Searching for spots: a comprehensive survey for the Arabian leopard *Panthera pardus nimr* in Saudi Arabia

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SUPPLEMENTARY MATERIAL 1 Methods.

Camera trap methods

After each camera deployment, a board with the exact date and time was held in front of the camera to record a date/time calibration image. Each image was labelled with the site, station, and unique camera ID and automatically recorded the image details such as image number, and date and time taken. Before data processing, a date/time offset was applied to all images to correct any inaccuracies. The automatic camera date/time was adjusted to reflect the date/time-calibration image for each camera.

Questionnaire Survey grid selection

When selecting questionnaire grid cells to survey, human population density was considered as an important factor. Human impacts demonstrably negatively affect leopard density (Rogan et al., 2022) so if the mean human population density was greater than 1 person per km^2, these cells were excluded without replacement. In Saudi Arabia, this density overlapped closely to major urban developments and were predominantly outside main leopard habitat. Of these, the mean density was 3.84 ± 4.59 people per km^2 (max 22 people per km^2). Only 59 cells (out of 942) exceeded this population density value and were excluded. Where the selected random grid cells overlapped with previously selected cells within our camera grids, no additional cells were selected to compensate for this. A total of 247 grid cells were selected for surveying using this method. Of these, 62 overlapped with core camera trap survey sites, 72 overlapped with areas identified as good leopard habitat, and 113 were randomly selected. Ultimately, 109 grid cells were surveyed by the field team. These were prioritised based on the likelihood of leopard presence, overlap with camera survey areas, and based on logistics including the presence of people to survey (desert areas were sparsely populated).

Questionnaire data management and collection

Interviews started with highlighting the confidentiality of the information and the anonymity of the interviewee, that the participant was welcome to refuse to participate, and could withdraw at any time. Interviewees were given an introduction to the project stating that the interviewer was working with an international conservation organisation interested in researching the wildlife in the area. They were also given an Informed Consent document to sign.

Initial questions related to the interviewee's affiliation to the area, including whether they were from the area, work in the area, and/or were resident. If they were not resident, they were asked

how often they visited the area and how long they stayed each year. The interviewees were also asked for their occupation. Occupations were grouped into 6 categories: farmer (including all livestock herders, bee keepers, farmers, etc.), indoor occupation (teachers, business men, students), military and police, retired, unemployed, or other (including any that refused to answer or were employed but did not state a profession). If the participant had seen a leopard at any time, they were asked if they had the contact details of the person who saw it (if not the participant). At the end of each interview, each participant was also asked if they would like to provide a name and phone number. All responses were recorded in the KoboCollect application on a tablet during the interview (KoBo Toolbox 2012).

SUPPLEMENTARY MATERIAL 2. Results.

*Questionnaire participant occupation and locality*

Of the participants, 72.48% were farmers. The remaining participants were split fairly evenly between the other occupations (military or police: 2.49%, indoor occupation: 5.35%, unemployed: 5.81%, or retired: 9.73%, other: 4.15%). There were also three questionnaires with no occupation answer recorded. The majority of the participants worked in the area where they were interviewed (52.67%) or lived there permanently (35.47%). A further 9.96% were from this area, lived elsewhere, but returned often. Less than 2% were visitors or there was no recorded answer.

Other animal sightings from questionnaire data

Caracals were correctly identified from the photograph by 63.94% of participants. Of the 539 respondents that correctly identified the caracal, 60.30% had not seen one in the previous year, 39.52% had seen one directly, and 0.19% had seen only tracks or scat. Of those that could not name the caracal from the photograph, 4.14% (12 participants) had seen it directly. Striped hyaenas were more reliably identified than caracal, with 84.70% of respondents answering correctly. Of these, 60.64% had seen one directly in the last year and 1.5% of these participants had also seen tracks or scat. 0.1% had seen track or scat only. Participants correctly identified Arabian wolves the most reliably, with 97.86% identifying them correctly. Just 14% of respondents had *not* seen signs of one in the last year, with 81.13% of participants having seen one directly and 2.61% seeing tracks or scat. Large prey species were less commonly seen than predators. Of the participants that identified the species correctly, 17.69% had seen an ibex and 8.51% had seen an Arabian gazelle in the last year. Smaller prey species were more commonly seen. Of those participants that identified them correctly, 65.78% of respondents had seen a Cape hare, and 78.17% had seen a rock hyrax in the last year.

References

KoBo Toolbox: Kobo Toolbox; 2012. http://www.kobotoolbox.org.
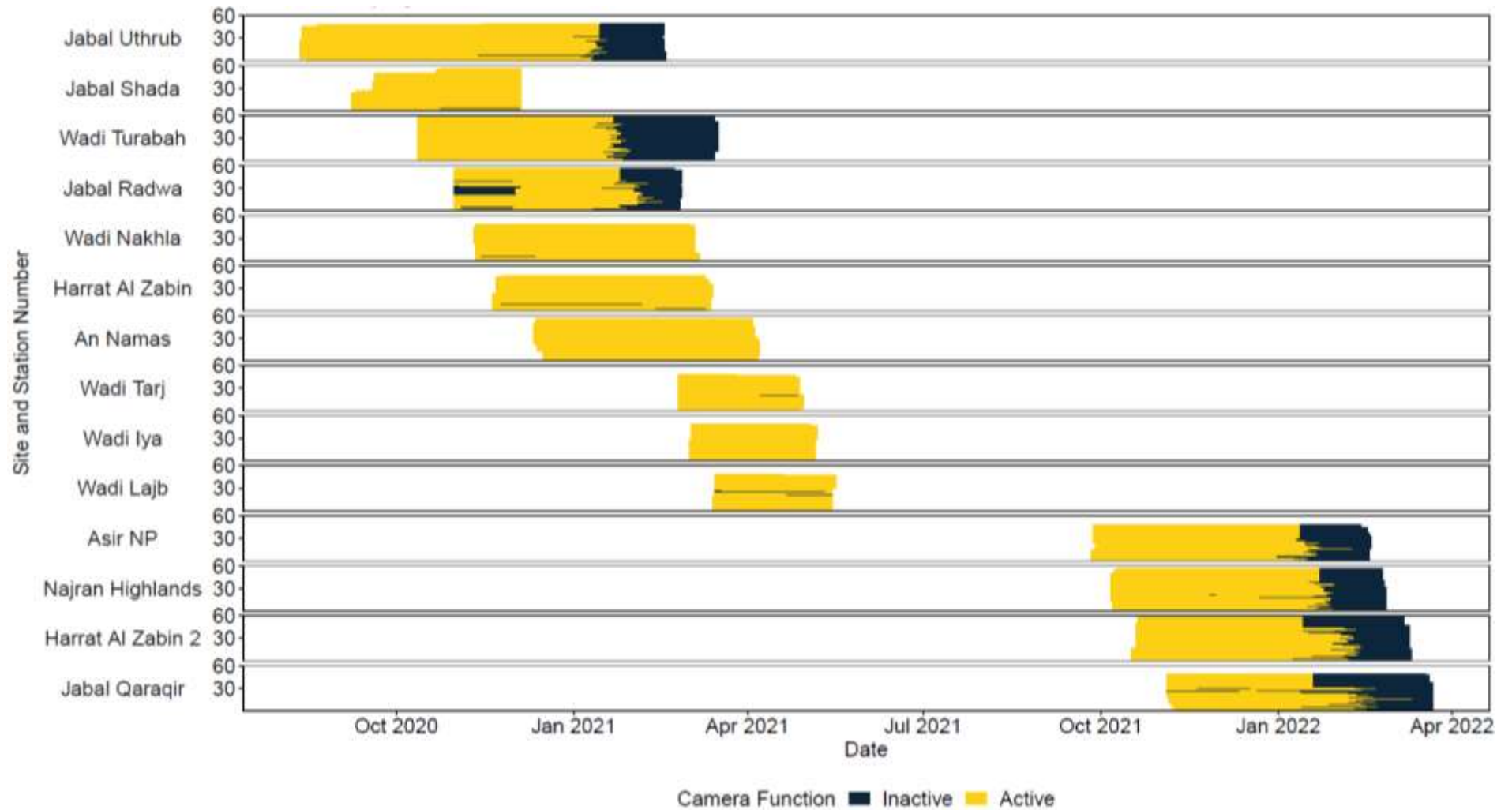
SUPPLEMENTARY FIGURE 1 Deployment times and activity status of camera traps in Saudi Arabia.

SUPPLEMENTARY TABLE 1 Number of active and inactive trap nights at each site.

| Site	Active (trap nights)	Inactive (trap nights)	Percent Active
An Namas	6042	2465	71.02
Asir NP	7039	2800	71.54
Harrat Al Zabin	3724	456	89.09
Harrat Al Zabin 2	9278	3956	70.11
Jabal Qaraqir	5300	2872	64.86
Jabal Radwa	4824	2426	66.54
Jabal Shada	4825	529	90.12
Jabal Uthrub	7410	2679	73.45
Najran Highlands	8461	3092	73.24
Wadi Iya	4082	158	96.27
Wadi Lajb	3328	468	87.67
Wadi Nakhla	8114	461	94.62
Wadi Tarj	3653	226	94.17
Wadi Turabah	5995	3459	63.41
Total	*82075*	*26047*	*Mean: 79.01±12.20*
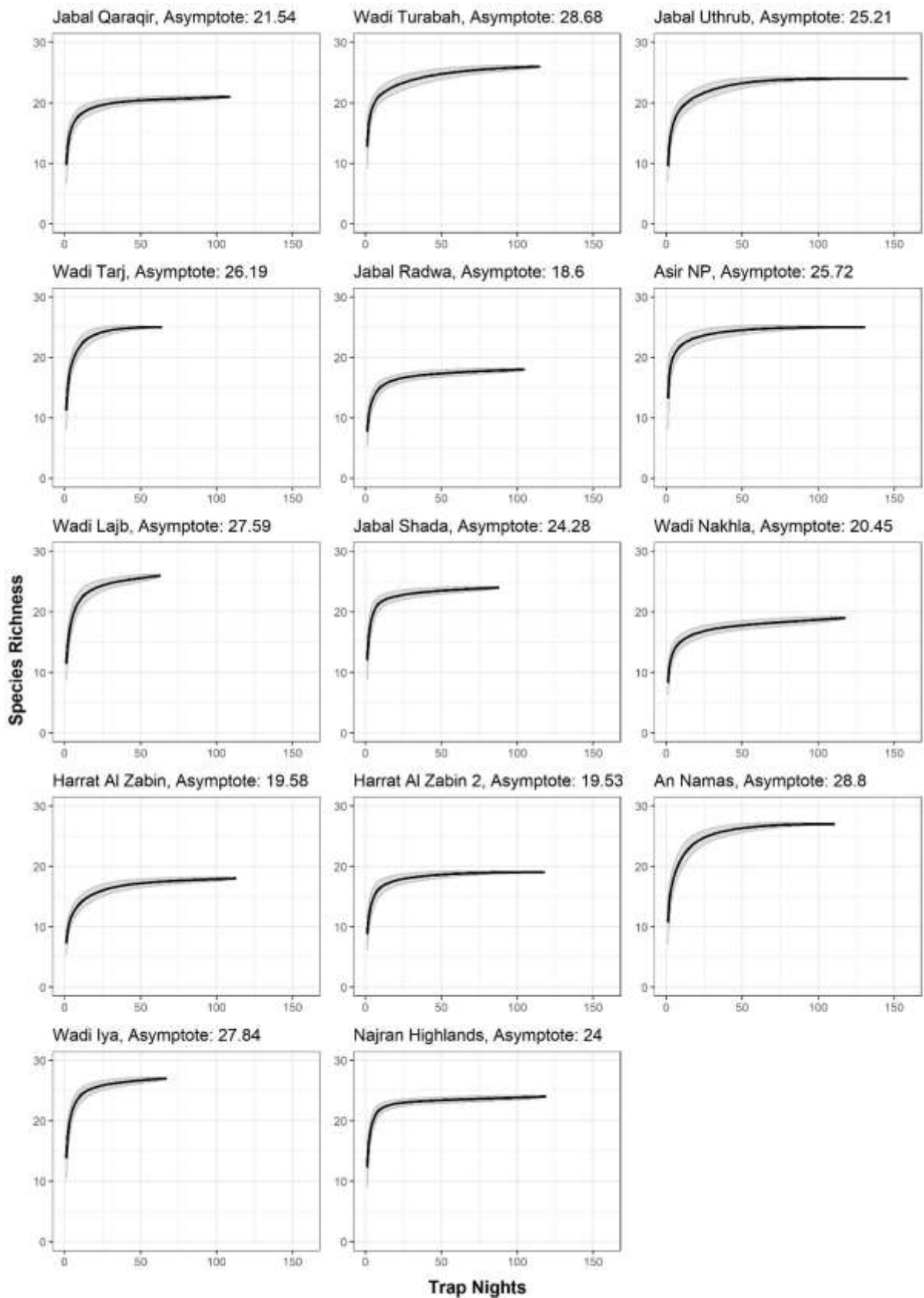
SUPPLEMENTARY FIGURE 2. Species accumulation curves for camera trap survey sites across the historical leopard range in Saudi Arabia. Mean trap nights to asymptote: 24.14, max: 28.80.
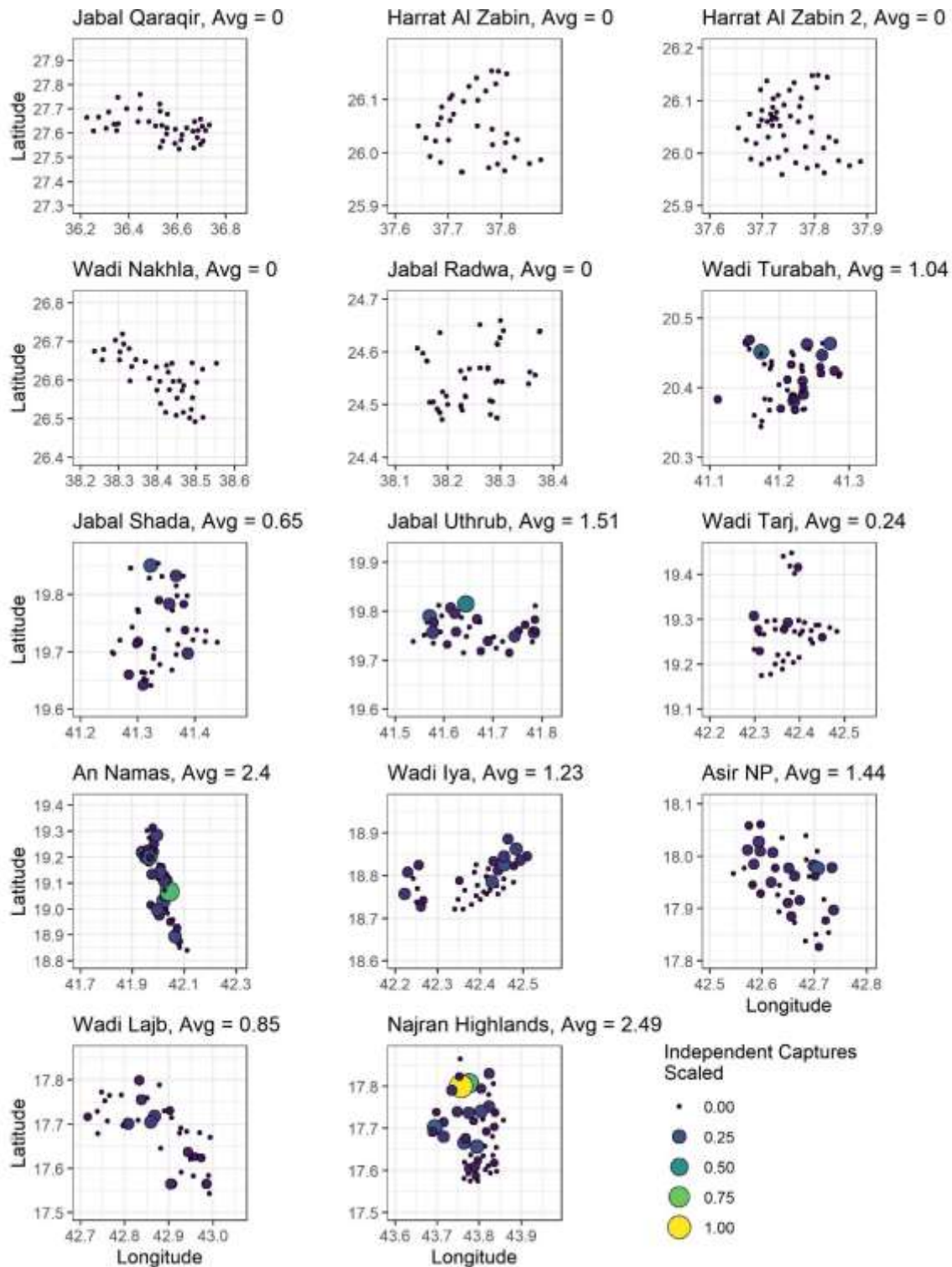
SUPPLEMENTARY FIGURE 3. Scaled number of independent records for caracal (*Caracal caracal*) for each camera station at 14 study areas in Saudi Arabia. Average number of independent captures per camera station is shown above each study area.
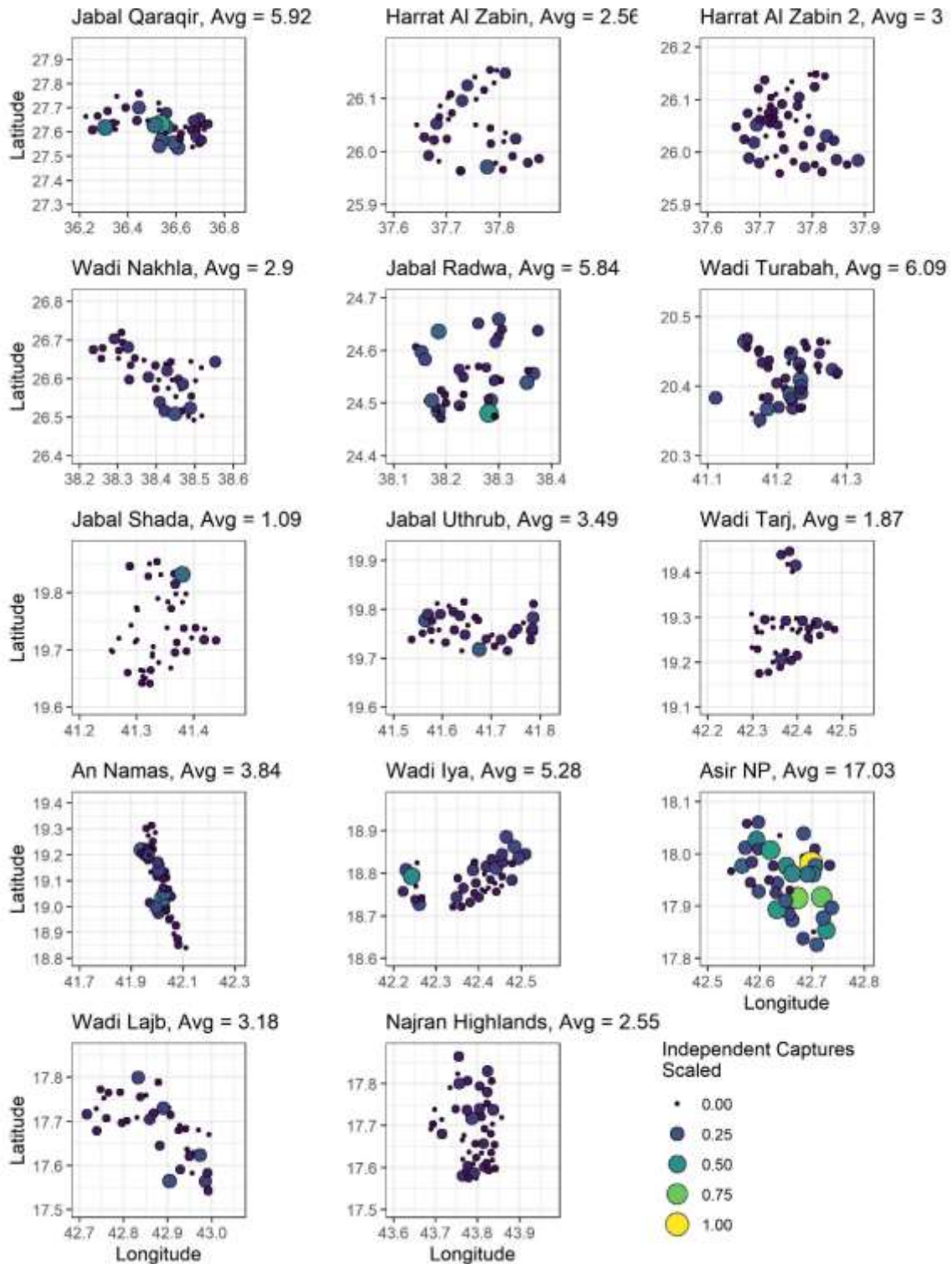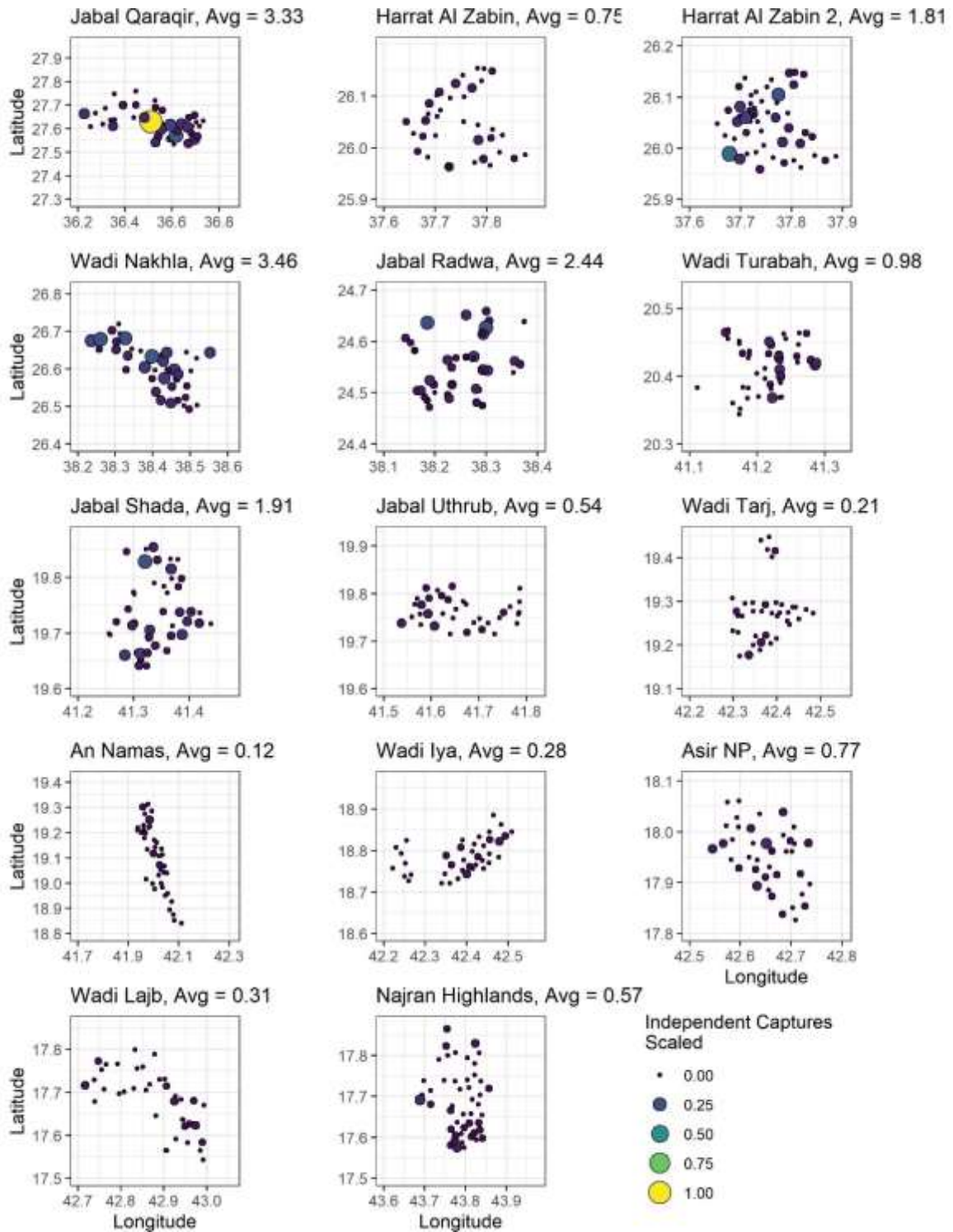
SUPPLEMENTARY FIGURE 4. Scaled number of independent records for Arabian wolves (*Canis lupus arabs*) for each camera station at 14 study areas in Saudi Arabia. Average number of independent captures per camera station is shown above each study area.
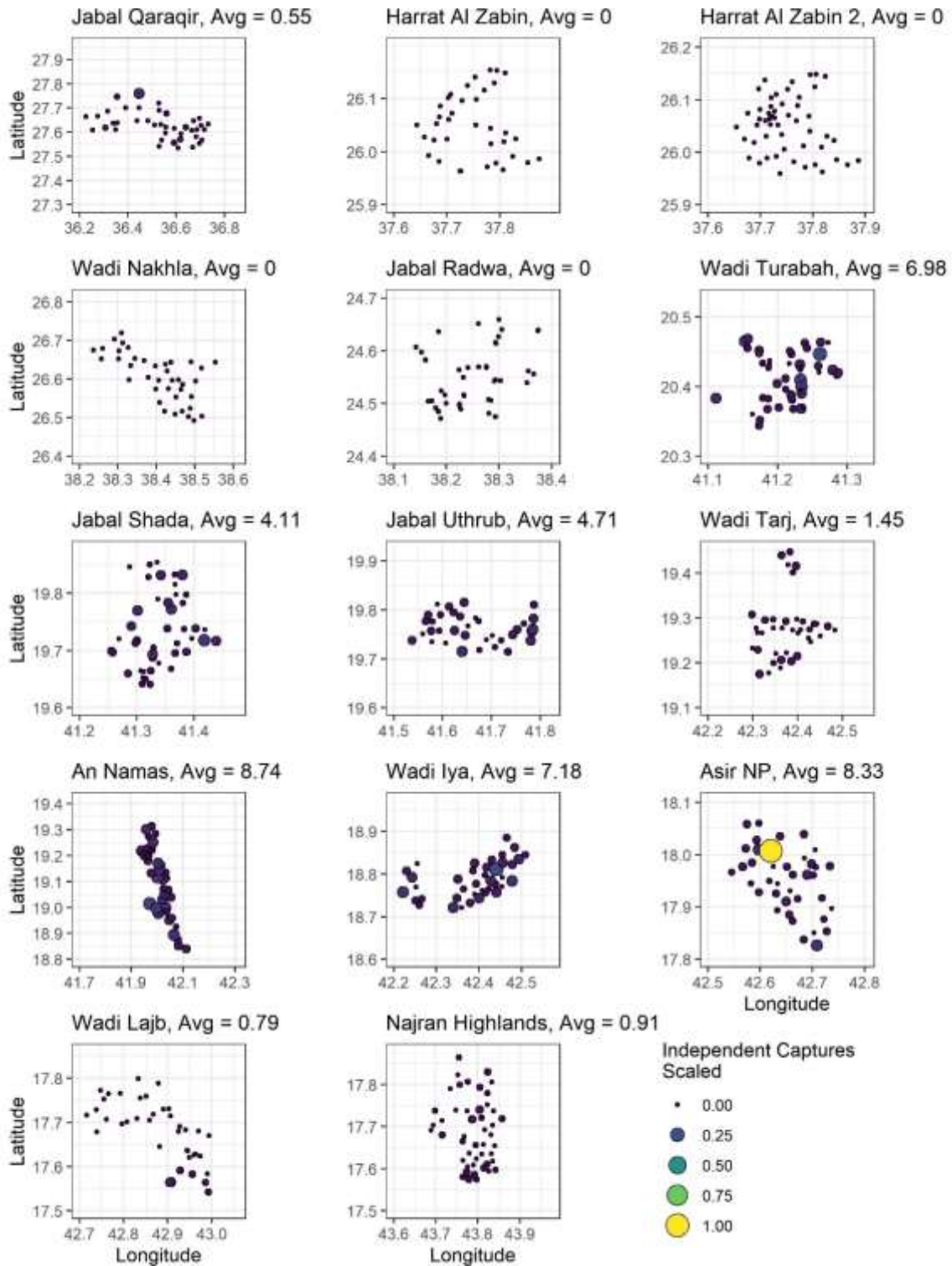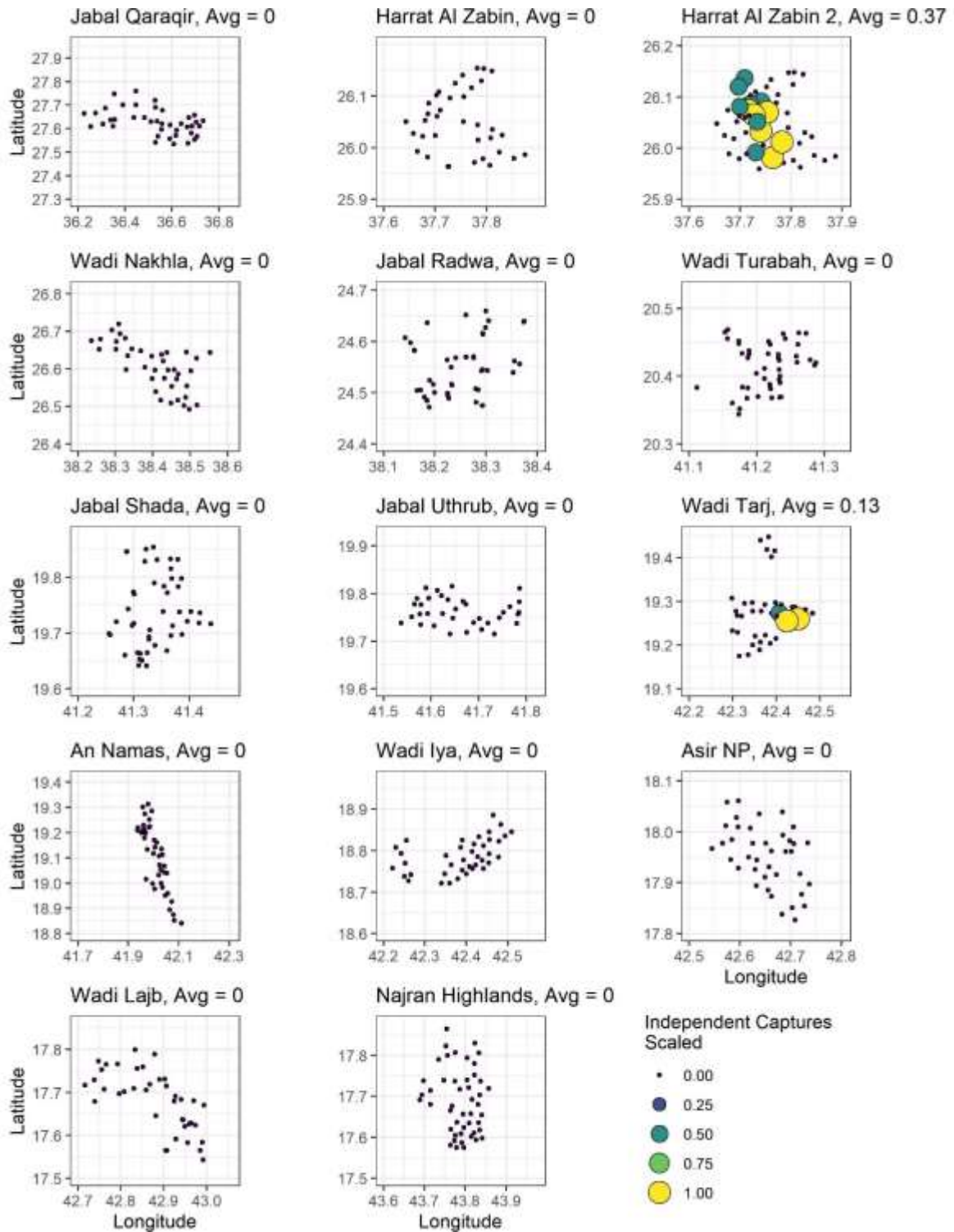
SUPPLEMENTARY FIGURE 5. Scaled number of independent records for striped hyaena (*Hyaena hyaena*) for each camera station at 14 study areas in Saudi Arabia. Average number of independent captures per camera station is shown above each study area.
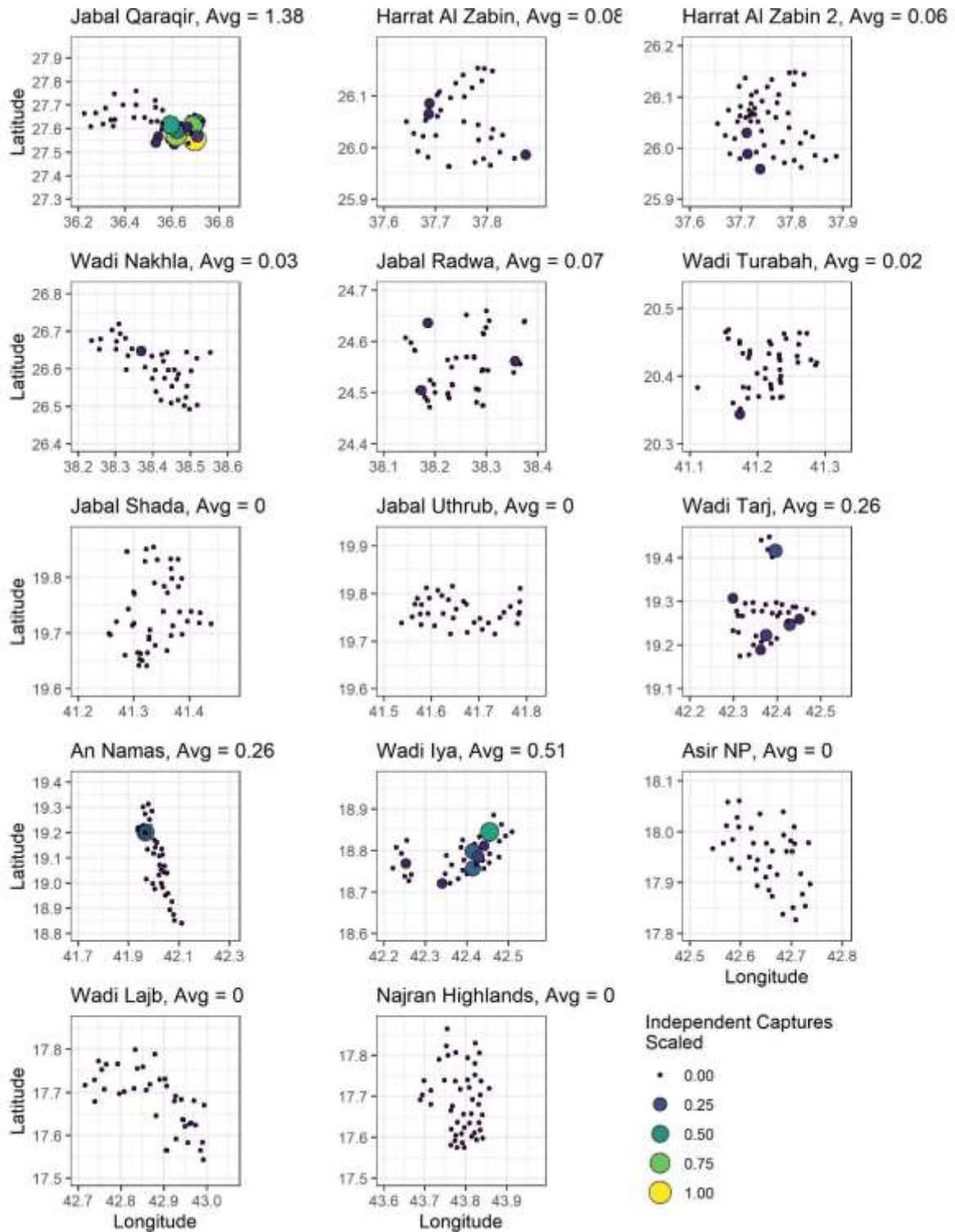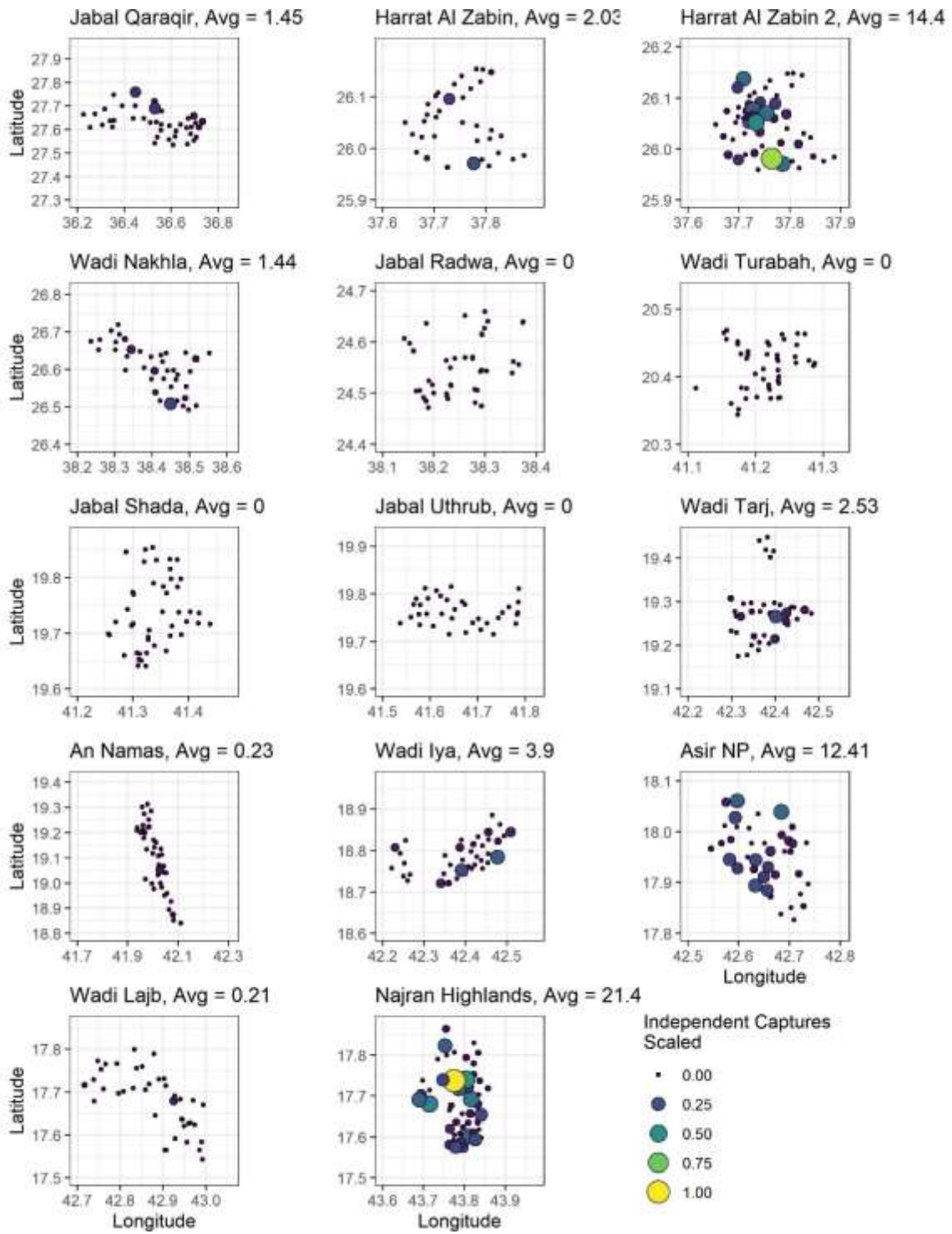
SUPPLEMENTARY FIGURE 6. Scaled number of independent records for African wild cats (*Felis lybica lybica*) for each camera station at 14 study areas in Saudi Arabia. Average number of independent captures per camera station is shown above each study area.
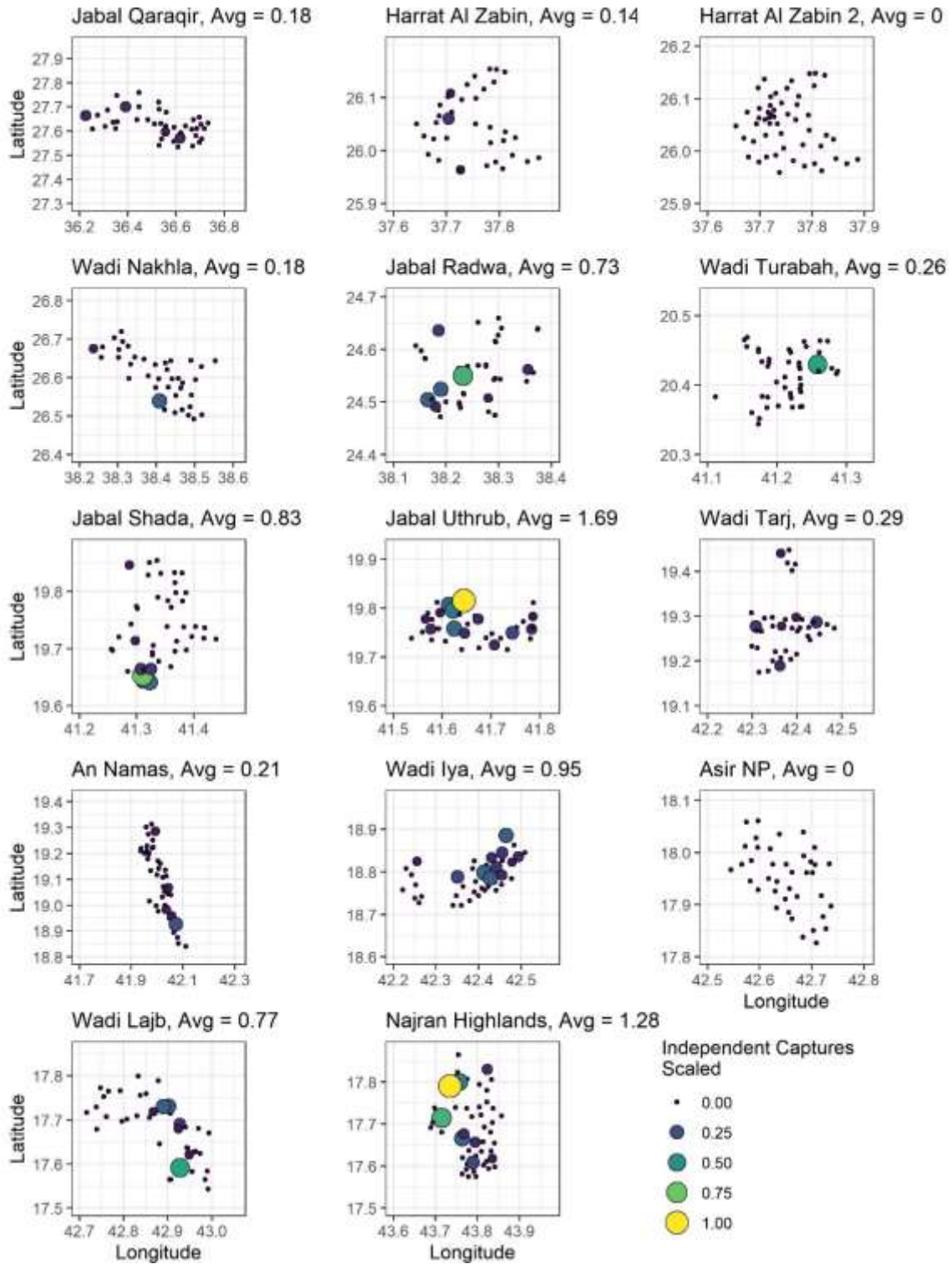
SUPPLEMENTARY FIGURE 7. Scaled number of independent records for Arabian gazelle (*Gazella arabica*) for each camera station at 14 study areas in Saudi Arabia. Average number of independent captures per camera station is shown above each study area.
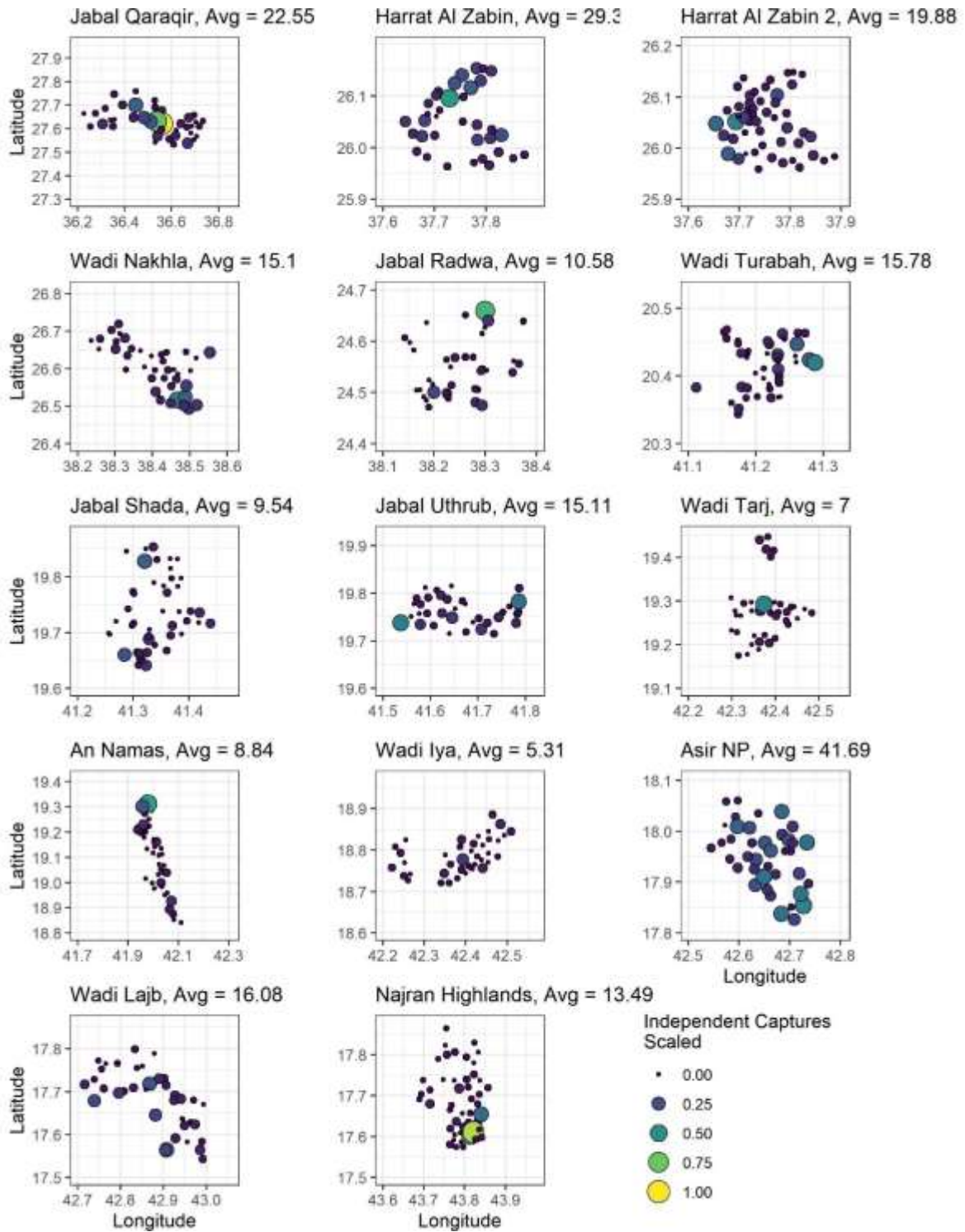
SUPPLEMENTARY FIGURE 8. Scaled number of independent records for Nubian ibex (*Capra nubiana*) for each camera station at 14 study areas in Saudi Arabia. Average number of independent captures per camera station is shown above each study area.

SUPPLEMENTARY FIGURE 9. Scaled number of independent records for Cape hare (*Lepus capensis*) for each camera station at 14 study areas in Saudi Arabia. Average number of independent captures per camera station is shown above each study area.

SUPPLEMENTARY FIGURE 10. Scaled number of independent records for rock hyrax (*Procavia capensis*) for each camera station at 14 study areas in Saudi Arabia. Average number of independent captures per camera station is shown above each study area.

SUPPLEMENTARY FIGURE 11. Scaled number of independent records for livestock (sheep (*Ovis aries*), goats (*Capra hircus*), dromedaries (*Camelus dromedarius*), and cattle (*Bos taurus*)) for each camera station at 14 study areas in Saudi Arabia. Average number of independent captures per camera station is shown above each study area.
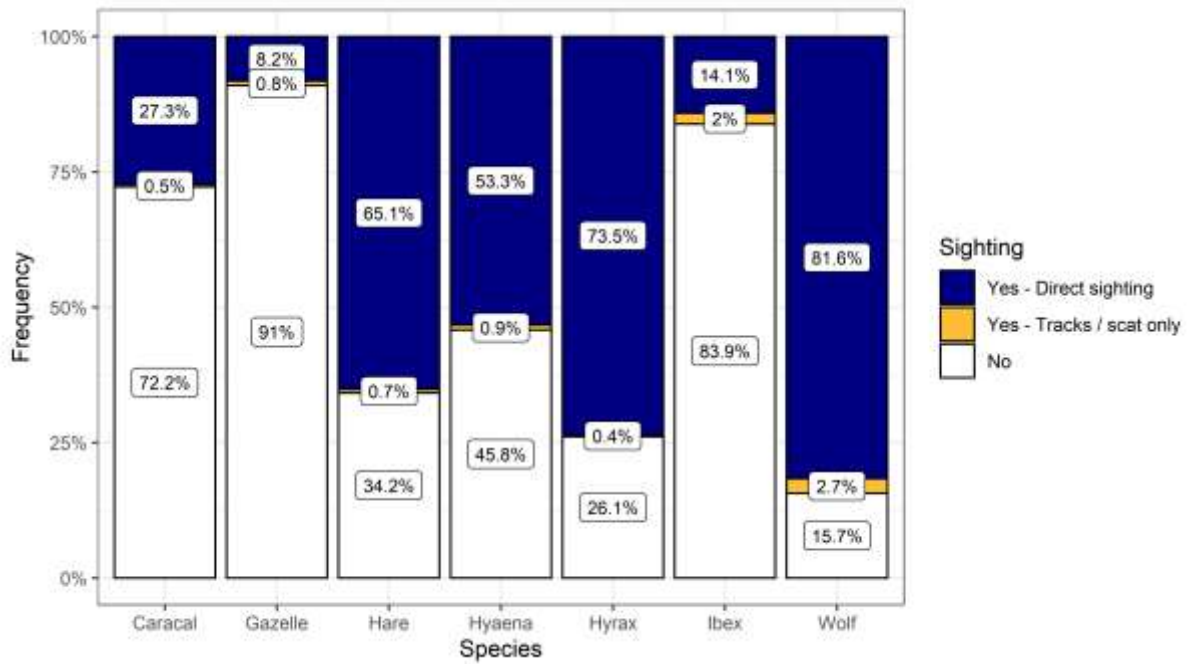
SUPPLEMENTARY FIGURE 12. Animal sightings within the last year (i.e., 2020-2021) from questionnaires conducted in the historical range of Arabian leopards in Saudi Arabia. Data presented as the percent of sightings from questionnaire participants who correctly identified the animal from the photograph.
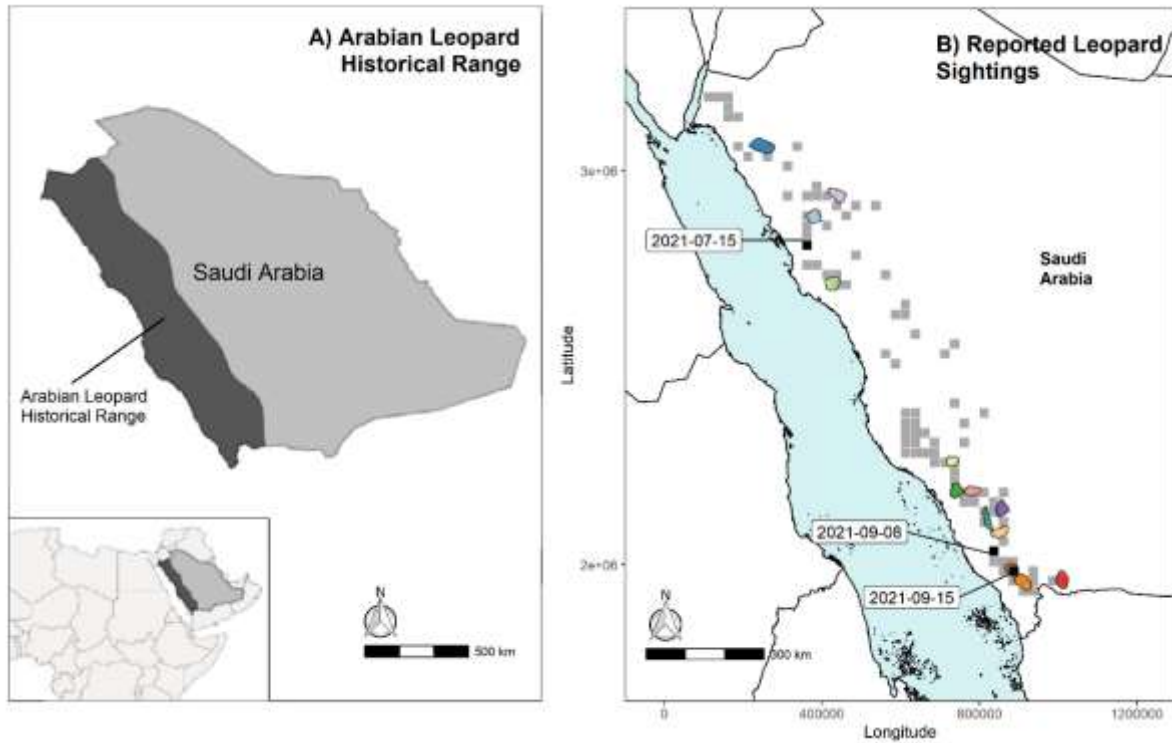
SUPPLEMENTARY FIGURE 13. A) The historical range of Arabian leopard in Saudi Arabia and B) Sightings of leopards within a year of the interview date (c. 2020-2021) reported in questionnaire surveys conducted across the historical leopard range. Grey tiles denote questionnaire grids, black filled tiles denote positive sighting reports (n = 3). Dates refer to the date the questionnaire was conducted. Camera survey sites are shown by coloured area (refer to Fig. 1 for site names).