IJABR Vol. 6(1): 141 - 148 (2014)

Original Article

MAPPING OF EXOTIC PLANT SPECIES IN YANKARI GAME RESERVE USING GIS TOOLS

*Muhammad, M[1]., Abdulhameed, A[1]. and Abdullahi, M. B[2]

1Abubakar Tafawa Balewa University, Bauchi State, Nigeria.
2 Federal University Kashere, Gombe State, Nigeria.

Submitted: March 21, 2014; Accepted: June 06, 2014; Published: June 30, 2014.

ABSTRACT

Invasive Plant species may modify habitat structure, affect ecosystem processes, influence associated organisms and threaten biodiversity worldwide. Early detection and mapping of these species will help in their management and possible control. This study mapped exotic species of Yankari game reserve using Geographic Information System (GIS). The existing map was Scanned, Georeferenced, Digitized, and Plotted with the attribute table and edited. Five exotic plant species were found in the Reserve namely *Azadirachta indica*, *Butea monosperma, Delonix rigia, Eucalyptus globules and Gmelina aborea*. Map of Yankari Game Reserve was produced showing exotic species in their appropriate positions. Queries by attribute and location were generated to test the genuineness of the Database. The management should embark on destructive harvest of these plants to avoid further invasion. Further research on whether the exotic plants have any allelophatic effects on the indigenous ones was suggested among other recommendations.

Keywords: Invasive Plant, GPS, Coordinates, AutoCAD

*Corresponding Author: mmjamaare@gmail.com, +234856591298, +2348136846444

INTRODUCTION

Species that are harmful and nonnative continue to spread globally (Thuller *et al.*, 2005) which is affecting natural areas including national parks and wildlife refuges where natural resource policies demand containment to protect native species (Allen et.al. 2009). These harmful species are referred to as invasive species. In responce to the increase in invasive species spread, spatial modeling and species – environment matching models are becoming commonplace for natural resources managers, agencies, and Nongovernmental organizations that need accurate maps of species distributions and abundance for risk analysis (Guisan and Thuller, 2005). One important tool that provides a visual picture of how abundant a species is and how it is distributed across the landscape is by mapping the species. This mapping is an important way to communicate inventory information when over-laid on a priority habitats or natural communities. One may be able to quickly evaluate the species that are priorities for control or eradication in such communities. However, mapping of exotic plants should always be integrated with general vegetation surveys and surveys being conducted by other agencies and organizations PIMIPG (2000). Data organized into maps and databases provide valuable information towards the development of a network-monitoring scheme.

To be cost-effective and efficient in utilizing resources, it is critical to know which plants exist and the extent of their occurrences. This information is essentially lacking in most of the conservation areas in tropical Africa and without location and distribution information, park resource managers lack the critical tools required to develop a focused strategy for addressing invasive plant management issues PIMIPG (2000). It is therefore necessary to develop such data base in Yankari Game Reserve because not only will this information benefit management planning efforts for this site, but it will assist in filling the information gaps for Nigerian biodiversity conservation. This paper, therefore aimed at mapping exotic plant species of Yankari Game reserve with the view to serve as a baseline for long-term monitoring, and assist in evaluation of changes in exotic plant populations over time and the detection of new exotic plant infestations in the reserve

Study area

Yankari Game Reserve lies in the southern part of the Sudan Savanna located in the North-east part of Nigeria. It covers an area of about 2,244 km^2. It is composed of savanna grassland with well-developed patches of woodland. It is also a region of rolling hills, mostly between 200m and 400m (656 and 1313ft). Kariyo hill is the highest point at 640m (2100ft) above sea level. It falls within the latitudes 9°50' N and 10°32'E

lying in the south-central area of Bauchi state, the vegetation composed mainly of Combretaceous trees and shrubs, *Afzelia, Anogiessus and Detarium* savanna woodland (Abdulhameed *et al.*, 2001).

Methodology

The methodology adopted for this research was divided into two: Field work and Laboratory Analysis. The work involved the use of GIS tools in mapping and analyses the exotic plant species in Yankari Game reserve.

Field work

(i) Data capture

Global Positioning System (GPS) was used for collecting the coordinates of the exotic plant species. The map of Yankari game reserve was acquired from Ministry of Lands and Survey (boundary map) in the study area (Wikki Camp-Salt lick) a preliminary survey of the species was made and later the locations of the different species were collected by recording the x and y coordinates using the GPS. This was done through sampling i.e. One location representing about 10 trees of the same species depending on the population of that species in the study area, all the locations of the different species were recorded in the GPS. Systematic sampling was used in the area (Sheley, 1999).

Trees were identified using standard taxonomic keys (Obot, and Ayeni, 1987), then a unique code number was given to each of the different species in such a way that whenever a location of a particular species is to be recorded in the GPS its own code number was written first and then the coordinates were recorded. Hence the prefixes of the number followed by serial number were typed.

Laboratory work

Boundary map of the reserve was prepared in the laboratory through the following steps: Scanning of the existing map; Georeferencing the map; Digitizing of the features on the map; Plotting of the positions of the species from the GPS into the digitized map of the reserve; and Creation of a spatial data base of the species.

(i) Scanning of existing map

The existing map (Boundary Map) of Yankari game reserve was scanned using an AO scanner. The scanned map was brought into an AutoCAD environment using AutoCAD overlay facilities Aronoff, (1991). The analogue map was converted to digital format through the process of scanning Sheley *et al.* (1999).

(ii) Georeferencing

This is the process whereby the scanned image of the reserve was referenced to real world coordinates in order to give it a geodetic significance. This involved the use of four corner coordinates of the map Aronoff, (1991). In this project, AutoCAD over lay was used for georeferencing.

At the end, the different features in the map assumed their respective positions with reference to the UTM coordinates (Sheley *et al.*, 1999).

(iii) Digitizing

The different layers of the map such as the boundary line of the reserve, the road distribution, buildings, spring etc were digitized. This was achieved by using appropriate commands in the AutoCAD environment e.g. Line command for line features such as road, boundary line, point command for point features such as trees etc. each layer of a feature is given a different symbol and colour (Sheley *et al.,* 1999).

(iv) Plotting of GPS Data

The recorded locations of the different species in GPS were downloaded into the computer system through the use of Map source software. All the necessary editing such as correcting the code numbers and names of the species was done in Map source. The data was then saved in a DXF extension and exported to AutoCAD where it was overlaid with the digitized map of Yankari game reserve. Consequently map of Yankari game reserve showing exotic species was produced.

All the exotic plants on the map and the records containing attributes of the trees were automatically displayed

c. Query by location

Queries by location achieved through the process of double clicking on parcels position, which immediately showed all information pertaining the parcel in question for example:

- Display parcel with *Azadirachta indica*

  Steps
- Query builder was doubled clicked.
- *Azadirachta* sp was double clicked
- Ok was double clicked

  The result of the query with *Azadirachta* were automatically highlighted as well as the parcels position in the map as shown in figure i.

Therefore, it becomes very clear and easy to see the locations of the species in the map and when query is made on any species the attributes of that species will be displayed automatically against the position of the species in the map. This means that different queries are readily possible and available. To sum it up tree species management was made easy (Maxwell, 2002).

RESULTS

Exotic plant species in the reserve

Table 1, showed the five exotic plants found in the reserve with their common, family, local and botanical names. These plants were initially introduced in Wikki camp which is the tourist center but due to minimum requirement for establishment, especially *Azadirachta indica* were spread into the reserve due to dispersal by Birds and Monkeys

.Table 1: Exotic plant species in Yankari Game Reserve

Botanical name	Family	Common name (English)	Hausa	Source
Azadirachta indica	Meliaceae	Neem tree	Dogon Yaro	Persia
Butea monosperma	Fabaceae	Flame of the Forest	Fanshana	Asia
Delonix regia	Caesalpiniaceae	Flamboyant tree	Dorawar turawa	Madagascar
Eucalyptus globules	Myrtaceae	Woollybut	zaiti/tirare	Australia
Gmelina aborea	Verbenaceae	Gmelina	Melana	Asia

Positions of exotic Plants in the Reserve

Scanned map of Yankari Game Reserve

Figure 1 showed the scanned map of the Reserve showing the boundary, road network, spring and buildings found in the reserve. The map is in digital forms which permit Georefencing to take place.

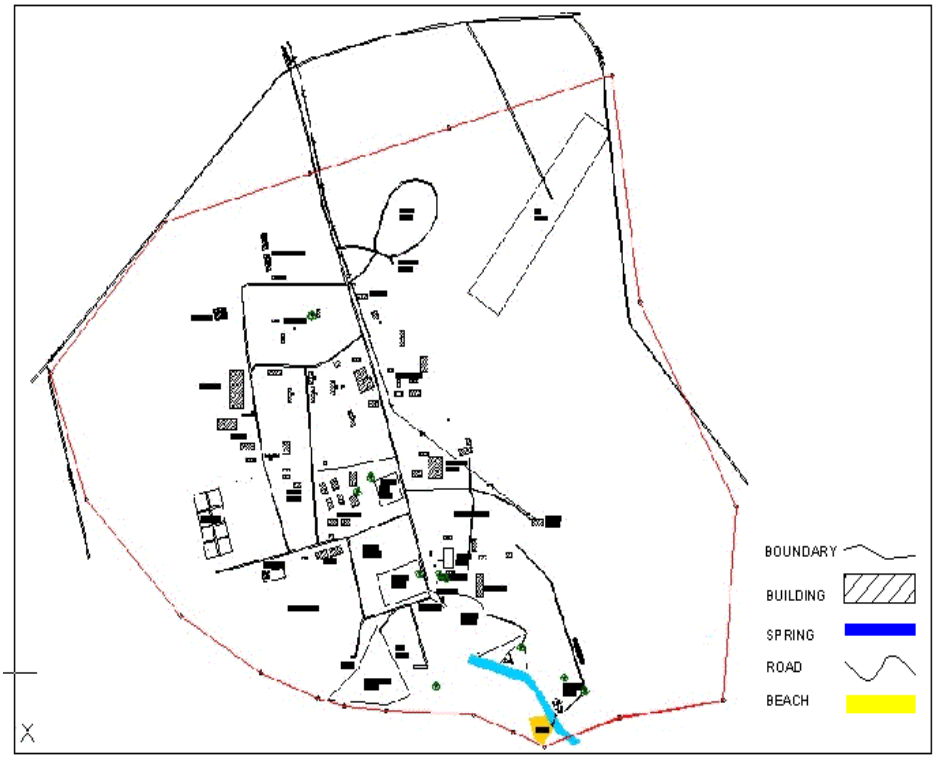

Figure 1: Showing Digitized Map of Yankari Game Reserve

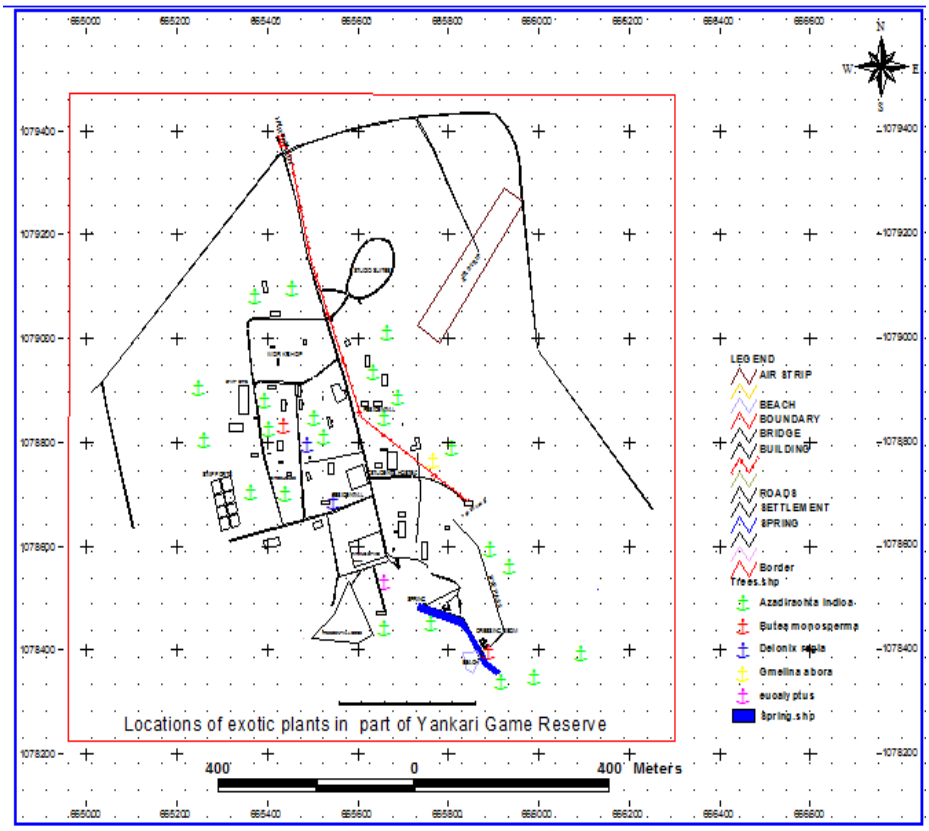

Figure 2: Map of Yankari Game Reserve showing the GPS positions of exotic species

The columns/fields contains the attributes of the species while the rows contain the record of each of the species. The table was created in such a way that each of the record was directly linked to the position of the respective species in GIS software (Arch View 3.2a) so that information about each of the species can be readily and easily displayed by simply double clicking the position of that species in the map. Hence this provides the most convenient way of assessing, retrieving and updating information about tree species. Consequently managing of tree species has been simplified.

DISCUSSION

The exotic plant species which were introduced into the reserve between 1978-1979 with the aim of decorating Wikki Camp so as to attract tourists are increasingly out competing the natural flora of the reserve. This agreed with the findings of Sheley *et al.* (1999) and Maxwel. (2002) which states that disturbed areas would be a good predictor of exotic species distribution. The exotic plant species are randomly distributed in the reserve from Wikki camp to Salt-lick area. This was also confirmed by Sheley *et al.* (1999) and Maxwel. (2002) that exotic species

distribution is likely to have a large random component.

Sheley *et al.* (1999) and Maxwel. (2002) states that the first step to managing exotic plants on a tract of land is to conduct an inventory of the species present. That is to know the different species present, where they occur and to know which of the exotic species are invasive.

In the case of *Azadirachta sp* each point represents ten individuals and each point represent two individuals for the others (*Butea, Delonix, Eucalyptus and Gmelina spp).* Those found in Wikki camp have reached a colonization/ Naturalization stage due to their ability to adapt to the environment, while those in the Salt-lick have formed satellite patches as a result of dispersal by Baboons, Birds and Humans. In addition, *Azadirachta spp* have the highest population due to the fact that the fruits are eaten by Baboons and some Birds as a result most of the patches are found close to the animal routes. This agreed with the findings of Sheley *et al.* (1999) and Maxwel (2002), Guison, and Thuller (2005). Which states that the first principle of plant dispersal is that there will be more patches near the source and the patches will decline along a diffusion gradient with increased distance from the source.

ACKNOWLEDGEMENTS

The Authors with to thank the management of Abubakar Tatari Ali Polytechnic, Bauchi, Management of Yankari Game Reserve for their help throughout the course of this work: in particular Mr Jonah who provided many useful discussions. We thank Adamu Makama Pindiga for the computer programme used to map the species.

REFERENCES

Abdulhameed, A., Sabo, A., Gani, A. M. and Sanusi, S. S. (2001). Phytosociological studies of asite Adjoining Yankari National Park, Bauchi state, Nigeria. *Research Journal of Science ,* 7,(12): 7-16.

Allen, J. A., Brown, C. S. and Stohlgren, T. J. (2009). Non-native plant invasions of the United States National Parks. *Biological invasions*, 11(10): 2195-2207.

Aronoff, S. (1991). *Geographic Information Systems: a Management Perspective*. WDL Publications. ISBN 0-921804-91-1. Pp 176-184.

Guison, A. and Thuller, W. (2005). Predicting species distributions: offering more than simple Habitat models. *Ecology letters.* 8(9): 993-1009.

Maxwell, B. D. (2002). "Inventory" *Invasive Plant Management: Center for Invasive Plant Management,* Bozeman, MT. Montana state university. PP 239

Sheley. R, Roberts, E. and Cooksey, D. (1999). Montana Noxious Weed Survey and Mapping System. *Weed Mapping Handbook*. Bozeman, MT, Montana State University. PP 321

Thuller, W., Richardson, M. D., Pysek, P., Midgley, G. F., Hughes, G. O. and Rouget, M. (2005). Niche-based modeling as a tool for predicting the risk of alien plant invasions at A global scale. *Global change Biology*. 11(12): 2234-2250.