basal / informatics
ECOLOGICAL VERIFICATION

Edwards Plateau Ranch

Kimble County, TX · 2,340 acres · Mar 2025 — Jan 2026

14 camera stations · Edwards Plateau ecoregion

Station CW-04 · 18 Jun 2023 · 14:11 — sounder of feral hogs (Sus scrofa), infrared capture

Parcel-Level Nature Exposure Report

PREPARED FOR

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Ground-truth ecological verification

Executive Summary

Overall Nature-Risk Rating	*Feral Hog Exposure Score*
Critical	**76** / 100

This assessment covers a 2,340-acre parcel in Kimble County, TX. Camera trap monitoring detected 12 species across the property, including 2 invasive species (Feral Hog, Axis Deer). The overall nature exposure risk is rated **CRITICAL** with a Feral Hog Exposure Score of 76/100. Estimated annual invasive species damage totals $114,533. Detection frequencies are IPW-adjusted for non-random camera placement.

Key Findings

• **Feral hog damage estimated at $107,835/year** (10-yr NPV: $832,670), based on IPW-adjusted detection frequency of 63.4% across 2,340 acres.

• **1 ESA-listed species** with potential habitat overlap identified. Estimated compliance cost: $15,000–$85,037.

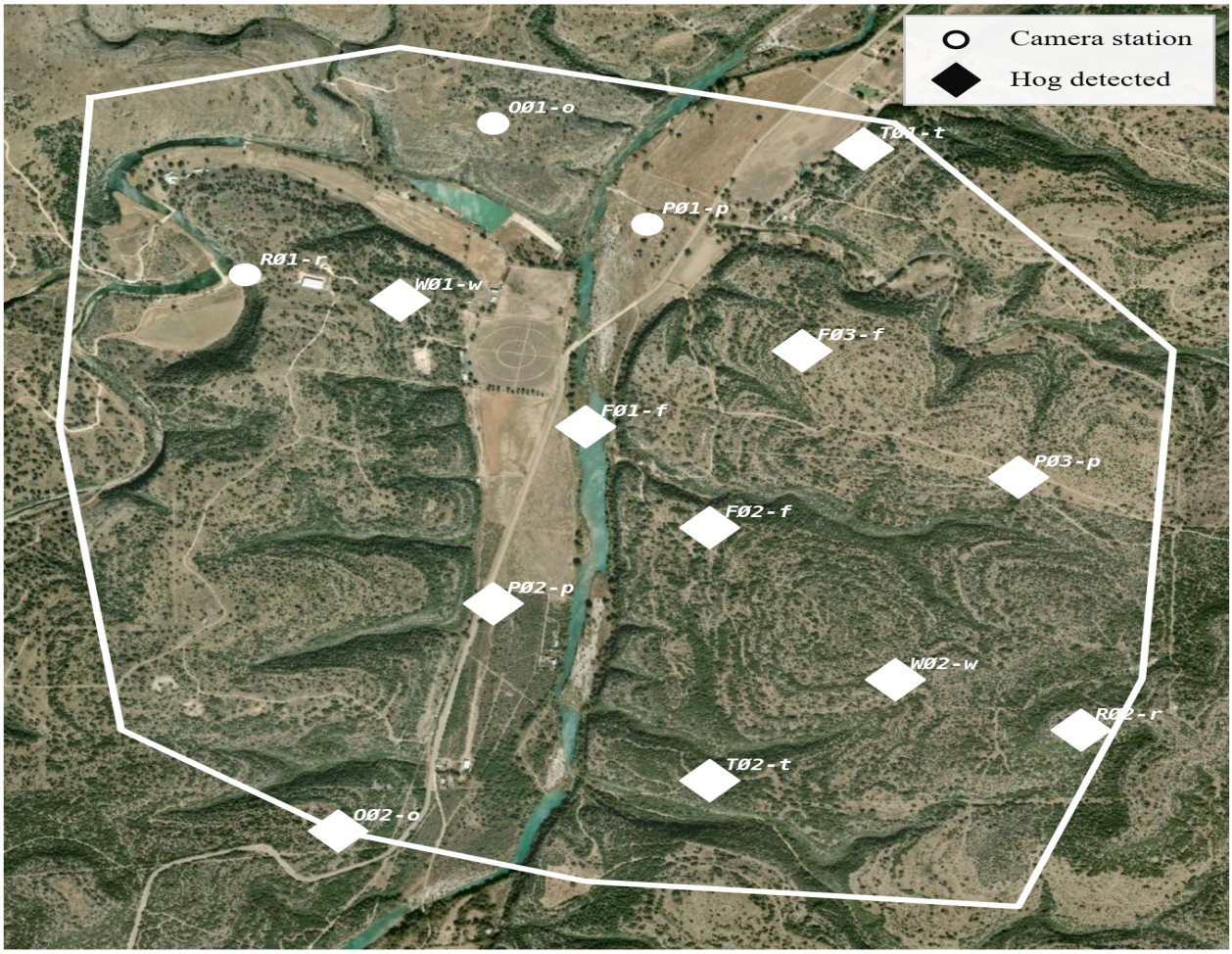
• **Bias correction reduced feral hog detection frequency by 15.2 percentage points** (raw 78.6% → adjusted 63.4%), correcting for non-random camera placement near feeders and water sources.

• **Monitoring gaps identified** requiring an estimated 17 additional cameras to improve corridor coverage. Current data confidence: grade D.

Assessment Metrics

Species detected	**12**	*Invasive species*	**2**
Est. annual loss	**$114,533**	*ESA species flagged*	**1**
Monitoring months	**11**	*Camera density*	**1.11/km²**
Data confidence	**D**	*Bias correction*	**Applied**

Parcel Overview



Camera stations shown as open circles; stations where feral hogs were detected are marked with a filled navy diamond. Each label carries a placement-context suffix: f = feeder, p = food plot, w = water, t = trail, r = random, o = other. The parcel boundary is the white outline. Imagery: Esri World Imagery.

Species Inventory

	Species	Events	Det. Freq.	Conf.	Risk Flag
I	Feral Hog	674	63.4%	B	*INVASIVE — MODERATE*
I	Axis Deer	55	33.3%	B-	*INVASIVE — MODERATE*
N	White-tailed Deer	1384	100.0%	B+	—

	Species	Events	Det. Freq.	Conf.	Risk Flag
N	Raccoon	378	93.8%	F	—
N	Nine-banded Armadillo	230	72.0%	D	—
N	Wild Turkey	442	66.0%	C+	—
N	Coyote	189	65.6%	C	—
N	Eastern Cottontail	79	61.9%	D	—
N	Bobcat	110	46.1%	C+	—
N	Virginia Opossum	40	26.1%	F	—
N	Gray Fox	10	23.9%	D	—
N	Red Fox	20	16.6%	D	—

Detection frequencies are IPW-adjusted for non-random camera placement (Kolowski & Forrester 2017). Raw frequencies before correction are available in the full data export.

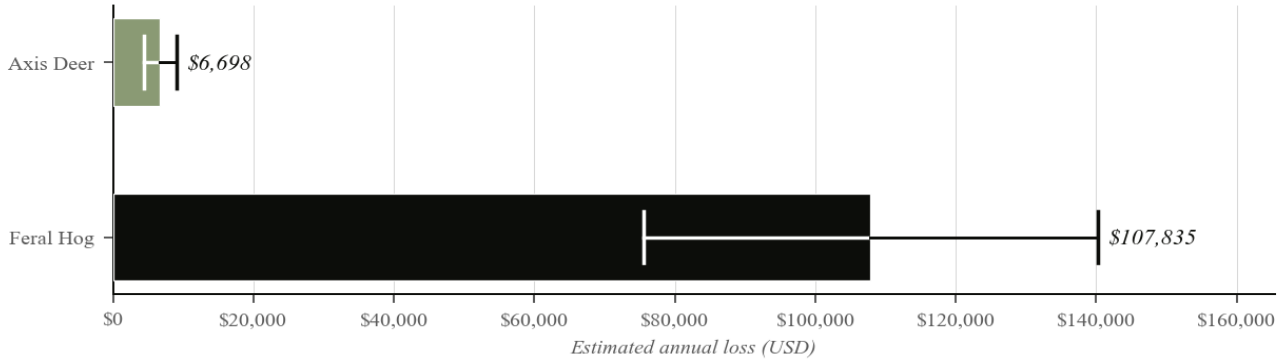
Events = independent detections (30-min threshold). Confidence grades reflect corridor coverage, temporal completeness, and detection frequency (A = highest).

Invasive Species Damage Projection

76	**$107,835**	**$832,670**
Feral Hog Exposure Score	*Estimated Annual Loss*	*10-Year NPV (5% discount)*

Confidence interval (±30%): $75,484 – $140,185.

Damage Estimates with Confidence Intervals



Model Assumptions

Feral Hog

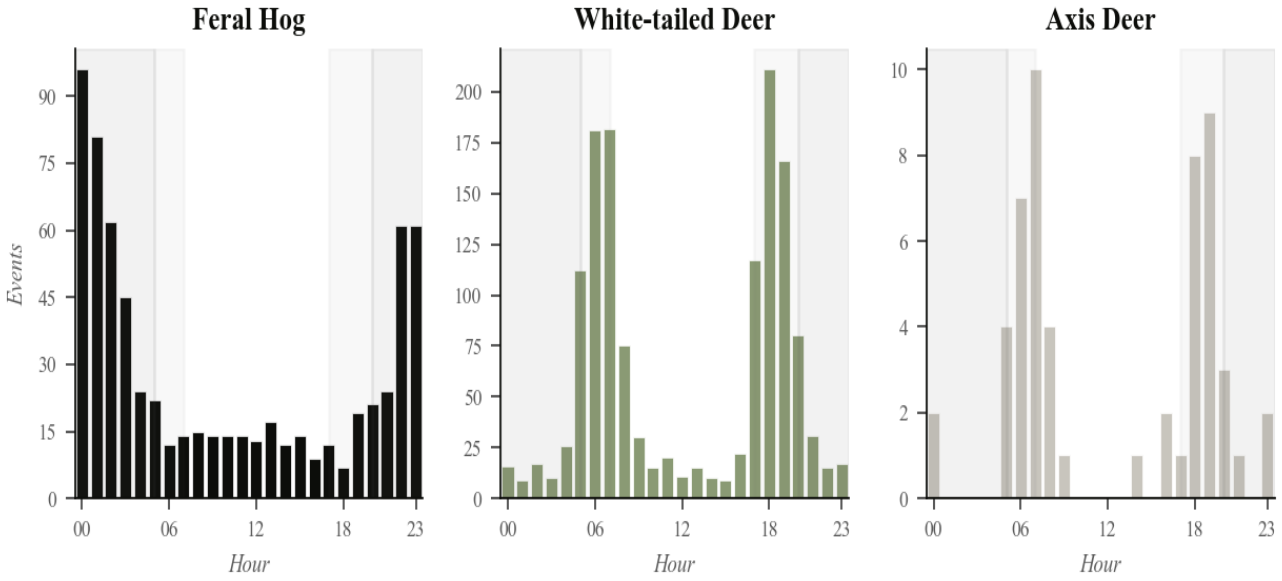
Parameter	Value
Base rate source	USDA-APHIS base rates (USDA-APHIS)
Base cost	$53.79/acre/year
Ecoregion calibration	1.15×
Detection frequency (IPW-adjusted)	63.4%
Logistic frequency scale	0.7450
Parcel acreage	2,340 acres
Discount rate (NPV)	5.0%
NPV horizon	10 years
Confidence grade	B
CI width	±30%

Axis Deer

Parameter	Value
Base rate source	USDA-APHIS base rates (Texas Parks & Wildlife estimate)
Base cost	$12.50/acre/year
Ecoregion calibration	1.10×
Detection frequency (IPW-adjusted)	33.3%
Logistic frequency scale	0.2082
Parcel acreage	2,340 acres
Discount rate (NPV)	5.0%
NPV horizon	10 years
Confidence grade	B-
CI width	±35%

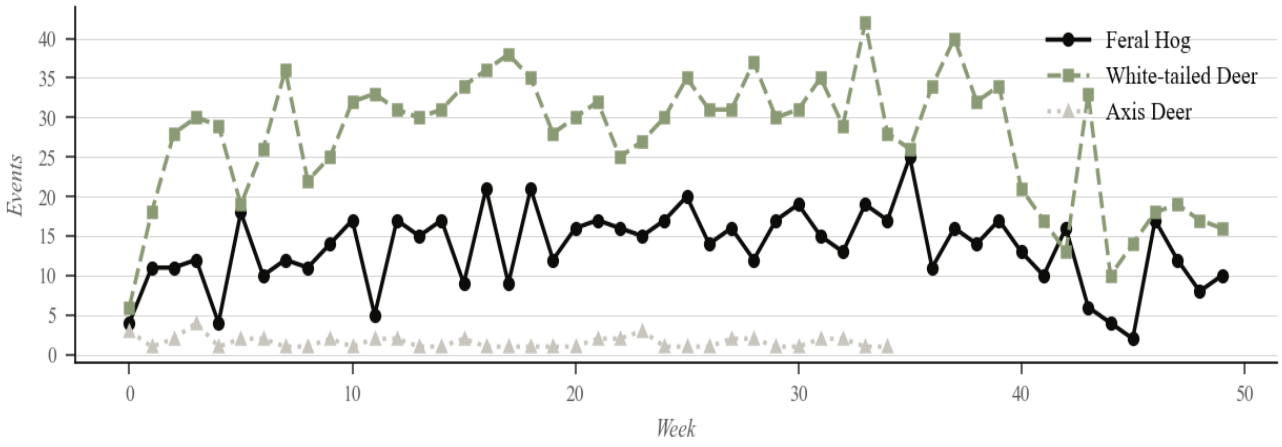
Detection frequency is a relative activity index, not absolute density. Broadley et al. 2020 showed density-dependent movement can cause cameras to underestimate population declines by up to 30%.

Activity Patterns



Independent events by hour of day. Shading indicates dawn (05:00–07:00), dusk (17:00–20:00), and night periods.

Weekly Activity Trend



Weekly independent event counts. Trend lines show direction of activity over the monitoring period.

Feral Hog: Nocturnal (66% nocturnal, 21% diurnal)

White-tailed Deer: Crepuscular (10% nocturnal, 36% diurnal)

Axis Deer: Crepuscular (9% nocturnal, 34% diurnal)

Data Confidence

Overall confidence grade	**D**
Monitoring duration	**11 months**
Camera density	**1.11 cameras/km²**
Bias correction	**Applied**

Species Confidence Grades

Species	Det. Freq.	Grade	Cameras	Events
Feral Hog	63.4%	B	11/14	674
Axis Deer	33.3%	B-	4/14	55
White-tailed Deer	100.0%	B+	14/14	1384
Raccoon	93.8%	F	12/14	378
Nine-banded Armadillo	72.0%	D	8/14	230
Wild Turkey	66.0%	C+	9/14	442
Coyote	65.6%	C	10/14	189
Eastern Cottontail	61.9%	D	7/14	79

+ 4 additional species (see Species Inventory table for full list)

Regional Classification Accuracy

Source: **hunter-verified corrections** | Validation status: **literature_baseline**

Species	Accuracy
White Tailed Deer	99.1%
Feral Hog	94.2%
Axis Deer	91.3%

Detection-to-density calibrated via paired surveys at Matagorda Bay. Classification accuracy from hunter corrections in Edwards Plateau habitat units.

Top Monitoring Gaps

Gaps in corridor coverage where additional cameras would most improve data confidence.

Corridor	Habitat Unit	Gap (m)	Species Affected	Cameras Needed
Forest Grass Edge	HU-1209020104-30a-41	1488	Cottontail Rabbit	7
Forest Grass Edge	HU-1209020104-30a-41	1436	Cottontail Rabbit	7
Riparian	HU-1209020104-30a-41	1271	Feral Hog	3

Methodology

What This Report Measures

Three pipeline outputs, in order of methodological primacy: **(1) detection frequency**, the raw events per camera-day — a relative abundance index requiring no movement assumption; **(2) density** in animals per square kilometer, derived from the bias-adjusted detection frequency through the Random Encounter Model (Rowcliffe et al. 2008); and **(3) tier** (Low / Moderate / Elevated / Severe), the binary-decision-grade classification per Mayer & Brisbin (2009) hog-density bins. The composite Exposure Score (0–100) is a piecewise-linear transform of density anchored on the tier cutoffs for visual legibility on a single gauge.

Damage dollars are not a pipeline output. The supplementary annual-loss projection on the cover page is scaled from third-party per-hog damage figures (Anderson et al. 2016) × parcel area × crop modifier and is labeled MODELED PROJECTION throughout. A loan committee with an internal damage model should consume the density and rate above and replace our dollar figure with their own.

Detection Pipeline

Camera-trap images are processed in two stages: Microsoft MegaDetector v5 locates animals (minimum confidence 0.3); Google SpeciesNet performs taxonomic classification. Both models are deployed without site-specific fine-tuning. Raw detections are grouped into independent events using a two-threshold scheme: photos within 60 seconds of one another from the same camera/species form a trigger burst, and bursts within 30 minutes of one another consolidate into one event. The 30-minute independence threshold is standard in camera-trap ecology and prevents repeat-counting of the same individual. All metrics in this report use independent event counts, never raw photo counts.

Density Estimation (REM)

Density is estimated using the Random Encounter Model (Rowcliffe et al. 2008), which does not require individual identification — essential for hogs and deer at distance, where natural marks are unreliable at population scale:

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D = (y / t) × π / (v × r × (2 + θ))
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where y/t is detections per camera-day, v is the species-specific mean daily travel distance, r is the camera detection radius (0.015 km), and θ is the camera detection angle (0.7 rad). Daily-distance values are sourced per species from the literature: 6.0 km/day for feral hog (Kay et al. 2017), 1.5 km/day for white-tailed deer (Webb et

al. 2010), 10.0 km/day for coyote (Andelt 1985). Species without a published *v* are reported as detection-rate index only, with the density estimate omitted.

Placement-Bias Correction

Cameras placed at feeders, trails, water, or food plots violate REM's movement-independence assumption. Kolowski & Forrester (2017) document detection inflation of 1.4–9.7× over random placement depending on species and context. The pipeline applies two complementary corrections to the per-camera detection rate *before* it enters REM, and reports both alongside the raw rate.

Method 1 — Literature-prior ratio adjustment (primary). For each camera, deflate the observed rate by the per-species inflation factor for its placement context, then average across cameras. Factor table (mirrors the values applied by the pipeline):

Context	Feral hog	WT deer	Coyote
feeder	10.0×	4.0×	1.5×
food_plot	6.0×	3.0×	1.2×
water	3.0×	2.0×	2.0×
trail	4.0×	3.0×	5.0×
random	1.0×	1.0×	1.0×
other	1.5×	1.2×	1.3×

Method 2 — Hájek IPW with empirical propensities (diagnostic). The textbook IPW estimator (Hájek 1971; Cassel–Särndal–Wretman 1976) reweights to a target placement-context distribution (default: uniform across observed contexts). Reported alongside the primary method for transparency; not fed into REM. The two methods agree closely when the deployment is balanced and diverge when one context dominates — which is exactly the case where bias correction matters most.

Confidence Intervals

95% confidence intervals are computed by nonparametric bootstrap over cameras (1000 iterations, the design's primary stochastic source per Rowcliffe 2012). Each iteration also draws a perturbed daily-distance value ***v′ ~ N(v, sd)*** truncated to [0.5·v, 1.5·v] to propagate inter-individual movement variability without letting physically implausible draws inflate the upper tail. The bias-correction weights are recomputed on each bootstrap resample so IPW uncertainty also feeds into the CI.

Diagnostics: Kish (1965) effective sample size ESS = $(\Sigma w)^2 / \Sigma(w^2)$, and the maximum-weight ratio max(w)/mean(w). Caveats fire automatically when ESS < n/2, max-weight ratio > 5× (Cole & Hernán 2008 stabilization threshold), or no random-placement cameras anchor the deployment.

Recommendation Logic

Per species per survey period the pipeline emits one of three flags:

Condition	Recommendation
< 100 camera-days OR < 20 events	insufficient_data
CI upper / lower ratio > 1.5	recommend_supplementary_survey
Otherwise	sufficient_for_decision

Limitations

Detection frequency is a relative abundance index. Conversion to absolute density via REM rests on the daily-distance values and detection-cone parameters above; both carry inter-region uncertainty not fully captured by the bootstrap CI. **Damage projections are model-based, not observed losses.** They are scaled from third-party per-hog figures and a crop-class modifier, and should not be treated as a primary pipeline output. **Tier classification is defined for feral hog only at v1.** Other species appear with detection rate and density (where v is available) but no tier; tier extension to deer and coyote requires per-species cutoff literature review.

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Basal Informatics

Ground-truth ecological data for nature-risk assessment. We deploy scalable camera-trap networks across private land, process imagery through calibrated classifiers, and deliver bias-corrected species inventories and density estimates to agricultural lenders and reinsurers for TNFD and EU CSRD disclosure.

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