NATIONAL MUSEUMS OF KENYA

WILD DOG RESEARCH PROGRAMME

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Feasibility study - Wild dog research in Tsavo East National Park

1. Introduction

The decline in numbers of the wild dog (Lycaon pictus) throughout its range has caused widespread concern amongst conservation authorities. This has been reflected in the establishment of research programmes in several of the African range states of the wild dog, aimed at assessing the current status of the species, elucidating the reasons for its decline and examining the prospects for its conservation.

The National Museums of Kenya's wild dog research programme was set up to collect data on the wild dog in Kenya. In particular, the programme has been monitoring the Masai Mara wild dog population, which it has demonstrated suffers from rabies and has declined by more than 50% since 1988. The population may be bolstered by future immigration, but the risk of further outbreaks of disease remains to threaten the success of any recovery. With such an uncertain situation in Masai Mara it seemed imperative to find out whether prospects for the wild dog are any better in other locations.

Because of the paucity of detailed information for areas outside Masai Mara, it was decided that any area proposed as the site of new investigations should be subject to a feasibility study. This would confirm the continuing occurrence of wild dogs in the candidate study area and assess the ease (or otherwise) with which an intensive study of these animals could be carried out.

Based on the available information, Tsavo East National Park seemed the most suitable area to which to extend the wild dog research programme. The principal reasons for its selection were:

- recent sighting reports indicated that the wild dog still occurred there, and
- as a huge area (about 11,700 sq. km) of protected wilderness, virtually devoid of human activity, Tsavo East seemed to offer favourable conditions for wild dog conservation and it was felt that this potential should not be left unexplored.

Consequently, between October 28th 1991 and January 26th 1992, a feasibility study was conducted in Tsavo East and the following report describes its progress and findings.

2. Aims of the feasibility study

The study aimed to collect information about wild dogs in Tsavo East and about the factors which would affect any future study of the animals. The following were regarded as key questions:

- did wild dogs still occur in Tsavo East?
- if so, in what areas could they be found?
- did they form a resident population?
- how many were there?
- bearing in mind the number and distribution of the animals, was a further and more detailed study a practical proposition?
- what particular questions should any such study address?

3. The study area - Tsavo East National Park, Kenya

(see maps at end of report)

Tsavo East can be characterised as an area of semi-arid bushland and grassland extending over about 11,700 sq. km, situated roughly halfway between Nairobi and the coast of Kenya.

The park contains three rivers. Two are seasonal - the Tiva in the north and the Voi river in the south both dry up in times of low rainfall (January-February, May-October). The Galana river is permanent and is derived from the confluence of the Athi river, which flows from the north, and the Tsavo river, which joins from the west. The Galana river flows west to east across the middle of the park.

Areas to the north and south of the Galana river differ in their shares of vegetation types, with the southern area supporting a community consisting largely of open bushland and grassland, whilst the northern area contains a higher proportion of bushland. This can be seen on the vegetation map (see note on vegetation classification at end of this section).

Topographically the main features are the Yatta Plateau, a volcanic outcrop which runs down the western boundary of the park to just north of the origin of the Galana river, and the Yatta escarpment which abuts the southern tip of the Plateau and then runs west to east across the middle of the Park. Otherwise the park is generally flat with a few scattered outcropping rocky hills.

The area to the north of the Galana river is closed to general tourism and hence experiences a far lower level of human activity than the southern area where tourism is permitted.

Note on vegetation classification

Whilst there are various consequences of plant community composition and physical structure, for this study the most important were the ease of movement and quality of visibility permitted by the different categories of vegetation. These would have a major influence over whether and how any future research could be done on wild dogs in Tsavo East:

open bushland/grassland - flat, open terrain with no or only a light covering of trees and bushes, allowing unobstructed movement in a car or on foot and unrestricted visibility

bushland - movement with a vehicle difficult and obstructed, movement on foot not difficult but visibility restricted to <50m

dense bushland - off trails, walking is very difficult - in places the bush is impenetrable; visibility limited to close quarters

4. Methods

The researcher spent the periods 28/10/91-20/12/91 and 16/01/92-26/01/92 in Tsavo East, during which time information was collected in various ways:

- foot and vehicle patrols were carried out to look for wild dogs and/or signs of their presence and to gain an appreciation of terrain, vegetation and wildlife distributions and of the conditions under which any further study would be implemented.

- written records of wild dog sightings in Tsavo East were researched and supplemented with data on further sightings made during the study period.

- informal discussions were held with KWS officers and rangers, local people and tour drivers in order to develop an idea of how the number and distribution of wild dogs might have altered over recent years.

The results of the investigation are presented below. The results for the areas to the north and south of the Galana river (referred to as "Northern area" and "Southern area" respectively) are presented separately for convenience of discussion. Some information was obtained on areas outside Tsavo East, and this is summarised in a third section of results.

5. Results for Northern area

(a) Wild dog sightings

date	location	comments	source
20/01/92	Masobo	1 wd at waterhole	APU
13/01/92	Nthalakana	group of wd (no.?)	TSC
29/11/91	Nthalakana	21 wd on Yatta Plateau	TSC
06/11/91	Nthalakana	2 wd at waterhole	SLJ
05/11/91	Mukoka	wd tracks in Tiva bed	SLJ
??/11/91	Rhino corner	wd pack hunting impala on airstrip	TSC
??/??/91	Mukoka	2 wd on Tiva	APU
??/??/91	Kilimanyenze	4 wd	APU
??/10/90	Kilimanyenze	2 wd near N. boundary	APU
??/06/90	Ithumba	3 wd	APU
??/06/90	Nthalakana	>20 wd on airstrip on Yatta	APU
23/06/90	Nthalakana	wd on Yatta (no.?)	TSC
05/02/90	Nthalakana	wd on Yatta (no.?)	TSC
early 90	Nthalakana	30-50 wd on Yatta	TSC
??/??/90	Mukoka	6 wd on Tiva	APU
Circa 85	Nthalakana	>90 wd on road from TSC	TSC
??/05/60	Tabanguji	large pack of wd baying leopard up tree	APU
??/06/60	Lugards falls/ Diandaza	wd seen between Lugards and Diandaza	APU
15/11/48	Kimathena	50-60 wd	APU

Abbreviations

wd - wild dog/s
APU - Antipoaching or other KWS personnel
SLJ - the researcher
TSC - Tsavo Safari Camp staff
no.? - number unknown

This table is derived from written records consulted in Tsavo East and from sightings reported during the study period. It almost certainly under-represents the occurrence of wild dogs in the Northern area. This is mainly because of incomplete records and casual reporting procedures. For example the KWS written records were very limited - there was no useful documentation for the period between 1960 and 1990.

It is likely that before about 1991 many wild dog sightings went unreported because there was no general awareness of the need to record them and no formal system by which to do so. Even where a recording system is in place sightings can still go unrecorded. For example Tsavo Safari Camp has a log book of game sightings which goes back about ten years. In it the Camp's drivers record sightings of less-commonly-seen local wildlife, but they restrict entries to sightings made on game drives with guests. While wild dogs are regularly spotted under other circumstances, such as firewood collection trips etc, these encounters go unrecorded.

By an oversight, pre-1990 TSC records were not consulted. This would have provided more information on the presence of wild dogs in the area over the past decade. However interviews at TSC suggested that the pattern of sightings since 1990 has been much the same as that over the previous decade.

(b) Results of interviews

Of the people I spoke to who suggested an area where it would be likely to find wild dogs, most named the area around the Yatta Plateau, Nthalakana and the nearby Tiva river. So opinion corresponded with the distribution of actual recorded sightings.

An interesting belief of the Kamba people living just to the north of the Ithumba area is that the Yatta Plateau is patrolled by a large pack/s of wild dogs which makes it risky to venture into thick bush in those parts.This has a parallel with Galana Ranch (a large cattle ranch between Tsavo East and the coast), where I was told that local people believed a large pack of wild dogs was roaming in the coastal forests to the east in an area called Alango Shira. Whether these tales are just relics from the "old days" when it was more common to encounter large packs, or whether they still apply today is not clear. In this context the comparatively recent (1985) sighting of over 90 wild dogs on the side of the Yatta Plateau is very interesting.

In populated areas just outside the Northern area, interviews suggested that wild dogs are rarely seen. Kasaala is a village close to the northern park boundary and interviewees said they had not heard of wild dogs in their area for several years.

On Galana Ranch interviewees said that it was a long time since wild dogs had been seen there. This was corroborated by KWS pilots who said that several years ago they would occasionally spot wild dogs on the ranch but nowadays they never do, even though the intensity of aerial patrols is now greater than ever.

(c) Ecological aspects of the Northern area

The Northern area is largely bushland. There is a broad gradient from dry grassland and open bushland in the east near Galana Ranch, through a central block of bushland which then assumes a more open configuration towards the base of the Yatta Plateau in the west. Along the foot of the Plateau there is a mosaic of bushland and open spaces on the eastern side, while the opposite side, which forms one bank of the Athi River, supports a strip of riverine woodland and bushland. The Yatta Plateau itself is mostly bushland, which grades from dense to open from north to south.

Tsavo East is semi-arid and the highly localised availability of water in the dry season is an important factor in the ecology of the Northern area. The only river, the Tiva, is seasonal and dependent on rainfall outside Tsavo East. During the study period the river filled quickly after heavy rains in the Kitui area in November and December, but was a dry lugga again by January. Even so water remains available just below the surface of the river bed. For example in early November 1991 there had been no significant rain in the Northern area since April that year and yet water was present a short way down in the river bed. This illustrates the importance of the Tiva to water-dependent wildlife at the driest times of the year.

Waterholes provide another source of water, but probably most are empty at the driest times. One interesting water point is in the caves of Shimu ya Shetani in the dense bush between Diandaza and Ithumba. Here the tracks of many species, including wild dogs, have been found.

The general scarcity of water results in a high concentration of wildlife along the Tiva during the dry season. Species recorded close to the river were elephant, buffalo, waterbuck, bushbuck, eland, Grant's gazelle, impala, gerenuk, lesser kudu, dik-dik, giraffe, zebra and warthog. Predators included black-backed jackals, striped and spotted hyenas, bat-eared foxes, genets, ratels and mongooses. Lions and leopards were heard and their tracks seen. Along the Athi River in the TSC area, a single patrol recorded elephant, buffalo, waterbuck, Grant's gazelle, oryx, impala, dik-dik, gerenuk and lesser kudu. Cheetahs were seen and lion tracks were found. It is likely that the wildlife communities of the Tiva and Athi rivers are much the same (excluding species like hippos and crocodiles which occur in the permanent but not the seasonal river).

Dominant antelope species in the Northern area seemed to be dik-dik, which were extremely numerous, impala, Grant's gazelle and gerenuk.

(d) Logistic aspects for consideration in planning future research

Any future study of wild dogs will depend heavily on being able to locate the animals and follow their movements. Three methods were tried in the Northern area. Patrols were carried out on foot, in a car and, on three occasions only, in an aircraft. The limited experience with the aircraft was supplemented with discussions with pilots as to the practicalities of using 'planes to study wild dogs. All three methods had shortcomings when tried in the bushland which covers much of the area apparently utilised by the wild dogs.

On foot it is generally possible to go where wild dogs go, but it is impossible to move as fast, as far and as quietly as the animals can. In the bushland, in which much of the work will be going on, it will be difficult to approach wild dogs closely on foot (especially if they are as wary of man as some interviewees reported), and impossible to keep them in sight once they move off. However, it is likely that the animals follow game trails in the bush and if so it would be possible to track them even though opportunities for direct observation would be limited.

Foot patrols can provide the chance of direct observation of wild dogs where an understanding of the animals' behaviour allows one to plan an "ambush". In this study, patrols were confined to areas which appeared likely to contain wild dogs. The researcher's only sighting of wild dogs occurred at a waterhole at the base of the Yatta Plateau near Nthalakana. The patrol had stopped moving and was in cover when the wild dogs emerged from the bush to drink (06/11/91). An APU patrol watched a wild dog under similar circumstances at Masobo (20/01/92).

In the Yatta area, the bushland will severely restrict the freedom of movement of a vehicle and therefore it would be impractical to rely on a car for following the wild dogs.

It seems to be difficult to spot wild dogs from the air in the Yatta area. Whilst pilots have confirmed that they used to spot wild dogs on Galana Ranch, no-one has spotted them on the Yatta Plateau, where the sightings reports show they have regularly occurred. The researcher was told of aerial sightings of large groups of wild dogs (40 and 120 animals) on the Tiva river dating from at least fifteen years ago (not in sightings list), but no-one has spotted any wild dogs there in recent times whilst records indicate they do occur in the area.

This suggests that aircraft would be of little use in spotting wild dogs. Performance might be improved by the use of radiotracking, a technique which is often applied in wild dog studies. The aircraft first locates a group of radiomarked wild dogs by the signal, and visual contact may then be established. The locational information allows the animals to be approached for detailed observation on the ground. The problems of moving in the bush have already been described and whether this sort of operation could work well there is doubtful. The data produced might amount to no more than a series of locations obtained from the aircraft and little or no other detailed information because it proved too difficult or took too long to get close to the animals on the ground.

The time lag between location by the aircraft and follow-up on the ground could be minimised by using a helicopter, but this technique has the drawback of being prohibitively expensive and unfortunately cannot be regarded as a serious proposition.

6. Discussion of results for Northern area

With reference to the aims of the study, it seems clear that the wild dog still occurs in the Northern area of Tsavo East. The data suggest that there is a near constant presence of wild dogs in the northern area, which may represent a resident population. The area utilised by the animals includes the Yatta Plateau and extends eastwards from there towards Masobo and north to the Tiva river and the northern boundary. Of course this apparent distribution could just be an artifact of the distribution of observational effort, but some support for the proposed pattern is gained from the reported absence of wild dogs from Galana Ranch in the east and the general lack of sightings of wild dogs by APU patrols and observation posts in the eastern areas of the park.

While the study has answered some questions, many remain to be addressed. The number of wild dogs in the northern area is unknown, but an accurate estimate of population is essential as the basis for any conservation planning. It is not clear whether the population is increasing or decreasing. The sightings data suggests that since 1990 there has been little change in numbers (if one accepts that frequency of sightings is proportional to population), but this should be looked at more critically.

The general shortage of water and the resulting concentrations of game along the Tiva and Athi rivers must be important in directing how wild dogs utilise the area. There is little information on which species form the prey of wild dogs in this area though one interviewee opined that kudu are an important ingredient. There was also a record of the wild dogs hunting impala. Whether the wild dogs hunt in the same cursorial way as their counterparts in more open environments like Serengeti is not known, but it seems inevitable that much hunting activity will occur in a mosaic of bushland and more open vegetation where the opportunities for long chases are limited. In this light it would be interesting also to learn how the local cheetahs hunt. Perhaps both species are able to use cover to approach prey more closely than they can in open plains.

Bearing in mind the Masai Mara situation, the question of disease in Tsavo East should be addressed. Jackals and bat-eared foxes seemed common in the Northern area. In Masai Mara these species have been severely reduced through epidemics of rabies and canine distemper. So this is circumstantial evidence that Tsavo East has not suffered recent outbreaks of such diseases. Are there particular reasons for this, and is it reasonable to expect Tsavo East, or at least its wild dogs, to remain unscathed (for example Machakos is not far from Tsavo East and supports a thriving rabies reservoir in domestic dogs, which one might expect to pose a threat to canids in Tsavo East)?

The many ecological questions which arise from a consideration of the results are not simply academic curiosities - if they can be answered they will allow an assessment of the future for wild dogs in Tsavo East and serve as a basis for any conservation action which might be deemed necessary. Further research will face significant logistic difficulties. But the situation is not hopeless and "Overall conclusions and proposals for further research", which follows the discussion of the remainder of the results, suggests how further investigations could be conducted.

7. Results for the Southern area

(a) Wild dog sightings

date	location	comments	source
02/11/91	Voi	4 wd on farm 4km from Voi	farmer
??/09/86	Voi River	2 wd	APU
??/??/84	Mudanda Rock	34 wd	APU
??/04/70	Mudanda Rock	wd pack hunting eland	APU

The only other records obtained were references by some of the early European explorers who passed through Tsavo East, eg HCV Hunter records meeting a large pack of wild dogs on the Maungu Plains (in Willoughby, Capt. Sir JC, 1889, East Africa and its Big Game; Longmans, Green & Co). Similar references from this period by other travellers tell of encountering wild dogs on the Dika and Ndara Plains.

Over the period 11-24th November 1991, the Southern area was patrolled using a vehicle. No wild dogs were seen and no signs of their presence (tracks at waterholes etc) detected.

(b) Results of interviews

Most people were sceptical about the presence of wild dogs in the Southern area. Of five tour drivers interviewed, none had seen, or heard of anyone else seeing, a wild dog in Tsavo East. Some of the drivers claimed to have been visiting Tsavo East for the last fifteen years. Experienced KWS personnel suggested that if wild dogs did visit the Southern area they might be found in the open southern plains (Dika and Ndara), or around Mudanda Rock and Buffalo Wallows. As with the interviews concerning the Northern area, opinions correspond with actual sightings. However all interviewees were of the opinion that it was more likely to find the animals in the Northern area.

Interviews carried out just outside the Southern area, at the Ministry of Livestock Development (LMD) field station near Buchuma Gate, at a small farm near Mackinnon Road and at a KWS game control station in Bura, Taita Hills, yielded no reports of wild dogs in those areas.

(c) Ecological aspects of the Southern area

The vegetation of the Southern area is more open than that of the Northern area. Thick bush is confined to the periphery of the area and there are large areas of open grassland and bushland (see vegetation map). A strip of riverine and swamp vegetation follows the Voi river.

Game seen in the Southern area included elephant, giraffe, buffalo, zebra, warthog, waterbuck, impala, Grant's gazelle, fringe-eared oryx, eland, lesser kudu, kongoni and dik-dik. The density of game on the open plains was lower than elsewhere, presumably because these areas were extremely dry at this time. The most common species on the plains were oryx, zebra, kongoni and Grant's gazelle but even their numbers were low. Wildlife appeared concentrated at the edges of the park and along the Voi river. A migration of game out of the park to look for water and grazing occurs at this time.

Carnivores included cheetah (Ndara plain), black-backed jackal and bat-eared foxes. Lions and hyenas were heard but not seen.

(d) Logistic aspects for consideration in planning future research

The apparent very low incidence of wild dogs in the Southern area makes further research appear unnecessary at this stage.

8. Discussion of results for Southern area

In view of the high level of tourist traffic in the area, the extensive road network and the relatively open terrain, it seems inconceivable that wild dogs are resident here but never spotted.

Perhaps the wild dog is a sporadic visitor to the Southern area, utilising the areas of thicker vegetation (eg around Mudanda Rock). This would reflect a change in habit from the beginning of this century, when travellers reported wild dogs hunting on the plains.

It would be interesting to investigate what factors have caused this apparent change - is it due to increased human activity in the area, a drier climate and less game on the plains? Would the planned installation of waterpoints and fences to curtail emigration of game in the dry season favour a return of the wild dog?

Such theoretical questions are interesting but must be subordinated to the need to discover more about the situation in the northern area, where wild dogs have at least a semi-permanent presence.

9. Results from areas outside Tsavo East

(a) Wild dog sightings

date	location	comments	source
19/12/91	Samburu	2 wd on Ol Doinyo Lenkiyo	SC
??/12/91	Tsavo West	2 wd at Ngulia Rhino Sanctuary	APU
08/11/91	Tsavo West	ditto	APU
??/??/91	Lamu District	12 wd on Manda Island	APU
??/04/91	Dodori Nat.Res.	8 wd in Kiwaiyu area	APU

Abbreviations

SC - a safari company

(b) Results of interviews

Many of the KWS personnel interviewed had been brought up and recruited in other parts of the country. These people often suggested other areas where wild dogs occurred, based on their experience prior to coming to Tsavo. Suggested locations were generally in north and eastern Kenya, which reflects the backgrounds of the interviewees.

Areas around Isiolo, Marsabit, Garsen and Garissa were said to support wild dog populations, usually outside national parks and in areas where people tend livestock. Several interviewees related the behaviour of wild dogs which attacked their cattle and goats.
Dodori National Reserve was named as a place where wild dogs den regularly, though this was said to be to four or five years ago.

Tsavo West was mentioned and it was pointed out that wild dogs used to be seen often on the plains in the area around Maktau, where one interviewee recalled having watched them hunt oryx there. This view is lent credence by Col. RM Meinertzhagen who also watched wild dogs chasing oryx at Maktau in 1906 and describes it in his book Kenya Diary 1902-1906 (Oliver & Boyd, London).

The available evidence testifies to the historical accuracy of some of the views expressed by the interviewees, with the real problem being to establish whether the descriptions still apply today.

10. Discussion of results for areas outside Tsavo East

Taken at face value these results suggest that there could be several further wild dog populations in north-eastern Kenya, largely outside formally protected areas, but with some measure of protection provided by the remoteness of their ranges. As there are no hard data to back this supposition, further research is needed.

11. Overall conclusions and proposals for further research

The results of this feasibility study are not all-illuminating but at least represent some advance on the state of ignorance which existed previously. The presence of wild dogs in the north-western corner of Tsavo East has been established and logistic difficulties facing a further study of these animals have been identified. In spite of these difficulties it may be possible to obtain further information on the wild dogs. Efforts should commence as soon as possible to test the method suggested below.

Proposal for an ecological study of wild dogs in Tsavo East

Method

This study would concentrate on the wild dogs around the Yatta Plateau in the Northern area of Tsavo East.

In 5(d) above the logistic problems posed by the generally closed vegetation in the area have been described. The prospects are not good for a method relying on intensive aerial radiotracking and ground-based follow-up to provide detailed data from prolonged direct observation of the animals. The aircraft may do its job well enough but ground-based observers will often have problems reaching the animals on the ground.

This renders the cost-effectiveness of this technique unattractive as aircraft hire is expensive and the technique probably will not produce much detailed data.

A more cost-effective method of research would be the very basic one of a systematic ground-based survey of the area, looking for signs of recent wild dog activity (eg tracks). In the bushland, which covers most of the area wild dogs probably move along game trails, of which there is an extensive network. This would allow their movements to be followed, but initially would not provide many opportunities for direct observation of the animals. Later as movement patterns emerged it might be possible to plan ambushes at which the animals could be observed, sampled for disease and possibly radiocollared if it seemed that this could be useful.

The survey would initially concentrate on the Yatta area in the vicinity of Nthalakana, where wild dog activity seems most intense. The survey would map the trail system and the incidence of wild dogs and other large mammal species. Other features such as vegetation community structure and location of waterholes would be mapped in detail.

Two or three Waliangulu ex-poachers should be hired to act as trackers in this survey. These people know the area and the ecology of its wildlife intimately and are at home in the bush.

Prospective results

The survey should produce detailed information on wild dog movement patterns in the area and at minimum would certainly provide in-depth information on the large mammal community of the Yatta Plateau (something about which little is currently known).

Once the success of the technique was established coverage would be expanded with the aim of identifying the home range of the wild dogs. Because the basic locational data on wild dogs will be accompanied with detailed background information on the ecology of the survey area it should be possible to deduce how the wild dogs are using the area. Eventually an estimate of the number of packs could be made, and from that a population estimate can be derived.

This would help answer the most basic of the ecological questions relating to the conservation significance of Tsavo East for the wild dog ie why are the animals utilising this and not other areas of the park? The relatively high concentrations of game along the Athi and Tiva rivers may be an important factor in making the area attractive. An understanding of the reasons why wild dogs occupy this range could be applied to an overall assessment of Tsavo East in terms of wild dog habitat quality, and of its potential as a site for wild dog conservation.

Justification

Admittedly, attempting the research on this basis will be a painstaking business and it is not 100% certain that it will prove an effective way of studying wild dogs. But some attempt must be made to obtain more information on the Tsavo East population and there is nothing to suggest that expensive methods would work any better than this basic approach.

As well as being cheap, the proposed method has no "downside". Even if little or no data is secured on wild dogs themselves, at the very least the research will provide valuable data on the general ecology of the large mammal community of the Yatta area.

Costs

Costs can be kept very low. A vehicle, camping gear and some radiotracking equipment have already been acquired. Costs are limited to wages for the trackers, food, fuel and maintenance for the vehicle and contingencies. They should be no more than $1,000 per month.

Recommendation

Because the proposed research is slightly speculative in that the technique to be used is unusual, it is recommended that it proceeds on a trial basis at first, perhaps with a probationary period of two or three months. If it proved successful it would be hoped that support could then be obtained for a further two years.

Other research activities

Unexpectedly the study also provided a small amount of information on the wild dog in areas outside Tsavo East. It would seem sensible to follow this up by carrying out a survey of the wild dog in Kenya in order to arrive at an accurate census figure and to see whether there are any critical wild dog populations elsewhere, especially outside protected areas. This would put the populations in Tsavo East and Masai Mara into perspective on the national and African scales. This would be an ideal project for the wild dog research programme, but it lies outside the scope of this report.

12. Acknowledgements

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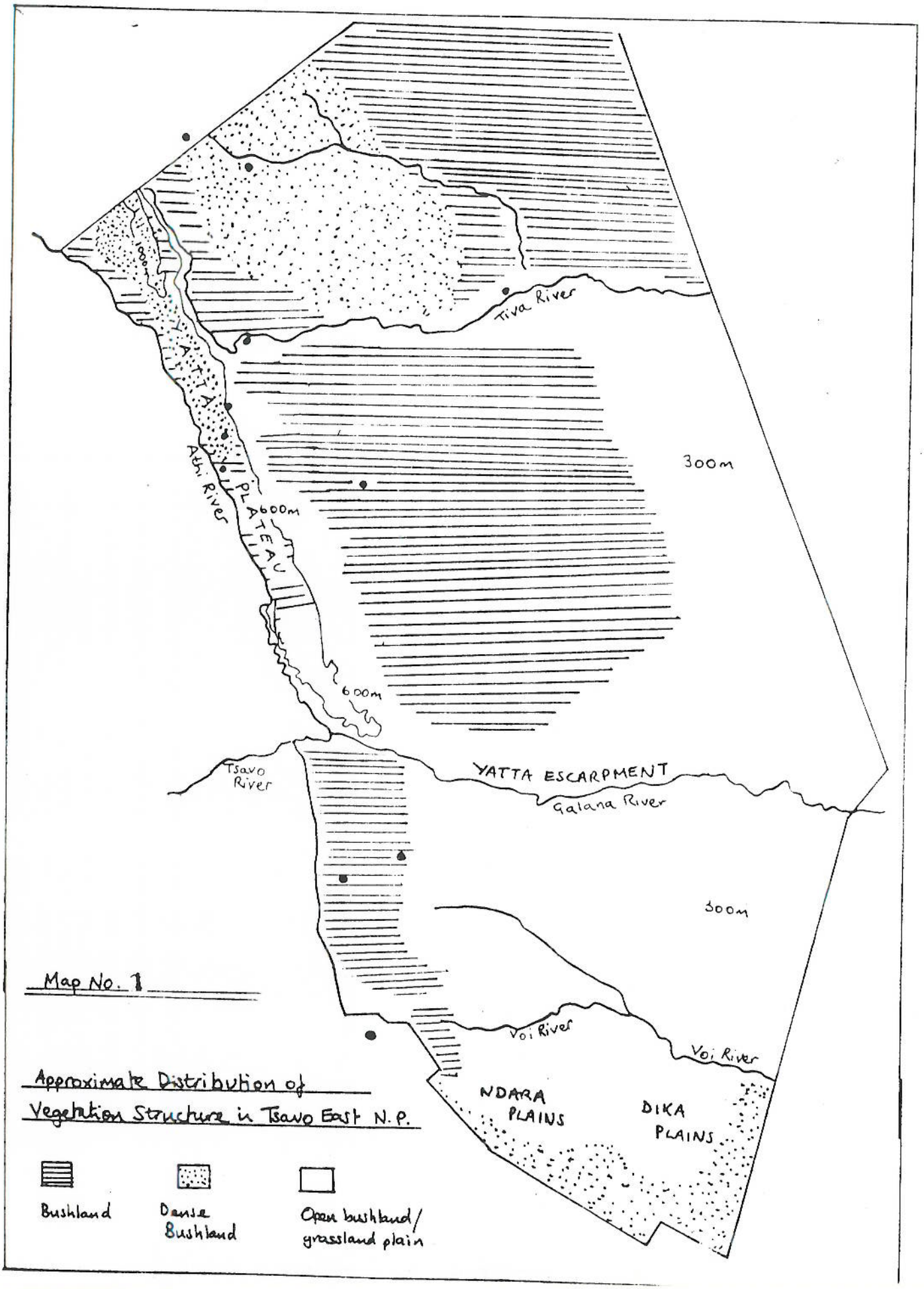
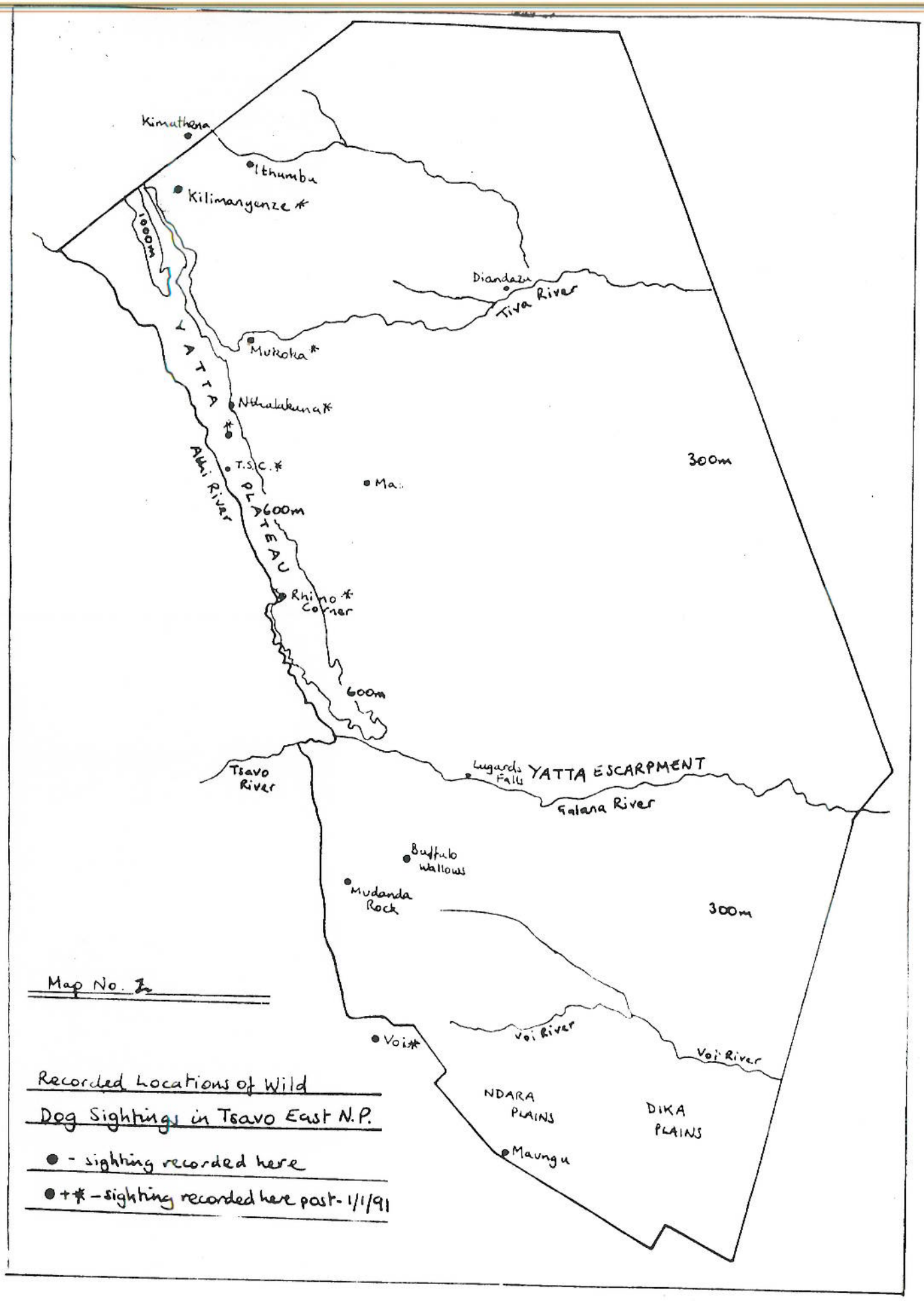

Tiva River
ATTA
Athi River
PLATEAU
600m
300m
600m
Tsavo River
YATTA ESCARPMENT
Galana River
300m
Voi River
Voi River
NDARA PLAINS
DIKA PLAINS
Map No. 1
Approximate Distribution of Vegetation Structure in Tsavo East N.P.
Bushland
Dense Bushland
Open bushland/ grassland plain


Kimuthena
Ithumba
Kilimanyenze *
1000m
Diandazu
Tiva River
Mukoka *
YATTA
Nthalakuna *
T.S.C. *
Athi River
Ma
300m
PLATEAU
600m
Rhino * Corner
600m
Tsavo River
Lugards Falls
YATTA ESCARPMENT
Galana River
Buffalo Wallows
Mudanda Rock
300m
Map No. 2
Voi *
Voi River
Voi River
NDARA PLAINS
DIKA PLAINS
Maungu
Recorded Locations of Wild Dog Sightings in Tsavo East N.P.
● - sighting recorded here
●+* - sighting recorded here post-1/1/91