are soon reduced to dust by living insects. Dried insects are brittle and legs break off easily. Store them away from light in a box with a tight fitting lid and plenty of mothballs.



Horns and Antlers

Strive to collect horns and antlers of all species occurring in your area. Collect antlers from animals at different ages.

Faecal Pellets and Scats

Deer and antelope pellets if dried and lacquered will retain their natural appearance. Carnivore scats need more time to dry and shrink in the process.

Other Animal Signs

Nests, dung beetle pellets, porcupine quills, plaster casts of tracks, shed snakeskins, honeycombs etc.

Skins and Hides

Professional preservation and tanning is preferred. Where this is not possible they should be stretched on a frame (large hides) or nailed to a board (reptile and small mammal skins). For display hides and skins do not have to be pliable, but they must be well cured. Remove superfluous fat by scraping with a rounded knife and rub with salt. After several days of repeated application of salt the remaining fat will come off easily. Dry in shade for a week while still stretched on frame or board.

Keep a sack of salt well sealed in plastic to protect it from moisture so it can be easily collected when needed.

Interesting Plants and Plant Parts

This might be corkscrew climbers, pieces of bark, a slice from the base of an exceptionally large tree, commercially valuable plants, medicinal plants, tree seeds, a root system, pressed plants.

Poaching Evidence

Snares, traps, arms, projectiles, implements.

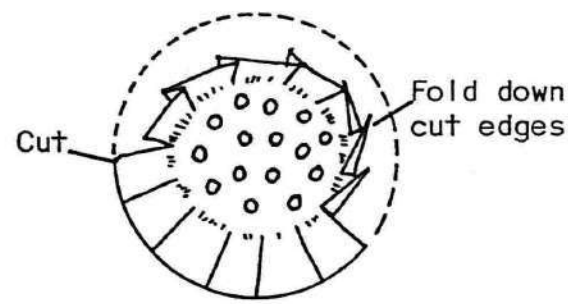
Implements and Artifacts

Baskets, tools, furniture, ornaments carvings made from natural materials by tribals living in and around the protected area.

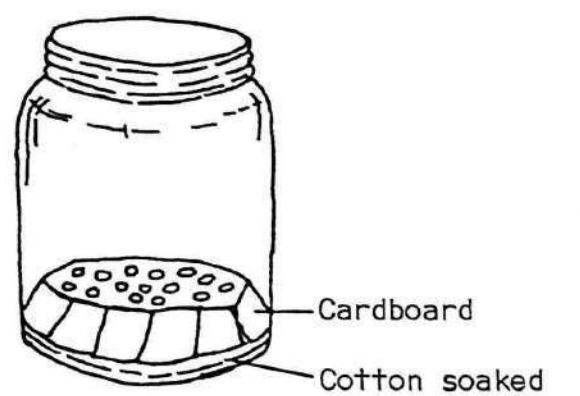
Killing Jar

Kill insects in a killing jar. Pour a layer of plaster of Paris, some three to four centimeters thick, in the bottom of a wide-necked jar. Let it dry. Soak the dry plaster of Paris with carbon tetrachloride from the chemists. Do not use potent poisons like cyanide. Cover the plaster with a piece of blotting paper cut to size. Most insects quickly die painlessly when thrown into the jar. Large beetles should be left overnight.

Alternative Type of Killing Jar
(does not require plaster of Paris)



Cardboard disk with diameter 2 cm larger than diameter of jar.

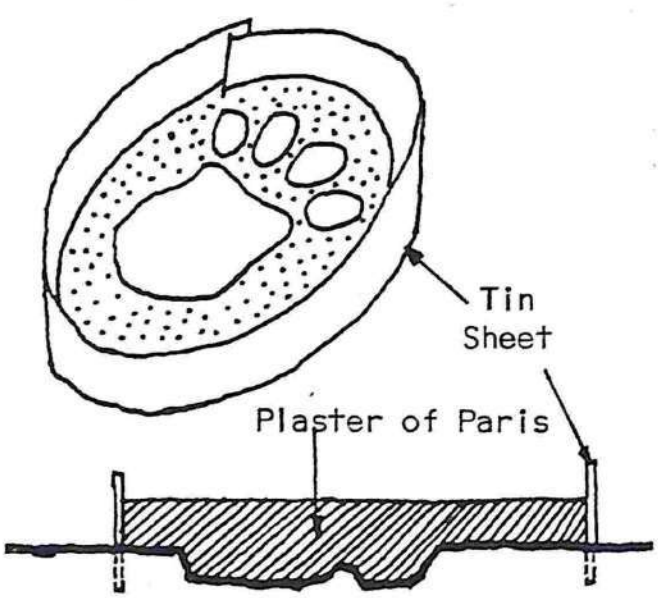


MAKING A PLASTER CAST

Materials: Plaster of Paris, a mixing container, water bottle, trowel or knife, a strip of tin sheet 10 cm x 50 cm or four pieces of wood 3 x 1 x 15 cm.

1. *Search for a pugmark or hoof print with a deep and clear impression. Encircle it with the tin sheet or four pieces of wood to form a mould. Remove sticks, gravel and mud.*

2. *When mixing the plaster sprinkle the powder into the water,not the other way round. Let the plaster soak up the water before stirring. Stir and add plaster until you obtain a smooth and runny mixture which you pour into the mould. Scratch information about location and type of track onto the back of the hardened cast.*



Negative cast

*You now have a **negative cast** on which the impression of the footprint is raised. If you want the footprint to appear just like the original, use this **negative cast** as a mould to pour a positive or true-to-life image of the footprint.*

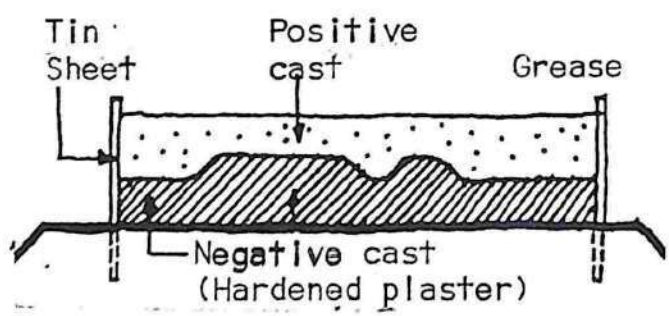
Positive Cast

1. *Scrape off surface irregularities from the negative cast. Paint with several coats of lacquer.*

2. *Place the negative cast facing upwards on a level base of moist sand or clay. Grease it thoroughly with whatever grease is available. Wind the strip of tin sheet around the negative cast and push down into the sand or clay. Pour plaster until it covers the highest portion of the track by at least one centimeter.*

When the plaster has completely hardened separate the new positive cast from the negative cast.

If you use cement instead of plaster, use very fine sand in a mixture of one part cement to one part of sand.Keep the cement moist during setting.



Simple Display Techniques

TO FAMILIARISE THE MANAGER WITH SIMPLE TECHNIQUES FOR DISPLAY OF OBJECTS IN EXHIBITIONS.

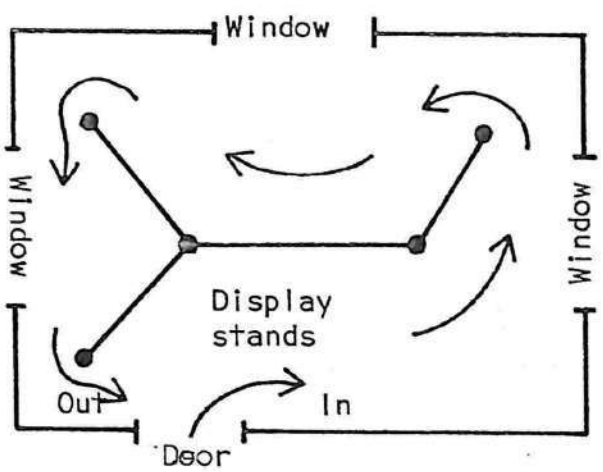
A manager or education officer who has taken the trouble to collect potential display material (Public 3.4) is likely to look for ways of incorporating them into displays and exhibits. Those in areas with many visitors may aspire to a large exhibition inside a visitor centre. The majority will probably make do with single displays or a group of displays. Indoor displays can be put up in ticket or travel agency offices and hotel lobbies. Outdoor displays may be placed at strategic locations inside the tourism development sites or along nature trails. A mobile exhibition could be set up at local schools for a few days at a time. Many parks have some extra space in an exisiting building or can set up an inexpensive temporary structure which could house a small exhibition.

The objectives and information content of displays and exhibitions follow the principles in Public 1.6 and Public 3.3.

This technique describes methods for mounting flatwork and display objects.

THE EXHIBIT ROOM

Visitor flow and lighting are the main considerations. People should also not see more than a small portion of the items on exhibit at any one time. Display stands should subdivide the floor space into distinct sections which are passed by in sequence. They should be arranged to receive sufficient light from windows.



Fit the walls with wooden runners to support plywood or softboard display panels. Display panels in the centre are mounted on stands and are freely movable. The lower panel edge is at about 90 cm, the upper edge 210 cm from the floor for optimal viewing height.

FLATWORK DISPLAYS

Displays which consist of pictures, maps, diagrams and text are called flatwork. To stand up to the inevitable touching and cleaning in an exhibition they need to be heat laminated before mounting on the display board. Many photographers have the necessary materials and heat press. Flatwork thus treated is waterproof and can be cleaned with a moist cloth. Businesses specializing in picture frames and mounts have heat presses to bond even large pictures directly onto a plywood display board.

Raised Flatwork Mounts

A picture mounted on plywood can be raised from the background by the use of wooden support blocks. This adds a third dimension (and interest) to the two-dimensional flatwork display.

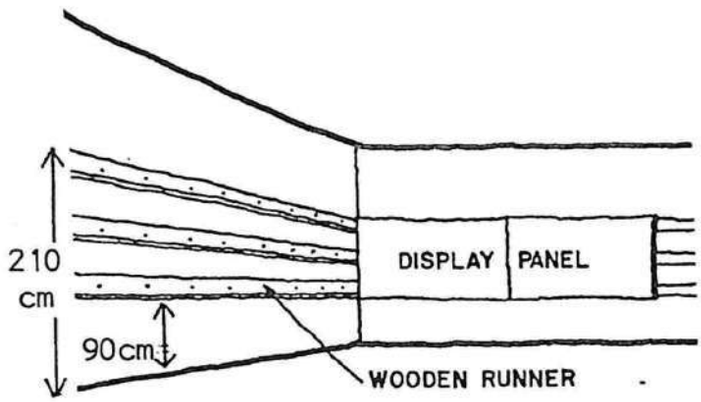


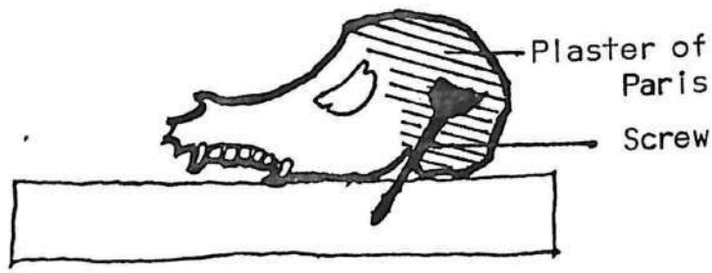
PHOTO ALBUM/PICTURE STORY

If you have a camera you can quickly assemble a picture story from colour prints with appropriate captions. The story can be displayed in an ordinary photoalbum with the picture in one pocket of the album and the text in the adjoining one. If you are afraid of losing pictures staple the pockets and screw the album spine to the table top.

SKULL MOUNTS

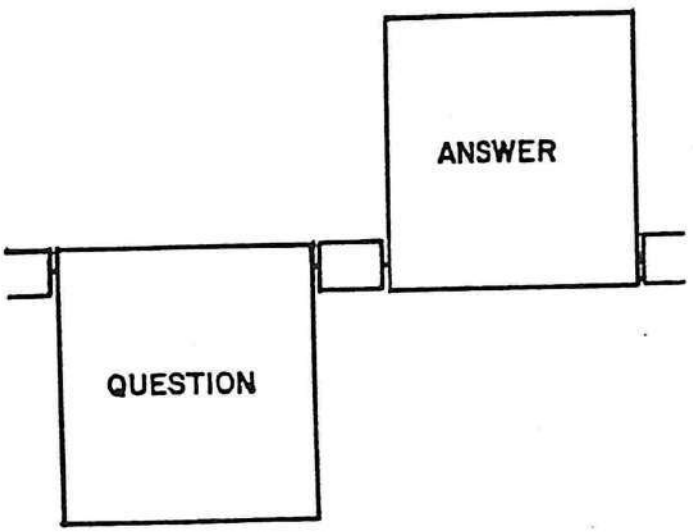
Small to medium size skulls can be mounted as follows. Drive a long screw diagonally into a board. Fill the brain cavity with a thick mixture of plaster of Paris. Push the skull onto the screw and let the plaster harden.

Large skulls too can be mounted in a way that mounting supports cannot be seen. A large ungulate skull can be mounted on a tree stump with screws driven through the lower jawbones from the inside. A long bolt anchored in the stump protrudes through a hole drilled into the hard bone of the upper palate and is secured with a nut from above.



FLIP BOARDS

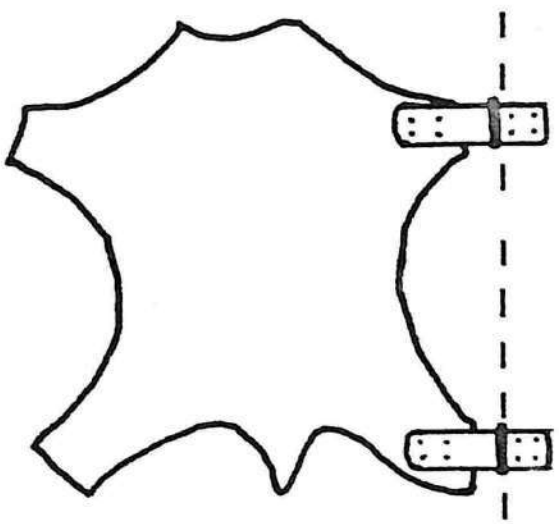
Flip boards are a simple, but popular and effective gimmick to interest people and involve them by allowing them to manipulate an exhibit. They are boards suspended on hinges, which on the front carry a question. When lifted they reveal the answer to the question on the back of the board or in the space until then covered by it.



SKIN BOARDS

The texture of animal skins invites touching, which stimulates the interest necesary to read a short text to learn more about the animal.

Skins, if they are not too large, can be nailed to heavy plywood cut to the same shape as the skin. The board attached to a vertical support by way of hinges can freely move back and forth. People tend to walk up, feel the skin, move the board and read the text on its back.



Alternatively, one might display a skin of an animal killed by poachers together with the weapon or trap used to kill it.

LETTERING

Lettering is best done by a professional sign painter. It can be done in oil or acrylic paint on laquered plywood plaques. It can also be drawn in ink on stiff white paper or ivory board. Labels drawn in ink as well as photographs and line drawings should be heat laminated.

DEALING WITH THE LOCAL PEOPLE

INTRODUCTION TO THE SECTION

Protected areas in India are often small, have ecologically unsound boundaries and are generally surrounded by human habitation. Over half of the national parks and about two thirds of the sanctuaries have settlements inside their boundaries. Encroachment, livestock grazing and collecting of forest products result in conflict between park authorities and local people.

There are no easy solutions and it is impossible in this manual to give a comprehensive prescription for dealing with human pressure. Practical solutions and action opportuni- ties will emerge from detailed knowledge and objective analysis of the local situation which is the reason why techniques in this section focus on locating, describing and quantifying human pressure and its impact.

The available strategies for dealing with the human pressure problem are law enforcement and cooperation. Law enforcement is the traditional and often only approach followed for managing relationships with the local people (Public 4.7 and 4.8).Credible law enforcement is necessary but by itself provides an insecure base on which to place the future of India's parks and sanctuaries. The law loses its deterent power in the face of poverty and it is frequently subverted by vested interest.

As an alternative and complementary to law enforcement, managers can seek cooperation with the local people. Regular contacts and consultations serve to ward off and resolve conflict. Protected area authority and local people can agree on permissible forms of land use in a reserved forest buffer zone or embark on wasteland rehabilitation for mutual benefit. On a more ambitious level, cooperation might entail "eco-development" to reduce people's dependency on protected area resources.

Education may complement either strategy but in itself will scarcely have a significant influence on what is essentially a resource conflict.

Section Content

Classifying Human Pressure Areas

TO HELP THE MANAGER LOCATE AND CLASSIFY AREAS SUBJECT TO HUMAN PRESSURE

Human pressure on a protected area appears in a variety of forms; air and water pollution, attempts at commercial exploitation, construction of dams and roads, livestock grazing and collecting of firewood and minor forest products (MFP).

A protected area is seldom small enough, or the budget large enough to deal with the human pressure problem in its entirety. Part of the area and one or a group of villages must be selected for priority treatment either by law enforcement, or cooperative agreements and ecodevelopment or both. Likely places to start are areas where pressure is high and at the same time limited and well defined in extent.

The initial block by block pressure assessment is based on staff statements. Local staff usually know quite well which compartments in the blocks under their jurisdiction are subject to one or the other kind of pressure. Systematic collection and verification of their statements will show how pressure is geographically distributed within the protected area.

A number of indirect indicators such as proportion of block area affected by human use, or livestock density, can be used for an assessment of the relative intensity of pressure.

More detailed investigations which measure the impact of pressure directly can be undertaken in selected localities (Public 4.2).

This technique describes how to determine distribution of human pressure and rank forest blocks according to relative pressure on them.

PRESSURE TYPES

Some types of pressure affect entire areas, e.g. grazing, firewood collecting, and others are concentrated in specific spots, e.g. use of waterholes by domestic cattle. For the pressure assessment we are mainly concerned with problems which affect areas because "pressure spots" are very likely to be included in the "pressure areas". To start, draw up a list of such problems. The final list may be longer or shorter than the example. Reduce that list to the most prevalent pressure types.

STAFF STATEMENTS

In each range, ask the range officer and several forest guards whether compartments under their authority are affected by each of the problems on

List of Problems

1. *Encroachment for cultivation*
2. *Grazing by stock from resident villages*
3. *Grazing by neighbouring village stock*
4. *Grazing by intinerant herders*
5. *Fodder cutting*
6. *Firewood cutting*
7. *Thatchgrass cutting*
8. *(Organized) poaching (and fishing)*
9. *Fires (deliberate or accidental)*

on the list. Talk to each person individually and try to obtain two or three independent opinions on each compartment. Answers are recorded as shown in the example. Note whether a compartment is thought to be only partly affected, e.g. 50%. Note also whether it is thought to be only lightly affected. The notes may help in verification of the results later.

Compare the statements obtained compartment by compartment. If statements agree well, e.g. all of three staff said "compartment X is affected by firewood cutting," they are likely to reflect the actual situation. If not, verify by sampling (Public 4.2).

At the end of the survey you will know what area and what proportion of blocks, ranges, and the whole reserve is affected by one, two or more of the problems on the list. The information should also be presented on maps.

How reliable are statements obtained from local staff?

Range officers and forest guards should know their beats well enough to give reasonable answers, but they may sometimes say what they think is expected rather than what they know to be true. In case of doubt, one should double check on some compartments by making a site visit or by actual sampling.

PROFORMA

Block: RAIWALA *Staff member posted in area since:* 3|12|87

Compartment		*Encroachment*	*Firewood*	*Grazing*	*Affected comp. area*	*Observations*
No.	*Area (ha)*					
1	236	✓	✓	✓	236	about 80 ha in encr.
2	282	–	✓	✓	282	
3	343	–	–	–	100	seasonal cattle grazing in valley portion.
etc						

BLOCK COMPARISON FOR PRESSURE

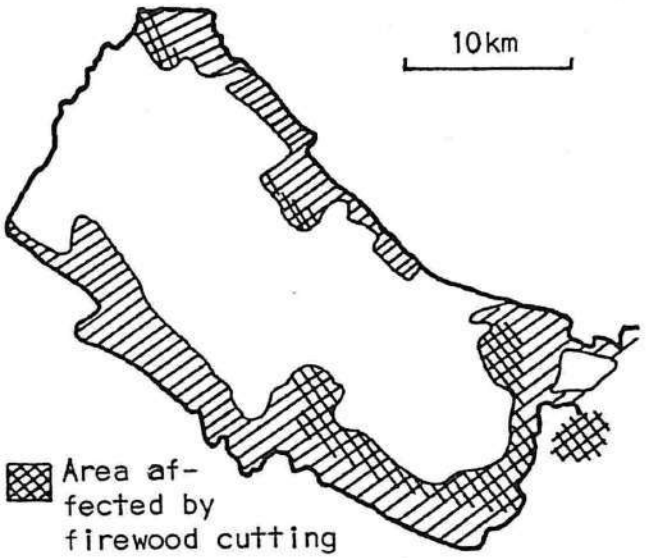
In addition to the map showing the affected area, one can compare individual forest blocks and rank them as subject to low, medium, high pressure. Actual impact is, of course, best measured by sampling (Public 4.2) but this may be too difficult to do for a whole protected area. As a substitute we can use indicators which are easier to evaluate.

Indicators for the Relative Pressure Ranking

Use all or some of the listed indicators to classify each block. How the classifying is done follows below.

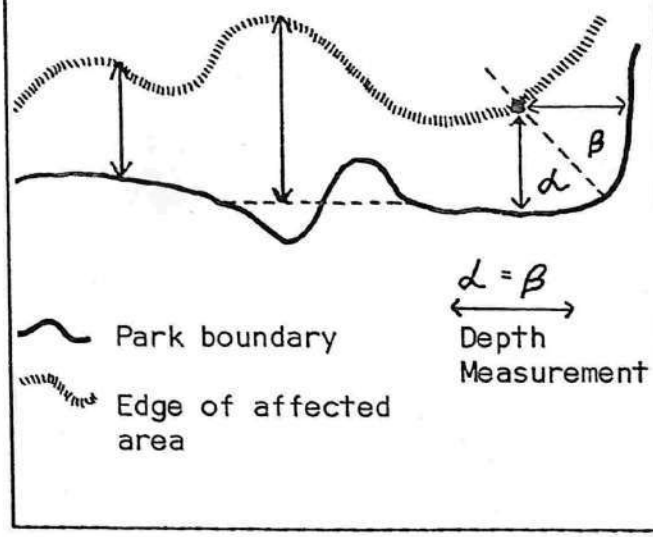
1. **Proportion of affected area:** This has been determined from staff statements. Express in percent of block area. There is one difficulty in using this indicator. A smaller proportion of affected area in one block as compared to another can mean one of two things: less human pressure or a much greater and less accessible range area. Proportion of affected area therefore works best for blocks of comparable size and accessibility. Consider combining small blocks for the purpose of pressure comparison.

2. **Distance of the affected area from the boundary:** This indicator complements the "proportion of affected area" as it measures how close human pressure gets to the geographical core of a park or sanctuary. Some blocks score low on account of affected area because they are (a) further away from the boundary than others or, (b) their affected area is long and narrow and projects far into the geographical core of the reserve.



MEASURING DEPTH OF AFFECTED AREA

Measure the maximum depth at right angles from the boundary in steps of 0.5 km. Where the configuration of the boundary may lead to ambiguous results, make the measurement as shown.



3. **Livestock density:** If you can find out the number of livestock known to regularly graze in each block, calculate livestock density in terms of livestock units (LU) per hectare or square kilometer. You may have to account for itinerant herds or periods without grazing. In this case, LU-days per annum may be a better measure.

4. **Population pressure:** Add up the number of people living in villages known to make regular use of a block and calculate how many people depend in some way on one square kilometer of the block's affected area.

5. **Trail density:** Use the indicator for boundary blocks if conditions are suitable as noted in Public 4.3.

PRESSURE SCORES AND RANKING

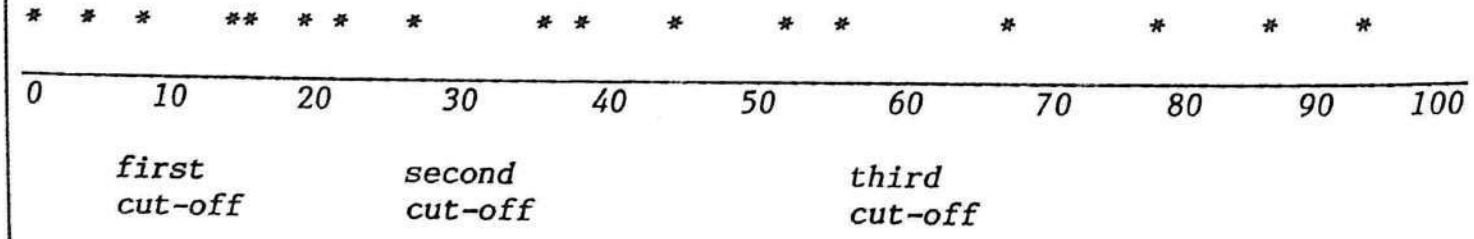
Each block receives an overall pressure score which is used to determine its pressure rank. Proceed as follows:

1. Score each block separately for each indicator. Note the values obtained for a particular indicator and visually allocate scores from 1 to 4. (box below).

VISUAL ALLOCATION OF PRESSURE SCORES

Values (proportion of affected area in %) for 20 blocks:
68, 26, 0, 0, 39, 20, 4, 45, 94, 79, 8, 0, 0, 14, 52, 36, 22, 15, 88, 55,

The range of values is 0 to 94. It helps to visualize the distribution of the values within this range by drawing a sketch



Scoring: 0-10 = 1; 11-30 = 2; 31-60 = 3; 61-94 = 4.

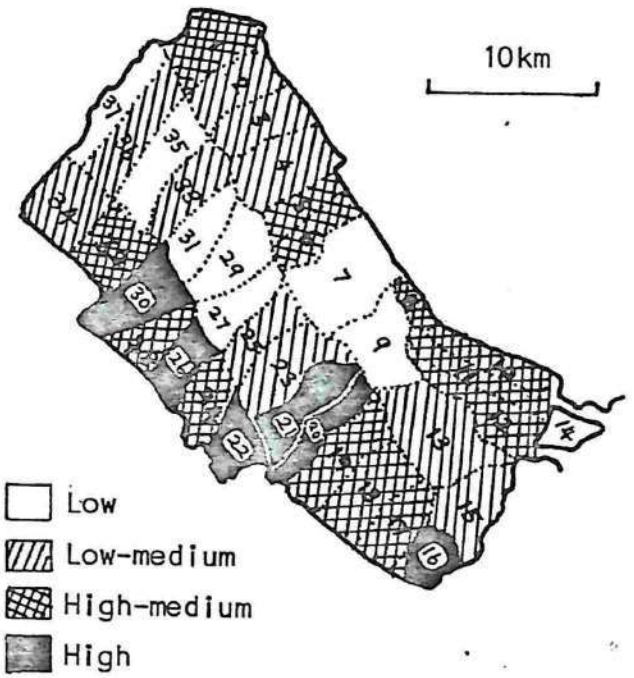
2. For each block calculate a block pressure score by averaging the scores obtained in respect to each indicator used for that block.

3. Allocate pressure ranks according to pressure score.

0 - 1.0	=	low
1.1 - 2.0	=	medium
2.1 - 3.0	=	high medium
3.1 - 4.0	=	high

CALCULATING BLOCK PRESSURE SCORE

	B1	*B2*	*B3*
% affected area	*3*	*2*	*1*
Affected area edge dist. to boundary	*2*	*3*	*0*
LU density	*1*	*2*	*1*
Human population density	*2*	*3*	*2*
Trail density	*2*	*4*	*1*
Mean (and block pressure score)	*2.0*	*2.8*	*1.0*



Pressure Rank by Block

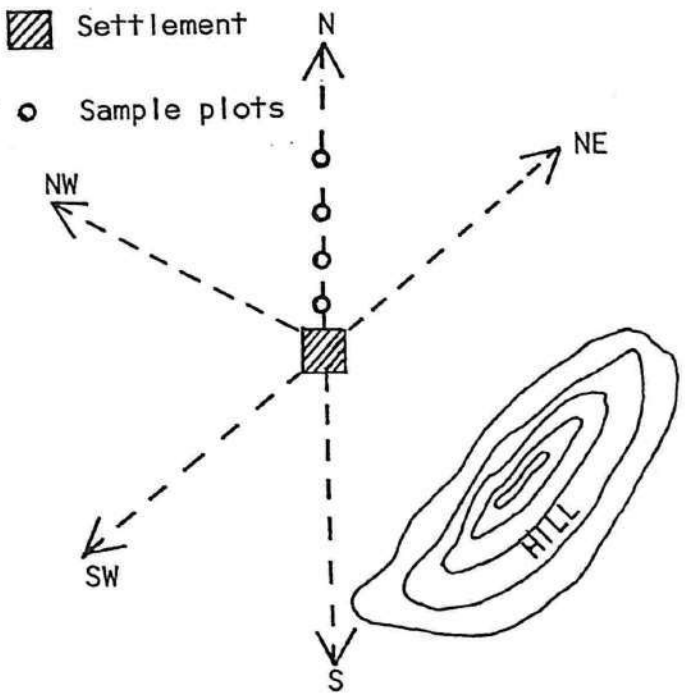
Settlement Impact Analysis

TO PROVIDE THE MANAGER WITH FACTUAL DATA ON THE EFFECTS OF SETTLEMENTS ON WILDLIFE AND ITS HABITAT

Conservationists frequently wish to remove settlement from within protected areas. It is simple to list the negative impacts of such settlements e.g. vegetation degradation, accelerated erosion, occupance of water etc. It is much more difficult to quantify the intensity of these impacts. Before making decisions in respect to resettlement the protected area manager ought to make an assessment of actual need and urgency of requisite action by quantifying the impact and clearly defining the affected areas. In case of national parks the legal position is clear i.e. no settlement, but the rules applying to sanctuaries leave more flexibility.

The major impacts of settlements on wildlife habitat can be summarized as follows. Damage to forest habitats results mainly from overgrazing and trampling, firewood collecting and felling for timber. Impact is generally in the form of erosion, disappearance of palatable species and cover, invasion of weeds and competition between wildlife and livestock for scarce water in the pinch period. Impact of this kind tends to be concentrated in the vicinity of settlements. For the manager it is important to know how far this impact reaches, how serious it is and where priority action is required.

This technique describes how to rapidly collect relevant data by sampling.



SAMPLING DESIGN

Choose a settlement inside the park or near its boundary.

Set up transects radiating out from the settlement, far enough to ensure that the area of impact is covered. Transects should ideally reach a point where impact is zero. This may be 10 km from the settlement centre. However, frequently there is no "zero impact" zone as one enters the sphere of influence of another settlement first.

Assess impact at every 200 m along the transects by evaluating the variables given below. The size of the sample plot depends on the nature of the variable.

Large plot = circle (5-10 m radius)
Medium plot = sampling frame (0.25 - 1 m sq) (Habitat 2.4)
Small plot = point sample (Habitat 2.3)

(To sample four 5 km transects you need 4 people to work for 4 mornings).

TYPES OF EROSION

Sheet erosion refers to the erosion of topsoil from the surface by wind or water. Exposed tree roots are a sign of sheet erosion.

Gully erosion refers to eroding of top soil and subsoil by water flowing in deep and narrow channels whose sides often cave in.

Rill erosion refers to erosion of top soil by water in numerous shallow channels which feed gullies or which might become gullies themselves later.

VARIABLES

Sample each site for all or some of the variables listed.

Ground Cover

Estimate percentages of bare ground, annual and perennial grasses, weeds, and livestock dung (point sampling, Habitat 2.3) to determine effects of overgrazing e.g. excessive bare ground and replacement of annual grasses by perennial species or weeds.

Erosion

Estimate severity of erosion on a four point scale (large plot).

(1 = no erosion; 2 = low medium; 3 = high medium; 4 = severe erosion.)

Grass Height

Measure predominant grass height and record in classes. (0-5 cm, 5-10 cm, 10-20 cm, more than 20 cm). Throw a 50 x 50 cm sampling frame three times (Habitat 2.4).

Wood Cutting and Lopping

(Large plot but plot size may have to be increased in order to get a sufficiently large count (50 stems) or more. Alternatively the variable can be evaluated in sections of a continuous belt transect (2 m wide) along the transect line). Count the number of stems, saplings, trunks larger than 3 cm diameter. Stems branching from a trunk below 1 m above ground are counted separately. Count both cut and uncut stems.

Count of the number of lopped stems. Stems cut above chest height are considered lopped.

Note the proportion of cut stems and lopped stems out of total stems counted.

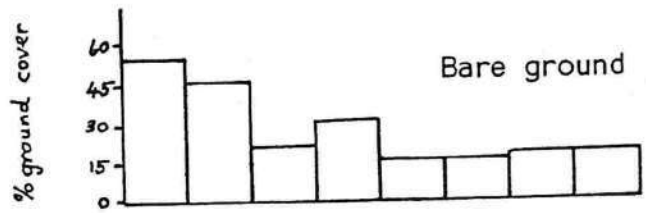
Wildlife Dung

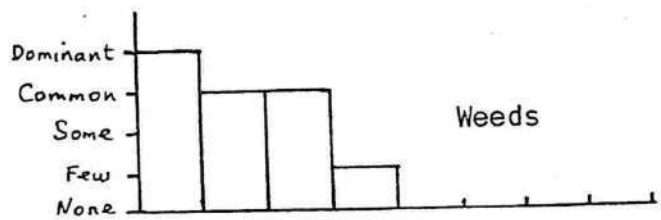
(Large plot) Count the number of dung and pellet groups. (Record droppings of Nilgai separately as it commonly occurs in areas of heavy cattle grazing.)

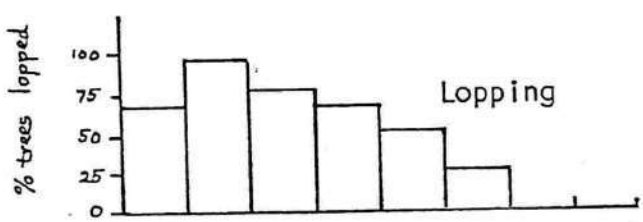
Analyzing and Presenting the Data

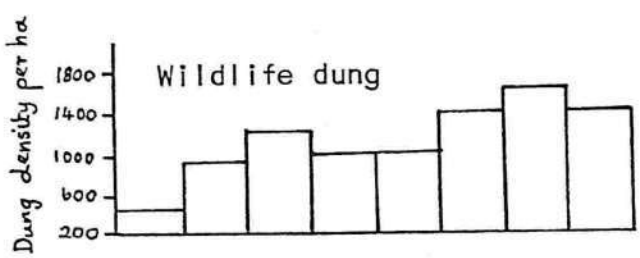
1. Average the data obtained for each variable per distance segements; e.g. all plots within 0.5 and 1 km from the settlement. Present the data per variable in the form of histograms.

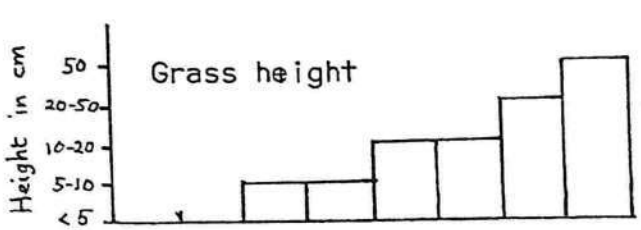
2. Translate the sampling data into plot scores which increase with severity of impact. No impact scores 1 and most intense impact scores 4. No wildlife dung is rated as 1 and abundant presence of dung is rated as 4. No domestic stock dung is rated as 1 and abundant domestic stock dung is rated as 4. For each plot calculate a composite mean from all variables.

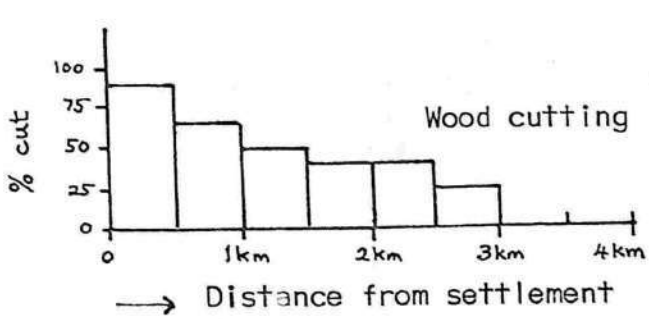












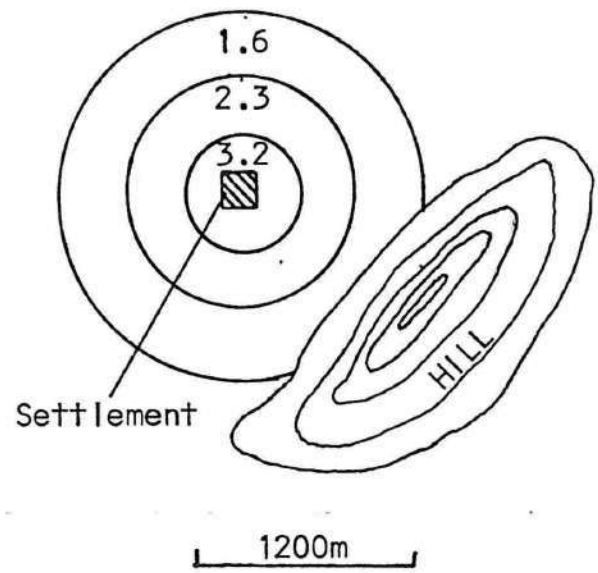
SAMPLE PLOT SCORES

Transect N

Variable	*Sample plots*			
	1	2	3	etc
Bare ground	4	4	2	
Weeds	2	1	0	
Livestock dung	4	4	4	
Erosion	3	3	2	
Grass height	4	3	1	
Wildlife dung	3	2	2	
% cut stems	4	4	2	
Mean composite plot score	3·4	3	1·9	

3. Enter the composite mean scores on a table per transect and average for plots with equal distance from the settlement. This value is a measure of impact at the respective distance from the settlement. Present this value in the form of concentric circles around the settlement.

Mean Impact Scores

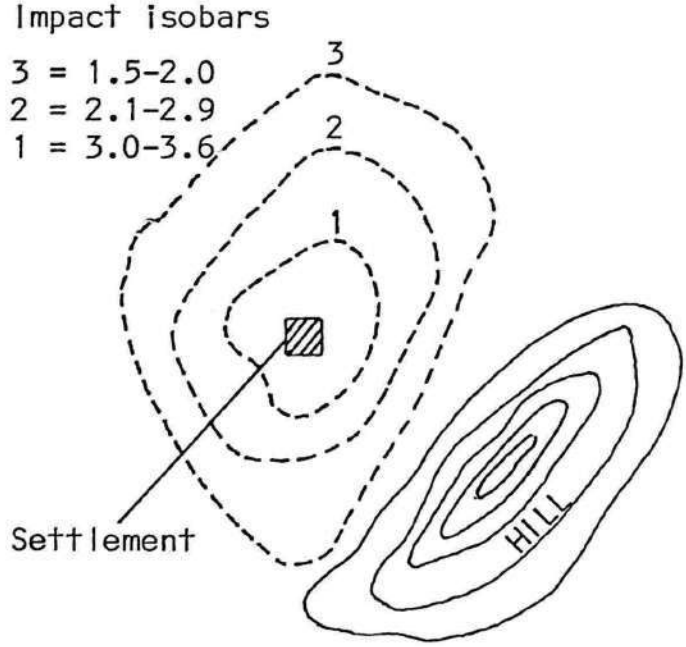


MEAN PLOT SCORES BY TRANSECT

Plot		Transects					
No.	Dist	S	SW	NW	N	NE	Mean
1	200m	3·1	2·8	3·6	3·4	3·6	3·3
2	400m	3·0	2·7	3·2	3·	3·3	3·0
3	600m	2·6	2·5	1·9	3·0	2·7	2·4
4	800m	2·1	2·0	1·9	1·8	2·6	2·1

Impact isobars

3 = 1.5-2.0
2 = 2.1-2.9
1 = 3.0-3.6



4. If plot scores vary widely from transect to transect it may be better to look for similar impact (similar scores) on each transect. Present this visually as impact isobars.

Trail Survey in Boundary Areas

TO HELP THE MANAGER LOCATE UNMAPPED TRAILS

Forest roads, even those rarely used or no longer fit for vehicle traffic, are generally shown on maps. However, regularly used trails are often not shown. A high density of trails leading into the protected area suggests much movement across its boundaries and indicates a potential problem area. Trail density has been noted to co-vary with the percentage of area affected by livestock grazing and firewood or timber cutting. It is useful in the assessment of human pressure on the park (Public 4.2). Trail density can be used as an indicator of comparative pressure in protected areas where the boundary is such that people can easily cross it anywhere. Trail density is not a good indicator of pressure where the boundary is such that access to the protected area is convenient only through a few "bottlenecks".

There is another reason to survey and map the foot trails. Being able to point out such trails accurately on a map makes it easier to issue instructions to foot patrols and may facilitate anti-poaching operations (Public 4.7).

This technique describes how to survey and record the position of major trails at the boundary.

EQUIPMENT/MATERIALS

Vehicle for boundary road survey, map scale 1:50,000 or larger, a pace-counter is optional for foot surveys.

SURVEY PREPARATIONS

Together with the staff conducting the survey, travel along a stretch of the boundary and note the well trodden trails which should be recorded as well as the more narrow and fainter trails which need not be recorded.

Survey by vehicle: Start the survey at an entrance gate or another prominent landmark which can be identified on your map. As survey line use boundary roads or roads inside the park which are within a few hundred meters and roughly parallel to the boundary. Record each trail distance along the boundary from the survey starting point, by the kilometer reading on the vehicle mileage counter (odometer). If the vehicle has no working odometer trail position has to be recorded as in the foot survey.

Survey on Foot: Foot surveys in areas inaccessible by road are similar except that locating trails is by prominent landmark and/or finding distance by counting paces (100 m after railway crossing, 300 m after bridge etc.)

CAUTION

Trails are sometimes very close together and may join not far from the survey line. If two trails are less than 30 meters apart count them as a single trail.

TRAIL SURVEY PROFORMA

Surveyor: S. Sharma

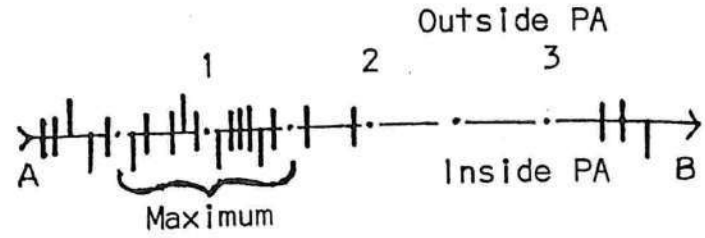
Date: 1.2.88 *By* vehicle/on foot

Section from: Bhag Rao

to: Raipur gate

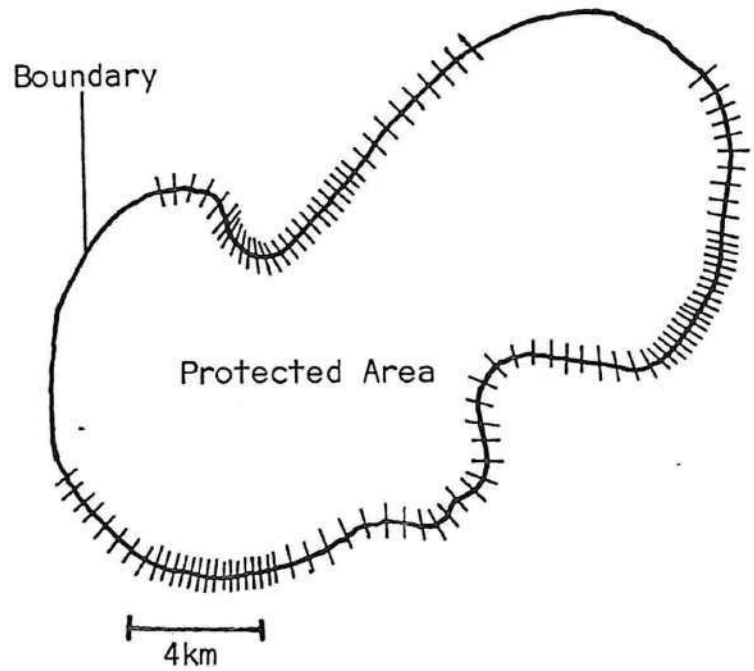
Km	*TL*	*TC*	*TR*	*FR or other landmarks observations*
0.1		✓✓		
0.2	✓			
0.3			✓	Plantation fence
0.4		✓		

TL = Trail on left of survey line
TC = Trail crossing survey line
TR = Trail on right of survey line
FR = Forest road



Overall Trail density = 5.4/km

Maximum Trail density per 1 km stretch = 10/km



||||||||| Trail Density >5/km
||||| Trail Density 0.5-5/km

Analyzing the Data

1. Plot the trails to scale on graph paper presenting the survey route as a straight line. Record the trails on the topo map. Draw an outline map of the protected area and show variations in trail density by shading, to obtain a visual impression of relative intensity.

2. Calculate trail density (trail crossings and trails leading inside park) over stretches of comparable length because the length of the respective survey line section has an effect on trail density. Find the maximum number of trails on any one kilometer section. A high trail density on any one stretch suggests that people frequently enter all along this stretch. Find the longest stretches without trail as an indicator of low disturbance.

Analyzing Forest Product Collection

TO HELP THE MANAGER ACQUIRE RELEVANT DETAILED INFORMATION

While conducting some of the preceding techniques (Public 4.1-4.2) some areas may have been identified as heavily affected by the collecting of firewood, fodder and other forest products. If one wants to mitigate the problem through development projects it is worthwhile to find out more detail e.g.:

What kinds of forest products are collected?
What quantities of each are collected in the various seasons?
Who are the collectors?
Where do the collectors come from?

Answers to these questions are readily available from local staff and additional efforts may seem unjustified. However, information from local staff is sometimes biased, incomplete, and usually not detailed and focussed enough to be useful for development project planning.

The technique is most suitable in situations where most traffic across the boundary is funnelled through relatively few, heavily used trails.

How to collect and analyze relevant data by observation at selected trails is explained in this technique.

OBJECTIVES

The survey and analysis will allow you to do the following:

- Identify places from where collectors originate and produce a map showing the communities known to make use of the affected area and the routes taken by the collectors to approach the protected area.
- Approximate quantities collected.
- Approximate the man-hours of labour spent in collecting.
- Find out the number of headloaders who most depend on the collecting and where they live.

PREPARATIONS

The area affected by the collecting of forest products and the location of major trails is presumably known and has been mapped (Public 4.1, 4.3).

Local staff will identify the trails which are most heavily used and will have to be monitored. Ask around to find out about the times of day when collectors arrive and leave. Make preliminary observations at various times, then decide on the sampling schedule and design a pro-forma to record observations.

DATA GATHERING

Observations at the Trail

Observation timing should be identical at the different observation points. One day-long observation (two observers, one in the morning, one in he afternoon) at each trail followed by several shorter observations are ideal. If the preliminary investigations and the day-long watch show that three out of four collectors enter between 7 and 11 am, then 75% of the sampling time should be allocated to that period and 25% to the post-noon period.

The observer should sit in a place where he is not immediately seen, otherwise some people may become suspicious and skirt the place. For this reason it is also advisable to change the observation point from day to day.

Data Analysis

For each trail one can calculate the average number of collectors and estimate the amount of forest products carried out per time period. The results can be extrapolated to make an estimate of yearly extraction considering that collection activity varies with the season and weather.

Inquiries with the Collectors

Once the sampling observations are complete, the observer may interview collectors to find out where they come from, how often they come, how much time they spend, whether the collected items are for sale or home consumption, and what other kinds of income they have. With their consent, collected items can be measured and weighed.

From the results of these investigations collecting patterns may be detected and certain types of collectors identified.

Firewood Collection Data Sheet

Observation Point: _____

Observer: _____ *Date:* _____ *Time:* _____

Time	*No. in party*	*Women*	*Children*	*Men*	*Also fodder cutting*	*From Village*	*Remarks (destination)*

EXAMPLE: DATA ANALYSIS

Raiwala and Balu Rao forest blocks have been ranked among the blocks subjects to high human pressure (Public 4.1).

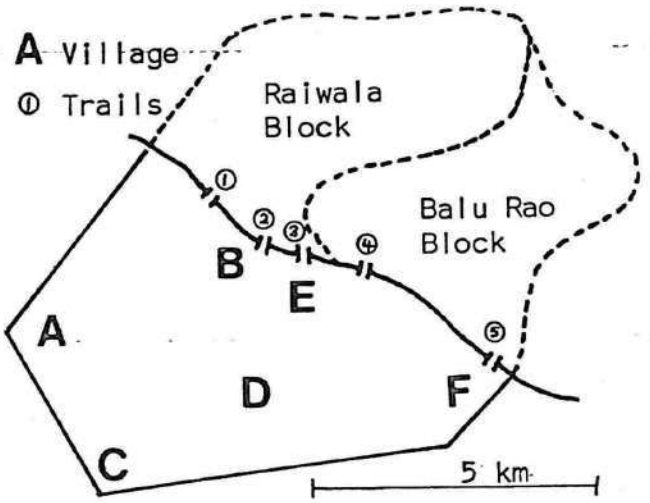
Most collectors enter the blocks through 5 heavily frequented trails.Nearly all collectors come from 6 villages (A,B,C,D,E,F) with a combined population of 3,500 people. Village C is the most distant, 4 km from the boundary.

About 600-700 collectors enter the blocks daily on the 5 observed trails. However, not all of the people from the villages directly adjacent to the boundary enter on these trails. The total number of collectors may therefore reach 700. The number goes down to 500 during the two-month harvest season. About 60% come from nearby villages (B,E,F) and the rest from the more distant villages (A,C,D).

Four out of five collectors enter on trails 3 and 4 near Balu Rao. Collectors from villages F also enter a neighbouring forest block. People from villages B,E,F tend to come daily whereas people from villages A,C and D come every second or third day.

About 60 women from the latter villages collect firewood daily as their only means of income.

Collectors from the distant villages arrive in large groups of 10-20 people. On the average, they spend 2 hours walking and 2 hours collecting. Those who live closer spend altogether 3 hours. Considering seasonal variations,a total of 650,000 (wo)man-hours of adult labour are spent on collecting every year. This labour could also be applied to plantation and other development works.



Village area dependent on forest in Raiwala and Balu Rao Blocks.

Man-hours Spent Collecting

	No. adult collect.	*Average collect. time*	*Total daily man/h*
Village A	51	4	204
Village B	123	3	369
Village C	81	4	324
Village D	111	4	444
Village E	162	3	486
Village F	43	3	129
Total			1,956

Collectors by Origin

	Number of collectors	*Headloading sole income*
Village A	60	18
Village B	145	-
Village C	95	20
Village D	130	22
Village E	190	-
Village F	50	-
Total	670	60

Very few collectors enter the forest before 7 a.m. and most have left it by 5 p.m.

Eighty percent of the collectors are women, 15% are children. The few men invariably cut single large poles which may weigh 40 kg and more.

The only forest products collected in significant quantities are firewood, and green fodder. Children usually carry only light (10 kg) bundles of dry sticks, some of which is from Lantana. Women's loads weigh between 28 and 36 kg, average of 31 kg.

Thirty percent of the collectors leaving the forest carry firewood (or poles) only, another 20% carry fodder only. The others carry firewood and fodder with about two thirds of the weight due to firewood.

Of the firewood some 60% of the weight of each bundle is due to large diameter stems (>4 cm at the base). These stems have usually been cut green or recently girdled to dry. Some approach polewood size.

Total annual biomass removal by collectors is estimated at 6,750 metric tonnes per year. This amounts to approximately 0.5 tonne per hectare of the area which is affected by collecting in the two blocks.

RESOURCE QUANTITIES REMOVED DAILY
(based on 650 daily collecting trips)

Type	*Approx. weight (kg)*
Dry, small sticks	*3,700*
Green, large stems	*5,500*
Large polewood	*1,300*
Green fodder	*8,000*
Total	*18,500*

Economic Valuation of Resource Loss

TO HELP THE MANAGER MAKE AN ECONOMIC ASSESSMENT OF RESOURCES LOST BY LOCAL COMMUNITIES TO A NATIONAL PARK.

When a national park is declared, local people inevitably lose access to resources which translates into a loss of income which many can ill afford. A detailed assessment of the loss can be used by the manager to back up budget requests for ecodevelopment which otherwise may range from woefully inadequate to exorbitantly high. The technique may also be used to approximate the value of a buffer zone to the local economy and justify inputs to maintain its productivity. The valuation may be combined with a community survey (Public 4.6).

The technique describes how to estimate, for selected villages, the loss of income resulting from access restrictions to a protected area.

ASSUMPTIONS AND LIMITATIONS

An economic valuation would normally consider market values of resources obtained from the park as well as employment opportunities. If a head-loader can sell what he or she collects in a day for Rs. 25, but could find alternative employment for a daily wage of Rs. 15, the loss to him or her would amount to Rs. 10. If not the loss would be Rs. 25. To simplify the valuation, let us make the reasonable assumption that alternative employment is generally not available. Throughout, losses are therefore expressed in terms of the market price of the particular resource or substitutes.

Not all losses are quantifiable in terms of market prices and one may have to substitute the price of an alternative. In the case of lost access to essential water resources one could substitute the cost of an artificial water supply, suitably spread over a period of several years, as an approximation of the annual cost of lost access.

Some losses e.g. greater inconvenience in access to temples or ancestral graves, cannot be readily quantified. They should be recognized apart from the economic losses.

The economic valuation does not include legal rights and leases held by individuals. These are assumed to be duly compensated, as required by the law, prior to park declaration.

The demand on forest resources by urban centres is difficult to quantify as well as to compensate. Urban centres and large revenue villages may have to be excluded from the valuation unless data are readily available in district census handbooks or with the block development officer.

SELECTING THE VILLAGES

Decide whether the valuation shall cover a single community or a group of communities. Select a village or a village cluster because it seems highly dependent on resources collected in the protected area or because it causes much disturbance to valuable wildlife habitat.

CATEGORIES OF LOSS

Losses can be put in the categories listed below. Decide which of them apply to the village(s) in question.

1. Green fodder
2. Firewood
3. Building materials
4. Raw materials for village craft
5. Minor forest products collected for sale or consumed locally.
6. Employment
7. Access to water
8. Crop predation

ECONOMIC VALUATION

Fodder: Loss is equal to the value of the fodder collected and that grazed or browsed in the park by productive livestock.

1. Find out about:

- o Number and species/breed of livestock kept (by direct census or from district census handbooks and development office records).
- o Number of unproductive animals (direct census and observation).

When is a domestic animal unproductive?

An animal is unproductive if it does not yield milk or wool and is not kept for sale or slaughter or as draught animal. The keeping of cattle merely to produce dung is not considered productive.

2. Obtain information about the average daily green fodder requirements of the local livestock breeds. Consult professionals in animal husbandry and/or interview representative households on the subject. In household interviews evaluate how much, if any, green fodder is grown or purchased.

Green Fodder Requirements

Number	Species/Age Group	LU	Daily Consumption (kg)		Grown/Purchased	
			Per LU	Total	Per LU	Total
92	Buffalo / adult	92	30	2,760	8	736
16	Buffalo / young	6.4	"	192	-	-
etc						
TOTAL						

3. Calculate the total daily requirement of green fodder which is either collected from the forest or grazed/browsed directly by livestock. For the calculation convert numbers and species of livestock kept into livestock units (LU) - see box.

Livestock Units

Below are the commonly used conversion factors for converting livestock numbers into livestock units.

Adult buffalo = 1, adult horse = 1,
Immature buffalo (to 2.5 years)= 0.4
Adult cattle = 0.8
Immature cattle (to 1 year) = 0.5
Goat/sheep = 0.1

4. Using average green fodder market prices calculate the value of the annual green fodder requirement which is procured from the forest.

5. Other factors to consider: Livestock are normally given dry fodder from agricultural residues, supplementary feed purchased in the market (oil cake etc.) and green fodder which usually comes from forest or pasture. Green fodder from the forest is either collected and taken to the village or grazed and browsed directly. Goats and sheep may spend most of their time grazing and browsing on public land but not necessarily always inside the national park and its buffer. Buffaloes and cattle may only be in the forest when crops are ripening in the field.Among the cattle and buffalo, the proportion of unproductive stock may be high and green fodder requirements vary with the breed. How much nutritional value the animals get from browsing and graz ing depends on the condition of the forest or range land.

Firewood: Calculate loss from the amount of firewood collected in the park and local market prices.

1. Evaluate consumption on household basis through interview, observation and weighing. Average the results from several households.

2. Calculate the value of the firewood which comes from the forest.

Firewood Consumption

No. Households	*Household consumption (kg)*			
	Dry/hot season	*Cold/wet season*	*Annual*	*From non-forest source*
Marginal farmers / landless				
Small farmer				
Large farmer				
TOTAL				

Building Materials: Calculate loss from the number of khacha houses, the quantity of materials to be replaced annually and the market price for these materials.

Loss of building materials only applies to khacha houses. An estimate of average annual replacement cost of poles and thatch should be obtained through interviews of household heads.

Raw Materials for Village Crafts: Loss is equal to the market value of the required raw material. If the raw material cannot be purchased, loss is equal to the market value of the items produced.

Find the number of households engaged in the craft and the quantity and market value of the raw material and the items produced.

Minor Forest Products for Sale or Consumption: Loss is equivalent to the sale price.

Find out the types and quantities of products collected and sold or consumed.

Employment: Calculate loss from the total number of man/days and the wages paid. If you are positive that people from the community under investigation will continue to get employment, deduct the equivalent amount.

Determine how many people from the community are (or used to be) engaged in extraction work or plantation, for how long, and at what wages.

Access to Water: Calculate an annual equivalent of loss from the expected life-time and the cost for construction and maintenance of an artificial source.

(If life-time is taken as 5 years, then total cost can be divided by five to arrive at an annual cost).

Determine whether or not a critical water source for the community is inside the protected area and whether or not this source is to be closed to village use. If yes, find out the cost of providing an artificial water source (tank, tube well, pump well) at the village itself.

Crop Predation: Calculate loss from the area of village cropland within 500 m of the boundary, the number of days for which the fields need to be watched, the number of crop watchers required and their daily wage rate.

Although people are prepared to put up with crop predation as long as they can enjoy the benefits of the forest resources, they perceive it as a great burden once that forest is closed to them. Crop predation also tends to increase with an increase of wildlife populations. The actual loss is difficult to determine. An approximation can be made by assuming that a 500 m strip of land adjacent to the park boundary is most heavily affected and that one crop watcher is needed for each 1.5 ha within this strip.

THE SUM OF LOSSES

The sum of losses provides a measure for the total monetary value of the resources extracted from the protected forest by the community per year. It says nothing about how well individual members of the community are able to absorb the loss which is an equally important factor when planning projects to reduce the hardships caused by barring access to a formerly accessible resource.

Conducting a Village Survey

TO HELP THE MANAGER COLLECT AND INTERPRET INFORMATION WITH RESPECT TO LOCAL PEOPLE'S DEPENDENCY ON THE RESOURCES OF HIS AREA.

An extension worker employed by the protected area authority must know about the economic and social realities of each village in order to be able to come up with recommendations and plans for cooperation between the protected area authority and local people. He must collect information about a) people's dependency on protected area resources, b) demography and land resources and c) people's needs and expectations.

We can define dependency in two ways:

1. *People are dependent on protected area resources if they have no access to such resources outside the protected area or if such alternative resources are in poor condition.*

2. *People are dependent on protected area resources if they are too poor to buy substitutes for resources lost to the protected area.*

In the survey one should, therefore investigate the existence, condition and accessibility of (forest) resources outside the protected area, and evidence of poverty in the communities known to use protected area resources.

Some material in this technique has been adapted from Microplanning: a tool for social forestry implementation issued by the National Wastelands Development Board, Ministry of Environment and Forests, GOI. This booklet also contains advice on technical planning which is not dealt with here.

How to plan a village survey and interpret its results is explained below.

MATERIALS AND LITERATURE

A map (scale 1:150,000) and a district census handbook with data on village level should be at hand. If census data are unavailable, block development officers and NGO's (non-government organizations) can also supply relevant information.

SURVEY AREA

The survey should extend to all villages from where people are known to regularly enter the protected area (Public 4.4). Compile a list of the names (and possible synonyms) of these villages. Houses are often widely scattered and villages may consist of

several sub-units known under different local names which may not even be found on the map. Identify and list sub-units of each village, if any. Compare the names on the list with those on the map and in the census handbook. Double checking in this way may show that villages marked on the map no longer exist or else that villages which should have been included were missed. Doing this thoroughly in the beginning prevents confusion later.

The survey area is drawn so as to encompass all villages on the final list. The area is generally wide where the protected area is adjacent to intensively cultivated land without alternative forest resources. It can be narrow where the boundary is inaccessible or where forest resources outside the park are available and preferred.

SURVEY PREPARATIONS

An extension worker with relevant experience should carry out the survey. If he is male, one may consider hiring a female social sciences graduate to assist.

There are two survey sheets to be filled in. One is for the village as a whole (village profile). The other (household survey) elicits opinions from men and women in individual households.

First, adjust the sample survey sheets to the local situation. Include only those questions which are likely to yield useful answers.Before finalizing it, field-test it in two or three villages.

VILLAGE PROFILE SURVEY

See the village patwari to obtain answers for the village survey sheet. The questions are objective and should be answerable without much difficulty. Nevertheless, cross-check the information later against census figures and information from block development officers. Some information, e.g.funding sources and local leadership, may have to be obtained from other sources or through personal observation.

Some valuable information may come from third sources. Village herdsmen sometimes provide better information about livestock numbers and ownership distribution than the patwari.

It is useful to have a map of the village and surrounding areas during the interview.

Data Analysis: Village Profile

During the final analysis, elaborate on some of the points noted on the village profile sheet, namely "leadership", "funding", and "political, social, religious groups".

Leadership

Institutions, individuals or local organizations which could be asked to provide leadership in project planning and implementation.

Political, Social, Religious Groups

Rivalry between groups which may affect project planning and implementation.

Funds

Funding sources which can be approaced and the approximate amounts.

VILLAGE PROFILE QUESTIONNAIRE

PERSON INTERVIEWED: _____ POSITION: _____
VILLAGE/BLOCK/DISTRICT: _____

Inside park? Yes/No To be resettled? Yes/No Distance to park _____km

DEMOGRAPHIC DATA

Population: Total_____ Male_____ Female_____ Children_____

Households: Total_____ Large_____ Small_____ Marginal_____* Landless_____

Khacha Houses: _____ School Yes/No Dispensary Yes/No

Livestock: Buffalo_____ Cattle _____ Goats/Sheep_____ Other_____

LAND RESOURCES

	Village:	Panchayat	Revenue
Total Land:	____ ha	____ ha	____ ha
Available for Forestry :	____ ha	____ ha	____ ha

Is park forest the only accessible forest? Yes/No
Distance to the nearest forest outside the park _____ km.

If park forest is preferred, why? Which blocks _____

Is there water shortage at any time? Yes/No for People/Livestock

When? _____ Are any critical water sources inside the park? _____

CROP PREDATION

Cropland subject to crop predation by wildlife: ____ ha by: elephant/deer/ nilgai/blackbuck/pig/monkey/other _____
People injured or killed by wild animals: Yes/No when _____

LEADERSHIP AND GROUPS: (Local leaders and organizations: Name, activity, type of leadership) Religious groups, cast, cooperatives etc.
FUNDING: possible sources and available amounts.
INTERVIEW PROCESS: (atmosphere, competence of interviewee etc)

* farming households defined according to guidelines issued by each state government.

HOUSEHOLD SURVEY

Interview at least 30 people in 30 households in each village (or less, of course, if the village is smaller). The proportion of households to be interviewed depends on the size of the village; 20% for a village with 150 households;10% for one with 300 households. Allocate the number of interviews in proportion to the number of households per landholding class. Interview all households in small villages.

Limit the number of questions asked during the visit. After 30 to 45 mintes many interviewees become impatient and the quality of the answers diminishes. Particularly when the "valuation of resource loss" (Public 4.5) is carried out at the same time, two visits may become necessary.

Complete the "interview process" section of the survey sheet as soon as possible after the visit.

HOUSEHOLD INTERVIEWS:
How many per landholding class?

A village has 100 households. We decide to interview 30 households. Of these households, 10 belong to large farmers, 60 to small or marginal farmers, 30 to the landless. Then interview 3 large farmers (10% of 30), 18 small/marginal farmers (60% of 30), and 9 of the landless (30% of 30).

HOUSEHOLD SURVEY QUESTIONNAIRE

NAME:_____ Male/Female

LANDHOLDING CLASS: Large/small/marginal farmer/landless

PRIORITY NEEDS (tick off three) Employment/Fuelwood/Fodder/Green manure/ Fruits/Protection from crop raiding by wildlife/drinking water for people/ drinking water for livestock/other_____

EMPLOYMENT: Number of family members of working age: _____

Employment outside Agriculture in man-days per year per family:

Headloading (for sale)_____ Forestry operations _____ Factory_____

Civil service _____ Craft (specify) _____

Unemployment (man-days per year per family): _____

Timing of the period of unemployment: Nov-Jan Feb-Apr May-June July-Oct

LIVESTOCK OWNED: Buffalo ____ Cattle ____ Goats/sheep ____ Others ____

Days per year when grazed in park ____ ____ ____ ____

RESOURCES OBTAINED IN THE PARK: If any other forest is near, is park forest still preferred? Yes/No. If yes, why?_____

Minor Forest Products Collected:

Type	Quantity collected per year
Firewood	_____
Fodder	_____
Other	_____

PERSONAL MESSAGE TO THE PARK AUTHORITY:_____

_____

_____

INTERVIEW PROCESS:_____

HOUSEHOLD SURVEY
Example for Analysis and Write-up

Priority Needs

Large farmers : protection from crop raiding*, firewood,
Small farmers : fodder, firewood, protection from crop raiding
Marginal farmers: employment, fuelwood, fodder
Landless : employment, fuelwood

* Crop raiding by elephant is sporadic and does most damage in sugarcane which is planted mainly by the large farmers.

Employment

Employment other than agriculture:
- headloading for urban firewood market (all landless households, 50% of marginal farmer households)
- forestry operations (all marginal farmer households, 40% of landless households, 20% of small farmer households)
- rope weaving (60% of both marginal and small farmer households)

If the collection of bhabar grass for rope weaving is stopped and the material cannot be obtained elsewhere, the village will lose at least 3,000 man-days of employment per year.

Annual unemployment averages 210 man-days for a marginal farming household and 290 for a landless household. This amounts to 7,680 man-days of unemployment for the village. Most of the unemployment falls in the period March through June.

Livestock Owned

	buffalo	cattle	goats/sheep
Large farmers			
Small farmers			
Marginal farmers			
Landless			
Total			
Average number of days animals spend grazing in park forest			

(contd.)

(contd. from previous page)

Forest Products obtained in the Park

All income groups, except the large farmer households, have members of the family entering the park forest at least 3 times a week. Park forest is preferred because it is more productive. Reserved forest outside the park has mature plantations of Sal and Teak but at ground level the forest is highly degraded and regeneration is nil.

Firewood

The average daily requirement of firewood for each landless and marginal farmer household is 3 kg per day and is supplemented with crop residues and dung. The wood is all collected in the park forest. Small farmers consume about 4 kg a day, partly bought and partly collected. Large farm households burn up to 8 kg a day because they do not burn crop residues or dung. Half is collected on their own holdings and the other half is bought.

Fodder

Large farmers grow or purchase fodder for their bullocks, their milking buffaloes and cows. Some 15% of the cattle and buffaloes owned by the other income groups are stall-fed and green fodder is collected in the park forest at the rate of 10 kg per animal per day. The remaining livestock, including goats and sheep graze in the park forest daily except for a period of two months after the harvest.

Rope weaving

About 19,000 kg of bhabar grass are collected between January and May each year which, manufactured into rope generates an income of about Rs. 45,000. This constitutes about a third of the total income of these households in the marginal farmer and landless class.

Personal Message to the Park Authority:

Give a summary of messages by each landholding group. Note if someone has made a proposal which is realistic enough to be followed up on.

Conducting Anti-poaching Operations

TO HELP THE MANAGER PLAN ANTI-POACHING STRATEGIES AND OPERATIONS

Stiff legislation and the deployment of additional manpower for protection under Project Tiger has greatly reduced poaching in Indian parks and sanctuaries. Yet, commercial poaching for rhino horn, musk, meat or ivory has not been eradicated entirely and only continuing vigilance at all levels can stop the lucrative business. Plant collecting (medicinal plants, orchids etc.) without license, for commercial purposes is another form of poaching.

Subsistence hunting and poaching for the pot is comparatively less serious because it is normally for the more common species like porcupines, pigs and chital. However, the large tribal drive hunts of Bihar and elsewhere with several thousand hunters converging on a protected area pose a severe threat to the continued survival of wildlife. These hunts are conducted quite openly and can be phased out through local political support, patient persuasion and increased law enforcement manpower.

This technique describes the major components of poaching control; preliminary inquiries, prevention, detection and capture.

PRELIMINARY INQUIRIES

Get a clear picture of the nature of the poaching that is going on.

- Commercial or subsistence poaching.
- Day or night.
- Wet season or dry season.
- Number of people involved/size of party.
- Middle men who purchase goods.
- Markets.
- Hunting techniques (Are they setting traps and return to them periodically? Are they using dogs?)
- Arms available to the poachers.
- Are there known poachers' villages.

Obtain the above information from informers and poachers who were caught. Find the preferred poaching locations and the access routes and map them (Public 4.3).

PREVENTION

Organized commercial poaching is usually the work of a few individuals. It is possible to mobilize latent resentment by villagers who do not participate in and share the benefits of poaching. Hold meetings and organize film shows in poaching strongholds. Explain conservation problems.

A high probability of conviction and stiff sentences will act as deterrent. Publicize and discuss recent captures and sentences and set up a system of informers. Support by police and local courts will allow you to keep a check on known firearm holders.

DETECTION

Detection is the first step to capture.

- Conduct spot checks of vehicles or of places where wild animals or their remains are suspected to be sold.
- Maintain an adequate patrolling intensity. Ensure that field staff are actually in the field and patrolling. Increase supervision if necessary.
- Post more staff in known poaching areas at times of increased poaching incidence. Keeping good files and regular updating of the "poaching map" will facilitate this.
- Patrols, motorized and on foot, should cover boundaries, known access routes, and water holes and preferred localities for target species.
- Patrol routes and schedules should vary. Keep the patrol groups small (two or three guards) and mobile. Tell the patrol to stay away from the roads.
- Move patrol personnel around frequently to reduce the risk of their forming alliances with local poachers.
- Maintain an effective radio communicaton network.

CAPTURE GROUP

To confront an organized and heavily armed poaching gang requires semi-military capability, transport, firearms and smooth, reliable communications between the units moving in the field. All anti-poaching activities need to be closely supervised by a suitably trained officer who can ensure the required discipline and expertise among the members of the capture group.

- The capture group of 4-5 men should patrol with field post staff from time to time, becomng familiar with the locality and the people. They should show an armed presence at irregular intervals.
- The capture group should be able to contact headquarters or other capture groups by walkie-talkie at any time.
- At least two men in the capture group should be armed.
- The group should have motorcycles or a jeep at its disposal. In some places, boats or elephants might be required for greatest mobility.
- The group should have field equipment and provisions for 2 to 3 day field operations.

Capture

For capture the poachers are best surrounded with law enforcement personnel outnumbering them at least 2:1. Challenge the poacher in the local language to explain his presence and purpose of being there.

Make the arrest and take the necessary precautions to prevent escape (handcuffs, lock-up at Range HQ). The poacher must be produced before the nearest district magistrate within 24 hours of the arrest.

Try to catch the poachers red-handed and secure any evidence they may have with them (firearms, snares, meat, skins, trophies).

Evidence in Poaching Cases

TO FAMILIARIZE THE MANAGER WITH DIFFERENT TYPES OF EVIDENCE AND ITS USE

The Wildlife Protection Act (WPA) provides the framework within which law enforcement takes place. The manager must, of course, be familiar with the most relevant sections so he knows what constitutes a punishable offence.

Law enforcement is effective only if offenders are convicted in a court of law. For a case to be prosecuted successfully, evidence must be secured which proves guilt beyond resonable doubt. The role of the manager is to ensure successful prosecution by registering poaching and encroachment cases with the court, cooperating with the public prosecutor in drafting the prosecution report, and supplying the prosecutor with evidence that holds up in a court of law.

A case is weak if it is solely based on statements by forestry staff because a skilled defence can easily cast doubt on the competence of prosecution witnesses. Staff statements should therefore be supported by independent experts, forensic lab reports, by circumstantial evidence and evidence in the form of confiscated equipment and contraband (Public 4.5 and WPA Section 50 (7)).

How to secure and use different types of evidence is discussed below.

TYPES OF EVIDENCE

Detained or Seized Articles

These include:

a. Tools used to commit the offence (traps, guns, axe etc.)
b. Means of transport (jeep, boat, bullock cart, elephant)
c. Illegally procured goods (timber, animal carcass)
d. Livestock

These articles can be detained or seized by forest staff from the level of forester upward or other officers specifically authorized to do do. An article is detained if its association with an illegal activity is not certain. It is subsequently either released to its owner or seized. The ownership of a detained article is under dispute. If convincing evidence suggests it was used in unlawful activity, an article can be seized. It is then considered government property unless someone offers convincing evidence to the contrary. A seized article can be disposed of through public auction. In either case, detention or seizure, the court should be notified.

A detained article can be released on bond by a forest officer (Sec.50(2), Sec.50(6)(b). A seized article cannot be released, but it can be auctioned off with the permission of the court (Sec.50(4), Sec.50(6)(a).

Circumstantial Evidence

Those clues which lead one to believe that an event happened in a certain way constitute circumstantial evidence. These are especially important when trying to reconstruct a sequence of events when the offender was not apprehended on the spot.To be convincing such clues should be expressed in terms of conclusions drawn from undisputable fact and observation. (e.g. We contend that the rifle belongs to the accused and that it was the same weapon which was used to shoot a Sambar near Bagh Rao. The reasons: A wounded and dying Sambar deer was found lying in a waterhole in Bhag Rao in the morning after the defendent was apprehended in the same general area inside the national park. A rifle was found only 50 m from where the defendent was arrested after a brief chase. Two shots had been heard 20 minutes before the arrest was made. Two cartridges were missing from the magazine.)

Witnesses

Staff making the arrest as well as independent witnesses can be called upon to give evidence in court. Staff statements should always be supported by additional evidence (Sec.50(7)).

The prosecution must be careful when choosing local witnesses. Subject to threat or bribery, they may experience inexplicable lapses of memory, alter earlier depositions, or disappear just before the trial, thus weakening the prosecution case.

Expert Opinion

Expert opinion can be in the form of lab reports, e.g. forensic lab reports about poison found in the internal organs or depositions by professionals e.g. a vet stating cause of death.

Public Auction of Seized Articles (Sec.50(4), (6)(a).

The loss of tools, weapons and vehicles can sometimes be a more effective deterrent than fines impose by a lenient court.Seized articles should therefore be auctioned off as soon as posible if the offender is unlikely to be caught. Swift action is essential. If too much time elapses, offenders may gather courage and claim their property under the pretext that it was used without their knowledge.

1. *Issue a claimant notice for the article stating a definite reporting time which should generally not exceed 7 days from the date of issue.*

2. *If no claimant has come forward by the specified deadline, transport the articles to some other place for public auction. If auctioned locally, the previous owner might exert undue influence during the bidding. To be able to transport seized articles to the place of auction without delay, provision should be made in the budget. Informer rewards should also be built into the budget.*

SECURING AND HANDLING OF EVIDENCE

Possibility A: Offender is caught red-handed.

It is, of course, best to apprehend offenders on the spot by intercepting at a suitable place (Public 4.7) and seizing articles used to commit the offence. These articles should be properly labelled and affixed with

detailed information. This will help prosection witnesses during cross examination.

After having established the identity of the offender and registered a case with the local police, the seized articles should generally be kept in a safe place until the trial is over. If this is difficult to do, as in the case of live animals, the court's permission should be sought for auctioning them off.

Compounding an Offence

If an offence is considered or committed under mitigating circumstances, forest officials can "compound" the case, that is dismiss the offender after realising a sum of money as fine. (Sec.54(1),(a),(b), Sec.54 (2),(3),(4).

However, it is <u>not</u> permitted to compound a case involving an animal species listed in Schedule I or part 2 of Schedule II of the Wildlife Protection Act for which minimum imprisonment of 6 months has been stipulated. A case can also <u>not</u> be compounded when the offence was committed inside a national park or sanctuary.

Forest officers have considerable discretionary power in exercising their authority and it is important for the directors of national parks and sanctuaries to ensure that these powers are not misused.

Possibility B: Offender escapes, but his identity is known or there is strong suspicion.

In his case it is especially important to secure evidence carefully. Seized articles should be kept.

<u>Wildlife poaching:</u> If the carcass of a wild animal is found, try to find circumstantial evidence which corroborates the following statements.

a. The animal did <u>not</u> die a natural death.
b. Its death was <u>not</u> due to an accident or in self defence.
c. It was deliberately injured by the suspect with the intention to kill.

1. Sketch, photograph, describe the location and position of the carcass. If the carcass is fresh, make an assessment of the condition of the animal. Later draw conclusions based on professional knowledge of the species and its behaviour (perhaps invite opinions from other experts in the field).

2. Search for signs of external injury (bullet wounds, cuts, trap remains, burns, snare marks) and sketch, photograph, describe. If the search for external injuries was inconclusive, open the body for an internal examination. Note discolourations, concussions, fractures. If poisoning is suspected collect samples from tongue, sto- mach content, liver, lungs, kidney and intestine to send to a forensic lab or call a veterinarian.

Lab Analysis of Samples for Poisoning or Disease

A number of institutions can be approached to assist with the analysis of samples:

State Forensic Laboratories (obtain address through police department). Agricultural Universities of the State (obtain address from education department) Veterinary Research Institute (Wildlife Division); Izatnagar, District Bareilly, UP.

3. Search the vicinity for other evidence (e.g. traps, snares, live electric wires, drag marks etc.)

4. Investigate in nearby teashops and ask cattle herders as well as known informers in regard to whereabouts of the suspect or the identity of the offender.

Encroachment: Patrols must be frequent in areas prone to encroachment because these must be detected early after the first sign of fresh clearing. The area must be visited frequently until the offender is met on the spot or can be traced to a nearby village. Once a family has settled on an encroachment it becomes extremely difficult to evict them.

Possibility C: The offender will probably not be caught.

Seized articles should be disposed of as soon as possible.

Is fishing illegal?

Fish are not (yet) listed in any schedule of the Wildlife Protection Act but fishing is prohibited by the law which applies to national parks and wildlife sanctuaries. Outside these areas, fishery departments regulate fishing.