



Ecological impact of alien plant invasion in national parks of an Indo-Burma biodiversity hotspot in India

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Summary

The present study aims to evaluate the ecological impact of invasion in two protected areas and provides the first authentic inventory of alien plants with their invasion status. Random sampling technique was followed along with nested quadrats to investigate the phytosociological status of invasion by the alien plants. The ecological studies revealed the occurrence of 207 alien plant species 193 genera under 59 families. The family Asteraceae exhibited the highest species diversity with 38 plant species followed by families like Fabaceae (20 species), Euphorbiaceae (8 species), Convolvulaceae (8 species) and Amaranthaceae (7 species). Most of the alien plants (31%) belonged to American origin followed by 9.18 % from Mexican, 9.17 % from African and 5.31% from European origin. Out of the total species recorded, it was observed that 60.38% herbs, 12.56% trees and 11.11% were shrubs. Phytosociological investigation showed that the lowest reading of Shannon diversity index ($H' = 1.897$) was found in the herb layer of disturbed habitats in the middle altitude of Murlen national park in comparison to the disturbed habitats in the middle altitude of Phawngpui national park ($H' = 2.198$). *Ageratina adenophora*, *Mikania micrantha*, *Ageratina riparia* and *Chromolaena odorata* were observed as the most noxious invasive alien plants. This database may be utilized to prepare the area's conservation or forest management plans.

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Keywords: *Ageratina adenophora*; *Ageratina riparia*; *Chromolaena odorata*; invasive alien plants; protected areas

Introduction

Invasion of native plants into natural forest ecosystems is considered one of the top five drivers of global environmental change leading to rapid biodiversity loss.¹ Invasive alien plant species (hereafter IAPs) modify ecosystem equilibrium by reducing native biodiversity.^{29,30&31} The rapid invasion by alien plants aggravated with increased global communication causes the accidental or conscious introduction of IAPs to different natural ecosystems crossing their own native range,¹⁶ causing significant proliferation and irreversible biodiversity loss.⁹ Earlier, it was believed that protected natural forest areas would be less prone to alien plant invasion due to their high biodiversity, species richness and less disturbance regime^{8&32} but recent studies show that invasion by alien plants escalated profusely, appearing as a significant threat to forest biodiversity in protected forests, national parks, wildlife sanctuaries globally.⁴ The Indian Himalayan Region (IHR) comprises of 20 national parks followed by wildlife sanctuaries (approx. 71) and nature reserves (approx. 41), accounting for approximately 6% of the total Himalayan landscape in the region's various ecoclimatic zones.¹⁴ In

recent research, a total of 10,289 taxa belonging to 2256 genera and 238 angiosperm families were reported from the Indian Himalayan region.²⁶

Around 297 species of alien naturalized plants of 65 families have been reported from the Indian Himalayan region,¹⁷ while 163 invasive alien plants reported from the Mizoram region²² and 216 invasive alien plants reported from Tripura region⁵, but comprehensive information on alien flora of important protected areas like national parks are scanty. To formulate the necessary conservation of natural forests, a database on IAPs and their impact on the natural forest in protected forest areas is required. Hence, the current ecological study was conducted in the natural protected forests of two national parks in Mizoram to prepare a comprehensive database of the alien plants in the natural forests and evaluate the ecological status of the most noxious invasives along the altitudinal gradient to understand their potential threats to the native biodiversity. The most noxious and neo-invasive IAPs have also been discussed, along with the top ten dominant native species.

Materials and Methods

Study Site

Mizoram, situated in the extreme eastern part of India, is adjoined by Bangladesh on the western side and Myanmar (Burma) on the eastern side. States like Tripura, Assam and Manipur also contain a common border consecutively on the state's west, north and east. With most forest areas (84.53% of the total geographical

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area), only 6.75% falls under the protected area network. Temperature range during the March-May (summer) stays around 18-29°C whereas during August-December (winter), temperature stays low (11-24°C). The rainfall profile exhibits annual rainfall of 2160 mm to 3500 mm.⁷ The research work was carried out in two protected areas viz. Phawngpui National Park (22.6510° N,

93.0276° E, elevation 780-2368 m; area 50 km²) and Murlen National Park (23.6574° N, 93.2785° E, elevation 490-2279 m, area 100 km²) in Mizoram, India (Fig. 1). For the more straightforward interpretation of the results, this classification was treated as lower (up to 900m), middle (901-1800m) and upper (1801-3600m) altitude in the protected areas.

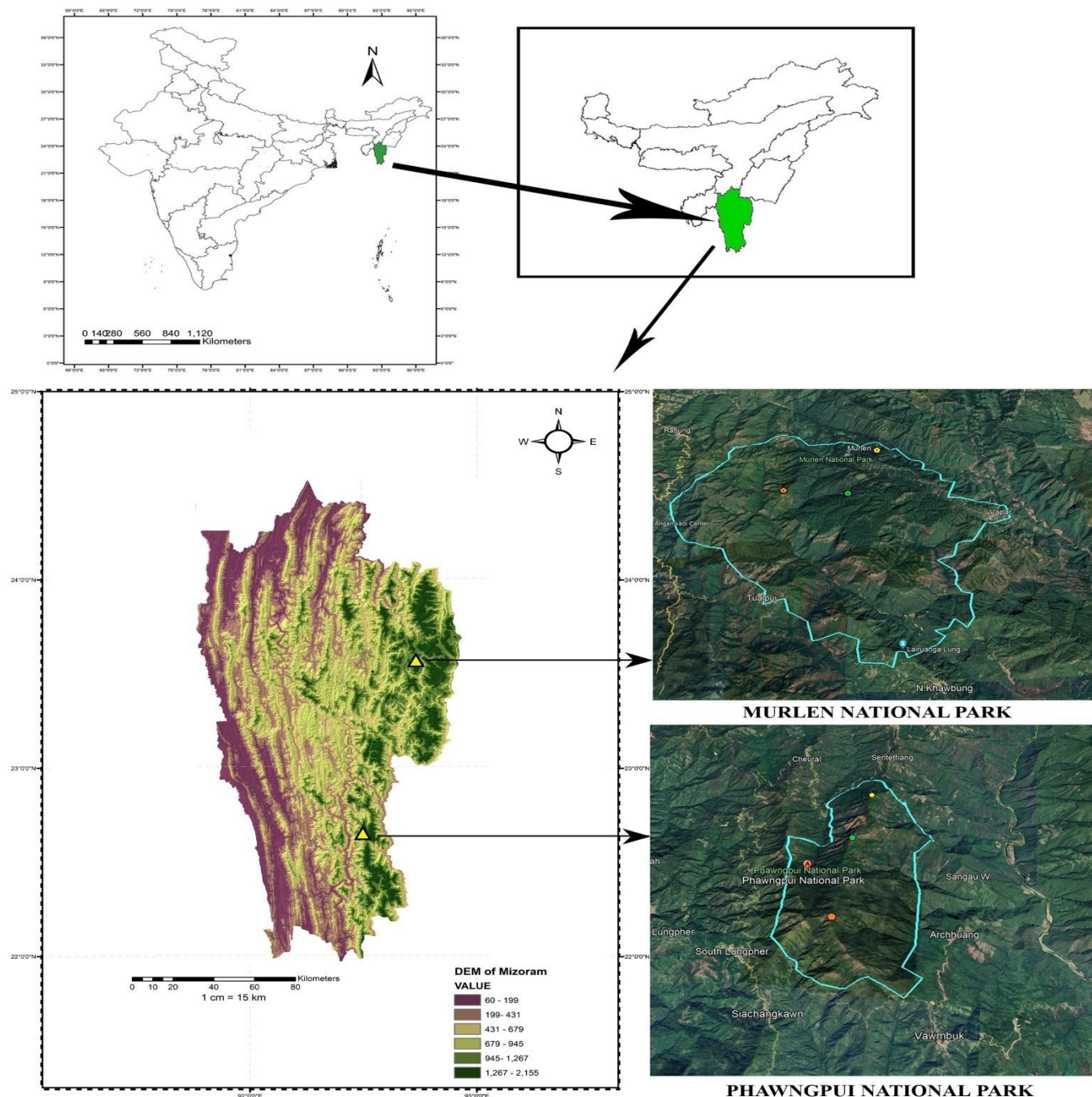


Figure 1. Elevation map of Mizoram with the study sites

Methods

Voucher specimens were collected during extensive field surveys in different seasons at regular intervals following the conventional method.¹⁰ The collected voucher specimens were preserved and deposited in the Central National Herbarium (CAL) with relevant field information. An inventory of alien plants found in these national parks was prepared by observing fresh collections and earlier

collected records found in the multiple herbaria (CAL, ASSAM and ARUN).

Phyto-sociological data were collected using a random sampling technique following the nested quadrat method with plot sizes of 400 m² where quadrats of 5m × 5m (shrub layer) and 1 m × 1 m (herb layer) were placed.¹² Most dominant ten noxious established invasive alien plants and five top neo-invasive species

were determined based on the importance value index (IVI).

Local people in the fringe villages of the national parks were interviewed with an open-ended questionnaire to collect data on the mode of introduction and socio-economic use of alien plants.

Ecological Data Analysis

The ecological impact of the invasion was determined based on their phytosociological data *i.e.*, relative densities, relative dominance, relative frequency, importance value index (IVI).¹² IVI of each species was calculated by adding relative values availed from dominance, density and frequency.³

The following formulae were used for the various calculations are:

$$\text{Density} = \frac{\text{No. of individuals of a species}}{\text{Total No. of quadrats studied}}$$

$$\text{Frequency (\%)} = \frac{\text{No. of quadrats of occurrence of a species}}{\text{Total number of quadrats studied}} \times 100$$

$$\text{Abundance} = \frac{\text{Total No. of individuals of a species}}{\text{Number of quadrats of occurrence}}$$

$$\text{Relative Frequency} = \frac{\text{Frequency of a species}}{\text{Frequency of all the species}} \times 100$$

$$\text{Relative Density} = \frac{\text{Density of a species}}{\text{Density of all the species}} \times 100$$

$$\text{Relative Dominance} = \frac{\text{Basal area of a species}}{\text{Basal area of all species}} \times 100$$

Where Basal area = πr^2 , where, r = radius of the species and π = 3.14.

Importance Value Index (IVI) = Relative Density + Relative Dominance + Relative Frequency

Diversity indices were calculated with the help of the following formula:

$$\text{Simpson's Diversity Index (SDI)} = 1 - \frac{\sum n(n-1)}{N(N-1)}$$

Where, n is no. of individual species exhibiting one trait (e.g., the number of individuals of a species); N = the total number of all available individuals.²⁴

The Shannon-Wiener information index (H')²³ was calculated with the help of the following formula:

$$H' = -\sum_{i=1}^s p_i \ln p_i$$

Where the ratio of species i is respective to the number of species (p_i) present which is multiplied by the natural logarithm of this ratio ($\ln p_i$).

The phyto-sociological data were analyzed using Sigmaplot software (Version 14.1). GPS locations were recorded using garmin montana 680 device and a digital elevation map was prepared with ArcGIS online tools.

Results and Discussion

Results of the study revealed a total of 207 alien plants (Please see Supplementary online material) belonging to 193 genera belonging to 59 families from Phawngpui and Murlen national parks cumulatively including 179 species (under 145 genera and 48 families) of dicotyledons and

21 species (under 18 genera and 6 families) of monocotyledons. Six species of gymnosperms (under 5 genera and 4 families) were also recorded. From Phawngpui national park (hereafter PNP), 185 IAPs were recorded belonging to 159 genera and 57 families and from Murlen national park (hereafter MNP), 176 IAPs were recorded belonging to 145 genera and 56 families (See Supplementary material).

The results on life form showed that 60.38% of plant species were represented by herbs followed by 12.56% trees, 8.21% climbers, 6.28% grasses, 11.11% shrubs, and only 1.44% species of sedges. The study results exhibit the dominance of herbs and shrubs (including climbers) over other habits of IAPs. Similar observations were also reported by Choudhury et al. (2017)² from Rajiv Gandhi Orang National Park, Assam and by Kumar et al. (2021)¹¹ from Nauradehi Wildlife Sanctuary, Central India. In the international context, Yen (2021)²⁸ reported the highest percentage of herbs among the IAPs in national parks in Vietnam.

In both the national parks, the majority of alien plants (29.97% MNP, 30.93% PNP) exhibited nativity to Tropical American origin followed by Tropical African (8.71% MNP, 9.18% PNP), Mexican (8.67% MNP, 9.16% PNP), European (4.83% MNP, 5.31% PNP) and from Australian (4.34% MNP, 3.86% PNP) origin (Fig. 2). Sekar (2012)²⁰ and Pathak et al. (2019)¹⁷ also reported dominance of tropical American and tropical African plants in Indian Himalayan Region.

In Phawngpui national park, the most dominant family was Asteraceae (38 spp.) and Fabaceae (20 spp.) followed by Poaceae (11 spp.), Euphorbiaceae (8 spp.), Solanaceae (8 spp.), Convolvulaceae (8 spp.), Amaranthaceae (7 spp.), Malvaceae (6 spp.), Verbenaceae (4 spp.) and Lamiaceae (4 spp.).

In Murlen national park, similarly, Asteraceae was the most dominant family with 36 IAPs followed by Fabaceae (15 spp.), Amaranthaceae (10 spp.), Poaceae (10 spp.), Convolvulaceae (8 spp.), Euphorbiaceae (7 spp.), Malvaceae (7 spp.), Solanaceae (7 spp.), Acanthaceae (4 spp.) and Apiaceae (3 spp.) where ten most dominant families contribute 60.79 % of total reported IAPs.

The dominance of families like Asteraceae, Poaceae, Fabaceae as effective invaders throughout altitudinal gradient in these two national parks implies that their high productivity of viable seeds aid in their successful dominance in the herb and shrub layers of the natural forests. Five dominant families viz., Asteraceae, Fabaceae, Euphorbiaceae, Poaceae and Convolvulaceae were also reported from Indian Himalayan Region by Pathak et al. (2019)¹⁷ as well as throughout India by Misra (2020)¹³.

Critical observation on the most invaded habitats in these two national parks (Fig. 3) revealed that tropical wet evergreen forest (38.07% MNP, 37.84% PNP), jhumlands (shifting cultivation lands) (31.82 % MNP, 31.89% PNP) and fallow lands (30.11 % MNP, 29.19% PNP) were the most predominantly invaded habitats followed by montane sub-tropical forest (19.32 % MNP, 21.08 % PNP) and temperate forests (5.68 % MNP, 5.41 % PNP). Additionally, the results revealed that most of

the IAPs were perennials (52.84 % MNP, 52.97% PNP) whereas remaining were annuals (47.73% MNP, 47.03 % PNP). The perennial population of IAPs in both the national parks in Mizoram imply that these perennial IAPs were established in various altitudinal gradient and the percentage of perennial alien plants in these PNP and MNP were higher than the average contribution of the

Indian Himalayan region (37%) reported by Pathak et al. (2019)¹⁷ making the natural vegetation vulnerable to degradation. Lesser number of annual IAPs compared to the perennials indicates that the jhumlands, fallow lands near the national parks lead to forest degradation which was replaced by the gregarious growth of the IAPs.

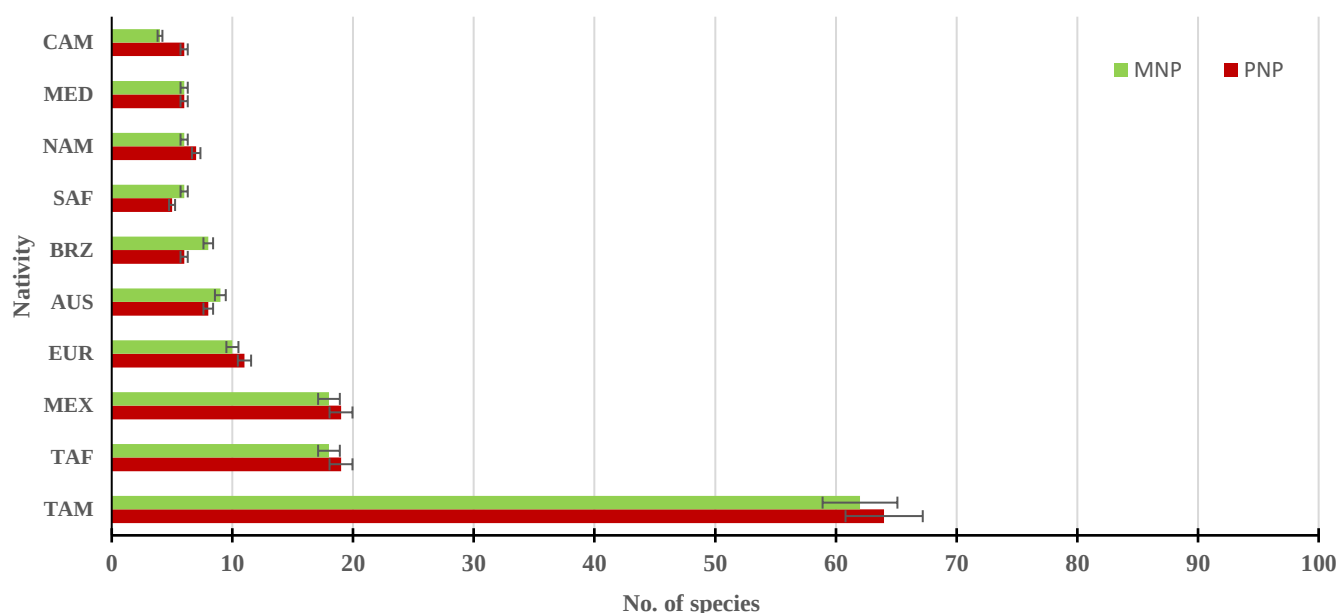


Figure 2. Nativity of the IAPs in PNP and MNP (CAM=Central America, MED=Mediterranean, NAM=North America, SAF=South Africa, BRZ=Brazil, AUS=Australia, EUR=Europe, MEX=Mexico, TAF=Tropical Africa, TAM=Tropical America, IAPs = Invasive alien plant species)

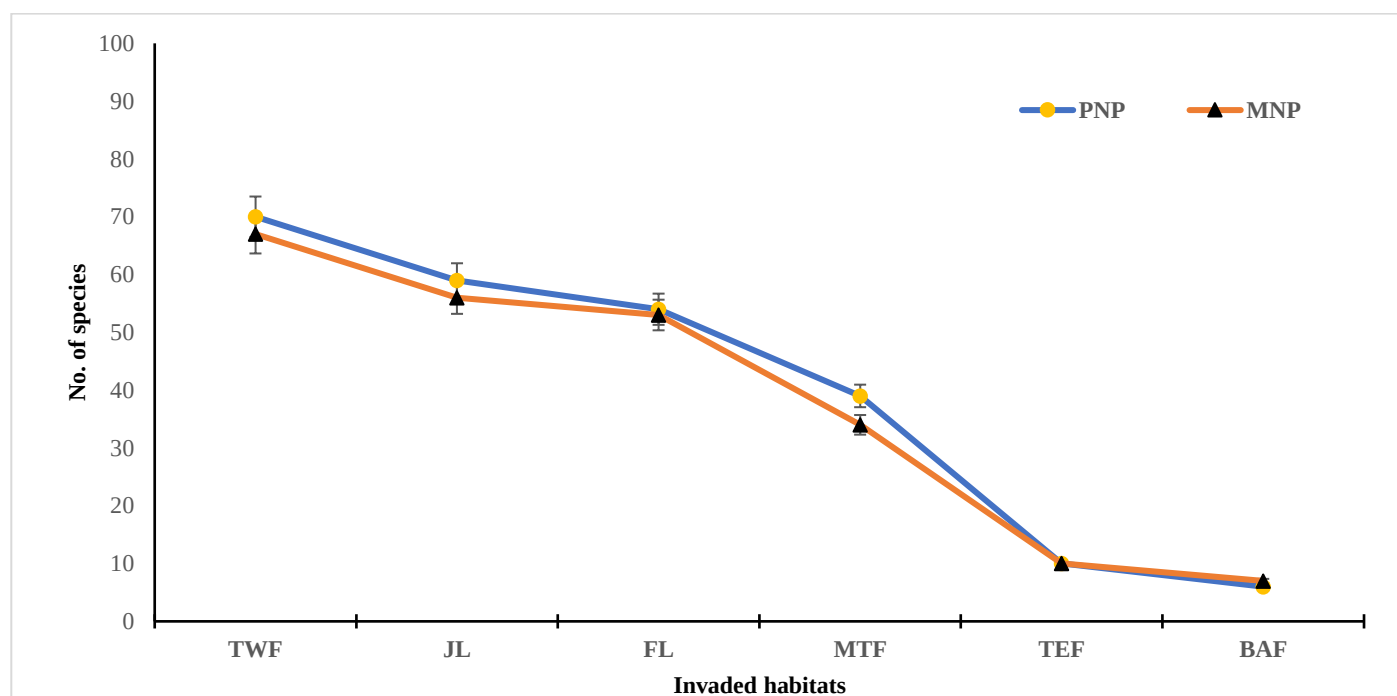


Figure 3. Habitats invaded by the IAPs in PNP and MNP (TWF=Tropical Wet Evergreen Forest, MTF=Montane subtropical Forest, TEF=Temperate Forests, JL=Jhumland, BAF=Bamboo Forests, FL=Fallow Lands, IAPs = Invasive alien plant species)

The open-ended interview conducted during the study revealed that 65.40% of the IAPs in PNP and 62.50% of the IAPs in MNP were possibly introduced unintentionally, while the remaining IAPs were introduced for ornamental, food, fodder, and timber use purpose

(Fig. 4). The abovementioned results imply that the IAPs from both the national parks appear as a threat to the native biodiversity but simultaneously they were also used for various socio-economic purposes of the fringe villagers of the national parks namely Sangau, Thathlang,

Vawmbuk, Vapar, Murlen and Hnahlan. The interview about the IAPs in fringe villages of PNP revealed that 90 species were used for medicinal purposes, 15 species as food, 51 as ornamental, 13 as green manure and 12 as fodder for the cattle. Similarly, IAPs in the MNP fringe

village were recorded as 86 species used for medicine, 48 as ornamentals, species as food and 9 as fodder for cattle. Choudhury et al. (2017)² observed similar revelations from Rajiv Gandhi Orang National Park in Assam.

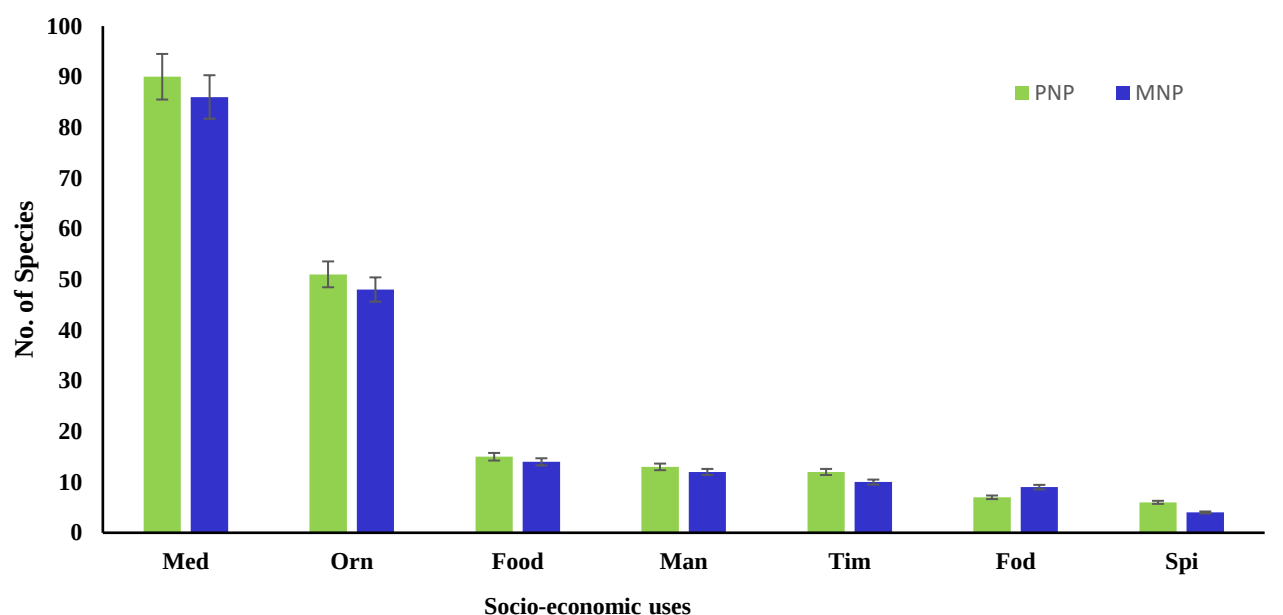


Figure 4. Socio-economic uses of IAPs in PNP and MNP (Med=Medicinal, Orn=Ornamental, Man=Manure, Tim=Timber, Fod=Fodder, Spi=Spice, IAPs = Invasive alien plant species)

An ecological investigation based on phytosociological data along an altitudinal gradient in both the national parks revealed that in lower altitudes (up to 900m), noxious IAPs like *Mikania micrantha* (IVI-34.81), *Chromolaena odorata* (IVI-63.01) were observed as most dominant whereas in middle altitude *Lantana camara* (IVI-43.23) and *Mikania micrantha* (IVI-41.69) were the most dominant. In upper altitude, native plants were most dominant viz. *Maesa indica* (IVI-30.19), *Buddleja macrostachya* (IVI-29.31), *Hedygium villosum* (IVI-38.97), *Colebrookea oppositifolia* (IVI-28.31), and *Phlogacanthus thrysiflorus* (IVI-25.11). Similarly, in the shrub layer of MNP, *Chromolaena odorata* (IVI-62.87), *Lantana camara* (IVI-46.62) were most dominant in lower altitude (up to 900m), *Chromolaena odorata* (IVI-60.45) and *Mikania micrantha* (IVI-42.17) were the most dominant in the middle altitude but in upper altitude, native plants were dominant namely *Colebrookea oppositifolia* (IVI-38.14), *Melastoma malabathricum* (IVI-38.65), *Mussaenda roxburghii* (IVI-27.23), *Rubus ellipticus* (IVI-26.09), *Maesa indica* (IVI-22.50) and *Buddleja macrostachya* (IVI-22.38). In the shrub layer of both the national parks, *Chromolaena odorata*, *Lantana camara*, *Mikania micrantha* were the most dominant IAPs. The upper altitude exhibited scanty presence of IAPs in the shrub layer. A similar observation was reported by Sengupta and Dash (2021)²¹ from protected areas in Tripura. Thus, the dominance of the IAPs in both the national parks is mainly observed up to middle altitude (901- 1800 m) but their presence becomes scanty in upper altitude (1801-2700 m). The reduction in the dominance of IAPs in upper altitude could be explained by the higher richness of native species in the suitable habitat compared to the unfavourable condition for alien

plants. Another important reason behind the dominance of native species in the upper altitude of the national parks in Mizoram could be attributed to the reduced anthropogenic disturbance regime compared to the lower and middle altitudes.

Throughout the herb layer in Phawngpui national park, *Ageratina riparia* (IVI-43.27) and *Ageratina adenophora* (IVI-63.43) were the most dominant in the lower to middle altitude (Table 1). *A. adenophora* was associated with naturally occurring plants like *Lepidagathis incurva* (IVI-14.11), *Persicaria chinensis* (IVI- 20.36) in the upper altitude. On the contrary, in herb layer of MNP, *Ageratina adenophora* (IVI-72.51) followed by *Ageratina riparia* (IVI-60.52) was the most dominant in middle altitude. In contrast, only *Ageratina adenophora* (IVI-42.61) was present associated with native plants like *Ainsliaea latifolia* (IVI-13.14), *Stellaria media* (IVI- 8.95), *Strobilanthes maculata* (IVI-18.00) and *Canscora andrographoides* (IVI-12.89) in upper altitude. Whereas in the herb layer, *Ageratina adenophora*, *Ageratina riparia*, *Ageratum conyzoides*, *Ageratum houstonianum*, *Bidens pilosa*, *Imperata cylindrica*, *Mimosa pudica* were the most dominant IAPs. The phytosociological data (Table 1) also helped to identify the neo-invasive plants namely *Tithonia diversifolia*, *Ipomoea hederifolia*, *Ipomoea cairica*, *Crassocephalum crepidioides* and *Galinsoga parviflora* spread in PNP and MNP. The noxious invasive IAPs and the neo-invasives gregariously invaded the disturbed natural forest areas in the lower and middle altitudes of the national parks. The noxious IAPs like *Ageratina adenophora*, *Crassocephalum crepidioides*, *Bidens pilosa* could reach up to 2358m peak altitude in disturbed trek routes in the upper altitudinal region, but mainly the

native plants had higher dominance (Table 2) in the upper altitude of the national parks.

The results of the phytosociological study revealed that the infestation of IAPs reduced in higher altitude compared to lower altitudes. This ecological

investigation also confirms that disturbance regime, i.e., habitat degradation, anthropogenic interference and forest fires play an important role in the species diversity of a national forest's shrub and herb layer.

Table 1. Importance value index (IVI) of the ten most-noxious IAPs and top five neo-invasive plant species in national parks in Mizoram

	Name of the plants (Most obnoxious IAPs)	IVI			Name of the plants (Neo-invasive IAPs)	IVI	
		PNP	MNP			PNP	MNP
1	<i>Ageratina adenophora</i>	63.45	72.51	1	<i>Tithonia diversifolia</i>	12.02	27.60
2	<i>Chromolaena odorata</i>	62.74	64.74	2	<i>Ipomoea hederifolia</i>	25.98	37.78
3	<i>Ageratina riparia</i>	43.25	60.52	3	<i>Ipomoea cairica</i>	19.12	38.57
4	<i>Mikania micrantha</i>	41.72	37.17	4	<i>Crassocephalum crepidioides</i>	19.38	11.46
5	<i>Lantana camara</i>	43.11	34.48	5	<i>Galinsoga parviflora</i>	23.31	16.02
6	<i>Imperata cylindrica</i>	23.83	26.71				
7	<i>Bidens pilosa</i>	20.74	26.6				
8	<i>Mimosa pudica</i>	27.19	25.9				
9	<i>Ageratum houstonianum</i>	28.51	22.54				
10	<i>Ageratum conyzoides</i>	10.63	18.88				

The analysis of biodiversity indices (Fig. 5) revealed that, in herb layer lowest species diversity (H') was observed in disturbed habitats ($H'=1.897$) situated in the middle altitude inside Murlen national park compared to the middle altitude of Phawngpui national park ($H'=2.198$) to shrub layer (Fig. 6).

Both the Simpson's diversity index (SDI) and Shannon diversity index (H') were highest, 0.917 and 2.661 respectively, for the shrub layer of upper altitude (1801-2700m) in Murlen national park, whereas for the herb layer, both SDI and H' were highest, 0.9255 and 2.744 respectively, for herb layer of upper altitude (1801-2700m) in Phawngpui national park.

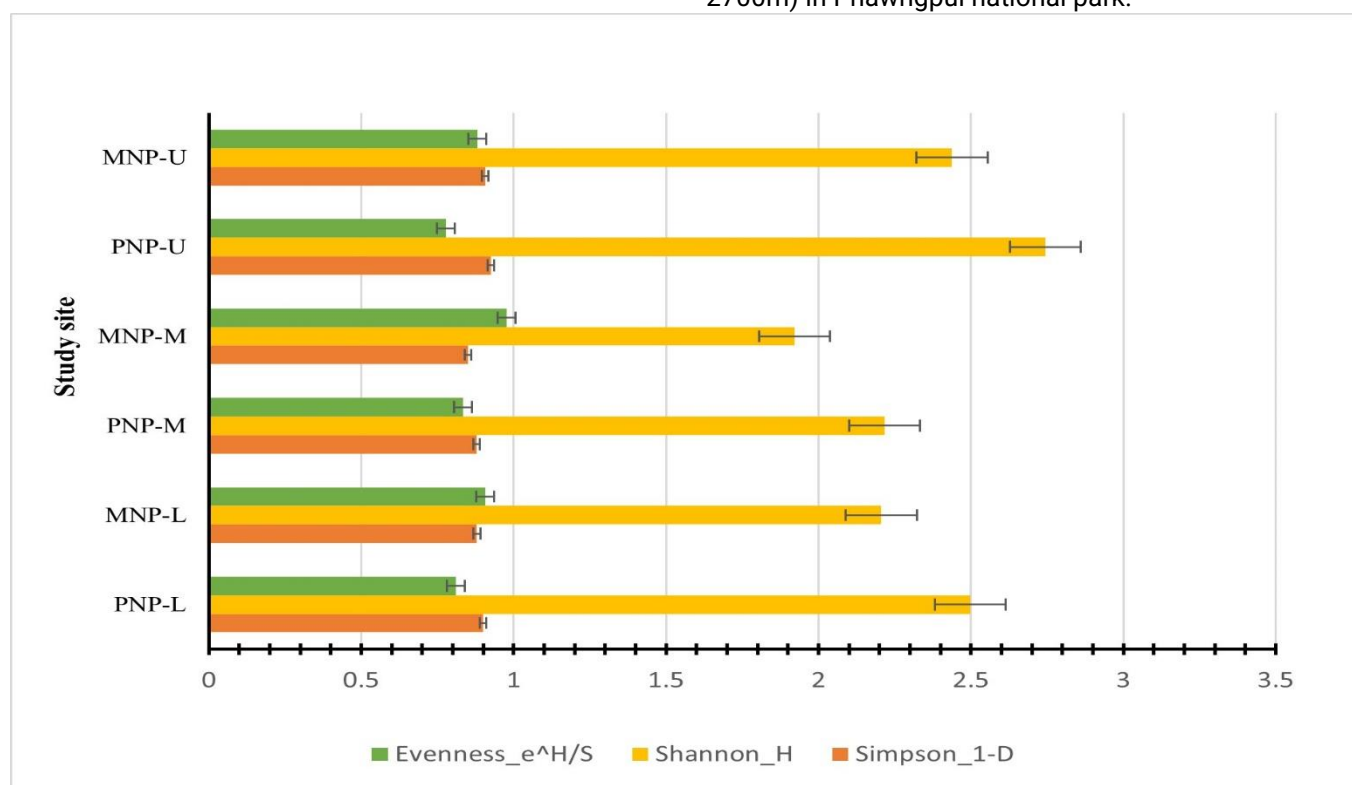


Figure 5. Biodiversity indices of herb layer based on altitudinal gradients in the two national parks (PNP- Phawngpui national park, MNP- Murlen national park, L= lower altitude, M= Middle altitude, U= Upper altitude).

Evaluation of Shannon's Species Diversity Index clearly shows that the undisturbed forest areas at upper altitude possess higher species diversity (PNP $H'=0.9255$; MNP $H'=0.9063$) in comparison to that of the anthropogenically disturbed natural forests (PNP $H'=0.9002$; MNP $H'=0.8795$) situated around lower and middle altitudes. The species diversity relies upon the

adaptation of IAPs to establish themselves to the new environment and adapt to the natural flora with the IAPs. The Shannon-Weiner index for the study areas ranges from 1.897 to 2.668 which resides well within the optimum range of 0.67 to 4.86 in tropical forests Indian sub-continent reported by Devi et al. (2018)⁶ and Tarakeswara Naidu et al. (2018)²⁷. These values also

indicate that the present scenario in lower to upper altitude forests in national parks in Mizoram is a diverse species system but lower as well as middle altitude are subjected to various disturbance regimes which paved the way for invasion by alien plants threatening native biodiversity. The concentration of dominance (Simpson's index) ranges from 0.8495 to 0.9255 in the herb layer whereas in the shrub layer, the values range from 0.8561 to 0.917 which falls within an optimum range from 0.64–1.34 for other tropical forests in northeast India as observed by Sahu et al. (2012)¹⁹ and Nohro & Jayakumar (2020)¹⁵. These comparisons to other tropical and temperate forests of India exhibit how alien plant species' invasion threatened the current study areas through anthropogenic and ecological factors.

Table 2. Importance value index of top ten native plants in national parks in Mizoram

Native plants top 10	PNP	MNP
<i>Hedychium villosum</i>	38.94	12.59
<i>Maesa indica</i>	30.25	26.76
<i>Phlogacanthus thrysiflorus</i>	30.16	–
<i>Lepidagathis incurva</i>	14.11	11.75
<i>Strobilanthes maculata</i>	11.21	18.05
<i>Colebrookea oppositifolia</i>	28.32	38.11
<i>Phlogacanthus curviflorus</i>	25.04	34.12
<i>Rubus ellipticus</i>	12.85	39.57
<i>Melastoma malabathricum</i>	21.09	–
<i>Mussaenda roxburghii</i>	15.38	–
<i>Ainsliaea latifolia</i>	–	14.79
<i>Canscora andrographoides</i>	–	24.11
<i>Buddleja macrostachya</i>	–	22.38

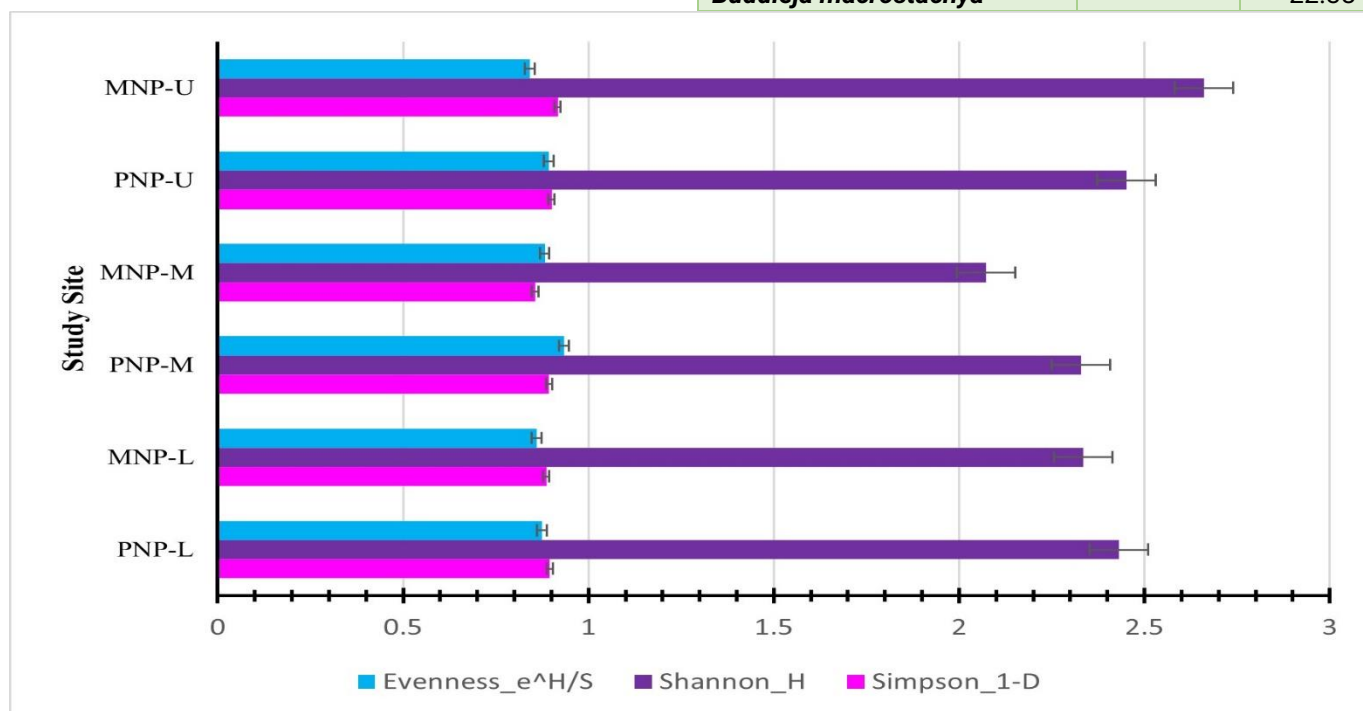


Figure 6. Biodiversity indices of shrub layer based on altitudinal gradients in the two national parks (PNP- Phawngpui national park, MNP- Murlen national park, L= lower altitude, M= Middle altitude, U= Upper altitude).

The ecological data interprets that a higher value of these indices represents increased species diversity and vice versa. Thus, the displacement and an imbalance in the ecosystem were exerted due to the impact of the invasive plants in the present study site, as reported by Pimentel et al. (2001)¹⁸.

Establishing a control and management framework for the IAPs in these national parks is important. Some of the impactful pathways to control IAPs include: (i) ecological restoration for the invaded ecosystems by increasing the population of dominant natural plant species having the ability to surpass invasive species growth, (ii) near the disturbed areas near national parks, the introduction of mechanical control method in combination with crop competition method, and (iii) a widely implemented successful cut-root-stock method combined with the introduction of native fast-growing grasses and legume species. Some other helpful control methods could be implemented, namely chemical control and biological control, as depicted by Singh (2017)²⁵ which needs further research in the study area. Various

awareness programmes and workshops must be organized in the study areas to educate the villagers, local forest department and students, regarding the impact of IAPs and their various sustainable control and management method.

Conclusion

Mizoram is part of the hotspot region of India-Burma and rich in many endemic species, where invasion by alien species is becoming a significant problem for endemic biodiversity conservation. Near PNP and MNP in Mizoram, most of the population are forest dwellers who primarily rely on forest resources. Therefore, a comprehensive inventory of invasive flora is widely needed to introduce them to the impact of the IAPs on these national parks and formulate sustainable scientific management strategy for long-term sustainable utilization. The present study fulfils the need for a comprehensive inventory, including the ecological status of the most noxious species and neo-invasive IAPs. As a concluding remark for the present study *Ageratina adenophora*, *Lantana camara*, *Ageratum conyzoides*,

Mikania micrantha, *Bidens pilosa*, *Chromolaena odorata*, *Imperata cylindrica* were observed as the most noxious invasive alien plants in different altitudinal gradient of natural forests in national parks of Mizoram. Invasion by these alien plants causes various damage to the natural native flora. It is pertinent to mention that five most neo-invasive species, namely *Ageratina riparia*, *Tithonia diversifolia*, *Ipomoea hederifolia*, *Crassocephalum crepidioides*, *Galinsoga parviflora* are the most potential invasive species in future which are presently spreading aggressively in the understory layer of the national parks in Mizoram. The biodiversity indices interpreted that the upper altitude of these national parks is less vulnerable to invasion by alien plants compared to the lower and middle altitude. Slash and burn methods were used by the locals and forest service to eliminate the noxious IAPs, although cut-stock-root techniques also exhibited better management. The local population may also need to be regularly informed about the effects and management of invasive alien plants through awareness campaigns.

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Author contributions

Conceptualization: R.S., S.S.D.; Data gathering and fieldwork: R.S.; Methodology: R.S.; Documentation review: R.S., S.S.D.; Data Analysis: R.S.; All authors have thoroughly read and subsequently agreed to communicate the manuscript for publication.

Declarations of interests

All authors of this manuscript declare that they have no conflict of interest.

Data Sharing

All relevant data are within the manuscript.

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Supplementary material

Table 1. Inventory of the alien plants in Phawngpui national park and Murlen national park in Mizoram

S No	Accepted Name	Family	Habit	Nativity	Taxonomic sub-group	Life cycle	Mode of introduction	Habitat (s) invaded	Local use(s)	Phawngpui National Park	Murlen National Park
1.	<i>Hygrophila auriculata</i> (Schumach.) Heine	Acanthaceae	H	TAF	D	A	F	FL	Food, Med	+	+
2.	<i>Hypoestes phyllostachya</i> Baker	Acanthaceae	H	SAF	D	A	OR	MTF, BAF	Orn	+	+
3.	<i>Ruellia tuberosa</i> L.	Acanthaceae	H	TAM	D	A	U	TWF	Orn	-	+
4.	<i>Thunbergia alata</i> Bojer ex Sims	Acanthaceae	CL	EMF	D	P	OR	MTF	Orn, Med	+	+
5.	<i>Alternanthera paronychioides</i> St. Hill.	Amaranthaceae	H	TAM	D	A	U	TWF	Med	-	+
6.	<i>Alternanthera philoxeroides</i> (Mahr.) Griseb.	Amaranthaceae	H	TAM	D	A	F	TWF	Food	+	+
7.	<i>Alternanthera sessilis</i> (L.) DC.	Amaranthaceae	H	TAM	D	A	U	TWF	Med	+	+
8.	<i>Alternanthera ficoidea</i> (L.) Sm.	Amaranthaceae	H	TAM	D	A	U	TWF	Med	+	-
9.	<i>Amaranthus spinosus</i> L.	Amaranthaceae	H	TAM	D	A	F	JL	Food	+	+
10.	<i>Celosia argentea</i> L.	Amaranthaceae	H	TAF	M	A	F	MTF, FL	Orn	+	+
11.	<i>Gomphrena serrata</i> L.	Amaranthaceae	H	TAM	D	A	U	MTF	Med	+	+
12.	<i>Aerva javanica</i> Juss.	Amaranthaceae	H	TAF, SAF	D	P	OR	TWF	Orn	-	+
13.	<i>Alternanthera pungens</i> Kunth	Amaranthaceae	H	TAM, MEX	D	A	U	TWF	Fod	+	-
14.	<i>Digera muricata</i> Mart	Amaranthaceae	H	NAF	D	A	OR	TWF, MTF	Orn	-	+
15.	<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants	Amaranthaceae	H	SAM, MEX	D	A	OR	JL, FL	Orn	-	+
16.	<i>Gomphrena celosioides</i> C.F.P.Mart.	Amaranthaceae	H	NAM	D	A	U	TWF	Orn	-	+
17.	<i>Annona reticulata</i> L.	Annonaceae	T	TAM	D	P	F	JL	Food	+	+
18.	<i>Annona squamosa</i> L.	Annonaceae	T	TAM	D	P	F	JL	Food	+	+
19.	<i>Anethum graveolens</i> L.	Apiaceae	H	SWA	D	A	F	JL	Sp	-	+
20.	<i>Apium graveolens</i> L.	Apiaceae	H	EUR	D	A	F	JL	Sp, Med	+	+
21.	<i>Eryngium foetidum</i> L.	Apiaceae	H	MEX	D	A	F	FL	Sp.	+	+
22.	<i>Cascabela thevetia</i> (L.) Lippold	Apocynaceae	T	MEX	D	P	OR	FL	Orn	+	+
23.	<i>Catharanthus roseus</i> (L.) G. Don.	Apocynaceae	H	TAM	D	P	OR	FL	Med	+	+
24.	<i>Plumeria rubra</i> L.	Apocynaceae	T	MEX	D	P	OR	TWF	Orn	+	-
25.	<i>Caladium bicolor</i> (Aiton) Vent.	Araceae	H	SAM	M	P	OR	TWF	Orn	+	+
26.	<i>Pistia stratiotes</i> L.	Araceae	H	TAM	M	P	U	WL	Orn	+	+
27.	<i>Araucaria columnaris</i> (G.Forst.) Hook.	Araucariaceae	T	AUS	G	P	OR	TEF	T	+	+
28.	<i>Araucaria excelsa</i> F. Br	Araucariaceae	T	AUS	G	P	OR	TEF	T	-	+

29.	<i>Asclepias curassavica</i> L.	Asclepiadaceae	H	TAM	D	A	O R	MTF	Med	+	+
30.	<i>Calotropis gigantea</i> (L.) R. Br.	Asclepiadaceae	S H	TAF	D	P	O R	TWF	Med	+	+
31.	<i>Calotropis procera</i> (Ait.) R. Br.	Asclepiadaceae	S H	TAF	D	P	U	TWF, FL	Med	-	+
32.	<i>Acmella radicans</i> (Jac.) R. R. Janses	Asteraceae	H	MEX	D	P	U	JL	Med	+	+
33.	<i>Ageratina adenophora</i> (Spreng.) R.M.King & H.Rob.	Asteraceae	H	MEX	D	P	O R	MTF, TEF	Man	+	+
34.	<i>Ageratina riparia</i> (Regel) R.M.King & H. Rob.	Asteraceae	H	CAM	D	P	U	TEF	Man	+	+
35.	<i>Ageratum houstonianum</i> Mill.	Asteraceae	H	TAM	D	A	O R	TWF, MTF	Bio	+	+
36.	<i>Ageratum conyzoides</i> (L.) L.	Asteraceae	H	TAM	D	A	O R	TWF, MTF	Med	+	+
37.	<i>Artemisia vulgaris</i> L.	Asteraceae	H	EUR	D	P	U	MTF	Med	+	+
38.	<i>Bidens pilosa</i> L.	Asteraceae	H	TAM	D	A	U	MTF, JL, FL	Med	+	+
39.	<i>Blainvillea acmella</i> (L.) Philipson	Asteraceae	H	TAM	D	A	U	JL, TWF	Med	+	+
40.	<i>Blumea lacera</i> (Burm.f.) DC.	Asteraceae	H	TAM	D	A	U	TWF	Med	+	+
41.	<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob.	Asteraceae	H	SAM	D	P	U	MTF, BAF, F L	Med	+	+
42.	<i>Cosmos bipinnatus</i> Cav.	Asteraceae	H	MEX	D	A	O R	JL, FL	Orn	+	+
43.	<i>Crassocephalum crepidioides</i> (Benth.) S. Moore	Asteraceae	H	TAM	D	A	U	MTF	Med	+	+
44.	<i>Cyanthillium cinereum</i> (L.) H. Rob.	Asteraceae	H	TAF	D	A	U	TWF	Med	+	+
45.	<i>Eclipta prostrata</i> (L.) L.	Asteraceae	H	TAM	D	A	U	JL	Med	+	+
46.	<i>Emilia sonchifolia</i> (L.) DC. ex DC.	Asteraceae	H	TAM	D	A	U	TWF, MTF	Med	+	+
47.	<i>Erigeron canadensis</i> L.	Asteraceae	H	SAM	D	A	U	TWF, MTF	Med	+	-
48.	<i>Erigeron karvinskianus</i> DC.	Asteraceae	H	MEX	D	A	U	TWF, MTF	Med	+	+
49.	<i>Galinsoga parviflora</i> Cav.	Asteraceae	H	TAM	D	A	U	MTF	Fo	+	+
50.	<i>Grangea maderaspatana</i> (L.) Poir	Asteraceae	H	SAM	D	P	U	TWF	Med	-	+
51.	<i>Mikania micrantha</i> Kunth.	Asteraceae	CL	SAM	D	P	U	TWF, MTF,	Med	+	+
52.	<i>Parthenium hysterophorus</i> L.	Asteraceae	H	NAM	D	A	U	TWF, MTF	Med	+	+
53.	<i>Sonchus asper</i> (L.) Hill	Asteraceae	H	MED	D	A	U	TWF, FL	Unk	+	+
54.	<i>Sonchus oleraceus</i> (L.) L.	Asteraceae	H	MED	D	A	U	TWF	Unk	+	+
55.	<i>Spilanthes acmella</i> (L.) L.	Asteraceae	H	BRZ	D	A	U	FL	Med	+	+
56.	<i>Synedrella nodiflora</i> (L.) Gaertn.	Asteraceae	H	WI	D	A	U	JL	Med	+	
57.	<i>Tithonia diversifolia</i> (Hemsl.) A.Gray	Asteraceae	H	MEX,	D	P	O R	MTF	Med, Orn	+	+
58.	<i>Tridax procumbens</i> (L.) L.	Asteraceae	H	CAM	D	A	U	TWF	Med	+	-
59.	<i>Xanthium strumarium</i> L.	Asteraceae	H	TAM	D	A	U	JL	Med, FU	+	+
60.	<i>Youngia japonica</i> (L.) DC.	Asteraceae	H	SAM	D	A	U	FL	Med	+	+
61.	<i>Centratherum punctatum</i> Cass.	Asteraceae	H	BRA	D	P	O R	FL, JL	Orn	+	+
62.	<i>Acanthospermum hispidum</i> DC.	Asteraceae	H	SAM	D	P	O R	FL, JL	Man	+	+
63.	<i>Bidens biternata</i> (Lour.) Merr. & Sherff	Asteraceae	H	SAF	D	P	U	TWF, JL	Fod	+	+
64.	<i>Cirsium arvense</i> (L.) Scop.	Asteraceae	H	EUR	D	P	F	TWF, TEF	Unk	+	+
65.	<i>Erigeron bonariensis</i> L.	Asteraceae	H	MEX,	D	A	U	TWF	Med	+	+

				TAM							
66.	<i>Galinsoga quadriradiata</i> Ruiz & Pav.	Asteraceae	H	MEX, TAM	D	A	U	JL, FL	Fod	-	+
67.	<i>Gnaphalium pensylvanicum</i> Willd.	Asteraceae	H	TAM	D	A	U	JL, FL	Fod	+	-
68.	<i>Gnaphalium polycaulon</i> Pers.	Asteraceae	H	TAM	D	A	U	JL, FL	Fod	+	+
69.	<i>Leucanthemum vulgare</i> Lam.	Asteraceae	H	EUR	D	A	U	MTF	Med	+	+
70.	<i>Sonchus wightianus</i> DC.	Asteraceae	H	AFG	D	A	U	TWF	Med	+	+
71.	<i>Cotula anthemoides</i> L.	Asteraceae	H	SAF	D	A	U	MTF	Med	+	+
72.	<i>Jacaranda mimosifolia</i> D.Don	Bignoniaceae	T	SAM	D	P	O R	TWF	Orn	+	+
73.	<i>Kigelia pinnata</i> Jacq.	Bignoniaceae	T	TAF	D	P	O R	TWF	Med	-	+
74.	<i>Pyrostegia venusta</i> (Ker Gawl.) Miers	Bignoniaceae	CL	BRZ	D	P	O R	FL	Orn	+	-
75.	<i>Dolichandra unguis-cati</i> (L.) L.G.Lohmann	Bignoniaceae	CL	CAM	D	P	U	TEF	Orn	+	+
76.	<i>Bixa orellana</i> L.	Bixaceae	T	BRZ	D	P	U	JL	Med	+	+
77.	<i>Rorippa dubia</i> (Pers.) Hara.	Brassicaceae	H	TAM	D	A	U	TWF	Unk	+	+
78.	<i>Brassica oleracea</i> L.	Brassicaceae	H	EUR	D	P	F	JL	Food	+	+
79.	<i>Cardamine hirsuta</i> L.	Brassicaceae	H	TAM	D	A	U	FL	Unk	+	+
80.	<i>Opuntia vulgaris</i> Miller	Cactaceae	H	SAM	D	P	U	JL	Med	+	+
81.	<i>Opuntia elatior</i> Mill.	Cactaceae	S H	TAM	D	P	U	JL,FL	Orn, Med	+	-
82.	<i>Calceolaria mexicana</i> Benth.	Calceolariaceae	H	MEX	D	A	F	TWF	Fod	+	+
83.	<i>Cleome rutosperma</i> DC.	Capparaceae	H	TAM	D	A	U	TWF	Med	+	+
84.	<i>Cleome viscosa</i> L.	Capparaceae	H	TAM	D	A	U	TWF	Med	+	+
85.	<i>Stellaria media</i> (L.) Vill.	Caryophyllaceae	H	NAM	D	A	U	JL	Food, Med	+	+
86.	<i>Spergula arvensis</i> L.	Caryophyllaceae	H	SAF	D	A	O R	JL	Orn	+	-
87.	<i>Casuarina equisetifolia</i> L.	Casuarinaceae	T	AUS	D	P	O R	MTF,TEF	Orn,T	+	+
88.	<i>Ceratophyllum demersum</i> L.	Ceratophyllaceae	H	TAM	M	A	U	WL	Orn	+	+
89.	<i>Chenopodium album</i> L.	Chenopodiaceae	H	TAM	D	P	U	FL	Med	+	+
90.	<i>Cuscuta chinensis</i> Lam.	Convolvulaceae	CL	MED	D	P	U	MTF, BAF	Med	+	+
91.	<i>Cuscuta reflexa</i> Roxb.	Convolvulaceae	CL	MED	D	A	U	MTF, BAF	Med	+	+
92.	<i>Evolvulus nummularius</i> (L.) L.	Convolvulaceae	H	TAM	D	P	U	TWF	Unk	+	+
93.	<i>Ipomoea alba</i> L.	Convolvulaceae	CL	TAM	D	P	O R	MTF	Med	+	-
94.	<i>Ipomoea cairica</i> Sweet	Convolvulaceae	CL	MED	D	P	O R	MTF	Orn	+	+
95.	<i>Ipomoea quamoclit</i> L.	Convolvulaceae	CL	TAM	D	P	O R	MTF	Orn	+	+
96.	<i>Ipomoea carnea</i> Jacq.	Convolvulaceae	S H	TAM	D	P	U	JL, FL	Orn	+	+
97.	<i>Ipomoea hederifolia</i> L.	Convolvulaceae	CL	TAM	D	A	U	JL, FL	Orn	+	+
98.	<i>Ipomoea purpurea</i> (L.) Roth	Convolvulaceae	CL	SAM	D	P	O R	JL, FL	Orn	-	+
99.	<i>Kalanchoe pinnata</i> (Lam.) Merr.	Crassulaceae	H	MAD	D	P	O R	FL	Orn,Med	+	+
100.	<i>Cupressus sempervirens</i> L.	Cupressaceae	T	AUS	G	P	U	TEF	T,Med	+	+
101.	<i>Thuja occidentalis</i> Bailey	Cupressaceae	T	NAM	G	P	U	TEF	T	+	-
102.	<i>Cyperus difformis</i> L.	Cyperaceae	SE	TAM	M	A	U	TWF	Fo	+	+

103	<i>Cyperus iria</i> L.	Cyperaceae	SE	TAM	M	A	U	TWF	Fo	+	+
104	<i>Cyperus rotundus</i> L.	Cyperaceae	SE	SAF, TAF	M	P	U	FL, JL	Med,Man	+	+
105	<i>Croton bonplandianus</i> Baill.	Euphorbiaceae	H	SAM	D	P	U	TWF	Fo	+	+
106	<i>Euphorbia milii</i> Des Moul.	Euphorbiaceae	H	MD	D	P	O R	TWF	Orn	+	+
107	<i>Euphorbia pulcherrima</i> Willd. ex Klotzsch.	Euphorbiaceae	S H	MEX	D	P	O R	TWF, FL	Orn	+	+
108	<i>Euphorbia hirta</i> L.	Euphorbiaceae	H	TAM	D	A	U	TWF	Med	+	+
109	<i>Jatropha gossypifolia</i> L.	Euphorbiaceae	H	TAM	D	P	U	TWF	Med	+	+
110	<i>Manihot esculenta</i> Crantz.	Euphorbiaceae	T	TAM	D	P	U	MTF	Food,Med	+	-
111	<i>Ricinus communis</i> L.	Euphorbiaceae	S H	MED	D	P	F	TWF	Food,Med	+	+
112	<i>Euphorbia cyathophora</i> Murray	Euphorbiaceae	H	CAM	D	A	O R	JL	Orn	+	+
113	<i>Sapium sebiferum</i> (L.) Roxb.	Euphorbiaceae	H	EAS	D	P	U	BAF	Unk		-
114	<i>Indigofera linnaei</i> Ali	Fabaceae	H	AUS	D	A	O R	TWF	Orn	+	-
115	<i>Senna obtusifolia</i> (L.) H.S.Irwin & Barneby	Fabaceae	H	NAM	D	A	O R	JL, FL	Orn	+	-
116	<i>Acacia auriculiformis</i> Benth.	Fabaceae	T	AUS	D	P	O R	TWF	Med	+	+
117	<i>Calliandra haematocephala</i> Hassk.	Fabaceae	S H	TAM	D	P	O R	TWF	Orn	-	+
118	<i>Cassia fistula</i> L.	Fabaceae	T	NAM	D	P	U	FL, TWF	M	+	+
119	<i>Leucaena leucocephala</i> (Lam.) de Wit	Fabaceae	T	MEX	D	P	U	TWF	Food	+	+
120	<i>Mimosa diplotricha</i> Wright	Fabaceae	S H	SAM	D	P	U	BAF, TWF	Med	+	+
121	<i>Mimosa pudica</i> L.	Fabaceae	H	BRZ	D	P	U	TWF, MTF	Med	+	+
122	<i>Caesalpinia bonduc</i> (L.) Roxb.	Fabaceae	T	TAF	D	P	U	TWF	Med	+	-
123	<i>Delonix regia</i> (Hook.) Raf.	Fabaceae	T	MAD	D	P	O R	TWF, MTF	Orn	+	-
124	<i>Peltophorum pterocarpum</i> (DC.) K.Heyne	Fabaceae	T	MAL	D	P	O R	TWF	Orn	+	-
125	<i>Senna alata</i> (L.) Roxb.	Fabaceae	S H	SAM	D	P	O R	JL ,FL	Med,Orn	+	+
126	<i>Senna occidentalis</i> (L.) Link.	Fabaceae	H	SAM	D	P	U	JL ,FL	Med	+	+
127	<i>Senna tora</i> (L.) Roxb.	Fabaceae	H	SAM	D	A	U	JL ,FL	Med	+	+
128	<i>Aeschynomene americana</i> L.	Fabaceae	H	TAM	D	P	U	MTF	Man	+	+
129	<i>Crotalaria pallida</i> Ait.	Fabaceae	H	TAM	D	A	U	TWF	Med	+	+
130	<i>Indigofera trita</i> L.f.	Fabaceae	S H	TAF	D	P	U	TEF	Unk	+	+
131	<i>Melilotus alba</i> Medik. ex Desr.	Fabaceae	H	EUR	D	A	F	JL,FL	Med	+	+
132	<i>Mucuna pruriens</i> (L.) DC.	Fabaceae	CL	TAF	D	P	F	JL,FL	Food,Med	+	+
133	<i>Tamarindus indicus</i> L.	Fabaceae	T	TAF	D	P	F	TWF	Food, Med	+	+
134	<i>Ulex europaeus</i> L.	Fabaceae	S H	EUR	D	P	U	FL	Orn	+	-
135	<i>Heliconia psittacorum</i> L.f.	Heliconiaceae	H	BRA, SAM	D	P	O R	MTF	Orn	+	-
136	<i>Juniperus communis</i> L.	Juniperaceae	T	NAM	G	P	O R	TEF	T	+	+
137	<i>Hyptis suaveolens</i> (L.) Poit.	Lamiaceae	H	TAM	D	A	U	MTF, FL	Med	+	+

138	<i>Leonotis nepetifolia</i> (L.) R.Br.	Lamiaceae	H	TAF	D	A	U	TWF	Med	+	-
139	<i>Ocimum americanum</i> L.	Lamiaceae	H	TAF	D	P	F	JL	Med	+	+
140	<i>Hyptis capitata</i> Jacq.	Lamiaceae	H	MEX	D	A	U	TWF	Med	+	+
141	<i>Torenia fournieri</i> E.Fourn.	Linderniaceae	H	IND O	D	A	O R	TWF	Orn	+	+
142	<i>Ammannia baccifera</i> L.	Lythraceae	H	TAM	D	A	U	JL	Med	+	+
143	<i>Magnolia grandiflora</i> L.	Magnoliaceae	T	NAM	D	P	U	MTF	Orn	+	+
144	<i>Althea rosea</i> (L.) Cav.	Malvaceae	H	EUR	D	P	O R	JL	Orn	+	+
145	<i>Malvastrum coromandelianum</i> (L.) Garcke	Malvaceae	H	TAM	D	A	U	TWF, BAF	Orn	+	+
146	<i>Malvaviscus palmanus</i> Pittier & Donn. Sm.	Malvaceae	H	TAM	D	P	O R	BAF	Orn	-	+
147	<i>Sida acuta</i> Burm.f.	Malvaceae	H	TAM	D	A	U	FL	Med	+	+
148	<i>Triumfetta rhomboidea</i> Jacq.	Malvaceae	H	TAM	D	A	U	TWF	Med	+	+
149	<i>Urena lobata</i> L.	Malvaceae	S H	TAF	D	P	U	JL	Med	+	+
150	<i>Malachra capitata</i> L.	Malvaceae	S H	BRA	D	A	U	FL	Orn, Man	+	+
151	<i>Martynia annua</i> L.	Martyniaceae	H	MEX	D	A	U	JL	Orn	+	+
152	<i>Cissampelos pareira</i> L.	Menispermaceae	CL	SAM , MEX	D	P	U	JL	Man	+	+
153	<i>Callistemon citrinus</i> (Curtis) Skeels	Myrtaceae	T	AUS	D	P	O R	TWF	Med	-	+
154	<i>Corymbia maculata</i> (Hook.) K.D.Hill & L.A.S.Johnson	Myrtaceae	T	AUS	D	P	O R	JL, FL	T	+	+
155	<i>Eucalyptus globulus</i> Labill.	Myrtaceae	T	AUS	D	P	O R	MTF	Med	+	+
156	<i>Bougainvillea glabra</i> Choisy	Nyctaginaceae	L	BRZ	D	P	O R	TWF	Orn	+	+
157	<i>Bougainvillea spectabilis</i> Willd.	Nyctaginaceae	L	BRZ	D	P	O R	TWF	Orn	+	+
158	<i>Boerhavia erecta</i> L.	Nyctaginaceae	H	MEX	D	A	U	FL	Man, Med	+	-
159	<i>Ludwigia adscendens</i> (L.) Hara.	Onagraceae	H	TAF	D	A	U	FL	Med	-	+
160	<i>Ludwigia perennis</i> L.	Onagraceae	H	TAF	D	A	U	FL	Food,Med	+	+
161	<i>Oxalis corniculata</i> L.	Oxalidaceae	H	EUR	D	P	U	JL	Food,Med	+	+
162	<i>Argemone mexicana</i> L.	Papaveraceae	H	SAM	D	A	U	JL	Ad,Med	+	+
163	<i>Passiflora foetida</i> L.	Passifloraceae	CL	SAM	D	P	O R	FL	Orn	+	+
164	<i>Peperomia pellucida</i> (L.) Kunth	Piperaceae	H	SAM	D	A	U	TWF	Med	+	+
165	<i>Chloris barbata</i> Sw.	Poaceae	G R	TAM	M	P	U	MTF, FL	Fo	+	+
166	<i>Echinochloa colona</i> (L.) Link	Poaceae	G R	SAM	M	A	U	JL	Fo	+	+
167	<i>Imperata cylindrica</i> (L.) Raeusch.	Poaceae	G R	TAM	M	P	U	FL	Fo	+	+
168	<i>Saccharum spontaneum</i> L.	Poaceae	G R	TWA	M	P	U	FL	Fo,R,Th	+	+
169	<i>Axonopus compressus</i> (Sw.) P.Beauv.	Poaceae	G R	TAM	M	P	U	FL,JL	Man	-	+

170	<i>Brachiaria mutica</i> Stapf	Poaceae	G R	TAF	M	P	U	JL	Fod	+	+
171	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	G R	TAF	M	P	U	FL,JL,TWF	Man	+	+
172	<i>Dinebra retroflexa</i> Panz.	Poaceae	G R	TAF	M	P	U	FL,JL	Fod	+	-
173	<i>Echinochloa crus-galli</i> (L.) P.Beauv.	Poaceae	G R	TAS	M	P	U	JL	Fod	+	+
174	<i>Eragrostis pilosa</i> P.Beauv.	Poaceae	G R	TAF	M	P	U	FL,JL	Fod,Man	+	+
175	<i>Cenchrus pedicellatus</i> (Trin.) Morrone	Poaceae	G R	TAF	M	P	U	JL	Fod	+	-
176	<i>Poa annua</i> L.	Poaceae	G R	TAS	M	P	U	JL	Fod	+	+
177	<i>Antigonon leptopus</i> Hook. & Arn.	Polygonaceae	CL	TAM	D	P	U	JL	Orn,Med	+	-
178	<i>Eichhornia crassipes</i> (Mart.) Solms.	Pontederiaceae	H	TAM	M	P	O R	WL	Man,Wwt	+	+
179	<i>Monochoria vaginalis</i> C.Presl	Pontederiaceae	H	SWA	D	A	U	MTF ,FL	Man	+	-
180	<i>Portulaca oleracea</i> L.	Portulacaceae	H	SAM	D	A	F.	JL ,FL	Orn	+	+
181	<i>Anagallis arvensis</i> L.	Primulaceae	H	EUR	D	A	U	JL	Med	+	+
182	<i>Clematis vitalba</i> L.	Ranunculaceae	CL	EUR	D	A	U	JL	Med, Orn	+	+
183	<i>Spermacoe hispida</i> L.	Rubiaceae	H	TAM	D	A	U	TWF	Med	+	+
184	<i>Salvinia molesta</i> D.Mitch.	Salviniaceae	H	BRA	Pt	P	O R	FL	Orn	-	+
185	<i>Mecardonia procumbens</i> (Mill.) Small	Scrophulariaceae	H	TNM	D	A	U	JL,FL,MTF	Med	+	+
186	<i>Scoparia dulcis</i> L.	Scrophulariaceae	H	TAM	D	A	U	FL	Med	+	+
187	<i>Brunfelsia americana</i> L.	Solanaceae	S H	WI	D	P	O R	JL	Orn	+	+
188	<i>Brunfelsia hopeana</i> Benth.	Solanaceae	S H	TAM	D	P	U	JL	Orn	+	-
189	<i>Datura metel</i> L.	Solanaceae	S H	TAM	D	P	U	TWF	Med	+	+
190	<i>Datura stramonium</i> L.	Solanaceae	S H	TAM	D	P	U	TWF	Med	+	+
191	<i>Nicotiana plumbaginifolia</i> Viv.	Solanaceae	H	TAM	D	A	U	JL	Med	+	+
192	<i>Physalis minima</i> L.	Solanaceae	H	TAM	D	A	U	TWF	Med	+	+
193	<i>Solanum torvum</i> Sw.	Solanaceae	S H	WI	D	P	U	FL	Med	+	+
194	<i>Physalis angulata</i> L.	Solanaceae	H	TAM	D	A	U	TWF	Fod, Man	+	+
195	<i>Dombeya mastersii</i> Hook. f.	Sterculiaceae	S H	TAF	D	P	O R	TWF, FL	Orn	+	-
196	<i>Melochia corchorifolia</i> L.	Sterculiaceae	H	TAM	D	A	U	JL	Fo	+	+
197	<i>Strelitzia reginae</i> Banks	Strelitziaceae	H	SAF	M	P	O R	JL	Med	-	+
198	<i>Corchorus aestuans</i> L.	Tiliaceae	H	SAM	D	A	U	JL, FL	Food	+	+
199	<i>Turnera ulmifolia</i> L.	Turneraceae	S H	MEX, CAM	D	P	U	TWF	Orn	+	+
200	<i>Typha angustifolia</i> L.	Typhaceae	G R	TAM	M	P	U	WL	Ht	+	+
201	<i>Pilea microphylla</i> (L.) Liebm.	Urticaceae	H	SAM	D	A	U	TWF	Med	+	+
202	<i>Clerodendrum chinense</i> (Osbeck) Mabb.	Verbenaceae	S H	VIET	D	P	U	TWF	Med	+	-
203	<i>Duranta erecta</i> L.	Verbenaceae	S H	MEX	D	P	O R	FL	Orn	-	+

204	<i>Lantana camara</i> L.	Verbenaceae	H	TAM	D	P	O R	TWF, MTF	Orn,Bas	+	+
205	<i>Stachytarpheta jamaicensis</i> (L.) Vahl	Verbenaceae	H	TAM	D	A	U	FL	Orn	+	+
206	<i>Lippia alba</i> (Mill.) N.E.Br.	Verbenaceae	S H	MEX, CAM	D	P	O R	TWF	Orn	+	-
207	<i>Cayratia trifolia</i> (L.) Domin	Vitaceae	CL	AUS	D	P	U	TWF, FL	Med	+	+

Abbreviations:

+ = present, - = absent; **Leguminosae (s.l.)**:- Leguminosae (sensu lato) includes all the three subfamilies (i.e., 1. Subfam. Mimosoideae, 2. Subfam. Caesalpinioideae, 3. Subfam. Papilionoideae); **Taxonomic Sub-group**: D:- Dicotyledons, M:- Monocotyledons, G:-Gymnosperms; Pt:- Pteridophyte; **Habit** : P:- Perennial, A:-Annual; **Nativity**: TAM:- Tropical America, SAM:-South America, CAM:-Central America, CAR:- Caribbean, CAS:- Central Asia, TNM:-Tropical North America, TAF:-Tropical Africa, TAS: Tropical Asia, EAF:-Eastern Africa, NAM:- North America, SAF:-South Africa, NAF:- North Africa (including Egypt, Kenya), AFG:- Afghanistan, WI:- West Indies, MEX:-Mexico, AUS:-Australia, EUR:- Europe, BRZ:-Brazil, MED:- Mediterranean; SWA= South West Tropical Asia; EAS:- Eastern Asia, INDO:- Indonesia, **Growth form**: H:-Herb, SH:-Shrub, GR:-Grass, SE:-Sedge, CL:-Climber, T:-Tree; **Mode of introduction**: U:-Unintentional, O:-Ornamental, F:-Food; **Habitats invaded**: TWF: - Tropical Wet Evergreen Forest, MTF:-Montane sub-tropical Forest, TEF-Temperate Forests, JL:-Jhumland, BAF:-Bamboo Forests, WL:-Wetland, FL:-Fallow Lands. **Uses** Med: medicinal, Man: Green manure, Bio: bioactive chemicals, Orn: ornamental, Sp: spice, T:timber, Ad:adulteration, Unk:unknown, Fo:fodder, R:rope making, Th: Thatching, Wwt :Waste water treatment, Ht: Hut thatch, FU: Biomass fuel, Bas: Basket Making.