

THE MOVEMENT PATTERN AND HOME RANGE OF SUMATRAN ELEPHANTS (*Elephas maximus ssp. sumatranus*) IN THE LANDSCAPE OF MILA-TANGSE IN PIDIE REGENCY, ACEH

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ABSTRACT

The sumatran elephant is the largest mammal species on the island of Sumatera. They are listed by the IUCN as critically endangered (IUCN, 2020). The current population throughout Sumatera lies on 22 home ranges and most of them are in critical condition (KLHK, 2020). One of the home ranges in Aceh Province is in the landscape of Mila-Tange, Pidie Regency. This landscape is a meeting point among the elephant herds. The herds that have been separated into small groups will gather with the other groups in several months. This phenomenon becoming one of the triggers for the incidents of human-elephant conflict. The conservation activity is being implemented by taking into account the needs of livelihood in the area. Therefore, the research was conducted to recognize the movement pattern and its range in this landscape during period of January to December 2021. The results show that the elephant herd range lies from 123 km² to 413 km². The movement patterns are concentrating in the type of shrubs (1.227 points which equal to 46.73%) and mixed dry land agriculture (923 points which equal to 35.15%). The roaming area and movement patterns are mostly influenced by the environmental factors including natural food, land cover and anthropogenic activities.

Keywords: *Sumatran Elephant, Mila-Tangse, Home Range, Movement Pattern, Animal Behaviour*

INTRODUCTION

The sumatran elephant is the largest mammal species on the island of Sumatera. They are referred to as an umbrella species for their important role in the forest ecosystem. The herds are wandering through the forest where at the same time distributing the seeds of trees and shrubs from one place to another (Tan *et al.*, 2021).

The elephant needs to have large areas for survival by wandering through their home ranges in various types of habitats (Goswami, 2017). According to Garsetiasih *et al.* (2018), the elephant herds occupy an extensive habitat in several types of ecosystems range from coastal, savanna, swamp to mountains as their home range. However, Rood *et al.* (2008) stated that elephants are animals with wandering areas within their habitat, means if elephants are in a narrow habitat, the elephant will continue to exist and maintain their home range.

This wildlife is included in the list of protected fauna species both at the national and international levels. The sumatran elephant is protected by Indonesia's Law No. 5/1990 on

Sustainable Natural Resources and Ecosystem Conservation. The distribution of sumatran elephants found in seven provinces; Aceh, Sumatera Utara, Riau, Bengkulu, Jambi, Sumatera Selatan and Lampung. The estimation of sumatran elephant population was 2.800 to 4.800 individuals and wandering for over 44 home ranges based on a survey and rapid assessment in 1980 (Blouch and Simbolon, 1985). The status of the sumatran elephant was escalated from endangered to critically endangered by the International Union for Conservation of Nature (IUCN) Red List in 2012. This is largely due to a significant decline in the sumatran elephant population at least 80% during the past three generations, estimated to be about 75 years (Gopala et al, 2011). The population has drastically declined to 700 individuals as well as the local extinction has occurred in for more than 20 home ranges within period of 2011-2017. The current population are only wandering within 22 home ranges in which most of them are in critical condition (KLHK, 2020). One of them is in the landscape of Mila-Tangse, Pidie Regency, Aceh Province.

The landscape of Mila-Tangse in Pidie District, Aceh Province is an area prone to human-elephant conflict (KMG). Pidie District was recorded as the first rank with the highest KMG cases in Aceh Province from 2016-2021. The elephant population in the landscape of Mila-Tangse is estimated to be 57 individuals (BKSDA Aceh, 2019). Based on the results of an analysis of elephant movements through the GPS Collar that was carried out by the Aceh BKSDA, the area of elephant movement in the landscape Mila-Tangse is estimated to be 43,00.17 hectares. Based on the distribution of elephant movements in the landscape of Mila-Tangse, the movements of elephant groups are not only within the forest area, but also outside the forest area. The movement of elephants within the forest area is 33,752.84 hectares, while outside the forest area it is 7,288.40 hectares. Areas of movement of elephants outside forest areas have the potential to cause human-elephant conflict (Aceh BKSDA, 2018). Another cause for KMG was due to types of livelihood crops such as banana, areca nut, durian and rice. These crops are favored by elephants as per the study case conducted by Berliani et al. (2016). The study shows that elephants do have favor for such crops such as rice, bananas including rubber, palm oil and areca nut. This situation increasingly influences the herds to stay longer in community farming areas.

The landscape of Mila-Tangse is the remaining habitat (refugia) for the elephant herd. It is expected to become one of the conservation areas for sumatran elephants while at the same time pay attention to the needs of livelihood. Therefore, it is significant to recognize the movement pattern and ranges of the herds in this landscape. This study aims to determine of the movement pattern and ranges used by the herds in this landscape by using GPS collar technology. It is also aim to find out the types of land cover which has experiencing disturbances by livelihood.

METHOD

Research on movement patterns and ranges of sumatran elephants in the Mila-Tangse landscape was carried out from January to December 2021. The main data in this study is GPS Collar data installed on one individual elephant in the elephant group in the Mila-Tangse landscape from July 2019 until December 2021. GPS Collar data was obtained from the Aceh Natural Resources Conservation Center (BKSDA Aceh).

The tools and materials in this research are GPS Collar (to determine the movement of elephants), computer/laptop (research support tool), ArcGis 10.3 software (to process spatial data) Microsoft Excel software (to perform statistical data analysis), Landsat 8 images, shapefiles slope class, river network shapefile, road network shapefile, residential area shapefile in the Mila-Tangse landscape. The objects in this research are The tools and materials in this research are GPS Collar (to determine the movement of elephants), computer/laptop (research support tool), ArcGis 10.3 software (to process spatial data)

Microsoft Excel software (to perform statistical data) analysis), Landsat 8 images, shapefiles slope class, river network shapefile, road network shapefile, residential area shapefile in the Mila-Tangse landscape. The objects in this study include the sumatran elephant group in the Mila-Tangse landscape.

The data were input into Microsoft Excel for compilation purposes. The spatial distribution data were mapped using ArcGIS 10.3. The home range of sumatran elephants in the Mila landscape was estimated using Minimum Convex Polygon (MCP) (Oshborn, 2004). The method was used to estimate the external contour and the center of activity of the home range (Kernohan et al., 2001).

RESULTS AND DISCUSSION

The study shows that the number of elephants in Mila's herd is 16 with the details of 4 young elephants, 5 calves and 7 adults (figure 1). The first collared installed by to Mila's herd was in January 13, 2017 in which subsequently removed due to battery run out in June 19, 2019. Within the same date, the installation of a new collar was carried out with the consideration of the herd movements is needed for the purposes of an early warning system so as to avoid the incidents of human elephant conflict. Based on the collar data, it is known that there are 2.626 locations being recorded in the elephant herd of Mila.



Figure 1. Mila elephant herd in the Mila-Tangse Landscape. The red circle shown Mila elephant that installed by GPS Collar

Mila is a wild elephant that was fitted with a GPS collar by BKSDA Aceh. Mila was selected to be fitted with a GPS collar because it is a group leader and thus determines the movement of the Mila's herd. According McComb et al. (2001) that matriarchs are the oldest, largest and may even be post-reproductive, regulating the activity, direction and rate of movement of the group. The leadership and experience of the matriarch is considered very important because it can determine the success of reproduction. Based on spatial analysis by using GPS collar point's, it is known that the Mila's herd have wandered in ranges from 123 km² to 413 km²

within period of July 2019 to December 2021. The determination of elephant's wandering area is the delineation and polygon of the outermost points of the herd movement along with the determination of Minimum Convex Polygon (MCP).

In 2019, the ranges area is 123 km², 176 km² in 2020 and it is 413 km² in 2021. The area of Mila's herd is varying every year. Abdullah (2009) reported that the range size of Asian elephants is vary between 32.4 km² to 166.9 km² which includes various types of forest ecosystems; swamp forest, lowland rainforest, peat forest and mountain rainforest. Meanwhile, according to Sukumar (2003) the home range of Asian elephants is fluctuating between 34 km² to 800 km² for females and 200 km² to 235 km² for males. The studies have conducted on Asian elephants have shown that elephant herds in Sabah occupied a minimum home range of between 250 km² to 400 km² in non-fragmented forest, whereas in the fragmented forest, the annual habitat of elephants is estimated to be around 600 km² (Alfred et al., 2012). The home range of Mila's herd based on the recording of GPS collar location points from July 2019 to December 2021 can be seen in Table 1.1.

Table 1. The home range of Mila's herd based on the recording of GPS Collar location points in 2019-2021

No.	Year	GPS Collar Location Record (Point)	Home Range (km ²)
1	2019	562	123
2	2020	1.039	176
3	2021	1.024	413
Total		2.625	238 (Average)

The movement of Mila's herd in the landscape of Mila-Tangse starting from the conservation area (CA Jantho) in the east to the west by approaching the settlement area as known as for other land uses (APL). The largest area of Mila's home range in 2021 is 413 km². Meanwhile on 2019 the home range area is only 123 km².

The elephant's home range in 2019 was concentrated in the East and did not move to the West (CA Jantho). One of the reasons was the availability of foods during that period, in which the elephants didn't need to spent a lot of energy to explore further. Harris et al., (2008) stated that elephants prefer to move in a short distance per day when their needs can be met. In addition, the eastern area of the landscape Mila-Tangse is preferred due to its pleasurable. The preferences home range of sumatran elephants are lowlands (<200 m) and slopes between 0 and 20% (Wilson et al., 2021). Elephants tend to avoid foraging or wandering in highland areas to save the energy (Wall et al., 2006). The larger the slope of an area, then it is more difficult for large mammals to occupy their habitat (Anggrita et al., 2018). In addition, this study has seen a narrow range of Mila's herd due to its data being used for only half a year in 2019 within period of July to December 2019.

Furthermore, the home range has increased to 176 km² in 2020 due to the extensive movements to the Production Forest area. The Mila's herd has also expanded to the Jantho Nature Reserve in 2021. The situations happened within period of 2020-2021 caused by the implementation of elephant drives to avoid elephant ventures into community farming area which done by the Provincial Agency of Natural Resources Conservation together with the local community and partners. The study shows that the movement of elephants is not the same every year. The individual elephant or elephant herds may not have equal access to all habitat at all times.

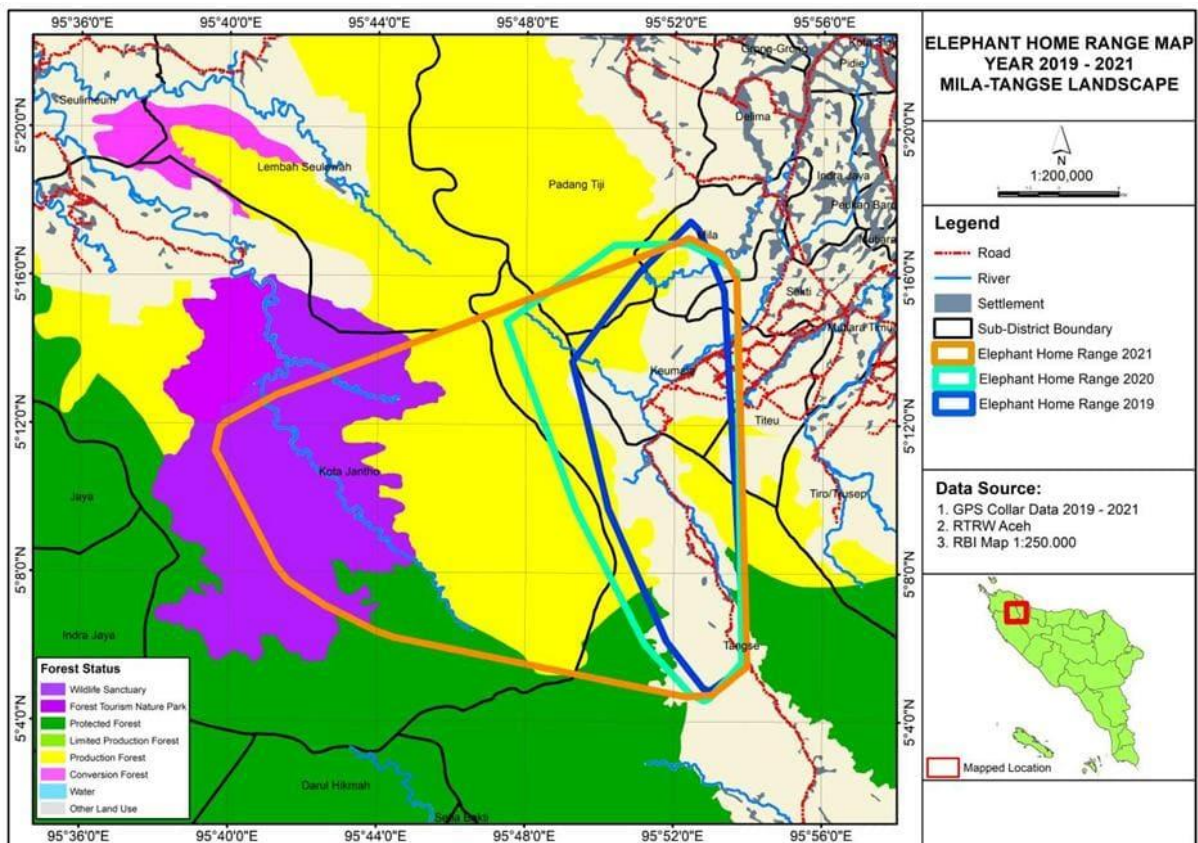


Figure 2. Mila elephant movement pattern in 2019 to 2021 based on area status

It is known that there are 10 types of land cover which mostly used by the Mila’s herd and other elephant herds in the landscape of Mila-Tangse based on the overlay data between the GPS collar location point and the land cover classification (KLHK, 2019). The distribution of Mila’s herd based on land cover and location points from the GPS record within period of 2019 to 2021 can be seen in Table 2.

Table 2. The distribution of Mila’s herd based on land cover and location points from the GPS record within period of 2019 to 2021

No.	Type of Land Cover	GPS Collar Location Record (point)	Percentage (%)
1	Shrubs	1.227	46,73
2	Dryland Farming Mingled with The Bush	923	35,15
3	Primary Dryland Forest	200	7,62
4	Savana	137	5,22
5	Secondary Dryland Forest	60	2,28
6	Paddy Field	42	1,60
7	Clearing	36	1,37
8	Settlement	1	0,04
Total		6.171	100,00

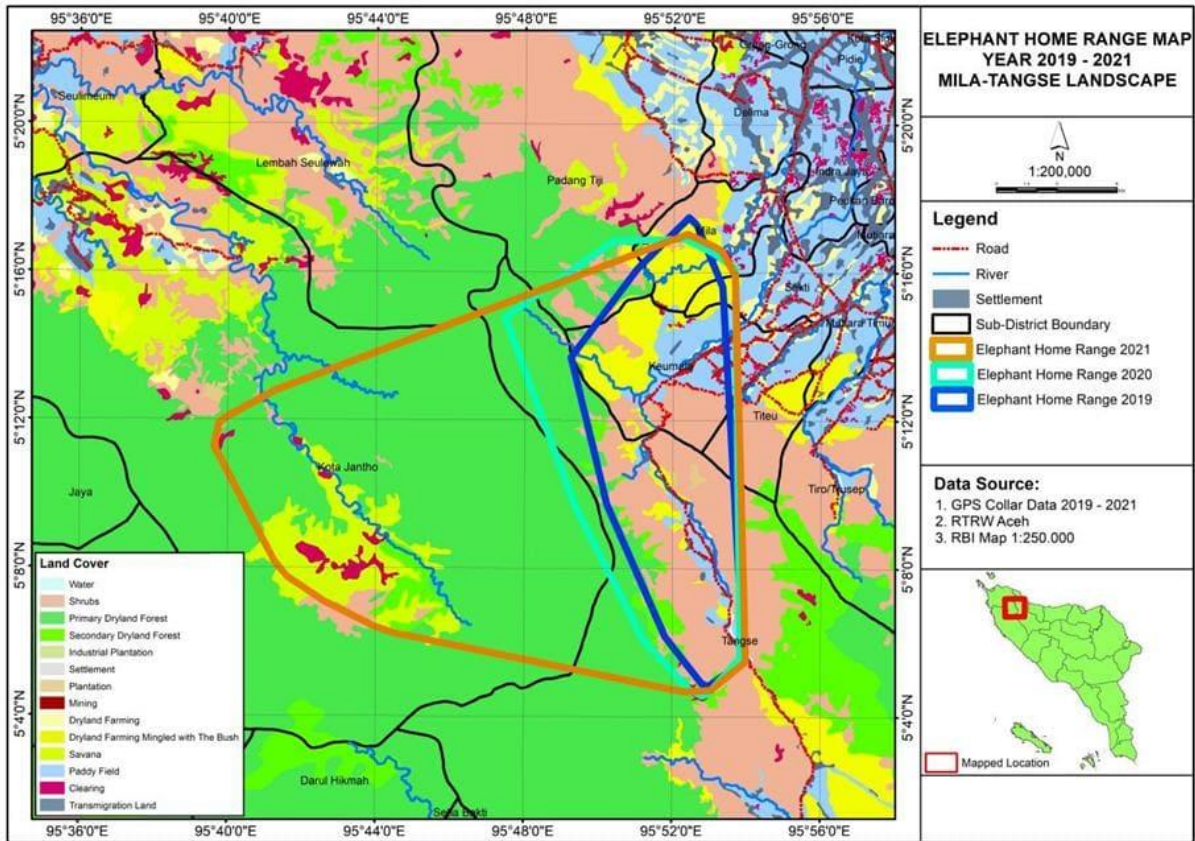


Figure 3. Mila elephant movement pattern in 2019 to 2021 based on land cover type

Based on the type of land covers, the elephants in Mila mostly found in the shrubs which was recorded at 1.227 points or equal to 46.73% and the mixed dry agricultural as recorded at 923 points or equal to 35.15%. This number has indicated that the elephant herds in Mila mostly used the mixed dry land and shrubs around the landscape of Mila-Tangse, which also indicate that the food supply is abundant and close to the edge of the forest used as resting or sheltering area. Mila herds is looking for food around the thicket area with its aim of approaching a dense canopy area as the place to rest during day time. As stated by English et al. (2014) that elephants as plant eaters are using habitats which has understory vegetation. Suhada et al., (2016) also stated that elephants like to consume the young shrubs, herbs and tree species with fine fibbers and fresh young bark.

The mixed of dry land agricultural cover is a suitable habitat for sumatran elephants since there are favoured food available in this area as well as its fairly dense canopy to protect elephants from direct sunburn. The study conducted by Wilson et al. (2021) at the same location by using GPS collar analysis from 2019 to 2021 known that the elephant herds mostly spent the time in mixed forest areas.

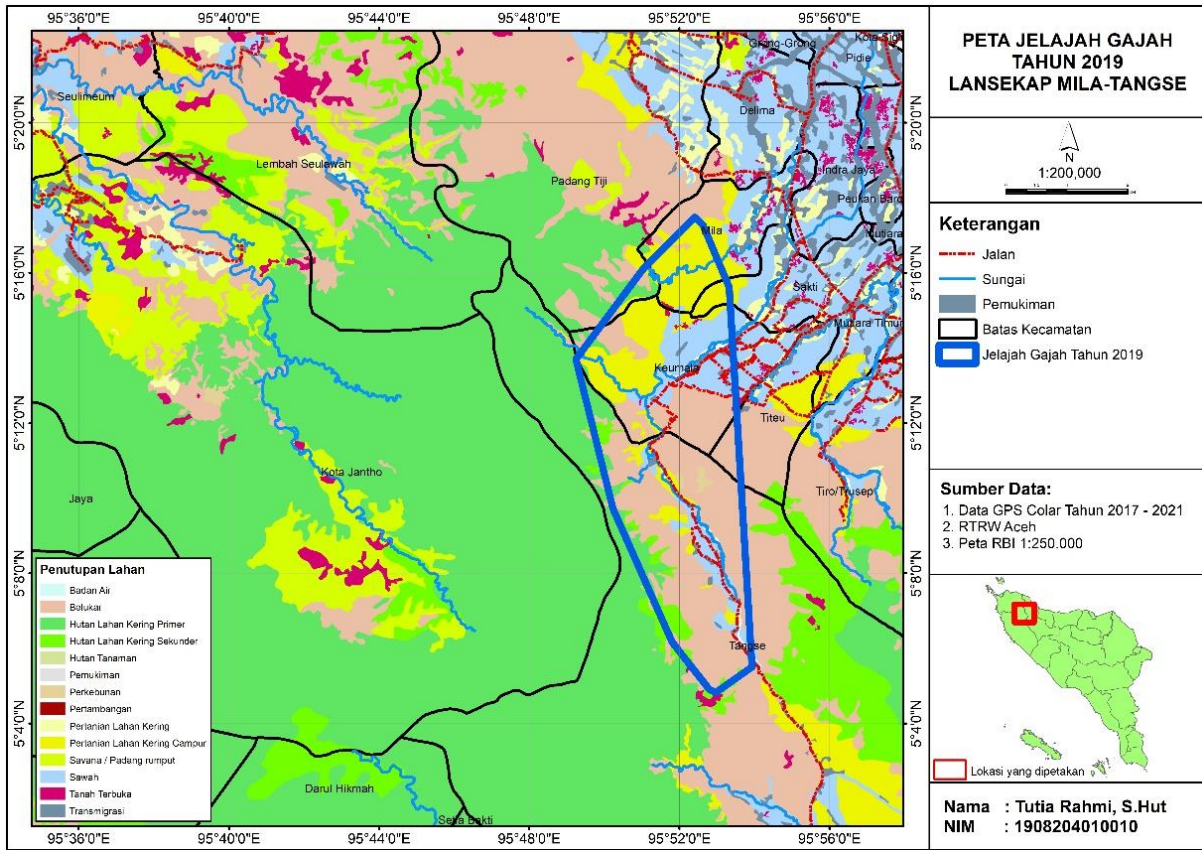


Figure 4. Mila's elephant movement pattern 2019 based on land cover

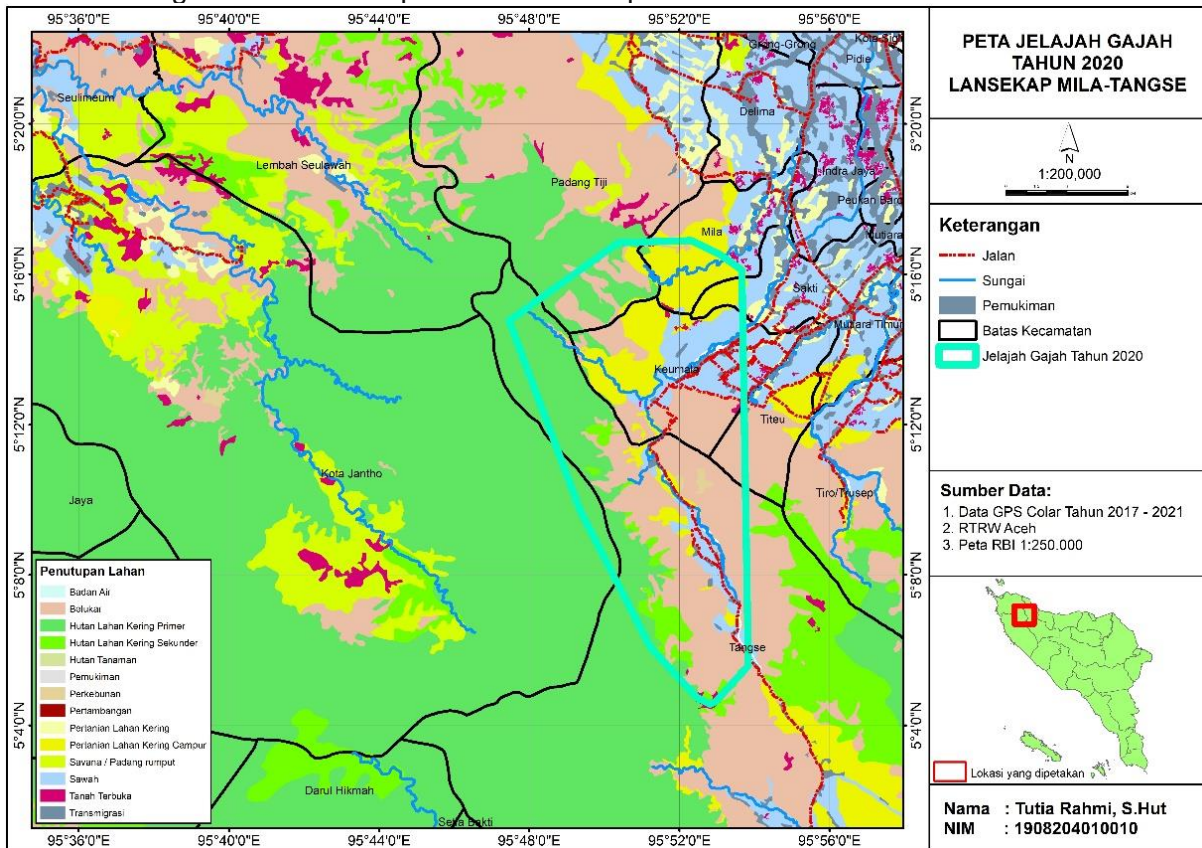


Figure 5. Mila's elephant movement pattern 2020 based on land cover

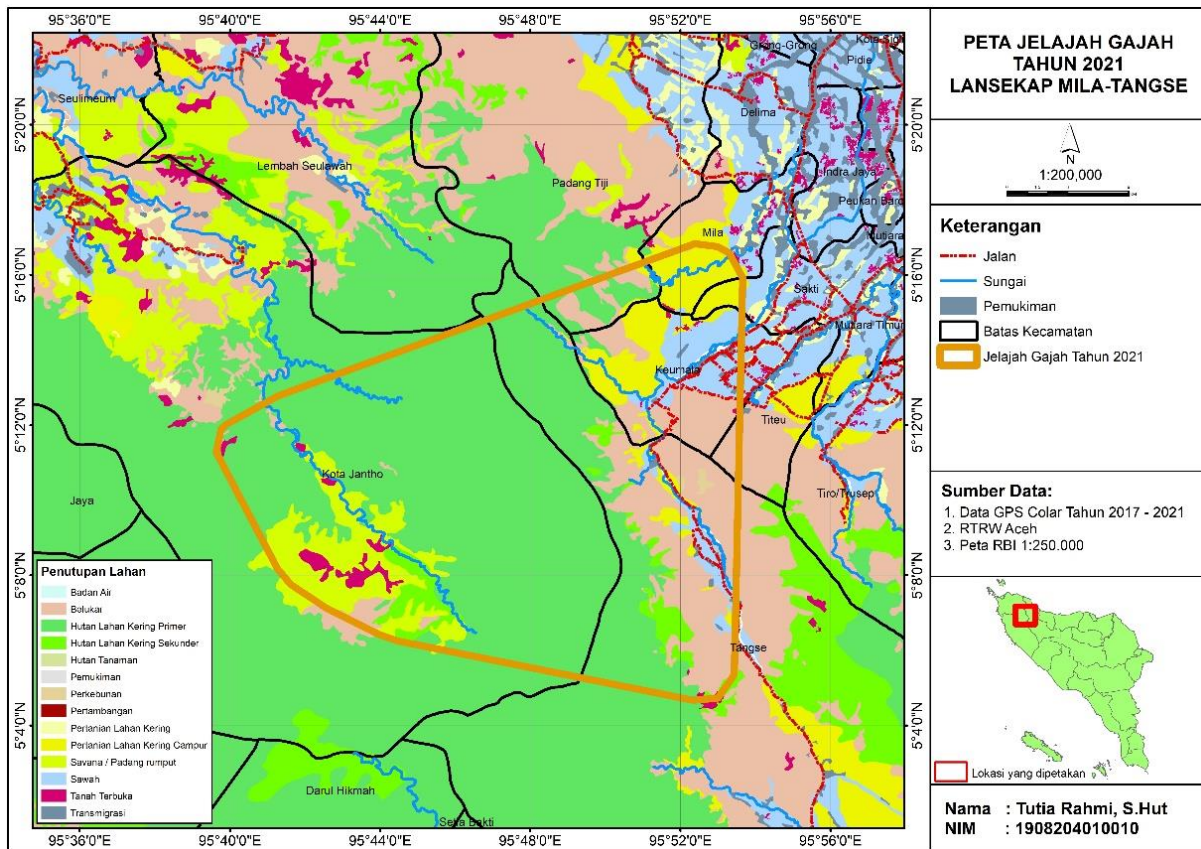


Figure 6. Mila's elephant movement pattern 2021 based on land cover

The elephant herds wandering tend to be close to the plantation areas and community settlements in which causes the un-avoiding conflict of human and elephant. Within the same time, human activities and the disturbances in the area close to their home range can also limiting the size of its home range. A number of studies have reported that settlements and poaching greatly affect the elephant movement patterns (Ruggiero, 1992; Tchamba et al., 1995; Sitati et al., 2003).

The Mila herds moved from various types of land cover. Sabri et al. (2014) stated that due to high demand of food, elephants are unlikely to be in one place for a long time, so the points of elephant movements are found in all types of land cover. The patterns and elephant home range are influenced by two factors, ecology and humans (Bahar et al., 2018). Studies of elephants in Africa and India in a landscapes that are mostly as open habitats shows that the size of elephant's home range is determined by a combination factors, including human disturbances, food availability, seasonal changes and the availability of water resources (Leuthold, 1977; Thouless, 1996) also presence of artificial barriers such as canals and loss of habitat (Joshua and Johnsingh, 1995).

Research by Sukumar (1989) stated that the home range of asian elephants is influenced by the availability of habitat, the more diverse the habitat the smaller the home range needed by the elephants to be able to meet with their various needs.

CONCLUSIONS AND RECOMMENDATIONS

Mila's elephant range varies from year to year. Within the period of July to December 2021, the home range varies from 123 km² to 413 km². It is 123 km² in 2019, 176 km² in 2020 and 413 km² in 2021. There are 8 types of land cover which mostly used by the elephants in Mila. The movement pattern of Mila's elephant was concentrated in the types of shrubs for 1.227 points or equal to 46.73% and mixed dry agricultural for 923 points or equal to 35.15%. Both of home range and movement patterns of Mila's elephant are strongly influenced by environmental factors including feed, land cover and anthropogenic activities.

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