

Comparing two methods for surveying nocturnal arboreal mammals in a tropical forest – thermal observations from an elevated platform and arboreal camera traps.

Mammal Research

Lucy N. Hughes^{1,2}, Trevor Hughes¹, Patrick J. C. White^{2*} *(p.white@napier.ac.uk)

¹Conservation Through Research Education and Action (CREA), Panama City, Panama

²Centre for Conservation & Restoration Science, Edinburgh Napier University, UK

Supplementary Information 1

(a)



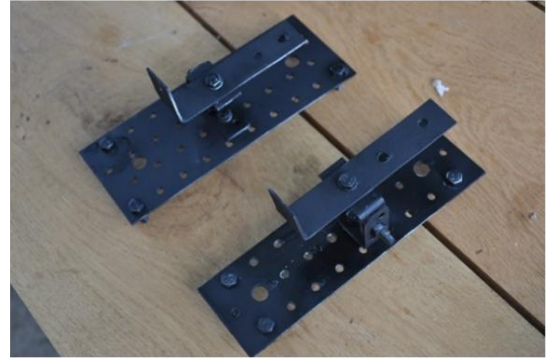
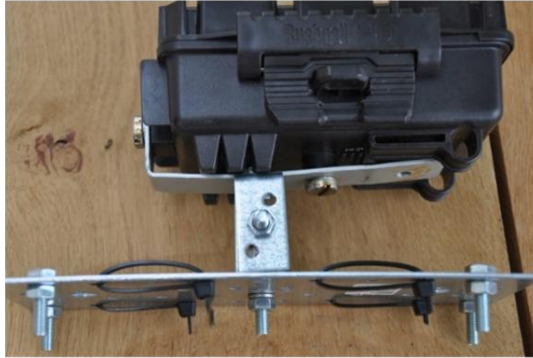
(b)



(c)



(d)



(e)



Fig. S1 Various items of survey equipment used in the study. (a) Tree stand chair strapped to a tree. (b) Observer in position on chair, safety harness and ropes can be seen. Observer can sit or stand comfortably and turn in 360° to see in any direction. (c) A set of tree sticks, essentially a ladder that straps to the tree. The tape has holes that pass over the button to keep it in place. With two sets, a harness and lanyard, an observer can climb high enough to set a tree stand without the need of SRT equipment. (d) Self constructed bracket mounts for camera traps allowing side to side and forward backwards adjustment (e) Camera traps mounted in trees.

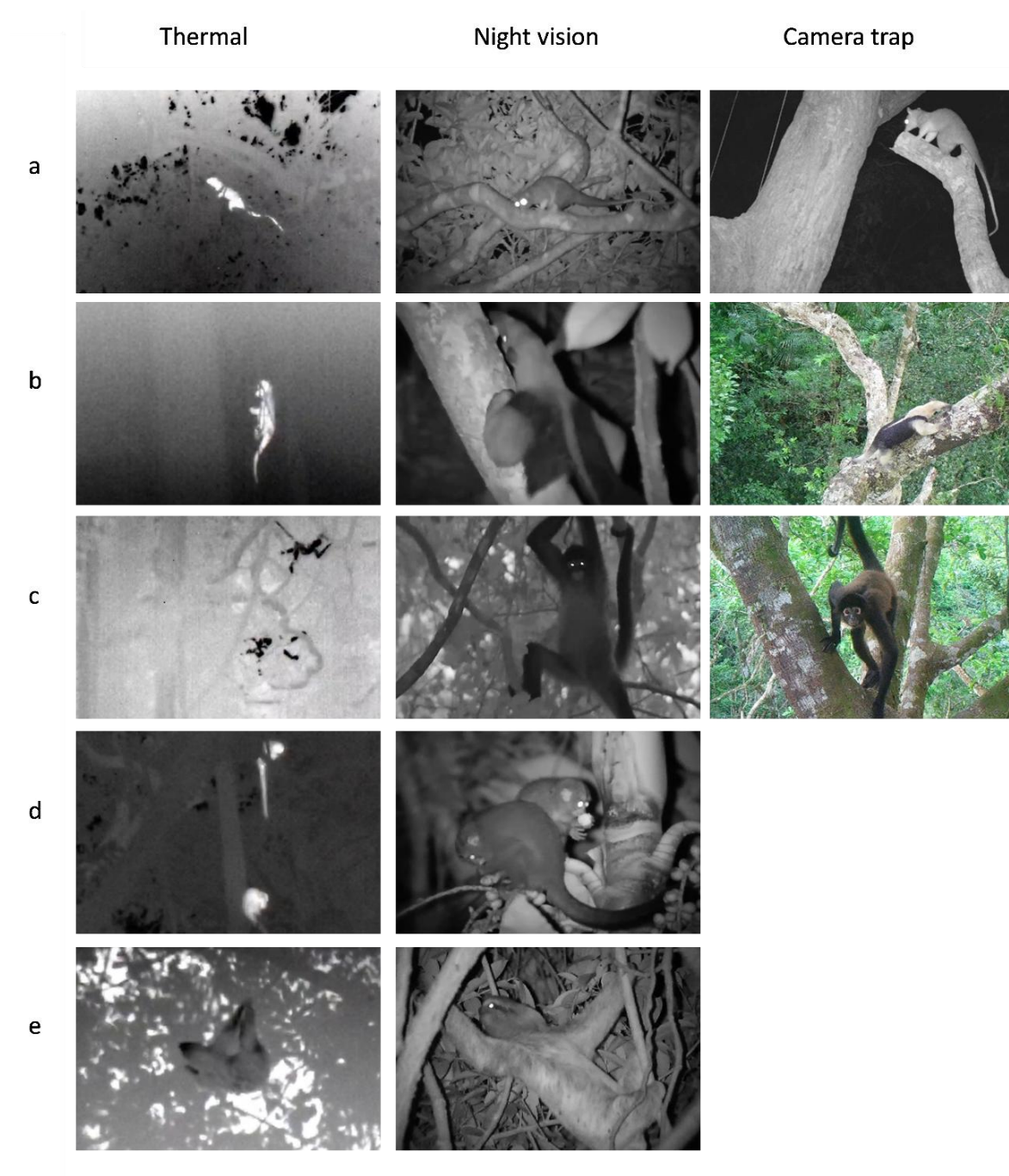


Fig. S2 Examples of images through thermal, night vision and camera traps: (a) Central American woolly opossum, (b) Northern tamandua, (c) Central American spider monkey, (d) Panamanian night monkey and (e) Brown throated sloth

Table S1 Manufacturers specifications for thermal and night vision devices used in the study (Binox 4T & Binox 4K) and trialled (OTS XLT & OTS LT 320) for comparison.

Manufacturer - Model	Type	Thermal	Night-vision	Base Magnification	Thermal sensor	IR iluminator	Cost 2024	Detection distance m **
ATN - OTS XLT	monocular	y		2.5 x	160 x 120 px	none	\$410	777m
ATN OTS LT 320	monocular	y		6 x	320 x 240 px	none	\$1,799	1554m
ATN - Binox 4K	binocular		y	4 x		850 nm	\$899	*
ATN - Binox 4T	binocular	y		1.25 x	384 x 288 px	none	\$3,299	686m

* Determined by IR illuminator

** Manufactures detection distance is the distance a target (size = 1.8m x 0.5m) spans 1.5 to 2 pixels assuming optimal conditions.

Table S2 shows a detailed breakdown of the equipment we used to climb into the canopy to set camera traps and the equipment used for the elevated nocturnal observations. This is high end equipment so savings could be made relative to this. The study was experimental and as such we trialled different equipment to achieve our goals. Table S3 gives a brief overview of the equipment rejected.

Table S2 A breakdown of items used and approximate costings (at time of writing in 2024).

Items	Approximate cost 2024 USD
Petzl Sequoia SRT Harness	469.95
Petzl Helmet strato vent	129.00
Petzl Zigzag	299.95
Petzl Chicane	149.95
Petzl OK carabiner x 5	19.95 each
Petzl Pantin foot ascender	79.95
Petzl Knee ascender kit	179.95
Petzl zillion 4m	244.95
Petzl Transport bag 45 x 2	159.95 each
Petzl eclipse throw line bag	79.95
Petzl eclipse throw line 300m	149.95
Petzl jet throw bags 350g	19.95 eacg
Yale blue moon X 2	288.00 each
Petzl tika core red/white headlamp	59.95
Hawke Helium Ultra Lite tree stand	289.99
Hawke Helium climbing sticks 30" (3 pack)	199.99
Hennesy Expedition hammock	169.95

Table S3 A breakdown of items tested and not used in survey.

Items	Reason for non-inclusion
Black Diamond "Cliff Cabana Double Portaledge"	Difficult to find a suitable location and time to set up. Not easy to move quietly. Inability to leave in situ for days due to animal / environmental damage risk.
Petzl Bosuns chair seat	Limited ability for observer to turn. Unsuitable for observations above head level.
Camera trap mounts	
Perdex direct camera mounts	Single 1/4-20 attachment point not as robust as two point attachment. Possibility of mammal loosening ball joint leading to camera trap falling.
Reconyx omni swivel mounts	Single 1/4-20 attachment point not as robust as two point attachment. Possibility of mammal loosening ball joint leading to camera trap falling
Thermal optics	
ATN OTS XLT 160 2.5x - 10x	Thermal monocular use over long periods led to eye strain and fatigue. The resolution was acceptable for locating but not for observation.
ATN OTS LT 320 6x-12x	Thermal monocular had no recording capability.
Energiser lithium batteries	One use batteries were deemed too environmentally costly. We used rechargables.

Table S4 Taxonomic information for species observed during study as well as IUCN status.

Order	Family	Genus	Species	Common Name	IUCN Status
Didelphimorphia	Didelphidae	Caluromys	derbianus	Central American woolly opossum	LC
Didelphimorphia	Didelphidae	Didelphis	marsupialis	Common opossum	LC
Didelphimorphia	Didelphidae	Marmosa	sp	Mouse opossum	LC
Didelphimorphia	Didelphidae	Metachirus	nudicaudatus	Brown four-eyed opossum	LC
Didelphimorphia	Didelphidae	Philander	opossum	Gray four-eyed opossum	LC
Cingulata	Dasypodidae	Dasypus	novemcinctus	Nine-banded armadillo	LC
Pilosa	Bradypodidae	Bradypus	variegatus	Brown throated sloth	LC
Pilosa	Megalonychidae	Choloepus	hoffmanni	Hoffmann's two-toed sloth	LC
Pilosa	Myrmecophagidae	Tamandua	mexicana	Northern tamandua	LC
Primates	Aotidae	Aotus	zonalis	Panamanian night monkey	NT
Primates	Atelidae	Alouatta	palliata	Mantled howler monkey	VU
Primates	Atelidae	Ateles	geoffroyi	Geoffroy's spider monkey	EN
Primates	Cebidae	Cebus	capucinus	Colombian white-throated capuchin	VU
Rodentia	Cricetidae	Nyctomys	sumichrasti	Vesper rat	LC
Rodentia	Cricetidae	Oecomys	bicolor	Bicolored arboreal rice rat	LC
Rodentia	Cuniculidae	Cuniculus	paca	Spotted paca	LC
Rodentia	Dasyproctidae	Dasyprocta	punctata	Central American agouti	LC
Rodentia	Echimyidae	Diplomys	labilis	Rufous tree rat	LC
Rodentia	Echimyidae	Hoplomys	gymnurus	Armored rat	LC
Rodentia	Echimyidae	Proechimys	semispinosus	Tome's spiny rat	LC
Rodentia	Erethizontidae	Coendou	quichua	Andean porcupine	DD
Rodentia	Sciuridae	Microsciurus	sp	Dwarf squirrel	LC
Rodentia	Sciuridae	Sciurus	granatensis	Red-tailed squirrel	LC
Carnivora	Felidae	Herpailurus	yagouaroundi	Jaguarundi	LC
Carnivora	Felidae	Leopardus	pardalis	Ocelot	LC
Carnivora	Felidae	Leopardus	wiedii	Margay	NT
Carnivora	Mustelidae	Eira	barbara	Tayra	LC
Carnivora	Mustelidae	Galictis	vittata	Greater grison	LC
Carnivora	Procyonidae	Bassaricyon	medius	Western lowland olingo	LC
Carnivora	Procyonidae	Nasua	narica	White-nosed coati	LC
Carnivora	Procyonidae	Potos	flavus	Kinkajou	LC
Artiodactyla	Tayassuidae	Pecari	tajacu	Collared peccary	LC