Appendix 2

Details of how fence maintenance was measured - score card and blind/non-blind test

In order to assess whether a fence is well-maintained or not, we created an index that incorporated the technical and human-maintained components as well as the context for each fence in order to provide a holistic, functional perspective.

Measuring the level of fence maintenance

Under ideal circumstances, a large number of randomly collected voltage readings repeated over the duration of the study period would have been an appropriate measure for assessing maintenance of each fence. Given the logistical constraints due to the short time period and large spatial spread of the study area, we had to devise a method that would accurately reflect the level of maintenance despite a lower number of visits to each fence. Furthermore, given that the specifications (length, power of the energizer, fence design, etc) for each fence are unique, an absolute threshold for the factors determining maintenance would not be functionally relevant, and thus each fence needs to be viewed and ranked in its specific context. For instance, some relatively short fences have disproportionately high-powered energizers powering them and therefore, undergrowth touching the fence and leaking current was less likely to functionally impact the functioning; ie, the fence yet had a high enough voltage to deter elephants. This would mean that less maintenance is necessary to maintain the functionality of short fences, making comparisons of any one or two fence maintenance measures across fences of different lengths or differently powered energizers an imperfect surrogate measurement of quality of maintenance. Furthermore, just as with voltage, fence maintenance might vary over time, meaning that there was a danger of small sample sizes leading to inaccurate assessments.

We took a two-pronged approach to addressing these constraints. First, we attempted to measure both the technical components (using a "tech score") and human maintenance ("human maintenance score") components of the fence to provide a holistic measurement of fence maintenance. We also noted any relevant contextual factors while visiting each fence. Second, we asked our co-authors to provide both blind (based on the data collected for each fence, but with no village name provided) and non-blind (based on the village name and our co-authors' long-term knowledge of those village fences) assessments of fence maintenance quality. Our approach helped prevent non-representative small samples from leading to inaccurate assessments of fence maintenance. For instance, a chance event like a storm toppling a tree on the fence could lead to having a low voltage but should have less effect on the other maintenance measures.

For both the tech score and human maintenance score, each of the components used to calculate the score were given a weight based on their relative importance for fence function (see Table S1-3). These weights were arrived at after detailed discussions with on-ground practitioners, Forest Department officials, an energizer manufacturer, and fence technicians. The technical score was calculated using the condition of the solar panel, battery, energizer and the voltage. Where the voltage exceeded 5500V, the voltage score was treated as a '1' and where it was below, as a '0'. The human-maintenance score was calculated by averaging the proportional level of maintenance (number of units well-maintained divided by the total number of units sampled) on three factors suggested to influence maintenance in the index; (i) trimmed undergrowth, (ii) position of posts, and (iii) position of the insulators.

Table S3: the parts of the fence assessed for the technical score and how they were scored. In each component the unweighted score was out of one.

Apparatus	**Conditions to note**	**Mode of inspection**	**Rationale**	**Weightage**
Solar Panel	Dust-free, exposed to sunlight, connected to the battery, position with respect to the sun	Visual inspection and solar charge monitor	The solar panel needs to be exposed to direct sunlight in order to generate electricity.	1/3
Battery	Adequate fluid levels, voltage	Visual inspection and voltmeter	The battery should be producing an output of 12v for the energizer to work effectively.	1/3
Energizer	In-built 'strength' reading on the energizer when the wires are disconnected	Physical inspection of indicator on the energizer after disconnecting the fence and switching the energizer on	This helps understand whether the energizer unit is functional	1/3
Voltage	Voltage greater than 5500 v was considered to be adequate to deter elephants. (pers. comm. DFO Konwar, Assam Forest Department	Gallagher G50900 SmartFix Fence Tester to see the voltage as far as logistically possible from the energizer.	The voltage tends to decrease as one moves further away from the source, ie, the energizer and hence a reading was sought as	1

	2019; Sukumar 1986 suggests 5000 v)		far away from the energizer as logistically feasible.	

Table S4: Elements of the “fence maintenance score”, their rationale for inclusion, and their relative weight in the final score. In each case, the proportion of sampled length/units in a satisfactory state was used as the unweighted score.

Variable	**Conditions to note**	**Mode of inspection**	**Rationale**	**Weightage**
Trimmed undergrowth	Proportion of sampled length of fence without undergrowth touching the live wire	Visual inspection	Undergrowth touching the live wire leads to a leak in the voltage.	1/3
Position of posts	Proportion of sampled posts firmly placed in the ground	Visual inspection	Posts that are not firmly placed in the ground are easier for elephants to breach and are also more likely to fall over, leading to a drop in the voltage.	1/3
Position of insulators	Proportion of sampled insulators in place, ie, insulating the live wire from the post	Visual inspection	Insulators ensure that the live wire does not come into contact with the posts, so as to prevent the current from leaking through.	1/3

Table S5: Contextual factors noted to inform blind assessments of each fence and rationale for their inclusion. These provided necessary information for interpretation of the technical and maintenance scores.

Contextual factor	**Conditions to note**	**Mode of inspection**	**Rationale**
Recent damage	Length of fence damaged recently (elephant breaches, storms, tree-falls etc); Presence of fresh signs such as footprints	Visual inspection	Recently damaged fences are not reflective of chronic levels of fence maintenance and hence circumstantial evidence in the form of footprints, debris, and condition of the damage were used to triangulate how recent the damage was.
Fence design	Description of fence; number of strands, position of posts (perpendicular or tilted)	Visual inspection	Whether the poles were placed in a tilted manner as recommended by fence technicians, the number of strands of wire as this helps make the fence comparable across sampling instances.
Fence modifications	Modifications post-implementation such as installing additional wires for post protection, gates	Visual inspection	Indicates investment in and maintenance of the fence.

Ease of maintenance	Terrain, proximity to road, kind of undergrowth	Visual inspection	Helps account for the difficulty of maintenance. For instance, fences installed in crop fields require lesser maintenance owing to lesser undergrowth that can potentially come in contact with the fence.

In order to calibrate and standardize the method of assessing fences, the indices were piloted in the field by four individuals who were briefed on the index, its components and the methodology. The individuals then independently surveyed a specified stretch of a fence on the same day, filling in the datasheet for the index. A similar design with two individuals was replicated across 4 stretches of fences during fieldwork.

There was a near-perfect congruence in measurements by all the individuals, suggesting that the method provided a consistent measurement of the level of maintenance.

Sampling strategy

Fences were repeatedly assessed (mean = 3.3 times, range 1-7 times) during the *sali* paddy ripening season which is when elephant presence and HEC peaks annually (Zimmermann et al. 2009). This helped make the fences comparable and account for the fact that some of the fences are set-up only for the duration of the *sali* paddy season while others are kept functional year-round.

A fence was assigned at random to each day when fieldwork was possible over the course of the season and was assessed based on the index created. Where sampling the entire length of the fence was not feasible owing to safety concerns or logistical reasons, the maximum length possible was sampled.

Additionally, once the randomly-sampled fence was assessed, other fences in the adjacent areas were assessed, time-permitting. This system ensured that fences were assessed as frequently as possible and gave a more robust assessment of the level of maintenance.

Going from empirical measurements to overall maintenance assessment

In order to verify the assessment of fence maintenance, the data were independently cross-verified by co-authors HKB and DS, who each had more than a decade of field experience regarding the use of fences for HEC mitigation in the study area. They were instructed to provide an assessment of the fences as ‘poorly-maintained’, ‘well-maintained’, or ‘not sure’. This was done in two ways:

(1) **Blind assessment**: The conservationists were presented the empirical data collected for each fence with the names of the villages and other identifying information removed.

(2) **Non-blind assessment**: The conservationists were presented with the list of the villages mentioned without the data collected.

Comparison of the blind and non-blind assessments helped ensure that the measures of fence maintenance were reflective of the conservationists’ field experiences (refer Fig 2 for the graph of assessment scores).

The blind assessments resulted in a quantitatively consistent assessment of what was considered well-maintained. The well-maintained fences (n=7) were those fences that had a technical score of 2 and a human maintenance score greater than 267. Furthermore, these were almost entirely consistent with the non-blind assessments.