ScienSage

Journal of Advanced Scientific Research

Available online through http://www.sciensage.info/jasr

ISSN
0976-9595
Research Article

INVASIVE ALIEN PLANTS: A THREAT TO THE TRADITIONALLY CONSERVED BIODIVERSITY OF THE SACRED GROVES OF BANKURA DISTRICT, WEST BENGAL, INDIA

Atanu Nayak*, Achintya Dey, Ram Kumar Bhakat

Ecology and Taxonomy Laboratory, Department of Botany & Forestry, Vidyasagar University, Midnapore, W.B., India.

**Corresponding author: anayakbot@gmail.com*

ABSTRACT

Invasive alien species (IAS) are marked as the second largest cause of biodiversity loss in the world. On the other hand, sacred groves (SGs) are the traditionally conserved forest pockets, maintained by indigenous people, serve as the in-situ conservation sites for local biodiversity. This paper highlights the diversity and status of the IAS in 5 sacred groves of Bankura district, West Bengal. This type of study was never done before in West Bengal, which focuses only on the invasive flora of the sacred groves. In this study we have found 27 invasive alien plants under 26 genera, belonging to 17 families of dicot angiosperms. Out of the 27 plant species, most of them (20 sp.,74%) are herbs. Moreover, maximum number (8 sp.) of the plants belong to the family Asteraceae. The major effects of the IAS are also mentioned. The nativity of the IAS were recorded and the 'Tropical America' is found to be the native place of maximum number of invasive plants (15 sp.), whereas *Parthenium hysterophorus* and *Croton bonplandianum* (F = 100%) are the most frequent species. The Sonamela Bograsini Than (Sl.-3) possesses maximum number of invasive plants (17 sp.), whereas Kadmaghati Maa Khayraburir Than (Sl.-1) has the least number (7 sp.). Moreover, the areas of the SGs are negatively correlated (r= -0.967) to the number of IAS found in that sacred grove, that means the small sacred groves are in more threat of invasion. Along with IAS, the other threats to the sacred groves are also mentioned and the authors recommend to imply proper control methods for the IAS and a strict government policy on the maintenance of the sacred groves.

Keywords: *Invasive alien species (IAS), Sacred grove, Biodiversity, Conservation, Bankura.*

1. INTRODUCTION

An invasive alien species (IAS), as the name suggests, is a non-native species that can threatens the native biodiversity. The IUCN [1] defined the IAS as "an alien species, which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity". At the Convention for Biological Diversity (1992) IAS are marked as the second largest cause of biodiversity loss in the world.

On the other hand, sacred groves are the traditionally conserved forest pockets, maintained by indigenous people, which are often dedicated to certain local deities or spirits [2-4]. In this sense, these are the near-virgin forests patches, where presence of IAS would surely reflects the imperfect status of their 'conserved' character. Sacred groves serve as the *in-situ* conservation sites for many rare, endangered and threatened native species of which many are medicinally important [5]. Immigration of IAS is a great threat to the conserved biodiversity of the sacred groves as they can damage the native flora by various means, like by supressing the native herbs through secretion of allelopathic chemicals [6], or by degrading the soil quality etc.

The nativity, status, path of immigration and effects of the IAS were studied by various eminent scholars [7, 8]. Though some of the IAS has medicinal properties [9], they are majorly considered as enemy of the native ecosystems [10]. On the other hand, sacred groves and their role as safe-houses to the native biodiversity were also studied by various scholars [11, 12]. So far, the few studies on the SGs of Bankura district were done by Basu, [13] and Nayak [14]. However, the effect of the IAS on the conserved biodiversity of the SGs has not been studied extensively. Among the very few ones, Pepsi et al. [15] have studied the alien flowering plants of the sacred groves of Kanyakumari district, Tamilnadu. In West Bengal, till date no published literature on the same issue is found. Moreover, the aspect of correlation between the size of the SGs and the diversity of IAS found on those SGs, has not been studied extensively. With this back ground, this paper highlights the diversity of the invasive alien plants and their correlation with the size of the five sacred groves of Bankura district, West Bengal, India.

2. MARTIAL AND METHODS

2.1. Study area

Bankura district (West Bengal, India) is situated between 22°38' and 23°38' North latitude and between 86°36' and 8746' East longitude. It has an area of 6,882 square kilometres. The areas to the east and north-east are low-lying alluvial plains, similar to predominating rice lands of Bengal. To the west the surface gradually rises, resulting into some rocky hillocks. Much of the area is covered with semi deciduous forests. There are mainly three predominant seasons in Bankura district, namely hot summer (April–May), monsoon (June–September) and cold season (November–February). The humidity is usually medium to high throughout the year and the rainfall, is usually well distributed. The average annual rainfall in the district is around 1,300 mm. Generally, July and August are the rainy months.

Fig. 1: Block map of Bankura district, W.B.
Credit: onefivenine.com

Table-1: Studied sacred groves of Bankura district, W.B.

S.N.	Name of the sacred groves	Location	Block	Area (m^2)
1	Kadmaghati *Maa Khayra burir Than*	23°15'56.21''N 87°06'43.96''E	Bankura-II	800
2	Deoli *Makrasini Than*	23°06'46.88"N 86°49'26.89''E	Hirbandh	1000
3	Sonamela *Bagrasini Than*	23°12'08.15''N 87°00'42.02''E	Bankura-I	400
4	Paharpur Maa Chandir Than	23°08'09.20''N 86°55'04.83''E	Indpur	700
5	Kulyatha *Gram Than*	22°53'57.19''N 87°10'46.91''E	Simlapal	600

Bankura district is the adobe of many sacred groves. Mostly the rural peoples, belonging to both tribal and non-tribal communities, have been maintaining these sacred groves since ancient times. In this study, five (5) sacred groves were surveyed (Table-1), situated in five different blocks (Bankura-I, Bankura-II, Hirbandh, Indpurand Simlapal) of Bankura district (Fig.1).

2.2. Data collection

The study was carried out through surveys from July, 2017 to June, 2018. During this time, at first, information about the existence of the sacred groves was gathered from various social communities situated in different parts of Bankura district. Then, field surveys were carried out by visiting the sacred groves in different seasons of the year. Five sacred groves (1 to 5) of Bankura district were surveyed entirely. The proper locations of the SGs were taken with the help of GPS and their areas were recorded.

For enlisting the invasive alien plant diversity, details of the plants were recorded on the spot and samples and photographs were taken. All the plants were identified with the help of 'Bengal Plants' [16] and Flora of Bankura district, West Bengal [17]. The information about the nativity of the exotic plants and their effects were also gathered from various published literatures like Khuroo AA, 2012 [18]; Debnath et al. 2015[19], and the BSI (ENVIS) database on IAS.

Frequency percentage (F) of the IAS was recorded by calculating their respective appearances in the sacred groves divided by the number of total sacred groves studied, multiplied by 100.

$$\text{Frequency } (F) = \frac{\textit{No.of sacred groves where the IAS present}}{\textit{Total no.of studied sacred groves}} \times 100$$

On the basis of the frequency percentage values, IAS are then distributed into five frequency classes: A (0-20 %), B (21-40 %), C (41-60%), D (61-80 %), and E (81-100 %) [20].

The gathered data were then analyzed accordingly. For the determination of the correlation between the area of the SGs and the numbers of IAS found in the respective SGs, the Pearson correlation coefficient (r) for the said dataset was calculated using the standard formula (Fig.2).

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

Fig. 2: Formula to calculate correlation coefficient.

Where, x_i and y_i are the individual sample points indexed with i and n is the sample size.

3. RESULTS & DISCUSSION

A total number of twenty seven (27) invasive alien plants under 26 genera, belonging to seventeen (17) families of

dicot angiosperms (Table-2) are recorded in this study. Out of the 27 plants, 20 species (74%) are herbs, 6 plants (22%) are shrubs and only one (1) species (4%) is climber in habit (Fig. 3). The Asteraceae family covers the maximum number of plants (8 sp.), followed by Amaranthaceae, Caesalpiniaceae and Lamiaceae (2 sp. each) and rest of the families have only one (1) species each (Fig. 4).

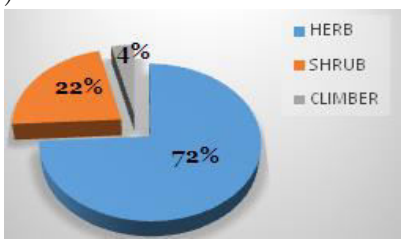

Fig. 3: Habit Types of the IAS

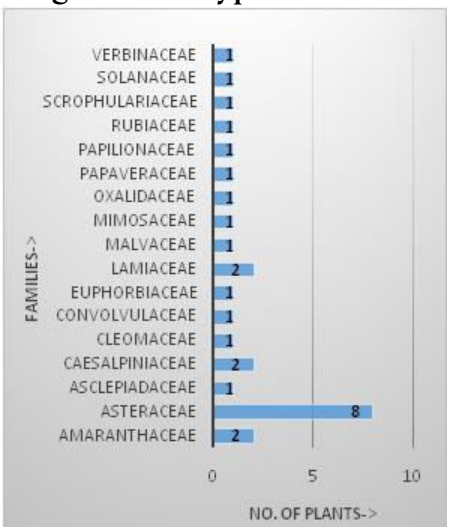

Fig. 4: No. of IAS under 17 families

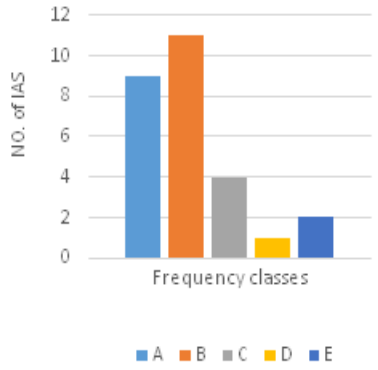

Fig. 5: Frequency class distribution of the IAS

On the other hand, the most frequent invasive plants of the studied sacred groves are *Parthenium hysterophorus*, and *Croton bonplandianum* (*F* = 100%; Frequency class- E) followed by *Ageratum conyzoides* (*F* = 80%; F. class-D). The frequency class distribution (Fig. 5) does not follow the frequency diagram as prepared by Raunkiaer (1934) and thus it reveals that the IAS community is heterogeneous in nature.

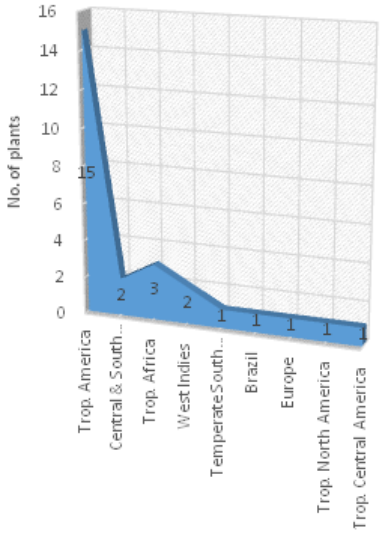

Fig. 6: Nativity distribution of the IAS

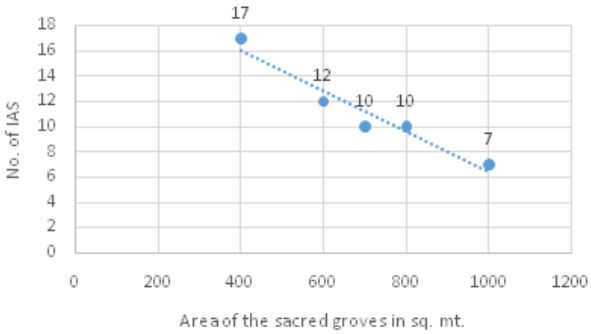

Fig. 7: Correlation between the area of the SGs and the no. of IAS (r = -0.967)

The nativity analysis of the IAS records nine (9) parts of the World (Fig.6), from where these plants were introduced to our country. Among the parts, Tropical America is the native place of maximum plants (15 sp.). Similarly, Tropical Africa is native place of three (3) species and 'West Indies' and 'Central and South America' are native places of two (2) species each.

Out of the five sacred groves we have studied, the Sonamela *Bograsini Than* (Sl.-3) possesses maximum number of invasive plants (17 sp.), whereas, Kadmaghati *Maa Khayraburi* (Sl.-1) has the least number (7 sp.).

Correlation between the area of the scared groves and the number of invasive alien plants it has affected with, shows that there exists a linear negative correlation (r= -0.967). That means the smaller SGs are affected by the higher number of invasive plants (Fig.7).This result indicates that the small sacred groves are in more danger than the bigger ones.

Table 2: Details of Invasive Alien Species (IAS) found in the sacred groves of Bankura district, W.B.

Name of the invasive alien plants (Family) (Habit*)	Nativity	Occurrence (SG no. #)	^*F*(%) & (*F*. Class)	Major effect(s)
Aerva lanata (L.)Juss. Ex Schult. (Amaranthaceae) (H)	Trop. America	3, 5	40 (B)	Displaces nearby herbs
Ageratum conyzoides L. (Asteraceae) (H)	Trop. America	1, 3, 4, 5	80 (D)	Aggressively colonize an area
Alternanthera sessilis (L.) R.Br. ex DC. (Amaranthaceae) (H)	Central & South America	3, 5	40 (B)	Form mono-specific colony
Argemone mexicana L. (Papaveraceae) (H)	Central & South America	2, 4	40 (B)	Release toxic chemicals
Blumea laciniata (Roxb.) DC. (Asteraceae) (H)	Trop. America	3, 4, 5	60 (C)	Allelopathic to rice and other crops
Calotropis gigantea (L.) R.Br. (Asclepiadaceae) (S)	Trop. Africa	2, 5	40 (B)	Reduces soil fertility
Cassia alata L. (Caesalpiniaceae) (S)	West Indies	3	20 (A)	Supress roadside native flora
Cassia occidentalis L. (Caesalpiniaceae) (H)	Trop. America	3	20 (A)	Form mono-specific colony
Chromolaena odorata (L.) King & Rob. (Asteraceae) (H)	Trop. America	2	20 (A)	Completely supress native vegetation
Cleome rutidosperma DC. (Cleomaceae) (H)	Trop. America	3, 4	40 (B)	Degrade soil quality
Crotalaria pallida Aiton (Papilionaceae) (H)	Trop. America	1, 3	40 (B)	Toxic to birds and large mammals
Croton bonplandianum Boil (Euphorbiaceae) (H)	Temperate South America	1, 2, 3, 4, 5	100 (E)	Colonize crop fields; reduce soil fertility
Eclipta prostrata (L.) Mant. (Asteraceae) (H)	Trop. America	2	20 (A)	Aggressively colonize an area
Evolvulus nummularius (L.) L. (Convolvulaceae) (H)	Trop. America	3, 4	40 (B)	Form colony; reduce soil fertility
Hyptis suaveolens(L.) Poit. (Lamiaceae) (S)	Trop. America	1, 3, 5	60 (C)	Supress coexisting plants; Alleolopathic
Lantana camara L. (Verbenaceae) (S)	Trop. America	2, 3, 5	60 (C)	Produce thickets; supress other herbs
Leonotis nepetiifolia (L.) R.Br. (Lamiaceae) (H)	Trop. Africa	5	20 (A)	Supress edge flora
Mikania micrantha Kunth (Asteraceae) (C)	Trop. America	2, 3	40 (B)	Damage other plants by suffocating them
Mimosa pudica L. (Mimosaceae) (H)	Brazil	1, 3	40 (B)	Form mono-specific colony
Oxalis corniculata L. (Oxalidaceae) (H)	Europe	4	20 (A)	Degrade soil quality
Parthenium hysterophorus L. (Asteraceae) (H)	Trop. North America	1, 2, 3, 4, 5	100 (E)	Allelopathic to other herbs
Scoparia dulcis L. (Scrophulariaceae) (H)	Trop. America	3, 4	40 (B)	Degrade crop field soil
Solanum torvum Sw. (Solanaceae) (S)	West Indies	5	20 (A)	Quickly overtops most herbs
Spermacoce hispida L. (Rubiaceae) (H)	Trop. America	2, 4	40 (B)	Aggressively colonize an area
Tridax procumbens L. (Asteraceae) (H)	Trop. Central America	1, 3,5	60 (C)	Competitor of several crops, decrease yield
Urena lobata L.(Malvaceae) (S)	Trop. Africa	2	20 (A)	Grows aggressively, pushes nearby plants
Xanthium strumarium L.(Asteraceae) (H)	Trop. America	5	20 (A)	Form colony; toxic to cattle

**H= Herb, S= Shrub, C= Climber; Trop. = Tropical; ^F = Frequency; #See Table-1*

4. CONCLUSION

As the safe-house of the local biodiversity, sacred groves play a significant role in the conservation, not only of life forms but also of the cultural heritages [21]. Many local cultures are intermingled with the grove deities, which ensure the presence of our cultural diversities. The sacred groves of Bankura district are mainly maintained by the rural ethnic communities, who possess many 'Traditional Ecological Knowledge' (TEK), which can be used to enhance the livelihood of the human race. But, due to the modern anthropogenic activities, the conserved sacred groves are also in great threat of destruction. One of the most serious threats, the IAS are rapidly expanding their kingdom. The native biodiversity of the sacred groves, which includes many important rare, endangered and threatened species [22] may be lost permanently if no action is taken soon. As this study

shows, the IAS community is heterogeneous in nature and smaller sacred groves are in more threatened condition than the bigger ones; so, care should be taken to eradicate the invasive alien species from the small SGs first, by applying various methods for different types of the IAS. For example, herbicides can only be used in the case of herbaceous IAS which is at the edges of the area and where there are no native species. Manual uprooting of the plants can also be done for the shrubby IAS. However, special methods should be developed to control the rapidly expanding IAS keeping in the mind the religious factors associated with these sacred groves. The local people should be involved in this work as they have been protecting these groves since long time. Moreover, a strong government policy on the SGs should be made which would recognise SGs as institutions of traditional Indian culture, respecting social and religious sentiments and as the repository of indigenous biodiversity. We also recommend to take initiative to educate the younger generations about the importance of sacred groves and their role in the *in-situ* conservation of biodiversity. This will ensure the proper maintenance and protection of the sacred groves in the upcoming years.

5. ACKNOWLEDGEMENTS

We are heartily thankful to the rural peoples of Bankura district for sharing various information about the sacred groves with us.

6. REFERENCES

1. Anonymous. IUCN guidelines for the prevention of biodiversity loss caused by alien invasive species, 2000.
2. Bhakat RK. *Science and culture,* 2003; **69**: 371-74
3. Bhakat RK, Sen UK. *Indian forester*, 2008; **134:866**-874.
4. Bhakat RK. *Indian Journal of Biological Sciences*, 2015; **21**: 59-62.
5. Bhakat RK, Pandit PK. *Indian Forester*, 2003; **129**: 224-232.
6. Maiti PP, Bhakat RK, Bhattacharjee A. *Science and Culture*, 2009;**75 (3-4)**: 137-141.
7. Sukumaran S, Parthiban B. *Bioscience Discovery*, 2014; **5(2)**: 204-217.
8. Das AP. *Pleione*, 2013; **7(2)**: 305-313.
9. Pant HM, Sharma N.. *Journal of Medicinal Plants Research*, 2010; **4(20)**: 2144-2147.
10. Ehrenfeld JG. *Annual Review of Ecology, Evolution, and Systematics*, 2010;**41**: 59–80.
11. Gadgil M, Vartak VD. *Journal of Bombay Natural History Society*, 1975; **72**: 314-321.
12. Bhakat RK. *W.B.Biodiversity Board Newsletter*, 2011; **4(1)**: 6.
13. Basu R. *Indian Forester,*2009;**135**:765-778.
14. Nayak A. *Conservational and Sociocultural impact of some Sacred groves of Bankura district, West Bengal.* M.Sc. dissertation (unpublished), Dept. of Botany & Forestry, Vidyasagar University, West Bengal, 2017.
15. Pepsi A, CelinPappa Rani J, Jeeva S, Sukumaran S. *Bioscience Discovery*, 2018; **9(1)**: 176-187.
16. Prain D: Bengal Plants, Vol.1 & 2, Botanical Survey of India, Calcutta; 1903 (1963 Rep. Edn.).
17. Sanyal, M: Flora of Bankura District, West Bengal. Bishen singh Mahendra Pal Shingh, Dehradun; 1994.
18. Khuroo AA, Reshi ZA, Malik AH, Weber E, *et al. Biological Invasions*, 2012; **14(1)**: 99-112.
19. Debnath B, Debnath A, Paul C. *Life Science Leaflets, International Research Journal*,2015;**70**: 9-21.
20. Raunkiaer C. The life forms of plants and statistical plant geography: being the collected papers of C Raunkiaer. Oxford, England: Clarendon press; 1934.
21. Bhakat RK. *Current Science*, 2009; **96**: 85.
22. Kushalappa CG, Bhagwat SA. Sacred Groves: Biodiversity, threats and conservation. In: Uma Shaanker, R., Ganeshaiah, K.N. and Bawa, K.S. (editors). Forest Genetic Resources: Status, Threats and Conservation Strategies. Oxford and IBH Publishing Co. Pvt. Ltd., 2001; 21-29.