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Supplementary file S1

Table S1. Details of forest cover and change (in square kilometers) from 2003 to 2017 in Arunachal Pradesh state, north-east India. Data from Forest Survey of India (FSI) reports 2003-2017. There was no report/data for 2007.

Assessment year	Very dense forest	Moderately dense forest	Open forest	Total forest	Percentage of area	Net change
2003	14,445	38,084	15,163	67,692	80.83	-26
2005	14,411	37,977	15,389	67,777	80.93	85
2009	20,858	31,556	14,939	67,353	80.43	-119
2011	20,868	31,519	15,023	67,410	80.5	-74
2013	20,828	31,414	15,079	67,321	80.39	-89
2015	20,806	31,181	15,167	67,154	80.3	-73
2017	20,721	30,955	15,288	66,964	79.96	-190

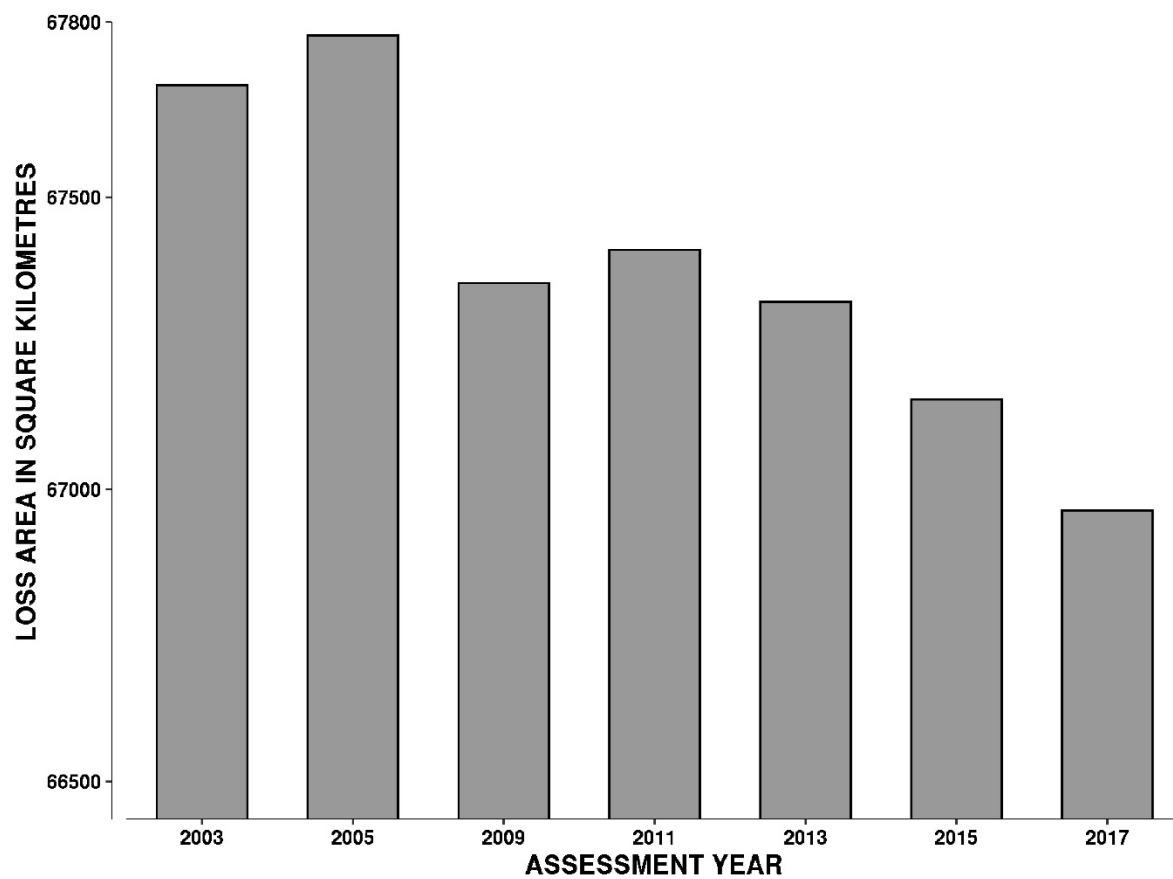


Fig. S1. Forest cover change from the period of 2003-2017. Data from Forest Survey of India reports 2003-2017 as shown in supplementary table S1.

Table S2. Tree cover loss within Arunachal Pradesh from 2001-2019. Loss of tree cover canopy density threshold greater than 30% indicates tree cover loss at pixels with minimum of 30% tree cover canopy density. Data from Hansen et al. (2013) and Global Forest Watch (2020).

Year	Loss of > 30% tree cover (km²)
2001	85.92
2002	70.1
2003	64.04
2004	127.93
2005	88.47
2006	97.93
2007	95.72
2008	110.05
2009	90.71
2010	59.28
2011	124.45
2012	143.46
2013	92.69
2014	130.33
2015	123.46
2016	189.94
2017	190.02
2018	113.40
2019	95.99
Total	2093.80

Table S3. List of images, year and the spatial extent of the classification of the image. Abbreviations in table: Reserve Forest (RF).

IMAGE NUMBER	DATASET	YEAR	EXTENT OF SPATIAL ANALYSIS
4651515_2011-01-07_RE3_3A_Analytic	RapidEye	2011	Nest Sites within Papum RF
4651515_2012-12-25_RE1_3A_Analytic	RapidEye	2012	Nest Sites within Papum RF
4651514_2013-11-14_RE2_3A_Analytic	RapidEye	2013	Papum RF
4651515_2013-11-14_RE2_3A_Analytic	RapidEye	2013	Nest sites and full extent of Papum RF
4651516_2013-11-14_RE2_3A_Analytic	RapidEye	2013	Papum RF
4651614_2013-11-14_RE2_3A_Analytic	RapidEye	2013	Papum RF
4651615_2013-11-14_RE2_3A_Analytic	RapidEye	2013	Papum RF
4651514_2014-12-29_RE2_3A_Analytic	RapidEye	2013	Papum RF
4651515_2014-12-29_RE2_3A_Analytic	RapidEye	2014	Nest sites and full extent of Papum RF
4651516_2014-12-29_RE2_3A_Analytic	RapidEye	2014	Papum RF
4651614_2014-12-29_RE2_3A_Analytic	RapidEye	2014	Papum RF
4651615_2014-12-29_RE2_3A_Analytic	RapidEye	2014	Papum RF
4651515_2015-11-21_RE1_3A_Analytic	RapidEye	2015	Nest Sites within Papum RF
20161212_061349_0c46_3B_AnalyticMS	PlanetScope	2016	Nest Sites within Papum RF
20161212_061350_0c46_3B_AnalyticMS	PlanetScope	2016	Nest Sites within Papum RF
20161212_061351_0c46_3B_AnalyticMS	PlanetScope	2016	Nest Sites within Papum RF
4651514_2017-11-04_RE2_3A_Analytic	RapidEye	2017	Papum RF

4651515_2017-11-04_RE2_3A_Analytic	RapidEye	2017	Nest sites and full extent of Papum RF
4651516_2017-11-04_RE2_3A_Analytic	RapidEye	2017	Papum RF
4651614_2017-11-04_RE2_3A_Analytic	RapidEye	2017	Papum RF
4651615_2017-11-04_RE2_3A_Analytic	RapidEye	2017	Papum RF
20180512_035145_100a_3B_AnalyticMS_SR	PlanetScope	2018	Nest Sites within Papum RF
20180512_035146_100a_3B_AnalyticMS_SR	PlanetScope	2018	Nest Sites within Papum RF
20190425_032704_0f36_3B_AnalyticMS_SR	PlanetScope	2019	Nest Sites within Papum RF
20190425_032705_0f36_3B_AnalyticMS_SR	PlanetScope	2019	Nest Sites within Papum RF
20190425_032706_0f36_3B_AnalyticMS_SR	PlanetScope	2019	Nest Sites within Papum RF

Table S4. Summary statistics (mean and standard deviation) for RapidEye and PlanetScope based forest loss maps after a manual inspection of points retrieved from a stratified random sample. The procedure was repeated for the images covering the full extent of Papum Reserve Forest (RF) as well as images only used for the prediction within nest sites. Abbreviations in table: RF = Reserve Forest, NF = non-forest, F = forest and LF = logged-forest during the given time period. User's Accuracy is the proportion of the area mapped as class *i* that has a reference class *i*. Producer's Accuracy is the proportion of the area of reference class *i* that is mapped as class *i*.

SPATIAL SCALE OF ANALYSIS	Papum RF 2013 - 2017	Nest Sites within Papum RF 2011-2019
Number of points sampled per reference class	700	700

Overall Accuracy	98.3 ± 0.8 %	95.2 ± 1.3 %
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	NF	F	LF	NF	F	LF
User's Accuracy	96.8 ± 0.8 %	99.9 %	78.4 ± 3.8 %	94.7 ± 3.3 %	96.9 ± 1.8 %	79.9 ± 3.2 %
Producer's Accuracy	94.7 ± 1.4 %	99.0 ± 0.1%	93.7 ± 1.8 %	95.8 ± 1.2 %	96 ± 1.3 %	93.2 ± 1.8 %

Table S5. Confusion matrices for classified maps derived from a stratified random sample of test points for Papum Reserve Forest (RF) and nest-sites with Papum RF, indicating the accuracy with which changing forest extent and deforestation is mapped for the periods 2013–2017 and 2011-2019 respectively. Abbreviations in table: RF = Reserve Forest, NF = non-forest, F = forest and LF = logged-forest.

Papum RF 2013-2017		Reference			Mapped Area Fraction
		Logged Forest	Forest	Non-Forest	
Map	Logged Forest	0.044	0.009	0.004	0.056
	Forest	0.001	0.876	0.000	0.877
	Non-Forest	0.002	0.000	0.065	0.067
Reference Area Fraction		0.047	0.885	0.068	1.000
Nest Sites within Papum RF 2011-2019		Reference			Mapped Area Fraction
		CF	F	NF	
Map	Logged Forest	0.141	0.028	0.007	0.176
	Forest	0.016	0.634	0.000	0.650
	Non-Forest	0.003	0.005	0.166	0.174
Reference Area Fraction		0.160	0.667	0.174	1.000

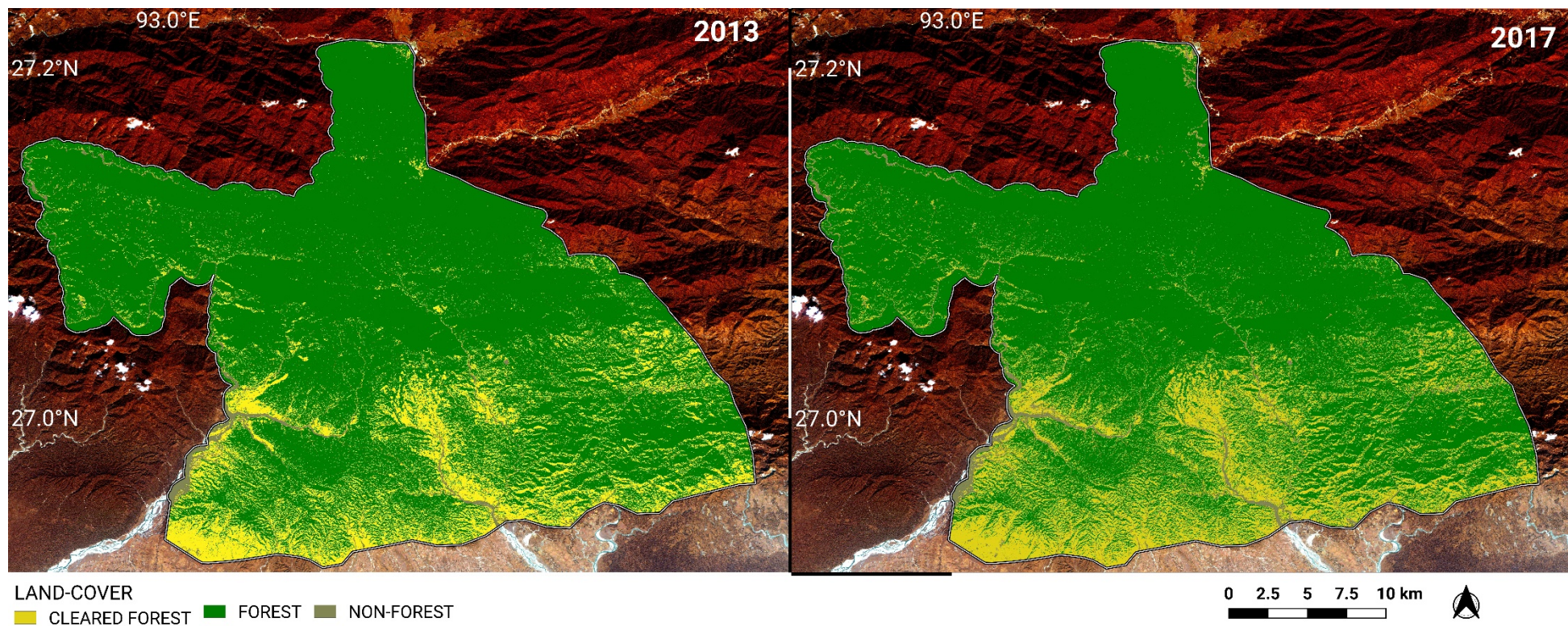


Fig. S2. Comparison of classified images of Papum Reserve Forest (plus a 500m buffer around the boundary). The ‘salt and pepper’ effect of deforestation, is evident in the southern regions especially in 2017. A colour coded classified image is overlaid on a RapidEye false colour composite image using the Red Edge (Band 4; 690 – 730 nm), Green (Band 2; 520 – 590 nm) and Blue (Band 1; 440 – 510 nm) spectral bands. Colours in the spectral image are the same as described in the caption of Fig. 1 in main text.

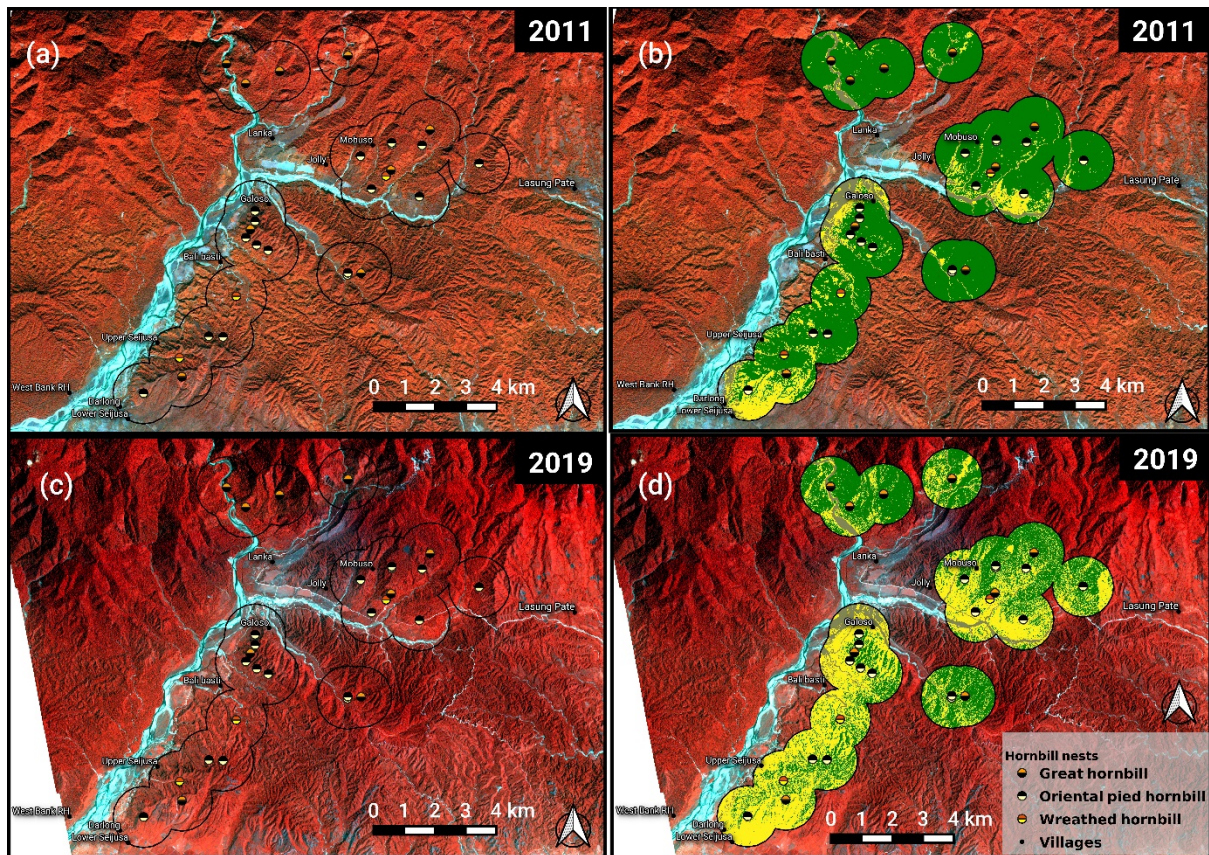


Fig. S3. Comparison of images between 2011 (a & b) and 2019 (c & d) of the nest sites. Images a. and c. are false colour composites of RapidEye (2011; RGB composite: band 4, band 2, band 1) and PlanetScope (2019; RGB composite: band 4, band 2, band 3) images. Panels b. and d. are the same false colour composites of the respective year, with an overlay of the classified image of the nest sites. Image classification colour key: yellow: logged-forest, green: forest and grey: non-forest. Nest sites monitored by the Hornbill Nest Adoption Program, of the three hornbill species are indicated in the figure legend: Great Hornbill *Buceros bicornis* Linnaeus, 1758, Wreathed Hornbill *Rhyticeros undulatus* (Shaw, 1811), Oriental Pied Hornbill *Anthracoceros albirostris* (Shaw, 1808). Solid black circles are villages. In the 2018 images, note the ash-grey areas on the southern hill slopes, indicative of fire scars. Surfaces with dark red indicated forest cover, lighter shades are either of cleared forest, plantations or secondary vegetation. Landslides and river beds are white. In the 2011 images, primary forest is dark orange to red. Secondary vegetation are bright shades of red while logged-forest areas are grey interspersed with red.

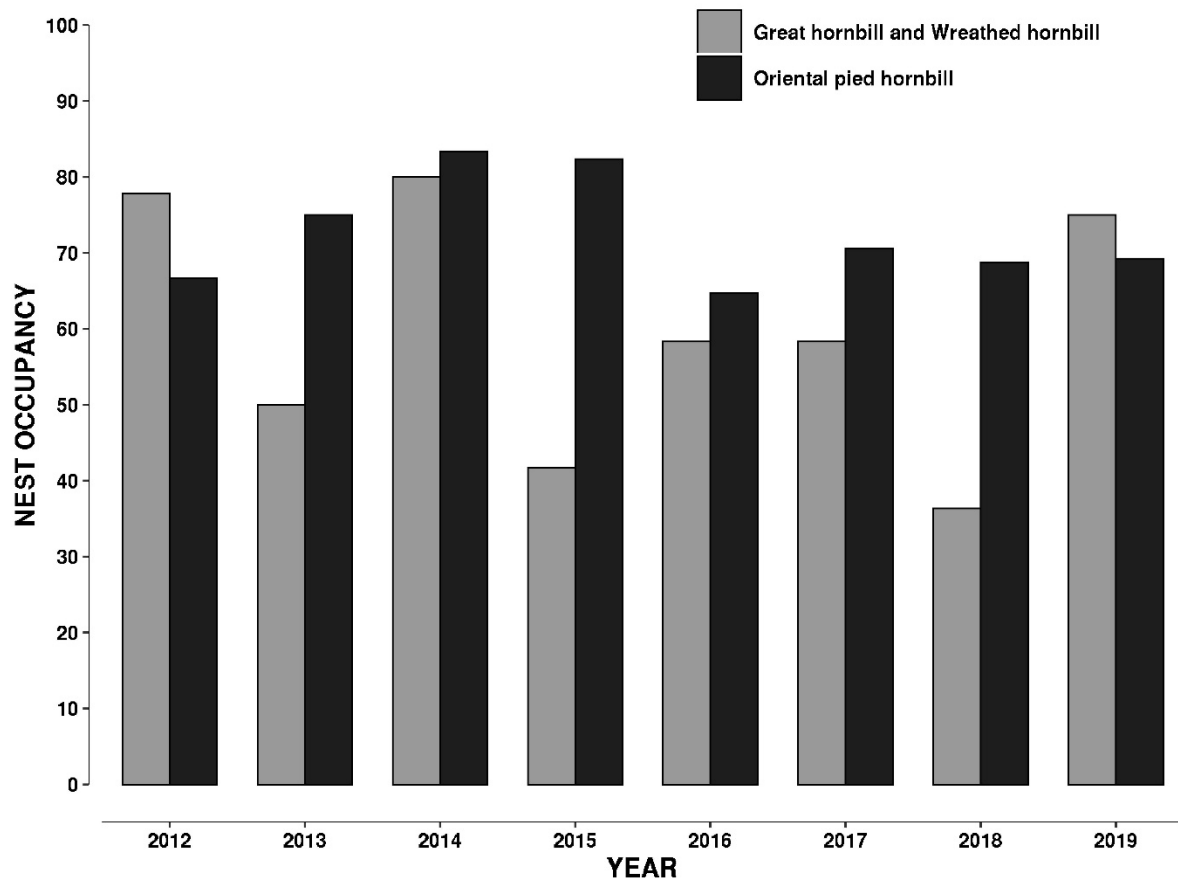


Fig. S4. Nest occupancy (percentage of monitored hornbill nests that were active) by the two large-bodied hornbills (Great Hornbill and Wreathed Hornbill) combined and the Oriental Pied Hornbill from 2012-2019 in the Papum Reserve Forest, Khellong Forest Division, Arunachal Pradesh.

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