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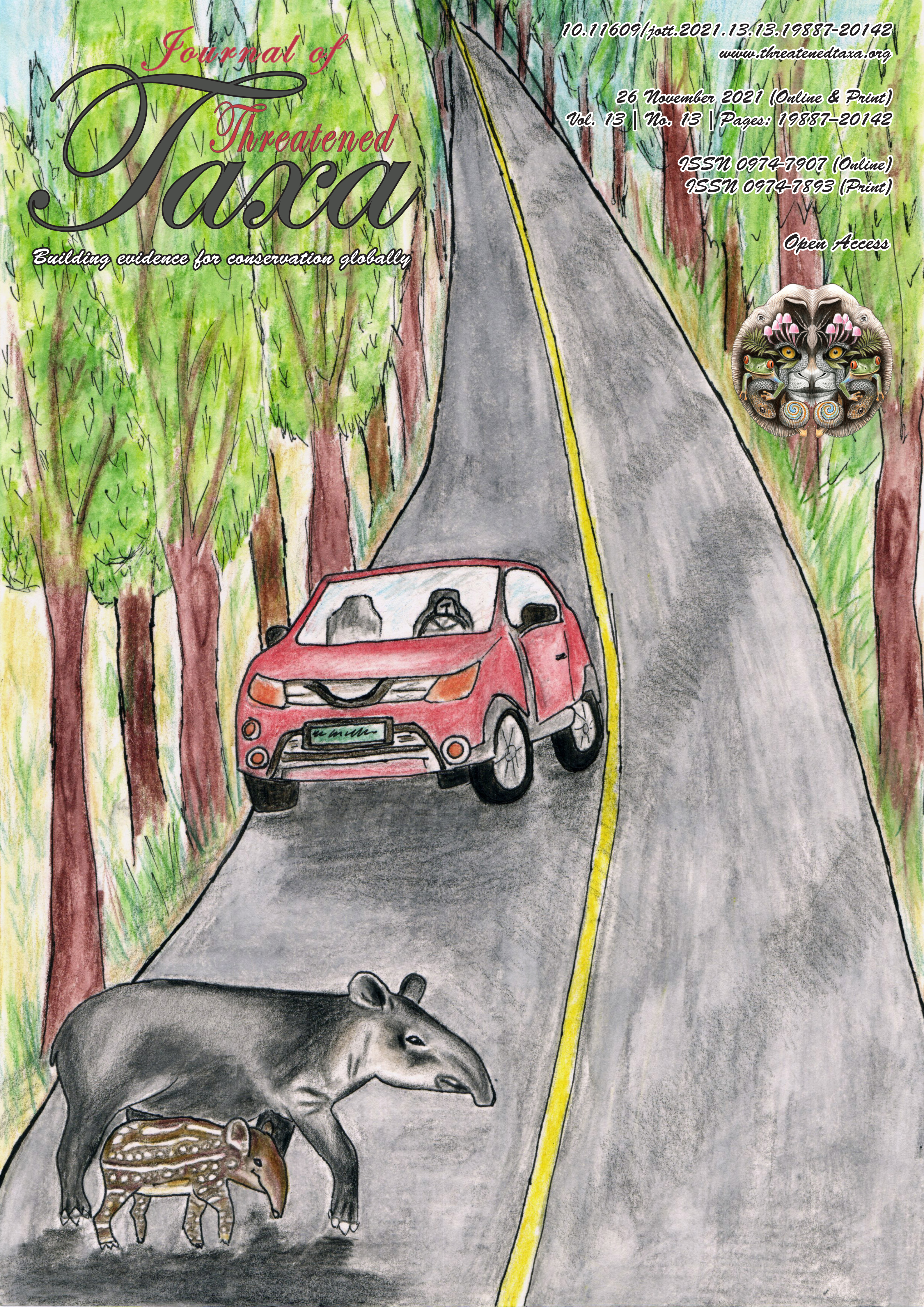

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Caption: Lowland Tapir *Tapirus terrestris* (Medium—watercolours on watercolour paper) © Aakanksha Komanduri.

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COMMUNICATION

Patterns of forest cover loss in the terrestrial Key Biodiversity Areas in the Philippines: critical habitat conservation priorities

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Abstract: The Philippines, home to over 20,000 endemic species of plants and animals, is facing a biodiversity crisis due to the constant decrease of forest cover. The Key Biodiversity Area (KBA) approach was developed to conserve species threatened with extinction using a site-based conservation strategy to select globally important sites using threshold-based criteria for species irreplaceability and vulnerability. This study investigates the applicability of remotely sensed data through geospatial analysis to quantify forest cover loss of the 101 terrestrial KBAs in the country between 2001 and 2019. Results showed that the study sites had 4.5 million hectares (ha) of forest in the year 2000. However, these sites have lost about 270,000 ha of forest in nearly two decades, marking a steady decline with an annual deforestation rate of 14,213 ha per year in these terrestrial KBAs. The majority of the study sites (58) had a high percentage of forest loss (>3.13%), and these should be prioritized for conservation. By the year 2030, it is forecast that a total of 331 thousand ha of forest will be lost unless there is a transformational change in the country's approach to dealing with deforestation. The results of this study provide relevant data and information in forest habitat in near real-time monitoring to assess the impact and effectiveness of forest governance and approaches within these critical habitats.

Keywords: Deforestation, forest habitat, geospatial technology, KBA.

Abbreviations: AZE—Alliance for Zero Extinction | DENR—Department of Environment and Natural Resources | GIS—Geographic Information System | IUCN—International Union for the Conservation of Nature | KBA—Key Biodiversity Area | UNEP—United Nations Environment Programme.

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INTRODUCTION

Forests are home to over 80% of the earth's terrestrial biodiversity (Aerts & Honnay 2011), including almost half of all avian species (Hilton-Taylor et al. 2009). Forests provide many ecosystem services that include conservation of threatened and endemic species (Gibson et al. 2011). However, these forests have undergone remarkable pressure (Drummond & Loveland 2010) over the past decades, leading to a global biodiversity crisis (Driscoll et al. 2018) which is even worse than climate change (University of Copenhagen 2012). There is no doubt that habitat loss, caused by the conversion of forest to non-forest land uses such as agricultural and built-up areas, is the predominant threat to biodiversity (Foley et al. 2005; Estavillo et al. 2013). As a result, many endemic species have either become extinct or threatened with extinction (Brooks et al. 2002). In the Philippines, there are more than 20,000 endemic species of plants and animals (Mittermeier et al. 1998; Conservation International Philippines 2020) and the country is home to 20% of all known flora and fauna species (Ambal et al. 2012). This mega-diverse country has long been recognized as one of the top biodiversity hotspots in the world (Gaither & Rocha 2013) due to the constant exploitation and destruction of its forest resources. This habitat destruction can generate zoonotic diseases (UNEP 2020), such as COVID-19 that caused a worldwide pandemic (Cucinotta & Vanelli 2020). Biodiversity also protects humans against infectious disease (Wood et al. 2014; Levi et al. 2016)

To this end, the Key Biodiversity Area (KBA) approach was developed. This site-based conservation approach is considered one the most effective means to halt biodiversity loss on global and regional scales (Eken et al. 2004; UNEP-CBD 2010). The KBAs are promoted by the International Union for the Conservation of Nature (IUCN) to identify and delineate important sites for the global persistence of biodiversity as manageable units (IUCN 2016; Kulberg et al. 2019), using standard criteria based on the concepts of species irreplaceability and vulnerability (Langhammer et al. 2007; Melovski et al. 2012).

In the Philippines, the identification and delineation of KBAs was initiated by Conservation International Philippines (CIP), the Biodiversity Management Bureau (BMB), formerly Protected Areas and Wildlife Bureau (PAWB), of the Department of Environment and Natural Resources (DENR), and the Haribon Foundation supported by Critical Ecosystem Partnership Fund (CEPF) (CIP et al. 2006). It was started in the country to support the government and other stakeholders in prioritizing and mainstreaming conservation efforts and formulating site-based strategies that protect these vulnerable and irreplaceable species within their habitats (Edgar et al. 2008).

A total of 228 KBAs were identified and delineated in the Philippines, which cover over 106,000 km^2, around 35% of the total land area of the country. The ecosystem coverage of these KBAs includes the following: terrestrial only with 101 KBAs (51,249 km^2); marine only with 77 KBAs (19,601 km^2); and combinations of terrestrial and marine with 50 KBAs (35,702 km^2). These KBAs are home to over 855 species, 396 of these are globally threatened species, 398 are considered restricted-range species, and 61 are congregatory species of birds (CIP et al. 2006; Ambal et al. 2012; FPE, 2020).

Hence, there is an urgent need for effective conservation and management of the remaining forest habitats of these threatened species in the country. One of the essential management strategies is through near real-time monitoring of the temporal and spatial trend of forest cover loss in these KBAs to investigate which critical habitats are more vulnerable to future degradation (Leberger et al. 2019), to identify biodiversity threats, to develop appropriate management interventions such as forest protection and reforestation, and evaluate its effectiveness (Jones et al. 2013). With the advent of remote sensing technology over the last decade, it is now possible to monitor spatial and temporal patterns of forest cover losses on a global scale using high-resolution satellite imaging (Buchanan et al. 2011; Hansen et al. 2013; Turner et al. 2003). Using remotely sensed data for forest monitoring will effectively contribute to the conservation and management of these habitats. Also, it has the potential to assess the impact of site-based policy implementation (Leberger et al. 2019).

This study aimed to quantify the spatial and temporal forest cover loss of the terrestrial KBAs in the Philippines between 2000 and 2019 using high-resolution satellite imaging of forest loss produced by Hansen et al. (2013). Also, it aimed to aid in monitoring efforts and identify the most critical terrestrial KBAs with the highest loss of forest cover - including percent loss - that need immediate intervention. A conservation priority ranking was created based on the annual rate of deforestation, which will demonstrate the applicability of the results of this study in forest monitoring of these sites. Finally, forecasting of the future trend of forest cover loss in these critical habitats was performed as well.

MATERIAL AND METHODS

Study Area

This study was conducted in 101 identified terrestrial KBAs across the 17 regions of the Philippine archipelago with a total area of 51,298.34 km^2 (Image 1) from June to October 2020. The 50 KBAs, with combined terrestrial and marine areas, were not included in the study because there is a need to delineate first the boundaries between the terrestrial and marine realms of the KBA prior to the computation of percentage forest cover of the KBA. If the boundaries will not be delineated, the marine portion of the KBA will be treated as non-forested areas and this will result in a very low percentage of forest cover although the terrestrial portion has a high percentage of forest cover. Due to the unavailability of the delineated realms of the 50 KBAs, the study was only limited to 101 terrestrial KBAs.

The Philippines, with more than 7,000 islands, is geographically located in the western Pacific Ocean and part of the southeastern Asian region which is among the biodiversity hotspots in the world with the highest concentration of terrestrial vertebrate species on the planet. According to the Foundation for the Philippine Environment (FPE) (2020), these terrestrial KBAs in the country represent several types of forest ecosystems across different elevations, namely; sub-alpine forest, mossy forest, montane forest (upper and lower), pine forest, semi-deciduous forest (moist deciduous), lowland evergreen forest, forest over limestone (karst), forest over ultrabasic soil, forest over ultramafic rocks, beach forest, and mangrove forest.

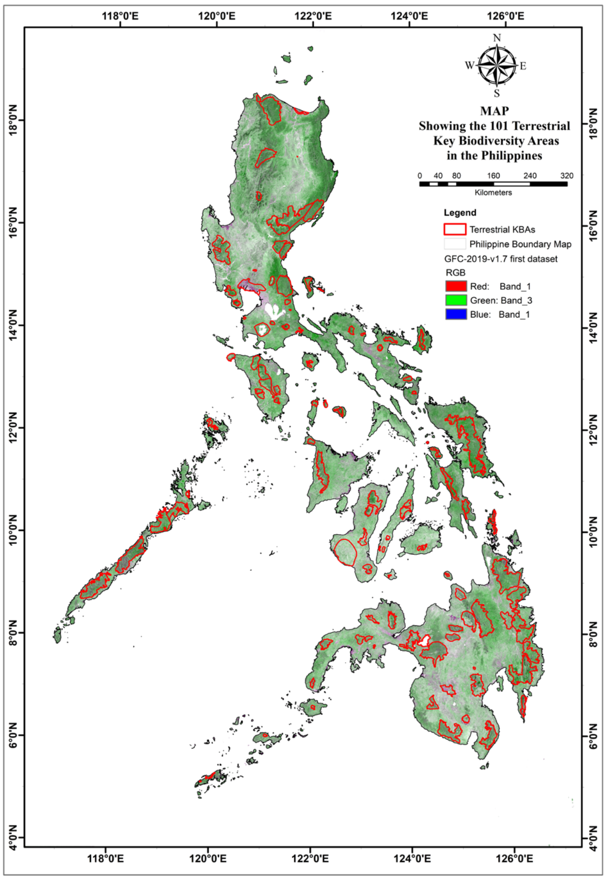


Image 1. Map showing the location of the 101 terrestrial Key Biodiversity Area study sites across the Philippine archipelago.

Data

Terrestrial key biodiversity areas shapefile

To investigate the spatial and temporal forest cover loss within the study sites, the vector maps in shapefile (.shp) format of the KBAs were requested from the world database of Key Biodiversity Areas developed and maintained by BirdLife International (2020). After extracting the spatial data of terrestrial KBAs in Geographic Information System (GIS) software, the maps were compared with the web-based Philippine KBA maps using the Geoportal Philippines (2020). Based on the comparative assessment, 21 of the 101 terrestrial KBAs were observed to have notable inconsistencies in terms of area and its boundaries. Nonetheless, the 21 terrestrial KBA boundaries from the Geoportal Philippines along with the 80 terrestrial KBAs without discrepancies from Birdlife International were selected and used in the analysis of this study, which represents the best sites for biodiversity conservation.

Hansen global forest change 2000–2019 version 1.7

The main dataset in quantifying the spatial and temporal loss in forest cover of the terrestrial KBAs in the Philippines, including the initial forest cover dataset for the year 2000, is the high-resolution global maps of 21st century forest cover change developed by Hansen et al. (2013). The product used in this study was version 1.7, which is the result of time-series analysis of Landsat data at a spatial resolution of one arc-second per pixel (30m x 30m) depicting forest extent and change such as loss (forest to non-forest) and gain (non-forest to forest state) during the period 2000 to 2019. These data are updated annually based on a high-end remote sensing technology and can be freely downloaded from the University of Maryland - Global Land Analysis and Discovery (UM-GLAD) website as raster data. The data can also be downloaded and visualized from the Google Earth Engine (GEE) data repository.

Geospatial processing and statistical analysis of forest cover loss

The software used to quantifying and process yearly forest cover loss of each terrestrial KBA was the Quantum Geographic Information System (QGIS) version 3.14 (pi). The KBA shapefiles were used in clipping the downloaded raster format of forest loss. After clipping, the raster datasets were converted to vector for an easier geostatistical calculation such as area determination. To facilitate the editing of the attribute data, the vector of forest cover loss was split into individual shapefiles following each KBA boundary. Finally, the area in hectares for annual forest loss per terrestrial KBA, between the periods 2001 and 2019, were calculated using the built-in calculate geometry tool. The general overview of the methodology is presented in Figure 1.

The total forest cover loss or the area change, percentage area change, and the annual rate of forest cover loss were computed using the following mathematical formulas by Hansen et al. (2013) which were also used in the study of Sulieman et al. (2017):

$$\Delta A = A2 - A1$$

where:

ΔA = forest cover loss or change in the area

A1 = beginning of the period (date 1)

A2 = end of the period (date 2)

$$PAC = \Delta A/TA \times 100$$

where:

PAC = percentage area change

TA = the total area of KBA

$$ARC = \Delta A/N$$

where:

ARC = Annual rate of change (ha/year)

N = the number of years between date one and date two of the study period

The percentage of forest cover loss was categorized from low to high which is adapted from the study of Leberger et al. (2019). The forecasting of the future trend of forest cover loss from 2020 to 2030 was performed using the forecasting function in MS Excel based on the existing historical forest loss values.

RESULTS

Spatial and temporal forest cover loss

The forest cover of the identified terrestrial KBAs in the Philippines was estimated at around 4.5 million ha in the year 2000, which represents 89% of the total terrestrial KBA area (Image 2). However, after almost two decades, the forest cover of these terrestrial KBAs, based on the GIS analysis of high-resolution remotely sensed data developed by Hansen et al. (2013), had decreased by around 270,000 ha, which is almost 6% of the total forest cover in the year 2000. It is estimated that the remaining forest cover within these terrestrial KBAs as of 2019 is around 81% with an area of 4.27 million ha. Moreover, the annual rate of forest cover loss for these priority areas for biodiversity conservation is computed at around 14,213 ha/year with an annual average deforestation rate of 6% (Image 3).

The scatter plot shows an increasing trend in the annual forest cover loss from 2001 to 2019. The period with the highest recorded rate of deforestation was between 2016 and 2017, but on a positive note, there has been a notable decrease of these losses in the last two consecutive years (2018 and 2019) (Figure 2).

The 10 terrestrial KBAs with the highest percentage of forest loss between 2000 and 2019, except for the KBAs with lake environments (Malasi Lake and Mungao Lake), are presented in Table 1. The percentage of forest loss was highest in Tawi-tawi Island, located in Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) with 27.88%. Based on the percentage frequency distribution presented in Table 2, the majority of the study sites (58)

Table 1. Top ten KBAs with the highest percent forest loss between 2001 and 2019.

Region	Terrestrial Key Biodiversity Areas	% Forest Cover Loss
BARMM	Tawi-tawi Island	27.88
XIII, XI	Bislig	25.75
IX	Mount Sugarloaf	19.24
IV-B	Mount Mantalingahan	17.14
IX	Lituban-Quipit Watershed	14.98
IV-B	Malpalon	13.01
IV-B	San Vicente-Roxas Forests	11.96
XI	Mount Agtuuganon and Mount Pasian	11.76
IV-B	Mount Calavite	11.49
IX	Mount Dapiak and Mount Paraya	11.11

Table 2. Percentage frequency distribution of forest loss in the study sites.

Classification	Percentage of forest loss	Frequency
Low	0–0.76	3
Moderate	0.77–3.13	40
High	>3.13	58
Total		101

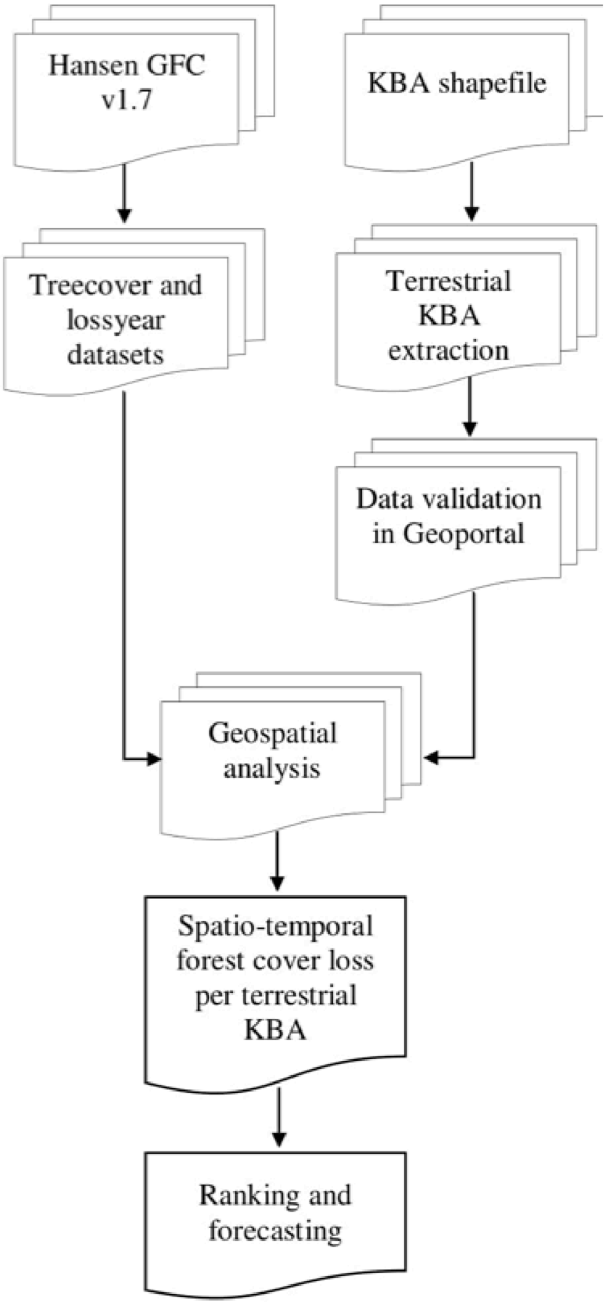


Figure 1. General overview of the methodology.

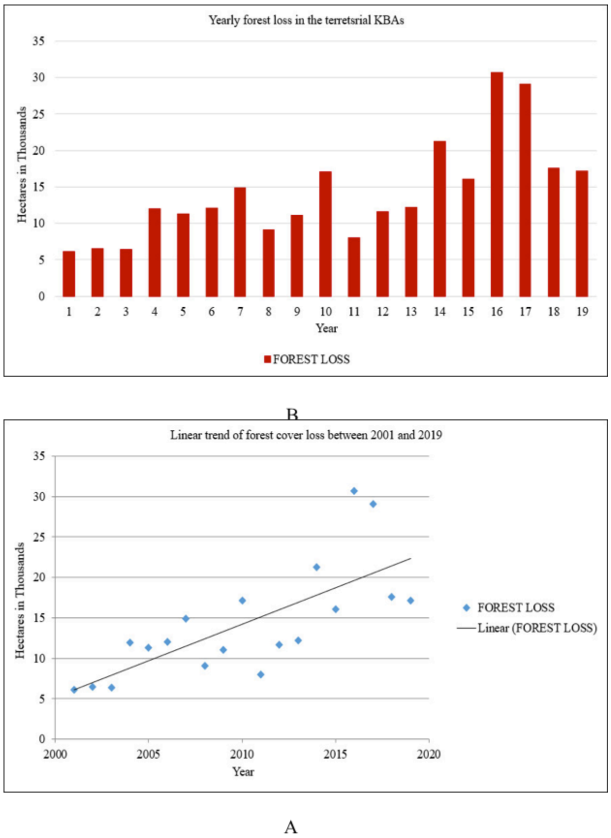
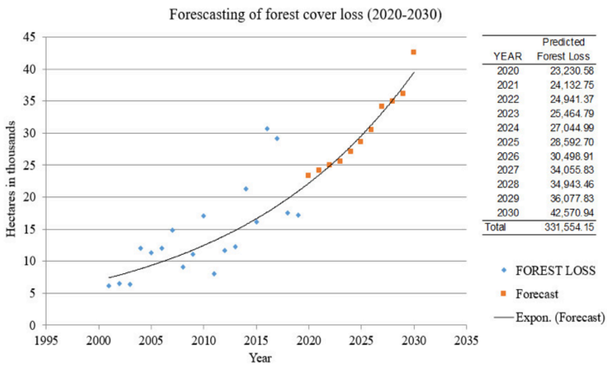


Figure 2. Forest cover loss in terrestrial key biodiversity areas: A—Annual loss | B—The linear trend of forest cover loss in nearly two decades.



YEAR	Predicted Forest Loss
2020	23,230.58
2021	24,132.75
2022	24,941.37
2023	25,464.79
2024	27,044.99
2025	28,592.70
2026	30,498.91
2027	34,055.83
2028	34,943.46
2029	36,077.83
2030	42,570.94
Total	331,554.15

Figure 3. Forecast of forest cover loss in terrestrial key biodiversity areas.

had a high percentage of forest loss with more than 3.13%. On the other hand, only three (3) among the 101 terrestrial KBAs had low percentage of loss, these are Timpoong and Hibok-hibok Natural Monument in Region 10, Mounts Banahaw and San Cristobal Protected Landscape in Region 4A, and Mount Kitanglad in Region 10, with 0.31%, 0.27%, and 0.24%, respectively.

The KBA with the highest net loss of forest area in nearly two decades was Bislig, located in Region 13 covering some portion of Region 11, which was around 38.5 thousand ha (Table 3), while the Timpoong and Hibok-hibok Natural Monument had the lowest area of forest loss (except for KBAs with lake environment) with only 10.59 ha in two decades. Moreover, the Bislig KBA also had the highest annual rate of deforestation with a loss of 2,031 hectares per year (ha/year). This was followed by Mount Mantalingahan in Region 4B and Samar Island Natural Park in Region 8, with 1,266 ha/

Table 3. Top ten sites with the highest forest loss between 2001 and 2019.

Region	Terrestrial Key Biodiversity Areas	Forest cover loss (ha)
XIII, XI	Bislig	38,589.02
IV-B	Mount Mantalingahan	24,071.86
VIII	Samar Island Natural Park	14,037.57
CAR, II, I	Apayao Lowland Forest	12,384.94
XIII	Mount Diwata Range	10,146.78
XI	Mount Agtuuganon and Mount Pasian	9,989.77
XIII	Mount Hilong-hilong	9,842.84
II	Quirino Protected Landscape	9,610.57
IV-B	San Vicente-Roxas Forests	9,221.44
IV-B	Victoria and Anepahan Ranges	8,742.57

Table 4. Top ten sites with the highest annual rate of deforestation.

Region	Terrestrial Key Biodiversity Areas	Annual rate of forest cover loss (ha/year)
XIII, XI	Bislig	2,031.00
IV-B	Mount Mantalingahan	1,266.94
VIII	Samar Island Natural Park	738.82
CAR, II, I	Apayao Lowland Forest	651.84
XIII	Mount Diwata Range	534.04
XI	Mount Agtuuganon and Mount Pasian	525.78
XIII	Mount Hilong-hilong	518.04
II	Quirino Protected Landscape	505.82
IV-B	San Vicente-Roxas Forests	485.34
IV-B	Victoria and Anepahan Ranges	460.14

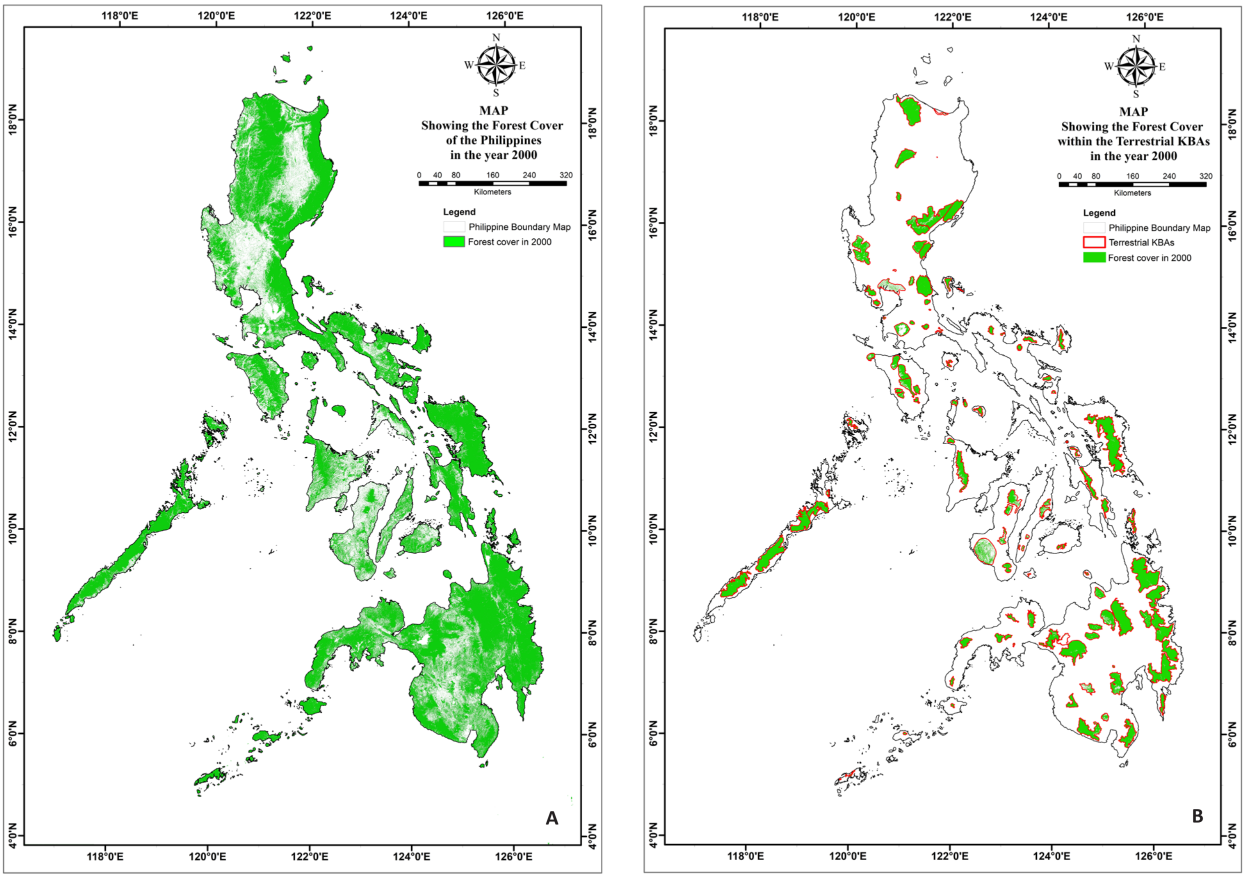


Image 2. Forest cover in the year 2000: A—Nationwide | B—Within terrestrial KBAs.

year and 738.82 ha/year forest loss, respectively (Table 4). The conservation priority ranking of the 101 terrestrial KBAs, ranked in terms of forest cover loss and the annual rate of deforestation, is presented in Appendix 1. This also includes relevant information such as the region and area of KBAs, forest cover and percent forest cover in the year 2000 and 2019, and percent forest cover loss.

DISCUSSION

Quantification of spatial and temporal forest cover loss using Hansen remotely sensed data

In the Philippines, the use of remote sensing for annual forest cover monitoring and loss detection in terrestrial KBAs, even on the national scale, is not yet fully developed compared to other tropical countries like Brazil (Instituto Nacional de Pesquisas Espaciais 2010) and India (Forest Survey of India 2019). Thus, remotely sensed satellite imagery, such as the dataset produced by Hansen et al. (2013), can contribute significantly to biodiversity monitoring (Tracewski et al. 2016). However, errors are inevitable for these datasets, for example, forest loss estimation in dry forests may be underestimated, as reported by Achard et al. (2014), but are working well enough in moist humid forest. Also, the accuracy assessment conducted by Mitchard et al. (2015) in Ghana showed a significant underestimation of forest change. Another limitation in the dataset is that it does not distinguish permanent deforestation from temporary forest disturbance like forest fires, forestry plantations, and shifting cultivation (Curtis et al. 2018). Nevertheless, the overall accuracy of forest cover loss of Hansen GFC dataset as shown in different studies is between 88% (Feng et al. 2016) to 93% (Hirschmugl et al. 2020) and it represents the best high-resolution, with 30m x 30m spatial resolution, global assessment of forest cover change that is freely accessible to the public (Hansen et al. 2010; Tracewski et al. 2016).

Critical habitat conservation priorities

The Tawi-tawi Island, identified in this study with the highest percent forest loss (27.88%) among the terrestrial KBAs, was also recognized as one of the Alliance for Zero Extinction (AZE) sites (AZE 2010) that holds two critically endangered (CR) species and one endangered (EN) species (IUCN 2008). The AZE sites are those that have threatened species constrained to just a single site globally (AZE 2010). Also, this KBA has 45 trigger species identified (Odevillas 2018). Trigger species are those that trigger either the irreplaceability criterion or vulnerability criterion within the KBAs (Langhammer et al. 2007), these could also be identified by combining both the endemism and rarity criteria (Yahi et al. 2012). Based on the findings of this study, 58 sites recorded a high percentage forest loss which suggests that these areas should be prioritized in terms of forest conservation and protection. It is also advisable that the strategies and good practices in forest conservation of the three (3) sites with the lowest percentage of forest loss should be adapted to other sites of this study.

The second site with the highest percent forest loss, which also had the highest annual deforestation rate, and with the largest area of forest cover loss within the study period is the Bislig KBA in Region 13 (Image 4). This terrestrial KBA has 33 trigger species and one (1) critically endangered species based on the data from the Haribon Foundation (2020) and red list of threatened species (IUCN 2008).

Mount Mantalingahan in Region 4B, with a total of 24,071.86 ha of forest cover loss between 2001 and 2019 and an annual deforestation rate of 1,266 ha/year, has one (1) endangered species, one (1) vulnerable species (Ambal et al. 2012), and 38 trigger species (Odevillas 2018). Although this KBA was already removed from the AZE list in 2010 after the *Palawanomys furvus* was reclassified as Data Deficient from Endangered (EN) species in 2008 (Ambal et al. 2012), the threat to biodiversity remains. This is mainly due to its high annual rate of forest cover loss as observed in this study.

The Samar Island National Park in Region 8, which ranked third in this study with the highest rate of forest cover loss, was also identified as a top priority site for protection due to its large number of trigger species with 180 species in total, and three (3) critically endangered species (Odevillas 2018). These findings suggest that the aforementioned terrestrial KBAs are more likely to experience species extinction in the coming decades without proper conservation and protection measures.

Status and trends of forest cover in the terrestrial key biodiversity areas in the Philippines

The identified terrestrial KBAs in the Philippines cover at least 17% of the estimated total land area of the country (30 million ha) and were declared as "critical habitats" under the Presidential Executive Order 578 in 2006. However, these sites alone are not enough for biodiversity conservation (FAO & UNEP 2020) especially in a country regarded as one of the top global biodiversity hotspots (Mittermeier et al. 1998). Therefore, an expansion of these habitats is necessary to increase conservation coverage of the threatened species (Kullberg et al. 2019). Also, there are only 27 protected terrestrial KBAs, 25 are partially protected, while the remaining 49 are unprotected or not covered with any legislative interventions (Ambal et al. 2012), which make these areas more vulnerable to anthropogenic deforestation that has a remarkable effect on forest cover (Margono et al. 2014). However, even a protected KBA is still vulnerable to land cover conversion for agro-industrial use, as observed in the buffer zones of Mount

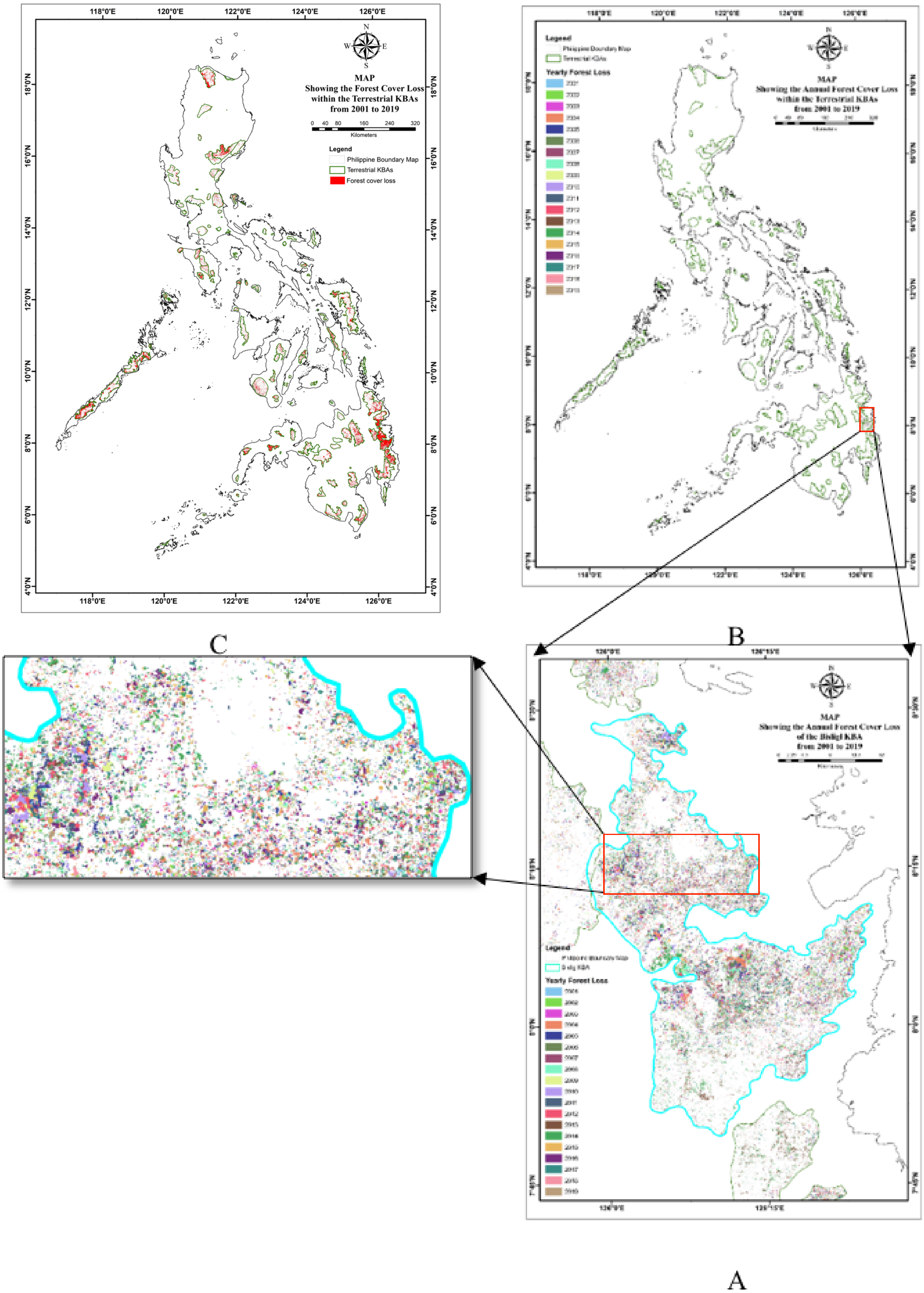


Image 3. Map showing the forest cover loss within the Philippines' terrestrial key biodiversity areas: A—The total forest loss from 2001 to 2019 | B—The annual forest loss from 2001 to 2019 | C—The annual forest loss of Bislig Key Biodiversity Area.

Image 4. The deforestation area in Bislig Key Biodiversity Area. © Francesco Veronesi.

Kalatungan (Azuelo & Puno 2018).

As reported by the DENR (2000) in its 2000 Philippine Forestry Statistics (PFS), the country's forest cover was around 5.4 million ha in the year 2000 (18% of the total land area), which implies that 83% of these forests were found in the terrestrial KBAs. Although forest cover increased in the country between 2000 and 2015, with an estimated area of seven million ha or a 22% increase (DENR 2019), a consistent decline in the forest cover of these terrestrial KBAs was detected in this study within the same period. The decline in forest cover in the country is also reported by Mongabay (2020) based on deforestation statistics stating that a total of 1,128,788 ha of forest was lost between 2001 and 2018. Globally, the rates of forest cover loss in Important Birds and Biodiversity Areas (IBAs) were highest in South America and southeastern Asia (Tracewski et al. 2016), which includes the Philippines. This indicates that the country's efforts in managing and protecting these critical habitats, as well as the existing environmental protection measures, are seriously inadequate (Oliver & Heaney 1996; Hammond 1997) due to the constant rate of deforestation and forest degradation within these areas, which are generally caused by logging, mining, and land conversion (from forest to non-forest) (Lillo et al. 2018). Although a promising finding was observed in the last two periods (2018 & 2019) due to the substantial decreased in the forest cover loss, there is still a need for annual forest cover loss monitoring to identify and evaluate the impact of policy and conservation interventions in the spatial and temporal forest cover loss in these areas (Broich et al. 2011).

Since the forest cover loss of the study sites exhibited an increasing trend, with a similar pattern of results obtained in the study of Leberger et al. (2019) on a global scale, it is predicted in this study that by the end of 2030 an area of approximately 331,000 ha of forest will be lost, equivalent to around 7.3% of the total forest cover in these sites (Figure 3). This immense decline in forest will leave these critical habitats with only 76% remaining cover, and in turn escalate the threat to the 25 Critically Endangered (CR), 40 Endangered (EN), and 117 Vulnerable (VU) species (Ambal et al. 2012) found in these sites. Unless there is a transformational change in the way the country manages and conserves its forests and biodiversity (FAO & UNEP 2020) through these terrestrial KBAs, extinction of species is imminent. For that reason, there is an undeniable need for near real-time monitoring of forest loss within these areas (Leberger et al. 2019), and ranking/prioritizing them for conservation based on vulnerability to degradation (Brooks et al. 2006).

CONCLUSION

The present study quantified the spatial and temporal pattern of forest cover loss in 101 terrestrial key biodiversity areas of the Philippines between the periods 2001 and 2019 using high-resolution satellite-based earth observation datasets. Remote sensing technology and geospatial analysis have a high potential for timely monitoring of the forest cover status of these habitats, an essential component of biodiversity conservation. The increasing trend of forest loss in the terrestrial KBAs, as observed in this study, with an annual deforestation rate of about 14,213 ha per year, clearly suggests that the efforts in the conservation of these critical habitats need recalibration. Thus a paradigm shift is necessary to manage these sites in an attempt to prevent the extinction of 182,000 species or at least improve their conservation status. There is also a need to expand the terrestrial KBAs in the country taking into consideration the threatened species of vascular plants since the identification and delineation of terrestrial KBAs was only based on some faunal taxonomic groups, such as amphibians, reptiles, birds, and mammals.

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Appendix 1. Conservation priority ranking of the 101 terrestrial key biodiversity areas based on the annual rate of forest cover loss.

Region	Terrestrial Key Biodiversity Areas	Area of KBA*	Forest cover in 2000*	% Forest cover in 2000	Remaining forest cover in 2019*	% forest cover in 2019	Forest cover loss*	% Forest cover loss	Annual rate of forest loss (ha/year)	Priority ranking
XIII, XI	Bislig	154.12	149.85	97	111.26	72	-38.59	-25.75	-2031.00	1
IV-B	Mount Mantalingahan	146.00	140.42	96	116.35	80	-24.07	-17.14	-1266.94	2
VIII	Samar Island Natural Park	333.00	330.24	99	316.20	95	-14.04	-4.25	-738.82	3
CAR, II, I	Apayao Lowland Forest	177.37	171.43	97	159.04	90	-12.38	-7.22	-651.84	4
XIII	Mount Diwata Range	93.80	92.08	98	81.94	87	-10.15	-11.02	-534.04	5
XI	Mount Agtuuganon and Mount Pasian	85.50	84.92	99	74.93	88	-9.99	-11.76	-525.78	6
XIII	Mount Hilong-hilong	240.24	237.66	99	227.81	95	-9.84	-4.14	-518.04	7
II	Quirino Protected Landscape	164.54	149.48	91	139.87	85	-9.61	-6.43	-505.82	8
IV-B	San Vicente-Roxas Forests	81.16	77.11	95	67.88	84	-9.22	-11.96	-485.34	9
IV-B	Victoria and Anepahan Ranges	164.79	163.46	99	154.72	94	-8.74	-5.35	-460.14	10
XIII, X	Mount Kaluayan-Mount Kinabalian Complex	180.98	180.99	100	172.26	95	-8.73	-4.82	-459.62	11
XI	Mount Kampalili-Puting Bato	169.91	166.94	98	158.89	94	-8.04	-4.82	-423.23	12
BARMM, XII	Mount Piagayungan and Butig Mountains	154.34	148.39	96	140.73	91	-7.66	-5.16	-403.09	13
IV-B	Cleopatras Needle	104.73	102.30	98	95.76	91	-6.55	-6.40	-344.64	14
IX	Mount Sugarloaf	34.42	32.73	95	26.43	77	-6.30	-19.24	-331.44	15
XI, XII	Mount Latian complex	95.08	87.45	92	82.40	87	-5.04	-5.77	-265.45	16
IX	Lituban Quipit Watershed	33.29	32.64	98	27.75	83	-4.89	-14.98	-257.23	17
XIII	Agusan Marsh Wildlife Sanctuary	54.77	49.20	90	44.94	82	-4.26	-8.66	-224.33	18
XII	Mount Busa-Kiamba	114.14	106.07	93	102.38	90	-3.68	-3.47	-193.74	19
VI, VII	Southwestern Negros	196.44	83.91	43	80.46	41	-3.45	-4.11	-181.36	20
III, I	Zambales mountains	139.68	118.49	85	115.05	82	-3.44	-2.91	-181.19	21
IV-A, III	Mounts Irid-Angilo and Binuang	115.21	114.08	99	110.71	96	-3.37	-2.95	-177.15	22
XI, XII	Mount Apo	99.08	85.68	86	82.48	83	-3.21	-3.74	-168.80	23
X	Mount Tago Range	83.42	68.33	82	65.22	78	-3.10	-4.54	-163.34	24
X, BARMM	Munai/Tambo	69.84	65.39	94	62.62	90	-2.77	-4.24	-145.95	25
VIII	Anonang-Lobi Range	58.05	56.98	98	54.34	94	-2.63	-4.62	-138.51	26
II, III	Casecnan Protected Landscape	90.72	82.07	90	79.96	88	-2.11	-2.57	-111.05	27
IV-B	Puerto Galera	37.31	32.33	87	30.54	82	-1.79	-5.54	-94.29	28
XII, BARMM	Mount Daguma	32.36	31.02	96	29.36	91	-1.65	-5.33	-87.09	29
IV-A	Polillo Islands	20.28	19.95	98	18.35	91	-1.60	-8.01	-84.11	30
IV-B	Iglit-Baco Mountains	56.30	47.19	84	45.61	81	-1.58	-3.35	-83.20	31
IV-B	Mount Calavite	18.15	13.50	74	11.94	66	-1.55	-11.49	-81.61	32
IV-B	Malpalon	14.09	11.86	84	10.32	73	-1.54	-13.01	-81.23	33
BARMM	Tawi-tawi Island	5.85	5.53	94	3.99	68	-1.54	-27.88	-81.11	34
IX	Mount Dapiak-Mount Paraya	14.67	13.57	92	12.06	82	-1.51	-11.11	-79.35	35
BARMM, XII	Liguasan marsh	39.42	18.10	46	16.65	42	-1.45	-8.01	-76.35	36
III	Aurora Memorial National Park	47.15	42.34	90	40.91	87	-1.42	-3.36	-74.83	37
VI	Central Panay mountains	105.58	94.56	90	93.27	88	-1.29	-1.36	-67.67	38

Region	Terrestrial Key Biodiversity Areas	Area of KBA*	Forest cover in 2000*	% Forest cover in 2000	Remaining forest cover in 2019*	% forest cover in 2019	Forest cover loss*	% Forest cover loss	Annual rate of forest loss (ha/year)	Priority ranking
III, II	North Central Sierra Madre Mountains	87.48	86.21	99	85.01	97	-1.20	-1.39	-62.92	39
VI	Mount Silay and Mount Mandalagan (Northern Negros)	68.88	45.21	66	44.06	64	-1.16	-2.56	-60.85	40
IV-B	Lake Manguao	6.45	5.32	82	4.18	65	-1.14	-21.46	-60.05	41
VIII	Mount Nacolod	33.49	32.80	98	31.67	95	-1.14	-3.47	-59.88	42
IV-B	Mount Halcon	50.95	44.43	87	43.30	85	-1.13	-2.55	-59.64	43
XI	Mount Hamiguitan (Tumadgo peak)	31.88	31.27	98	30.19	95	-1.08	-3.45	-56.69	44
IV-B	Busuanga Island	16.33	15.94	98	14.90	91	-1.04	-6.55	-54.99	45
X, IX	Mount Malindang	40.69	37.11	91	36.22	89	-0.90	-2.41	-47.16	46
IV-A	Taal Volcano Protected Landscape	65.93	31.98	49	31.10	47	-0.88	-2.76	-46.48	47
IV-B	Mount Hitding	17.77	16.56	93	15.70	88	-0.87	-5.24	-45.67	48
IV-B	Mount Siburan	11.57	9.53	82	8.68	75	-0.86	-9.00	-45.18	49
XIII	Mount Kambinlio and Mount Redondo	28.52	27.07	95	26.27	92	-0.80	-2.95	-41.97	50
VII	Mount Capayas	13.61	10.44	77	9.66	71	-0.78	-7.48	-41.07	51
VII, VI	Ban-ban	28.54	16.13	57	15.39	54	-0.74	-4.60	-39.07	52
VII	Central Cebu Protected Landscape	29.22	19.52	67	18.79	64	-0.73	-3.73	-38.27	53
VII	Cuernos de Negros	23.56	21.34	91	20.63	88	-0.71	-3.33	-37.41	54
XII	Mount Matutum	18.89	11.82	63	11.13	59	-0.69	-5.84	-36.35	55
III	Mount Dingalan	46.89	45.93	98	45.25	97	-0.67	-1.47	-35.49	56
CAR	Balbalasang-Balbalan National Park	81.54	77.79	95	77.12	95	-0.67	-0.86	-35.26	57
V	Catanduanes Watershed Forest Reserve	28.24	28.00	99	27.33	97	-0.67	-2.39	-35.18	58
IV-B	Balogo watershed	10.50	9.38	89	8.74	83	-0.63	-6.76	-33.35	59
III, NCR	Manila Bay	96.34	24.20	25	23.59	24	-0.60	-2.50	-31.81	60
V	Bacon-Manito	12.75	12.45	98	11.93	94	-0.53	-4.25	-27.84	61
V	Caramoan peninsula	18.85	18.72	99	18.23	97	-0.49	-2.64	-26.05	62
III	Angat watershed	15.41	13.29	86	12.82	83	-0.47	-3.52	-24.60	63
BARMM	Basilan Natural Biotic Area	4.48	4.45	99	4.02	90	-0.43	-9.58	-22.44	64
X	Mount Kalatungan Mountains Ranges Natural Park	35.77	31.90	89	31.48	88	-0.42	-1.31	-22.01	65
CAR, II	Mount Pulag National Park	13.29	12.56	94	12.18	92	-0.38	-3.03	-20.04	66
IX	Pasonanca Natural Park	10.42	10.03	96	9.66	93	-0.36	-3.63	-19.18	67
X	Mount Balatukan	35.25	29.24	83	28.90	82	-0.34	-1.16	-17.78	68
IV-B	Romblon Island	8.19	7.10	87	6.77	83	-0.32	-4.58	-17.10	69
IV-A	University of the Philippines Land Grants (Pakil and Real)	11.12	10.77	97	10.47	94	-0.30	-2.80	-15.87	70
III	Bataan Natural Park and Subic Bay Forest Reserve	25.25	23.47	93	23.17	92	-0.29	-1.24	-15.36	71
IV-B	Mount Hinunduang	8.22	8.08	98	7.79	95	-0.29	-3.59	-15.27	72
III	Mariveles mountains	12.10	11.23	93	10.94	90	-0.29	-2.57	-15.17	73
VIII	Biliran and Maripipi Island	12.76	12.36	97	12.07	95	-0.28	-2.29	-14.92	74
VI, VII	Mount Kanla-on Natural Park	24.78	16.22	65	15.94	64	-0.28	-1.74	-14.86	75
V, IV-A	Mount Labo	13.78	13.66	99	13.38	97	-0.28	-2.02	-14.52	76

Region	Terrestrial Key Biodiversity Areas	Area of KBA*	Forest cover in 2000*	% Forest cover in 2000	Remaining forest cover in 2019*	% forest cover in 2019	Forest cover loss*	% Forest cover loss	Annual rate of forest loss (ha/year)	Priority ranking
VI	North west Panay peninsula (Pandan)	12.06	11.70	97	11.44	95	-0.26	-2.18	-13.44	77
IV-B	Marinduque Wildlife Sanctuary (Central)	8.92	8.29	93	8.04	90	-0.25	-2.99	-13.06	78
VII	Nug-as and Mount Lantoy	10.46	6.67	64	6.47	62	-0.20	-2.96	-10.39	79
VII	Rajah Sikatuna Protected Landscape	12.40	11.22	91	11.03	89	-0.20	-1.74	-10.28	80
IV-A	Mount Makiling	6.23	5.92	95	5.76	93	-0.16	-2.71	-8.46	81
I	Kalbario-Patapat National Park	8.97	8.69	97	8.53	95	-0.16	-1.79	-8.17	82
V	Mount Isarog National Park	10.00	9.60	96	9.44	94	-0.16	-1.62	-8.16	83
IV-A	Pagbilao and Tayabas Bay	2.69	1.79	66	1.64	61	-0.15	-8.12	-7.63	84
IV-B	Mount Guiting-guiting Natural Park	15.34	15.22	99	15.07	98	-0.15	-0.99	-7.93	85
V	Bulusan Volcano Natural Park	3.72	3.42	92	3.30	89	-0.12	-3.45	-6.21	86
II	Buguey wetlands	10.87	2.34	22	2.26	21	-0.08	-3.52	-4.34	87
BARMM	Mount Dajo National Park	3.30	3.04	92	2.97	90	-0.07	-2.29	-3.67	88
X	Mount Kitanglad	31.02	29.55	95	29.48	95	-0.07	-0.24	-3.73	89
BARMM	Lake Lanao	36.35	3.14	9	3.08	8	-0.06	-2.01	-3.33	90
XII, XI	Mount Sinaka	1.75	1.54	88	1.48	85	-0.05	-3.46	-2.80	91
V	Mount Kulasi	3.05	3.03	99	2.97	98	-0.05	-1.81	-2.89	92
IV-A	Quezon National Park	1.98	1.95	98	1.90	96	-0.05	-2.39	-2.45	93
VII	Mount Kangbulagsing and Mount Lanaya	2.62	1.72	66	1.68	64	-0.04	-2.28	-2.07	94
IV-A	Mount Palay-Palay-Mataas Na Gulod National Park	1.83	1.77	97	1.74	95	-0.03	-1.55	-1.44	95
III	Candaba swamp	1.91	0.55	29	0.53	28	-0.03	-4.76	-1.39	96
IX	Mount Timolan	1.92	1.84	96	1.80	94	-0.03	-1.87	-1.81	97
IV-A	Mounts. Banahaw-San Cristobal Protected Landscape	11.33	10.68	94	10.65	94	-0.03	-0.27	-1.54	98
VII	Mount Bandila-an	1.78	1.60	90	1.57	88	-0.03	-1.65	-1.39	99
X	Timpoong and Hibok-hibok Natural Monument	3.73	3.45	93	3.44	92	-0.01	-0.31	-0.56	100
II	Malasi Lake	0.16	0.01	3	0.00	2	0.00	-52.57	-0.15	101
	Grand Total	**5129.8**	**4540.39**		**4270.33**		**-270.06**		**-14213.79**	
	Average			**86**		**81**		**-6**		

* Thousand ha

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