Mammal diversity survey in the northern coastal forests of Kenya: Arabuko-Sokoke forest and the Boni–Dodori forest system

Final Report (2010 & 2015)

Zoological Society of London, Worldwide Fund for Nature,

Kenya Wildlife Service

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Cover page images: Clockwise from top left: Leopard *Panthera pardus,* Dodori National Reserve; Critically Endangered Aders duiker *Cephalophus adersi,* Dodori National Reserve; African wild dog *Lycaon pictus,* Boni National Reserve; Golden-rumped sengi *Rhynchocyon chrysopygus* in Brachystegia habitat, Arabuko-Sokoke Forest

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Contents

Summary

This report summarises the findings of seven camera trap surveys set up in the forests of the northern coast of Kenya, in two different key areas; the Arabuko-Sokoke Forest, and in and around the more northern Boni-Dodori forest system. These sites are all representative of the coastal forests of the Eastern Africa biodiversity hotspot. The main study objective was to establish baseline data on the medium-to-large sized mammal communities of the northern group of forests as part of developing a longer term conservation and management plan for the area. Four surveys were carried out in 2010, and three surveys carried out in 2015. The combined species results are presented here.

The more northern coastal forests (Boni-Dodori region) recorded higher terrestrial mammal species richness than Arabuko-Sokoke Forest. The majority of medium-to-large mammal species were recorded much more frequently in the Boni-Dodori forest system. The Boni-Dodori forest system also emerges as the global centre for the Critically Endangered Aders' duiker (*Cephalophus adersi*).

Other species such as the lesser kudu *(Tragelaphus imberbis)* were recorded only in the dry coastal scrub habitats of northern coastal forests highlighting the additional importance of preserving the wider inter-connected mosaic of habitats representing complete communities of herbivores and predators in the coastal habitats. The combined results overall indicate the high diversity of mammal species in this region of Kenya, and further highlight this coastal region as a 'biodiversity hotspot'.

<u>Analysis notes</u>

Mammal species are the primary focus of the report. Other birds and reptiles identified in the images are summarised in Annex I.

For **trapping rate**, the following analysis parameters were used in the ZSL camera trap analysis tool:
- Days where at least **75% cameras were working,** with **a 75% camera performance threshold**.
- For the Boni Forest dataset, where there was a high camera failure - here the threshold for camera function was **decreased to 70%.**

For **occupancy analysis**:
- **Arabuko-Sokoke (A-S) Cynometra 2010** - 10 day x 11 occasions.
- **A-S Cynometra 2015** - 10 day x 7 occasions.
- **A-S Brachystegia 2015** - 10 day x 7 occasions.
- **Dodori 2010 (inside reserve)** - 10 day x 6 occasions.
- **Boni NR** - 10 day x 9 occasions.
- **Boni Forest** - 10 day x 8 occasions.
- **Dodori 2015 (mainly outside reserve)** - 10 day x 15 occasions.

1. Introduction

The Kenyan northern coastline represents the only remaining area in Kenya retaining a significant frontage of undisturbed natural habitat sequences, transitioning from coral reef, lagoons, mangrove, coastal forest and grasslands, and the interior bush within the 'coastal forests of Eastern Africa biodiversity hotspot'. The terrestrial elements of the system contain a number of unique and critically endangered species, notably the critically endangered coastal endemic, Aders' duiker *Cephalophus adersi*, a potentially new giant elephant shrew (Rhynchocyoninae) in the forests, hirola *Beatragus hunteri* in the interior and African wild dog *Lycaon pictus* ranging throughout.

This report summarises camera trap results from surveys across four sites in the Boni-Dodori forest system and two forest sites in Arabuko Sokoke Forest. Camera-trapping is a particularly suitable technique for longer term monitoring medium-sized to large mammals in forest habitats (Silveira et al. 2003, Gompper et al. 2006, Lyra-Jorge et al. 2008, Roberts 2011, Amin et al. 2015).

Objectives

1) To establish baseline data on the status, distribution and behaviour of medium-to-large mammals in the remaining Kenyan northern coastal forests.
2) To highlight the importance of Boni-Dodori forest system to mammal conservation within the Eastern African coastal biodiversity hotspot and to advocate that this biodiversity status information be incorporated into future land use planning, with a focus on finding ways for the local communities to integrate development of the region while sustaining and gaining benefit from this unique heritage.
3) To establish a standardised method with an associated protocol for the long term monitoring of mammal diversity in support of conservation planning for these highly threatened east African coastal forests.
4) To develop a local team trained in the field setup of camera traps and analysis of camera trap survey data.

2. Methods

2.1 Study area

The wooded habitats of coastal Kenya form part of the Coastal Forests of Eastern Africa biodiversity hotspot, an area known for globally significant levels of species richness and endemism (Burgess and Clarke 2000; Mittermeier et al. 2005). Much of this habitat in Kenya has been cleared for coastal development and agriculture (Mittermeier et al. 2005), however, several protected areas exist along the northern Kenyan coast. Boni and Dodori National Reserves, in Lamu East and Ijara Districts respectively, were gazetted in 1976. They lie adjacent to the Boni forest and these three areas, referred to henceforth as the 'Boni–Dodori forest system', form a cluster on the northern Kenyan coast (Figure 1). The remote location and history of insecurity have resulted in a comparatively low human population density and minimal development. Four principal villages, occupied by the Awer people, are located along a bush track running between the Boni and Dodori National Reserves, although the exact location of the gazetted boundaries remains uncertain.

The Arabuko-Sokoke National Reserve (NR), established in 1932, is 250 km to the south in Kilifi County. It is separated from the northern Kenyan coastal forests by two major intervening rivers, the Tana and Galana / Sabaki. It is completely encircled by un-clustered village settlements with an estimated human population greater than 100,000 (ASFMT 2002). Both study areas experience

illegal hunting and timber extraction, with impact of poaching likely to be much higher in the smaller but much more heavily populated Arabuko-Sokoke NR.

Habitat in the Boni–Dodori forest system consists of a mosaic of forest, thicket and savannah (Kuchar and Mwendwa 1982). Arabuko-Sokoke is mostly forested with three main vegetation types: Cynometra forest and thicket, Brachystegia woodland and mixed forest (ASFMT 2002).

2.2 Survey design and camera deployment

Survey design at each forest site consisted of cameras systematically spaced at 2 km intervals along a grid, orientated to the available habitat patches (Figure 1). One / two km spacing is normally recommended for mammal community surveys (Amin et al. 2014). A single camera-trap was placed at a height of 30–45 cm, positioned perpendicular to game trails at a distance of c. 4-8 m with the aim of obtaining full body lateral images of small antelopes and other mammal species. We used Bushnell Trophy Cam (Bushnell Outdoor Products, Cody, Kansas, USA) and Reconyx RM45 (RECONYX, Inc., Holman, WI, USA) digital cameras, programmed to take three pictures per trigger with no delay (Reconyx) and 1 sec. delay (Bushnell). All other default settings were used. The cameras have a trigger time of 0.1 sec. (Reconyx) and <1 sec. (Bushnell) with a detection range of 25+ m. The cameras use an infrared flash at night (or at low light levels in the day time), intended to minimise risk of startling animals. Each survey was conducted for a minimum of 50 days in order to achieve 1,000 camera-trap days of sampling effort (O'Brien et al. 2003) with 20 fully functioning cameras. The camera installation protocol called for survey teams to trigger photographs of themselves as the last action at the end of camera set up operations and as the first action on arrival to recover cameras, as a means to help verify camera function.

Training

Training of personnel involved in the deployment of cameras was conducted prior to the 2010 and 2015 surveys. Funding from the Darwin Initiative project allowed a more rigorous 3-day training workshop to be held before the setup of the 2015 camera trap grids. Subsequently teams were tested in their ability to:

1. Setup camera-traps following the Kenyan forest field setup protocol prepared for this study (preparation before camera setup, site selection, camera mounting, data recording, camera detection test, securing and final verification).

2. Obtain a reasonable well defined and consistent sample field of view to obtain good quality images.

3. Manage data downloads and storage reliably.

2.3 Data analysis

Data analysis was carried out using software developed at ZSL specifically to process images from camera trap arrays (Amin et al. 2016). This requires creation of four standard format data source files in Microsoft Excel describing 1) individual camera locations and associated fixed habitat variables 2) individual camera settings and configurations 3) individual camera setup, service and recovery history and 4) image details for every photograph from each camera. To create the latter file, metadata (image filename, date, time, temperature) were extracted automatically from folders of the original jpg image files using Exiv2 software (Huggel 2012; http://www.exiv2.org/index.html)

and entered into standard Excel formats. Date and time information in the meta-data were cross-checked against images. Details of each image content indicating image type (wildlife, livestock or preselected categories of 'other') and species identification (with information on number, age, sex and other behaviours where appropriate) were then added manually by visual inspection.

In this analysis the software was set to score a new species 'event' when a sequence of images of a target species appeared more than 60 minutes after the previous images of that species. Species trapping rates were calculated as the mean number of independent photographic events per trap day x 100 using cameras that operated for more than 75% of the survey period (this threshold was decreased for the Boni Forest grid where there was high camera failure; refer to analysis notes on page 3). The species camera trapping rate provides a simple index of relative abundance under the assumption that, all things being equal, a target species will trigger cameras more frequently when they are numerous, and vice versa. Of course many things can distort photograph frequencies for reasons unrelated to abundance alone, not least the chance effects of camera position in relation to important food or other resources. Trapping rates can offer a comparative index over time if applied in a standardized protocol ensuring that only carefully controlled like-for-like comparisons are made within species. Consistent positioning and management of cameras is very important in achieving this.

Species occupancy estimates derived from detection / non-detection histories have the advantage of incorporating a basic measure of detectability for each species, which is lacking in trapping rates. Occupancy estimates are therefore more rigorous for both within and between species comparisons, though limited to species generating adequate data sets. In this analysis, detection / non-detection histories based on 10-day sampling occasions for each camera were constructed to model occupancy in the ZSL analysis tool. The occupancy model used assumed equal detection probability at all camera sites, with no covariates.

Mammal species richness was filtered to apply only to species >=0.5kg in average adult body weight in order to minimize sample variation associated with body size (smaller individuals are less likely to trigger photographs, Tobler 2008). The total events for every species on each survey day were summed and analysed in the ZSL analysis tool using the first order jackknife estimator to predict expected species richness.

Circadian (24 hour) species activity / event timing patterns were compiled from the number of independent photographic events per hour.

We used the species trapping rate at each camera station to produce local species distribution maps. The camera trapping rates were depicted as circular symbols at each camera location on the map. The symbol size is linear weighted between the minimum and maximum figures depicted in the scaling displayed in the map legend.

3. Results

3.1 Camera trap survey effort

Rigorous training of field staff in camera setup had resulted in over 95% of the cameras with a well-defined and consistent sample field of view in 2015 (horizon in the upper half of the image and clear ground). As a result trapping rates (and potentially occupancy if a species was previously missed

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entirely at a site) increased dramatically for a number of the smaller mammal species (highlighted in the individual species accounts).

All seven camera trap surveys achieved the targeted minimum survey effort of 1000 camera traps days.

1) Arabuko-Sokoke Forest (2010 - 2015)

Total number of camera stations: 67 (1 failed)
Total number of days deployed: 5230 (4224 operational)
Total number of wildlife events: 6579

Arabuko-Sokoke Cynometra forest survey (2010, 2015)

Survey duration	01/10/10 – 22/01/11	12/01/15 – 21/03/15
Total number of camera stations	21	22
Total no. of days deployed	2220 (2015 operational)	1422 (1136 operational)
Total no. of wildlife events	701	3154

Arabuko-Sokoke Brachystegia forest survey

Survey duration	10/01/15 – 21/03/15
Total number of camera stations	24
Total no. of days deployed	1588 (1073 operational)
Total no. of wildlife events	2724

2) Boni-Dodori Forest (2010 – 2015)

Total number of camera stations: 81 (7 failed)
Total no. of days deployed: 7603 (7020 operational)
Total no. of wildlife events: 9719

Dodori National Reserve survey (inside reserve) (2010)

Survey duration	14/01/10 – 16/03/10
Total number of camera stations	20
Total no. of days deployed	1124 (1124 operational)
Total no. of wildlife events	1358

Dodori National Reserve survey (south of reserve) (2015)

Survey duration	27/02/15 – 27/07/15
Total number of camera stations	22
Total no. of days deployed	3240 (3236 operational)
Total no. of wildlife events	3039

Boni National Reserve survey (2010)

Survey duration	17/03/10 – 16/06/10
Total number of camera stations	20
Total no. of days deployed	1768 (1656 operational)
Total no. of wildlife events	3224

Boni Forest survey (2010)

Survey duration	19/06/10 – 06/09/10
Total number of camera stations	19
Total no. of days deployed	1471 (1004 operational)
Total no. of wildlife events	2098

Figure 1. Map of camera arrays in the Arabuko-Sokoke Forest (left) and Boni-Dodori forest ecosystem (right)
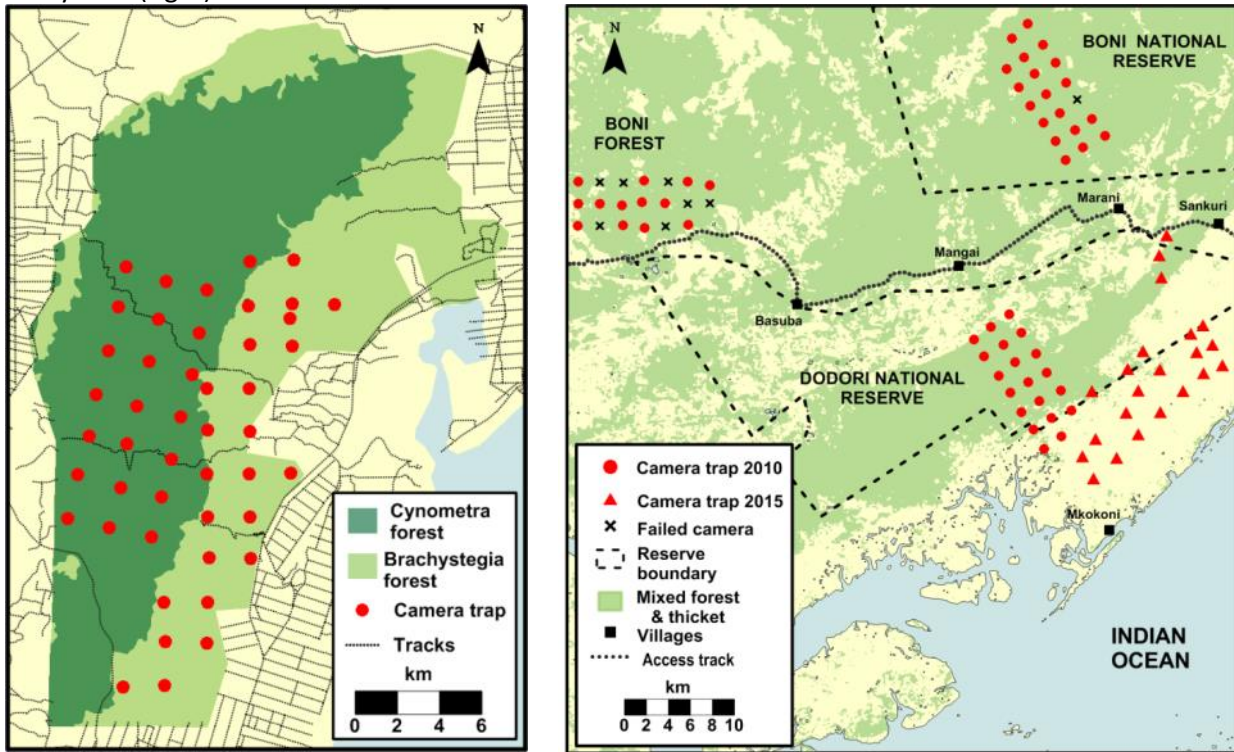
3.2 Mammal diversity

A total of 37 mammal species were photographed in the northern coastal forests (26 species in Boni NR; 29 species in Dodori NR; 24 species in Boni forest and 28 species in the open coastal scrub habitat south of the Dodori NR) and a total of 28 species were recorded in Arabuko-Sokoke Forest (Table 1). This includes the Aders' duiker ('Critically Endangered' under the IUCN Red List criteria); the African wild dog ('Endangered' under the IUCN Red List criteria), and a potentially new species of giant elephant shrew. Although we were unable to distinguish between Four-toed sengi (*Petrodromus tetradactylus*) and Rufous sengi (*Elephantulus rufescens*) in the images, we have assumed the presence of both species in these forest sites (Andanje et al. 2010). We excluded murid species as they were difficult to identify. Mammal species expected in the sample zone according to available distribution maps and literature which were not detected by the camera trapping survey are also listed in Table 2.

The species accumulation curves for medium-to-large (> 0.5 kg) terrestrial mammal species, the main target group for camera traps placed at ground level (Tobler et al. 2008), are shown in Figure 2. Dodori NR had much higher estimated species richness (32) and Arabuko-Sokoke Cynometra forest the lowest with 21 species (Table 3). The open coastal scrub habitat south of the Dodori NR had a species richness of 28 species.

Table 1. Mammal species recorded in the coastal forests of Kenya (2010 - 2015)

Cyn '10: Arabuko-Sokoke Cynometra forest 2010 survey; Cyn '15: Arabuko-Sokoke Cynometra forest 2015 survey;
Bra '15: Arabuko-Sokoke Brachystegia forest 2015 survey; Dod '10: Dodori National Reserve 2010 survey (inside reserve)
BNR '10: Boni National Reserve 2010 survey; BF '10: Boni Forest 2010 survey; Dod '15: Dodori National Reserve 2015 survey (mainly south of reserve)

Family	Species	Common Name	Habit	Habitat	AS Forest			BD Forest				IUCN Status
					Cyn '10	Cyn '15	Bra '15	Dod '10	BNR '10	BF '10	Dod '15	
Bovidae	*Cephalophus adersi*	Aders' duiker	Terrestrial	Forest	Y	Y	---	Y	Y	Y	Y	CR
Bovidae	*Cephalophus harveyi*	Harvey's duiker	Terrestrial	Forest	Y	Y	Y	Y	Y	Y	Y	LC
Bovidae	*Philantomba monticola*	Blue duiker	Terrestrial	Forest	Y	Y	Y	---	Y	---	---	LC
Bovidae	*Sylvicapra grimmia*	Common duiker	Terrestrial	Savanna / woodland	---	---	Y	---	---	---	---	LC
Bovidae	*Nesotragus moschatus*	Suni	Terrestrial	Forest	Y	Y	Y	Y	Y	Y	Y	LC
Bovidae	*Madoqua kirkii*	Kirk's dik-dik	Terrestrial	Savanna / woodland	---	---	---	Y	---	---	Y	LC
Bovidae	*Tragelaphus scriptus*	Bushbuck	Terrestrial	Woodland	Y	Y	Y	Y	Y	Y	Y	LC
Bovidae	*Tragelaphus imberbis*	Lesser kudu	Terrestrial	Savanna / woodland	---	---	---	Y	---	---	Y	NT
Bovidae	*Kobus ellipsiprymnus*	Waterbuck	Terrestrial	Savanna / woodland	---	---	---	Y	---	---	---	LC
Bovidae	*Syncerus caffer*	African buffalo	Terrestrial	Savanna / woodland	---	---	Y	Y	Y	Y	Y	LC
Hippopotamidae	*Hippopotamus amphibious*	Common hippopotamus	Semi-aquatic	Riverine savanna	---	---	---	Y	---	---	---	VU
Suidae	*Potamochoerus larvatus*	Bushpig	Terrestrial	Savanna / woodland	Y	Y	Y	Y	Y	Y	Y	LC
Suidae	*Phacochoerus africanus*	Common warthog	Terrestrial	Savanna woodland	---	---	---	Y	Y	Y	---	LC
Suidae	*Phacochoerus aethiopicus*	Desert warthog	Terrestrial	Savanna / woodland	---	---	---	---	---	Y	---	LC
Canidae	*Lycaon pictus*	African wild dog	Terrestrial	Savanna / woodland	---	---	---	---	Y	---	Y	EN
Felidae	*Caracal caracal*	Caracal	Terrestrial	Savanna / woodland	Y	Y	Y	Y	Y	---	Y	LC
Felidae	*Panthera leo*	African lion	Terrestrial	Savanna / woodland	---	---	---	---	---	Y	---	VU
Felidae	*Panthera pardus*	Leopard	Terrestrial	Mixed habitats	---	---	---	Y	Y	Y	Y	NT
Viverridae	*Civettictis civetta*	African civet	Terrestrial	Savanna / woodland	---	Y	Y	Y	---	---	Y	LC
Viverridae	*Genetta maculata*	Large-spotted genet	Terrestrial	Forest	Y	Y	Y	Y	Y	Y	Y	LC
Hyaenidae	*Crocuta crocuta*	Spotted hyaena	Terrestrial	Savanna / woodland	---	---	Y	Y	Y	Y	Y	LC
Mustelidae	*Mellivora capensis*	Honey badger	Terrestrial	Mixed habitats	Y	Y	Y	Y	Y	Y	Y	LC
Herpestidae	*Helogale parvula*	Common dwarf mongoose	Terrestrial	Savanna / woodland	Y	Y	Y	Y	Y	Y	Y	LC
Herpestidae	*Atilax paludinosus*	Marsh mongoose	Terrestrial	Mixed riverine	---	---	---	Y	---	---	---	LC
Herpestidae	*Herpestes sanguineus*	Slender mongoose	Terrestrial	Savanna	---	Y	---	Y	---	Y	Y	LC
Herpestidae	*Bdeogale omnivora*	Sokoke bushy-tailed mongoose	Terrestrial	Forest	---	Y	Y	Y	Y	Y	Y	VU
Herpestidae	*Ichneumia albicauda*	White-tailed mongoose	Terrestrial	Savanna	Y	Y	Y	---	Y	---	Y	LC

Family	Species	Common Name	Habit	Habitat	AS Forest			BD Forest				IUCN Status
					Cyn '10	Cyn '15	Bra '15	Dod '10	BNR '10	BF '10	Dod '15	
Elephantidae	*Loxodonta africana*	African elephant	Terrestrial	Mixed habitats	---	Y	---	Y	Y	Y	Y	VU
Orycteropodidae	*Orycteropus afer*	Aardvark	Terrestrial	Mixed habitats	Y	Y	Y	Y	Y	Y	Y	LC
Macroscelididae	*Petrodromus tetradactylus*	Four-toed sengi	Terrestrial	Forest	Y	Y	Y	Y	Y	Y	Y	LC
Macroscelididae	*Rhynchocyon chrysopygus*	Golden-rumped sengi	Terrestrial	Forest	Y	Y	Y	---	---	---	---	EN
Macroscelididae	*Rhynchocyon sp.*	Boni giant sengi	Terrestrial	Forest	---	---	---	Y	Y	Y	Y	?
Cercopithecidae	*Cercopithecus mitis albotorquatus*	Pousargue's Sykes's monkey	Arboreal	Forest	---	---	---	Y	Y	Y	Y	VU
Cercopithecidae	*Cercopithecus mitis albogularis*	Zanzibar Sykes's monkey	Arboreal	Forest	Y	Y	Y	---	---	---	---	LC
Cercopithecidae	*Chlorocebus pygerythrus*	Vervet	Semi-arboreal	Savanna / woodland	---	---	---	Y	---	---	Y	LC
Cercopithecidae	*Papio cynocephalus*	Yellow baboon	Terrestrial	Savanna / woodland	---	Y	Y	Y	Y	---	Y	LC
Galagidae	*Galago spp.*	Galago	Arboreal	Forest	Y	Y	Y	---	Y	---	---	LC
Hystricidae	*Hystrix sp.*	Porcupine	Terrestrial	Mixed habitats	Y	---	Y	Y	Y	Y	Y	LC
Leporidae	*Lepus sp.*	Hare	Terrestrial	Savanna / woodland	---	---	Y	---	---	---	---	LC
Nesomyidae	*Cricetomys gambianus*	Northern giant pouched rat	Terrestrial	Mixed habitats	Y	Y	Y	Y	Y	Y	Y	LC
Sciuridae	*Paraxerus palliatus*	Red bush squirrel	Arboreal/scandential	Forest	Y	Y	Y	---	---	Y	---	LC

Table 2. Medium-to-large mammal species expected in the sample zone according to available distribution maps and literature, but not detected in the camera trapping surveys.

Family	Species	Common Name	Habit	Habitat	IUCN Status
Erinaceidae	*Atelerix albiventris*	African hedgehog	Terrestrial	Savanna / Woodland	LC
Felidae	*Caracal aurata*	African golden cat	Terrestrial	Forest	NT
Felidae	*Felis silvestris lybica*	Wild cat	Terrestrial	Mixed habitats	LC
Felidae	*Leptailurus serval*	Serval	Terrestrial	Savanna / Woodland	LC
Herpestidae	*Herpestes ichneumon*	Egyptian mongoose	Terrestrial	Savanna / Woodland	LC
Mustelidae	*Aonyx capensis*	African clawless otter	Terrestrial	Riverine	LC
Mustelidae	*Ictonyx striatus*	Zorilla	Terrestrial	Savanna / Woodland	LC
Bovidae	*Ourebia ourebi haggardi*	Haggard's oribi	Terrestrial	Savanna / Woodland	VU
Bovidae	*Madoqua guentheri*	Guenther's dik-dik	Terrestrial	Savanna / Woodland	LC

Figure 2. Rarefied species accumulation curves for medium-to-large terrestrial mammals in Boni-Dodori forest system and Arabuko-Sokoke Forest (2010 – 2015).

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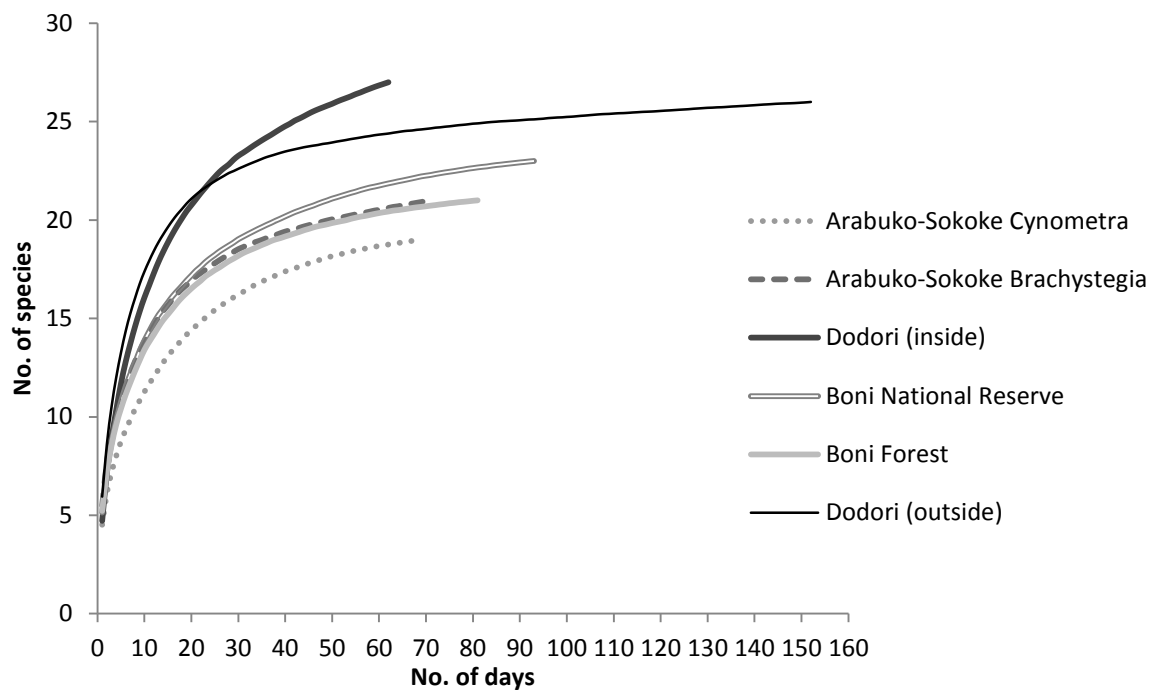
Table 3. Species richness estimates for medium-to-large terrestrial mammal species (>0.5 kg adult body mass) for the Boni-Dodori forest system and Arabuko-Sokoke Forest (2010 – 2015).

Site	Total number of species recorded	Jackknife-1 species richness estimate
Arabuko-Sokoke Cynometra forest	19	21
Arabuko-Sokoke Brachystegia forest	21	24
Dodori National Reserve (inside)	27	32
Dodori National Reserve (outside)	26	28
Boni National Reserve	23	25
Boni Forest	21	23

3.3 Species distribution, abundance and activity patterns

This section summarises the camera-trap survey results for each recorded species. The results are grouped by the major orders of ungulates, carnivores, primates, elephant shrews, rodents and lagomorphs. The number of events and trapping rates, occupancy estimates, activity / temporal patterns and distribution depicted on maps are provided for each species. All species images are camera trap images from the surveys with the exception of waterbuck.

1) ADERS' DUIKER (*Cephalophus adersi*)

Species notes:
- The most frequently recorded species in the Boni-Dodori forest system confirming this is the global centre of distribution for this critically endangered and poorly known coastal endemic antelope.
- Shown to be using the coastal bush as well as coastal thicket in on the south side of Dodori NR, although at lower frequency than in the coastal thickets of the interior.
- Strong evidence that the Arabuko-Sokoke population is very small and likely to be at risk of disappearance. No records at all in the Brachystegia forest habitat.
- Images of female Aders' duikers accompanied by and suckling young calves (e.g. Boni NR May 2010) were also obtained.

Global conservation status:
Critically Endangered (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	2	2
Arabuko-Sokoke Cynometra 2015	22	1	1
Arabuko-Sokoke Brachystegia 2015	24	0	0
Boni-Dodori 2010 & 2015	81	71	3958

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.101 (±0.071)	0.105	N/A	N/A
A-S *Cynometra* 2015	0.0 (±0.0)	0.048	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	56.068 (± 2.311)	0.95	0.95 (±0.049))	0.824 (±0.03)
Boni National Reserve	111.55 (± 4.191)	1	1 (± 0))	1 (±0)
Boni forest	60.14 (±2.132)	1	1 (± 0)	1 (±0)
Dodori 2015 (outside)	26.483 (±0.923)	0.864	0.864 (±0.073)	0.69 (± 0.034)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
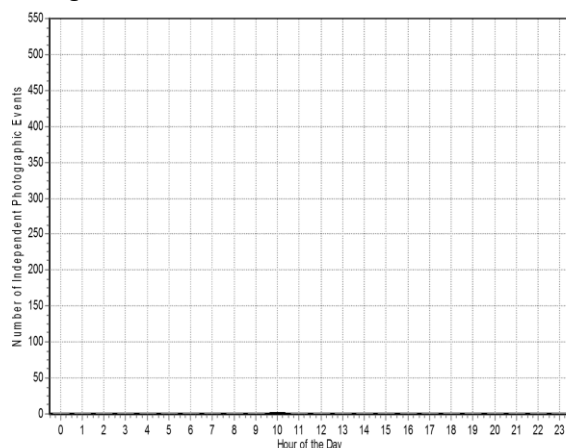
Timing of camera events: Boni-Dodori 2010 & 2015
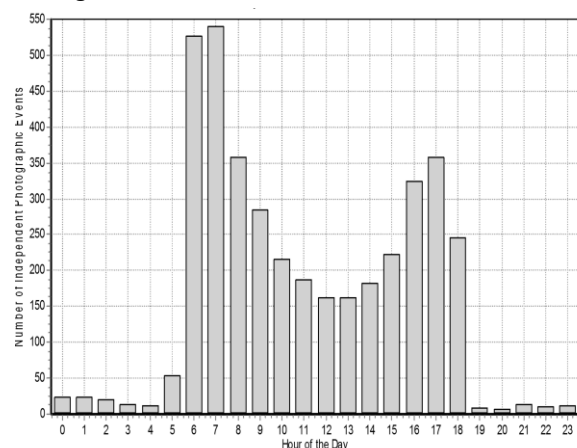
ADERS' DUIKER (*Cephalophus adersi*)
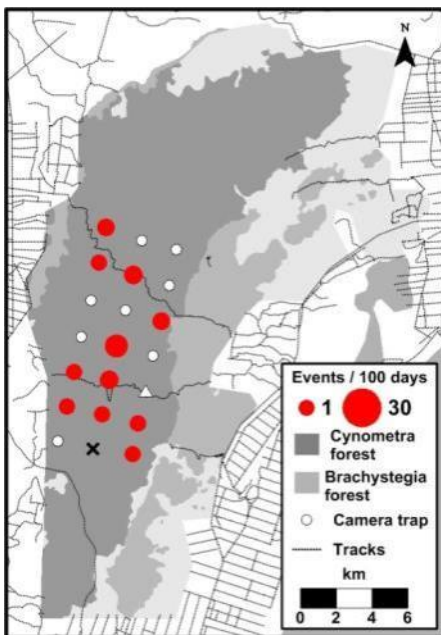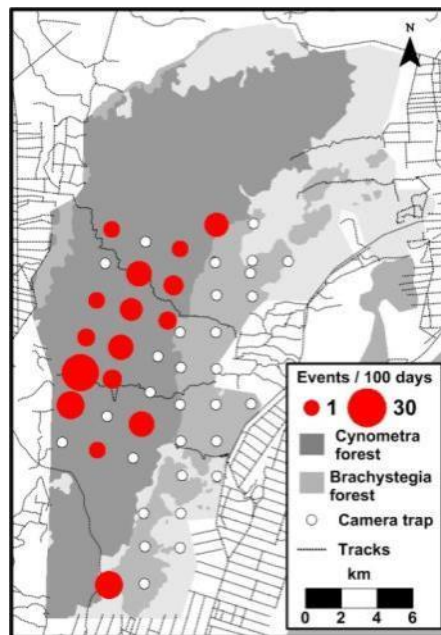
BONI-DODORI 2010 & SOUTH OF DODORI 2015
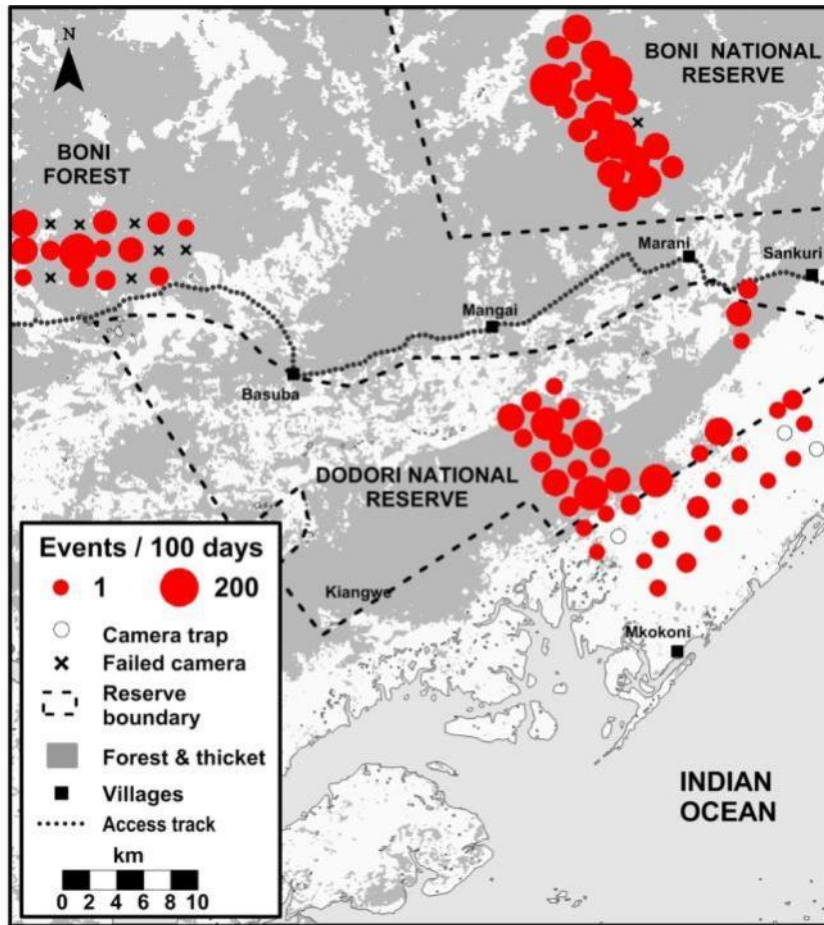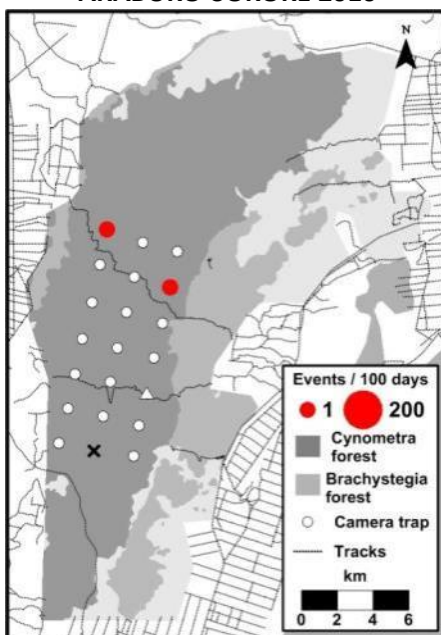
ARABUKO-SOKOKE 2010   ARABUKO-SOKOKE 2015

2) HARVEY'S DUIKER (*Cephalophus harveyi*)

Species notes:
- Present in all camera grids.
- Most frequent in the Boni NR and Boni Forest.
- Shows possible preference for Cynometra forest in the Arabuko-Sokoke Forest.
- Activity at Boni-Dodori forest system predominantly diurnal / crepuscular.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	6	8
Arabuko-Sokoke Cynometra 2015	22	5	5
Arabuko-Sokoke Brachystegia 2015	24	2	3
Boni-Dodori 2010 & 2015	81	24	110

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.413 (±0.141)	0.316	N/A	N/A
A-S *Cynometra* 2015	0.407 (±0.229)	0.19	N/A	N/A
A-S *Brachystegia* 2015	0.323 (±0.225)	0.095	N/A	N/A
Dodori 2010 (inside)	0.273 (±0.155)	0.1	0.163 (±0.143)	0.104 (±0.092)
Boni National Reserve	5.34 (±0.575)	0.684	0.705 (±0.11)	0.341 (±0.045)
Boni forest	1.399 (±0.395)	0.538	0.792 (±0.282)	0.115 (±0.05)
Dodori 2015 (outside)	0.125 (±0.062)	0.091	N/A	N/A

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
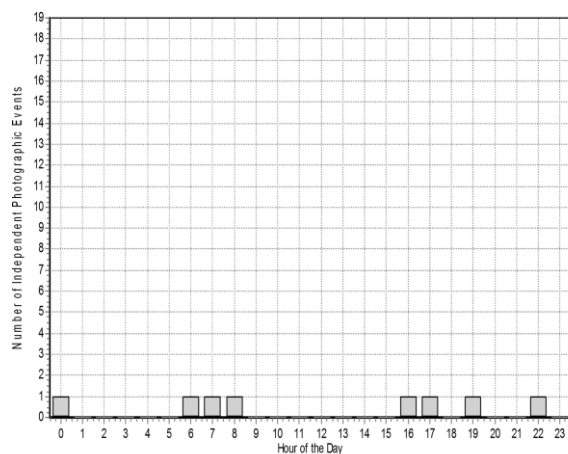
Timing of camera events: Boni-Dodori 2010 & 2015
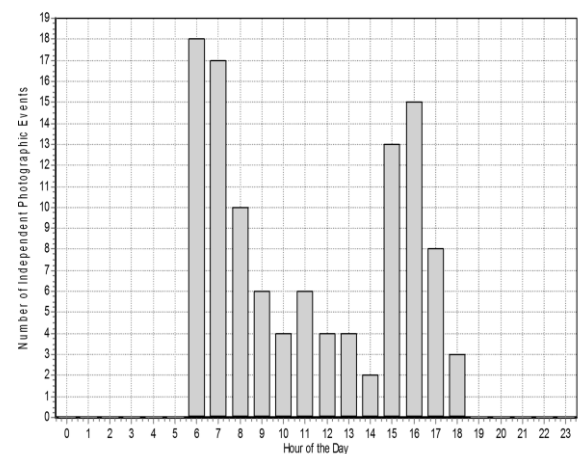
HARVEY'S DUIKER (*Cephalophus harveyi*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
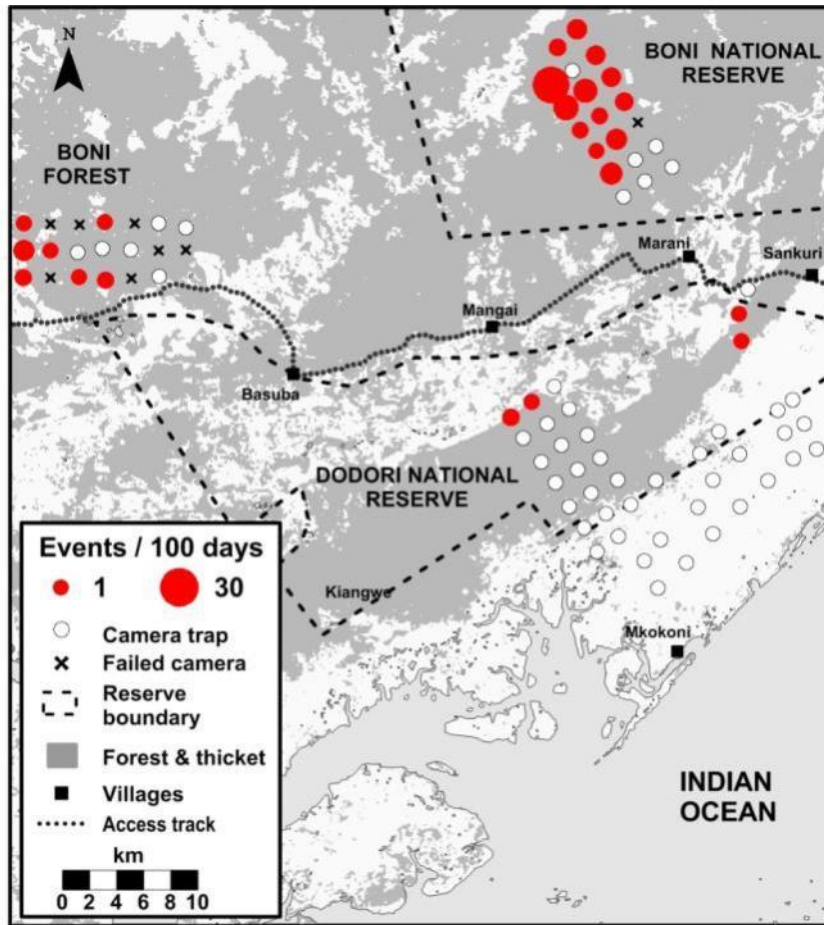
ARABUKO-SOKOKE 2010
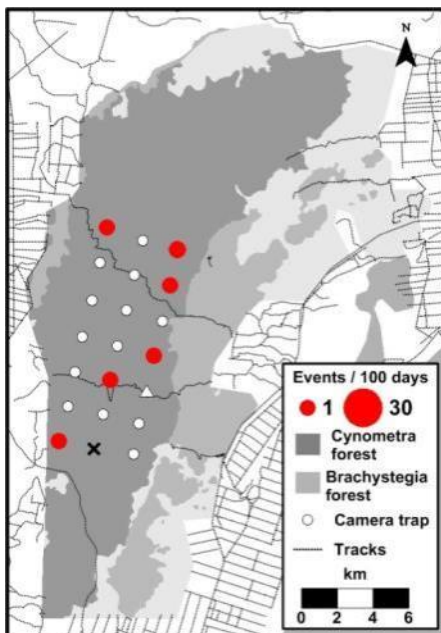
ARABUKO-SOKOKE 2015
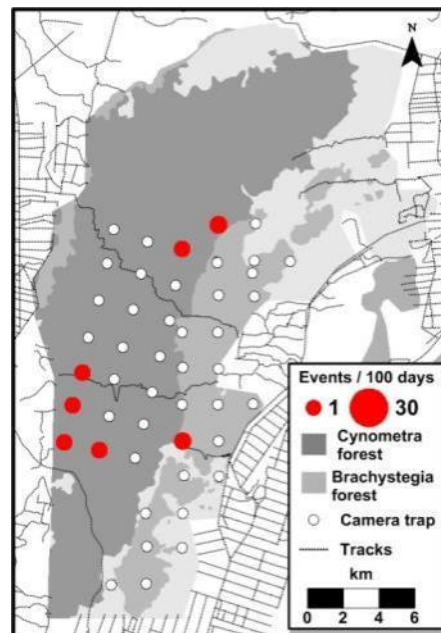
3) BLUE DUIKER (*Philantomba monticola*)

Species notes:
- Most frequently recorded in the Cynometra habitat of the Arabuko-Sokoke Forest, but no records from the Brachystegia habitat.
- Only two recorded encounters in the Boni-Dodori forest system, but these further confirm a northward range extension relative to the IUCN Red List distribution records.
- Timing of camera trap events in the Arabuko-Sokoke Forest indicates a predominantly diurnal / crepuscular activity pattern.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	11	27
Arabuko-Sokoke Cynometra 2015	22	14	54
Arabuko-Sokoke Brachystegia 2015	24	2	17
Boni-Dodori 2010 & 2015	81	2	1

Trapping rates, occupancy and detectability

| Survey | Trapping rate / 100 days (±SE) | Occupancy | | |
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	1.37 (±0.239)	0.526	0.622 (±0.148)	0.186 (±0.048)
A-S *Cynometra* 2015	5.181 (±0.759)	0.571	0.648 (±0.121)	0.305 (±0.054)
A-S *Brachystegia* 2015	1.114 (±0.377)	0.095	N/A	N/A
Dodori 2010 (inside)	0	0	N/A	N/A
Boni National Reserve	0.123 (±0.086)	0.053	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	0	0	N/A	N/A

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015

Timing of camera events: Boni-Dodori 2010 & 2015

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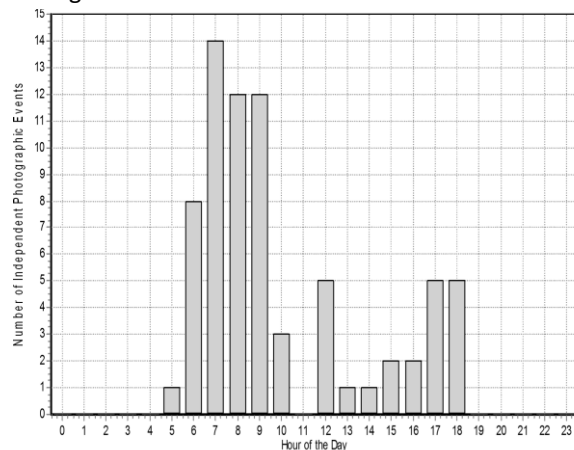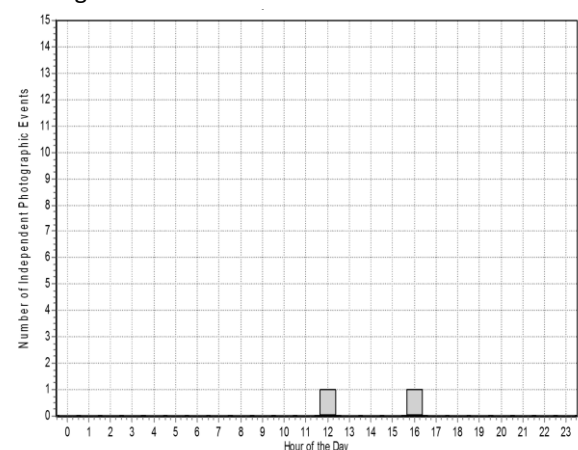
BLUE DUIKER (*Philantomba monticola*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
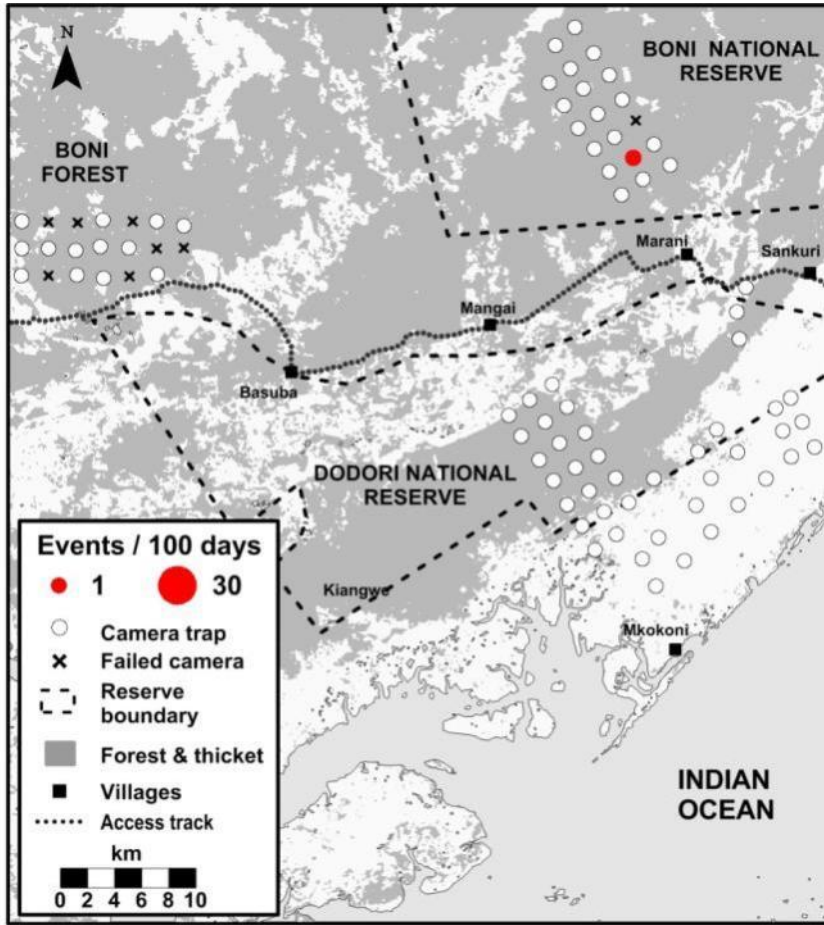
ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

4) COMMON DUIKER (*Sylvicapra grimmia*)

Species notes:
- Present along the entire Kenya coast according to IUCN Red List but only encountered in Arabuko-Sokoke Brachystegia forest in 2015.
- Low encounter frequency and distribution reflects study focus on denser habitats less preferred by this species.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	2	5
Boni-Dodori 2010 & 2015	81	0	0

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0.341 (±0.237)	0.095	N/A	N/A
Dodori 2010 (inside)	0	0	N/A	N/A
Boni National Reserve	0	0	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	0	0	N/A	N/A

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015

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COMMON DUIKER (*Sylvicapra grimmia*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
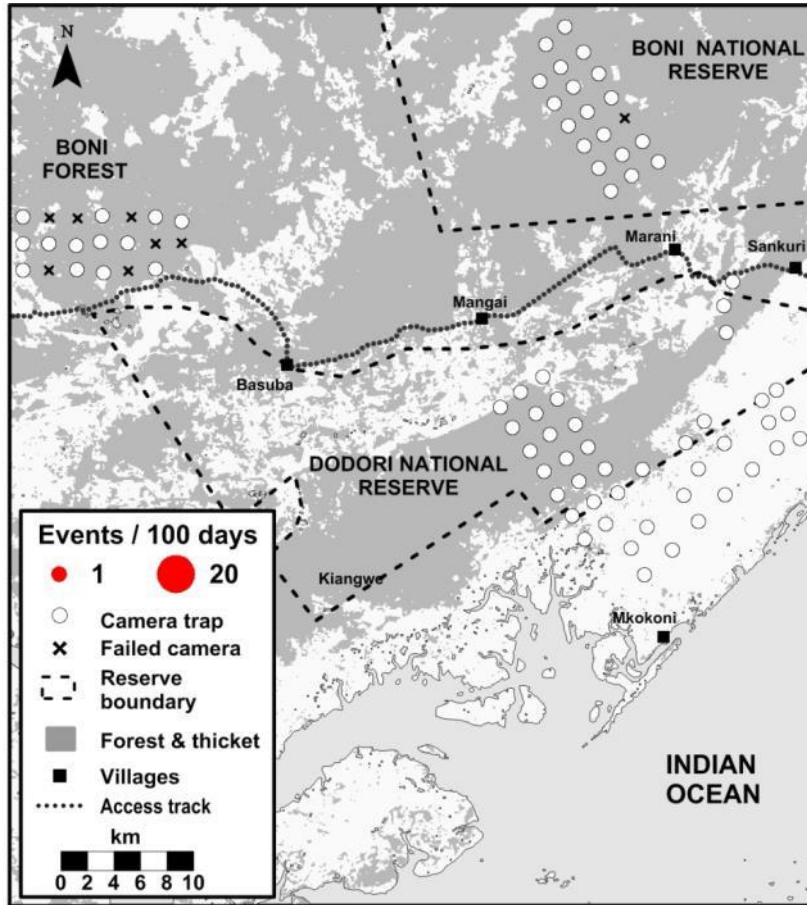
ARABUKO-SOKOKE 2010
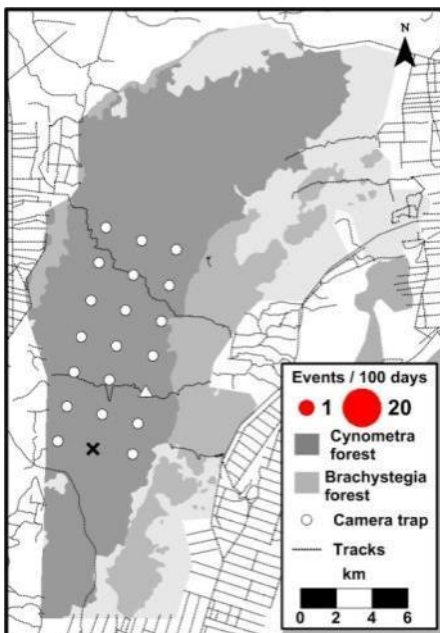
ARABUKO-SOKOKE 2015
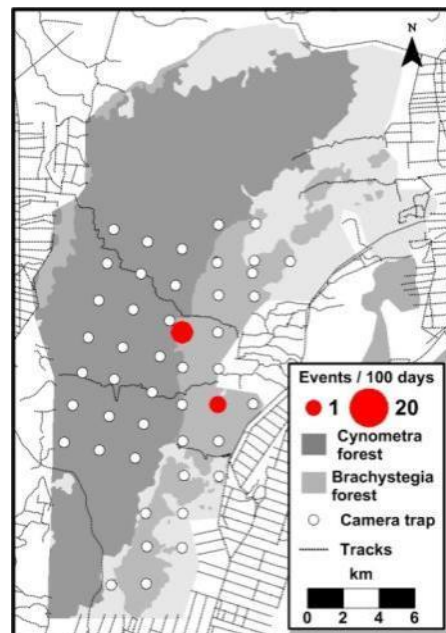
5) SUNI (*Nesotragus moschatus*)

Species notes:
- Most evenly distributed common species in the coastal forests.
- Encounter frequency at Boni-Dodori forest system second only to Aders' duiker.
- Regular in dryer bush to the south of Dodori NR.
- Camera trap encounters recorded throughout 24 hour cycle, with pronounced peaks at dawn and dusk.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	18	489
Arabuko-Sokoke Cynometra 2015	22	21	260
Arabuko-Sokoke Brachystegia 2015	24	20	412
Boni-Dodori 2010 & 2015	81	72	2884

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	23.963 (±1.275)	0.947	0.948 (±0.051)	0.612 (±0.038)
A-S *Cynometra* 2015	22.912 (±1.55)	0.952	1.0 (±0)	0.63 (±0.04)
A-S *Brachystegia* 2015	31.093 (±2.465)	0.952	0.963 (±0.047)	0.778 (±0.037)
Dodori 2010 (inside)	35.659 (±2.262)	1	1 (±0)	1 (±0)
Boni National Reserve	42.714 (±1.962)	0.947	0.947 (±0.051)	0.808 (±0.03)
Boni forest	77.722 (±3.641)	1	1 ±(0)	1 (±0)
Dodori 2015 (outside)	30.294 (±1.328)	0.955	0.955 (±0.044)	0.688 (±0.033)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015


Timing of camera events: Boni-Dodori 2010 & 2015


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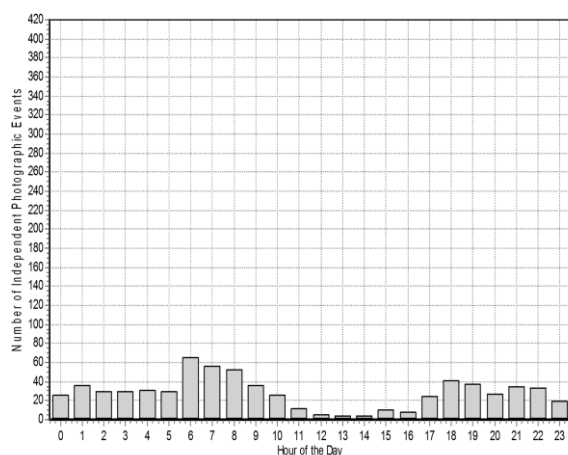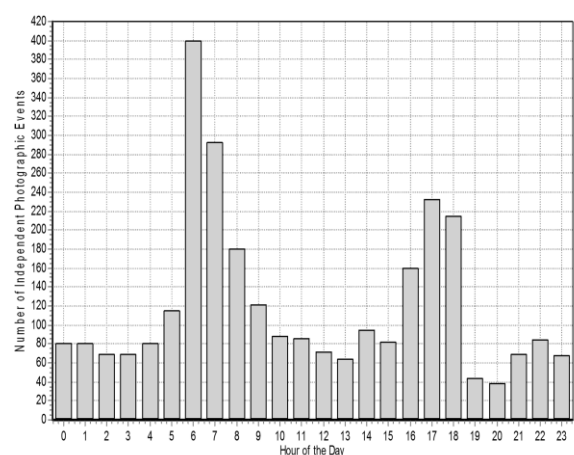
SUNI (*Nesotragus moschatus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
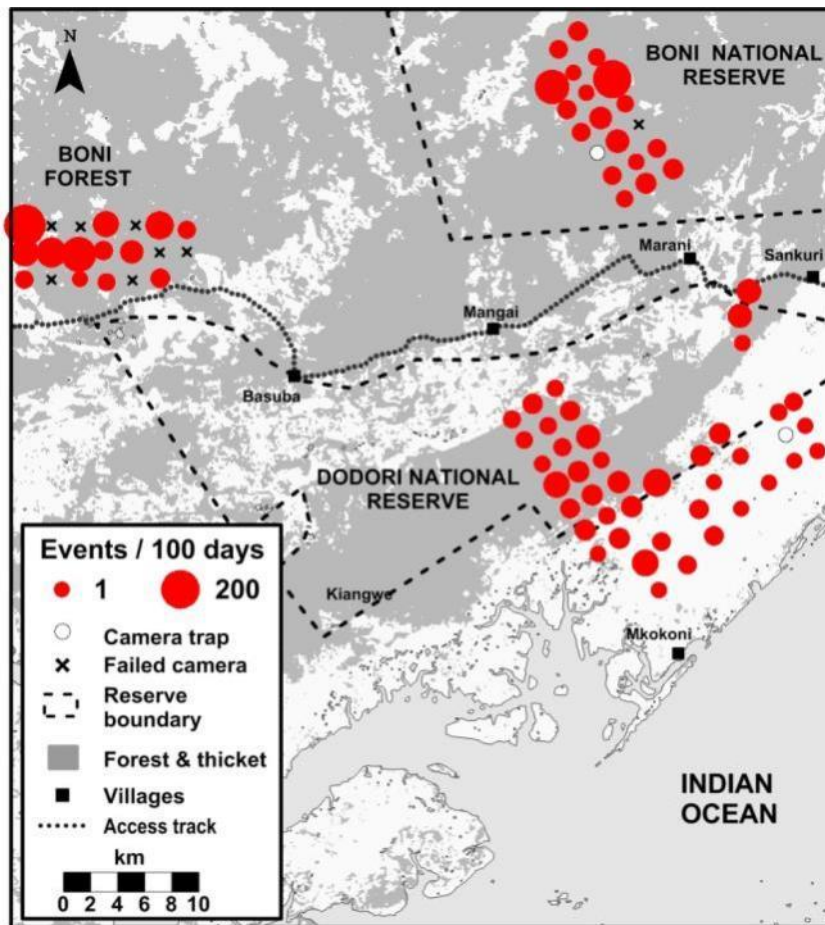
ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

6) KIRK'S DIK-DIK (*Madoqua kirkii*)

Species notes:
- Distribution reflects well-known association with dryer bush habitats. Not a coastal forest species.
- Restricted to the coastal scrub habitat to the south of the Dodori NR. Camera events recorded throughout 24 hour cycle with marked dawn and pre-dusk peaks.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	0	0
Boni-Dodori 2010 & 2015	81	7	205

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	0.091 (±0.091)	0.05	N/A	N/A
Boni National Reserve	0	0	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	6.351 (±0.613)	0.227	0.229 (±0.09)	0.401 (±0.073)

Activity pattern

Timing of camera events: Boni-Dodori 2010 & 2015
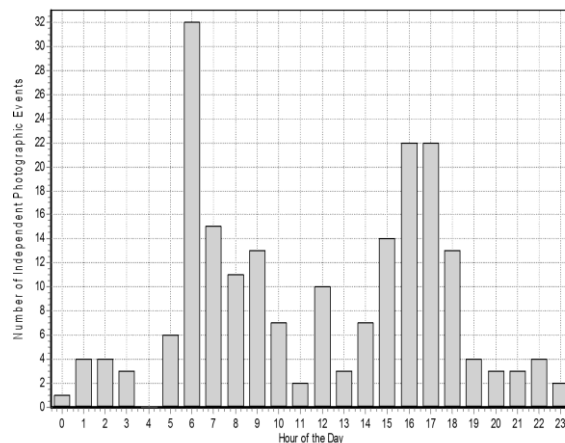
KIRK'S DIK-DIK (*Madoqua kirkii*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
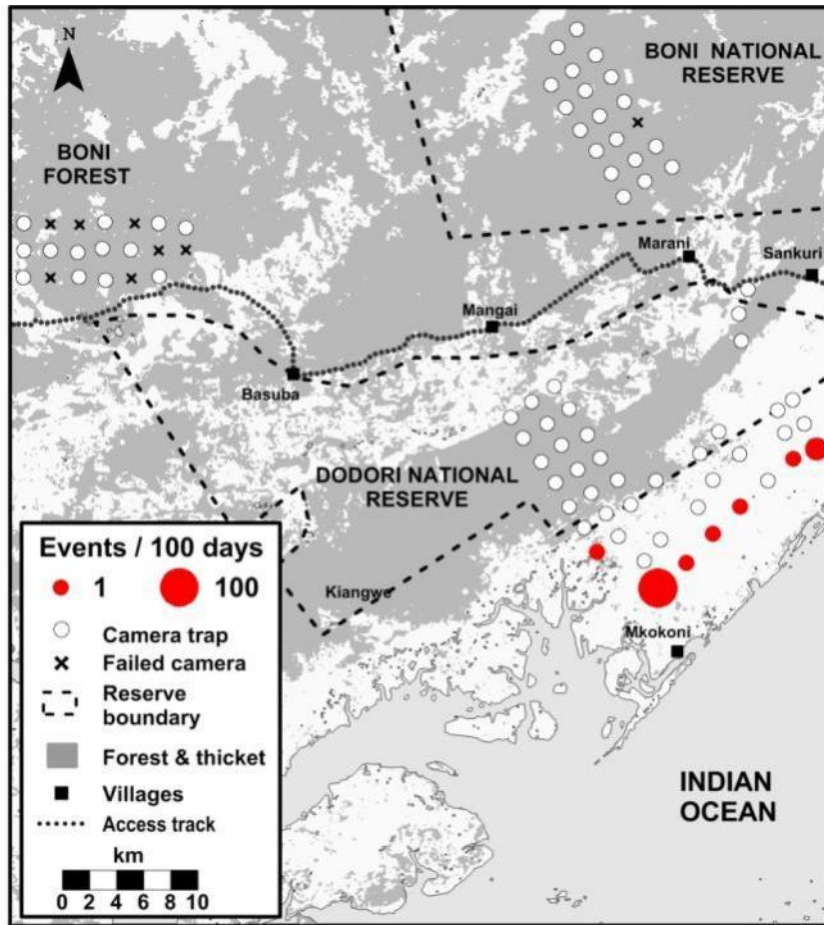
ARABUKO-SOKOKE 2010
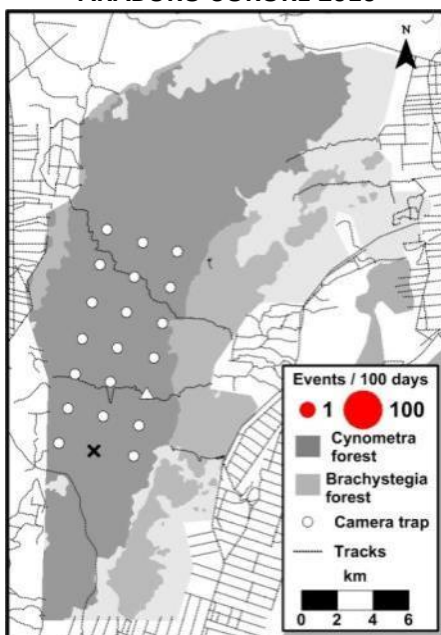
ARABUKO-SOKOKE 2015
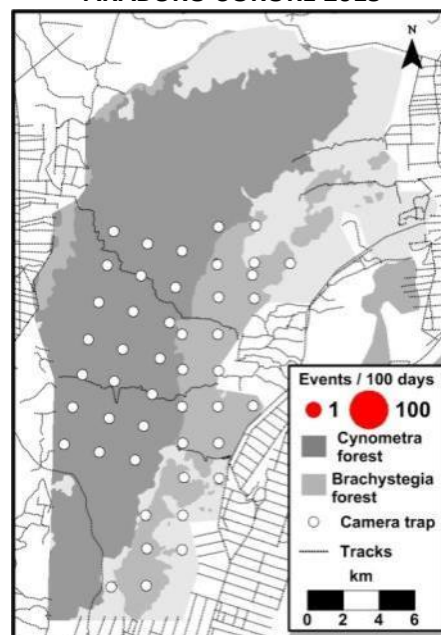
7) BUSHBUCK (*Tragelaphus scriptus*)

Species notes:
Species notes: • In the northern forests most frequently recorded in the Dodori NR and adjacent more open coastal scrub habitat to the south. • Strong preference for more open Brachystegia habitat indicated at Arabuko-Sokoke Forest. • Timing of camera events indicate activity throughout the 24 hour cycle.
Global conservation status: Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	1	1
Arabuko-Sokoke Cynometra 2015	22	2	2
Arabuko-Sokoke Brachystegia 2015	24	6	9
Boni-Dodori 2010 & 2015	81	29	110

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.051 (±0.051)	0.053	N/A	N/A
A-S *Cynometra* 2015	0.128 (±0.128)	0.095	N/A	N/A
A-S *Brachystegia* 2015	1.076 (±0.364)	0.238	N/A	N/A
Dodori 2010 (inside)	3.364 (± 0.609)	0.5	0.514 (±0.115)	0.343 (±0.053)
Boni National Reserve	1.087 (±0.259)	0.158	0.169 (±0.091)	0.259 (±0.088)
Boni forest	0.4 (±0.196)	0.077	N/A	N/A
Dodori 2015 (outside)	1.526 (±0.231)	0.591	0.648 (±0.119)	0.22 (±0.042)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
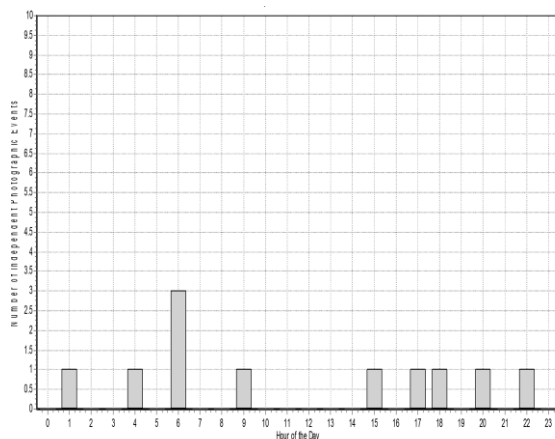
Timing of camera events: Boni-Dodori 2010 & 2015
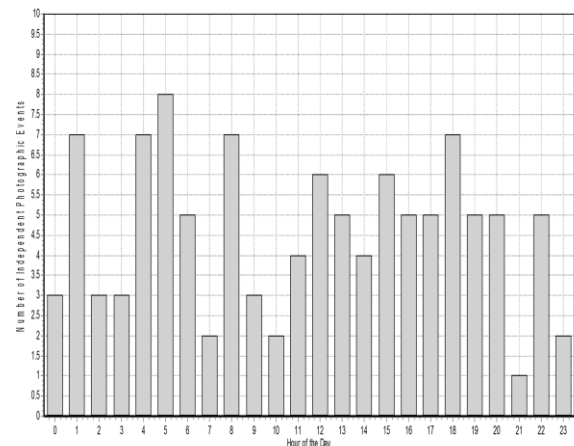
BUSHBUCK (*Tragelaphus scriptus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
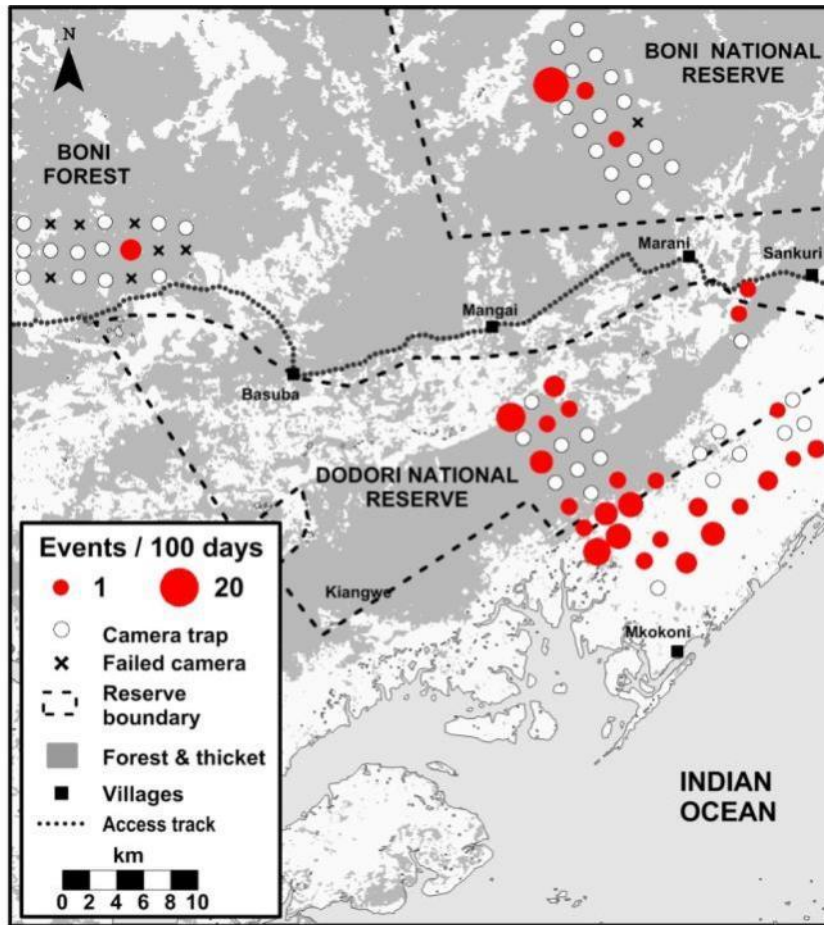
ARABUKO-SOKOKE 2010
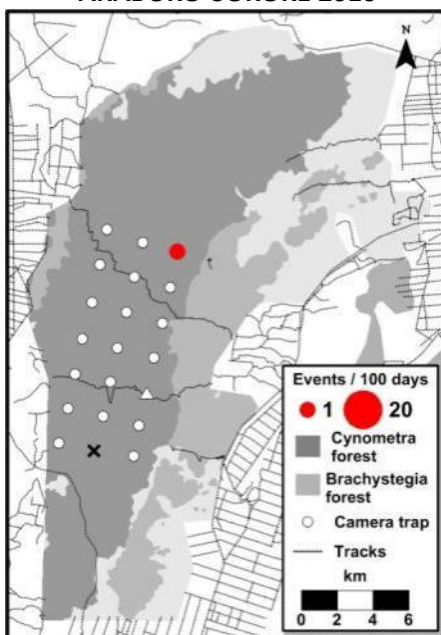
ARABUKO-SOKOKE 2015
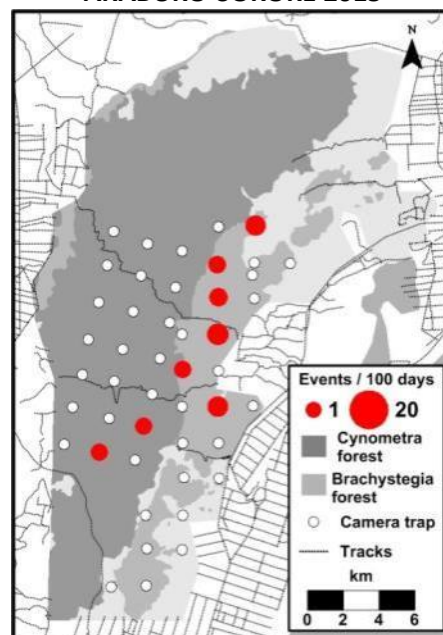
8) LESSER KUDU (*Tragelaphus imberbis*)

Species notes:
- Distribution reflects well-known association with dryer bush habitats. Not a coastal forest species.
- Only recorded in the dry coastal scrub habitats of northern coastal forests (Boni-Dodori forest system).
- Recorded at much higher frequency closer to the coast (Dodori 2015 survey) just south of Dodori NR. Indicates this area is important habitat for this near threatened species and would be further threatened if human development expands further into the Dodori area.
- Not present at Arabuko-Sokoke Forest.
- Timing of encounters indicates activity throughout the 24 hour cycle, with crepuscular peaks.
-

Global conservation status:
Near Threatened (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	0	0
Boni-Dodori 2010 & 2015	81	19	281

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	0.364 (±0.219)	0.1	0.163 (±0.143)	0.104 (±0.092)
Boni National Reserve	0	0	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	8.632 (±0.597)	0.773	0.775 (±0.09)	0.437 (±0.039)

Activity pattern

Timing of camera events: Boni-Dodori 2010 & 2015
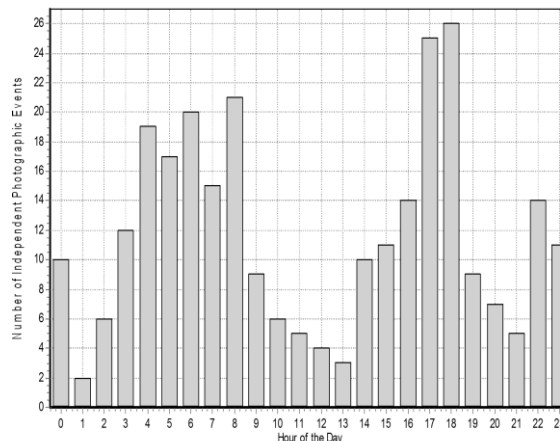
LESSER KUDU (*Tragelaphus imberbis*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
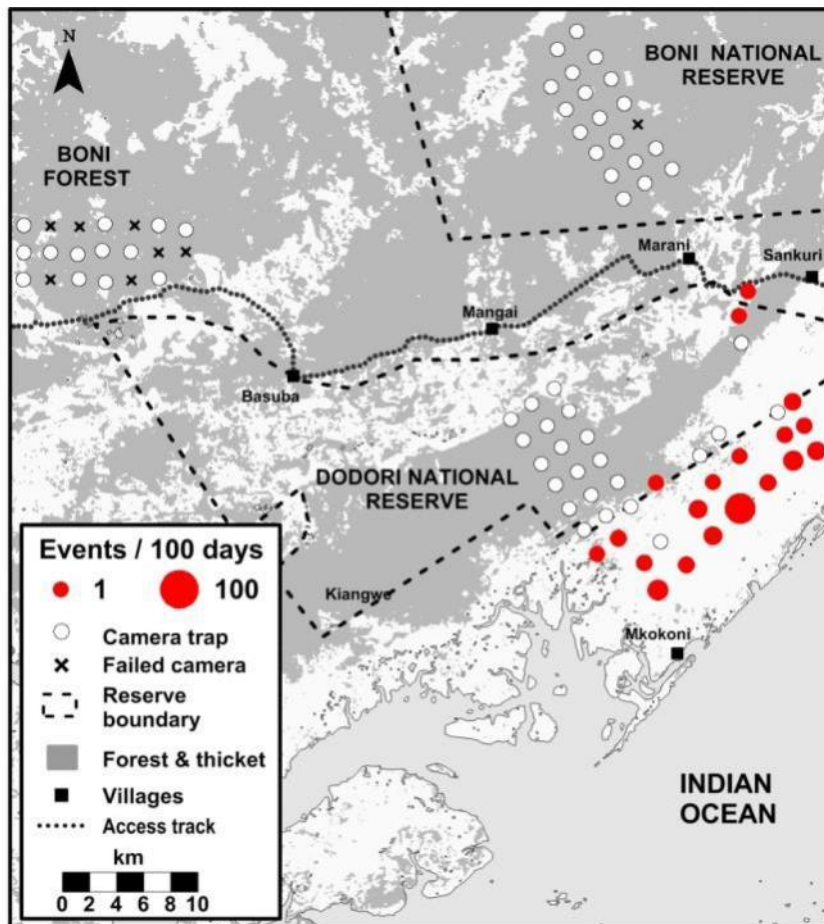
ARABUKO-SOKOKE 2010
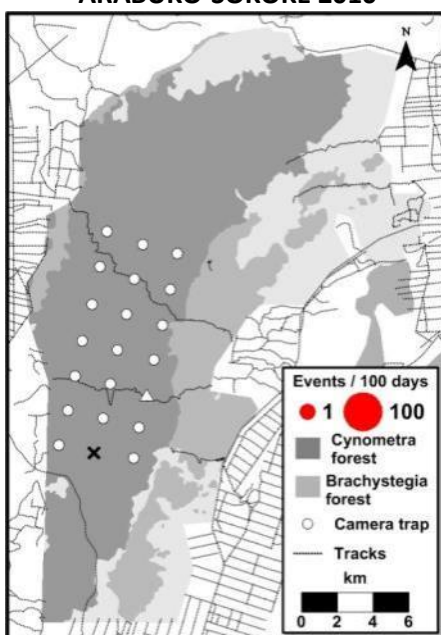
ARABUKO-SOKOKE 2015

9) WATERBUCK (*Kobus ellipsiprymnus*)

Species notes:	
• Not a species of coastal forest. • Only one event recorded; on south side of Dodori NR. (Note: Original camera trap image very poor quality; this individual was photographed outside the camera grids on the north Kenya coast between Witu and Lamu).	
Global conservation status: Least Concern (IUCN 2008)	

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia2015	24	0	0
Boni-Dodori 2010 & 2015	81	1	1

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	0.091 (±0.091)	0.05	N/A	N/A
Boni National Reserve	0	0	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	0	0	N/A	N/A

Activity pattern

Timing of camera events: Boni-Dodori 2010 & 2015

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WATERBUCK (*Kobus ellipsiprymnus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
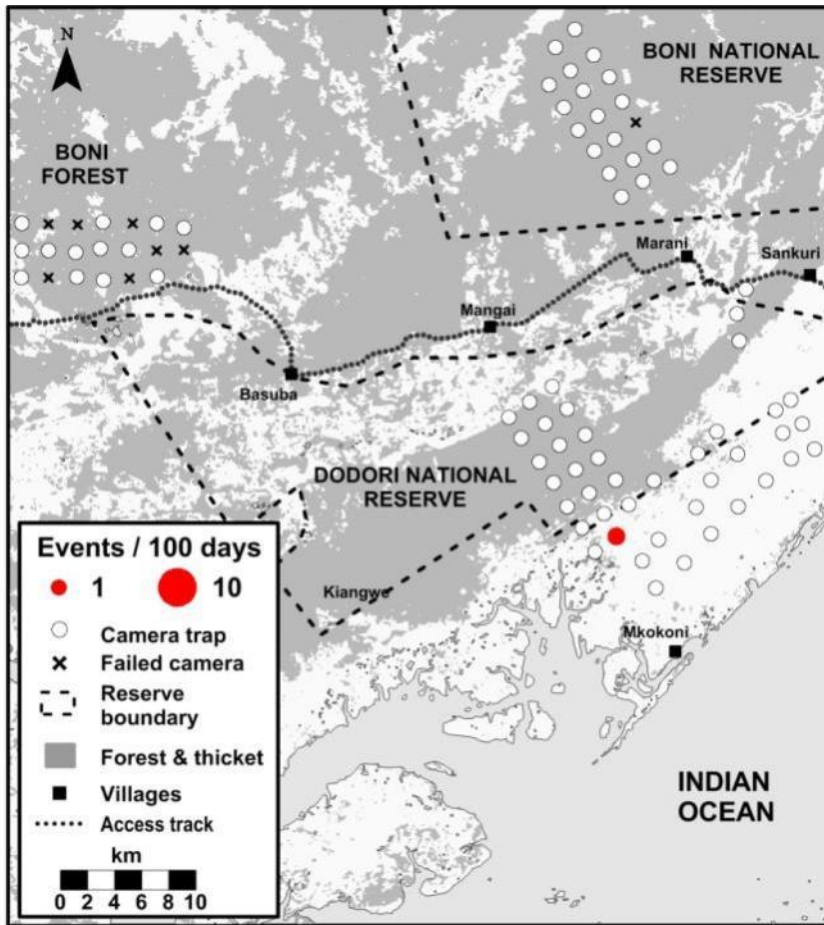
ARABUKO-SOKOKE 2010
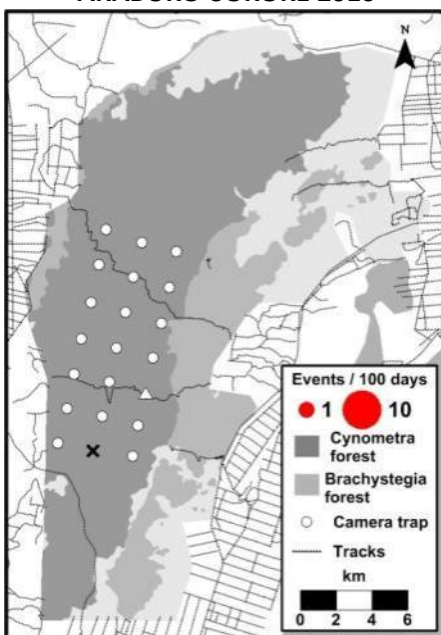
ARABUKO-SOKOKE 2015
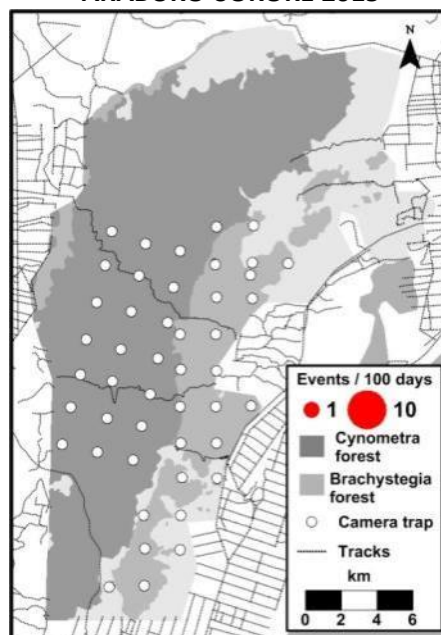
10)   AFRICAN BUFFALO (*Syncerus caffer*)

Species notes:
- Patchily present across the Boni-Dodori forest system.
- Evidence of at least one very large herd (>100) using Boni Forest as well as large solitary bulls.
- Status in Arabuko-Sokoke Forest very restricted; recorded only in Brachystegia habitat.
- Timing of camera trap events indicates activity throughout 24 hour cycle but with a preference for nocturnal activity.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	2	3
Boni-Dodori 2010 & 2015	81	20	144

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy:	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0.147 (±0.147)	0.095	N/A	N/A
Dodori 2010 (inside)	1.477 (± 0.408)	0.3	0.353 (±0.128)	0.196 (±0.064)
Boni National Reserve	1.235 (±0.286)	0.105	0.107 (±0.072)	0.363 (±0.114)
Boni forest	0.491 (±1.073)	0.385	0.386 (±0.135)	0.455 (±0.074)
Dodori 2015 (outside)	0.405 (±0.116)	0.273	0.335 (±0.128)	0.159 (±0.058)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
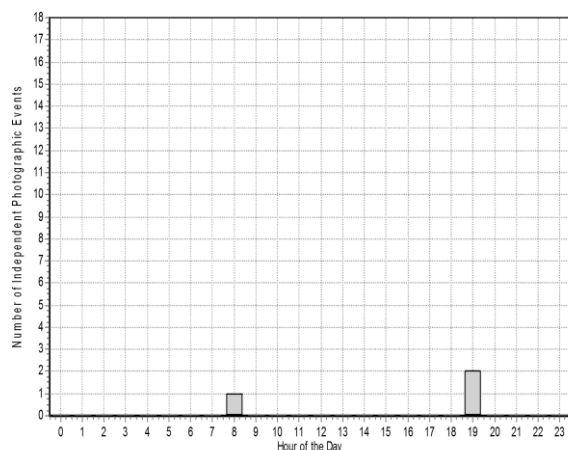
Timing of camera events: Boni-Dodori 2010 & 2015
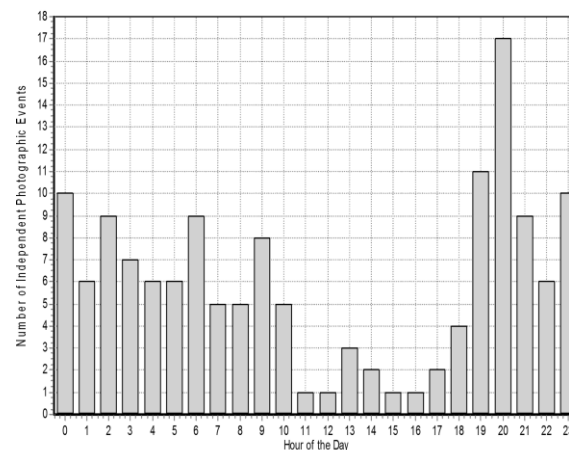
AFRICAN BUFFALO (*Syncerus caffer*)

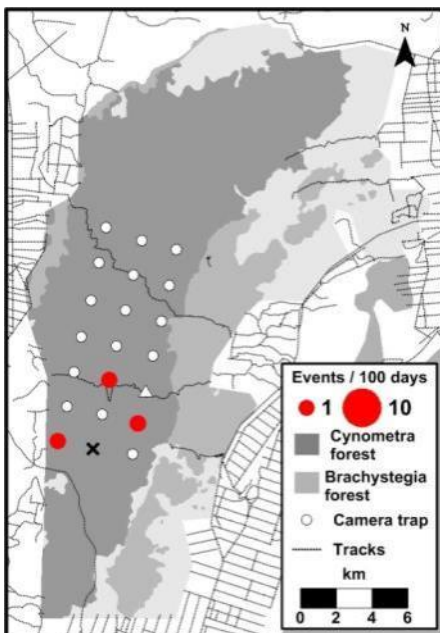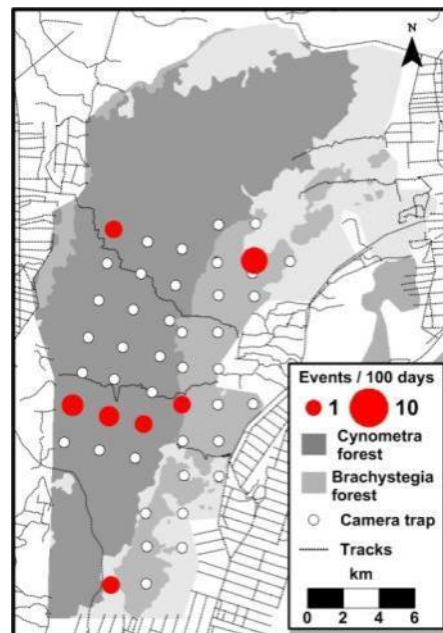## BONI-DODORI 2010 & SOUTH OF DODORI 2015
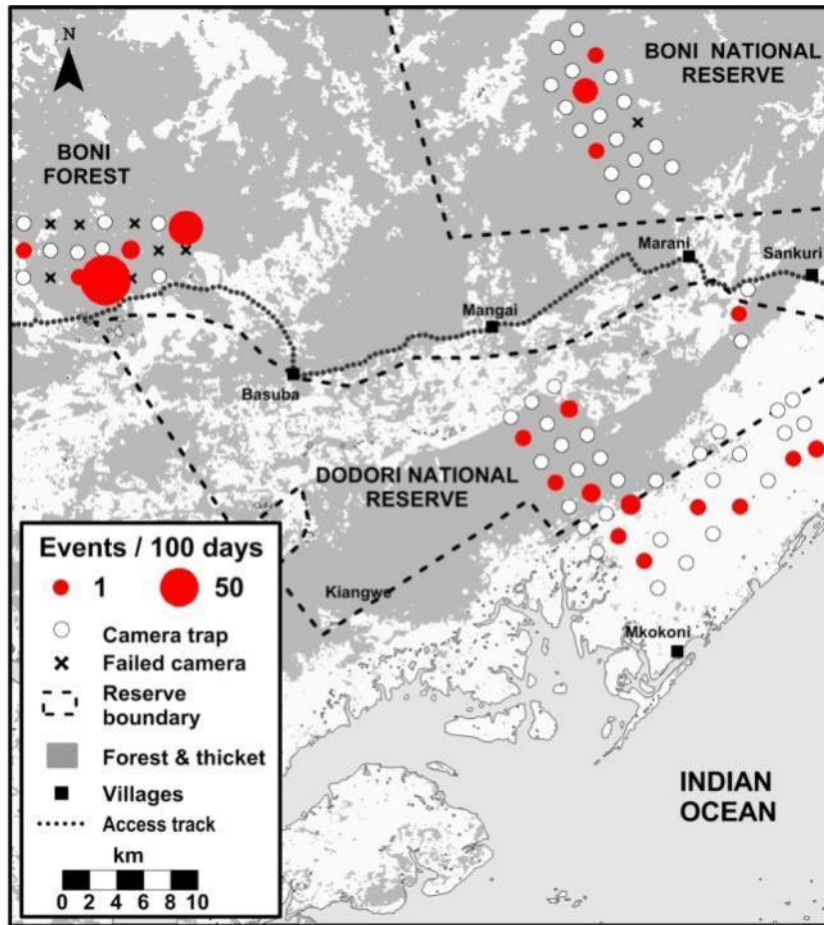
ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

11)   COMMON HIPPOPOTAMUS (*Hippopotamus amphibius*)

Common name: Common hippopotamus	
Species notes: • Only one event recorded, in Dodori NR at a camera close to the permanent water pools of the seasonal Dodori River.	
Global conservation status: Vulnerable (IUCN 2008)	

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia2015	24	0	0
Boni-Dodori 2010 & 2015	81	1	1

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	0.091 (±0.091)	0.05	N/A	N/A
Boni National Reserve	0	0	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	0	0	N/A	N/A

Activity pattern

Timing of camera events: Boni-Dodori 2010 & 2015

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COMMON HIPPOPOTAMUS (*Hippopotamus amphibius*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
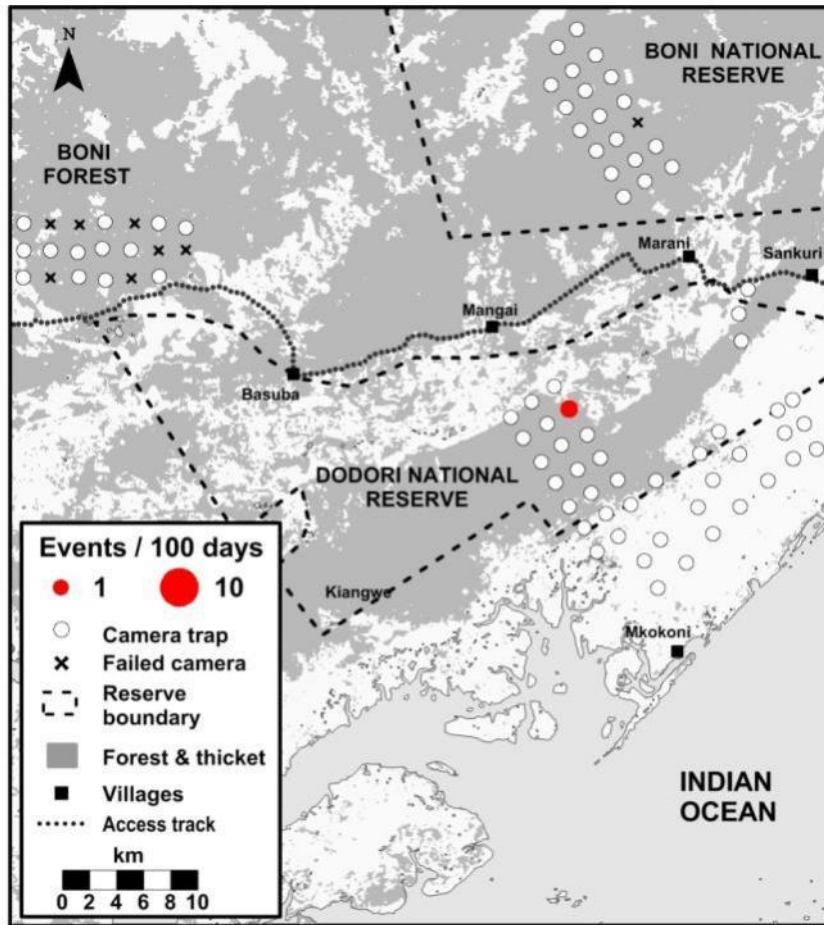
ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015
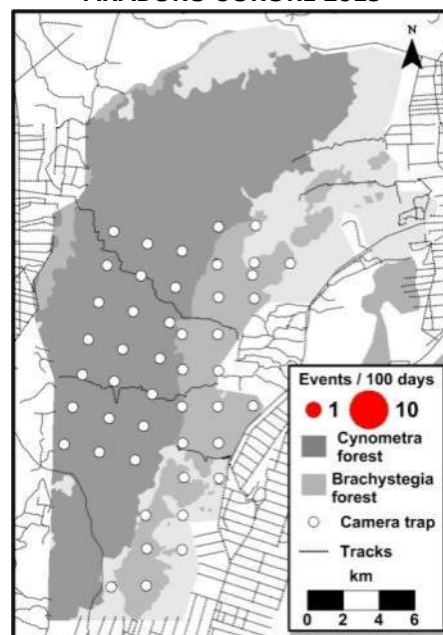
12)   BUSHPIG (*Potamochoerus larvatus*)

Species notes:
- Widespread in both thicket and coastal scrub of the Boni-Dodori forest system.
- Most frequently recorded in the Boni NR and Dodori area.
- Recorded at lower levels and perhaps more restricted to denser habitats in the Arabuko-Sokoke Forest.
- Timing of camera events shows activity throughout 24 hour cycle, perhaps with a preference for nocturnal activity.
- Piglets photographed at Dodori, 21 March 2015.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	3	3
Arabuko-Sokoke Cynometra 2015	22	4	5
Arabuko-Sokoke Brachystegia 2015	24	3	4
Boni-Dodori 2010 & 2015	81	33	59

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.152 (±0.087)	0.158	N/A	N/A
A-S *Cynometra* 2015	0.508 (±0.245)	0.143	N/A	N/A
A-S *Brachystegia* 2015	0.307 (±0.214)	0.143	N/A	N/A
Dodori 2010 (inside)	0.545 (±0.212)	0.25	N/A	N/A
Boni National Reserve	0.791 (±0.223)	0.526	N/A	N/A
Boni forest	0.899 (±0.376)	0.308	0.401 (±0.191)	0.145 (±0.07)
Dodori 2015 (outside)	0.935 (±0.187)	0.591	0.854 (±0.21)	0.116 (±0.036)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
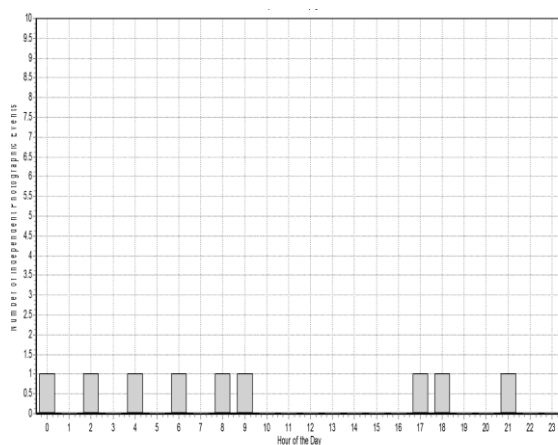
Timing of camera events: Boni-Dodori 2010 & 2015
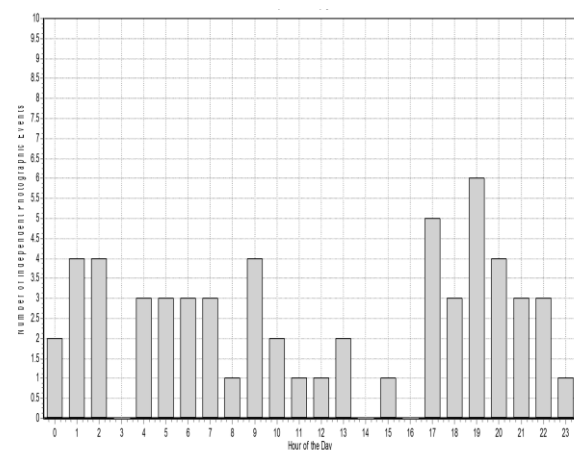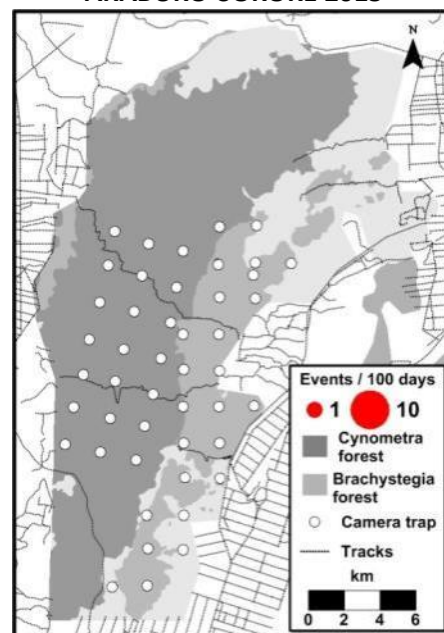
BUSHPIG (*Potamochoerus larvatus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
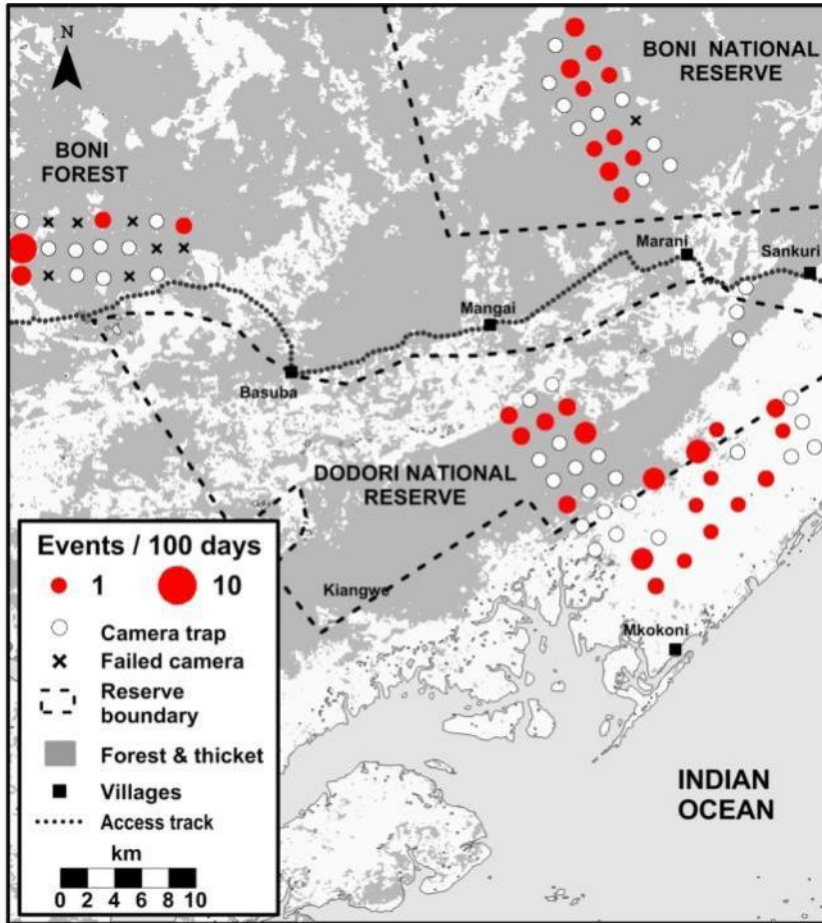
ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

13)   COMMON WARTHOG (*Phacochoerus africanus*)

Species notes:
- A species primarily associated with more open woodland and savannah habitats.
- Never recorded in the Arabuko-Sokoke Forest, low encounter rates recorded in the Boni-Dodori forest area across surveys in 2010.
- Observations notable as evidence of co-existence alongside two other similar sized suids; desert warthog and bushpig.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	0	0
Boni-Dodori 2010 & 2015	81	4	6

Trapping rates, occupancy and detectability

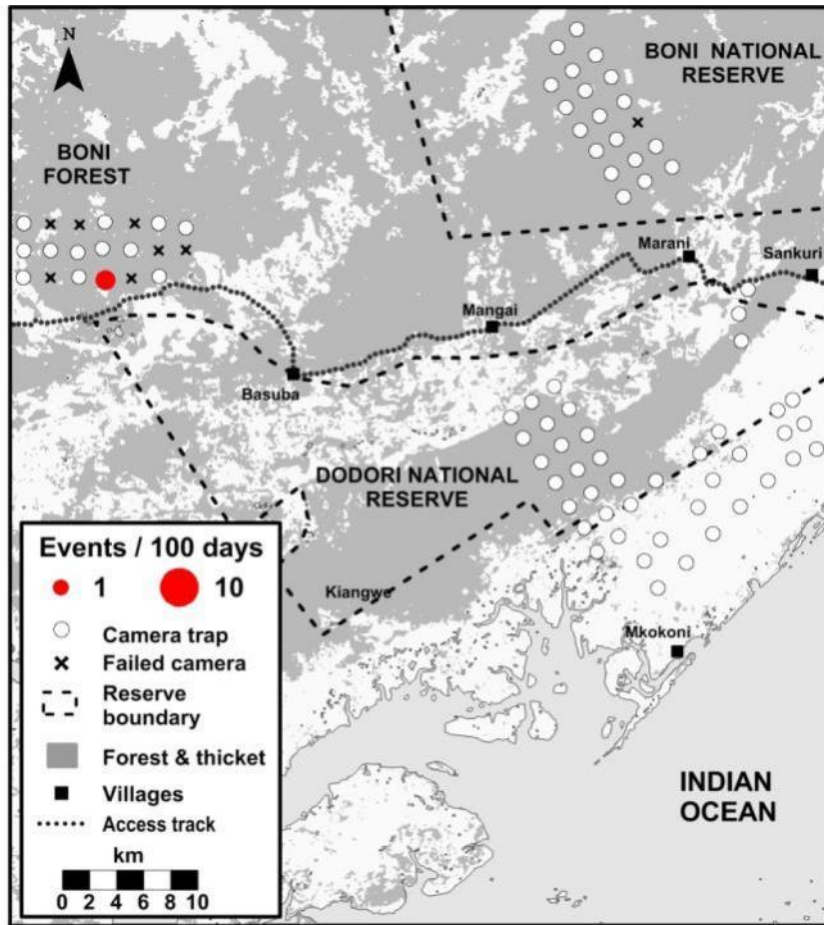| Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	0.091 (±0.091)	0.05	N/A	N/A
Boni National Reserve	0.06 (±0.06)	0.053	N/A	N/A
Boni forest	0.4 (±0.196)	0.154	N/A	N/A
Dodori 2015 (outside)	0	0	N/A	N/A

Activity pattern

Timing of camera events: Boni-Dodori 2010 & 2015
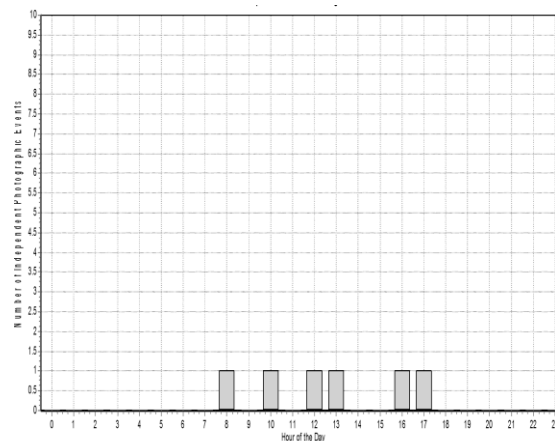
COMMON WARTHOG (*Phacochoerus africanus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
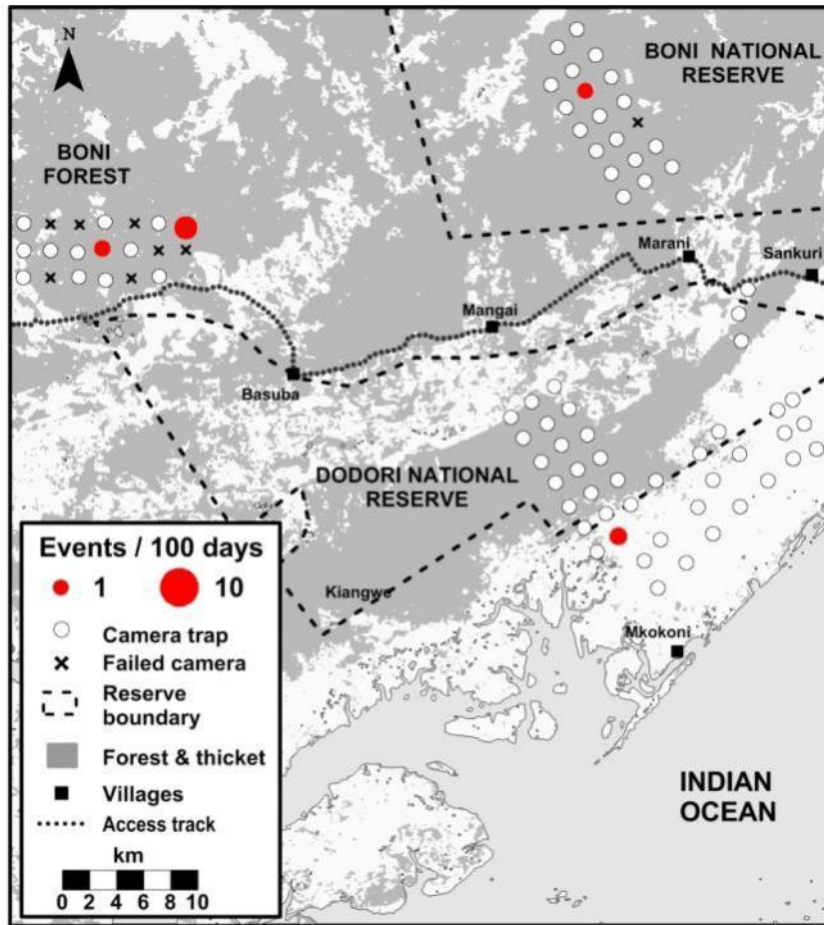
ARABUKO-SOKOKE 2010
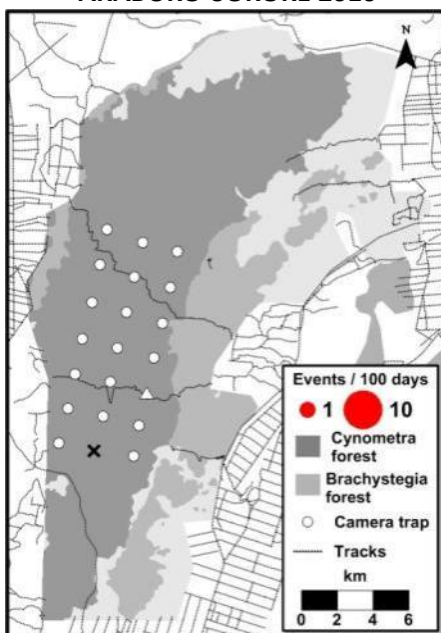
ARABUKO-SOKOKE 2015

14) DESERT WARTHOG (*Phacochoerus aethiopicus*)

Species notes:
- Like common warthog, a species primarily associated with more open woodland and savannah habitats.
- Identification of the images confirmed by T. Butynksi, Y. de Jong and J.P. d'Huart (pers. comms.).
- Only two events recorded, inland in the Boni Forest grid.
- Sympatry with two other suids: common warthog and bushpig.

Global conservation status:
Least Concern (IUCN 2011)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	0	0
Boni-Dodori 2010 & 2015	81	1	2

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	0	0	N/A	N/A
Boni National Reserve	0	0	N/A	N/A
Boni forest	0.2 (±0.14)	0.077	N/A	N/A
Dodori 2015 (outside)	0	0	N/A	N/A

Activity pattern

Timing of camera events: Boni-Dodori 2010 & 2015

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DESERT WARTHOG (*Phacochoerus aethiopicus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

15) AFRICAN WILD DOG (*Lycaon pictus*)

Species notes:
- Recorded on three occasions in Boni NR in 2010 and on one occasion in the coastal strip south of Dodori NR in 2015; minimum 3 individuals, but sampling method not suited to reliable group size assessment.
- The pattern of sporadic detections is typical of this wide-ranging species which occurs at low density throughout its range. Its presence in both survey periods is indicative of its persistence in the area.
- Not historically present in Arabuko-Sokoke Forest and no records in this survey.
- Occurrence of this internationally endangered species right down to the coast in the Boni-Dodori forest system highlights the conservation importance of this unique region.

Global conservation status:
Endangered (IUCN 2012)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	0	0
Boni-Dodori 2010 & 2015	81	4	4

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	0	0	N/A	N/A
Boni National Reserve	0.183 (±0.104)	0.158	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	0.033 (±0.033)	0.045	N/A	N/A

Activity pattern

Timing of camera events: Boni-Dodori 2010 & 2015
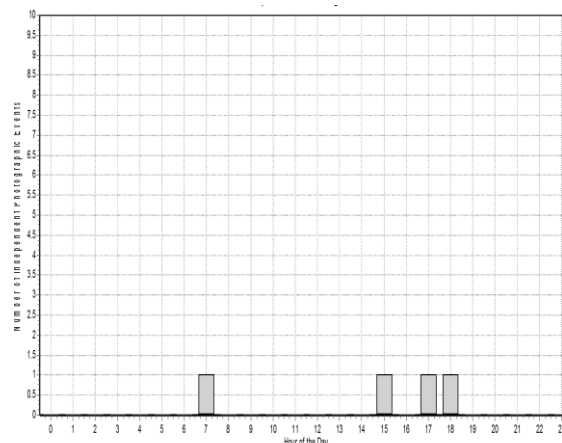
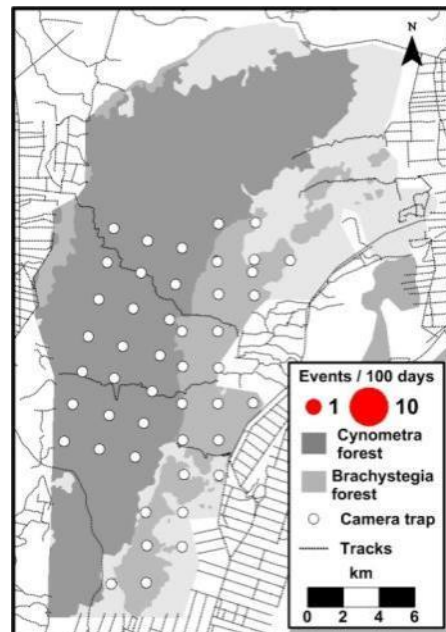# AFRICAN WILD DOG (*Lycaon pictus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
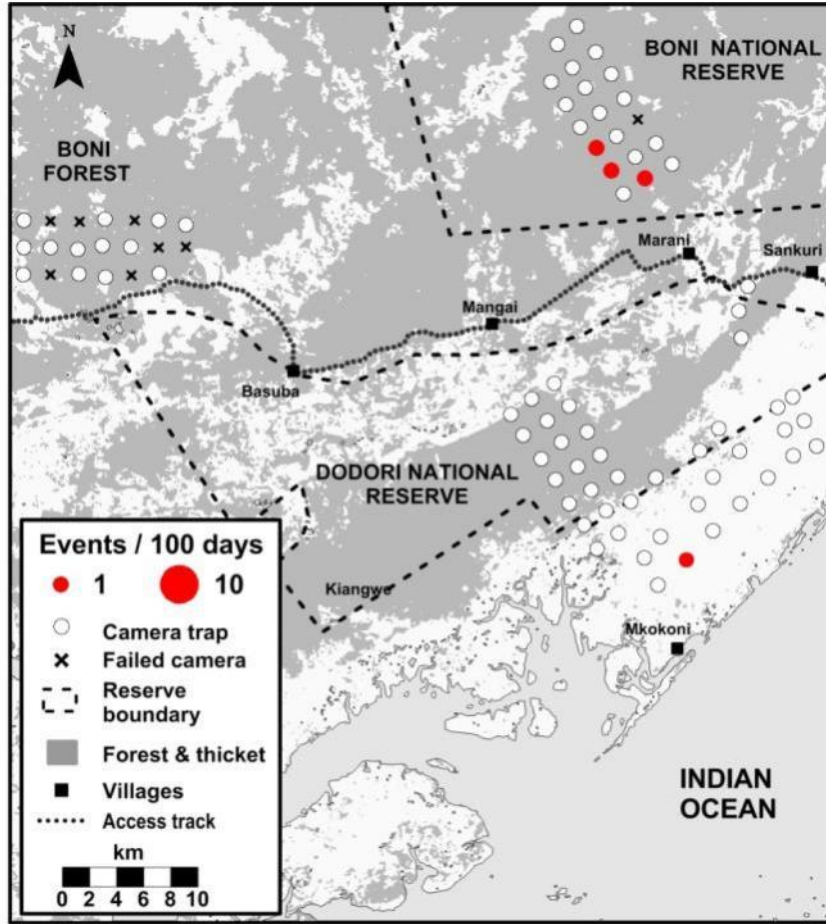
ARABUKO-SOKOKE 2010
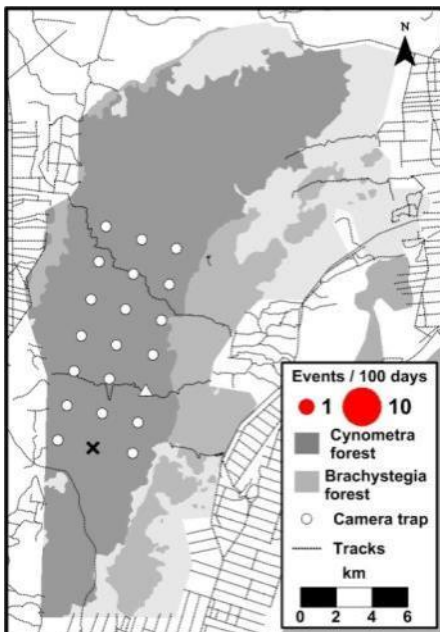
ARABUKO-SOKOKE 2015

16) CARACAL (*Caracal caracal*)

Species notes:
- Recorded in all grids except Boni Forest.
- Most frequently recorded in the Dodori area of the Boni-Dodori forest system, particularly towards the drier coastal bush to the south.
- Primarily recorded at night, but with consistent activity for a couple of hours after sunrise and in the late afternoon.
- Adult with young photographed Dodori, April 2015.

  [Note: possibility of golden cat *Caracal aurata* was considered during data processing, but all medium-sized cat images in this study were unambiguously attributable to caracal.]

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	3	3
Arabuko-Sokoke Cynometra 2015	22	3	6
Arabuko-Sokoke Brachystegia2015	24	4	5
Boni-Dodori 2010 & 2015	81	15	35

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.155 (±0.088)	0.158	N/A	N/A
A-S *Cynometra* 2015	0.558 (±0.268)	0.143	N/A	N/A
A-S *Brachystegia* 2015	0.615 (±0.292)	0.19	N/A	N/A
Dodori 2010 (inside)	0.364 (±0.177)	0.15	N/A	N/A
Boni National Reserve	0.365 (±0.145)	0.105	0.123 (±0.086)	0.19 (±0.107)
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	0.75 (±0.178)	0.409	0.617 (±0.212)	0.107 (±0.042)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
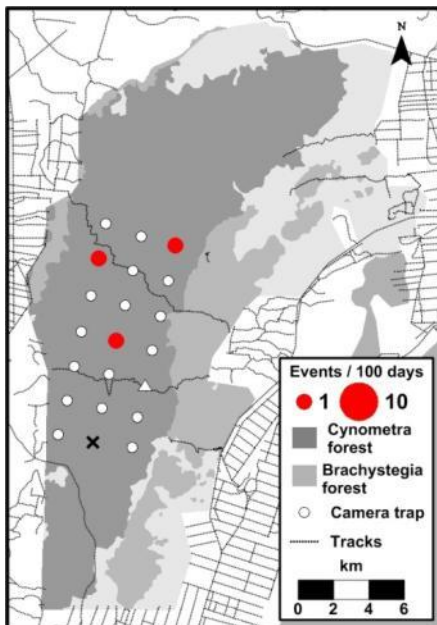

Timing of camera events: Boni-Dodori 2010 & 2015
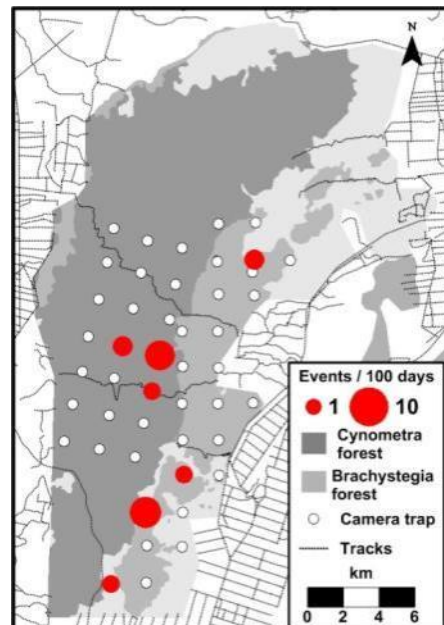

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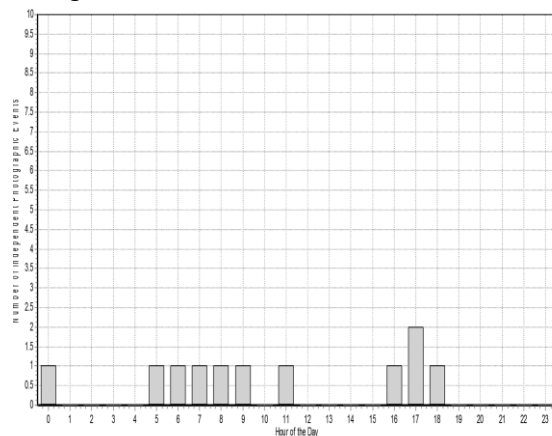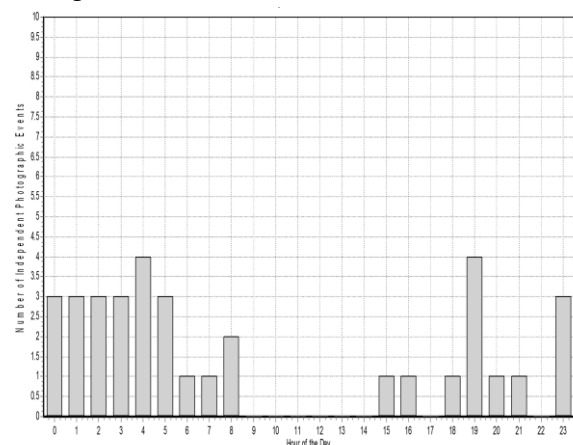
CARACAL (*Caracal caracal*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
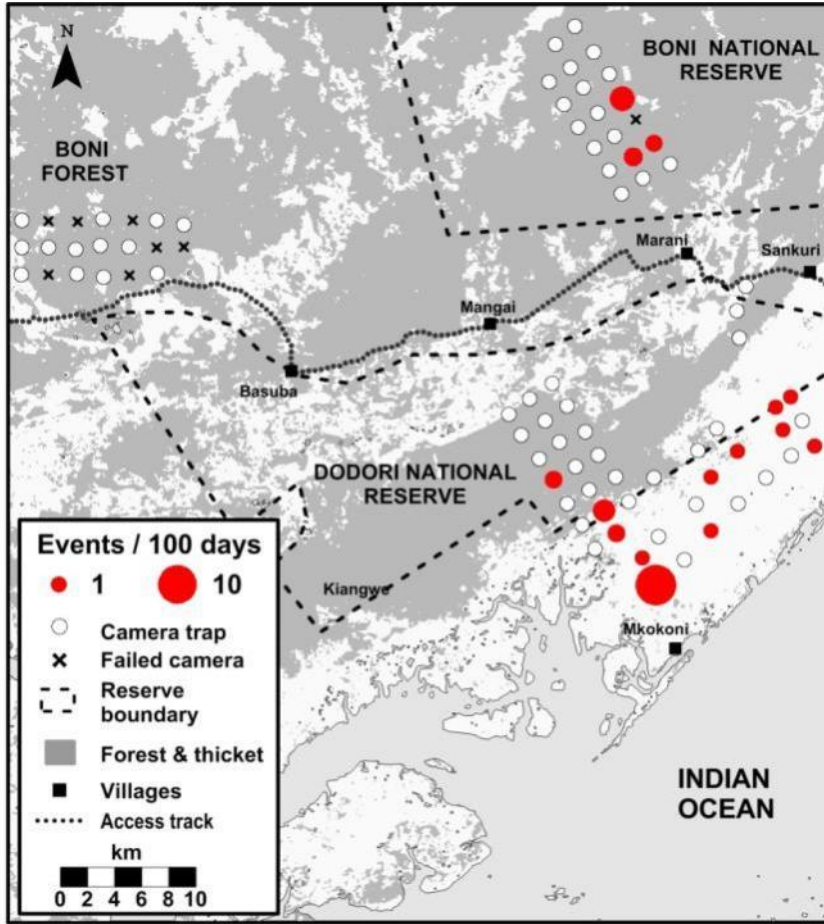
ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

17)   AFRICAN LION (*Panthera leo*)

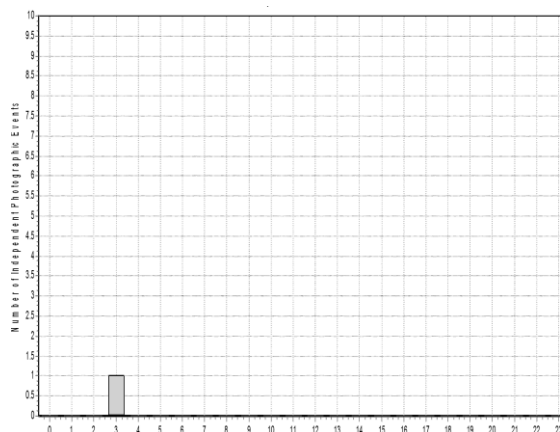| **Species notes:**	
• Only one event recorded, in Boni Forest during the 2010 survey.	
Global conservation status: Vulnerable (IUCN 2015)	

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	0	0
Boni-Dodori 2010 & 2015	81	1	1

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	0	0	N/A	N/A
Boni National Reserve	0	0	N/A	N/A
Boni forest	0.1 (±0.1)	0.077	N/A	N/A
Dodori 2015 (outside)	0	0	N/A	N/A

Activity pattern

Timing of camera events: Boni-Dodori 2010 & 2015

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AFRICAN LION (*Panthera leo*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
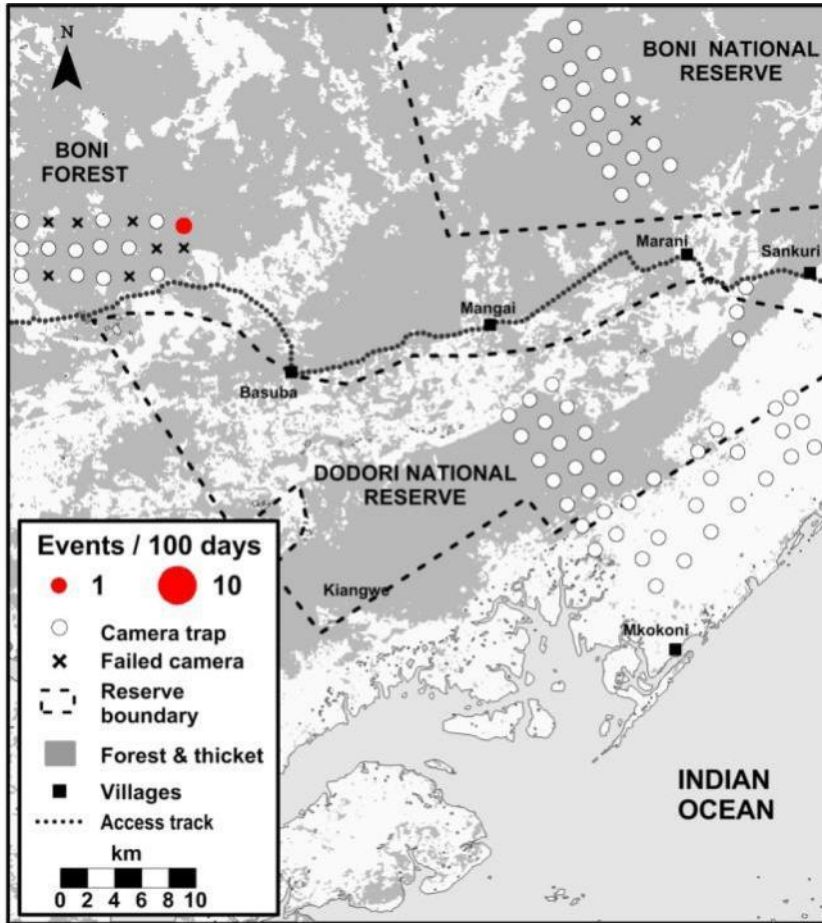
ARABUKO-SOKOKE 2010
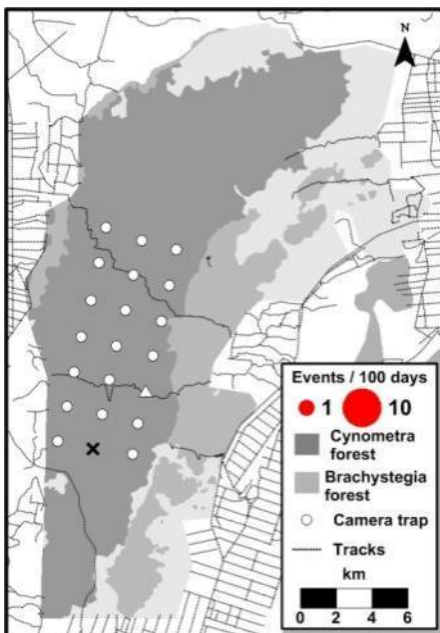
ARABUKO-SOKOKE 2015
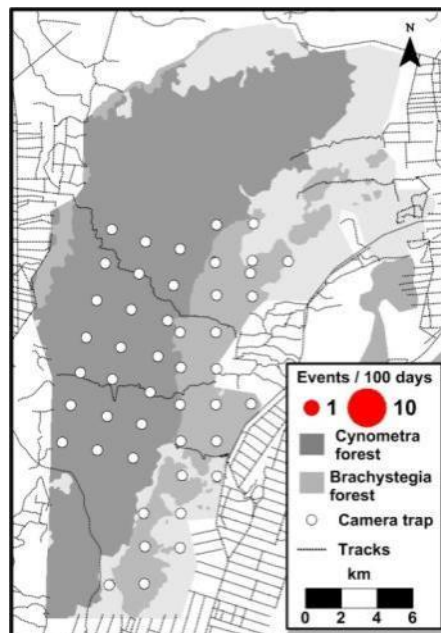
18)   LEOPARD (*Panthera pardus*)

Species notes:
- The most frequently recorded large carnivore in the Boni-Dodori forest system.
- Photograph sequences showing pairs of leopards, a mother resting and playing with a well grown cub, and several instances of leopards inspecting and marking cameras suggest a well-established population and confident, curious behaviour of this species in front of camera traps.
- In view of the latter, absence of any records from Arabuko-Sokoke Forest after more than 4000 camera trapping days, suggests it is probably now very infrequent or absent in this isolated forest.
- Camera trap encounters recorded throughout the 24 hour cycle with a marginal increase in frequency at night and an obvious peak around sunrise.

Global conservation status:
Near Threatened (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	0	0
Boni-Dodori 2010 & 2015	81	32	78

Trapping rates, occupancy and detectability

| Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	0.364 (±0.177)	0.2	N/A	N/A
Boni National Reserve	1.223 (±0.338)	0.526	0.807 (±0.244)	0.112 (±0.04)
Boni forest	4.196 (±0.69)	0.923	0.991 (±0)	0.258 (±0.046)
Dodori 2015 (outside)	0.311 (±0.105)	0.273	N/A	N/A

Activity pattern

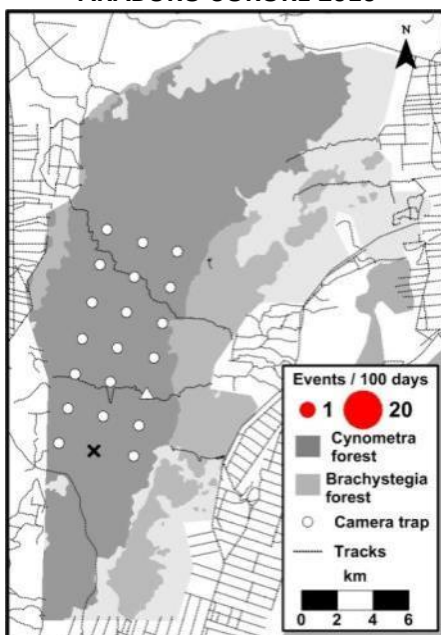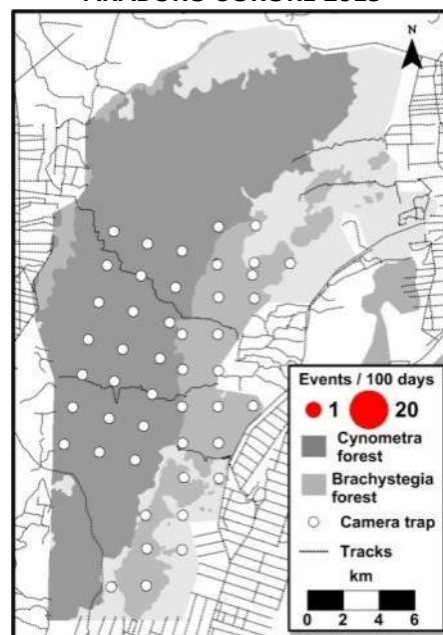Timing of camera events: Boni Dodori 2010 & 2015
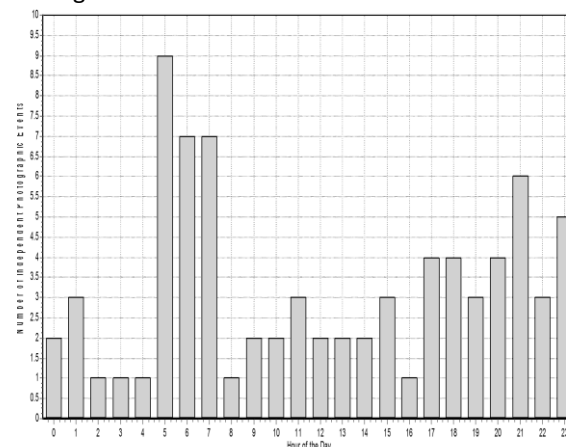
LEOPARD (*Panthera pardus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
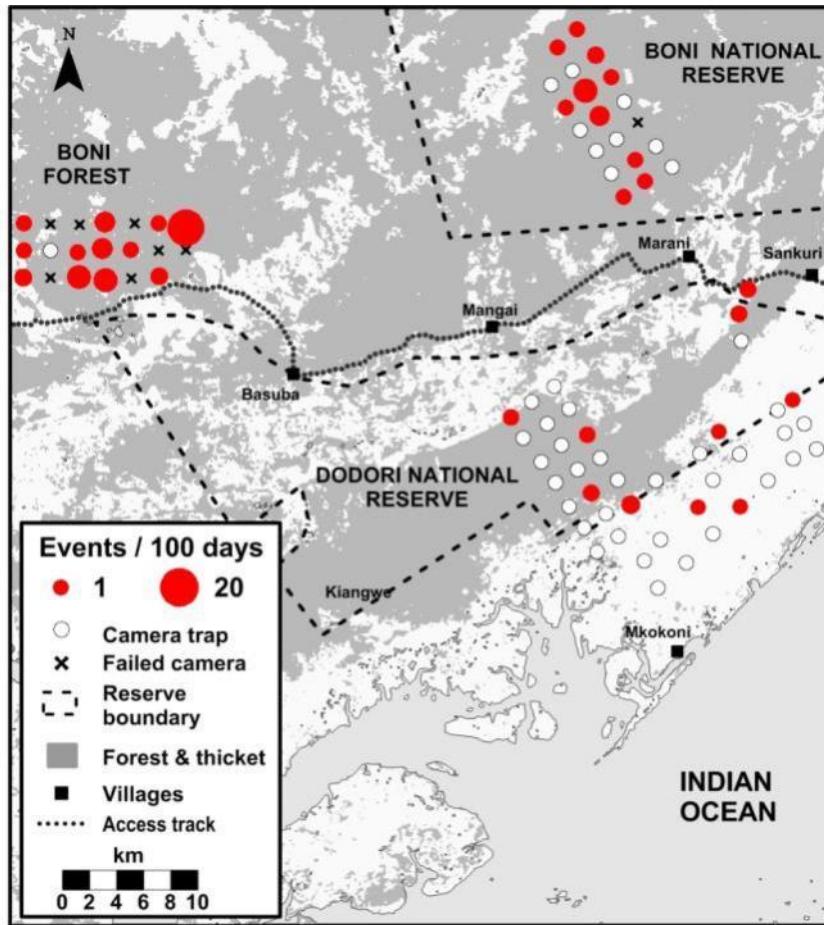
ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

19) AFRICAN CIVET (*Civettictis civetta*)

Species notes: • Most frequently recorded in the Brachystegia habitat of Arabuko-Sokoke Forest. • At Boni-Dodori only recorded in the more southerly Dodori NR. Generally low trapping frequency suggests a low preference for the sample habitats for this generally widespread small carnivore. • Timing of camera trap encounters indicates a nocturnal activity pattern. **Global conservation status:** Least Concern (IUCN 2015)	

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	1	2
Arabuko-Sokoke Brachystegia 2015	24	9	12
Boni-Dodori 2010 & 2015	81	5	7

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0.128 (±0.128)	0.048	N/A	N/A
A-S *Brachystegia* 2015	1.216 (±0.525)	0.381	N/A	N/A
Dodori 2010 (inside)	0.364 (± 0.177)	0.15	N/A	N/A
Boni National Reserve	0	0	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	0.093 (±0.054)	0.091	N/A	N/A

Activity pattern

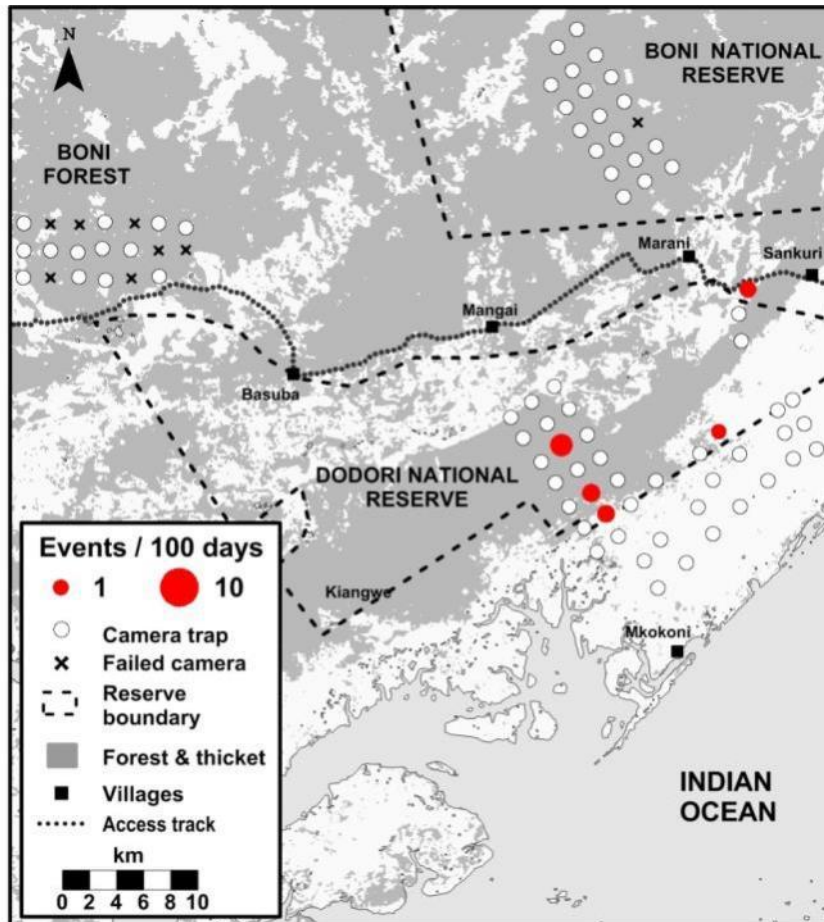Timing of camera events: Arabuko-Sokoke 2015
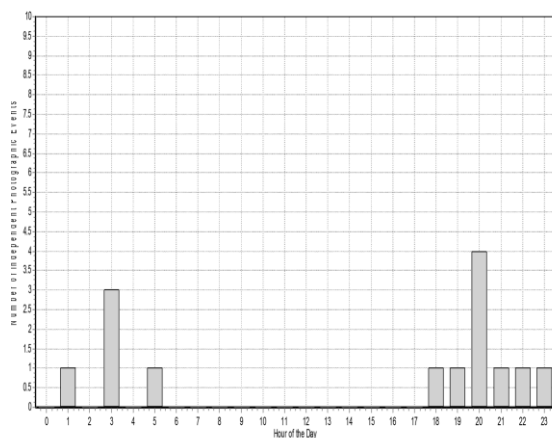
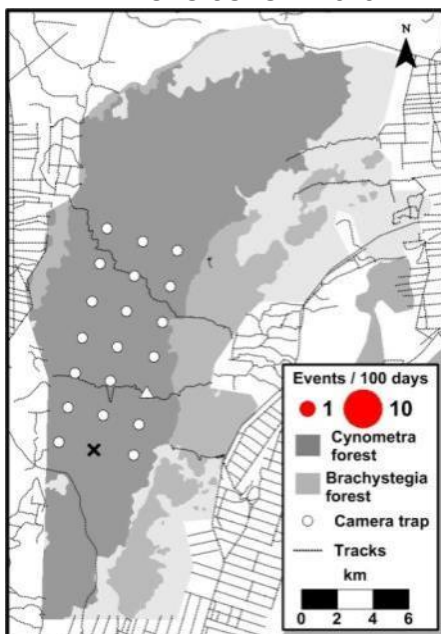Timing of camera events: Boni-Dodori 2010 & 2015
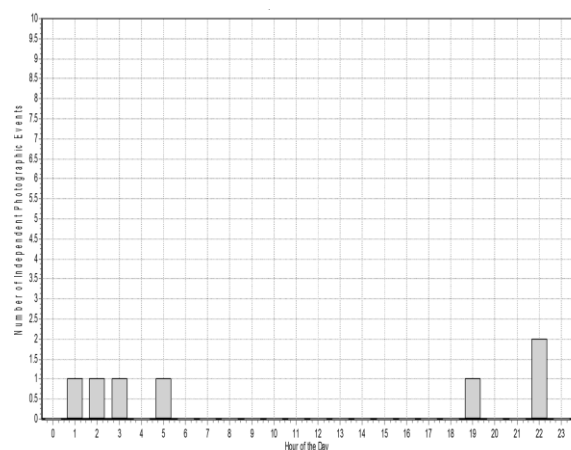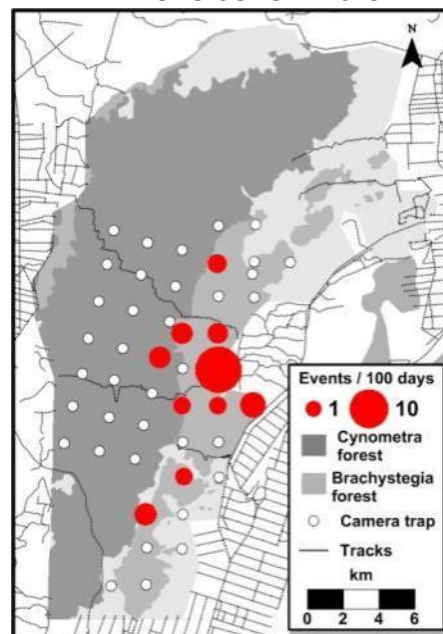
AFRICAN CIVET (*Civettictis civetta*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

20)   CENTRAL AFRICAN LARGE-SPOTTED GENET (*Genetta maculata*)

Common name: Central African large-spotted genet	
Species notes: • The most frequently recorded small carnivore across all camera grid sites. • Highest encounter rates in Arabuko-Sokoke Forest with increased trapping rate and occupancy in 2015 compared to 2010, believed to be associated with improved camera trap setup. Refer to the Training section of Methods, page 5. • The possibility of common genet *Genetta genetta* presence in the drier coastal bush south of Dodori NR was considered, but the nocturnal infra-red images did not reveal any clearly identifiable cases. • Timing of camera events indicates a clearly nocturnal activity pattern.	
Global conservation status: Least Concern (IUCN 2008)	

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	9	39
Arabuko-Sokoke Cynometra 2015	22	21	177
Arabuko-Sokoke Brachystegia 2015	24	20	120
Boni-Dodori 2010 & 2015	81	46	159

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	1.873 (±0.336)	0.474	0.496 (±0.121)	0.296 (±0.053)
A-S *Cynometra* 2015	17.006 (±1.659)	0.952	1.0 (±0.0)	0.582 (±0.041)
A-S *Brachystegia* 2015	11.533 (±1.015)	0.857	0.926 (±0.072)	0.442 (±0.046)
Dodori 2010 (inside)	2.909 (±0.497)	0.65	0.749 (±0.135)	0.207 (±0.044)
Boni National Reserve	0.482 (±0.145)	0.368	N/A	N/A
Boni forest	0.899 (±0.317)	0.462	0.637 (±0.239)	0.13 (±0.055)
Dodori 2015 (outside)	3.401 (±0.373)	0.864	0.872 (±0.074)	0.376 (±0.037)

Activity pattern
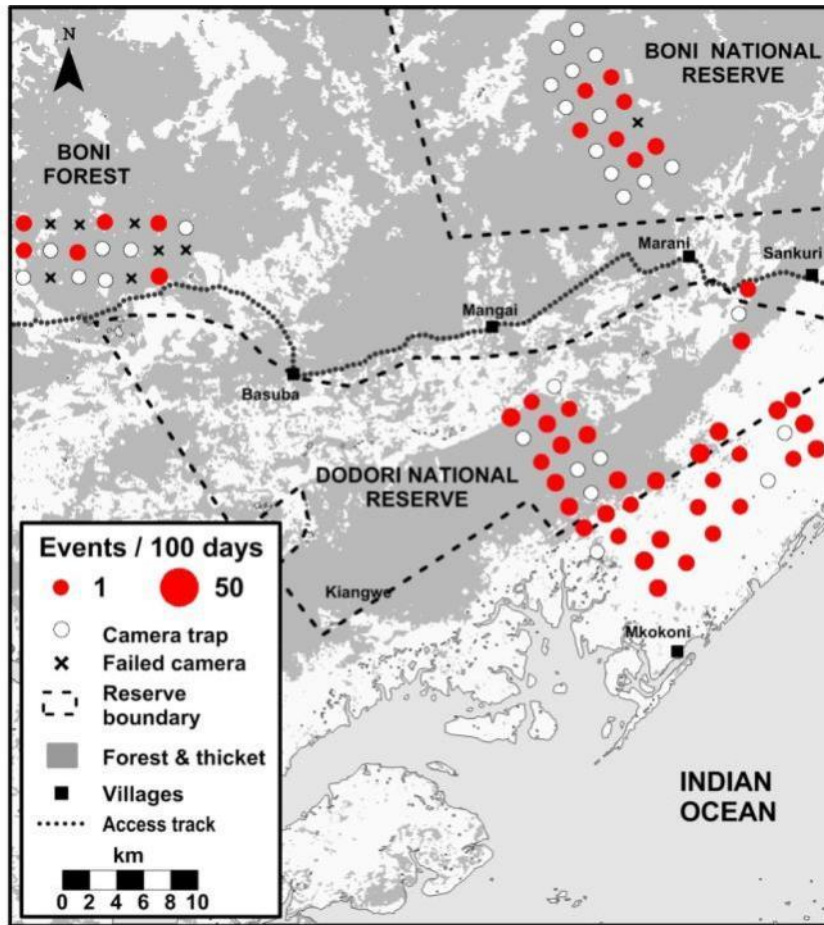
Timing of camera events: Arabuko-Sokoke 2015
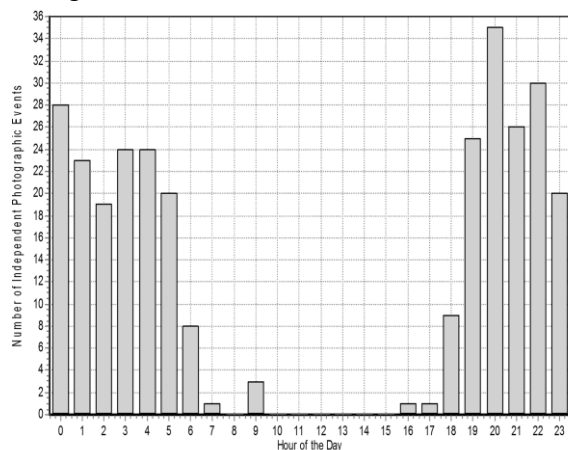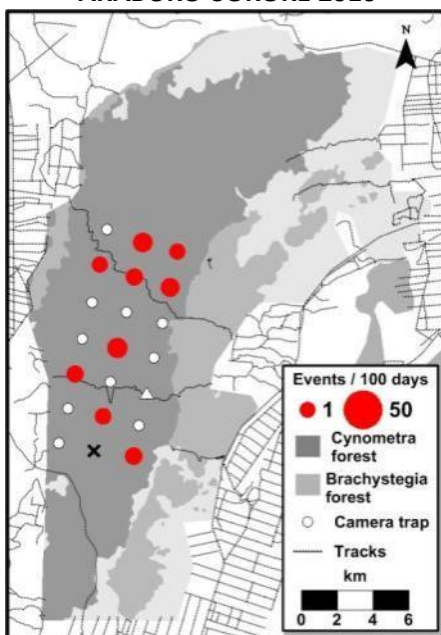
Timing of camera events: Boni-Dodori 2010 & 2015
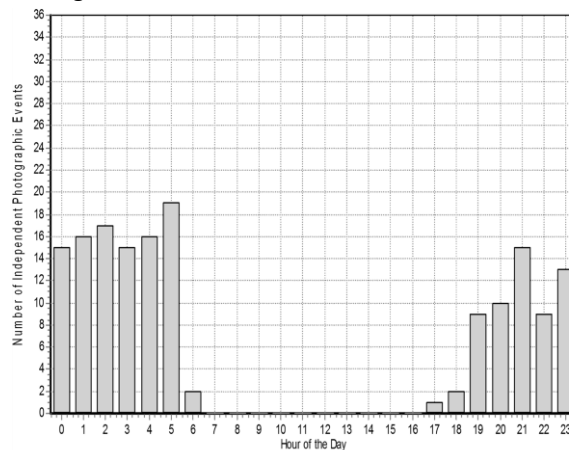
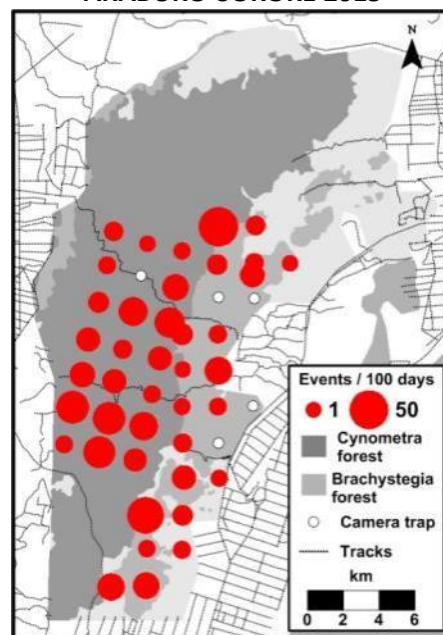# CENTRAL AFRICAN LARGE-SPOTTED GENET (*Genetta maculata*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

21) SPOTTED HYAENA (*Crocuta crocuta*)

Species notes:
- Recorded at moderate frequency across the Boni-Dodori forest system.
- Only one encounter recorded in the Arabuko-Sokoke Forest in the Brachystegia habitat.
- Timing of camera trap data indicates a nocturnal activity pattern peaking in the middle hours of the night.

Global conservation status:
Least Concern (IUCN 2015)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	1	1
Boni-Dodori 2010 & 2015	81	20	35

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0.147 (±0.147)	0.048	N/A	N/A
Dodori 2010 (inside)	0.818 (±0.362)	0.2	0.269 (±0.137)	0.146 (±0.072)
Boni National Reserve	0.482 (±0.184)	0.263	N/A	N/A
Boni forest	0.799 (±0.304)	0.308	0.401 (±0.191)	0.145 (±0.07)
Dodori 2015 (outside)	0.311 (±0.095)	0.318	N/A	N/A

Activity pattern

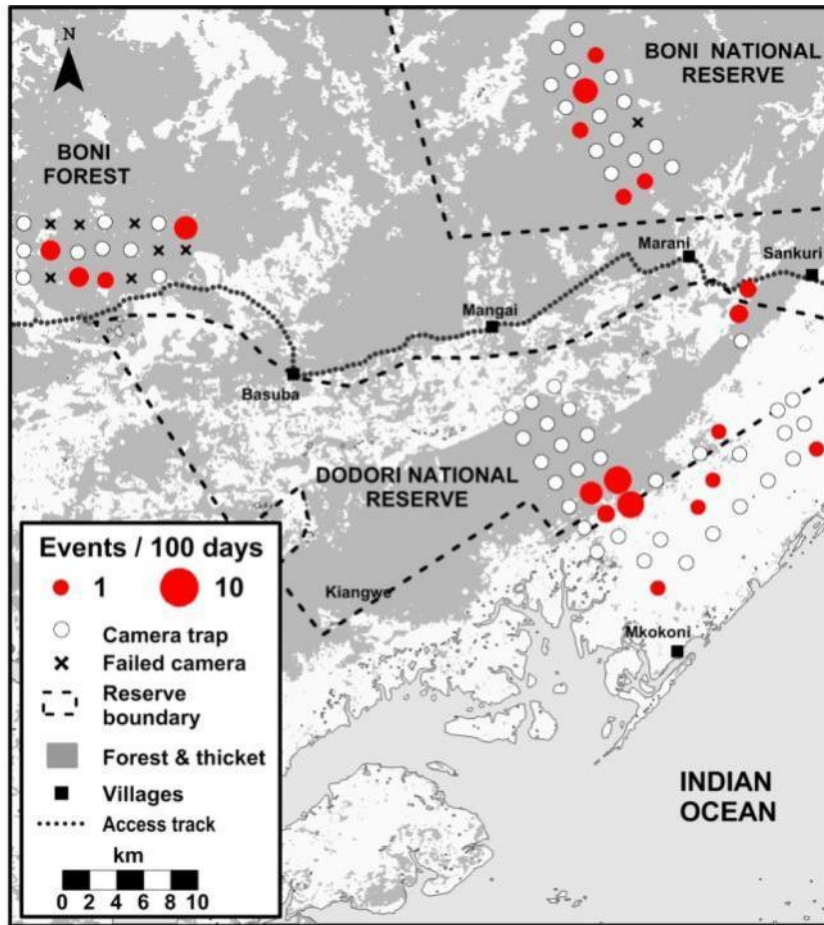Timing of camera events: Arabuko-Sokoke 2015
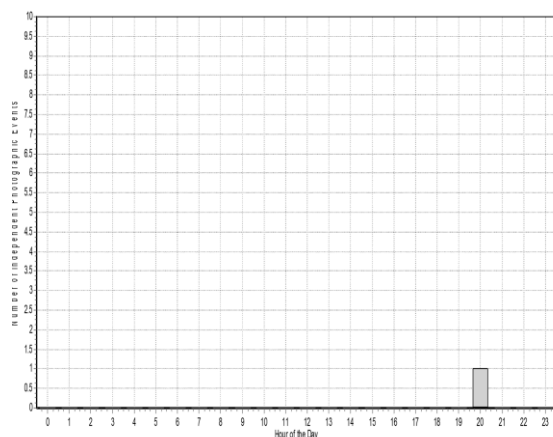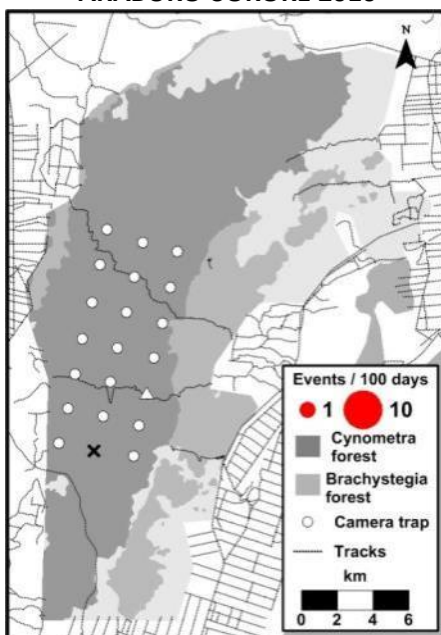
Timing of camera events: Boni-Dodori 2010 & 2015
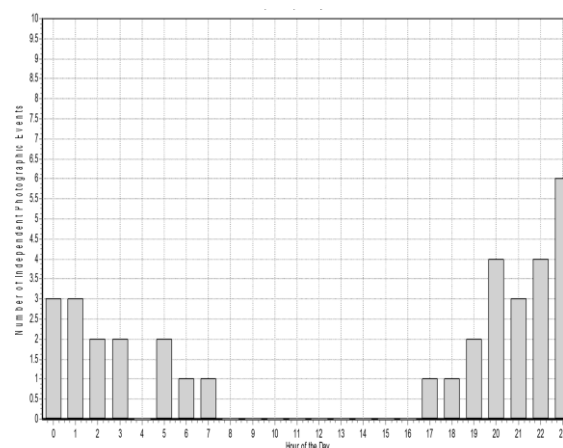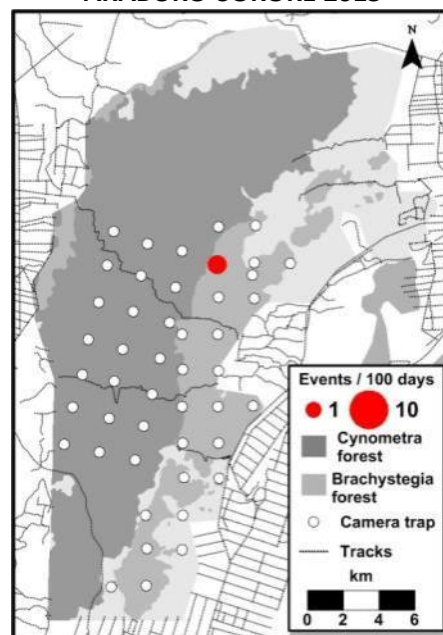
SPOTTED HYAENA (*Crocuta crocuta*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

22) HONEY BADGER (*Mellivora capensis*)

Species notes:
- Encountered at low frequencies across all survey sites.
- The pattern of events is as expected for this wide-ranging and mobile small carnivore, which is found in a very wide variety of habitats throughout its range.
- Timing of camera trap data suggests a more strictly nocturnal pattern of activity at Arabuko-Sokoke Forest compared to Boni-Dodori forest system, which may merit further investigation in relation to disturbance.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	1	1
Arabuko-Sokoke Cynometra 2015	22	5	9
Arabuko-Sokoke Brachystegia 2015	24	7	12
Boni-Dodori 2010 & 2015	81	12	19

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.051 (±0.051)	0.053	N/A	N/A
A-S *Cynometra* 2015	0.509 (±0.247)	0.238	N/A	N/A
A-S *Brachystegia* 2015	0.922 (±0.344)	0.333	0.625 (±0.278)	0.117 (±0.059)
Dodori 2010 (inside)	0.182 (±0.127)	0.1	N/A	N/A
Boni National Reserve	0.243 (±0.119)	0.211	N/A	N/A
Boni forest	0.1 (±0.1)	0.077	N/A	N/A
Dodori 2015 (outside)	0.375 (±0.104)	0.227	0.254 (±0.098)	0.236 (±0.068)

Activity pattern

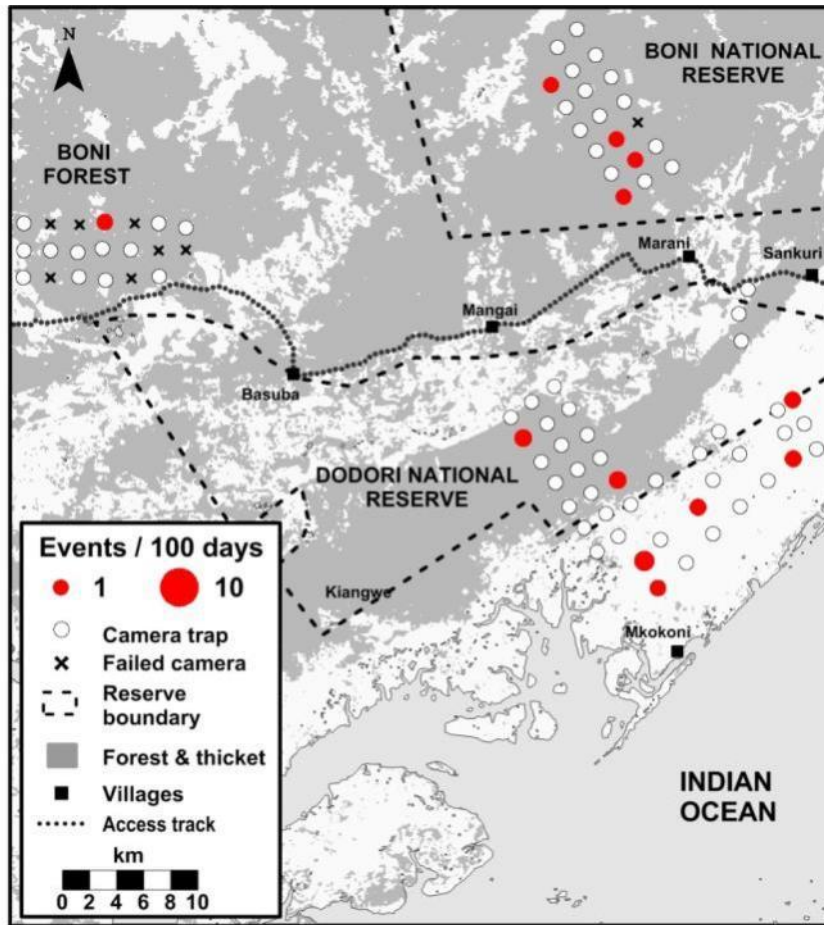Timing of camera events: Arabuko-Sokoke 2015
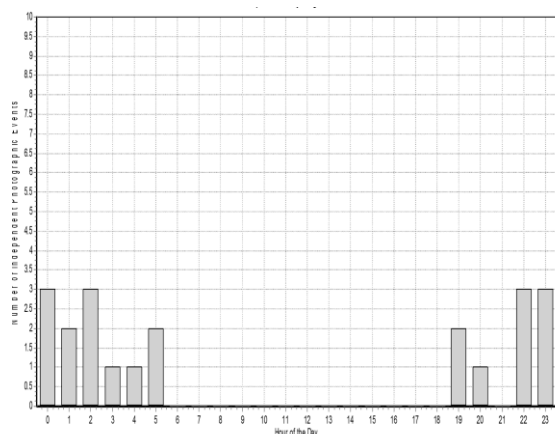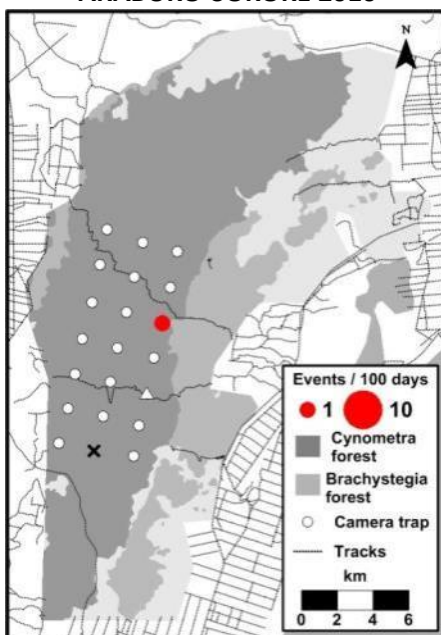
Timing of camera events: Boni-Dodori 2010 & 2015
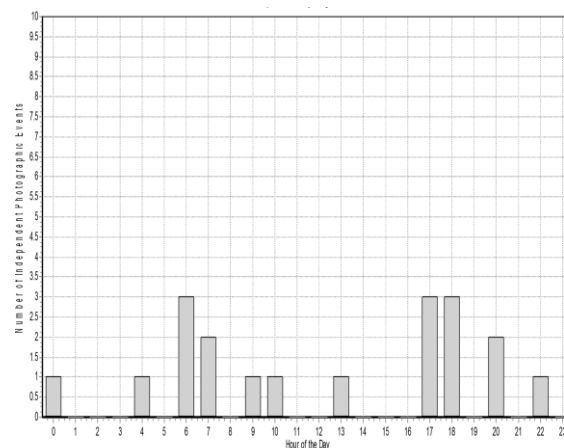
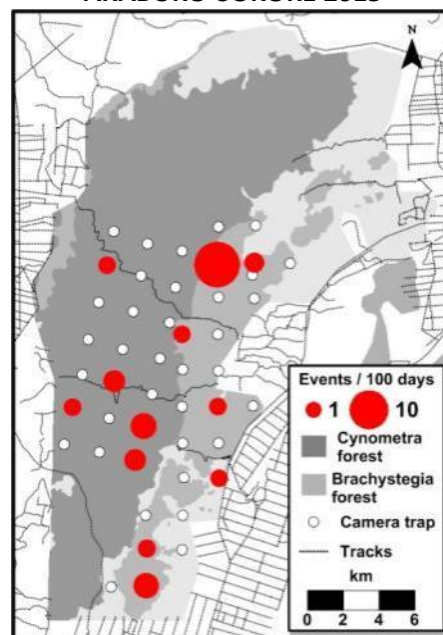# HONEY BADGER (*Mellivora capensis*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

23) COMMON DWARF MONGOOSE (*Helogale parvula*)

Species notes:
- Most frequently recorded in the dryer bush south of Dodori NR at Boni-Dodori and in the Cynometra forest at Arabuko-Sokoke.
- Increase in occupancy between 2010 and 2015 in Arabuko-Sokoke Cynometra forest likely due in part to improved camera trap setup. Refer to the Training section of Methods, page 5.
- Timing of camera encounters suggests a diurnal / crepuscular activity pattern.
- The possibility that images from Boni-Dodori forest system = see photo - may represent the Somali dwarf mongoose, *Helogale hirtula* requires further investigation although this species is generally believed to occur further inland.

Global conservation status:
Least Concern (IUCN 2015)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	1	1
Arabuko-Sokoke Cynometra 2015	22	9	17
Arabuko-Sokoke Brachystegia 2015	24	4	9
Boni-Dodori 2010 & 2015	81	22	42

Trapping rates, occupancy and detectability

| Survey | Trapping rate / 100 days (±SE) | Occupancy | | |
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.051 (±0.051)	0.053	N/A	N/A
A-S *Cynometra* 2015	1.397 (±0.368)	0.429	0.642 (±0.182)	0.175 (±0.051)
A-S *Brachystegia* 2015	0.672 (±0.319)	0.19	N/A	N/A
Dodori 2010 (inside)	0.182 (±0.127)	0.1	N/A	N/A
Boni National Reserve	0.123 (±0.086)	0.105	N/A	N/A
Boni forest	0.4 (±0.196)	0.308	N/A	N/A
Dodori 2015 (outside)	1.059 (±0.198)	0.636	0.795 (±0.153)	0.154 (±0.037)

Activity pattern
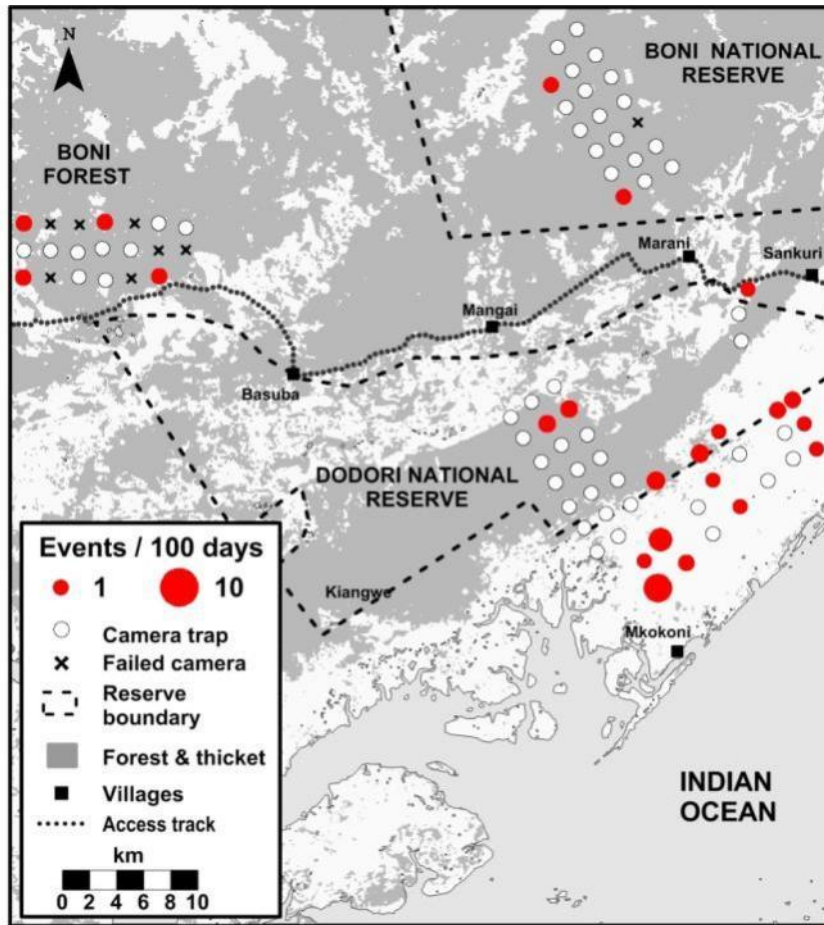
Timing of camera events: Arabuko-Sokoke 2015
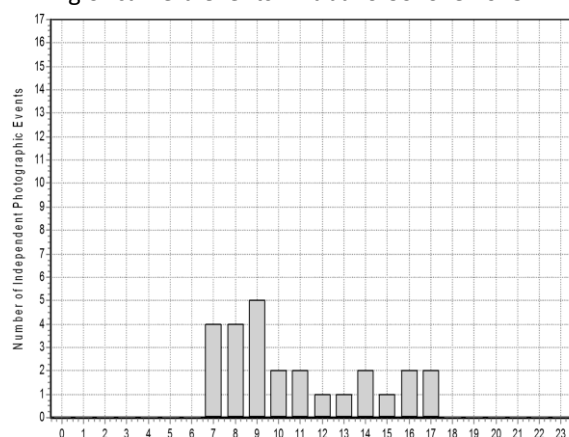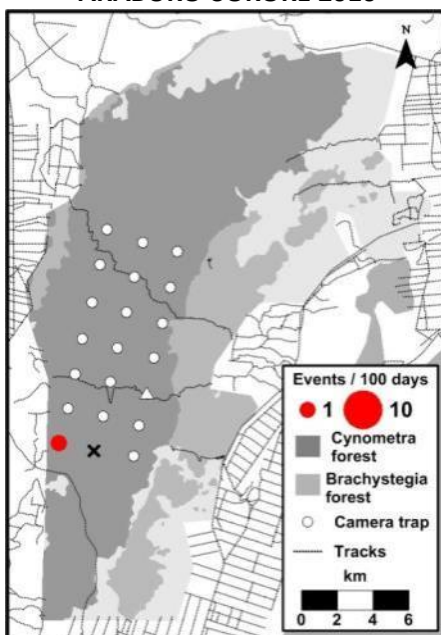
Timing of camera events: Boni-Dodori 2010 & 2015
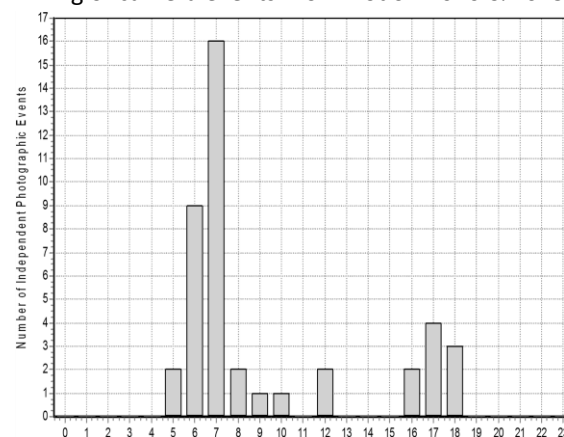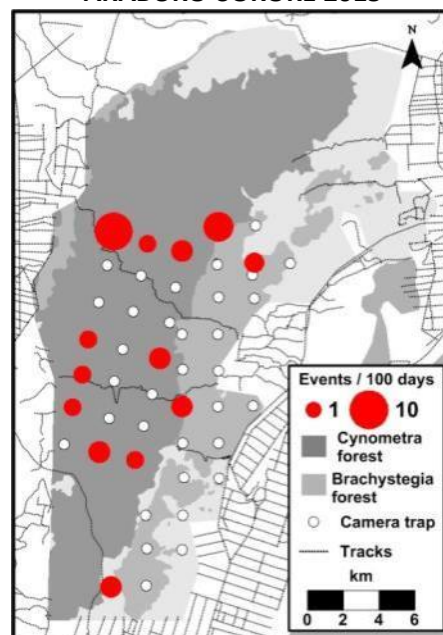
COMMON DWARF MONGOOSE (*Helogale parvula*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

24)   MARSH MONGOOSE (*Atilax paludinosus*)

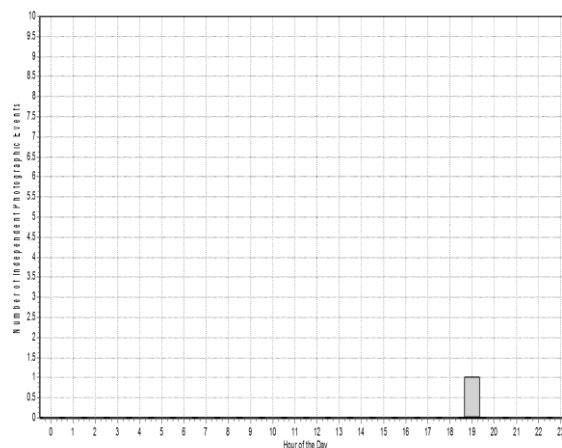| **Species notes:**	
• Only one event recorded, in Dodori NR in 2010 at a camera close to the Dodori River, where a hippo was also photographed, suggesting this generally widespread species is habitat limited within the surveyed areas.	
Global conservation status: Least Concern (IUCN 2015)	

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	0	0
Boni-Dodori 2010 & 2015	81	1	1

Trapping rates, occupancy and detectability

| Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	0.091 (±0.091)	0.05	N/A	N/A
Boni National Reserve	0	0	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	0	0	N/A	N/A

Activity pattern

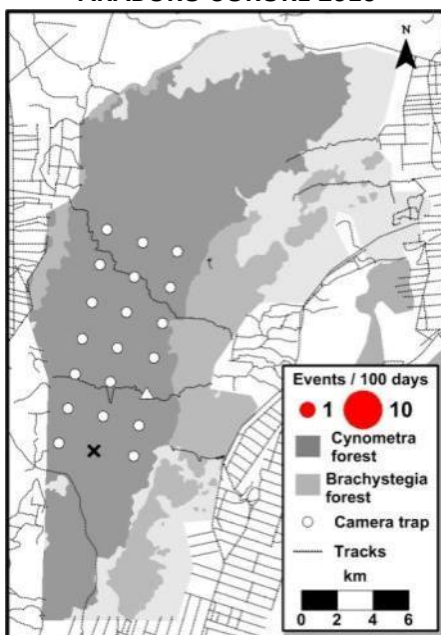Timing of camera events: Boni-Dodori 2010 & 2015
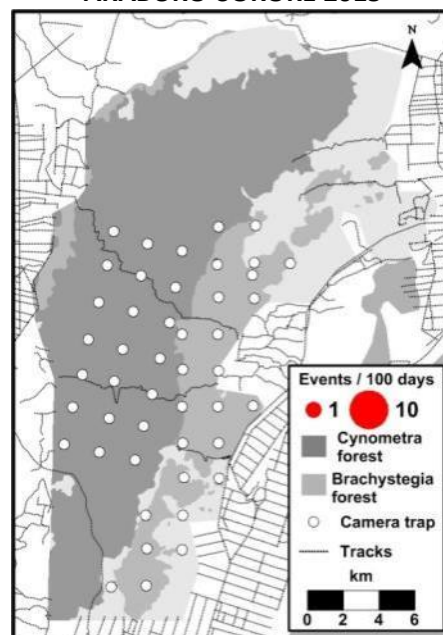
MARSH MONGOOSE (*Atilax paludinosus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
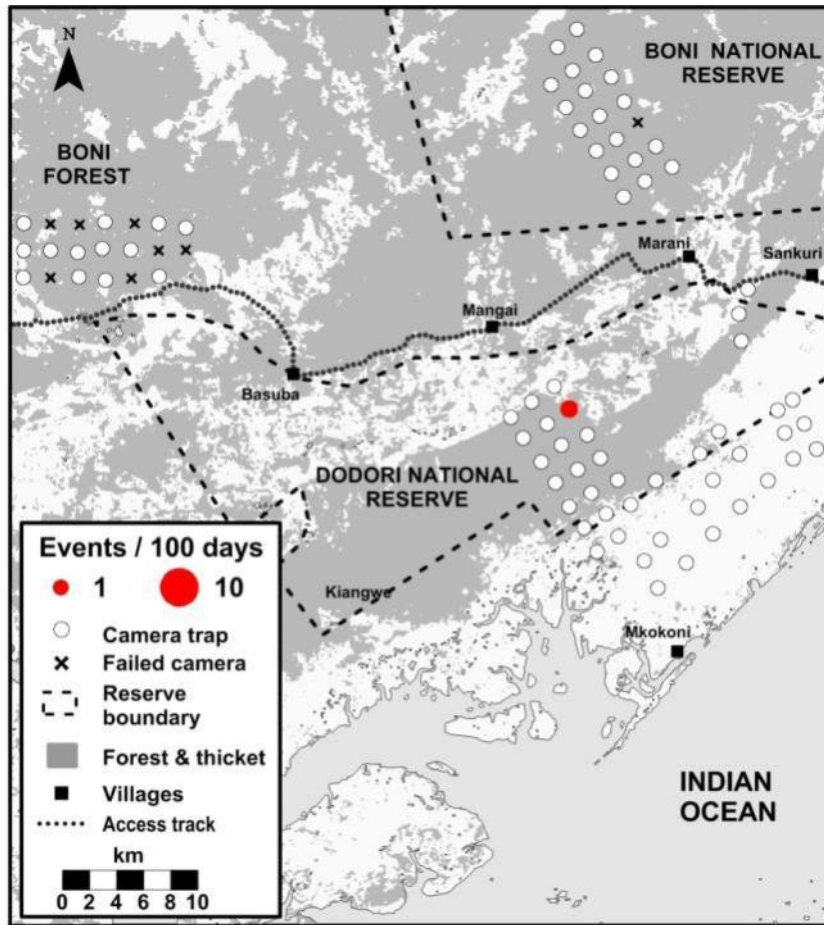
ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

25) SLENDER MONGOOSE (*Herpestes sanguineus*)

|	
Species notes: • Only a few encounters recorded of this very small, quick-moving and largely solitary small carnivore • A species of wide global range, not especially associated with coastal habitats. • Recorded only in daylight. **Global conservation status:** Least Concern (IUCN 2008)	

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	1	2
Arabuko-Sokoke Brachystegia 2015	24	0	0
Boni-Dodori 2010 & 2015	81	4	4

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	**Modelled occupancy (±SE)**	**Probability of detection (±SE)**
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0.252 (±0.176)	0.048	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	0.091 (±0.091)	0.05	N/A	N/A
Boni National Reserve	0	0	N/A	N/A
Boni forest	0.2 (±0.14)	0.077	N/A	N/A
Dodori 2015 (outside)	0.031 (±0.031)	0.045	N/A	N/A

Activity pattern

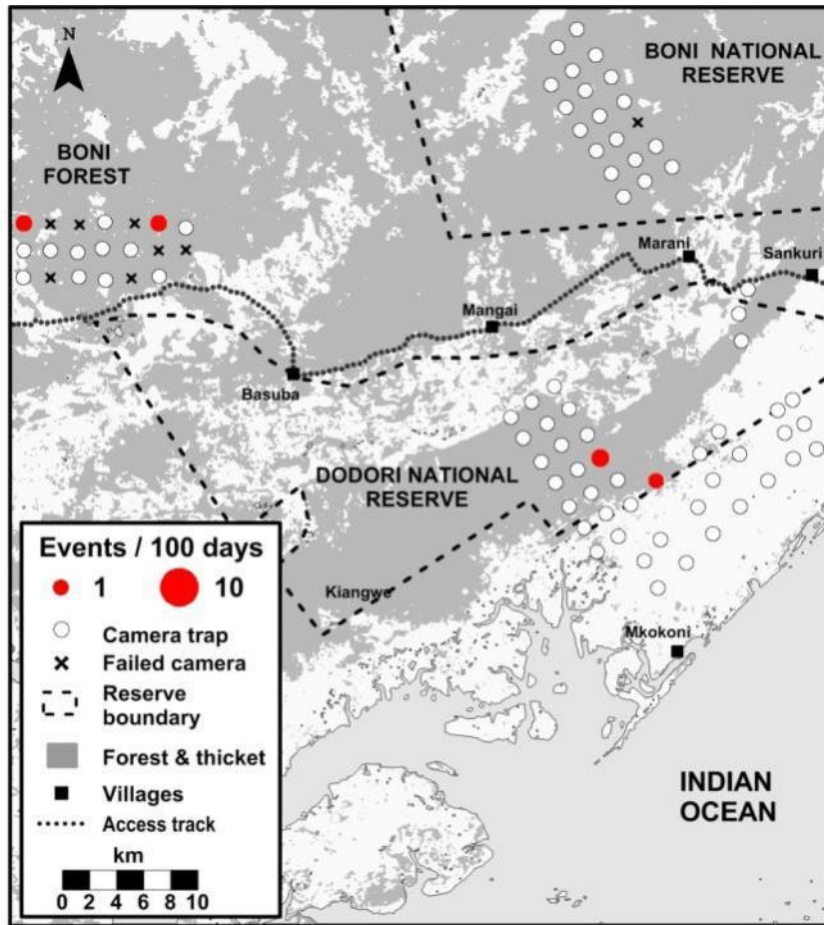Timing of camera events: Arabuko-Sokoke 2015
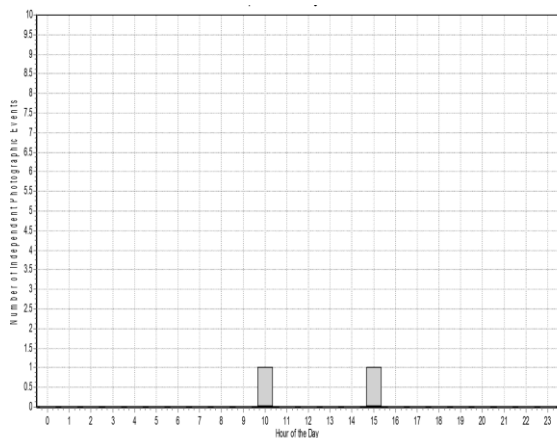
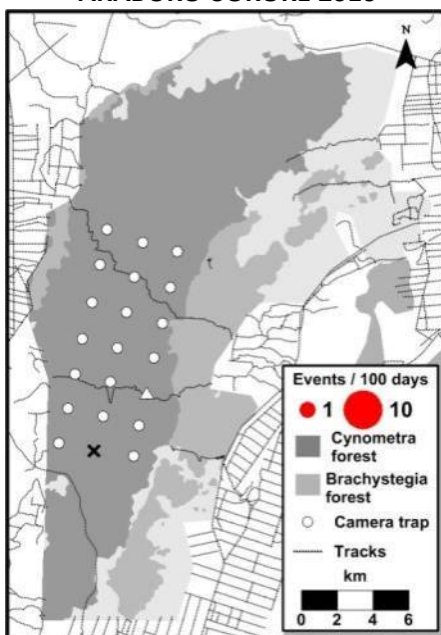Timing of camera events: Boni-Dodori 2010 & 2015
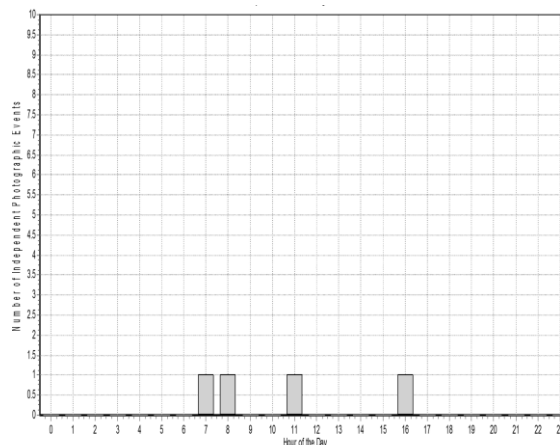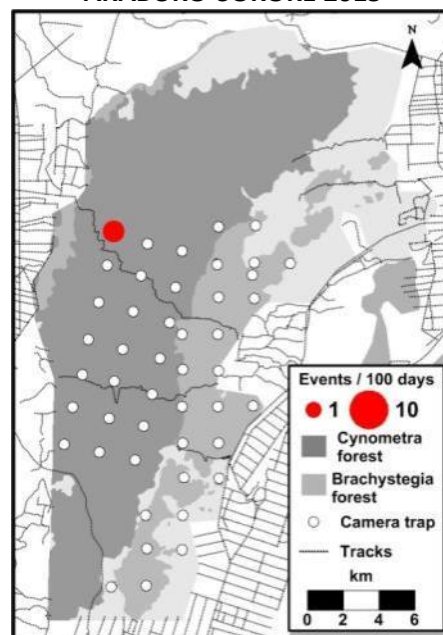
SLENDER MONGOOSE (*Herpestes sanguineus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

26)   SOKOKE BUSHY-TAILED MONGOOSE (*Bdeogale omnivora*)

Species notes:
- Widely distributed across all sampled habitats in the Boni NR and Boni Forest of the Boni-Dodori forest system.
- Camera trapping results suggest a strong preference for the Brachystegia habitat of the Arabuko-Sokoke Forest.
- Both forest regions important for the conservation of this 'Vulnerable' species.
- Photographed travelling in pairs on several occasions.
- Timing of camera trap encounters indicates a strictly nocturnal activity pattern.

Global conservation status:
Vulnerable (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	3	3
Arabuko-Sokoke Brachystegia 2015	24	12	61
Boni-Dodori 2010 & 2015	81	36	131

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0.232 (±0.162)	0.095	N/A	N/A
A-S *Brachystegia* 2015	6.631 (±1.379)	0.524	0.597 (±0.125)	0.349 (±0.057)
Dodori 2010 (inside)	1.545 (±0.386)	0.4	0.557 (±0.19)	0.135 (±0.051)
Boni National Reserve	3.273 (±0.434)	0.684	0.709 (±0.111)	0.329 (±0.044)
Boni forest	4.296 (±0.659)	0.615	0.634 (±0.14)	0.315 (±0.057)
Dodori 2015 (outside)	0.405 (±0.116)	0.318	0.486 (±0.197)	0.106 (±0.046)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
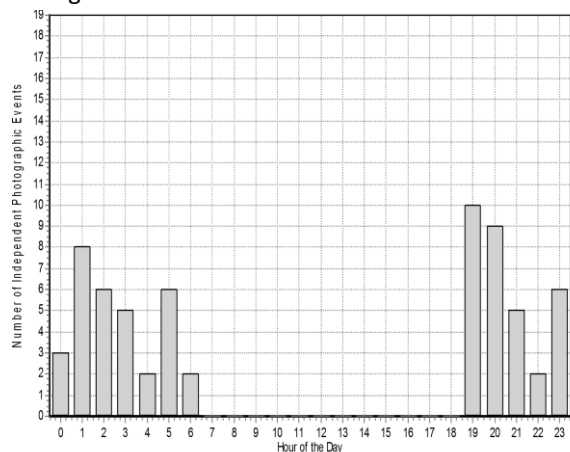
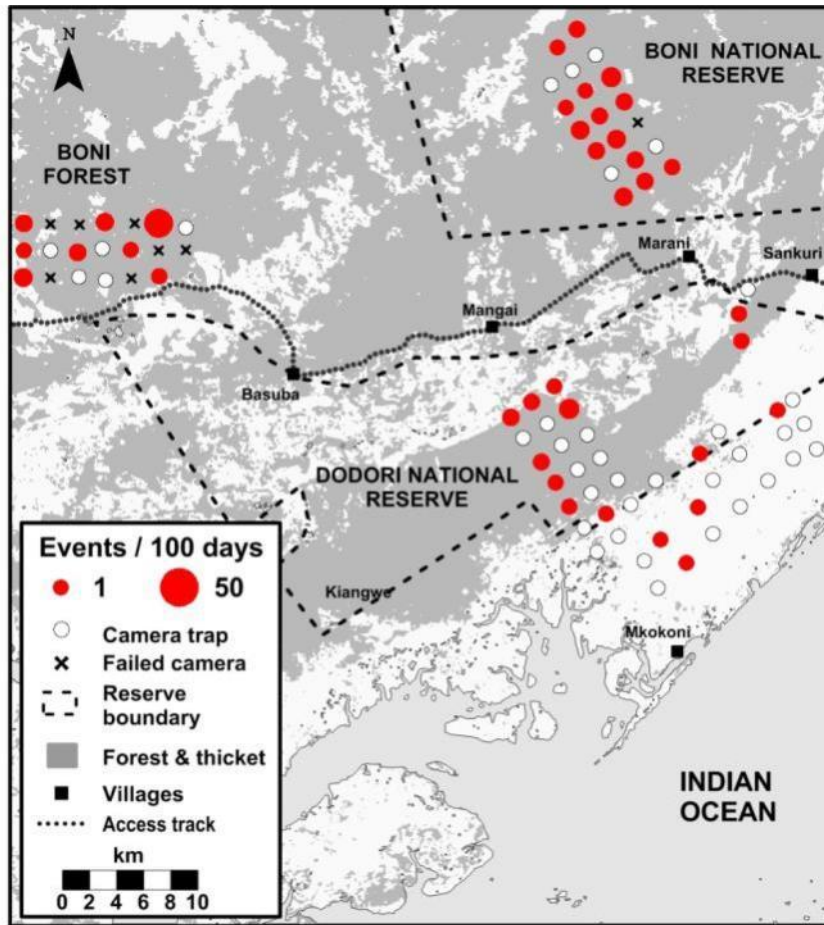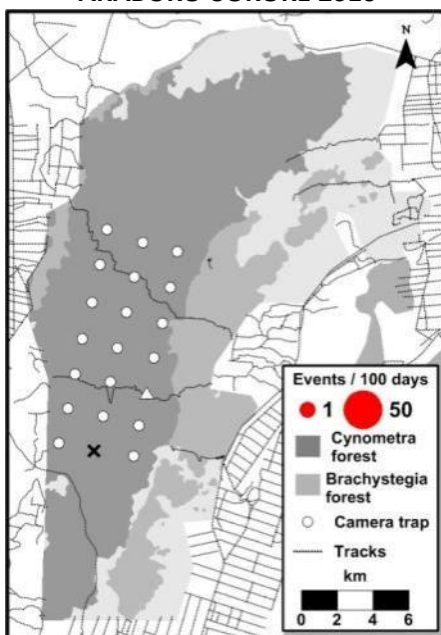
Timing of camera events: Boni-Dodori 2010 & 2015
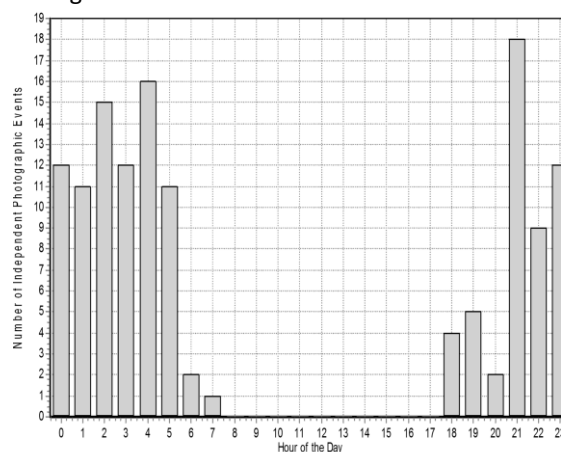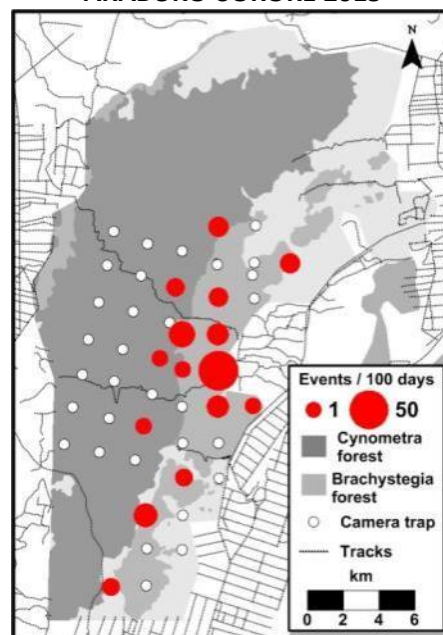
SOKOKE BUSHY-TAILED MONGOOSE (*Bdeogale omnivora*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

27) WHITE-TAILED MONGOOSE (*Ichneumia albicauda*)

Species notes:
- Mainly encountered in the drier coastal habitats to the south of Dodori NR, and in the Brachystegia habitat in Arabuko-Sokoke Forest.
- Global population is stable and generally wide-spread; this species is not closely associated with the coastal forests.
- Timing of camera trap events indicates a nocturnal activity pattern.

Global conservation status:
Least Concern (IUCN 2015)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	2	2
Arabuko-Sokoke Cynometra 2015	22	1	2
Arabuko-Sokoke Brachystegia 2015	24	5	7
Boni-Dodori 2010 & 2015	81	8	24

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.101 (±0.071)	0.105	N/A	N/A
A-S *Cynometra* 2015	0.143 (±0.143)	0.048	N/A	N/A
A-S *Brachystegia* 2015	0.593 (±0.352)	0.143	N/A	N/A
Dodori 2010 (inside)	0	0	N/A	N/A
Boni National Reserve	0.06	0.053	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	0.75 (±0.167)	0.318	0.344 (±0.109)	0.234 (±0.057)

Activity pattern
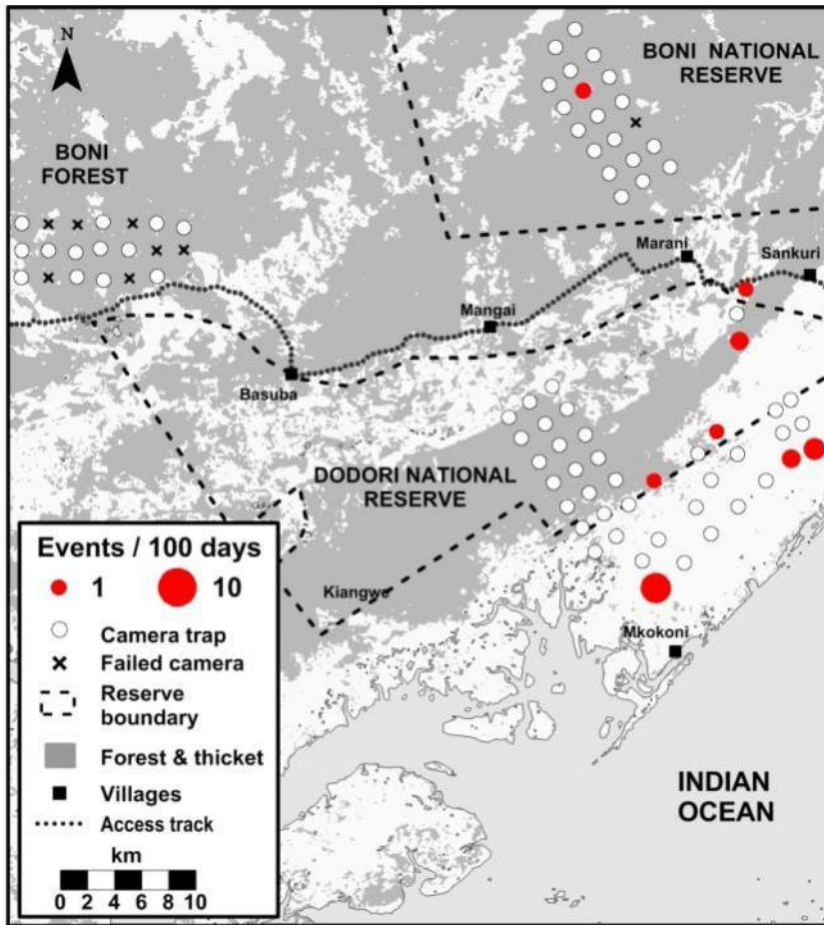
Timing of camera events: Arabuko-Sokoke 2015
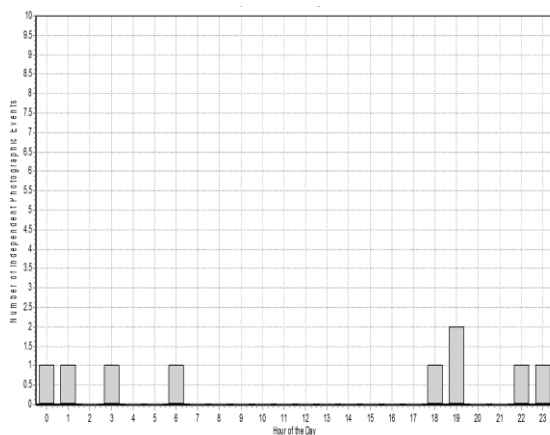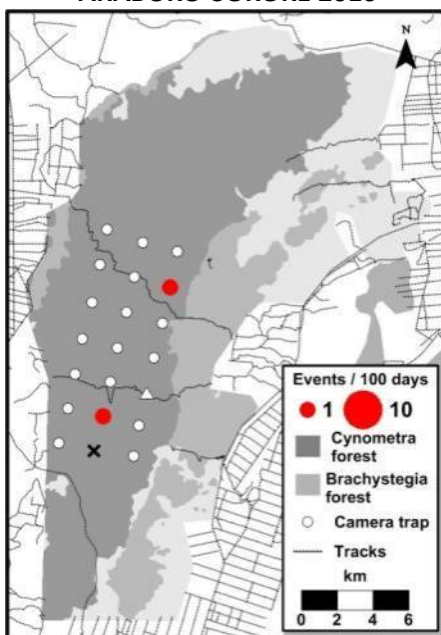

Timing of camera events: Boni-Dodori 2010 & 2015
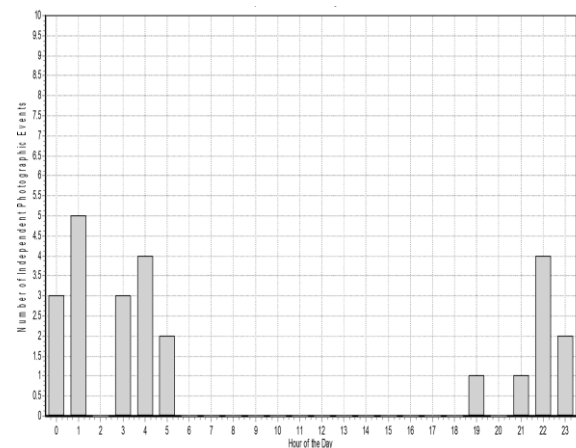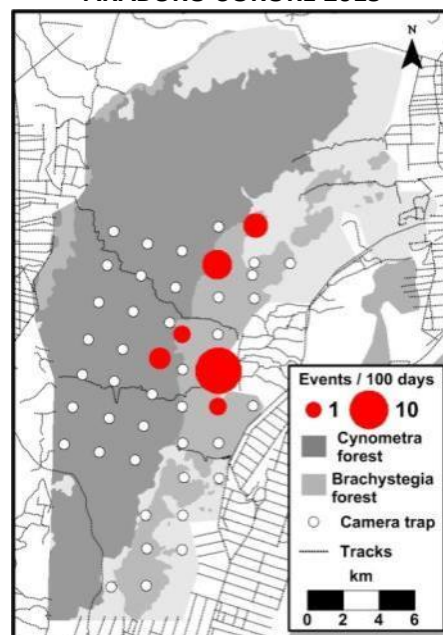
WHITE-TAILED MONGOOSE (*Ichneumia albicauda*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

28)   AFRICAN ELEPHANT (*Loxodonta africana*)

Species notes:
- Detected in all camera trap grids of the Boni-Dodori forest system including a herd of 26 with at least 5 young passing a camera in the Boni Forest in 2010.
- At least four present in the Cynometra habitat of Arabuko-Sokoke Forest in 2015 though not detected there in 2010.
- Timing of images indicates activity across the 24 hour cycle.
- Photo from Arabuko-Sokoke Cynometra forest, 2015.

Global conservation status:
Vulnerable (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	5	9
Arabuko-Sokoke Brachystegia 2015	24	0	0
Boni-Dodori 2010 & 2015	81	13	24

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0.901 (±0.424)	0.238	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	0.273 (± 0.155)	0.1	N/A	N/A
Boni National Reserve	0.12 (±0.084)	0.105	N/A	N/A
Boni forest	1.199 (±0.404)	0.231	0.236 (±0.12)	0.337 (±0.092)
Dodori 2015 (outside)	0.218 (±0.092)	0.227	N/A	N/A

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
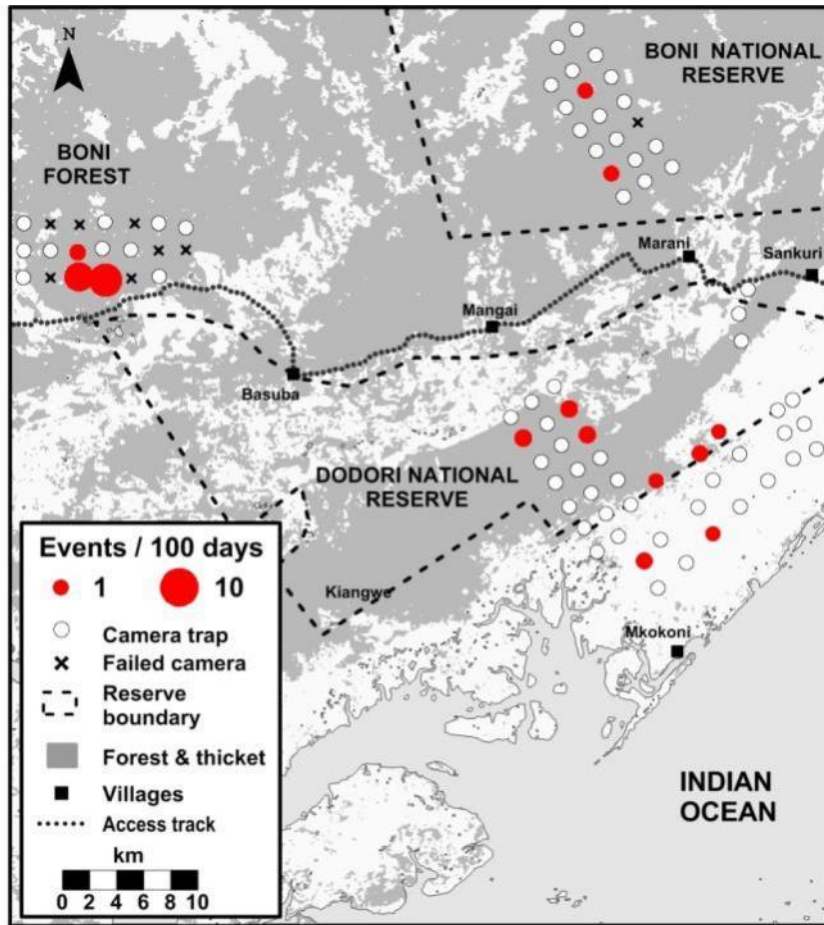

Timing of camera events: Boni-Dodori 2010 & 2015
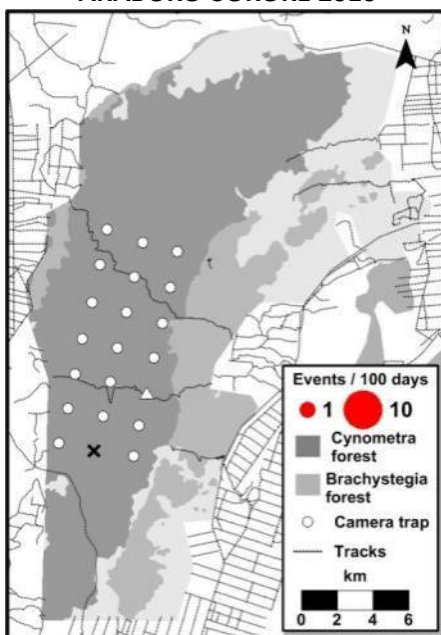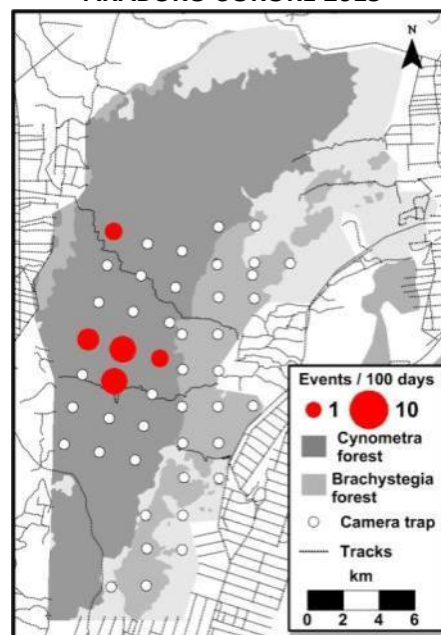

66
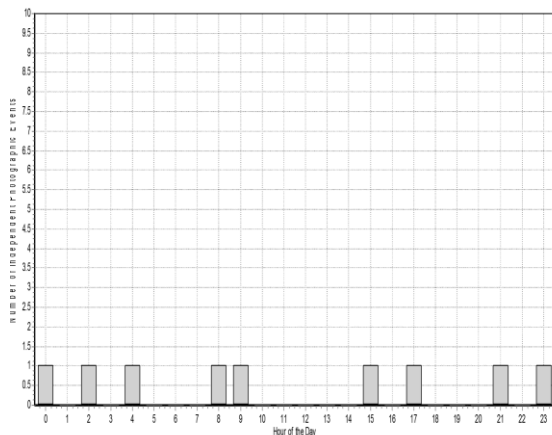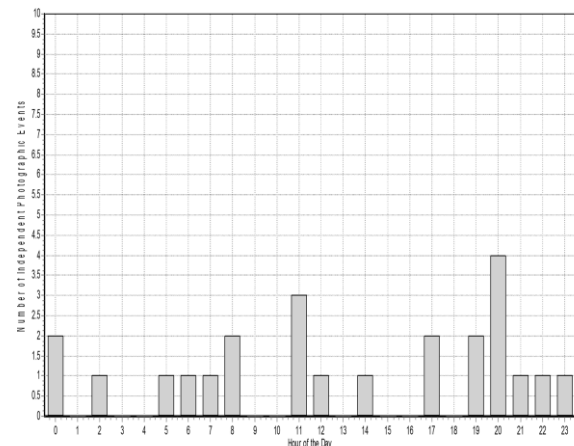
AFRICAN ELEPHANT (*Loxodonta africana*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

29)   AARDVARK (*Oryceteropus afer*)

Species notes:
- Present in all habitats of the Boni-Dodori forest system.
- Only recorded in Cynometra habitat at the Arabuko-Sokoke Forest.
- Extensive digging and den systems provide important niches for other species.
- Timing of camera trap encounters confirms the well-known nocturnal habits.

Global conservation status: Least Concern (IUCN 2015)


Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	2	2
Arabuko-Sokoke Cynometra 2015	22	3	4
Arabuko-Sokoke Brachystegia 2015	24	1	1
Boni-Dodori 2010 & 2015	81	17	28

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.099 (±0.069)	0.053	N/A	N/A
A-S *Cynometra* 2015	0.43 (±0.242)	0.143	N/A	N/A
A-S *Brachystegia* 2015	0.17 (±0.17)	0.048	N/A	N/A
Dodori 2010 (inside)	0.364 (± 0.177)	0.15	N/A	N/A
Boni National Reserve	0.422 (± 0.154)	0.316	N/A	N/A
Boni forest	0.5 (±0.217)	0.308	N/A	N/A
Dodori 2015 (outside)	0.374 (±0.113)	0.182	0.204 (± 0.095)	0.206 (± 0.073)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
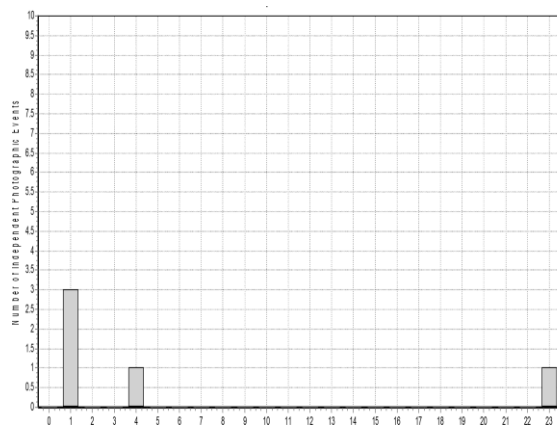
Timing of camera events: Boni-Dodori 2010 & 2015
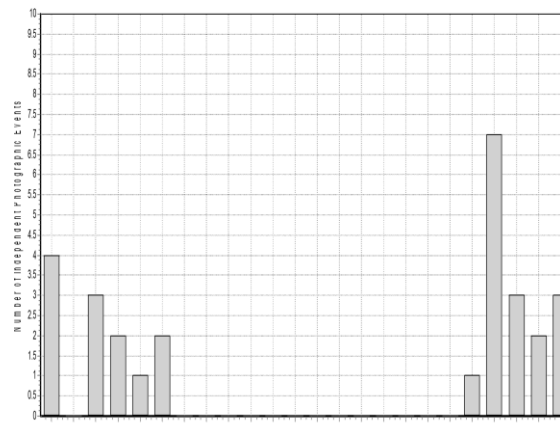
AARDVARK (*Oryceteropus afer*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

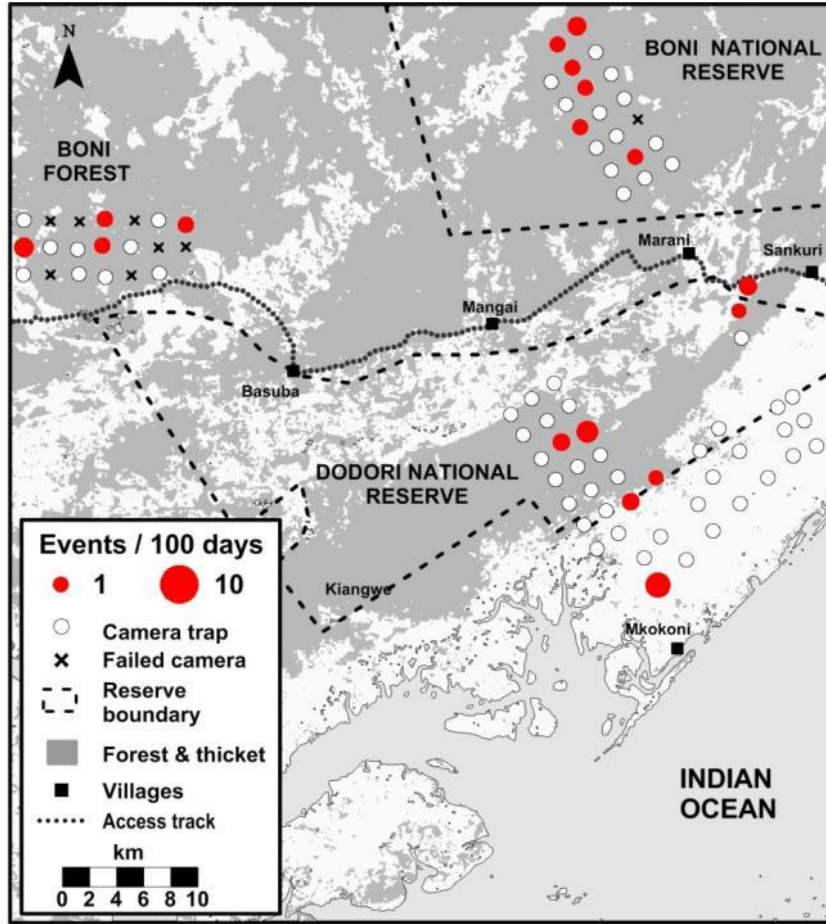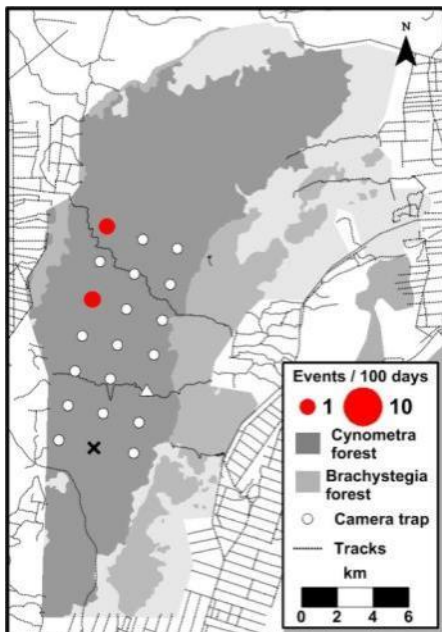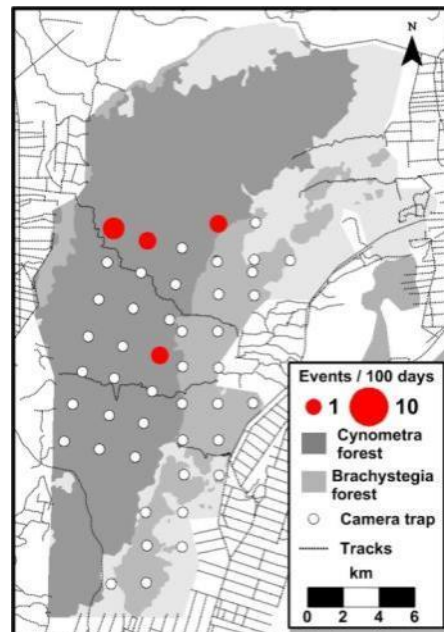## ARABUKO-SOKOKE 2015

30)   FOUR-TOED SENGI (*Petrodomus tetradactylus*)

Species notes:
- One of the most frequently recorded species in the survey and one of the few recorded at higher frequencies at Arabuko-Sokoke Forest compared to Boni-Dodori forest system.
- Occupancy increased dramatically between the 2010 and 2015 Arabuko-Sokoke Cynometra forest surveys. This is in part due to improved camera trap setup through extensive field training (refer to Training section of methods, page 5).
- Data indicate a nocturnal activity pattern, with an activity peak just before dawn.

Global conservation status:
Least Concern (IUCN 2015)


Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	5	76
Arabuko-Sokoke Cynometra 2015	22	21	2087
Arabuko-Sokoke Brachystegia 2015	24	18	1469
Boni-Dodori 2010 & 2015	81	32	523

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	3.706 (±0.394)	0.263	0.263 (±0.101)	0.533 (±0.075)
A-S *Cynometra* 2015	187.0 (±4.845)	0.952	0.952 (±0.046)	0.95 (±0.018)
A-S *Brachystegia* 2015	149.19 (±7.218)	0.905	0.905 (±0.064)	0.958 (±0.019)
Dodori 2010 (inside)	6.636 (±0.711)	0.45	0.452 (±0.112)	0.46 (±0.057)
Boni National Reserve	10.719 (±0.962)	0.474	0.474 (±0.115)	0.432 (±0.055)
Boni forest	21.479 (±1.894)	0.462	0.462 (±0.138)	0.679 (±0.062)
Dodori 2015 (outside)	1.494 (±0.242)	0.318	0.325 (±0.102)	0.331 (±0.06)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
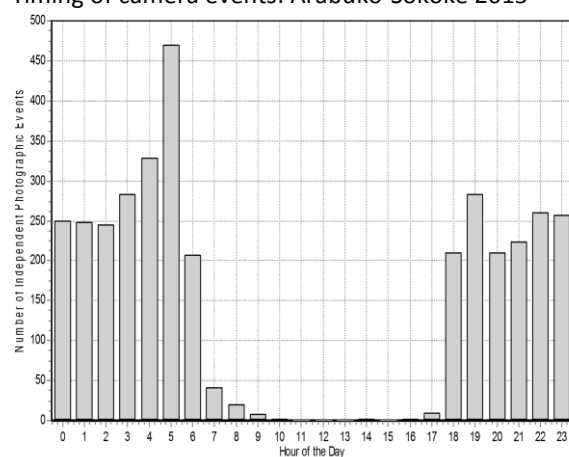
Timing of camera events: Boni-Dodori 2010 & 2015
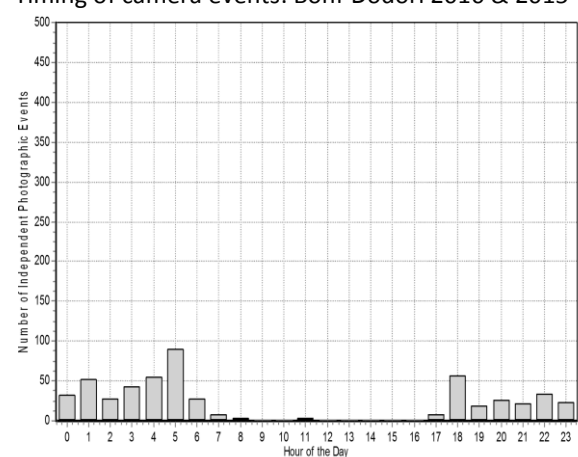
FOUR-TOED SENGI (*Petrodomus tetradactylus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

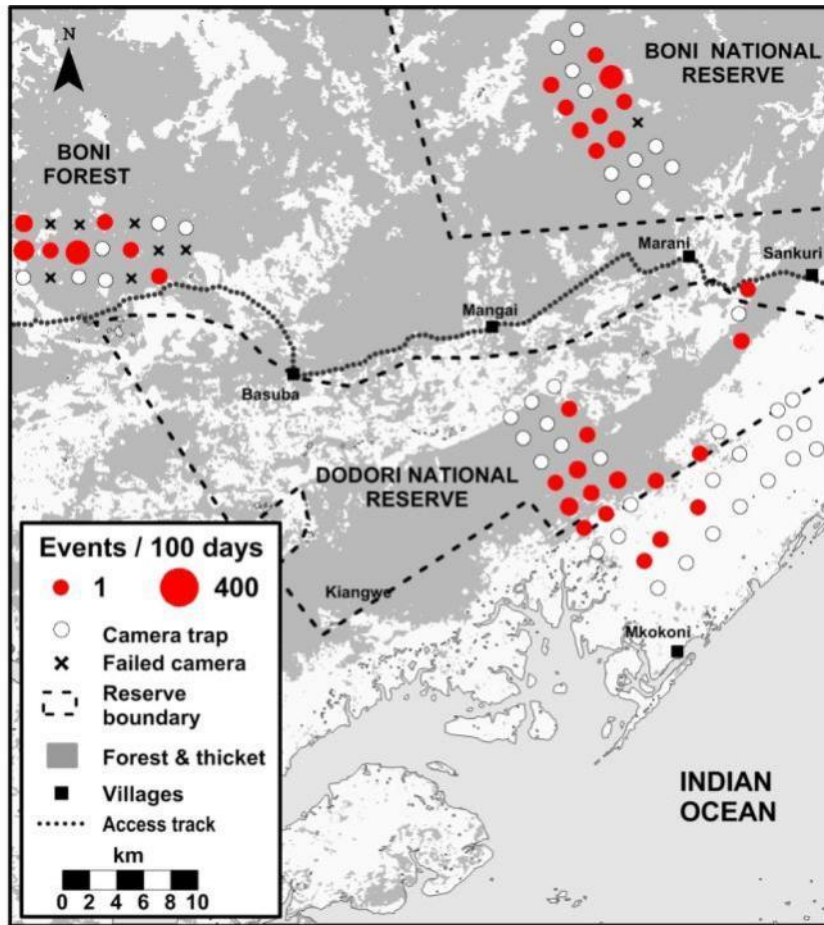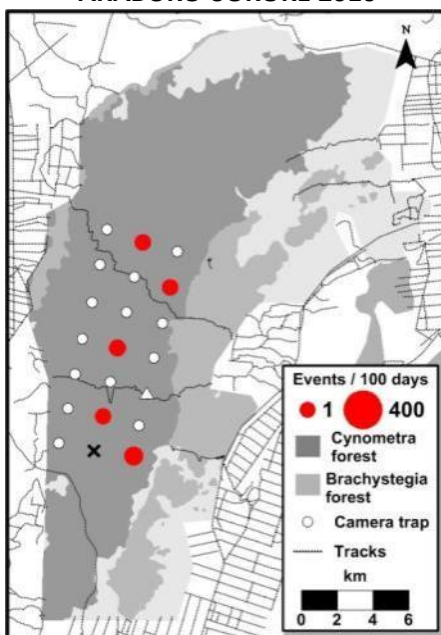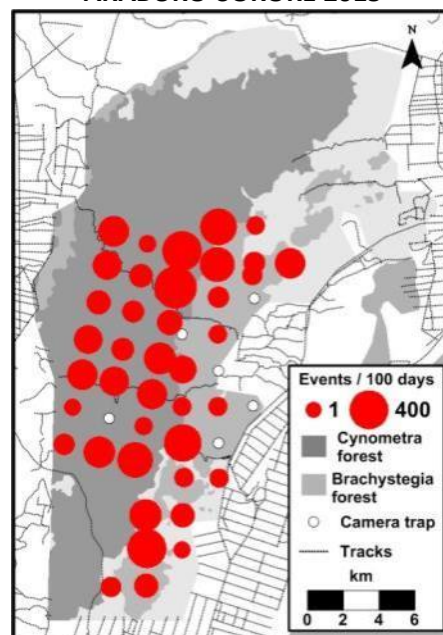## ARABUKO-SOKOKE 2015

31) GIANT SENGI (*Rhynchocyon sp.*)

Species notes:

- At Arabuko-Sokoke Forest, the well-known golden-rumped sengi (*R. chrysopygus*) was found to be widespread, recording 100% occupancy in the Cynometra habitat (2015) and c. 70% occupancy in the Brachystegia forest.
- Giant sengis of the Boni-Dodori forest system were distinctive in consistently lacking the golden rump colouration. Currently it is unresolved as to whether these are separate species.
- At Boni-Dodori forest system, giant sengis were found in all habitats, but at higher frequency in Boni Forest and Boni NR.
- Occupancy increased dramatically between the 2010 and 2015 Arabuko-Sokoke Cynometra forest surveys. This is in part due to improved camera trap. Refer to the Training section of Methods, page 5.
- Giant sengis in both areas were diurnal / crepuscular, in contrast to the nocturnal four-toed sengi.

Global conservation status:
Endangered (IUCN 2015)

Arabuko-Sokoke golden-rumped sengi

Boni-Dodori giant sengi

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	10	27
Arabuko-Sokoke Cynometra 2015	22	20	151
Arabuko-Sokoke Brachystegia 2015	24	15	148
Boni-Dodori 2010 & 2015	81	33	208

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	1.22 (±0.252)	0.526	0.643 (±0.158)	0.171 (±0.047)
A-S *Cynometra* 2015	13.99 (±1.29)	0.905	1.0 (±0.0)	0.534 (±0.041)
A-S *Brachystegia* 2015	15.674 (±1.361)	0.714	0.735 (±0.101)	0.557 (±0.051)
Dodori 2010 (inside)	1.455 (±0.382)	0.15	0.154 (±0.082)	0.336 (±0.098)
Boni National Reserve	5.379 (±0.683)	0.789	0.8 (±0.095)	0.376 (±0.042)
Boni forest	7.892 (±0.804)	0.846	0.852 (±0.101)	0.409 (±0.05)
Dodori 2015 (outside)	0.716 (±0.242)	0.182	0.183 (±0.083)	0.423 (±0.079)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
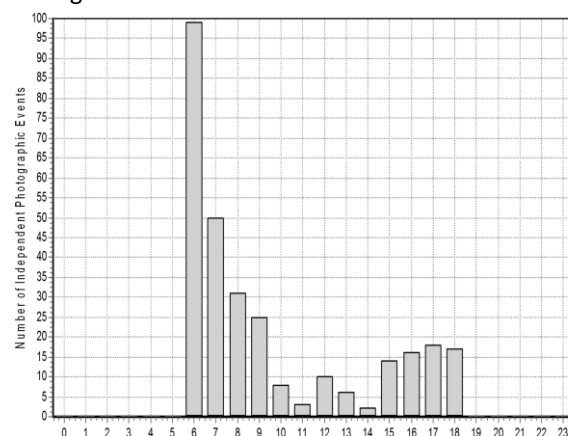
Timing of camera events: Boni-Dodori 2010 & 2015
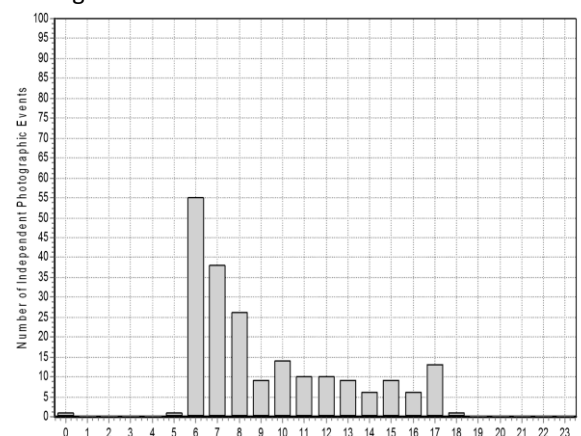
GIANT SENGI (*Rhynchocyon sp.*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

32)   SYKES'S MONKEY (*Cercopithecus mitis*)

Common name: Sykes's monkey
 	
Species notes:
• Two different subspecies in the area:
    ○ Pousargues's Sykes's monkey (*C. mitis albotorquatus*) at Boni-Dodori forest system.
    ○ Zanzibar Sykes's monkey (*C. mitis albogularis*) at Arabuko-Sokoke Forest.
• Highest encounter rates in Arabuko-Sokoke Cynometra forest in 2015 survey; not recorded in Brachystegia forest.
• The restricted, fragmented range and vulnerable status of Pousargues's subspecies highlights the importance of the Boni-Dodori forest system for this distinctive form.
 	
Global conservation status:
Zanzibar Sykes's monkey: Least Concern (IUCN 2008)
Pousargues's Sykes's monkey: Vulnerable (IUCN 2008)
	
	Pousargues's Sykes's monkey
	
	Zanzibar Sykes's monkey

Camera trap survey results

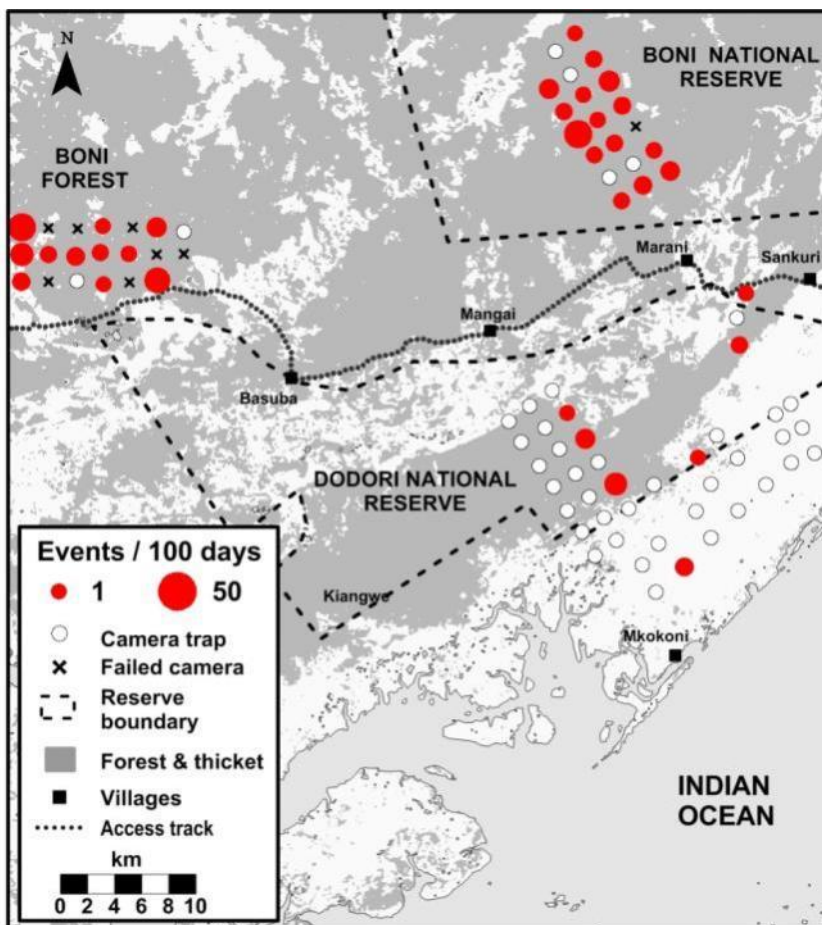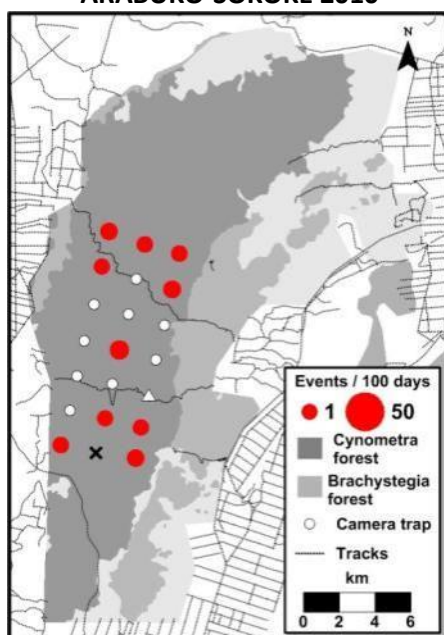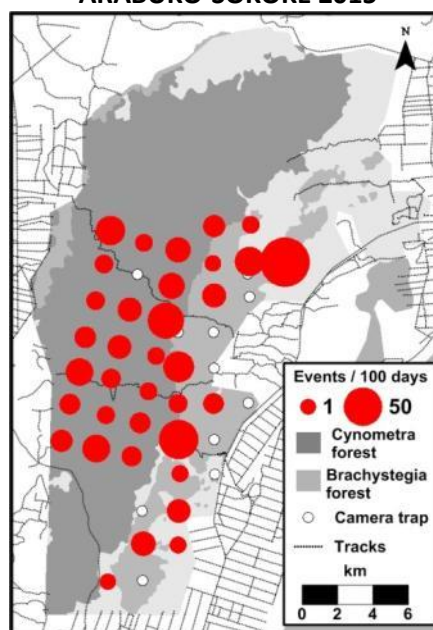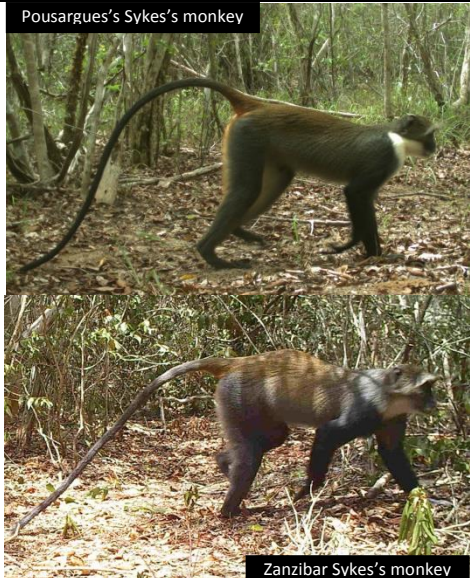| Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	3	3
Arabuko-Sokoke Cynometra 2015	22	12	39
Arabuko-Sokoke Brachystegia 2015	24	2	2
Boni-Dodori 2010 & 2015	81	26	46

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.155 (±0.088)	0.158	N/A	N/A
A-S *Cynometra* 2015	3.298 (±0.633)	0.524	0.619 (±0.127)	0.32 (±0.053)
A-S *Brachystegia* 2015	0.147 (±0.147)	0.048	N/A	N/A
Dodori 2010 (inside)	0.818 (±0.252)	0.4	N/A	N/A
Boni National Reserve	0.548 (±0.174)	0.316	N/A	N/A
Boni forest	0.5 (±0.217)	0.308	N/A	N/A
Dodori 2015 (outside)	0.686 (±0.142)	0.364	0.409 (±0.12)	0.206 (±0.052)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
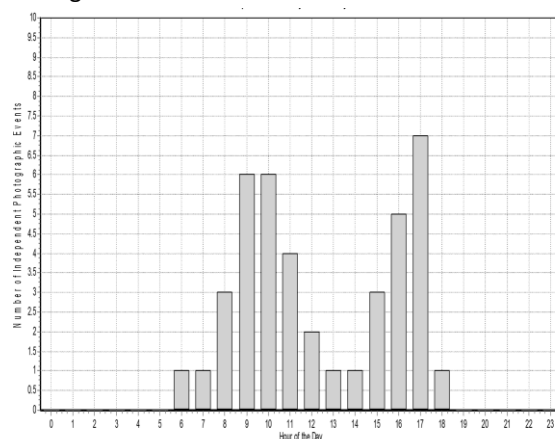
Timing of camera events: Boni-Dodori 2010 & 2015
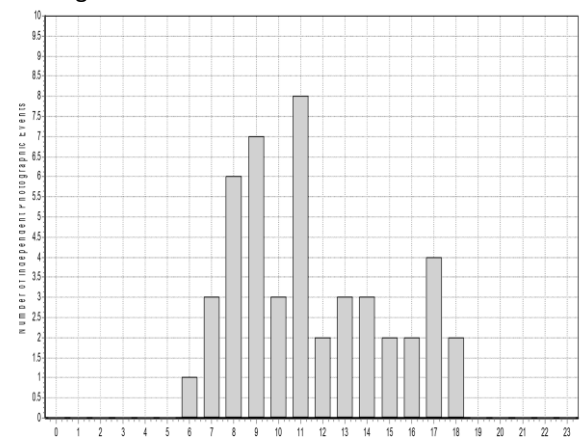
SYKES'S MONKEY (*Cercopithecus mitis*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

33) VERVET (*Chlorocebus pygerythrus*)

Species notes:
- Not closely associated with coastal forest habitat generally but regularly recorded on the coastal side of Dodori NR where habitats are more open.
- No encounters recorded in the Arabuko-Sokoke Forest.
- Mainly encountered in groups.
- Timing of camera trap events indicates a diurnal activity pattern.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

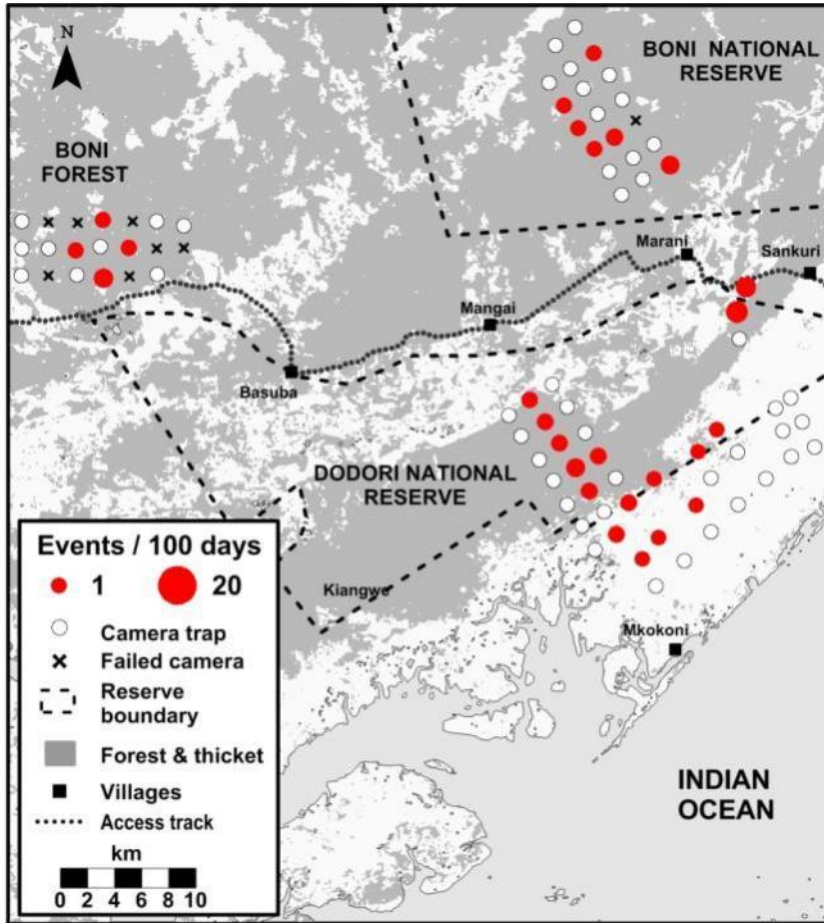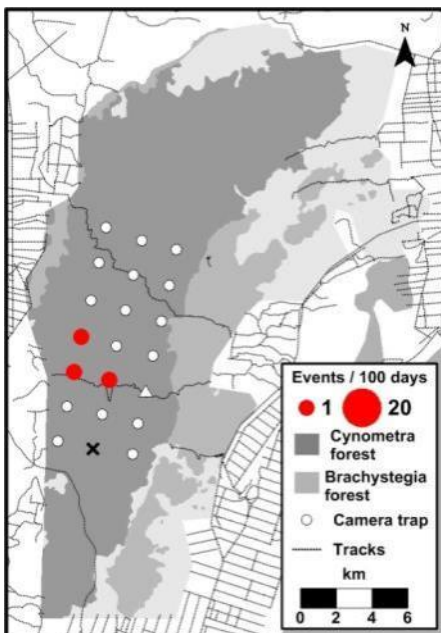| Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	0	0
Boni-Dodori 2010 & 2015	81	12	58

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0	0	N/A	N/A
Dodori 2010 (inside)	0.818 (±0.283)	0.2	0.317 (±0.186)	0.109 (±0.067)
Boni National Reserve	0	0	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	1.528 (±0.213)	0.364	0.372 (±0.105)	0.321 (±0.056)

Activity pattern

Timing of camera events: Boni-Dodori 2010 & 2015
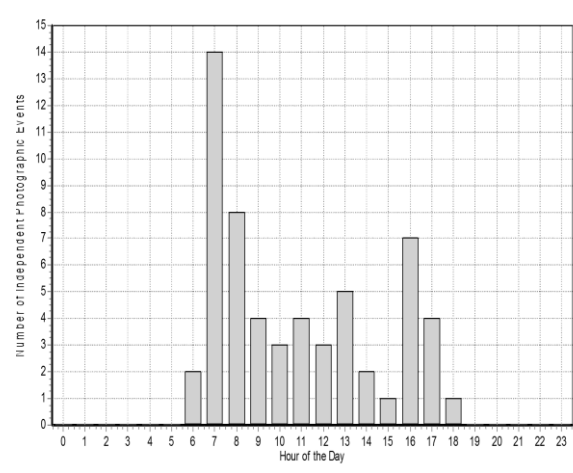
VERVET (*Chlorocebus pygerythrus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015

ARABUKO-SOKOKE 2010
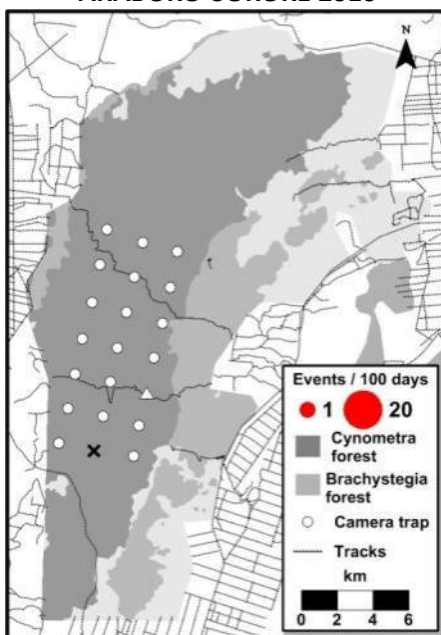
ARABUKO-SOKOKE 2015
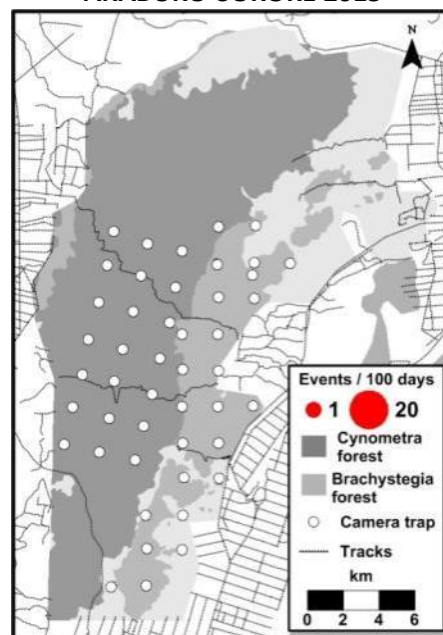
34)   YELLOW BABOON (*Papio cynocephalus*)

Species notes:
- Most frequent in the Brachystegia habitat of the Arabuko-Sokoke Forest, and along the dryer coastal side of Dodori NR.
- Distribution in Arabuko-Sokoke Forest is typical of this species, which is predominantly specific to Brachystegia woodland (Kingdon et al. 2008)
- Always in groups.
- Timing of camera trap events indicates a diurnal activity pattern.

Global conservation status:
Least Concern (IUCN 2008)
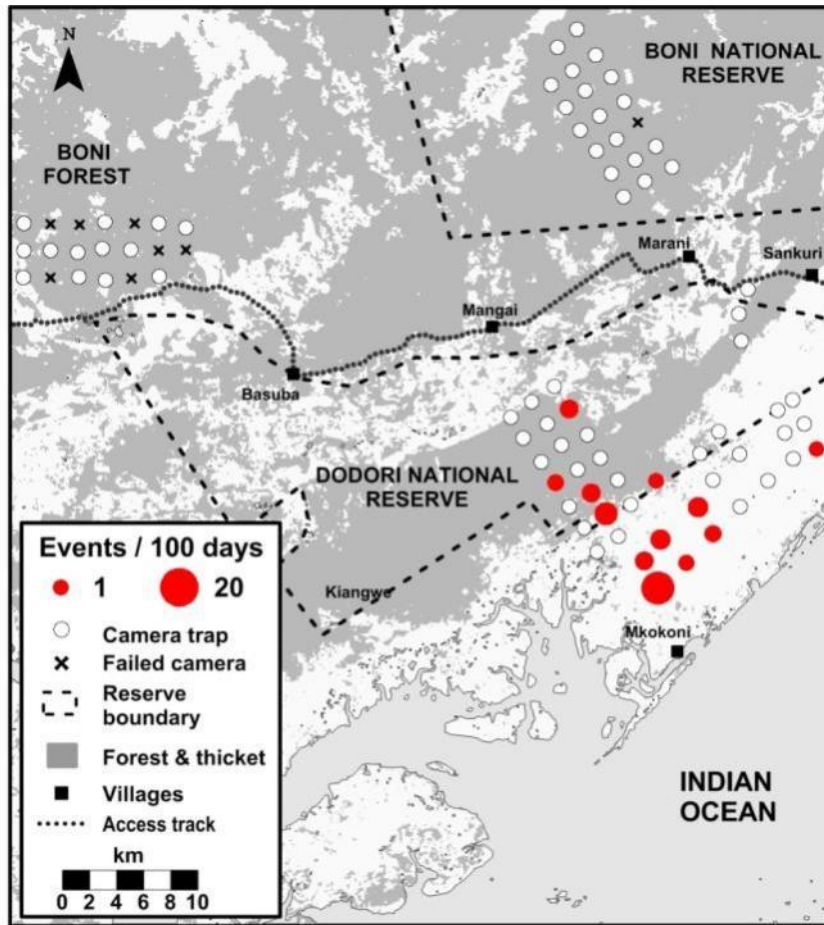
Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	1	1
Arabuko-Sokoke Brachystegia 2015	24	13	50
Boni-Dodori 2010 & 2015	81	17	59

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0.111 (±0.111)	0.048	N/A	N/A
A-S *Brachystegia* 2015	5.381 (±0.729)	0.619	0.717 (±0.125)	0.312 (±0.054)
Dodori 2010 (inside)	0.818 (±0.252)	0.25	N/A	N/A
Boni National Reserve	0.123 (±0.086)	0.105	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	1.494 (±0.242)	0.455	0.461 (±0.108)	0.35 (±0.051)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
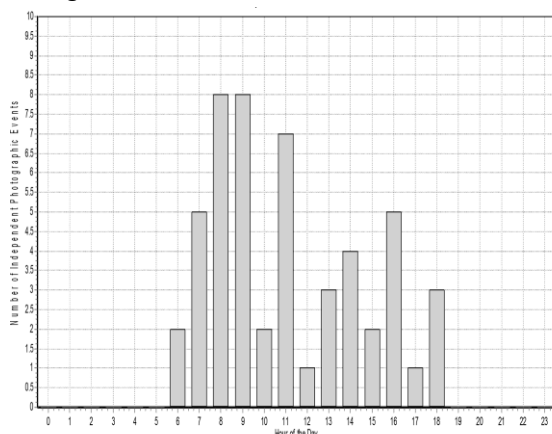
Timing of camera events: Boni-Dodori 2010 & 2015
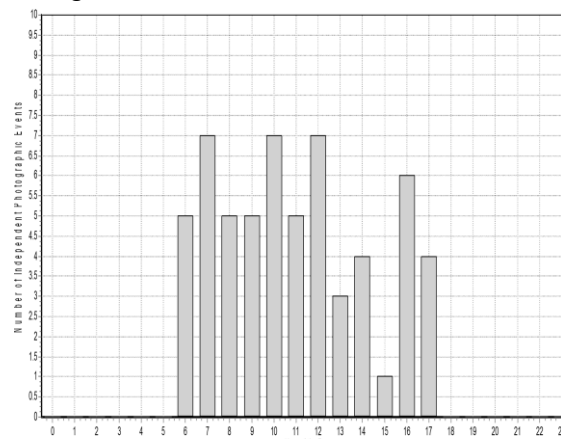
YELLOW BABOON (*Papio cynocephalus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
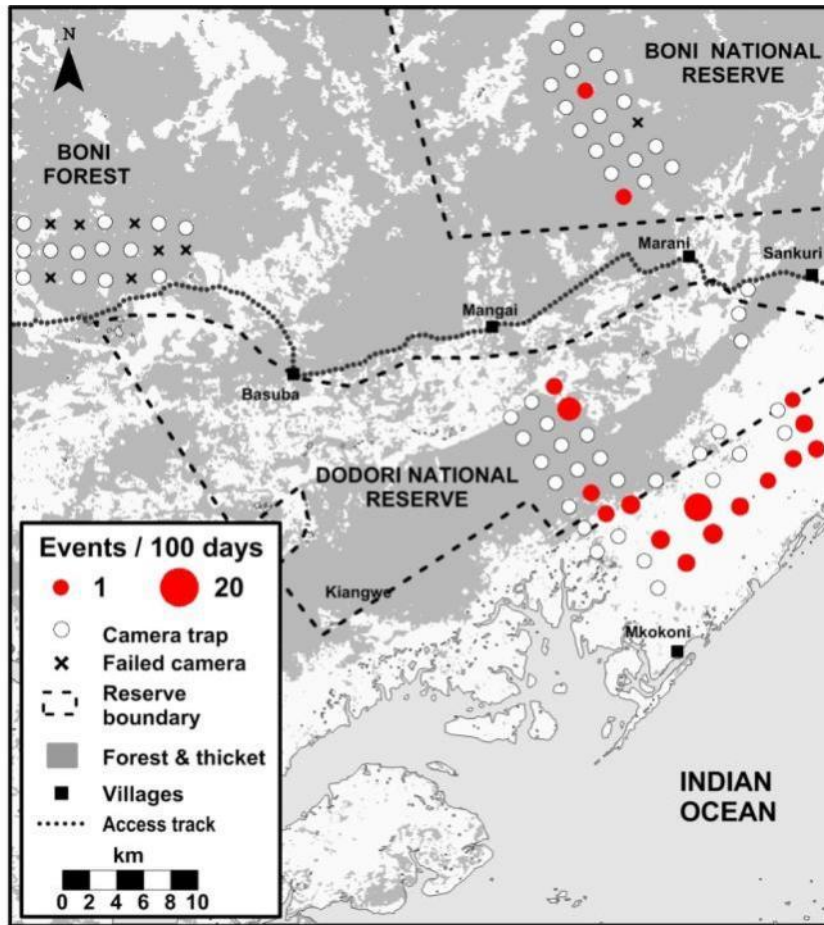
ARABUKO-SOKOKE 2010
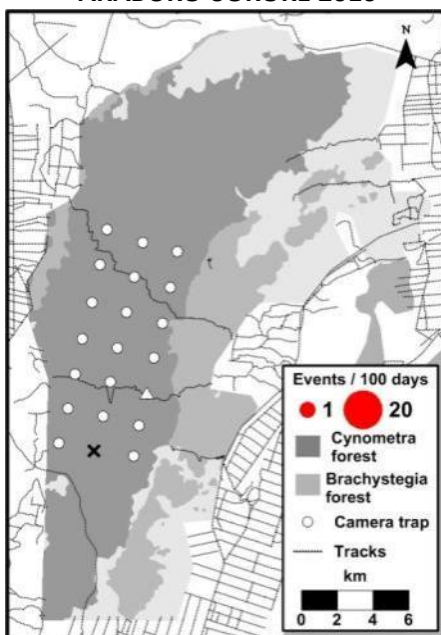
ARABUKO-SOKOKE 2015
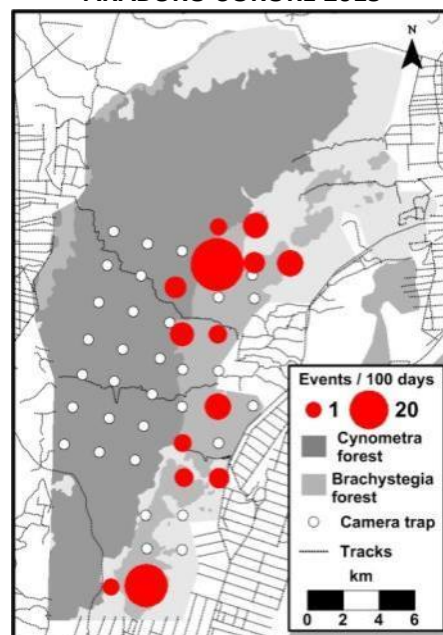
35) GALAGO spp.

Species notes:
- Regular images of Galagos were obtained in the Brachystegia habitat of Arabuko-sokoke in 2015.
- Images were very infrequent in all other grids.
- Small-eared greater galago *Otolemur garnettii* probably accounts for most events. Some images may show more lightly built individuals, but because of swift movements and low nocturnal resolution, camera trapping is not well suited to bushbaby identification.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	2	2
Arabuko-Sokoke Cynometra 2015	22	7	8
Arabuko-Sokoke Brachystegia 2015	24	11	31
Boni-Dodori 2010 & 2015	81	1	1

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.101 (±0.071)	0.105	N/A	N/A
A-S *Cynometra* 2015	0.905 (±0.371)	0.33	N/A	N/A
A-S *Brachystegia* 2015	3.21 (±3.56)	0.524	0.647 (±0.15)	0.294 (±0.75)
Dodori 2010 (inside)	0	0	N/A	N/A
Boni National Reserve	0.063 (±0.063)	0.053	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	0	0	N/A	N/A

Activity pattern

Timing of camera events: Arabuko-Sokoke 2010 & 2015
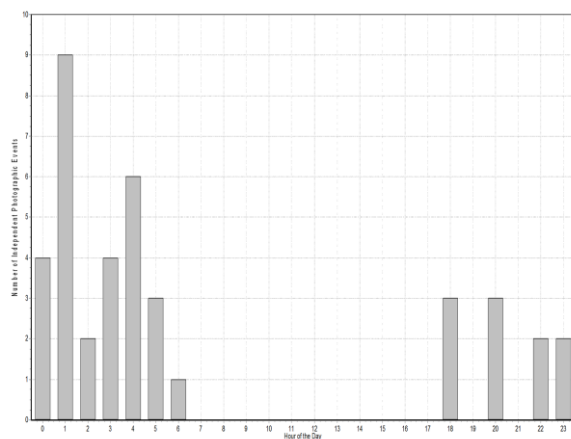
Timing of camera events: Boni-Dodori 2010 & 2015
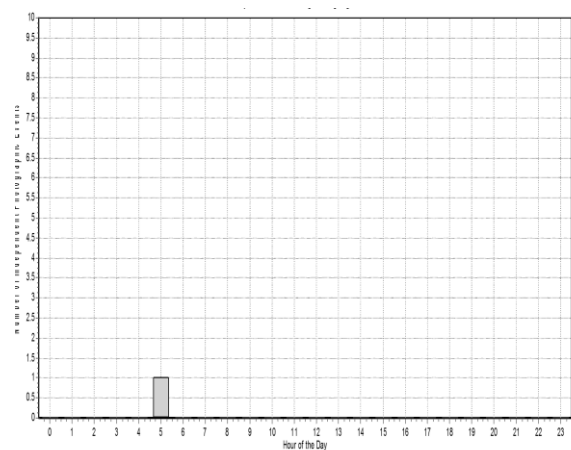
GALAGO spp.

BONI-DODORI 2010 & SOUTH OF DODORI 2015
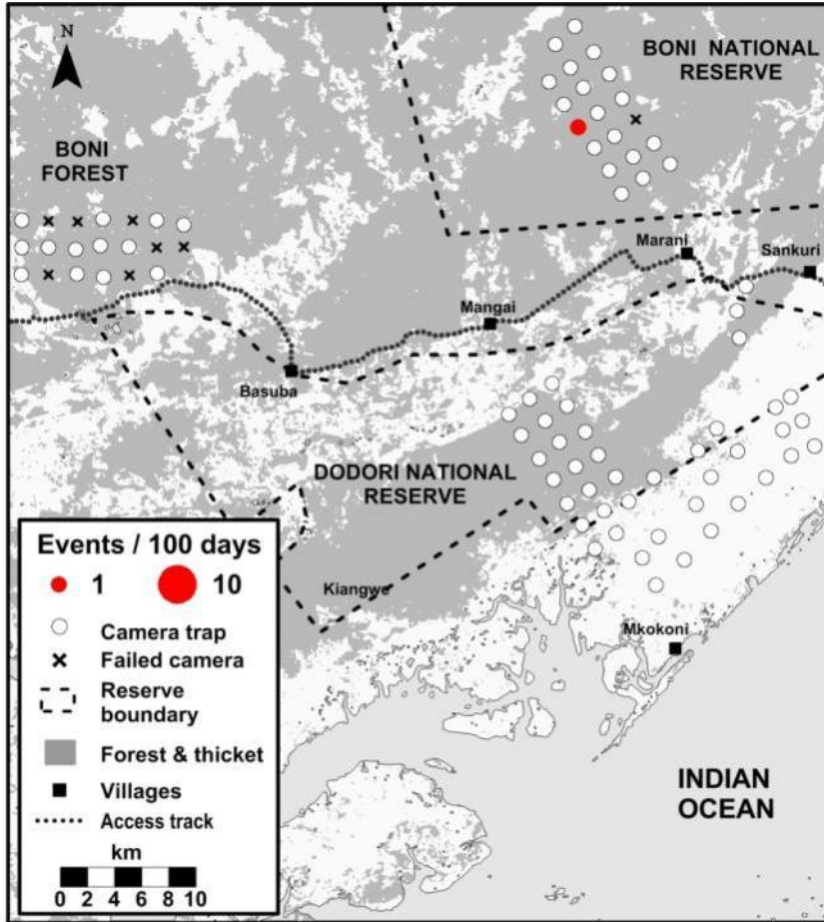
ARABUKO-SOKOKE 2010
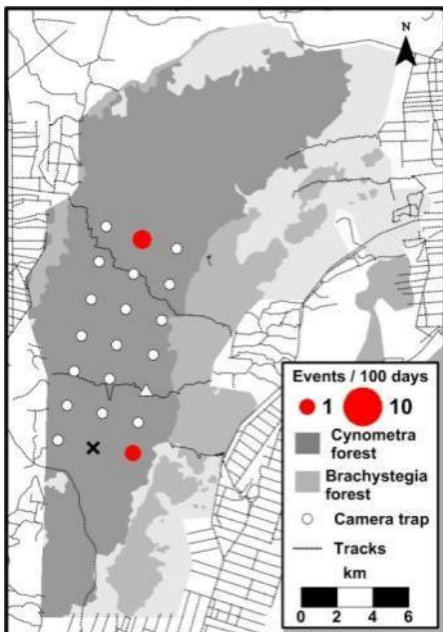
ARABUKO-SOKOKE 2015
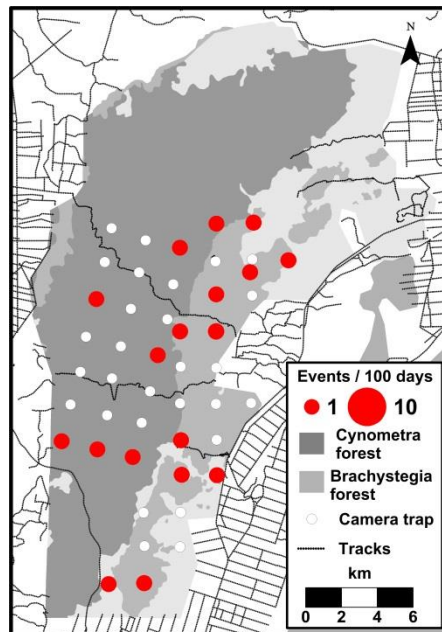
36)   PORCUPINE (*Hystrix sp.*)

Species notes:
- Records represent a range extension compared to IUCN Red List distribution map (IUCN Red List 2016) which shows no porcupine presence along the Kenya coast.
- Locally distributed in all camera grids with no indication of habitat preference.
- Available distribution data places two species, Crested porcupine *H. cristata* and Cape porcupine *H. africaeaustralis* living sympatrically in adjacent coastal areas of Tanzania; they are not distinguishable in the available images and it remains unresolved from this study which species is involved along the Kenya coast.
- Timing of camera events indicate a nocturnal activity pattern.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	2	3
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	2	3
Boni-Dodori 2010 & 2015	81	18	39

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.152 (±0.087)	0.105	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0.161 (±0.161)	0.095	N/A	N/A
Dodori 2010 (inside)	0.932 (±0.27)	0.25	N/A	N/A
Boni National Reserve	0.422 (±0.154)	0.105	0.11 (±0.074)	0.287 (±0.108)
Boni forest	0.599 (±0.276)	0.308	0.482 (±0.271)	0.103 (±0.064)
Dodori 2015 (outside)	0.501 (±0.127)	0.318	0.423 (±0.154)	0.134 (±0.051)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
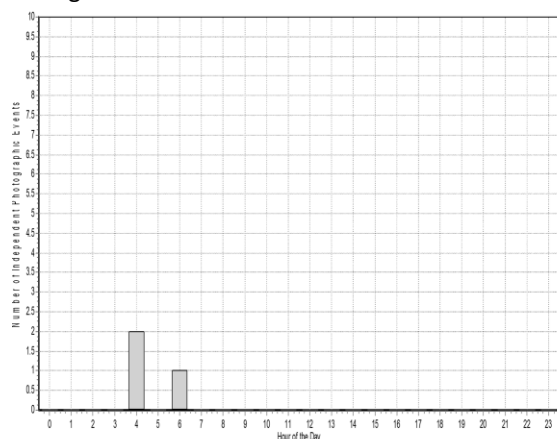
Timing of camera events: Boni-Dodori 2010 & 2015
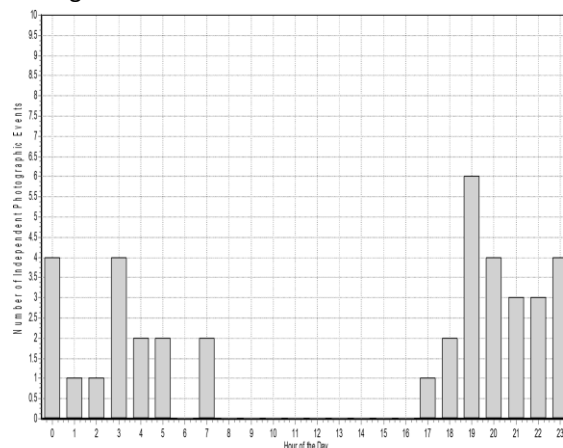
PORCUPINE (*Hystrix sp.*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
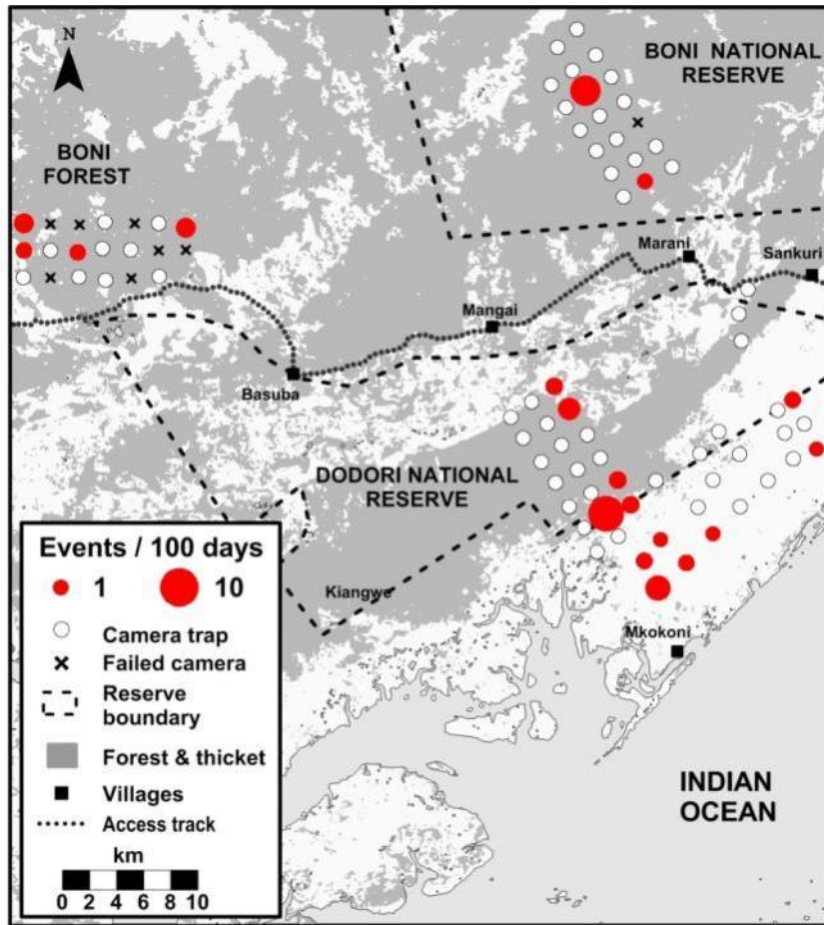
ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

37) NORTHERN GIANT POUCHED RAT (*Cricetomys gambianus*)

Species notes:
- Generally distributed across all camera grids with an indication of relatively increased occupancy in the Brachystegia habitat of Arabuko-Sokoke Forest.
- A small species likely to have been sampled more efficiently by the improved camera settings through extensive field training in 2015 (refer to Training section of methods, page 5).
- Species is nocturnal.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	4	6
Arabuko-Sokoke Cynometra 2015	22	9	43
Arabuko-Sokoke Brachystegia 2015	24	17	129
Boni-Dodori 2010 & 2015	81	24	83

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.304 (±0.121)	0.211	N/A	N/A
A-S *Cynometra* 2015	4.426 (±0.815)	0.381	0.39 (±0.108)	0.494 (±0.075)
A-S *Brachystegia* 2015	11.797 (±1.136)	0.667	0.678 (±0.105)	0.572 (±0.053)
Dodori 2010 (inside)	0.545 (±0.212)	0.2	N/A	N/A
Boni National Reserve	2.246 (±0.411)	0.526	0.576 (±0.129)	0.243 (±0.048)
Boni forest	2.198 (±0.446)	0.385	0.396 (±0.139)	0.317 (±0.072)
Dodori 2015 (outside)	0.498 (±0.141)	0.182	0.185 (±0.084)	0.354 (±0.079)

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
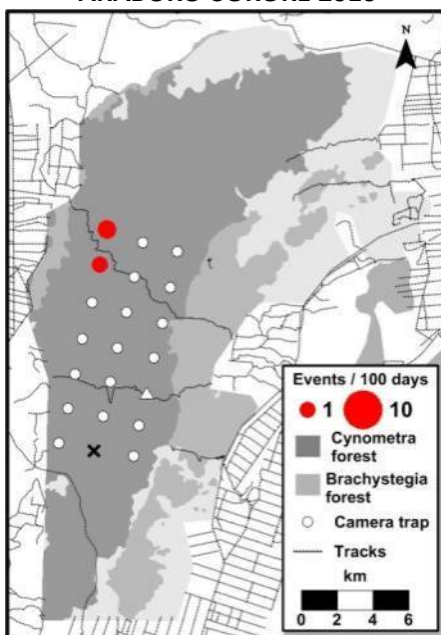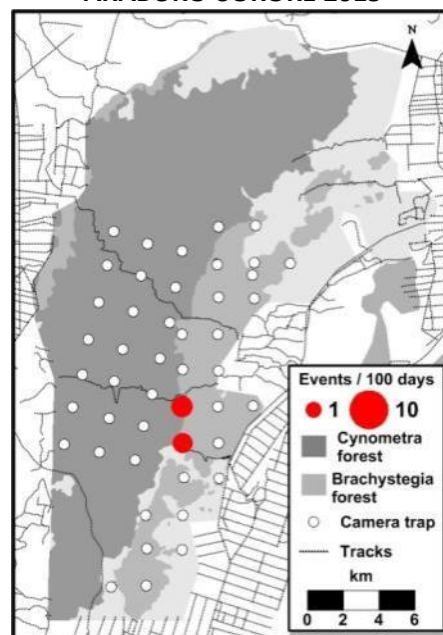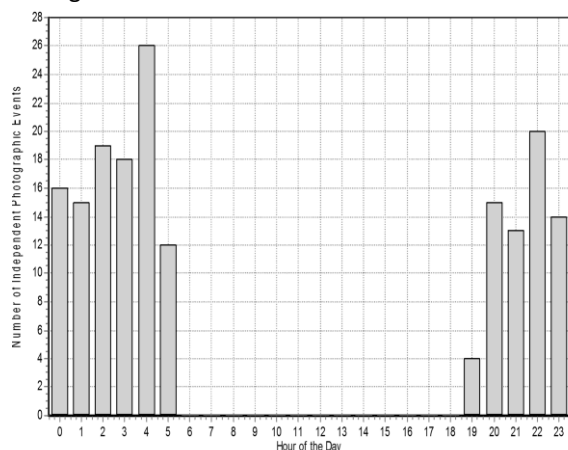

Timing of camera events: Boni-Dodori 2010 & 2015
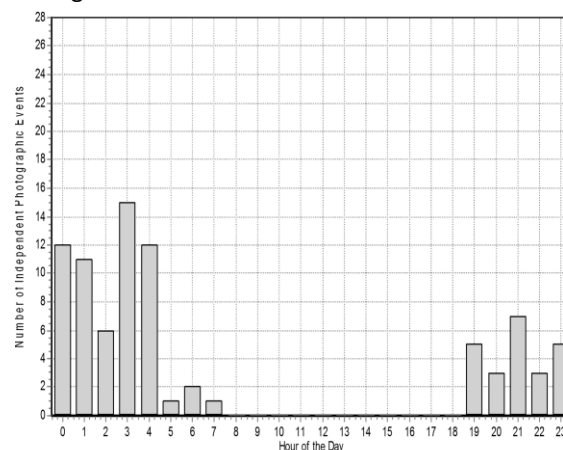
NORTHERN GIANT POUCHED RAT (*Cricetomys gambianus*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
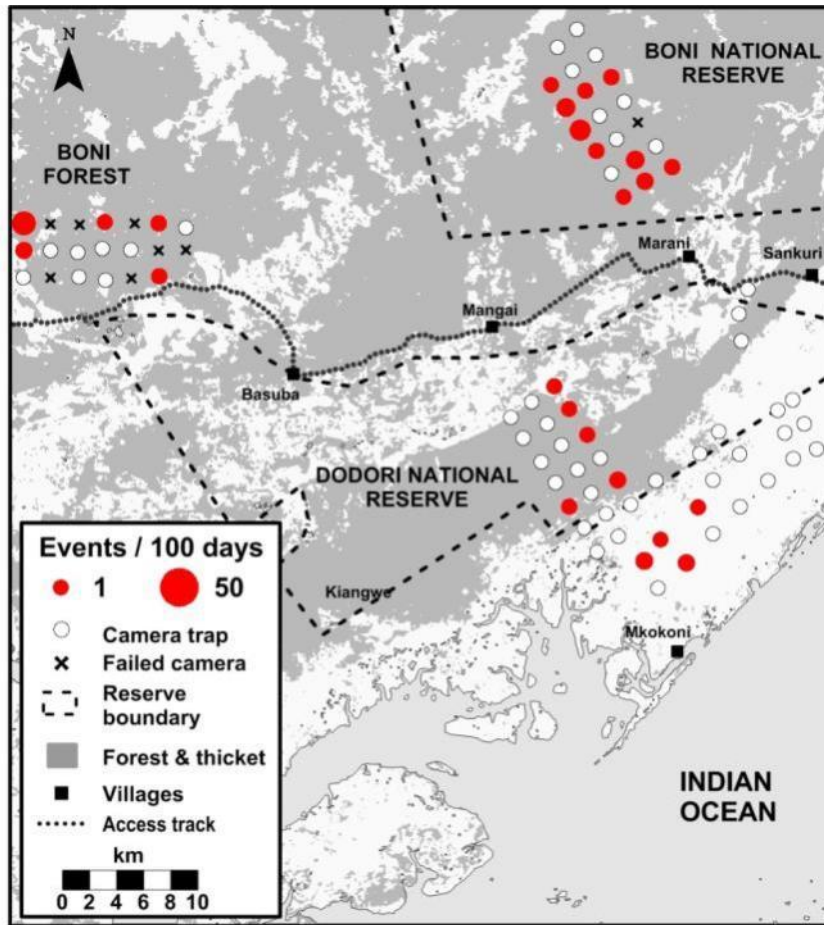
ARABUKO-SOKOKE 2010

ARABUKO-SOKOKE 2015

38)   SQUIRRELS (*Heliosciurus sp. & Paraxerus sp.*)

Species notes:
- Squirrels of at least two different species including certain *Paraxerus* and probable *Heliosciurus* were photographed in all survey grids at Arabuko-Sokoke Forest.
- The red bush squirrel *Paraxerus palliatus* was identified from colour images at Arabuko-Sokoke Forest and identifiable in nearly all the squirrel images from Boni Forest, where the subspecies *P. p. tanae* is recognised.
- The image opposite of *P. palliatus* was obtained in Arabuko-Sokoke Brachystegia forest.

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	3	6
Arabuko-Sokoke Cynometra 2015	22	13	44
Arabuko-Sokoke Brachystegia 2015	24	7	33
Boni-Dodori 2010 & 2015	81	9	16

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0.301 (±0.12)	0.105	N/A	N/A
A-S *Cynometra* 2015	3.815 (±0.647)	0.619	0.736 (±0.121)	0.304 (±0.049)
A-S *Brachystegia* 2015	2.555 (±0.649)	0.333	0.368 (±0.114)	0.374 (±0.074)
Dodori 2010 (inside)	0	0	N/A	N/A
Boni National Reserve	0	0	N/A	N/A
Boni forest	1.598 (±0.385)	0.615	0.984 (±0.296)	0.101 (±0.041)
Dodori 2015 (outside)	0	0	N/A	N/A

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015
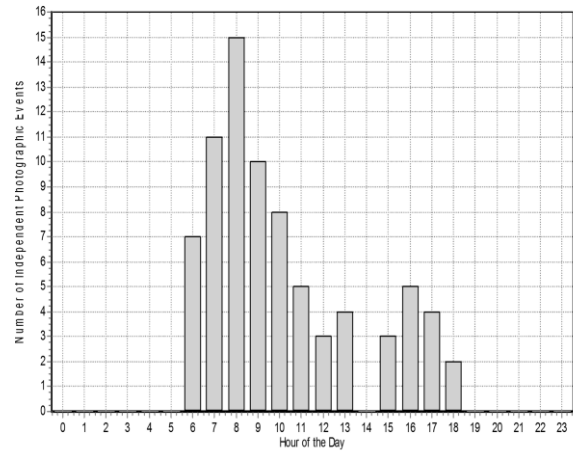
Timing of camera events: Boni-Dodori 2010 & 2015
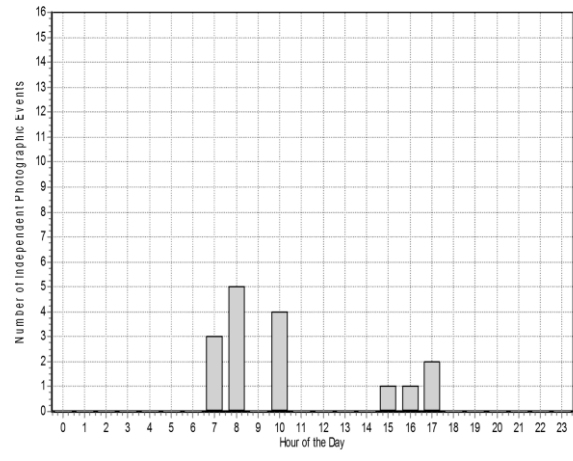
SQUIRRELS (*Heliosciurus sp. & Paraxerus sp.*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
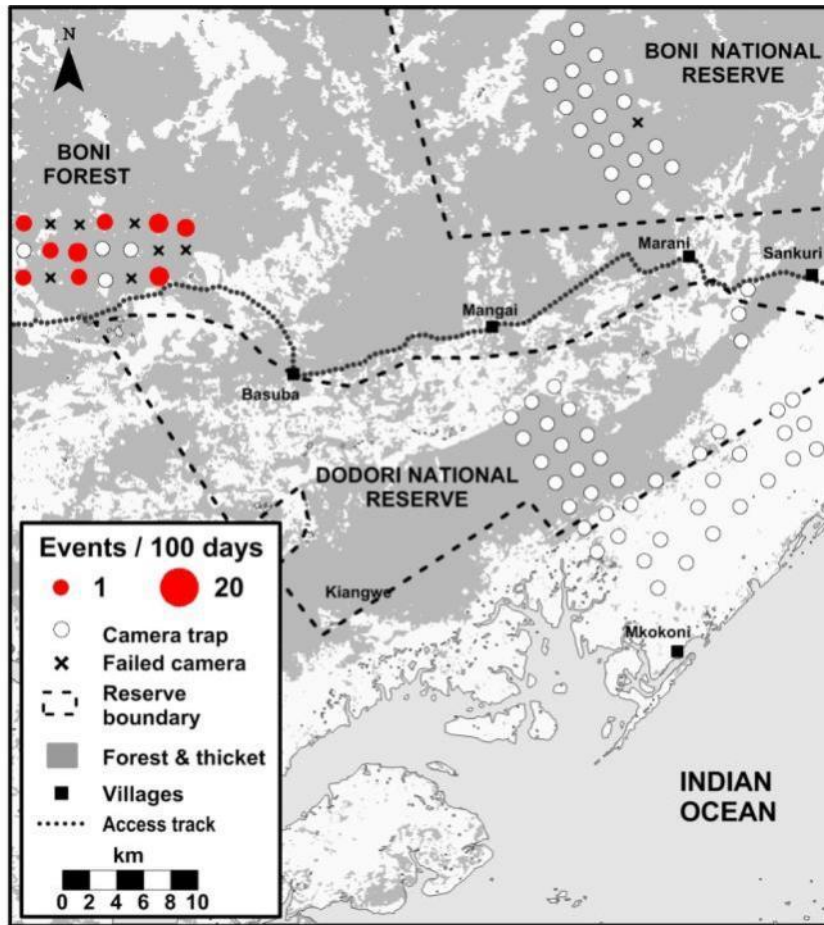
ARABUKO-SOKOKE 2010
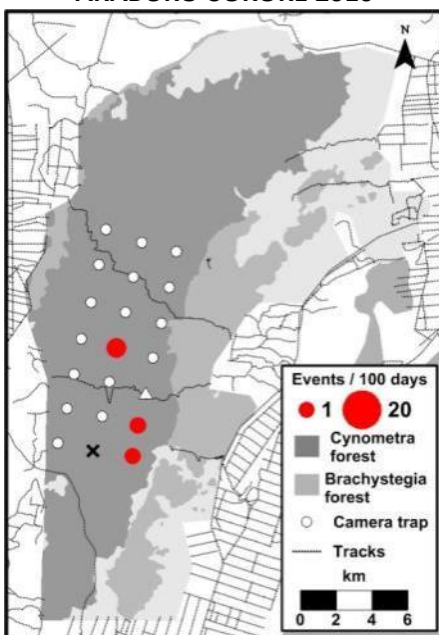
ARABUKO-SOKOKE 2015

39) HARE (*Lepus sp.*)

Species notes:
- Only one event recorded, in Arabuko-Sokoke Brachystegia forest.
- Unexpected in this habitat and image not sufficient to make a firm species identification.

Note that according to IUCN Red List Cape hare *Lepus capensis* is the only species recorded in Eastern Kenya and is indicated to be distributed throughout the coastal region (Drew et al. 2008 downloaded March 2016).

Global conservation status:
Least Concern (IUCN 2008)

Camera trap survey results

Survey	No. of sites	No. sites present	Number of events
Arabuko-Sokoke Cynometra 2010	21	0	0
Arabuko-Sokoke Cynometra 2015	22	0	0
Arabuko-Sokoke Brachystegia 2015	24	1	1
Boni-Dodori 2010 & 2015	81	0	0

Trapping rates, occupancy and detectability

Survey	Trapping rate / 100 days (±SE)	Occupancy		
		Naïve occupancy	Modelled occupancy (±SE)	Probability of detection (±SE)
A-S *Cynometra* 2010	0	0	N/A	N/A
A-S *Cynometra* 2015	0	0	N/A	N/A
A-S *Brachystegia* 2015	0.0	0.048	N/A	N/A
Dodori 2010 (inside)	0	0	N/A	N/A
Boni National Reserve	0	0	N/A	N/A
Boni forest	0	0	N/A	N/A
Dodori 2015 (outside)	0	0	N/A	N/A

Activity pattern

Timing of camera events: Arabuko-Sokoke 2015

HARE (*Lepus sp.*)

BONI-DODORI 2010 & SOUTH OF DODORI 2015
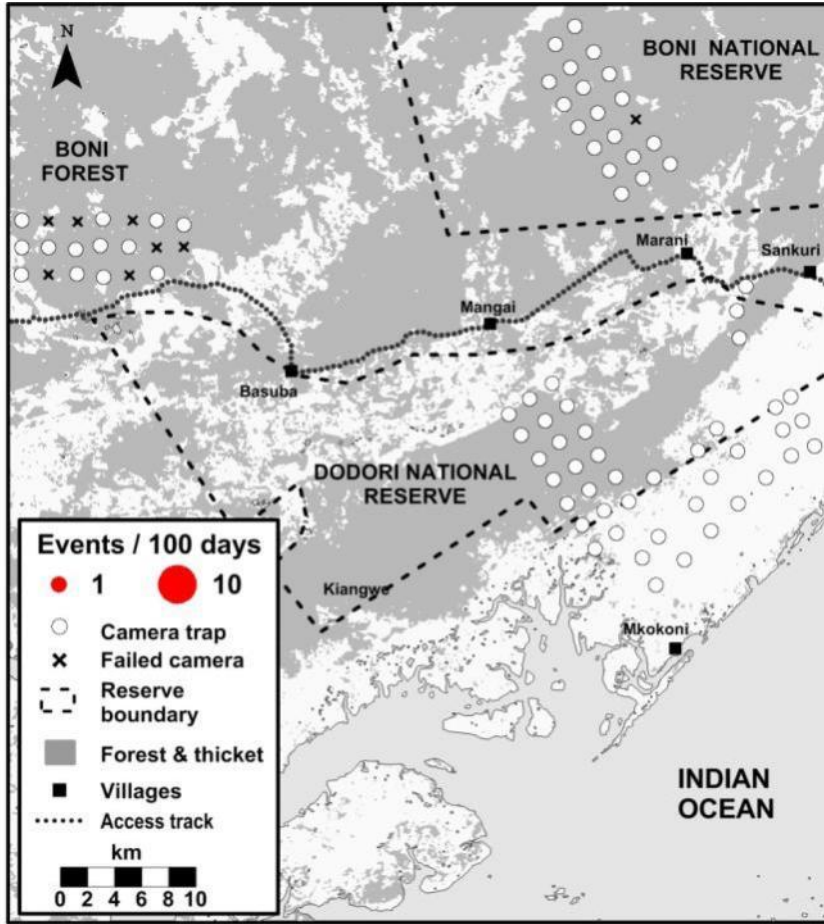
ARABUKO-SOKOKE 2010
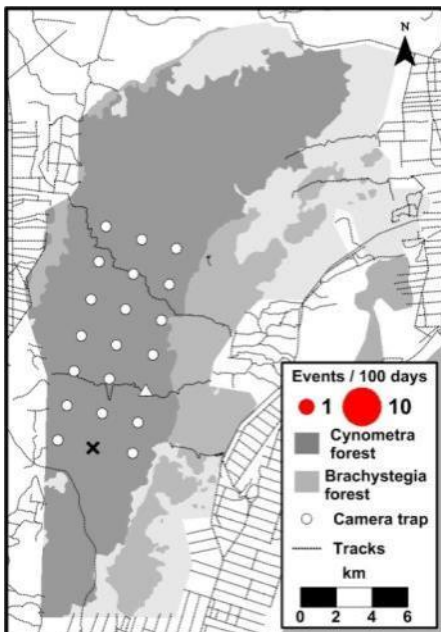
ARABUKO-SOKOKE 2015
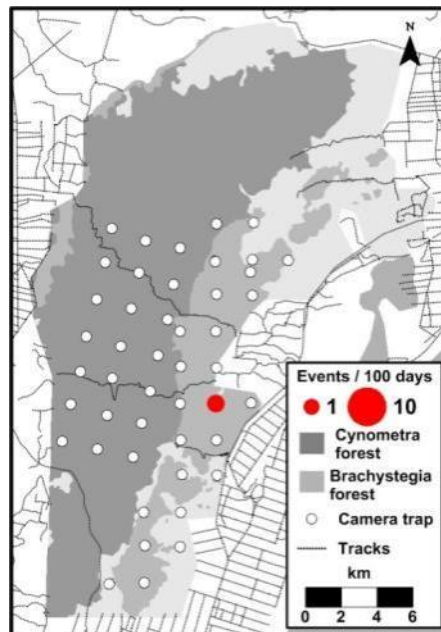
4. Conclusions and Recommendations

The camera trap study has been efficient and successful in providing a quantitative methodology to assess the richness and relative abundance of the medium-to-large terrestrial mammal component of northern coastal forests of Kenya: Boni-Dodori forest system and Arabuko-Sokoke Forest.

The study has confirmed that the Boni-Dodori forest system is of major importance to mammal conservation within the eastern African coastal biodiversity hotspot, with indications that it remains relatively undisturbed, holding complete and fully functioning communities of predators and herbivores.

The study recommends that this status is recognised and incorporated into future land use planning for the area, with a focus on findings ways for the local communities to integrate development of the region while sustaining and gaining benefit from this unique heritage.

37 mammal species were found in the Boni-Dodori forest system. In order to compare species richness between sites species composition is standardised with respect to habitat preference and body size. 32 forest and mixed habitat terrestrial medium-to-large mammal species (>0.5 kg adult body weight) have been confirmed in the northern coastal forest system. In comparison, in Arabuko-Sokoke Forest, the only other large coastal forest reserve south of the Tana River, 28 mammal species were recorded of which 24 were forest and mixed habitat terrestrial medium-to-large mammal species.

An outstanding result of our study has been that the Critically Endangered Aders' duiker's status, as measured by two metrics (camera trapping rate and occupancy), were both one to two orders of magnitude greater in the northern forest sites, compared to the Arabuko-Sokoke Forest. The very high levels of occupancy in the Boni-Dodori camera-trap grids, very close to or at 100%, suggest that this species is consistently distributed through this habitat. Data from this study were used to develop a replicate count N-mixture model giving an estimate of 27 Aders' duikers (SE = 5.2, 95% CI = 16.74 – 37.13) across 19 camera sampling units in Boni NR. This was based on an average home range of 19.2 ha for Aders' duiker derived from regression analysis of home range against body weight using the most complete home range estimates available from radio telemetry studies of four other forest duiker species. Using the information that occupancy was effectively 1 and an assumption that each camera sampling unit was located within a separate home range, a density estimate of 7.3 duikers / km^2 (95% CI = 4.5 – 10.1 duikers / km^2) was obtained. Applying this density estimate to the 84 km^2 Boni NR survey grid, we conclude an estimate of approximately 600 Aders' duikers in this sample area.

The potential forest and thicket area measured from the classified map (Figure 1, page 8 shows a large part of the area) is at least 3,000 km^2. This more than triples the combined previously known range of Aders' duiker; 420 km^2 Arabuko-Sokoke Forest and less than 500 km^2 of scattered duiker habitat across five isolated forests on Unguja Island in Zanzibar (Finnie 2002). These new data strongly indicate that the Boni–Dodori forest system is the most important known population centre for this critically endangered coastal forest endemic.

Other notable findings in the northern coastal forests include:

1. A significant population of a very distinctive form of the giant sengi in the northern coastal forests, with the corollary that the range of the better known golden-rumped elephant shrew in Arabuko-Sokoke Forest could now be even smaller than previously understood.

2. Range extensions for rufous sengi and four-toed sengi (confirming observations from the pilot study; Andanje et al. 2010).

3. Confirmation of range extension for the Sokoke bushy-tailed mongoose in the northern coastal forest system. The species was first reported from Milimani in Boni in 1995 (Engel & van Rompaey 1995 quoted in Mammals of Africa, Taylor 2013).

4. Recording of three Suid species living in close proximity in Boni forest: Common warthog; Desert warthog and bushpig.

5. Presence of important population of African wild dog (listed as 'Endangered') confirmed alongside a suite of large carnivores (lion, leopard and spotted hyaena).

6. The results also indicate higher density of suni and Harvey's duiker in the northern coastal forest relative to Arabuko-Sokoke Forest with range extension for Suni: IUCN Red List indicates northern limit of Suni as 'lower Tana River'.

7. Range extension of the caracal based on the IUCN Red List distribution map.

8. Range extension confirmed for porcupines along the central and north Kenyan coast relative to IUCN Red List and Mammals of Africa maps.

9. Range extension for the blue duiker *(Philantomba monticola)* relative to published distribution maps (Kingdon 1997; East 1999; IUCN SSC Antelope Specialist Group 2008). The distance from the nearest known population is over 200 km.

10. Comparative lack of human activity in the northern coast forest camera grids during the sampling periods. People moving through the forest were detected on a handful of occasions at Arabuko-Sokoke Forest grids, but no images of people were recorded at Boni-Dodori.

11. Besides revealing a greater number of species in the Boni-Dodori forest system compared to Arabuko-Sokoke Forest, camera trap trapping rates were higher (often much higher) at Boni-Dodori for every one of the 24 species shared between the two sites. There were only four species unique to the Arabuko-Sokoke Forest. Two of these species had exact equivalents in the Boni-Dodori forest system (the two different giant sengis and the two forms of Sykes's monkey). The other two species unique to the Arabuko-Sokoke Forest in this data set, the hare *(Lepus sp.)* and common duiker *(Sylvicapra grimmia)*, were recorded at very low frequencies and are not closely associated with coastal forest. This further underlines the conservation significance of the Boni-Dodori forest system as a relatively undamaged and well-populated wildlife habitat in a key biodiversity zone (Musina et al. 2015).

Insecurity, logistics and resources prevented simultaneous operation of camera grids and the repeated surveys in some of the forest sites. There was also a marked difference between the 2010 and the repeated 2015 Arabuko-Sokoke Cynometra forest grid trapping rates and occupancy for a number of the small mammal species. This is most likely due in part to improved camera trap setup (adjusted camera angle for target species) following the rigorous field training workshop 2015. Such training is important as part of camera trap surveys to ensure good data quality and minimize data loss.

The forest thicket map (Figure 1, page 8) also helps identify future camera trap study areas and highlights the potentially isolated status of the forest and thicket habitat of Dodori NR. This sector is separated over much of its length by a wide belt of grassland, through which the major vehicle

access route runs linking the four main villages of the area. The grassland mosaic around these coastal forests is of biodiversity importance in its own right, inhabited by species such as Haggard's oribi, a distinctive form classified as Vulnerable by IUCN (East 1999, IUCN SSC/ASG 2008). This geography emphasises the need for conservation management and planning to retain the habitat mosaic and to prevent isolation of Dodori National forest.

The Boni-Dodori forest system represents the only remaining sector of the Kenya coastline retaining a significant frontage of undisturbed natural habitat sequences, transitioning from coral reef to lagoons, mangroves, coastal forest and grasslands, through to the interior bush, all supporting endangered biodiversity. The surveys also emphasise the undisturbed nature of the mammal community in this zone, underscoring the extremely high biodiversity conservation value of the region. This is all the more urgent given the land-grabs, land conversion, and the felling of indigenous hardwoods associated with and driven by the planned development of a major seaport at Lamu and cross country pipeline development (Morris and Amin 2012).

5. Acknowledgements

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Annex I: Bird and Reptile Species

Eighteen bird species and two reptile species were also photographed in camera trap arrays at Arabuko-Sokoke and Boni-Dodori, 2010 and 2015. These are summarised in brief below.

BIRDS

	Family	Species	Common Name	AS Forest			BD Forest				IUCN Status
				Cyn '10	Cyn '15	Bra '15	Dod '10	BNR '10	BF '10	Dod '15	
1	Threskiornithidae	*Bostrychia hagedash*	Hadada ibis	---	---	---	Y	Y	Y	Y	LC
2	Accipitridae	*Terathopius ecaudatus*	Bateleur	---	---	---	---	---	Y	---	NT
3	Accipitridae	*Accipiter tachiro*	African goshawk	---	Y	---	---	---	---	---	LC
4	Phasianidae	*Pternistis afer*	Red-necked francolin	---	---	---	---	Y	Y	---	LC
5	Phasianidae	*Guttera pucherani*	Crested guineafowl	---	Y	Y	Y	Y	Y	Y	LC
6	Phasianidae	*Dendroperdix sephaena*	Crested francolin	---	---	Y	---	---	Y	Y	LC
7	Columbidae	*Streptopelia decipiens*	African Mourning dove	---			---		Y	---	LC
8	Columbidae	*Turtur chalcospilos*	Emerald-spotted wood dove	---	---	Y	---	Y	Y	Y	LC
9	Columbidae	*Turtur tympanistria*	Tambourine dove	---	Y	Y	---	---	---	---	LC
10	Strigidae	*Strix woodfordii*	African wood owl	---	---	Y	---	---	---	---	LC
11	Pycnonotidae	*Phyllastrephus fischeri*	Fischer's greenbul	---	Y	---	---	---	---	---	LC
12	Pycnonotidae*	*Nicactor gularis*	Eastern nicator	---	Y	---	---	---	---	---	LC
13	Turdidae	*Neocossyphus rufus*	Red-tailed ant-thrush	---	Y	---	---	---	---	---	LC
14	Muscicapidae	*Erythropygia quadrivirgata*	Eastern bearded scrub robin	---	Y	Y	---	---	---	---	LC
15	Malaconotidae	*Laniarius aethiopicus sublacteus*	Tropical boubou	---	Y	Y	---	---	---	Y	LC
16	Malaconotidae	*Laniarius funebris*	Slate-coloured boubou	---	Y	---	---	---	---	---	LC
17	Malaconotidae	*Telophorus viridis*	Gorgeous bushshrike	---	Y	Y	---	---	---	---	LC
18	Estrildidae	*Hypargos niveoguttatus*	Peter's twinspot	---	---	---	---	---	Y	---	LC

* Current allocation on IUCN Redlist, but subject to revision.

REPTILES

	Family	Species	Common Name	AS Forest			BD Forest				IUCN Status
				Cyn '10	Cyn '15	Bra '15	Dod '10	BNR '10	BF '10	Dod '15	
1	Varanidae	*Varanus albigularis*	White-throated monitor	---	---	---	---	---	---	Y	?
2	?	*Unidentified snake*		---	---	Y	---	---	---	---	N/A