

Supplement: Study Area

Huai Thap Salao–Huai Rabam Non-Hunting Area, Thailand

This study was conducted in the Huai Thap Salao–Huai Rabam Non-Hunting Area (HTSHR) establishment area in Lan Sak District, Uthai Thani Province, western Thailand. Nineteen years of climate records from the Huai Kha Khaeng Wildfire Research Centre (2019) indicate a mean annual temperature of 27.5°C and mean annual rainfall of 1,438 mm, with the rainy season occurring from May to October. Vegetation within HTSHR is dominated by seasonally dry forest and comprises deciduous dipterocarp forest (DDF; 37.88%), mixed deciduous forest (MDF; 14.70%), mixed deciduous forest with bamboo (MDFB; 18.71%) and smaller proportions of open areas and water bodies (28.72%). All forest types experience annual low-intensity surface fires.

The terrain is generally gently undulating and consists mainly of flat areas (83.10%), with smaller proportions of open slopes (14.91%), midslopes (0.98%), ridgetops (0.74%) and valleys (0.27%) (Pongpattananurak, 2020). More broadly, the area comprises foothill plains and low hills sloping from west to east, with a mean slope of approximately 5.61% (range: 0–70%) and elevations ranging from 148 to 322 m above sea level (Phumsathan et al., 2022b).

Huai Kha Khaeng and Thung Yai Naresuan Wildlife Sanctuaries were inscribed on the UNESCO World Heritage List in 1991 under criteria (vii), (ix) and (x) (UNESCO, 1991; IUCN, 2025). The most recent IUCN Conservation Outlook Assessment describes the property as “good with some concerns”, recognising gains from patrols and law enforcement while highlighting continuing risks from boundary pressures, potential development and renewed illegal offtake (IUCN, 2025). In response to sustained human pressure along the buffer landscape, the Ministry of Natural Resources and Environment formally designated HTSHR on 23 February 2023, with legal publication in the Royal Gazette on 26 April 2023. The designated area covers approximately 25.93 km² and adjoins the north-eastern boundary of Huai Kha Khaeng Wildlife Sanctuary, including part of the Huai Thap Salao Reservoir (Figure S3). Field data were collected during 2021–2023, corresponding to the early designation phase, when the area was transitioning from the Huai Thap Salao–Huai Kok Kwai National Forest (HTSHKK) to HTSHR and was managed as a transitional management zone.

Management actions during this period were staged. In December 2020, livestock grazing was prohibited, resulting in the removal of 2,470 domestic animals and associated infrastructure from the western and southern shoreline of the Huai Thap Salao Reservoir (Phumsathan et al., 2022b) (Figures S4 and S5). From March 2021 to March 2022, a walking patrol programme was initiated with a limited budget. From April 2022 to April 2023, increased budgets supported a more standardised patrol programme and the introduction of a formal registration system for forest resource collection, with permitted entry restricted to 06:00 am to 06:00 pm.

Following habitat restoration through the participation of government agencies, local authorities and communities, community-based wildlife tourism has emerged around restored banteng habitat. This activity has generated supplementary income for local residents while strengthening community incentives to support habitat protection and wildlife conservation (Figure S6). This development suggests that the recovery of banteng habitat use was not associated with patrolling alone, but with a broader collaborative governance process combining enforcement, habitat restoration, local participation and community stewardship. It highlights the value of an integrated buffer-zone management model in which conservation outcomes are linked with locally meaningful livelihood opportunities.



Figure S2. Photographic evidence from camera traps illustrating the focal species and variations of key anthropogenic drivers within the Huai Thap Salao-Huai Rabam Non-Hunting Area. Images capture banteng (*Bos javanicus*) (a, b); anthropogenic disturbance primarily driven by non-timber forest product (NTFP) (c, d); research activities (e, f); ranger patrolling (g, h).

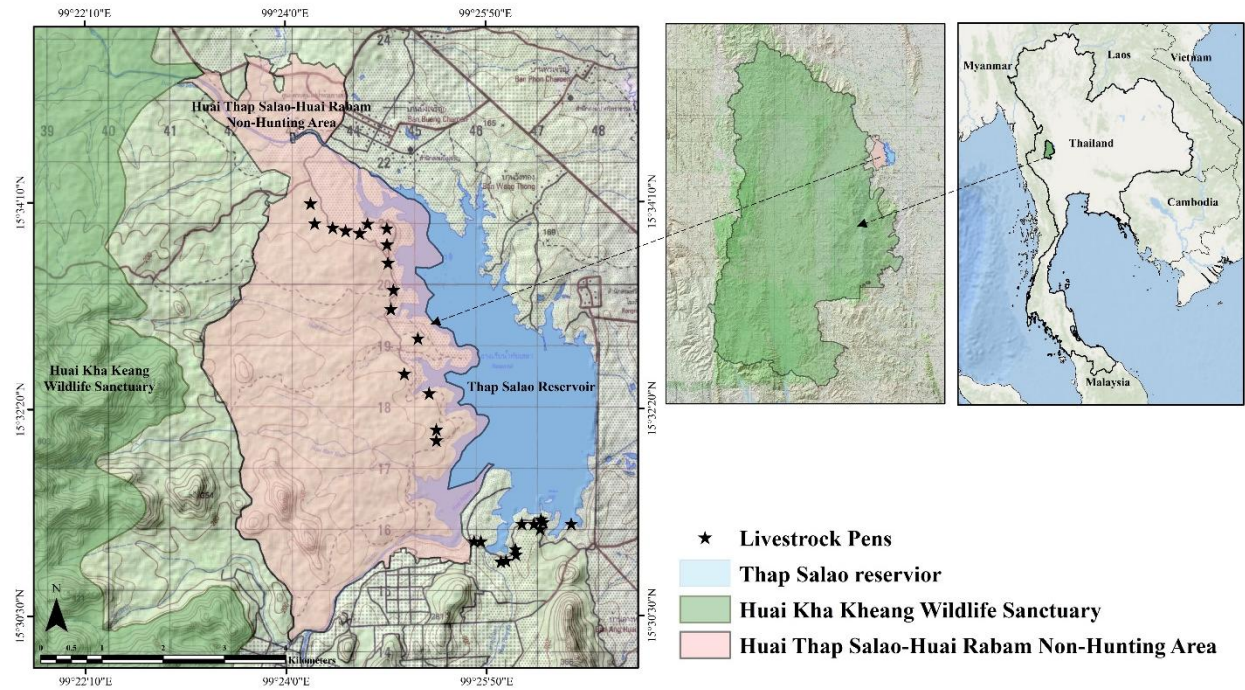


Figure S3. Location of the Huai Thap Salao–Huai Rabam Non-Hunting Area, Thailand, along the north-eastern boundary of Huai Kha Khaeng Wildlife Sanctuary within the Huai Kha Khaeng–Thung Yai Naresuan Wildlife Sanctuaries World Heritage Area.



Figure S4. Livestock grazing along the shoreline of Huai Thap Salao Reservoir in 2018, before the official designation of the Huai Thap Salao–Huai Rabam Non-Hunting Area.



Figure S5. Landscape condition along the shoreline of Huai Thap Salao Reservoir after livestock were removed from the area in 2020.



Figure S6. Community-based wildlife tourism activities operated by local residents along the shoreline of Huai Thap Salao Reservoir within the Huai Thap Salao–Huai Rabam Non-Hunting Area in 2026.



Figure S7. Banteng use of open-edge habitat formerly occupied by domestic cattle following livestock removal.

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