Advancing Wildlife Monitoring:
Drone-Based Sampling for Roe Deer Density Estimation

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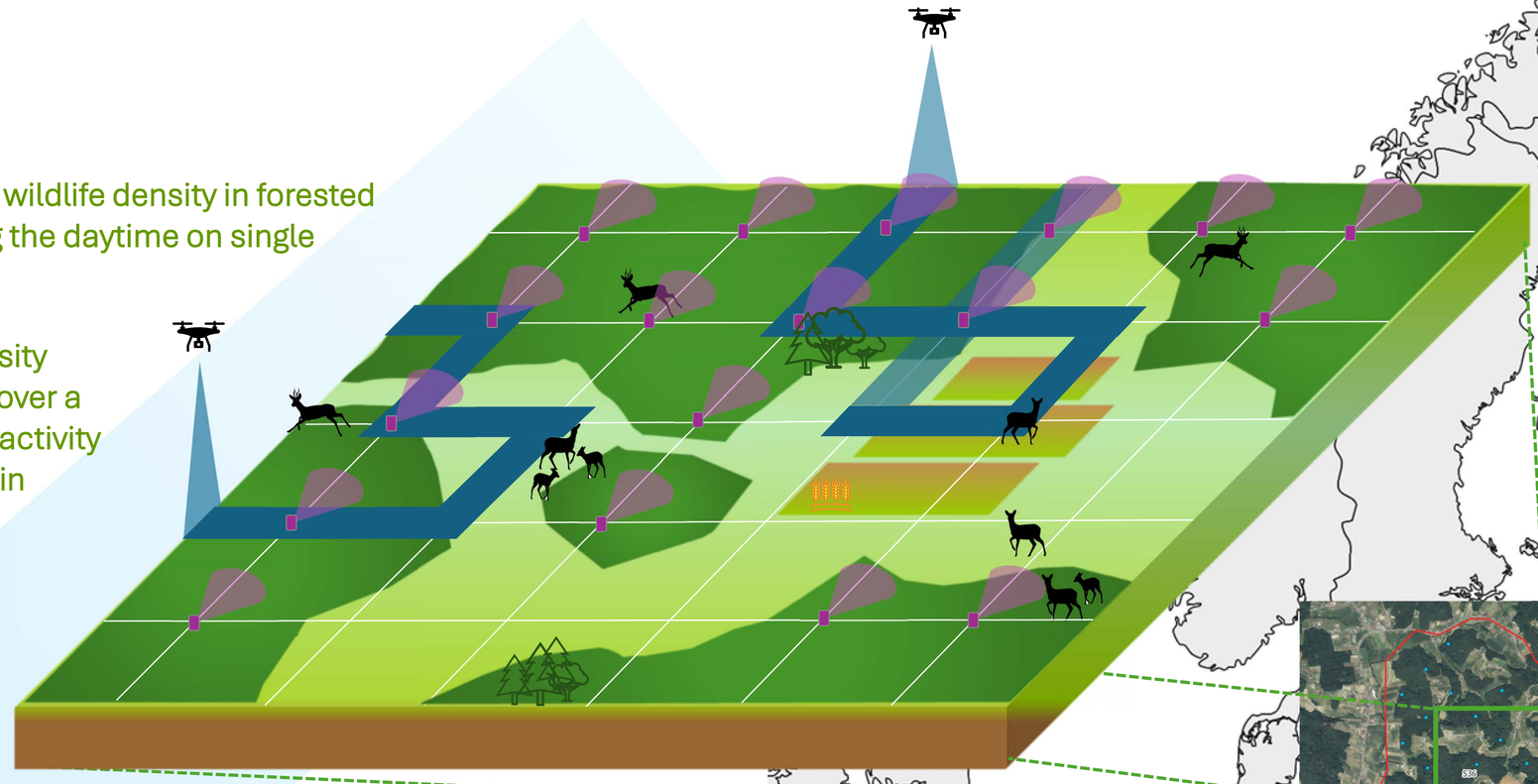
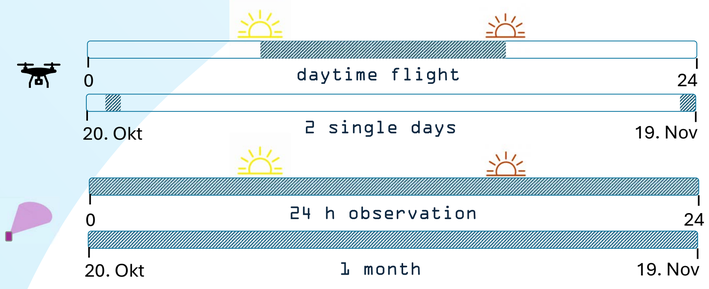
Drone derived density reflects wildlife density in forested and non-forested areas during the daytime on single days.

Camera trap derived REM density represents an averaged value over a month-long period, capturing activity throughout the entire day within forested areas.

Although both methods aim to estimate density, they offer fundamentally different perspectives on wildlife activity.





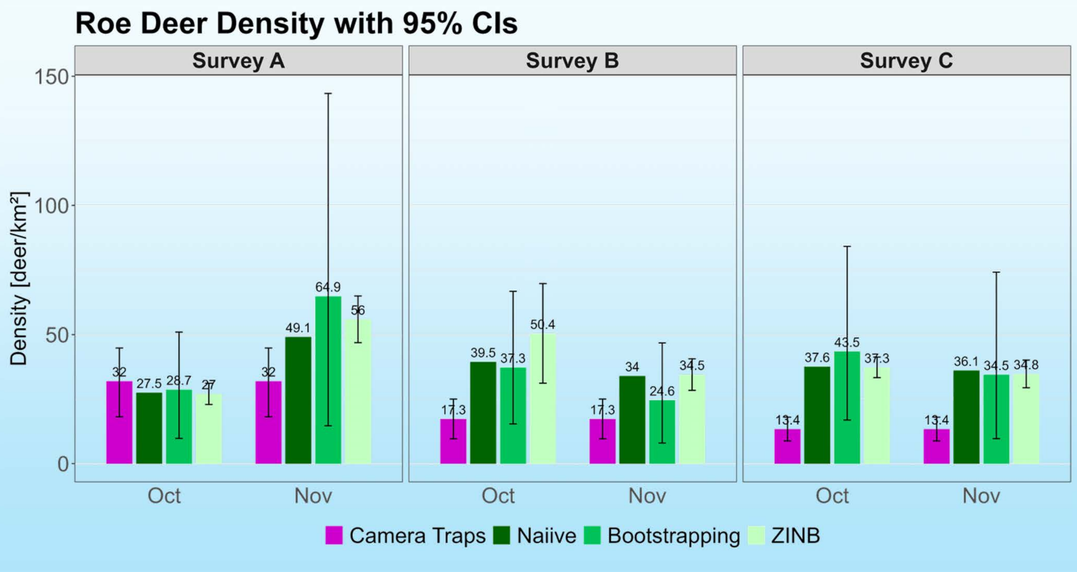
Methods & Study Area

Study area	3 areas: A, B and C Size: 2.98 - 5.49 km^2 Elevation: 267 - 476 m a.s.l.
Drone flights	Transect length: 350 m Flight altitude: 60 m AGL
Camera traps	Units: 21 (A), 22 (B and C) 350 m grid
Naiive extrapolation	Sightings/total flown area (km^2) *100
Bootstrapping transect densities	Sightings/km^2 per transect 1.000 iterations
Modelling	Count data models Controlling for transect size Zero inflated negative binomial (ZINB)

Results

In a total of 227 transects, between 11.9 and 25.5% of the area was covered per flight day and area. The number of roe deer sightings ranged from 21 to 37. Camera trap (CT) densities ranged from 13.4 to 32.0 deer/km^2. Drone estimates per flight day ranged from 27.0 to 64.3 deer/km^2. An analysis of variance shows weakly significant differences between the methods used ($F = 3.57$, $p = 0.038$). A post hoc Tukey test shows no differences between the three drone estimates in detail, but weakly significant differences between the bootstrapping and ZINB methods with CT density ($p = 0.038$ and $p = 0.026$, respectively).

	Size (km^2)	Flight month	Covered area (km^2)	Covered area (%)	Sightings	Transects with sightings (%)	Number of transects
Survey A	2.98	Oct	0.76	25.5	21	22.5	40
		Nov	0.51	17.1	25	28.6	28
Survey B	5.49	Oct	0.94	17.1	37	27.7	47
		Nov	0.74	13.5	25	22.2	36
Survey C	5.36	Oct	0.93	17.4	35	37.8	45
		Nov	0.64	11.9	23	34.3	31



Extrapolation of count data showed significant similar density results for three methods with increasing complexity

- Naïve area-based extrapolation
- Bootstrapping transect densities
- Modelling using a zero-inflated negative binomial distribution (ZINB)

and significant differences to CT-derived REM densities.

Download detailed information about the poster content

arxiv.org/abs/2508.03545

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