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Short communication

MISTLETOE INFECTION OF WOODY PLANT SPECIES AT BAHIR DAR UNIVERSITY MAIN CAMPUS, BAHIR DAR, ETHIOPIA

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ABSTRACT: Study of woody plants composition and invasion by mistletoes was conducted in Bahir Dar University main campus vegetation. A total of 28009 individual trees were checked for mistletoes infection and 764 trees were found parasitized. Three species of mistletoes were identified. *Erianthemum dregi* was more frequent and more abundant (58.68%). The infested host trees belonged to 11 species that were members of 10 genera and eight families. The most parasitized host family was Fabaceae. The host species most susceptible to the mistletoes were *Sesbania sesban* and *Jacaranda mimosifolia*. Host specificity is highest for *Phragmenthera regularis* (H′ = 0.046). This survey study on vegetation infection by mistletoes demonstrated the need for further study on biological and environmental factors for infection of host species and seeking for appropriate ecosystem management programs.

Keywords/phrases: Host tree, hemiparasite, infection, mistletoe, susceptibility

INTRODUCTION

Bahir Dar University Main Campus (BDUMC) is one of the areas in Bahir Dar town containing remnant and planted woody species. Plantation of the exotic species started in 1975 by the then campus re-afforestation group (Berhanu Abraha *et al*., 2006) while almost all the native vegetation is self-regenerated. As a result, the university campus is well rehabilitated. The woody species are pillars to the welfare of the ecosystem functions. However, these species are being affected, more than others, by mistletoes that are hemiparasites. Mistletoes are perennial epi-phytes, which are capable of photosynthesizing but dependent for water and mineral nutrients on the host plant. They are natural associates of woody forests and are considered as factors for the decay of forests because they retard growth of the hosts and some ultimately cause death (Jeet *et al*., 2006). In many parts of the world, mistletoes are viewed as pests because of their impacts upon plants, human health and animals (Marvier and Smith, 1997). For this reason, both the study and management of mistletoes have historically been focused on the control and even on the elimination of some of the population (Marvier and Smith, 1997). If pest mistletoes are to be managed and threatened species conserved, their population biology must sufficiently be understood to formulate management strategies.

Tropical regions are underrepresented in the mistletoes literature (Watson, 2001). Bahir Dar University being part of the tropical region, nothing is known about the rate of infection of the vegetation by mistletoes. The objective of this study was therefore to examine the diversity of woody vegetation of (BDUMC) the campus and illustrate the distribution of mistletoes on the woody species.

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MATERIALS AND METHODS

Description of the study area

The study was conducted in Bahir Dar University Main Campus (Fig. 1). Bahir Dar University (BDU) is one of the largest universities in Ethiopia, which has more than 45,000 students in 53 undergraduate and 30 graduate programs. The Bahir Dar area receives high rainfall from May to October and low rainfall from November to March (maximum of 1683 mm and minimum of 93.4 mm (NMABB, 2000–2010)). The lowest mean annual temperature over eleven years was 8.7°C recorded in December while the highest was 28.3°C recorded in April.

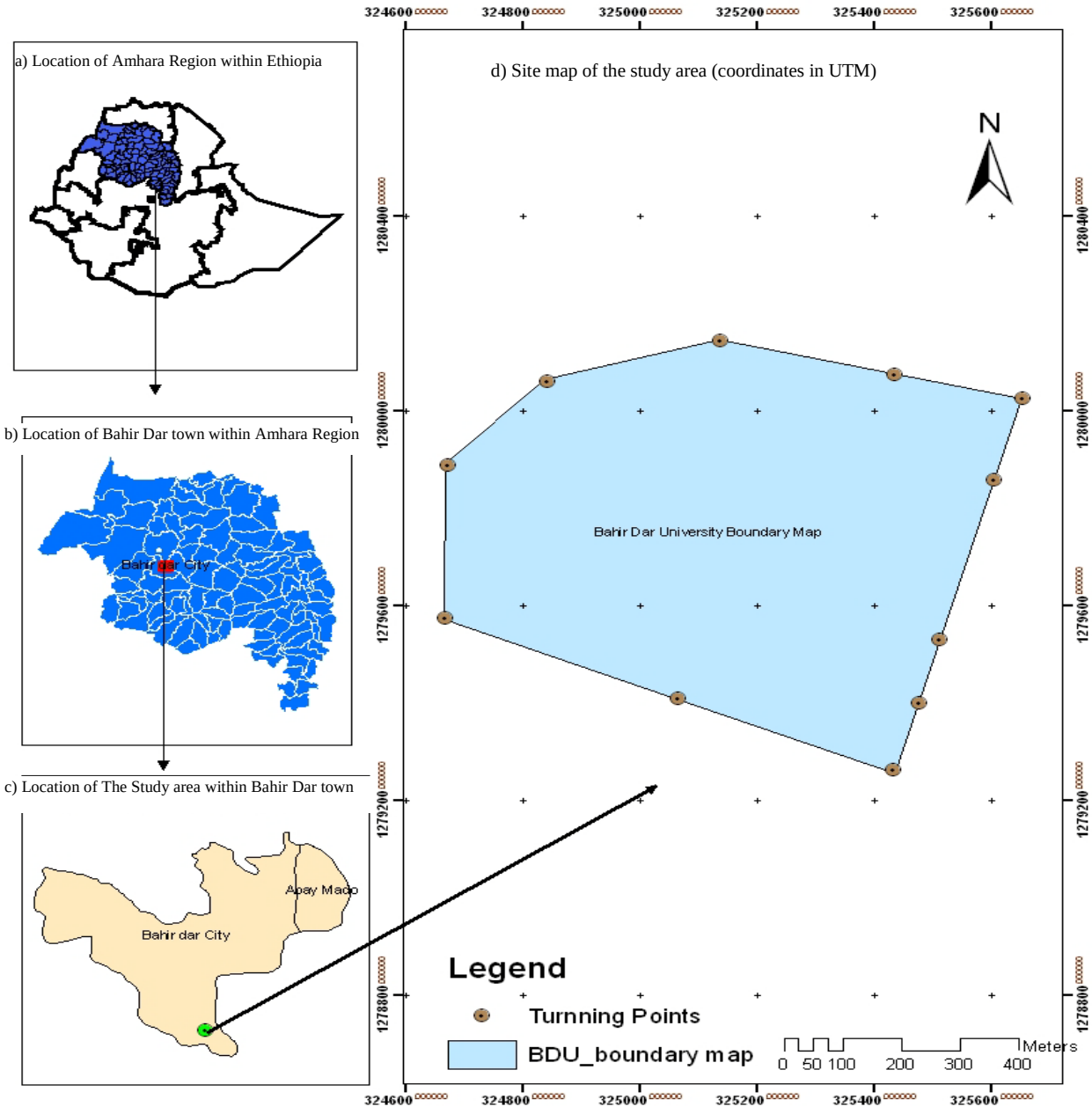

Fig. 1. Location map of Bahir Dar University, which is located in Bahir Dar town, Amhara Region.

Data collection

The study was conducted from November 2010 to January 2011. All woody species were checked for determination of invasion by mistletoes. Identification of the local names, which facilitated the species identification, of the host species and the mistletoe species was carried out by consulting the guards and gardeners in the University. Scientific names were obtained by referring to the series of volumes written on the Flora of Ethiopia and Eritrea (Hedberg and Edwards, 1989; Azene Bekele, 1993; Edwards, *et al*., 1995; 2000).

Statistical analysis

Chi-square (χ^2) test of independence was used to visualize the association between the host species and the distribution of mistletoe species. To compare the degree of host specificity between mistletoe species, Shannon-Wiener diversity index ($H' = -\sum pilnpi$) was employed (Magurran, 1988). Mistletoes with low diversity values are the most specific, parasitizing a small number of hosts with one or few hosts usually dominant, while those with high diversity values are the least specific parasitizing many hosts.

RESULTS

Twenty eight thousand and nine woody plants belonging to 83 species, 71 genera and 40 families were checked for mistletoe infestation. Of these, 764 (about 2.7% of the total) of the plants were infected (Table 1). Most of the infected individuals belong to four species (*Sesbania sesban,* n=418; *Jacaranda mimosifolia,* n=193; *Casuarina equisetifolia,* n=59 and *Cordia africana,* n=46). The hemiparasites belong to three species of three genera all in the Loranthaceae family (Table 2).

The most preferred host species in the study area are *S. sesban* and *J. mimosifolia,* which compose 71.4% and 16.9% of the host plants, respectively. Of the total population of the above two species, 9.9% and 19% of the individuals were infected, respectively. Each infected plant of the two species had a parasite load of 3.7 and 7.1 per plant, respectively. Other species with heavy load include *C. Africana*, *F. sycomorus* and *G. robusta* (Table 1).

The most parasitized host families are Fabaceae (43.46%) and Bignoniaceae (38.17%). Other infested families include Rubiaceae (6.83%), Casuarinaceae (4.63%), Moracaeae (1.55%), Proteaceae (2.34%), Meliaceae (0.77%) and Rosaceae (0.07%) (Table 2). The most abundant mistletoe species is *E. dregi* followed by *T. globiferus, amounting to* 58.62% and 38.34%, respectively (Table 2).

Shannon–Wiener Diversity index revealed that *P. regularis* has a greater degree of host specificity. This is evident from its low host diversity value (H' = 0.046). *E. dregei* has diversified hosts (H' = 1.749) (Table 2).

Host preference by the two dominant mistletoes was checked using Chi-square test. The results revealed significant differences at 95% confidence level ($\chi^2 = 236$; d.f. = 10; P = < 0.0001). Specifically, a residual analysis revealed that *J. mimosifolia, F. sycomorus* and *G. robusta* are significantly preferred by *E. dregei* while *C. equisetifolia, C. africana and S. sesban* are suitable hosts for *T. globiferus*. There were no significant differences for preference of other host species.

Table 1. Inventory of infected woody species and proportion of infection by mistletoes in BDUMC.

Host species	Total number of individuals	Number of infected individuals	Number of mistletoes found	Parasite load per infected plant	Origin of the plant
Acacia abyssinica	7	1	1	1.0	Indigenous
Acacia etbaica	7	2	7	3.5	Indigenous
Azadirachta indica	33	7	28	4.0	Exotic
Casuarina equisetifolia	306	59	166	2.8	Exotic
Cordia africana	414	46	315	6.8	Indigenous
Ficus sycomorus	73	13	56	4.3	Indigenous
Grevillea robusta	90	21	84	4.1	Exotic
Jacaranda mimosifolia	1016	193	1367	7.1	Exotic
Rubus spp	32	3	3	1.0	Exotic
Sesbania sesban.	4269	418	1549	3.7	Exotic
Tecoma stans	438	1	5	5.0	Exotic
Total	6009	764			

Table 2. Distribution of mistletoes and diversity of host species.

Mistletoes (Loranthaceae)	Host species	Number of hemiprasites	Host family	% relative abundance of the Grand total	Diversity value
	Sesbania sesban	826	Fabaceae	23.05	0.338
	Jacaranda mimosifolia	954	Bignoniacaeae	26.63	0.352
	Cordia africana	127	Rubiaceae	3.54	0.117
	Casuarina equisetifolia	47	Casuarinaceae	1.31	0.056
	Ficus sycomorus	49	Moraceae	1.36	0.059
Erianthemum dregi	*Grevillea robusta*	70	Proteaceae	1.95	0.780
	Azadirachta indica	15	Meliaceae	0.41	0.022
	Rubus spp	1	Rosaceae	0.02	0.002
	Acacia athbaica	7	Fabaceae	0.19	0.012
	Tocoma stnas	4	Bignoniacaeae	0.11	0.007
	Acacia abyssinica	2	Fabaceae	0.05	0.004
Sub-total		2102		58.62	1.749
	S. sesban	688	Fabaceae	19.20	0.317
	J. mimosifolia	413	Bignoniacaeae	11.52	0.249
	C. africana	188	Rubiaceae	3.29	0.154
	C. equisetifolia.	119	Casuarinaceae	3.32	0.113
Tapinantus globiferus	*F. sycomorus*	7	Moraceae	0.19	0.012
	G. robusta	14	Proteaceae	0.39	0.022
	A. indica	13	Meliaceae	0.36	0.022
	Rubus spp	2	Rosaceae	0.05	0.004
	T. stnas	1	Bignoniacaeae	0.02	0.002
Sub-total		1445		40.34	0.895
Phragmenthera regularis	*S. sesban*	35	Fabaceae	0.97	0.046
Grand total		3582		~99.96	

DISCUSSION

Considerable numbers of woody plant species in the BDUMC are harbouring mistletoes, and the infection is selective. Naturally, parasitism by mistletoes constitutes a continuum of host specificity. Specialist mistletoes are typically restricted to single or few host species while generalist mistletoes use various host species with little or no preference. Specialization can be essential to mistletoes for different reasons. The main reason is that it increases the efficiency in capturing resources. However, specialist mistletoes may not be capable of surviving in environments with low relative abundance of their hosts. Norton and Carpenter (1998) suggested that variation in relative abundance of hosts could act as a key factor for host specificity. This pattern, according to the above authors, is evident from Loranthaceous mistletoes, which show low host specificity in heterogeneous tropical forests and form high host specificity in temperate forest, which are relatively poor in species number. Some plants may be non-susceptible due to their hard barks, difficult to penetrate by the mistletoe spores. Previous studies by Aukema (2003) found distinct genetic races of species of mistletoes for different species of hosts. Future genetic race and biochemical studies and experiments on germination and compatibility would be necessary to show the nature and mechanisms of mistletoes' specificity. In this study, the two mistletoes could be considered as host generalists since they were virtually observed on all of the host species. This pattern may change by an interaction between seed dispersing birds, mistletoes and host species.

Large woody trees are more preferred by vectors for mistletoes' seeds. The mistletoe seeds can get fertile area for germination and nutrition on the branches of such trees. The mature mistletoes also get good amount of water and shelter from the big trees. The hemiprasitic load

difference between the two most harboring species (*S. sesban* and *J. mimosifolia*) clearly shows the impact of size on harboring the hemiparasites. This is a good indicator that age and size, in addition to susceptibility, of a tree are the main determining factors for infection by mistletoes and for their establishment.

Light incidence has been suggested to be an important factor in the post-dispersal establishment of mistletoes (Chazaro *et al*., 1992 cited in De Baun *et al*., 2002), which are opportunistic plants in disturbance-dependent high light environments (Norton and Reid, 1997). Norton and Reid's result suggested that the high amount of light and the canopy opening in fragmented edges could be explaining factors in the increment of mistletoes. Sometimes non-host species could be infected under the canopy of the most severely infected species. This probably might be the case for some species with only single infection incidence in the campus. *Acacia abyssinica* and *Tocoma stans* are cases in point.

Most mistletoes do not kill their hosts, as this would lead to their own demise. In most cases, both mistletoes and hosts are able to live together without excessive effect on each other. Sometimes, most or all mistletoes die on their host tree because of drought, insect attack or some other factors (Watson, 2001).

CONCLUSION

About 11out of 83 woody species of Bahir Dar University Main Campus vegetation (about 2.7%) have been nfected by Misteltoes. The most infected species are *S. sesban, J. mimosifolia, C. equisetifolia* and *C. Africana. Jacaranda mimosifolia* had the heaviest hemiparasitic load per individual infected plant. From the three Loranthaceous Misteltoe species, *Erianthemum dregi* has diverse hosts as compared to *Phragmenthera regularis* , which has only one host species, *S. sesban.*

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