

Primates census with thermal drones: A New Horizon?



IPS-MPS'23

KUCHING • MALAYSIA

Joint Meeting of the International Primatological Society and the Malaysian Primatological Society

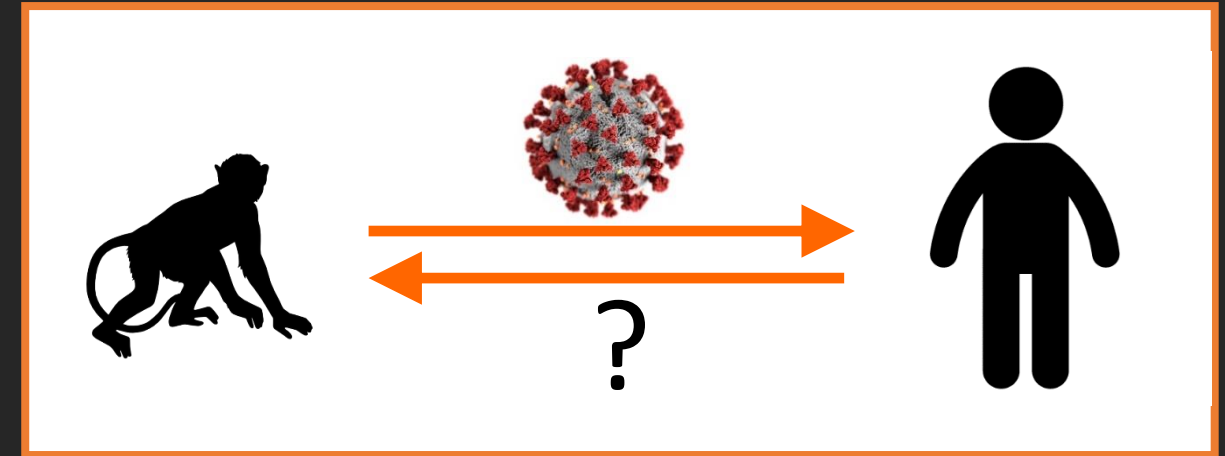




> 80% of all primate sp in Southeast Asia threatened with extinction



Emerging treats



Primate conservation?

Methods of monitoring threatened species with minimal disturbance, resources, manpower, and reduced human-primate interfaces



Thermal imaging with Uncrewed Aerial Vehicle

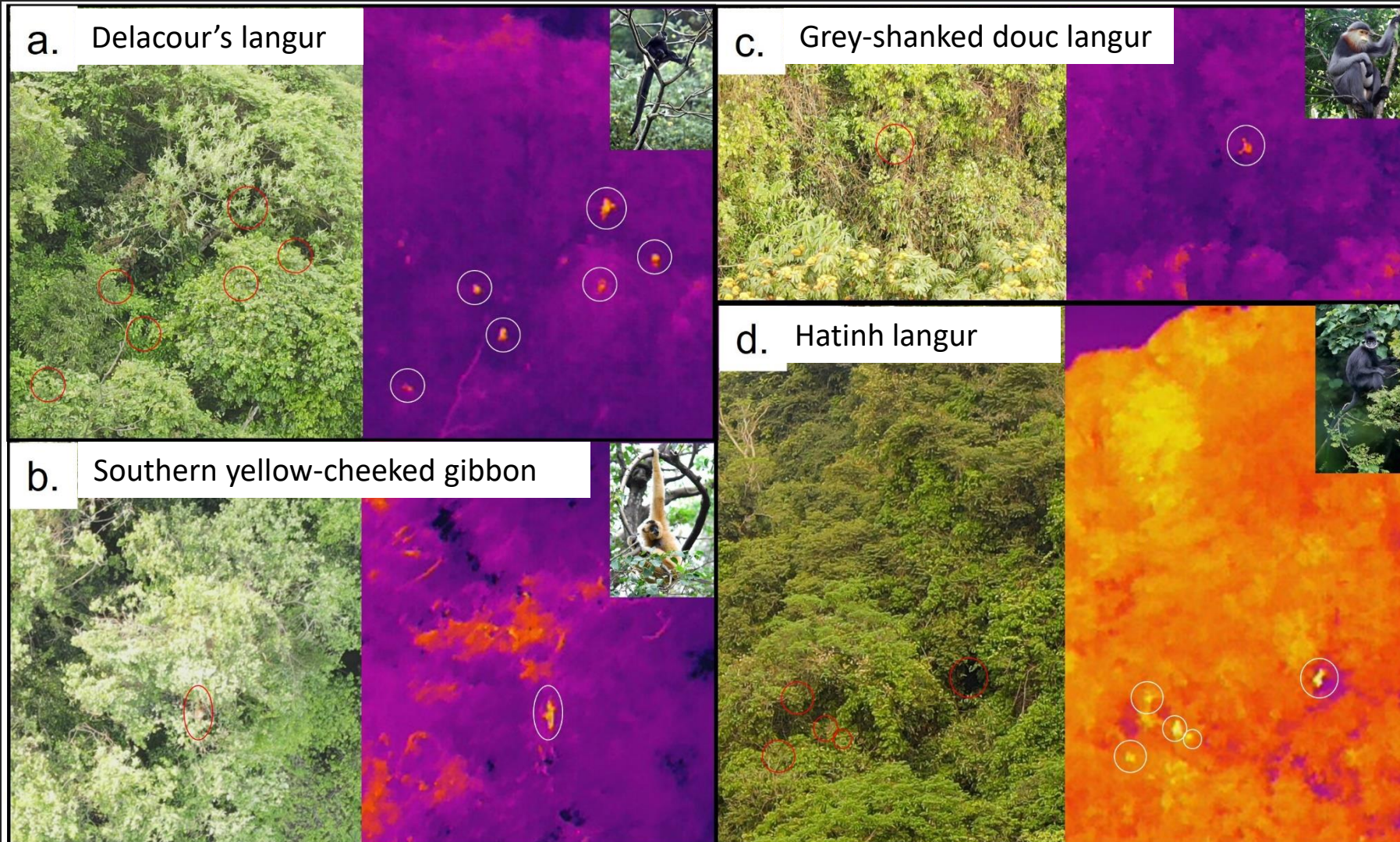


RGB and thermal infrared sensors

Increased probability of detection and group size estimates compared to standard visual monitoring !

No reaction of primates to drone flying > 40 m above the canopy

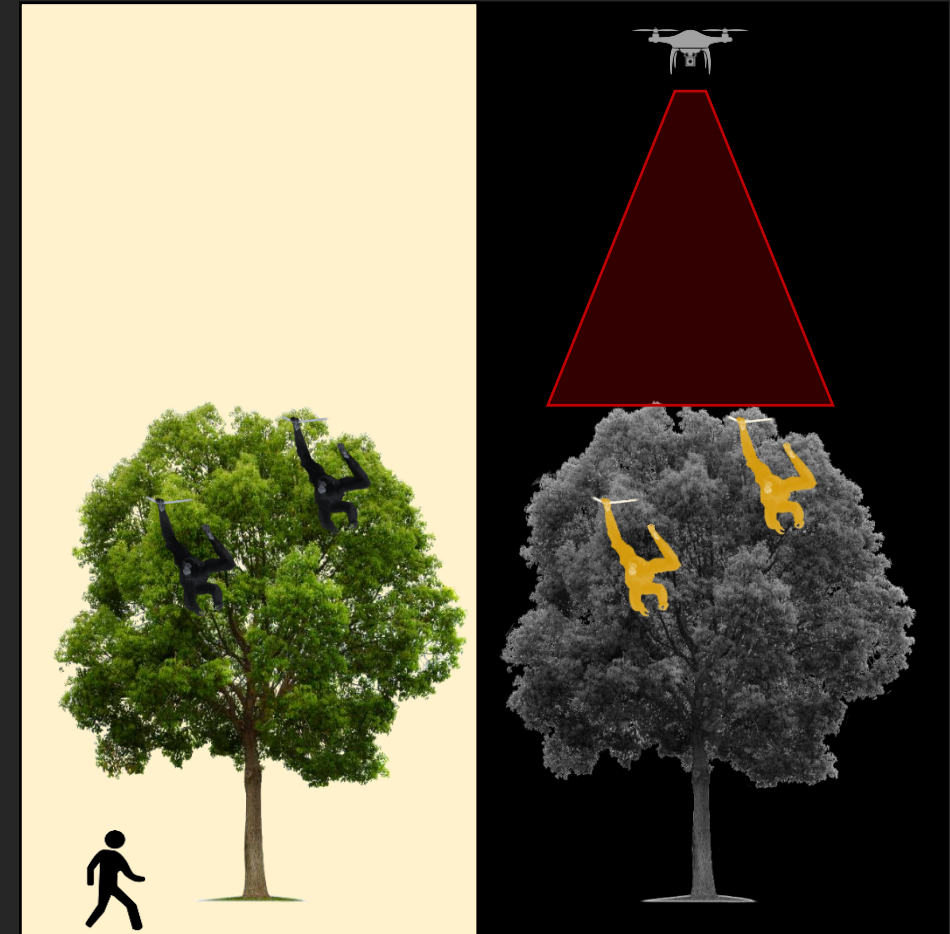
Gazagne *et al.* (2023) *Primates*



Objective

→ **Detection capabilities** of thermal drones to conduct primate census and explore the **relevance** of this methodology to **monitor primate communities**

Method: **Ground versus aerial survey**



Objective

→ **Detection capabilities** of thermal drones to conduct primate census and explore the **relevance** of this methodology to **monitor primate communities**



Which species can be detected and count?

Hypothesis: **Reliability species-specific** according to

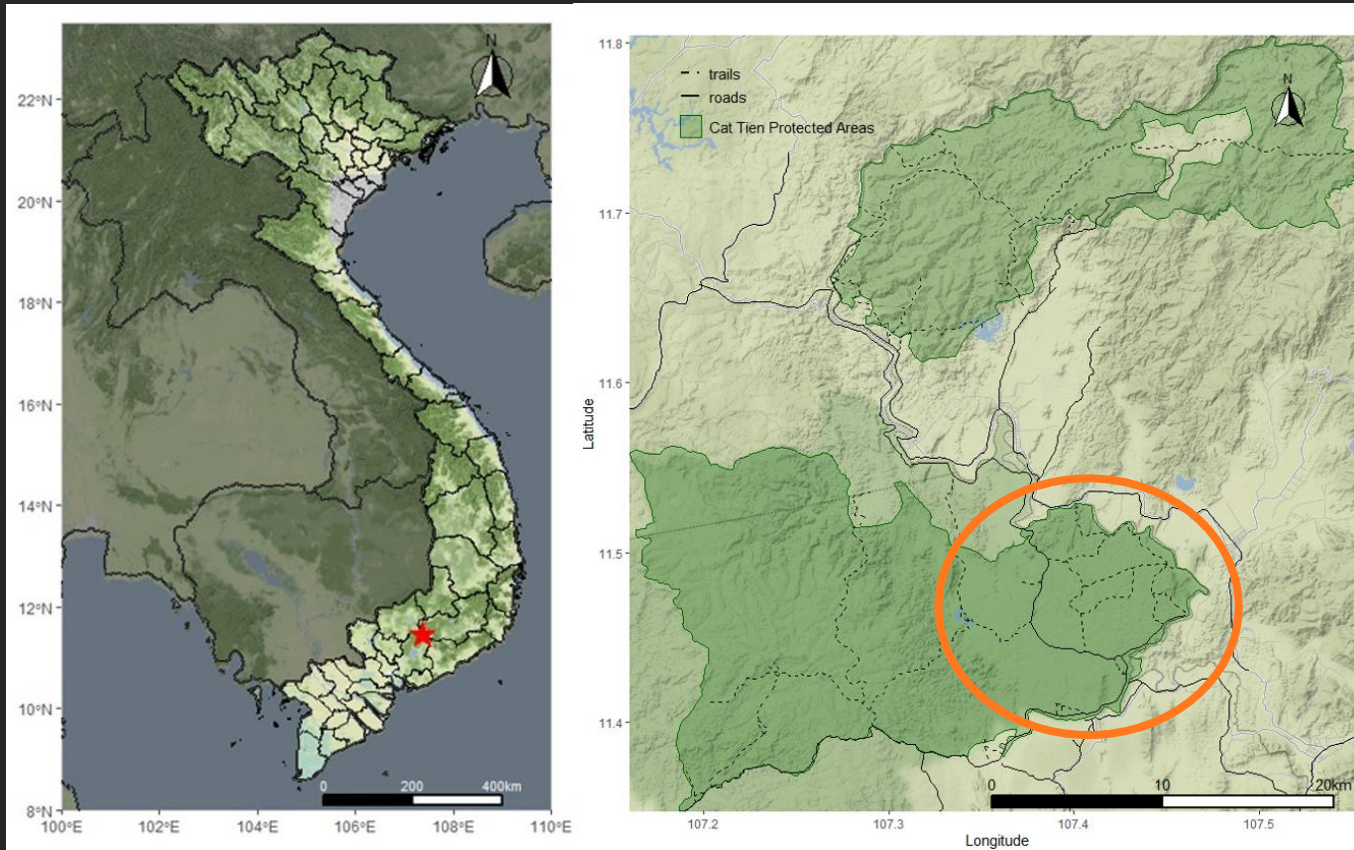
- body size,
- group size and home range size,
- Behavior: spatial organization at sleeping sites and reaction to drone



Study site and Study species

Cát Tiên National Park:

Lowland dry-evergreen forests in Eastern Nam Cát Tiên



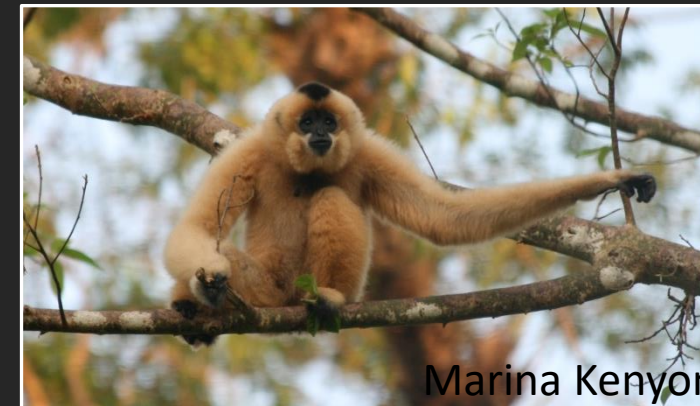
Study area ~100 km²



Black-shanked douc langurs
(*Pygathrix nigripes*) CR



Annamese
silvered langur
(*Trachypithecus
margarita*) EN



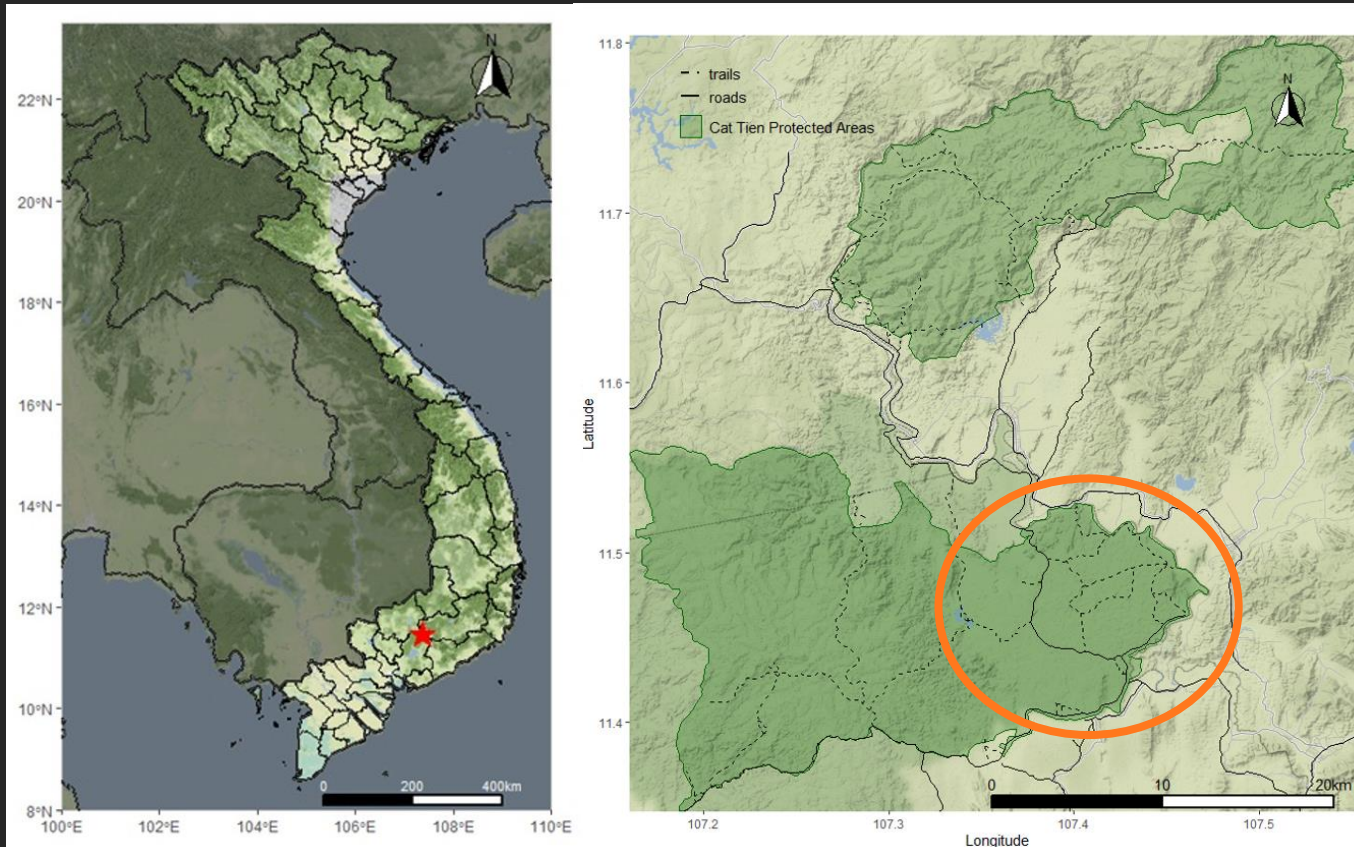
Marina Kenyon

Southern yellow-cheeked crested
gibbon (*Nomascus gabriellae*) EN

Study site and Study species

Cát Tiên National Park:

Lowland dry-evergreen forests in Eastern Nam Cát Tiên



Study area ~100 km²



Stump-tailed macaques (*Macaca arctoides*) VU



Northern pig-tailed macaques (*Macaca leonina*) VU



Long-tailed macaques (*Macaca fascicularis*) EN

Thermal Drone



Drone with thermal infrared radiometric sensor	DJI Mavic 3 Thermal
Price	~ 5500 euros
Flight time	45 min
Weight	920 g
Sensor resolution	640 × 512 pixels
Equivalent Focal Length	24mm, 48MP
Field of view	75° x 61°
Hybrid zoom	56 x



Ground

Survey methods

N = 132 surveys : 6 replicates along **N=22 1-km**

transects from 9th January-14th May 2023

5:30 am to 5:00 pm

79 min \pm SD 17 min

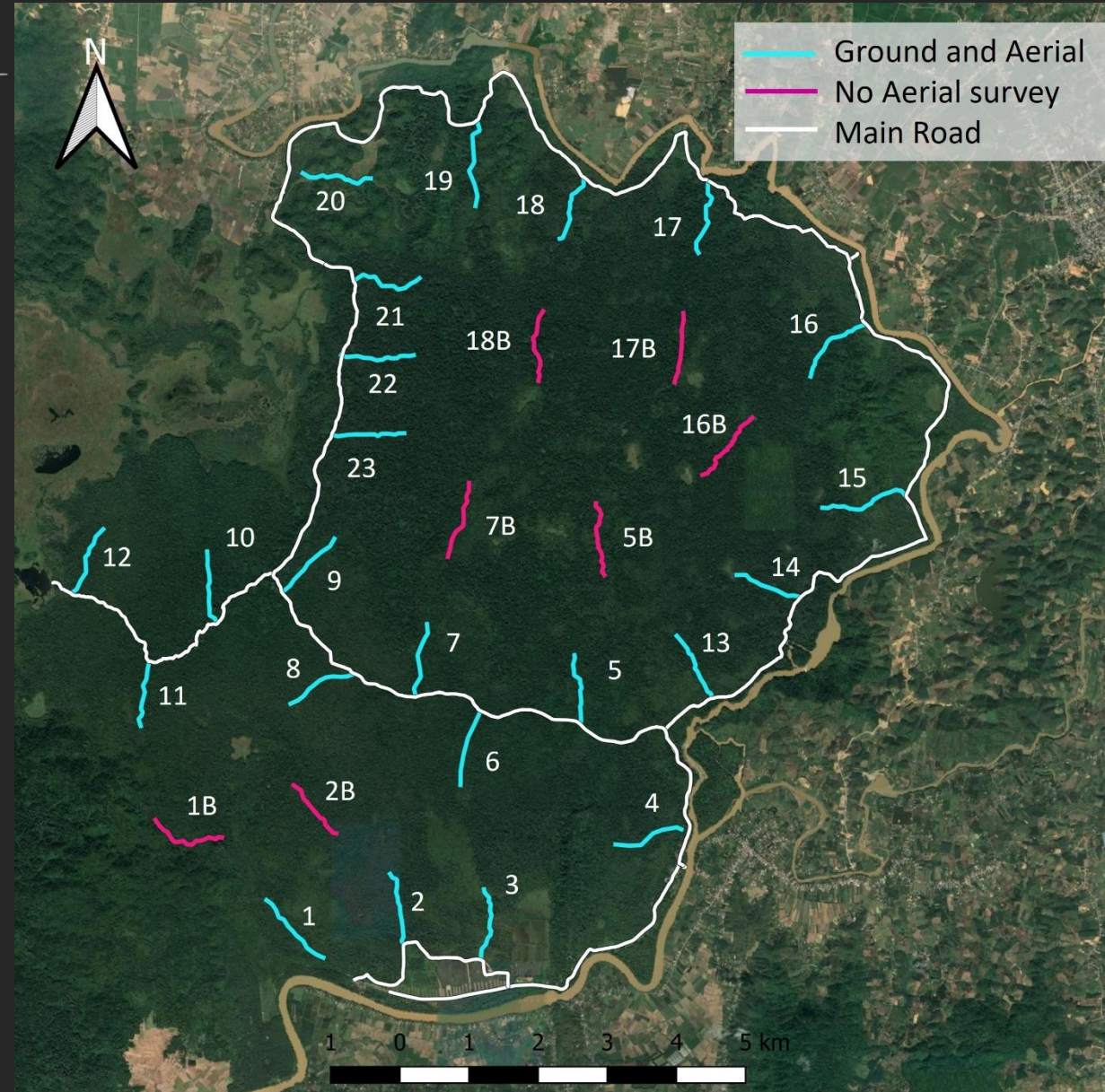
Aerial



5:05 am, N=111

7:46 pm, N=21

14 min \pm SD 2 min





Ground

Survey methods

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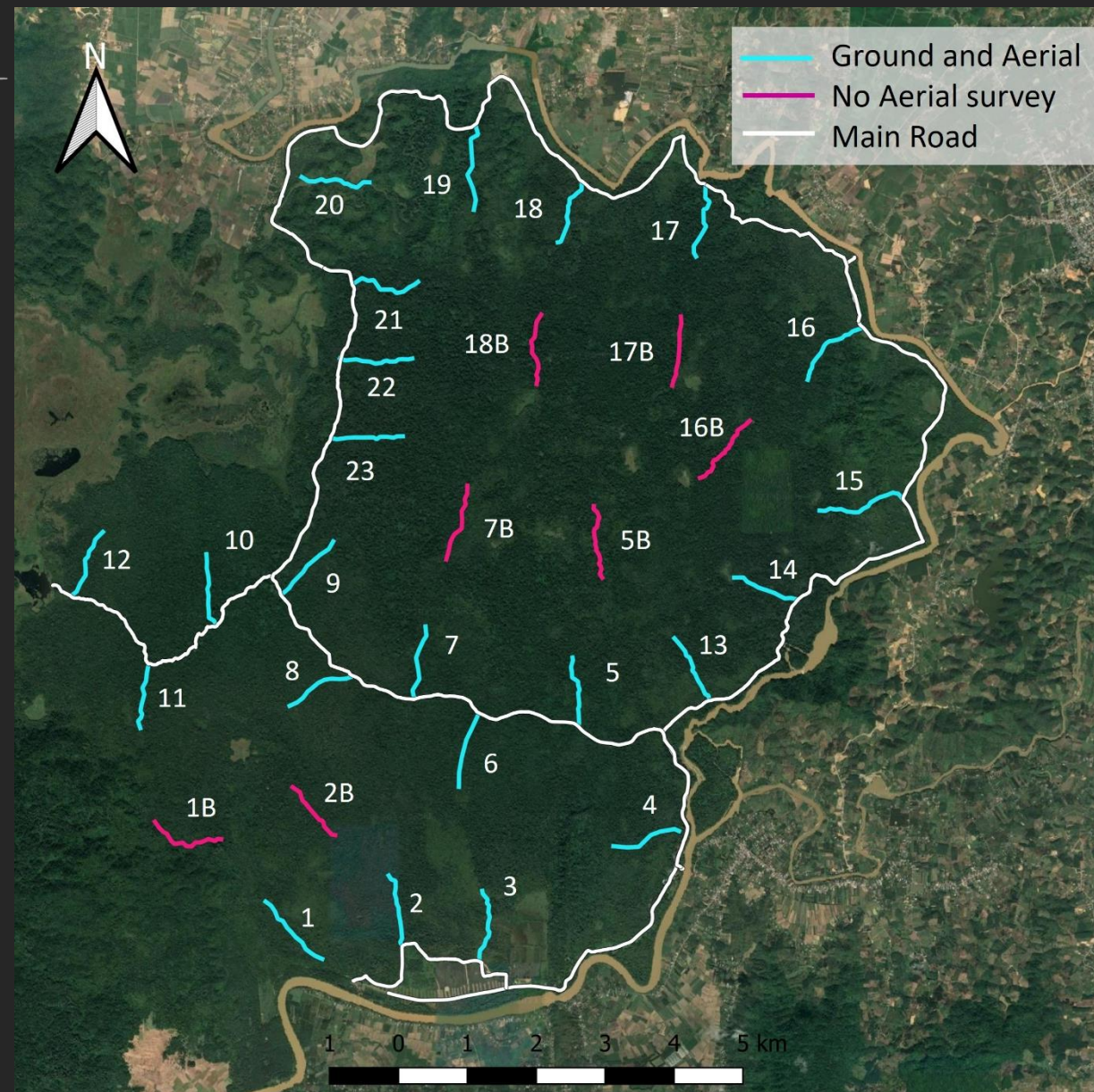
14 min \pm SD 2 min

Data collection

Species, number of individuals and groups, behavior, GPS coordinates, environmental data

Species' behavior at sleeping sites and reaction to the drone

Aerial



Aerial survey methods

Flights parameters:

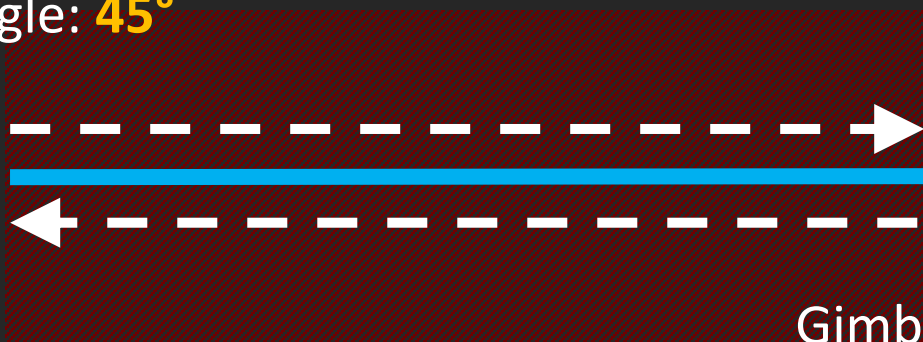
→ Pre-programmed flights: back (90°) and forward (45°)

→ 60-70 m from the ground level

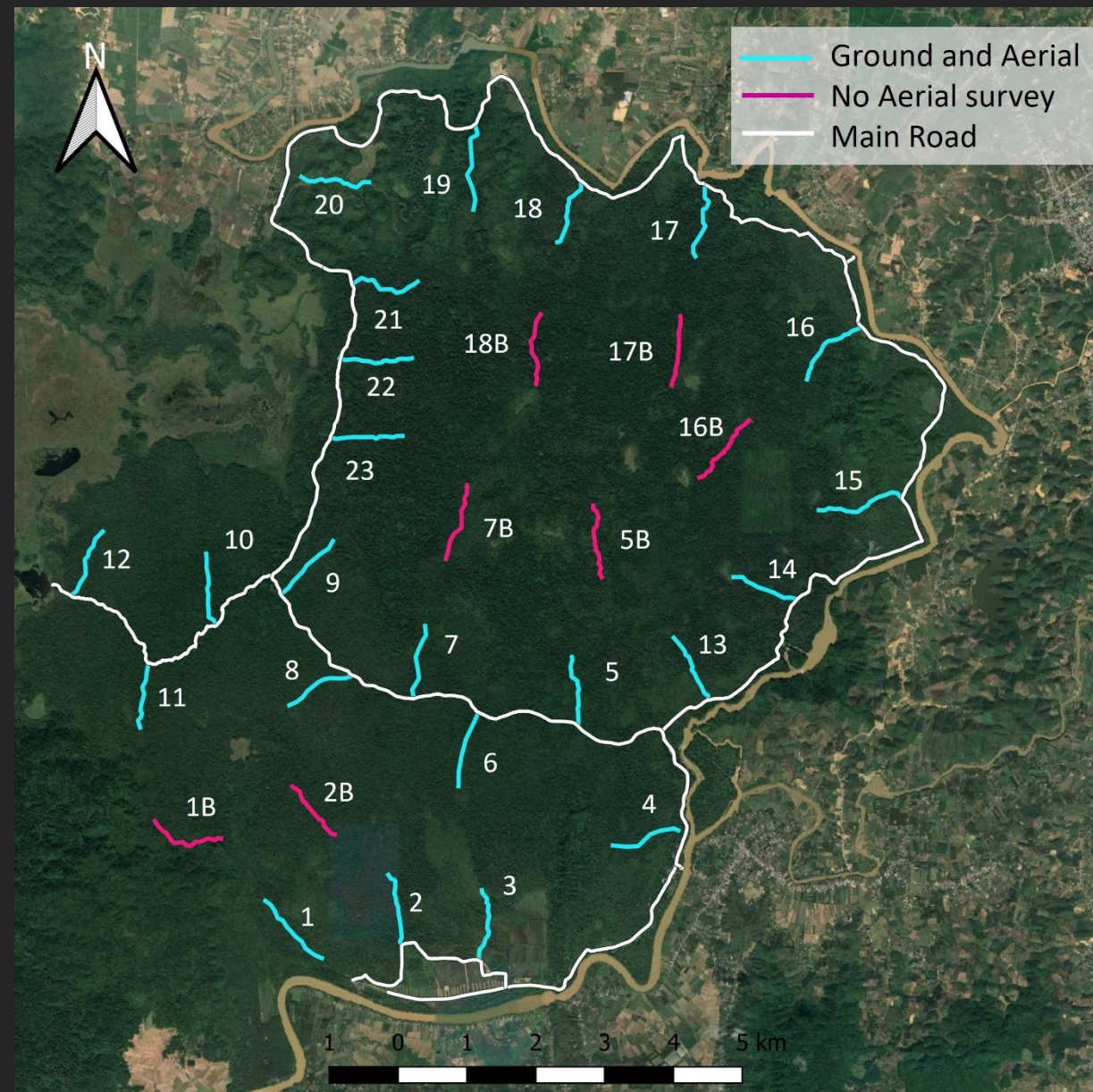
→ Flight speed 3 m.s^{-1}

Gimbal

angle: 45°



Gimbal
angle: 90°

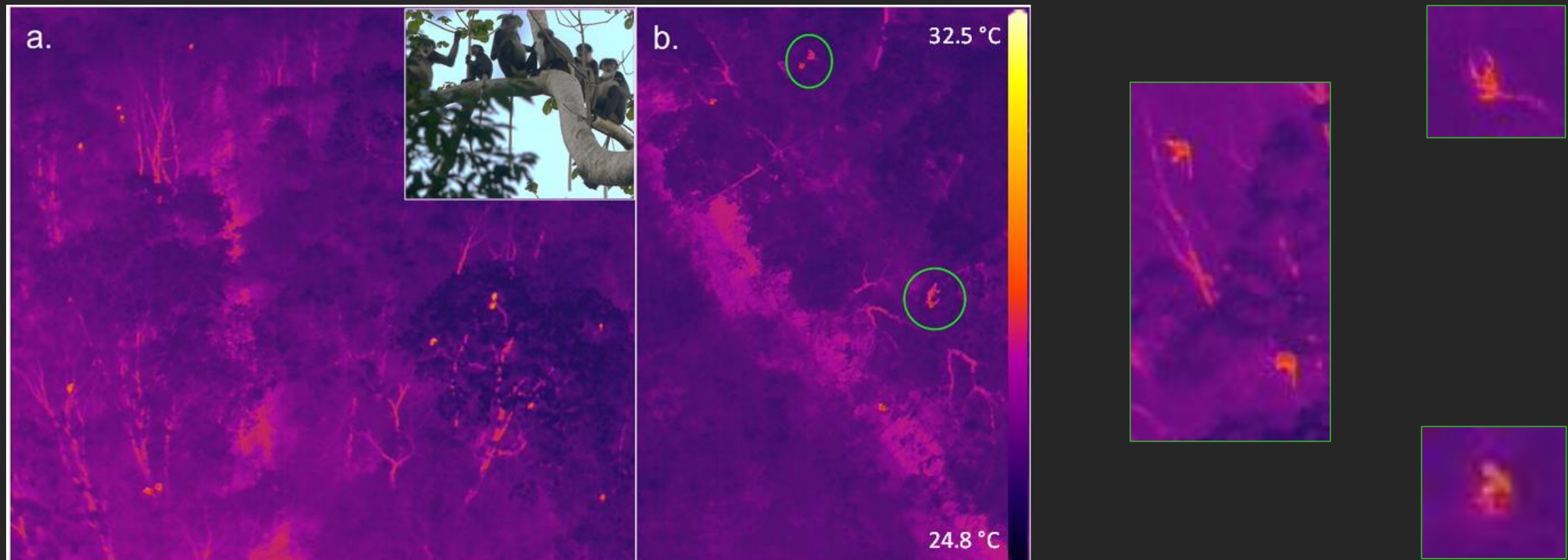


Reliability of thermal drone for each primate species



Reliability of thermal drone for each primate species

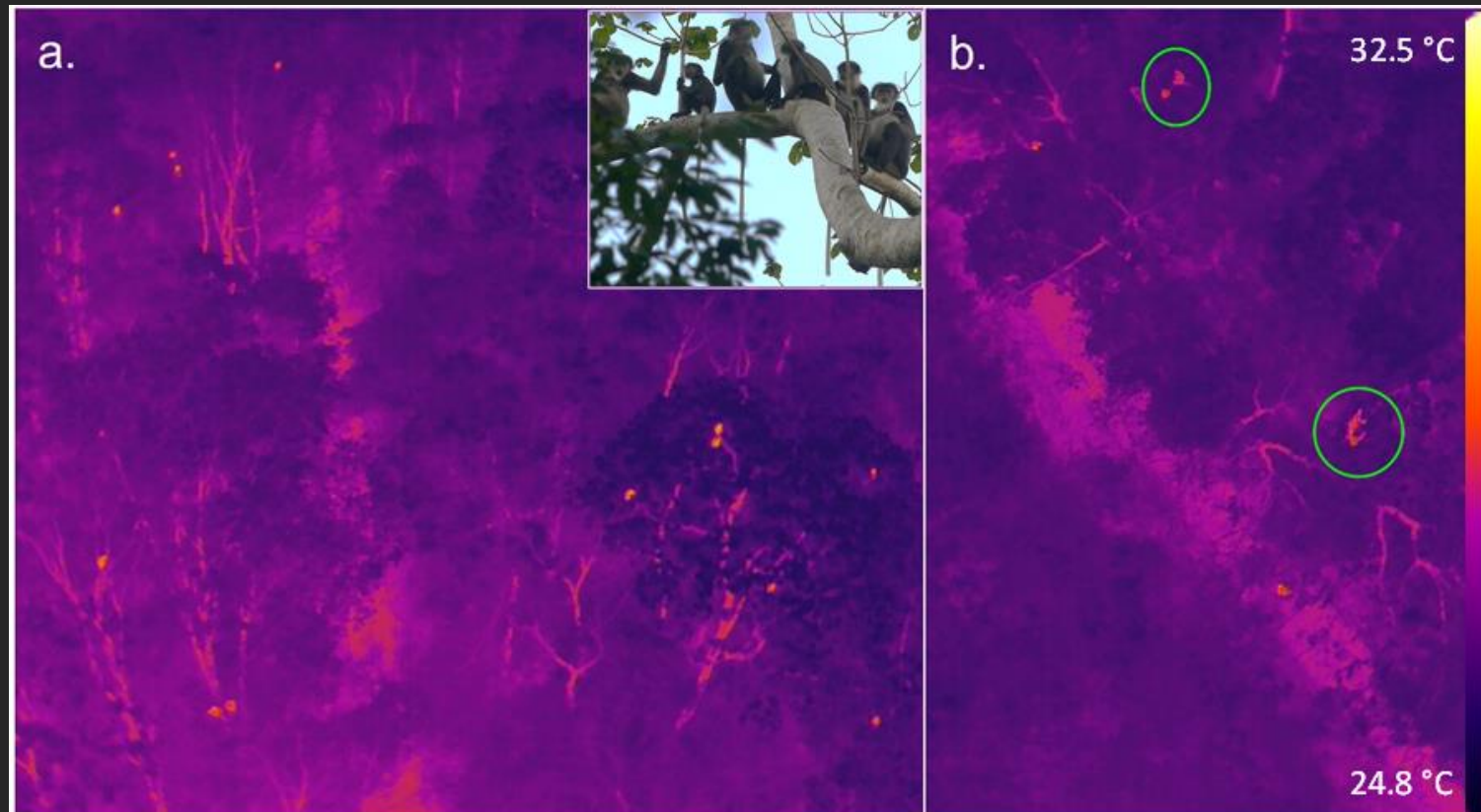
Black-shanked douc langurs



The average surface temperature was **28.5°C**, range: 22.6°C to 35.3°C (N=388)

Reliability of thermal drone for each primate species

Black-shanked douc langurs



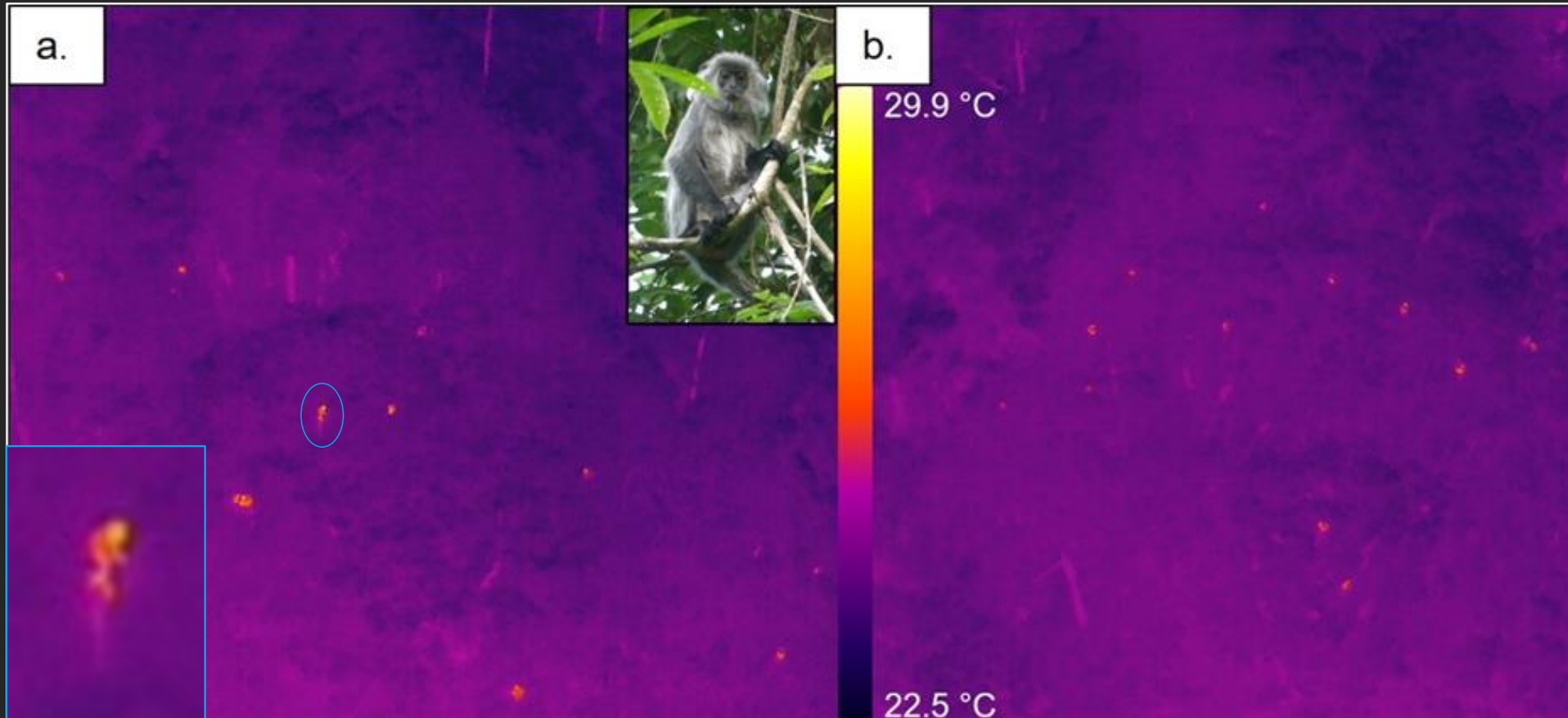
Behavior

- Sleep in emergent trees or high stata in the canopy
- Use few sleeping trees
- No visible response to the drone

The average surface temperature was **28.5°C**, range: 22.6°C to 35.3°C (N=388)

Reliability of thermal drone for each primate species

Annamese silvered langur



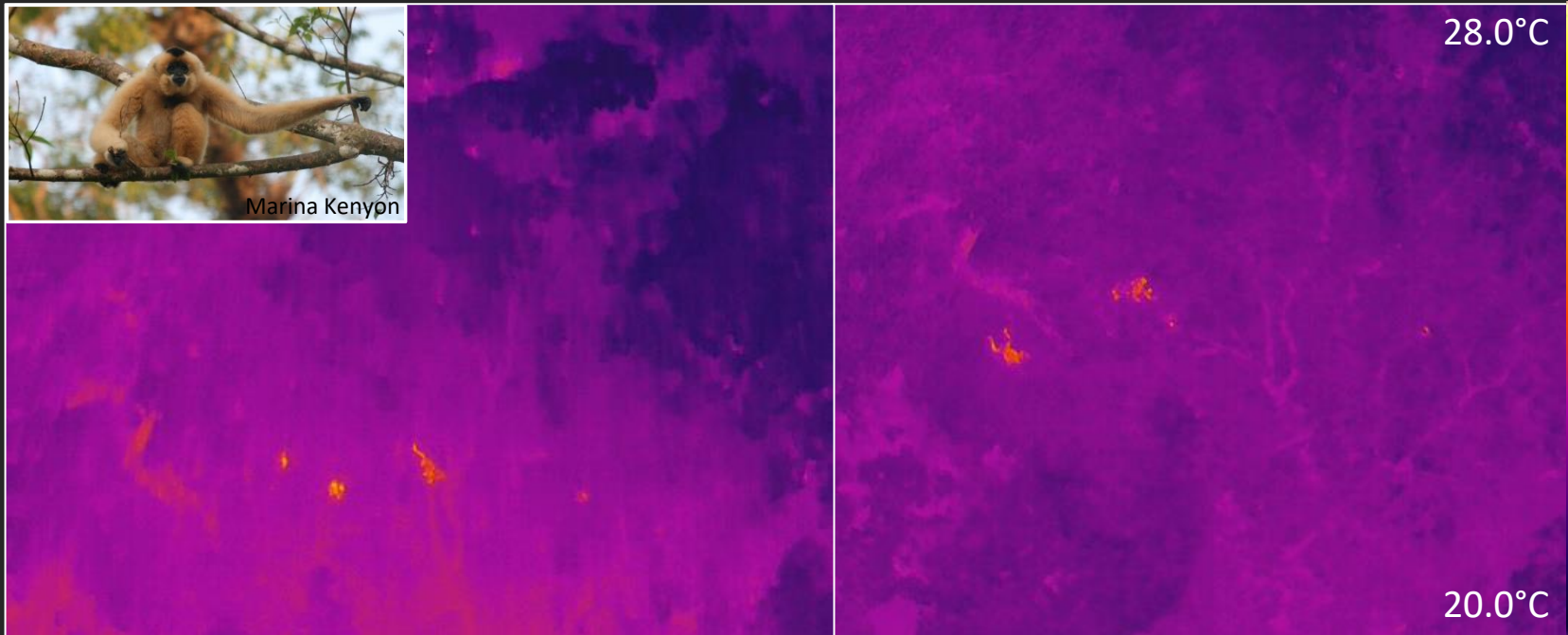
Behavior

- Sleep in low-high stata in the canopy
- Use few sleeping trees
- Movement (avoidance) or no visible response to the drone

The average surface temperature was **26.4°C**, range: 24.4°C to 29.9°C (N=109)

Reliability of thermal drone for each primate species

Southern yellow-cheeked crested gibbon



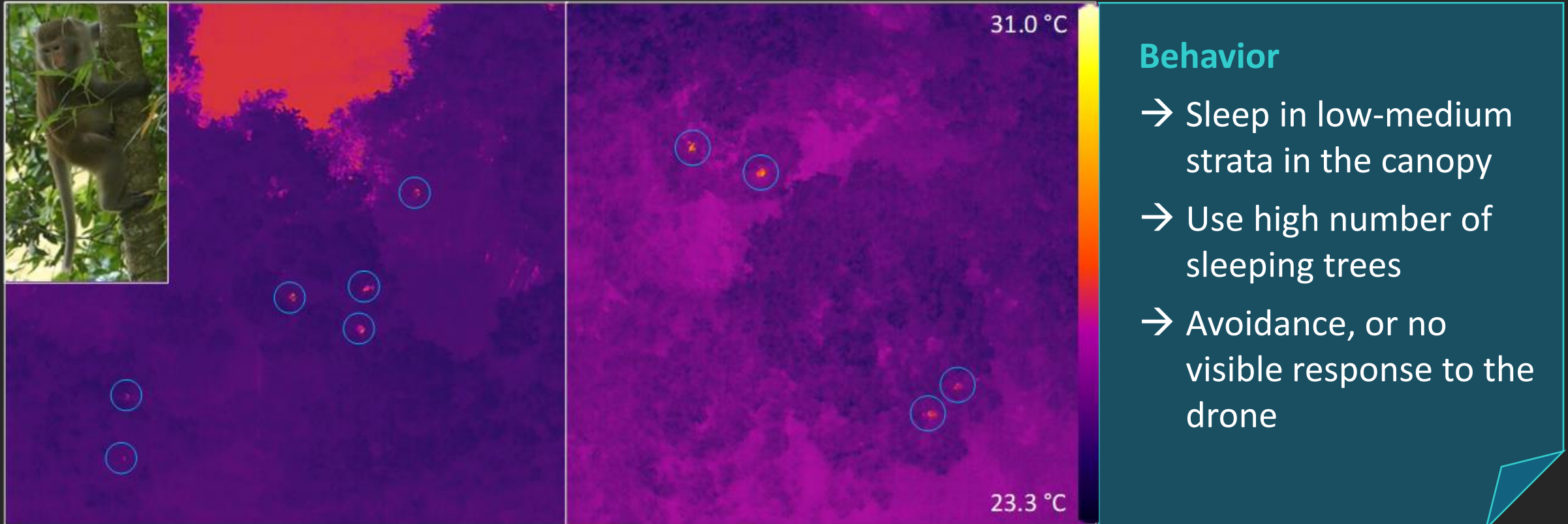
Behavior

- Sleep high stata in the canopy
- Use few sleeping trees
- Flight and avoidance, but return to sleeping trees

The average surface temperature was **24.8°C**, range: 20.6°C to 27.9°C (N=41)

Reliability of thermal drone for each primate species

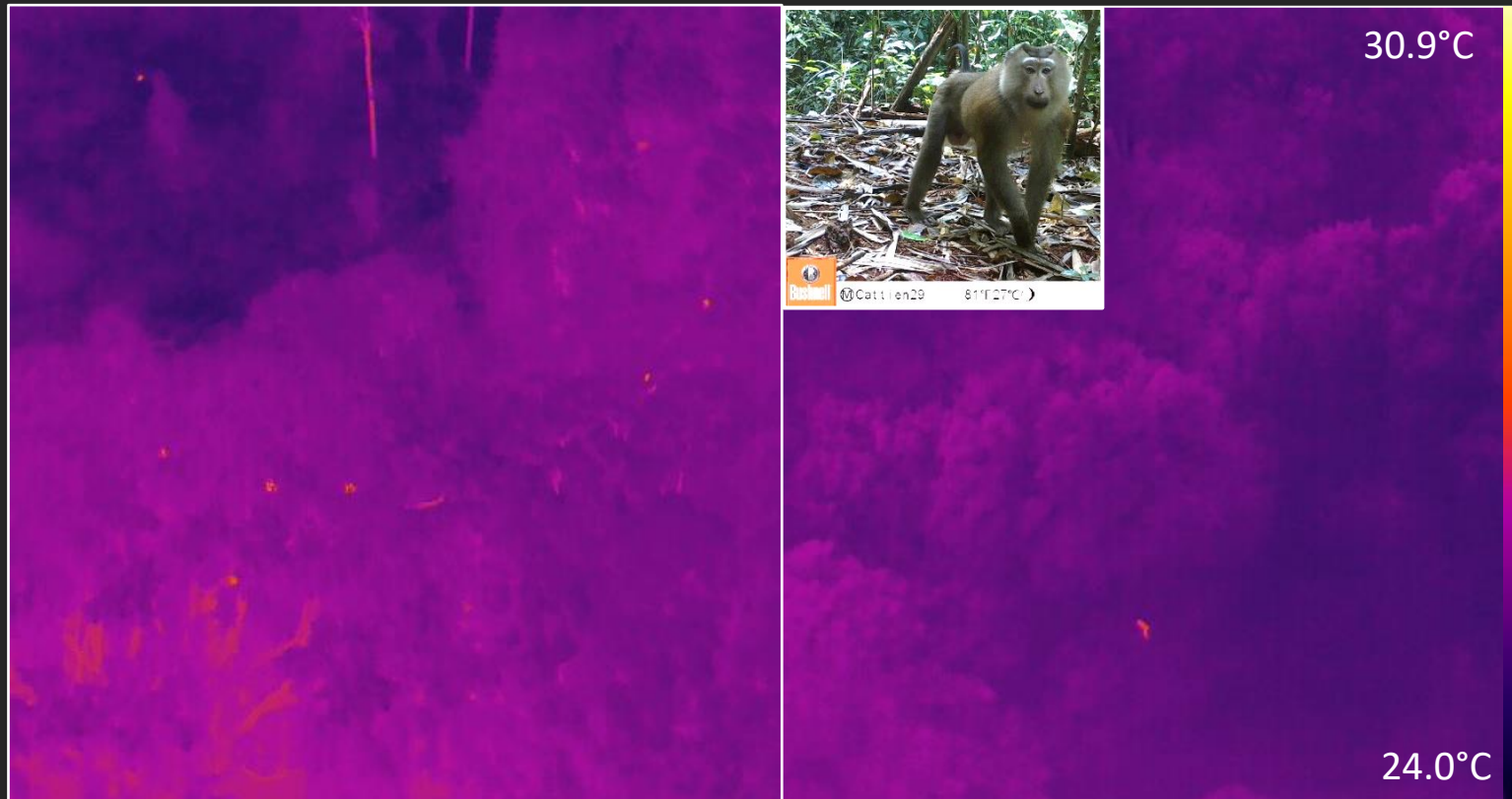
Long-tailed macaques



The average surface temperature was 27.7°C , range: 24.0°C to 33.7°C (N=66)

Reliability of thermal drone for each primate species

Northern pig-tailed macaques



Behavior

- Sleep in low-medium strata in the canopy
- Use high number of sleeping trees
- Flight, avoidance, or no visible response to the drone

The average surface temperature was **29.2°C**, range: 24.8°C to 32.4°C (N=60)

Reliability of thermal drone for each primate species

Stump-tailed macaques ?



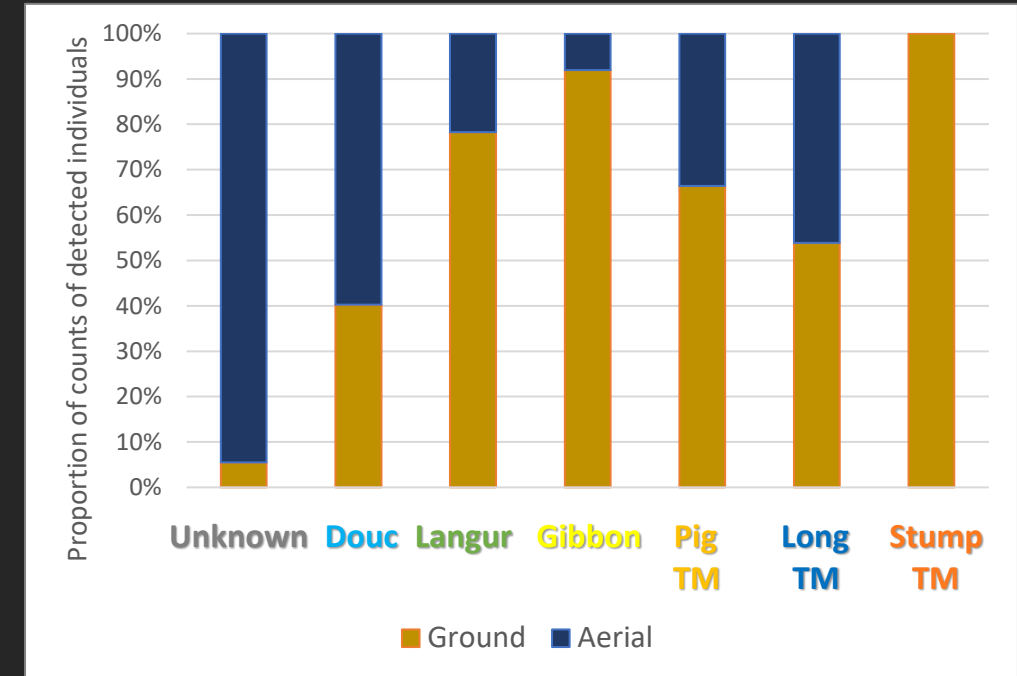
→ No identification with aerial survey...

Reliability of thermal drone for each primate species



Counts of detected individuals

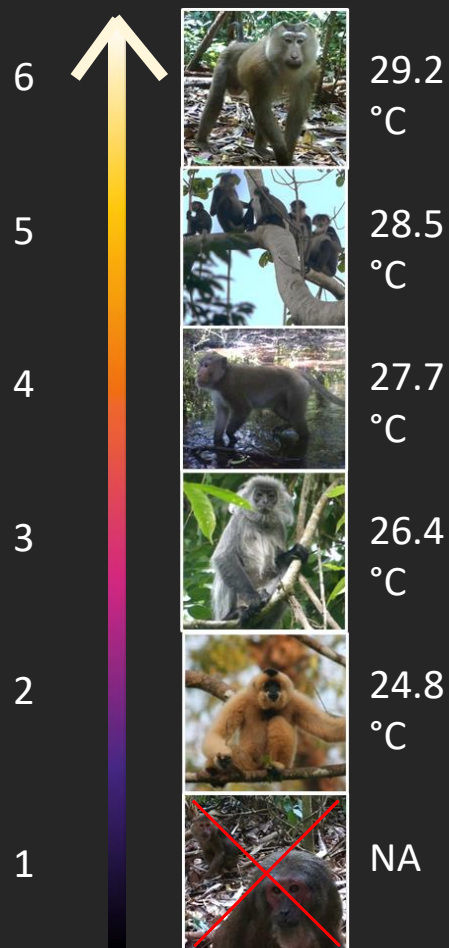
	Ground survey	Aerial survey
Unknown	15	256
Douc	696	1033
Langur	54	15
Gibbon	125	11
PigTM	435	220
LongTM	111	95
StumpTM	13	0
Total count	1449	1723



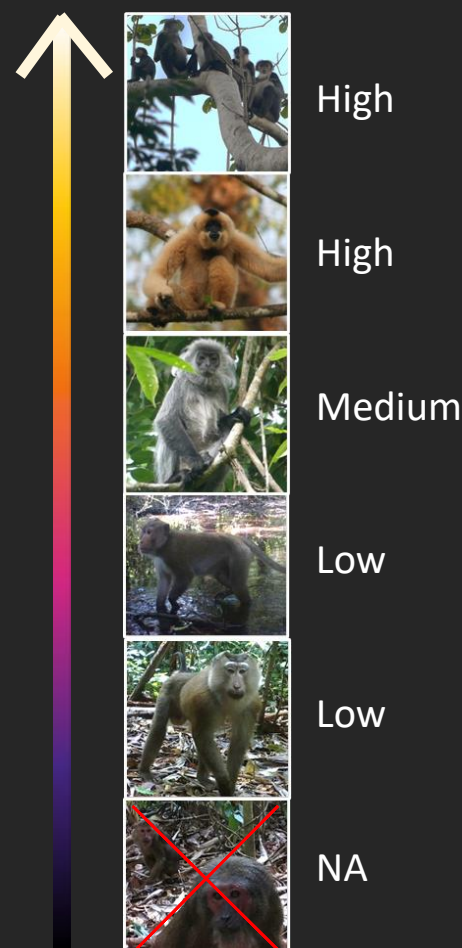
→ Higher number of Detection with the thermal drone but better species identification with ground survey!

Reliability of thermal drone for each primate species

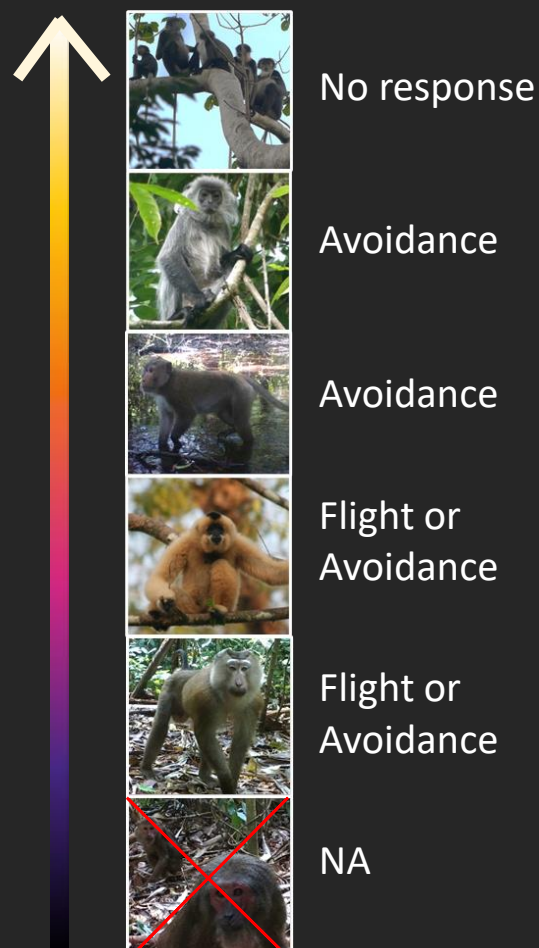
Detected surface temperature



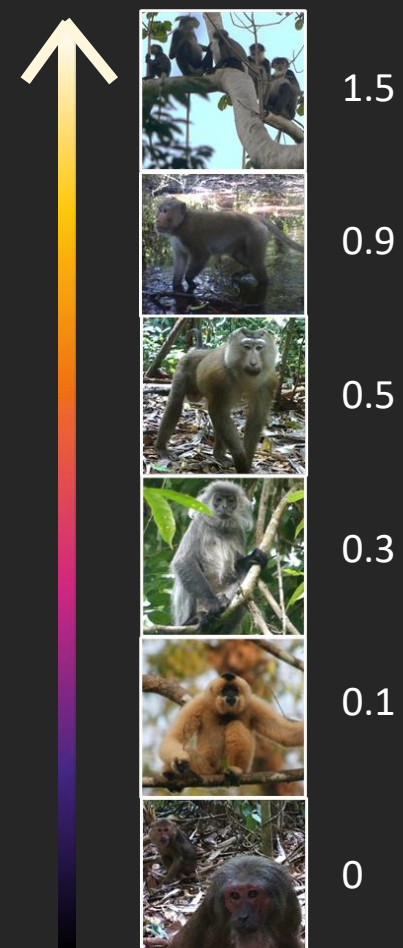
Accurate count at sleeping sites



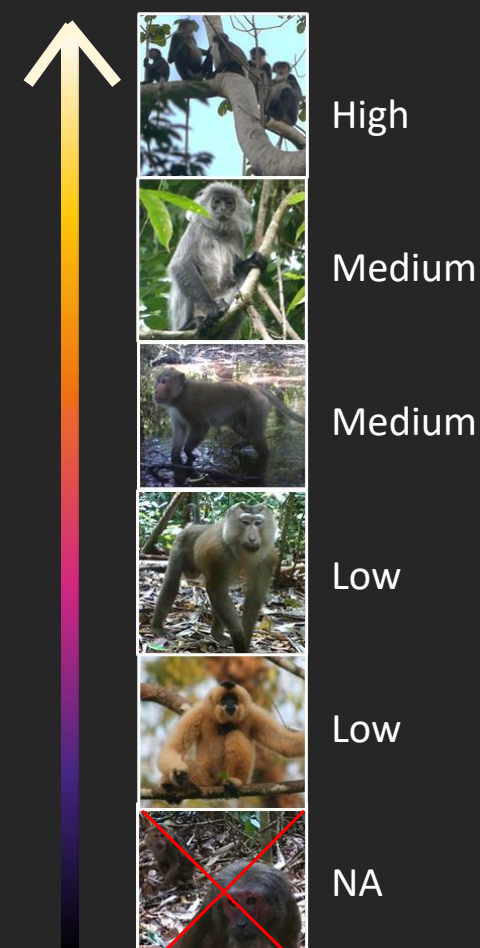
Response to drone



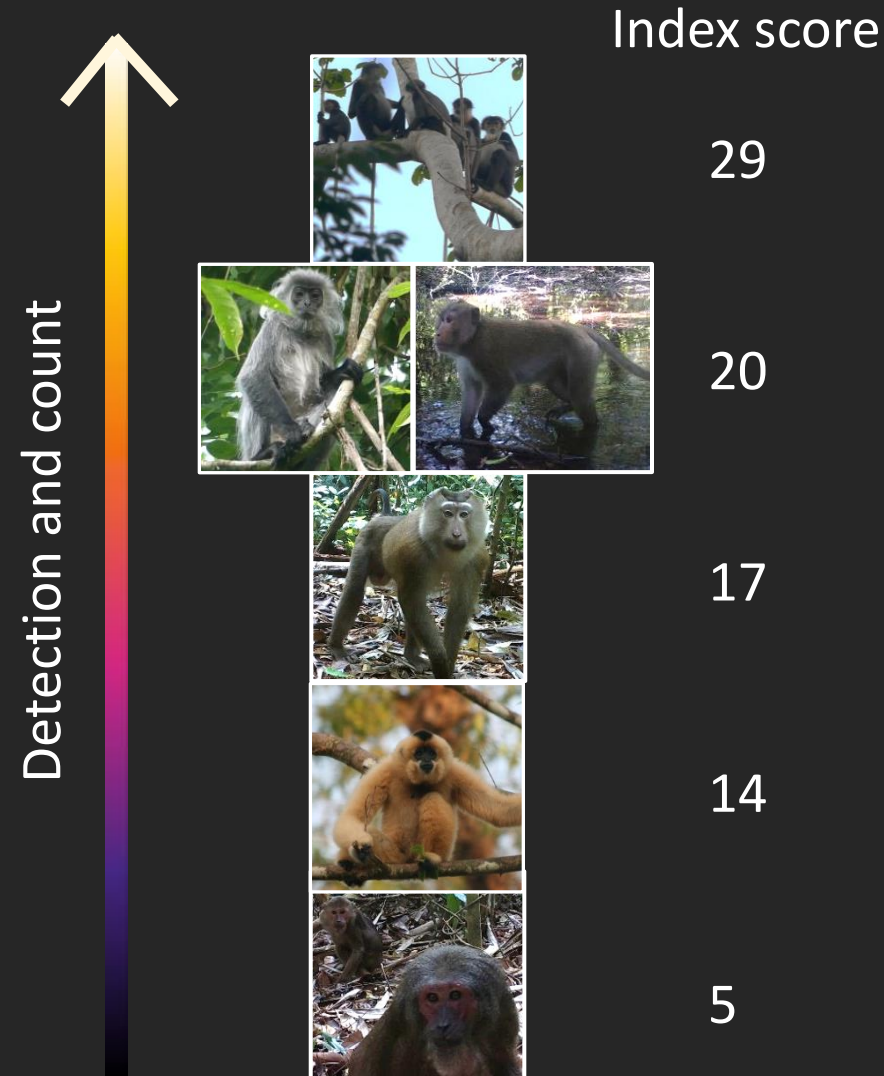
Nb count aerial/ Nb count ground survey



Identification based on thermal image



Thermal detection index based on results



Thermal detection Index based on literature

Index	Body size (cm)	Group size	Density (Ind/km ²)	Canopy height (m)	Tolerance to novelty
1	< 30	1	< 1	0	Flight
2	> 30-40	2-6	> 1-5	> 0-5	Avoidance and Flight
3	> 40-50	> 7-20	> 5-10	> 5-15	Avoidance
4	> 50-60	> 20-60	> 10-15	> 15-25	No visible reactions and avoidance
5	> 60	> 60	> 15	> 25	No visible reactions

Species	Body size	Group size	Dens.	Can. H.	Tol. to novelty	Index total
<i>Pygathrix nigripes</i>						
<i>Trachypithecus margarita</i>						
<i>Macaca fascicularis</i>						
<i>Macaca leonina</i>						
<i>Nomascus gabriellae</i>						
<i>Macaca arctoides</i>						
<i>Nycticebus pygmaeus</i>						

Thermal detection Index based on literature

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Black-shanked douc langurs
(*Pygathrix nigripes*) CR



Species	Body size	Group size	Dens.	Can. H.	Tol. to novelty	Index total
<i>Pygathrix nigripes</i>	4	3	4	5	5	21
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Annamese silvered langur
(*Trachypithecus margarita*) EN



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<i>Trachypithecus margarita</i>	3	4	2	4	4	17
<i>Macaca fascicularis</i>						
<i>Macaca leonina</i>						
<i>Nomascus gabriellae</i>						
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Long-tailed macaques
(*Macaca fascicularis*) EN



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<i>Trachypithecus margarita</i>	3	4	2	4	4	17
<i>Macaca fascicularis</i>	3	4	2	4	4	17
<i>Macaca leonina</i>						
<i>Nomascus gabriellae</i>						
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Northern pig-tailed macaques
(*Macaca leonina*) VU



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<i>Pygathrix nigripes</i>	4	3	4	5	5	21
<i>Trachypithecus margarita</i>	3	4	2	4	4	17
<i>Macaca fascicularis</i>	3	4	2	4	4	17
<i>Macaca leonina</i>	4	5	2	3	2	16
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Southern yellow-cheeked crested gibbon (*Nomascus gabriellae*)
EN



Marina Kenyon

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<i>Nomascus gabriellae</i>	3	2	3	5	2	15
<i>Macaca arctoides</i>	4	5	1	3	1	14
<i>Nycticebus pygmaeus</i>						

Stump-tailed macaques (*Macaca arctoides*) VU



Thermal detection Index based on literature

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<i>Nomascus gabriellae</i>	3	2	3	5	2	15
<i>Macaca arctoides</i>	4	5	1	3	1	14
<i>Nycticebus pygmaeus</i>	1	1	1	4	5	12

Pygmy slow loris
(*Nycticebus pygmaeus*) EN



Thermal detection Index based on literature



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<i>Nycticebus pygmaeus</i>	1	1	1	4	5	12

→ **Global scale meta-analysis** on all primates' taxon to predict the feasibility per species of using a thermal drone (Gazagne *et al.*, in prep)

Reliability of thermal drone for each primate species ?



Reliability of thermal drone for each primate species ?



Potentially all according to the study site!



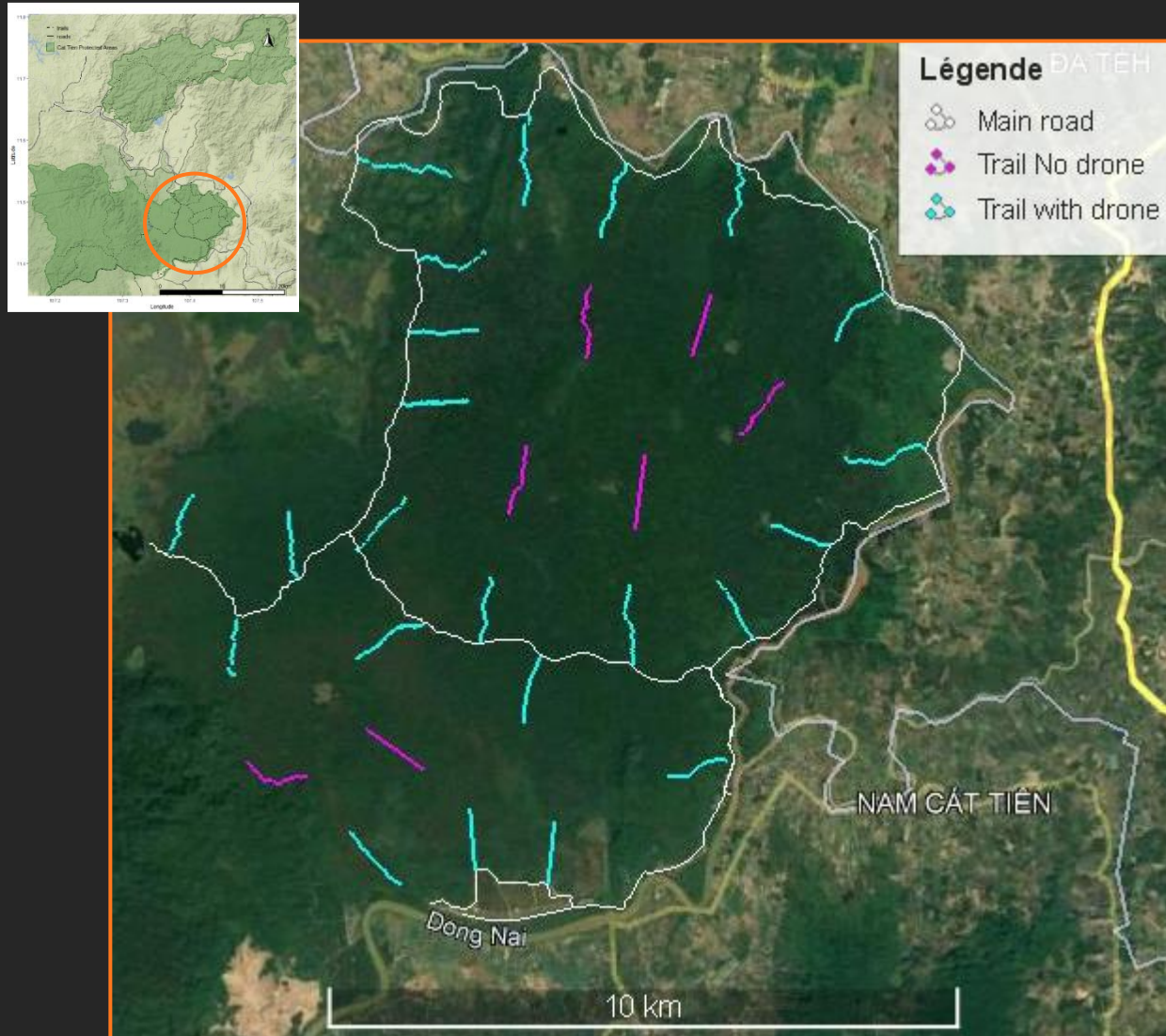
Reliability of thermal drone for each primate species ?



Thermal drone could be effective for langurs long-term monitoring

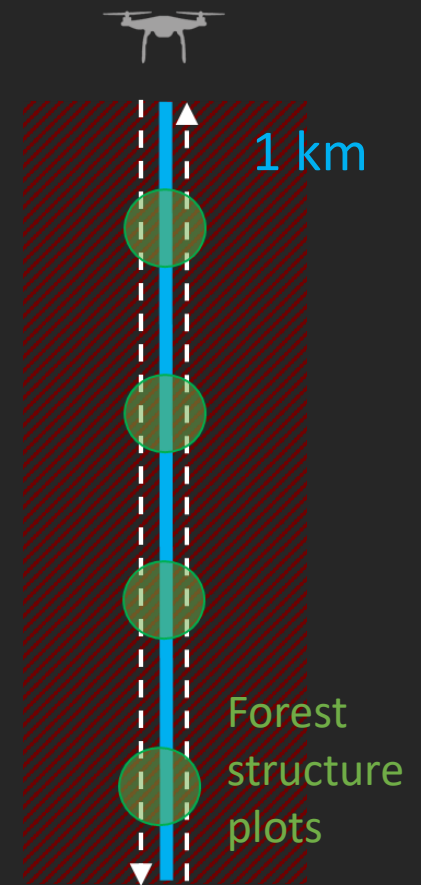
→ Study on black-shanked douc langurs sleeping site selection
(Gazagne *et al.*, in prep)

Outlook for Monitoring Primate Communities



Estimate **probability of occupancy** and **detection**
(Gazagne *et al.*, in prep)

→ Comparisons of species diversity and distribution at different sites in relation to ecological variables



Pros and Cons of Thermal drone use!



- Low disturbance
- Allow detection and count of elusive species and detection of elusive behaviors
- Bring new insight on species habitat use and sleeping site selection
- Fast survey

- Weather (temperature, wind, rain), temporal, and biological limitations
- Battery limitation
- Transmission/signal issue with the receiver depending on the terrain, canopy height, vegetation density...
- Cannot survey remote/large areas
- Regulation and price...



Primates census with thermal drones: A New Horizon



Systematic methodology for primate species census!

Acknowledgement

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 Mr. Pham Xuan Thinh (Cat Tien National Park, Vietnam)
 Mr. Nguyen Van Thanh (Cat Tien National Park, Vietnam)
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 Dr. Dusit Ngoprasert (Conservation Ecology Program, KMUTT, Thailand)
 Endangered Primate Rescue Center (Cuc Phuong, Vietnam)



Contact: evagazagne@live.fr and Eva.Gazagne@uliege.be

