

Invasive Weeds in Southern and South-eastern Rajasthan with Special Reference to ‘Nals’ and Gorges

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ABSTRACT

Destruction of habitats and growth of invasive species are the major threats to the ecosystem universally. These species alter the composition of native community and disturb the micro-climatic conditions which results in considerable economic as well as ecological imbalance. Anthropogenic activities play a vital role in accelerating the growth of weeds in natural ecosystem which impact native flora adversely. Since 2019, the study has been commenced to assess the distribution of potential invasive species especially weeds in different habitats of southern and south-eastern Rajasthan and suggest need of efficient management/eradication practices to control their spread as the habitat is more sensitive for dispersal. The objective of the paper was to study the flora of invasive weeds with their current distribution and status. The study also focused on the potential as well as their effect on the invaded areas. During the study period, 27 species were reported from 26 ‘nals’ and gorges and 12 other species were also reported in and around five cities of the region. The assessment of the alien flora is expected to be helpful in designing informed management and monitoring strategies against problematic plant invasions.

Key words : Invasive species, ‘Nals’ and Gorges, Management practices

Introduction

According to the IUCN (2000) alien invasive species are the species which establish themselves in natural ecosystems/habitats, multiply, change, and pose a threat to native biodiversity. Invasion of long-established ecosystems by organisms is a natural phenomenon, but anthropogenic factors have greatly increased the rate, scale and geographic range of invasion which results into a number of native species at the risk. Depending on actual impacts and human perceptions, between 50 and 80% of invasive plant species can be classified as weeds/pests, and the remaining species are ‘benign invaders’ whose im-

Abbreviations

International Union for Conservation of Nature – IUCN, Convention on Biological Diversity – CBD, Botanical Survey of India – BSI, Environmental Information System – ENVIS, Rajasthan State Biodiversity Board - RSBB, Wildlife Sanctuary – WLS

pacts on environment or economy frequently go beyond the range of practical detection (Richardson *et al.*, 2000).

Invasions are a continuous process rather than a singular incident which help a species to expand its gene pool and build up viable populations. In the work on “Invasive alien plants in the forests of Asia and the Pacific” Sankaran and Suresh (2013) de-

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scribed 110 invasive species along with their nativity, habitat, threat and damage, uses and management practices. Important attributes that make an alien species invasive, include its widespread geographical range, ability to modify growth and development in response to change environment, better competitive ability, fast growth, allelopathic nature, several modes of dispersal etc (CBD, 2010).

In India, about 20,000 flowering plants are recorded so far including cultivated/naturalized ones with approximately 15% endemic species (ENVIS, 2020). Rajasthan has about 2034 angiospermic plant species including cultivated/naturalized ones (RSBB, 2023). Dubey (2008) reported more than 80 angiospermic invasive plant species from the state. Dubey and Chaudhary in 2011 also reported 32 alien plant species from Jaisamand Wildlife Sanctuary and in 2018 Charan and Singh described 96 invasive species from the Thar Desert of Bikaner division.

The southern and south-eastern part of Rajasthan is biologically rich with a long chain of hills, perennial streams, dense forests, deep gorges, huge plateaus, and wetlands. Tiagi and Aery (2007) reported 1378 plant species (including cultivated as well as ornamental) belonging to 126 families from the south and south-east region of the state. The region is characterized by a number of 'V'/'U' shaped valleys known as 'nals'/gorges as it is the part of Aravallian and Vindhyan range. 'Nals' are the area between two parallel mountain chains or a fold present in a chain itself. In contrast, gorges are deep narrow valleys formed because of regular erosion of floor of the valley by the flowing stream. Perennial, semi-perennial, seasonal or ephemeral streams can be found in these places. Sharma (2009) has studied the flora of Menal, a gorge situated in Chittorgarh district and revealed 105 Angiospermic plant species from the area. 441 species of Angiospermic flora has been studied by Banu and Sharma in 2017 from the 'nals' of Phulwari Wildlife Sanctuary, Udaipur.

The report of Punjab ENVIS Centre (2013-14) stated the most important invasive plants *Lantana camara*, *Hyptis suaveolens*, *Prosopis juliflora*, *Parthenium hysterophorus*, *Leucaena leucocephala* created havoc in the habitats and threat to the native species. Hence, it is essential to identify the pathways of invasions and develop strategies to contain them. The objective of the study was to assess invasive weeds and provide information on the current distribution of the plants which can help to investi-

gate current and prospective pathways of invasions and make future plans.

Study Area

The southern and south-eastern region of Rajasthan is rich in floral and faunal diversity. The study of invasive weeds was carried out in 26 'nals' and gorges *i.e.* 1. Phulwari ki Nal in Phulwari WLS – Udaipur, 2. Kankan ki Nal – Range Ongna, Udaipur, 3. Ubeshwar Nal – Udaipur, 4. Keora ki Nal – Udaipur, 5. Khokharia ki Nal – Udaipur, 6. Mogya ki Nal – Khumbhalgarh WLS, Rajsamand, 7. Menal – Chittorgarh, 8. Vanjoi ki Nal – Dungarpur, 9. Sandol ki Nal – Jhadol Tehsil, Udaipur, 10. Tani ki Nal – Kumbhalgarh WLS, Rajsamand, 11. Bedla ki Nal – Girwa Tehsil, Udaipur, 12. Kamalnath ki Nal – Jhadol Tehsil, Udaipur, 13. Khanchan ki Nal – Phulwari WLS, Udaipur, 14. Kunda *Khoh*/gorge - Shahbad Tehsil, Baran, 15. Sukha *Khoh* - Shahbad Tehsil, Baran 16. Madho *Khoh* - Shahbad Tehsil, Baran 17. Telni *Khoh* - Shahbad Tehsil, Baran, 18. Pindasal *Khoh* - Shahbad Tehsil, Baran, 19. Soorpa *Khoh* – Shergarh WLS, Baran, 20. Udeswar Nal – Chhapli Village, near Diver (Rajsamand), 21. Sitamata ki Nal – Sitamata WLS, Chittorgarh, 22. Umarjokh Nal – Udaipur, 23. Darrah ki Nal – Darrah Tiger Reserve, Kota, 24. Kekadiya *Khoh* – Mandalgarh Tehsil, Bhilwara, 25. Thela *Khoh* - Mandalgarh Tehsil, Bhilwara, 26. Bhimlat *Khoh* – Bundi. Besides this 5 cities of southern Rajasthan namely Udaipur, Dungarpur, Chittorgarh, Bhilwara, Mt. Abu were also surveyed minutely. Emphasis was given on municipal parks, roadsides and trenching grounds to search the invasive/exotic species.

Materials and Methods

During the study period, extensive field surveys were made in the areas since 2019. Preliminary information has been done and the information about plants was noted in the field note book. Photographs of the plants were taken at the spot. Various floras: - Flora of Rajasthan-Volume 1-3 (Shetty and Singh, 1987-93); Flora of Indian Desert (Bhandari, 1990); Flora of Rajasthan:-South and South-East Region (Tiagi and Aery, 2007); Flora of South Central Rajasthan (Yadav and Meena, 2011) were referred for identification and confirmation of plant species. Information on habit, habitat, threat and damage caused, uses and methods of management were ei-

Table 1. List of Invasive/exotic plants that have successfully naturalized in 'Nals'/Gorges

S. No.	Species and families	Presence of the species in 'Nals'/Gorges with location																										Status	
		(The serial number of locations are in same order as given in the study area)																											
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26		
1.	<i>Argemone mexicana</i> L. (Papaveraceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	B
2.	<i>Sida acuta</i> Burm. f. (Malvaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	C
3.	<i>Hiptage benghalensis</i> (L.) Kurz (Malpighiaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	C
4.	<i>Aglaiia odoratissima</i> Bl. (Meliaceae)										✓																	C	
5.	<i>Prosopis juliflora</i> (Sw.) DC. (Fabaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
6.	<i>Cassia uniflora</i> Mill. (Caesalpinaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
7.	<i>Cassia tora</i> (L.) Roxb. (Caesalpinaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
8.	<i>Cassia obtusifolia</i> (L.) H.S. Irwin & Barneby (Caesalpinaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
9.	<i>Caesalpinia decapetala</i> (Roth) Alston (Caesalpinaceae)						✓																					C	
10.	<i>Leucaena leucocephala</i> (Lam.) de Wit (Mimosaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	B
11.	<i>Coccinia grandis</i> (L.) Voigt (Cucurbitaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	C
12.	<i>Ageratum conyzoides</i> L. (Asteraceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	B
13.	<i>Ageratum houstonianum</i> Mill. (Asteraceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	B
14.	<i>Parthenium hysterophorus</i> L. (Asteraceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
15.	<i>Verbesina encelioides</i> (Cav.) Benth. & Hook.f. ex A. Gray (Asteraceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
16.	<i>Xanthium strumarium</i> L. (Asteraceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	B
17.	<i>Bidens biternata</i> (Lour.) Merr. & Sherff (Asteraceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	C
18.	<i>Zinnia elegans</i> Jacq. (Asteraceae)						✓																✓					C	
19.	<i>Tagetes minuta</i> L. (Asteraceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	B
20.	<i>Acanthospermum hispidum</i> D.C. (Asteraceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
21.	<i>Cryptostegia grandiflora</i> Roxb. ex R.Br. (Apocynaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	B
22.	<i>Cuscuta reflexa</i> Roxb. (Convulvulaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	B
23.	<i>Physalis maxima</i> Mill. (Solanaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	B
24.	<i>Datura innoxia</i> Mill. (Solanaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	B
25.	<i>Lantana camara</i> L. (Verbenaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
26.	<i>Hyptis suaveolens</i> (L.) Poit. (Lamiaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
27.	<i>Saccharum spontaneum</i> L. (Poaceae)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	C

✓ = Presence of species; Status shows invasiveness of the plant species: - A. Problematic, B. Becoming problematic/likely to become problematic, C. Presently non-problematic weeds

ther collected or compiled from authentic web sites, research papers and books. Recognizing invasive plants was the first step in managing them, both those that have sneakily entered our ecosystems and those that may do so in the future. According to their abundance and invasiveness the species have also been categorized into problematic, becoming problematic or likely to become problematic and presently non-problematic weeds.

Result and Discussion

During the period, 27 species were reported from 26 'nals' and gorges of southern and south-eastern region (Table 1) and 12 other species in and around 5 cities of the region that can invade a variety of habitats such as home, damp lowlands, dry roadsides, wastelands and catchment areas (Table 2). The potential for invasive plant species to alter ecosystem structure and function in the invaded areas has also been recognized. According to their invasiveness and proliferation, the species have been classified into three categories: - **A.** Problematic, **B.** Becoming problematic/likely to become problematic, **C.** Presently non-problematic weeds (Table 1 & 2).

A. Criteria of problematic weeds

- Can grow in dry to moderate moist condition
- Unbrowsable
- Extensive stretch with thicket forming (grow in dense)
- Hinder regeneration of local species
- Generally no use or of little use

- Spreading fast
- Pause high competition to native species
- Already has occupied large area

B. Criteria of becoming problematic/likely to become problematic weeds

- Spreading speed fast
- High seed production
- Thicket forming
- Presently occupied less area but spreading fast
- In future may pose ecological problems in the natural ecosystems

C. Criteria of presently non-problematic weeds

- Still spread is relatively very less
- Generally dense thickets are not seen (growing sparsely or making small patches)

Conclusion

'Nals'/Gorges provide specific environment to support various floral species. Catchment areas/water courses of these areas are more sensitive zones for the dispersal of propagules and seeds of the species. *Lantana camara*, *Hyptis suaveolens*, *Prosopis juliflora*, *Parthenium hysterophorus* are some examples that caused considerable harm to the fragile biodiversity therefore effective check on invasive weeds is necessary via repeated uprooting, pulling and digging out small seedlings. The monitoring programmes must be carried out on regular basis. To mitigate the adverse impact of such invasive species, environmental education and public awareness campaigns

Table 2. Exotic species found in and around cities of Southern Rajasthan

S. No.	Species and families	In/around cities	Status
1.	<i>Muntingia calabura</i> L. (Muntingiaceae)	Dungarpur	C
2.	<i>Casuarina equisetifolia</i> L. (Casuarinaceae)	Udaipur	C
3.	<i>Conocarpus erectus</i> L. (Combretaceae)	Chittogarh and total Udaipur	C
4.	<i>Terminalia buceras</i> (L.) C. Wright (Combretaceae)	Bhilwara, Udaipur	C
5.	<i>Buddleja madagascariensis</i> Lam. (Scrophulariaceae)	Present in stream parallel to road leading from Mt. Abu to Mt. Abu talhati	C
6.	<i>Spathodea campanulata</i> P. Beauv. (Bignoniaceae)	Udaipur	C
7.	<i>Antigonon leptopus</i> Hook. & Arn. (Polygonaceae)	Udaipur	B
8.	<i>Eichhornia crassipes</i> (Mart.) Solms (Pontederiaceae)	Large catchment areas	A
9.	<i>Tradescantia spathacea</i> Sw. (Commelinaceae)	Udaipur	B
10.	<i>Canna indica</i> L. (Cannaceae)	Udaipur	C
11.	<i>Cyperus alternifolius</i> Rottb. (Cyperaceae)	Gumania nala of Udaipur	A
12.	<i>Bambusa vulgaris</i> Schrad. Ex J.C. Wendl. (Poaceae)	Udaipur	C

Status shows invasiveness of the plant species: - **A.** Problematic, **B.** Becoming problematic/likely to become problematic, **C.** Presently non-problematic weeds

at national and local levels are the need of the time. Management practices through biological, chemical and mechanical methods for eradication of these species are needed to check their further spread.

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