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Spatial Distribution and Abundance of Invasive Alien Plant Species in Gamo Gofa Zone, Ethiopia

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Abstract:

Introduction and spread of invasive alien plant species is affecting natural environment, economy, and society, including human health. The current threats posed by existing invasive alien plant species are significant and are growing at an alarming rate. As a result, Habitats such as roadsides, arable lands, grazing lands, villages and towns are in a great challenge of suffering from the invasion of IAPS in the study area. Therefore, mapping the spatial distribution of invasive alien plant species was carried out in Gamo Gofa Zone. The objective of this study was to examine the distribution and abundance of invasive alien plant species and develop the distribution map of major invasive alien plant species that is crucial for environmental monitoring and early warning systems. In order to achieve the objectives latitude and longitude coordinates was recorded at 10 kms intervals using hand held GPS in 12 accessible Districts and presence/absence and abundance of invasive alien plant species was observed and recorded. The distribution maps of invasive alien plant species were prepared using latitude and longitude coordinates recorded by GPS in different locations of the study area. The results of the study indicated that major invasive alien plant species that are found in Gamo Gofa Zone include *Parthenium hysterophorus*, *Prosopis juliflora* and *Lantana camara*. Other invasive alien plant species observed and recorded as minor invaders in the study area were; *Senna occidentalis*, *Xanthium strumarium*, *Parkinsonia acuelata* and *Calotropis procera*. During field observation, heavy infestation of invasive alien plant species was recorded on the roadsides followed by arable land. On the other hand, natural forest is the least infested habitat in the study area. Generally, disturbed habitats are more infested by invasive alien plant species than natural habitats.

Keywords: Invasive alien species, habitats, natural environment, maps, latitude, longitude, Gamo Gofa

1. Introduction

Invasive alien species of plant are accidentally or intentionally introduced in to the country are subsequently escaping from their entry points and their spread is increasing at alarming rate from time to time. However, quantitative assessments of the area covered by invasive alien species, the land use/land cover change due to these plants and the rate of distribution and spread have not been undertaken in Ethiopia. Even in the absence of precise figures, it is clear that the spread of invasive alien species in Ethiopia has increased in the last decade, both in terms of area coverage and plant density (Demissew Sertse, 2005).

Moreover, these species are causing severe damages to natural environment and habitats leading to the loss of many plant species of important to the natural heritage of a country in Ethiopia in general and in Gamo Gofa in particular. However, the technique of Geographic Information System (GIS) was not applied in identifying the spatial distribution of many existing invasive alien species in Gamo Gofa Zone. As the result, there were no developed maps, showing the distribution and abundance of invasive alien species that can be used to localize areas requiring interventions most urgently in the study area.

Therefore, it is very crucial to fill the existing information gap in identifying the distribution and abundance of invasive alien species of plants. In this context, the study was initiated to develop the map of the spatial distribution and abundance of invasive alien plant species in Gamo Gofa Zone.

2. Materials and Methods

Research was conducted on the Gamo Gofa Zone of South Nations, Nationalities and Peoples Regional State. Gamo Gofa Zone is located between 5°30' - 6°30' N latitude and 36°29'-37°30' E longitude.

2.1. Materials

Materials used include, GPS (Global positioning system), Digital camera, Arc View GIS 3.3 software, SPSS software, and Car.

2.2. Sampling Techniques

For this study, systematic sampling technique was used to assess the level of infestation of invasive alien species of plants in different habitats. First sample location was selected at the border of the Zone and other sample locations were taken at each 10 kms interval along the asphalt and gravel road accessible by car.

2.3. Method of Data Collection

Latitude and longitude coordinates were recorded using hand held GPS in 12 accessible Districts. The presence/absence and abundance of invasive alien species of plants was observed and recorded in different habitats. Abundance rating was done at each sampling locations by using qualitative estimates (table 1).

2.4. Data Analysis

Latitude and Longitude readings recorded by GPS in different locations of the study area was entered in to computer with Arc View GIS 3.3 software and the distribution map of invasive alien plant species was prepared.

3. Results And Discussion

Major invasive alien plant species found in Gamo Gofa Zone include *Parthenium hysterothorus*, Mesquites (*Prosopis juliflora*) and *Lantana camara*. These species constitute a major constraint to biodiversity, agriculture as well as animal and human health in the study area. Other alien invasive species observed as minor invaders in the study area are *Senna occidentalis*, *Xanthium strumarium*, *Parkinsonia ocluelata* and *Calotropis procera* (Table 2). Out of these invasive alien plant species, *L. camara* and *P. ocluelata* are introduced in to the Zone deliberately or intentionally for their various uses.

The scale of the infestation/abundance/ of *Parthenium hysterothorus* was very abundant at sample location with longitude and latitude coordinates 3133610 and 710479 respectively. It was also recorded to be very abundant at other sample location of the Daramalo District with longitude and latitude coordinates 395112 and 700465 respectively and abundant at sample location with longitude and latitude coordinates 363680 and 696059 respectively. The results of the study indicated that the rest sample locations of Gamo Gofa Zone are absent, present and frequent (Figure 1).

It recently became a major crop weed in the study area. Heavy infestation of *Parthenium hysterothorus* was observed in Kucha and Daramalo districts. Moreover, *Parthenium hysterothorus* entered crop fields having a very abundant scale of infestation (Figure 2).

The results of the study indicated that the invasion of *Prosopis juliflora* is high in the study area, particularly in the Districts such as Arba Minch Zuria, Mirab Abaya and surrounding areas where as the rest Districts of the Zone are not yet infested. The scale of the infestation of the plant is abundant in Mirab Abaya at sample location with longitude and latitude coordinates 358314 and 686733 respectively. Its infestation scale/abundance is frequent at other sample location of Arba Minch Zuria District with longitude and latitude coordinates 340336 and 667074 respectively. The direction of spread of *Prosopis juliflora* is from roadsides to different habitats nearby. Therefore, the encroachment of *Prosopis juliflora* in grazing lands, forestlands and agricultural lands need special attention.

Maps of the study area, developed by using Arc View GIS 3.3 software showing the abundance and distribution of *Prosopis juliflora* in Gamo Gofa Zone can thus be used to localize areas requiring interventions most urgently (Figure 3) and (Figure 4).

Hot spot areas of *Lantana camara* in Gamo Gofa Zone were Selam Ber, Mella, Sewla, Arba Minch and surrounding areas forming impenetrable thickets in urban green spaces, waste areas and grazing lands. Moreover, it started encroaching of bush lands and forestlands near Selam Ber town. The distribution and abundance of *Lantana camara* in Gamo Gofa Zone is mapped as follows.

The results of the study indicated that, some of the problems of *Lantana camara* invasion, include encroaching bush lands, quickly takes over valuable grazing lands and its dense growth suppressed grasses and other useful forages under its canopy.

Heavy infestation of *Lantana camara* was observed in different habitats especially urban green spaces, grazing land and wastelands. The direction of spread is from villages and towns to grazing lands and bushy lands. (Figure 5) and (Figure 6).

Other alien invasive species observed as minor invaders in the study area were *Senna occidentalis*, *Xanthium strumarium*, *Parkinsonia acuelata*, and *Calotropis procera*. Out of these species, currently recorded as threats, include *Xanthium strumarium*, *Senna occidentalis*, and *Calotropis procera*. These species were introduced in to the study area unintentionally and exclude other species in places where they occupy. They highly compete with native species for light, space, water and nutrients.

Senna occidentalis is distributed in Arba Minch Zuria, Miraba Abaya, Kucha and Daniba Gofa Districts of Gamo Gofa Zone. The infestation scale of the plant is abundant at one-sample points and frequent in four sample sites of Arba Minch Zuria. It is frequent at two sample points, rare at one sample location of Mirab Abaya and frequent in Kucha and Denib Gofa Districts (Figure 7) and (Figure 8). Habitats infested by this plant were observed to be roadsides and arable lands

Xanthium strumarium was found only in Arba Minch Zuria District. It is observed to be distributed in limited areas of the District. The scale of the infestation of the plant is abundant at sample location with longitude and latitude coordinates 331619 and 648706 respectively. Its abundance is frequent at other sample location/point of the District with longitude and latitude coordinates 336608 and 632274 respectively. The results of the study indicated that the rest Districts of Gamo Gofa Zone are free from the infestation of *Xanthium strumarium* (Figure 9) and (Figure 10).

Parkinsonia acuelata was introduced to the study area intentionally. The seedlings of *Parkinsonia acuelata* were distributed for the farming communities to be planted in private farms from government nurseries. Currently it is found in Arba Minch Zuria, Mirab Abaya and Daniba Gofa Districts. The scale of the infestation of the plant is rare in Daniba Gofa and present in Arba Minch Zuria and Mirab Abaya Districts (Figure 11) and (Figure12).

Calotropisprocera was introduced to the study area unintentionally following road construction. It is currently observed on roadsides of Arba Minch Zuria District. Its scale of infestation is present (uncertain or a single occurrence). It is also growing in Arba Minch town as an ornamental plant with care and good management. This shows that *Calotropisprocera* was not recognized as an invasive plant (Figure 13) and (Figure14).

4. Conclusion

Invasive alien species of plants have a significant effect on natural environment and habitats, leading to the loss of many native plant species and these species were found to be the cause of loss of agricultural and grazing lands, have a considerable impact on biodiversity.

No attempt had been made by all concerned bodies including farming communities to control and/or prevent further introduction and dissemination of the invasive alien plant species in Gamo Gofa Zone. Prevention and early detection are most effective techniques that can be used to avoid problems caused by invasive alien plant species. Therefore, invasive alien species of plant management programs should make an effort to undertake preventive actions in areas that are not yet infested

5. Acknowledgement

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6. References

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Annexure

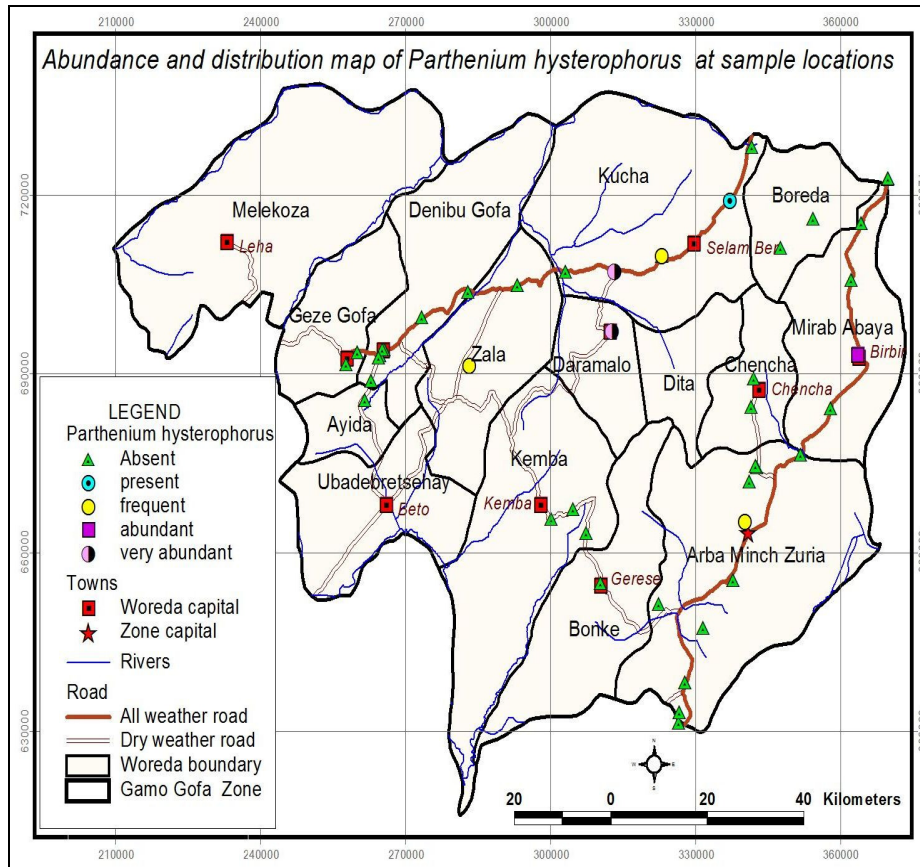


Figure 1: Abundance and distribution of *Parthenium hysterophorus*

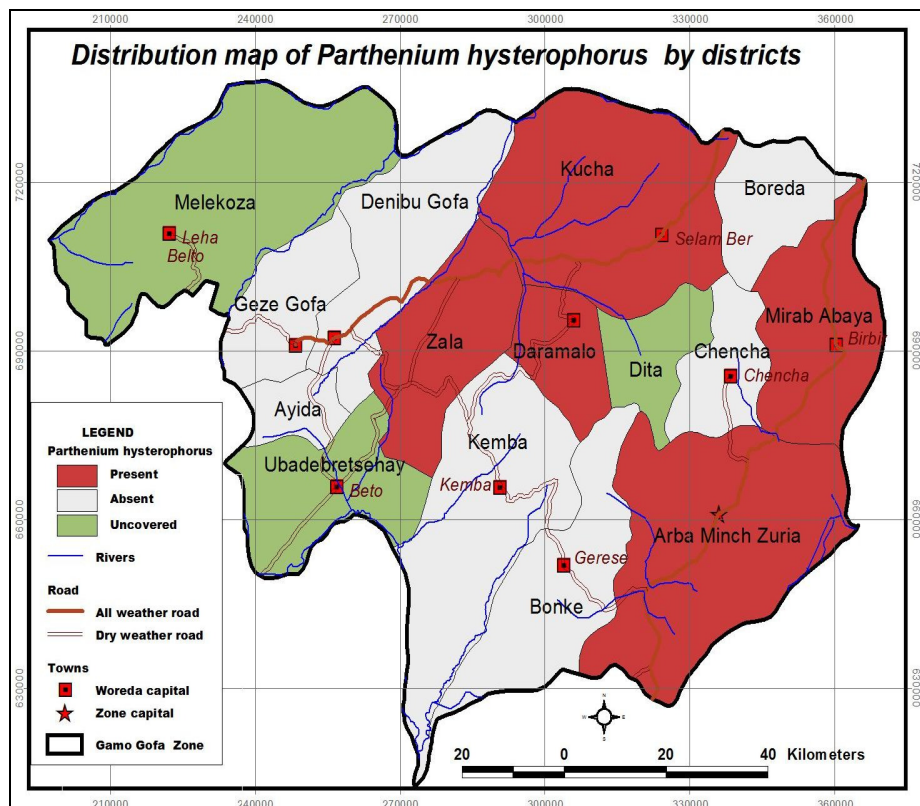


Figure 2: The distribution of *P. hysterophorus* by Districts in Gamo Gofa Zone

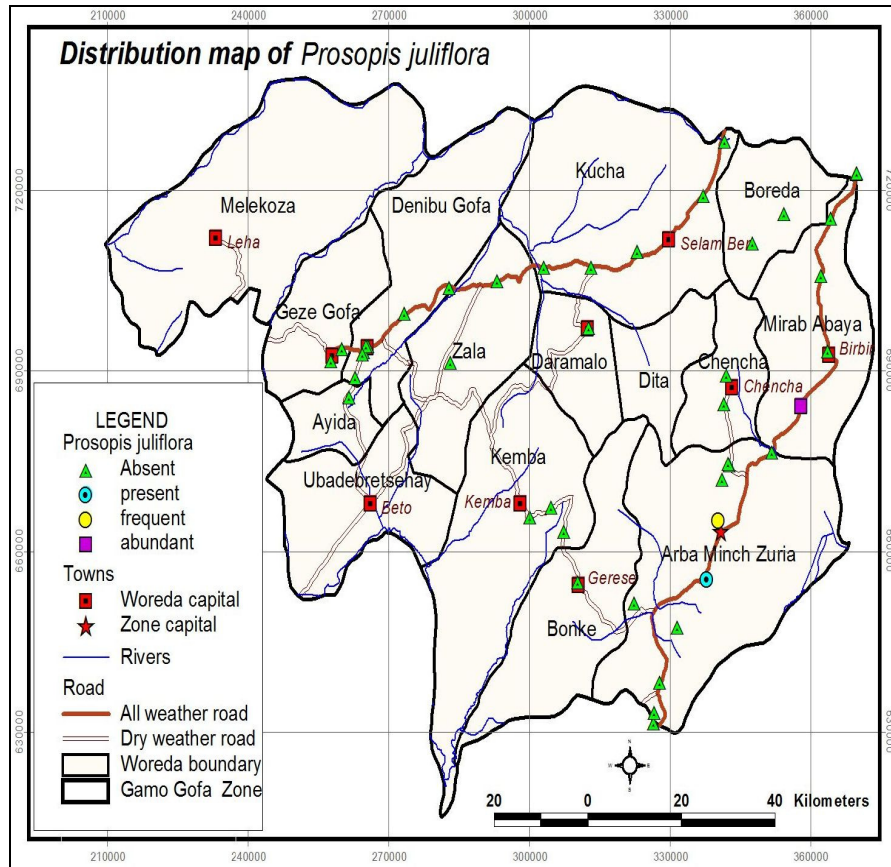


Figure 3: Abundance and distribution of *P. juliflora* at sampling Points along the survey routes

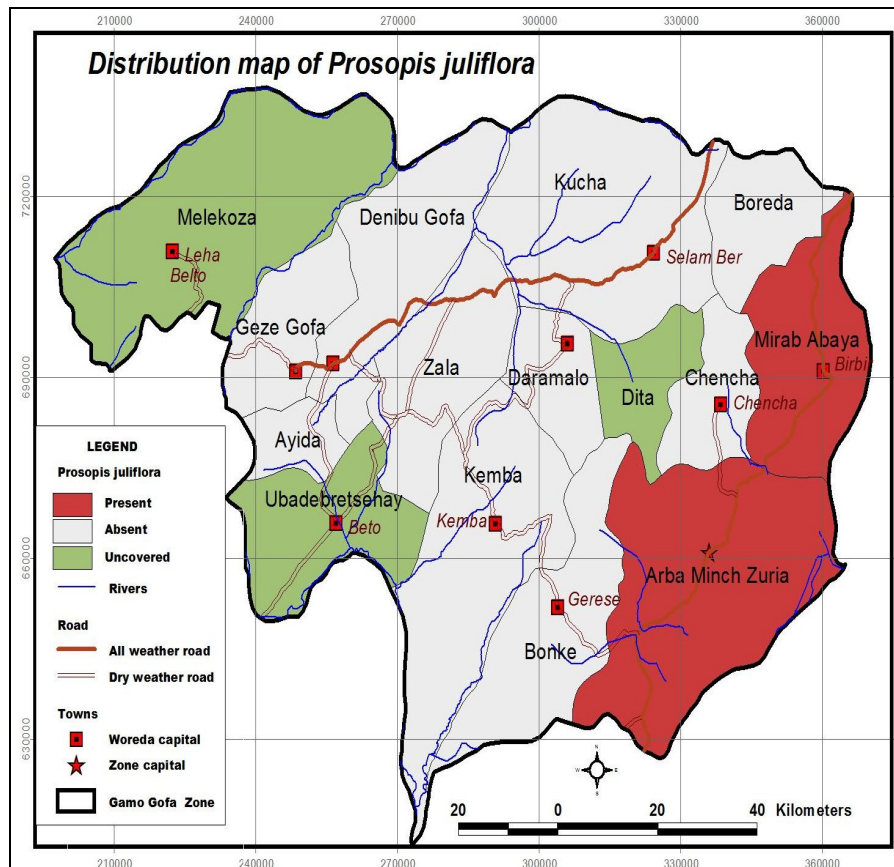


Figure 4: Distribution of *Prosopis juliflora* by Districts in Gamo Gofa Zone

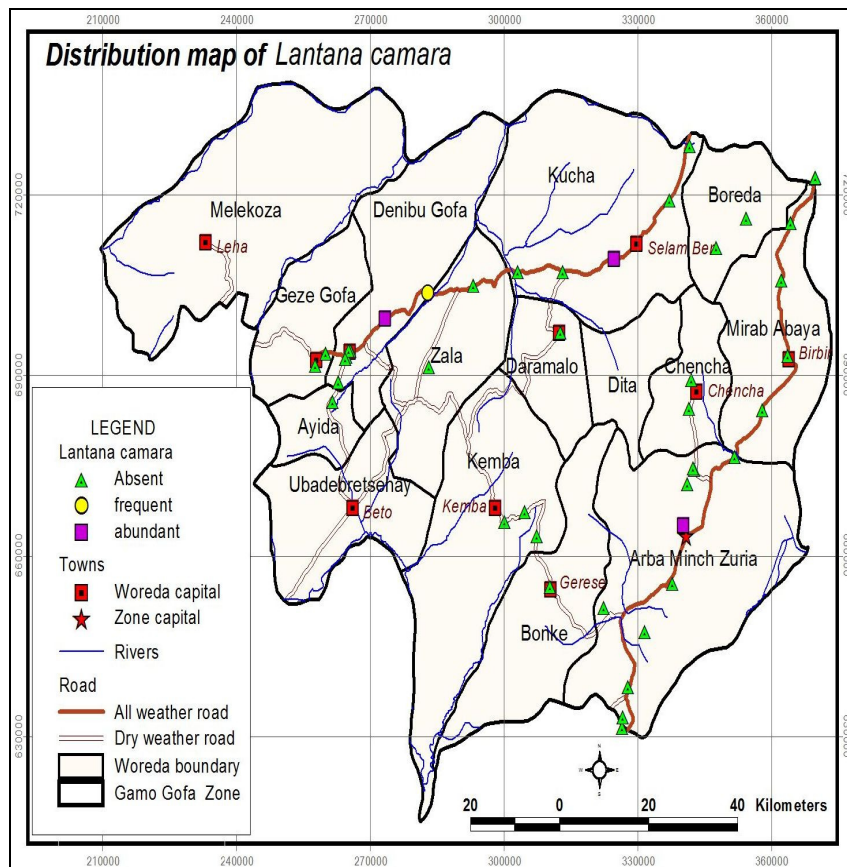


Figure 5: Abundance and distribution of *L. camara* at sampling Points along the survey routes.

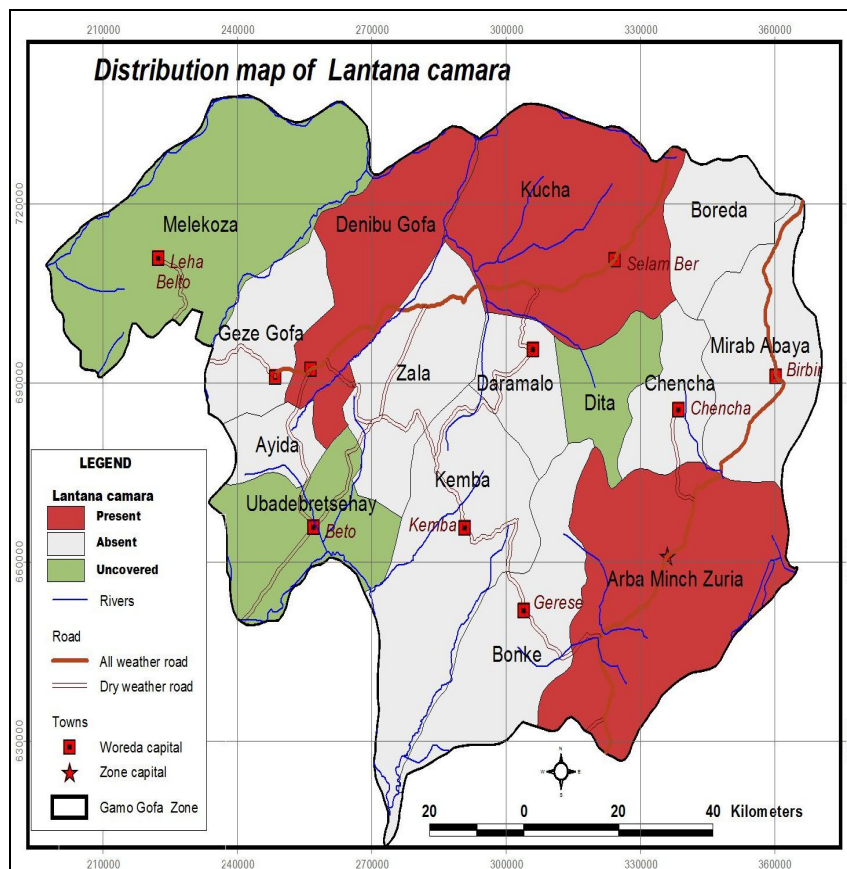


Figure 6: Distribution of *L. camara* by Districts in Gamo Gofa Zone

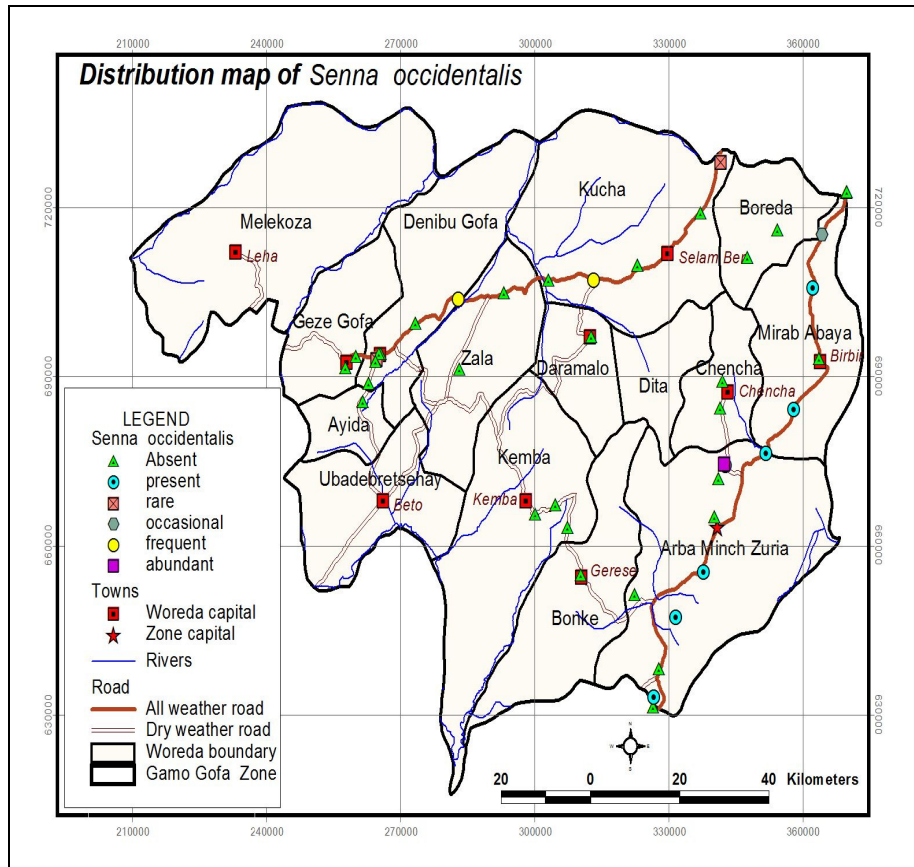


Figure 7: Abundance and distribution of *Senna occidentalis* at sampling Points along the survey routes.

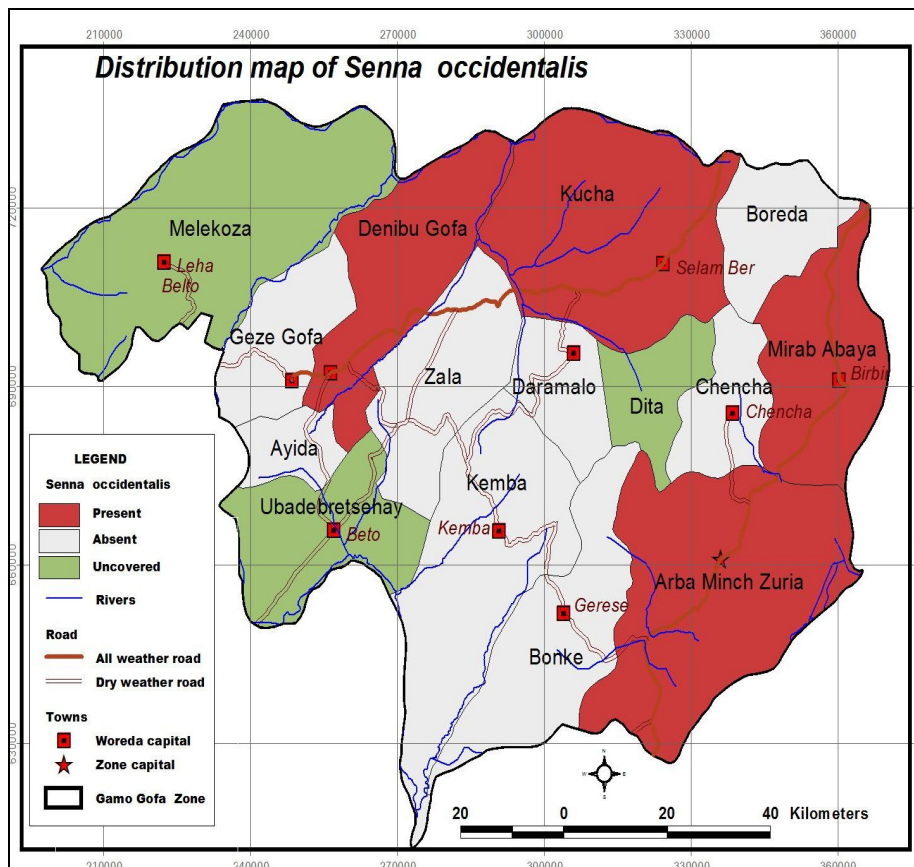


Figure 8: Distribution of *Senna occidentalis* by Districts in Gamo Gofa Zone,

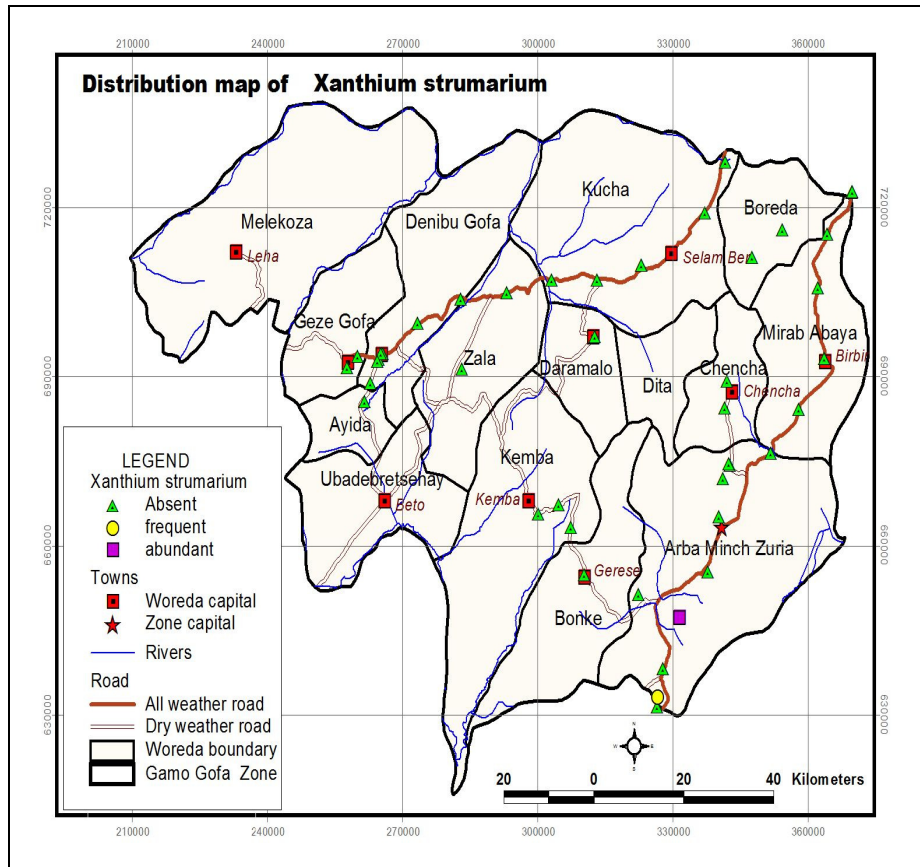


Figure 9: Abundance and distribution of *Xanthium strumarium* at sampling Points along the survey routes.

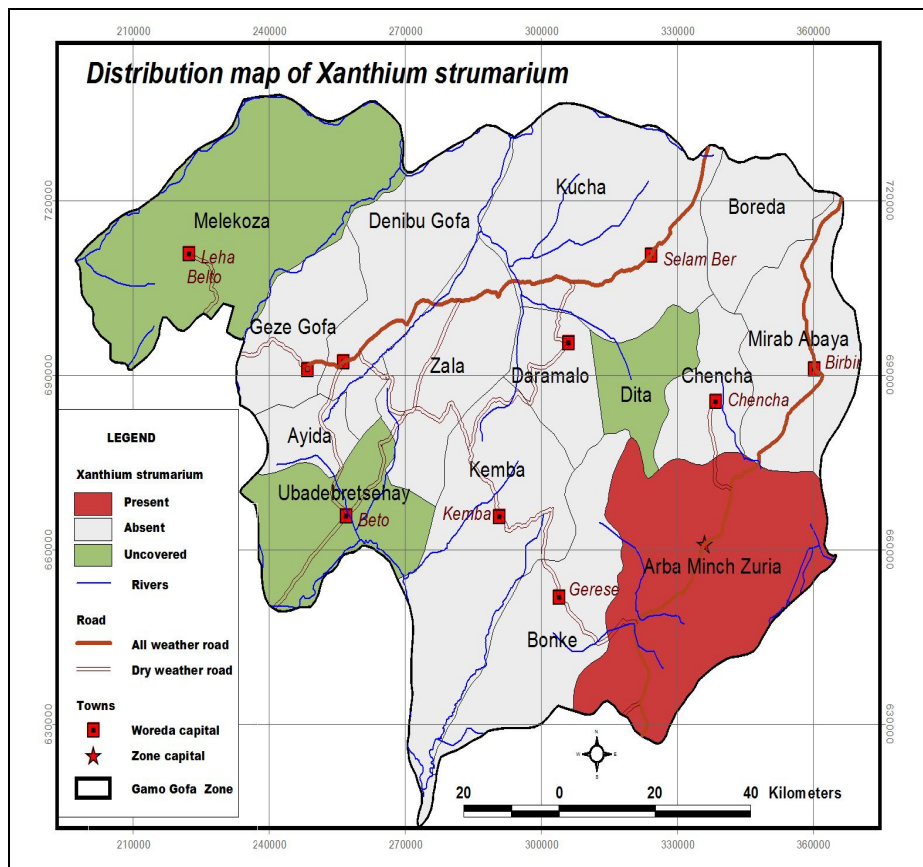


Figure 10: Distribution of *Xanthium strumarium* by Districts in Gamo Gofa Zone

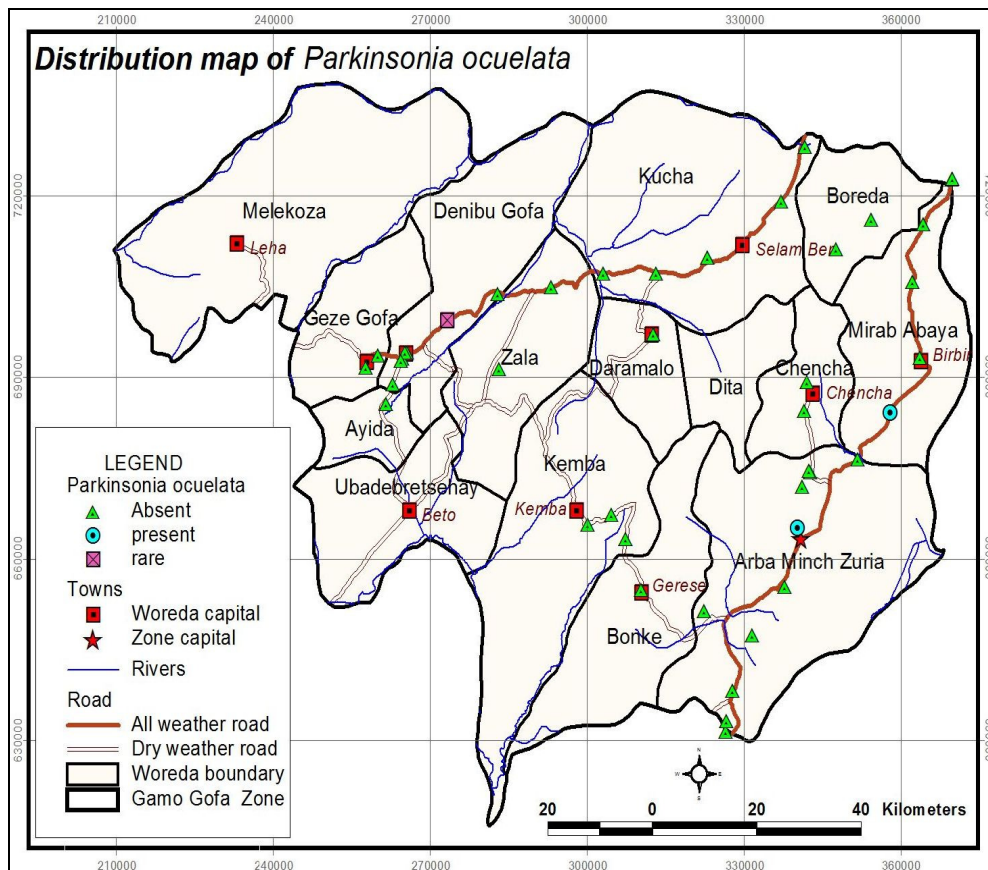


Figure 11: Abundance and distribution of Parkinsonia ocelata at sampling Points along the survey routes.

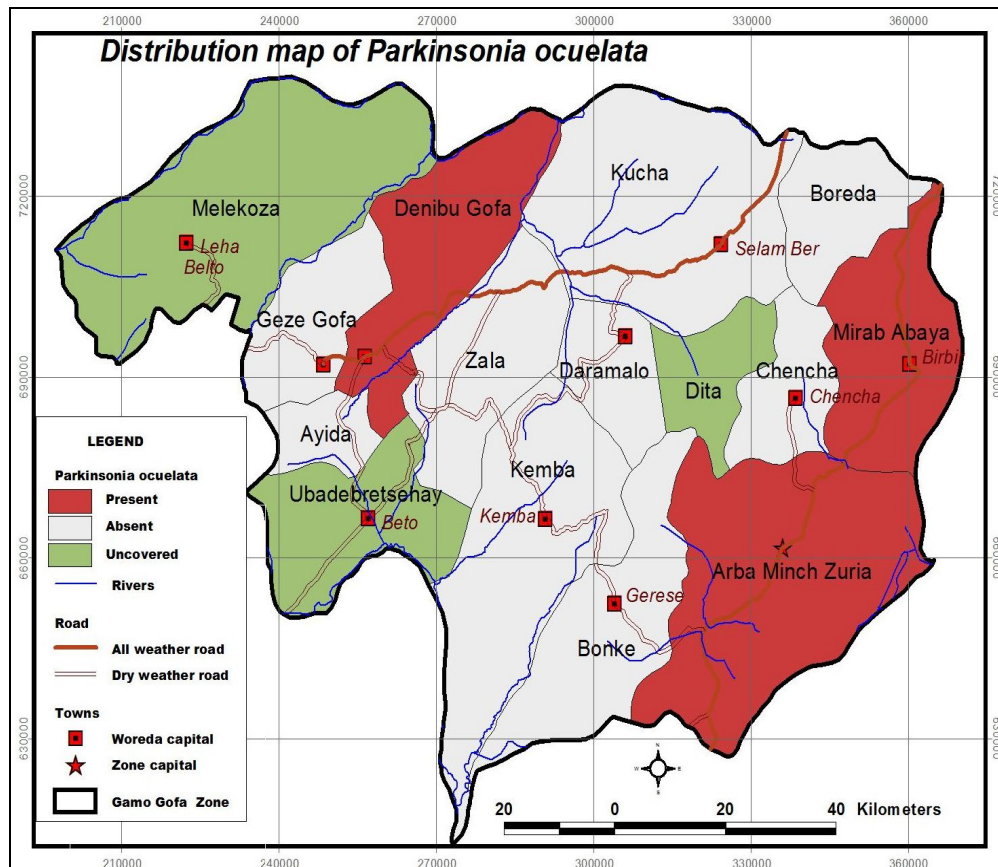


Figure 12: Distribution of Parkinsonia ocelata by Districts in Gamo Gofa Zone

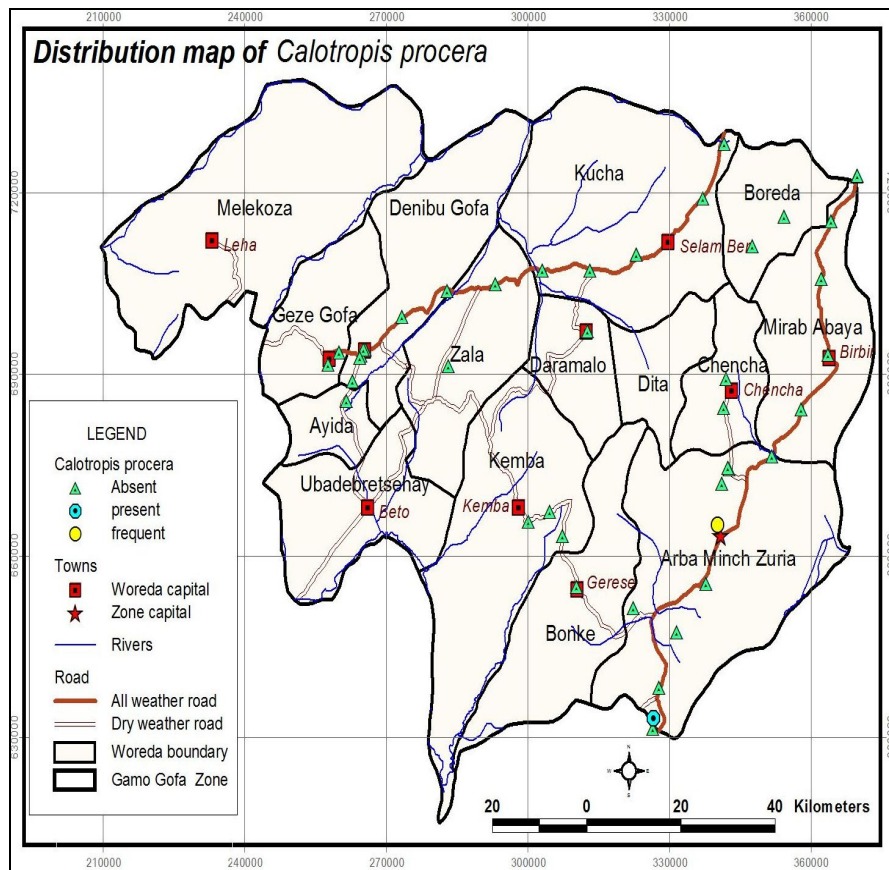


Figure 13: Abundance and distribution of *Calotropis procera* at sampling Points along the survey routes.

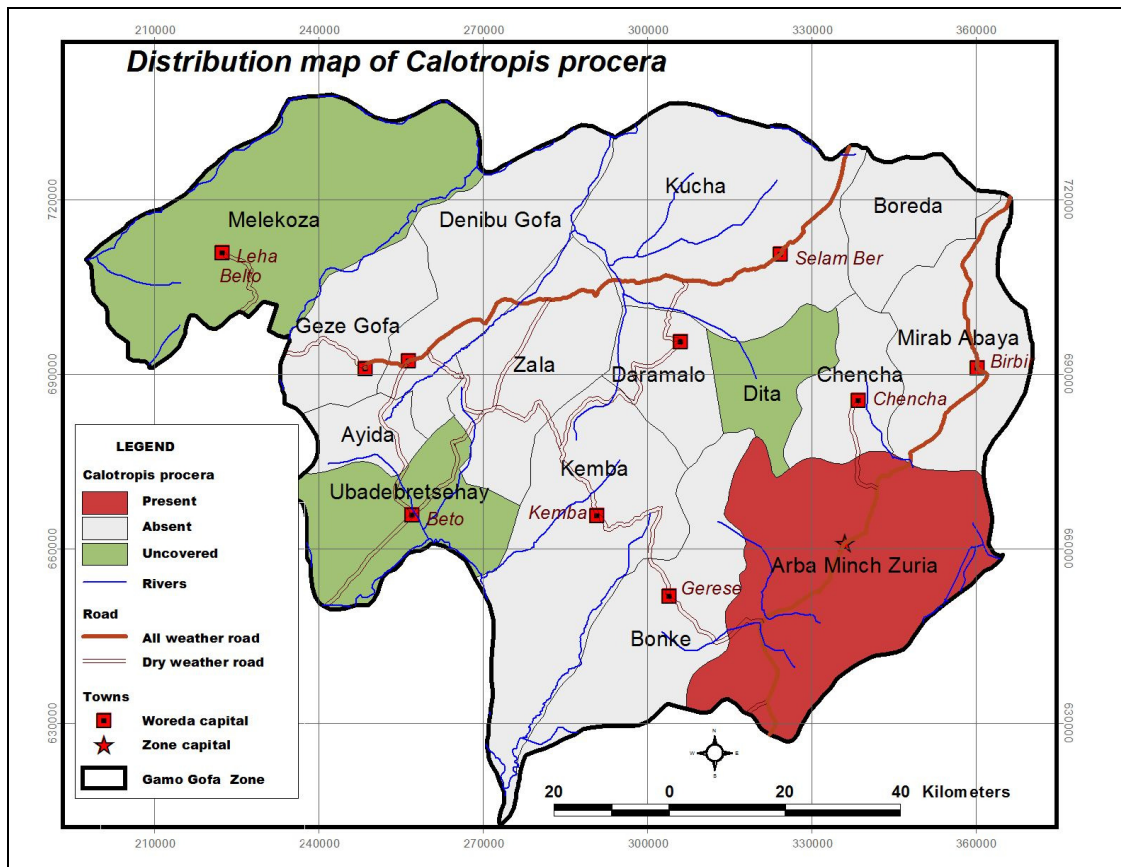


Figure 14: Distribution of *Parkinsonia oclata* by Districts in Gamo Gofa Zone

No	Abundance rating	IAPS coverage in percent	Description
1	Absent	0	no occurrence
2	Present	1-5	a single occurrence
3	Rare	6-15	one sightings of one or a few plants
4	Occasional	16-30	a few sightings of one or a few plants
5	Frequent	31-50	Continuous uniform occurrence of well-spaced individuals (many sightings of single plants or small groups)
6	Abundant	51-75	Continuous occurrence of species with a few gaps in distribution (many clamps or stands)
7	Very Abundant	>75	continuous dense occurrence of species (extensive stands)

Table 1: Description of the scale of infestation /Abundance/ rating

No	Scientific name	Family	growth habit
1	<i>Lantana camara</i>	Verbenaceae	Shrub
2	<i>Parthenium hysterphorus</i>	Asteraceae	Herb
3	<i>Prosopis juliflora</i>	Leguminaceae	Tree
4	<i>Xanthium stromarium</i>	Asteraceae	Herb
5	<i>Senna occidentalis</i>	Fabaceae	Herb
6	<i>Parkinsonia ocuelata</i>	Fabaceae	Tree
7	<i>Calotropis procera</i>	Asclepiadaceae	Shrub

Table 2: Invasive alien plant species composition in Gamo Gofa Zone