

Invasive Alien Species of Asteraceae and their Economic Importance in Nilgiri District, Tamil Nadu, India

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ABSTRACT

Nilgiris is one of the major biological communities affected by alien and invasive species in the plant kingdom. Nilgiris has a rich biodiversity of invaded by alien species. The present study deals with the Asteraceae member of invasive plants species in Nilgiri District. The Nilgiris hills were colonized by the British who introduced a number of Mediterranean and European plants. Most of the invasive exotic plants belong to Asteraceae family. A total of 103 invasive species of Asteraceae plants were recorded, belonging to 68 genera during the present study. 25 percentages of the invasive species are considered to be of medicinal value; namely, *Galinsoga parviflora*, *Silybum marianum*, *Erigeron canadensis*, *Taraxacum officinale*. But some of the species like *Lagascea mollis*, *Senecio vulgaris*, *Solidago canadensis* and *Parthenium hysterophorus* are considered to have high allelopathic properties as well as having harmful effects on nature and plant population. Exotic species are normally introduced in a habitat by humans rarely in a planned manner but or by accident. These aliens in due course, by proliferation, get naturalized. Even though they get acclimatized and naturalized with the habitat they have to be considered as invasive. In addition a prolific alien has every chance of creating its own micro climate in the habitat, alienating the endemic species of the habitat. To stop proliferation of such weeds, timely monitoring and removal must be done. Best method of stopping further proliferation is by removing en masse the flowering tops of the weeds by mechanical or any other practicable means.

1. Introduction

The Indian region, because of its diverse climatic and environmental conditions, is highly vulnerable to biotic invasion. Moreover, a burgeoning population, high rate of trade and transport, coupled with greater movement of people favors the accidental and intentional entry of plant species in this region. The recent fast rate of economic growth of the country is also expected to leave its mark on loss of plant diversity and increased invasion of alien species. Generally defined, an invasive species is a species, that is non-native to the ecosystem under consideration, and whose introduction will cause or is likely to cause economic or environmental harm or harm to human health (Kohli *et al.*, 2012). The Earth's flora is dynamic and has been constantly changing over a period of time. Changes may be natural or human-aided, although in the recent past the latter has played a vital role. In fact, the movement of plants from one part of the earth to the other has become very common and frequent owing to better trade and transport facilities. Plant species that move from one geographical region to the other (either accidentally or intentionally), establish and proliferate there and threaten native ecosystems, habitats and species are known as invasive alien plants (Richardson *et al.*, 2000). Plant movement or introduction to an alien environment is not a new phenomenon but has been an important part of our history. A number of economically important plants such as crops and ornamentals are introduced plants that have proved especially beneficial and non-harmful to the human race. However, many introduced

plant species initially considered to be valuable have become a nuisance and are difficult to manage. Invasive plants are responsible for global environmental changes, biodiversity crisis, species endangerment and disruption of ecosystem processes essential for human welfare (Drake *et al.*, 1989, Parker *et al.*, 1999, Mack *et al.*, 2000, Mooney *et al.*, 2005, Charles and Dukes, 2007, Herron *et al.*, 2007, Pejchar and Mooney, 2009).

Besides, there are several other reports available that provide information on the invasive flora of a particular region and area. Kohli¹ have provided information on the status of invasive plants in the north-western Himalayan region and have stated that three invasive weeds - *Ageratum conyzoides*, *Parthenium hysterophorus* and *Lantana camara* found in this region have caused considerable harm to the fragile biodiversity (Kohli *et al.*, 2004, Kohli *et al.*, 2006). Several reasons, such as fragile soil, anthropogenic activity, tourism, pollution, rapid industrialization, urbanization and the livestock-dependent lifestyle of the aboriginals such as the Gaddi or Gujjar communities, are responsible for the establishment of invasive and declining biodiversity (Kohli *et al.*, 2006). Asteraceae is one of the most dominant families in the Indian flora not only by number but also in their abundance.

2. Materials and methods

Study area

The Nilgiri District, in Tamil Nadu has been one of the most beautiful areas of the Southern part of India ($11^{\circ} 12'$ to $11^{\circ} 43'$ N and $76^{\circ} 14'$ and $77^{\circ} 1'$ E) with a vast diversity of

angiosperms. Present study have been undertaken from Doddabetta Reserve Forest (2636m MSL) the Nilgiri District Tamil Nadu. It is a highest peak of Nilgiri District (Figure 1).

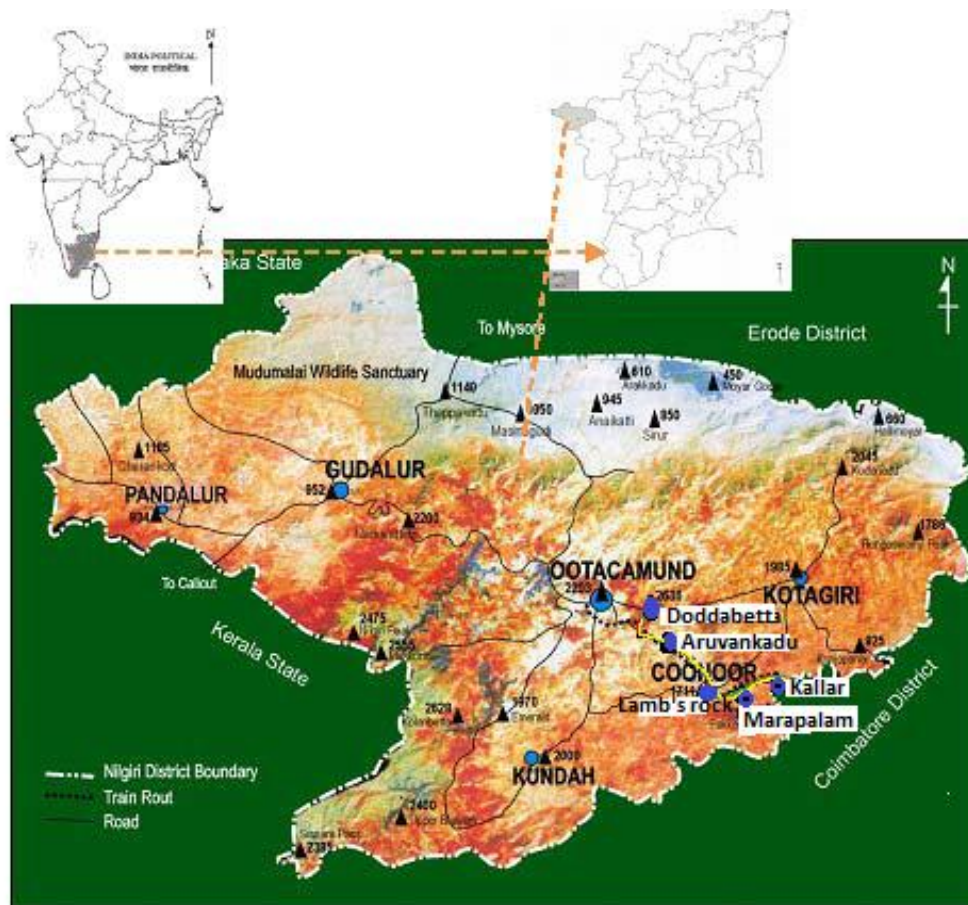


Figure 1. Map of The Nilgiri District where in Invasive alien species were recorded in study area

During the present study, regular field trips were made from June - May during the years 2018 - 2019 to explore alien invasive plant species of Asteraceae family. All the collected plant specimens were pressed, poisoned and mounted on herbarium sheets and herbarium specimens were prepared by standard methodology (Jain and Roa, 1976). Plant species were identified with the help of regional floras. Flora of the Presidency of Madras" (Gamble, 1935), The Flora of the South Indian Hill Stations (Fyson, 1915-20), Flora of Tamil Nadu (Nair and Henry, 1983), The Flora of Tamil Nadu and Carnatic (Mathew, 1969-1983), The flora of Nilgiris, Tamil Nadu (Sharma *et al.*, 1977) and Manual of cultivated plants (Bailey, 1949). The Herbarium sheets of these plants have been deposited in the Herbarium of Centre of Medicinal plants Research in Homoeopathy at Emerald Acronym SMPRGH, The Nilgiri District, Tamil Nadu under CCRH, Ministry of AYUSH (Harbajan Singh, 2010).

3. Results and Discussion

A total of 103 species of Asteraceae plants were recorded belonging to 68 genera during the present study. In the study habit wise distribution is as follows: there are 7 shrubs, 21 under shrub, 70 herbs, 2 under herbs, 2 climbers and 1 tree (Table1). There were 23 perennials and 80 Annuals (Table1). 25 percentage of the invasive species have are medicinal value, *Galinsoga parviflora*, *Silybum marianum*, *Erigeron*

canadensis, *Taraxacum officinale*. But some of the species like *Lagascea mollis*, *Senecio vulgaris*, *Solidogo canadensis* and *Parthenium hysteroporus* are considered to have high allelopathic properties as well as harmful effects on natural plant population.

Habit

Among six habits, herbs dominated the flora with 70 Species following by Under Shrub 21 Species, Shrubs 7 species and under herb, Climbers each 2 species in present study. (Table 1, Figure 2).

Nativity of Invasive species

23 species from Europe, 13 species from Mexico, 11 species from Tropical America, 9 species from America, 8 Species from Africa, 6 from Mediteranian region, 4 species from China and North America, 3 species each from Brazil, Euroasia, South Africa, Central America, 2 species each from Indo-Malasia, Australia, South America respectively. One species from Dalmatin, Japan, Philipens, Ethiopica and North Tropical America. These invasive naturalize in Nilgiri District Tamil Nadu, India. (Table 1, Figure 3)

Despite several known invasive plants in India, there is no complete listing of invasive plants. According to one source, around 18% of Indian flora is adventives aliens, of which 55%

are from America, 30% from Asia and 15% from Europe and Central Asia (Nayar, 1977). More recently, Reddy has identified 173 invasive plants belonging to 117 genera and 44 families, based on his comprehensive work. Tropical America (74%) and tropical Africa (11%) have contributed to most the invasive floras of the countries of the world. On the list over 40% of the species of threatened and endangered species are there due to invasive species (Reddy, 2008, Wilcove *et al.*, 1998). Rejmanek and Randall, 1994, estimated that 20% or more of plant species are non-indigenous in many continental areas,

and 50% or more on many islands. As many as 10% of the 260,000 vascular plant species are estimated to be potential invaders. Although large numbers of exotics have become naturalized in India and have affected the distribution of native flora to some extent, only a few among terrestrial exotics have conspicuously altered the vegetation patterns of the country, *Ageratum conyzoides*, *Chromolaena odorata*, *Ageratina adenopora*, *Mikania micrantha*, *Parthenium hysterophorus*, among many others.

Table 1: Invasive Aliens of Asteraceae Collected in The Study Area.

S.No	B. Name of the plants	Nativity	Life form	Habit	Uses	Habitat	Mode of introduction
1.	<i>Achillea millefolium</i> L.	Europe	H	P	M	CL	Ui
2.	<i>Acanthospermum hispidum</i> DC.	Brazil	H	A	M	W	Ui
3.	<i>Adenostemma lavenia</i> var. <i>reticulatum</i> (DC) Panigrahi.	Africa	H	A	Nk	F	Ui
4.	<i>Ageratina adenopora</i> (Spreng) R.M King & H. Rob.	Mexico	US	P	M	RS	Ui
5.	<i>Ageratum conyzoides</i> (L.) L.	South America	H	A	M	W	Ui
6.	<i>Ageratum houstonianum</i> Mill.	Mexico	H	A	Ch	W	Ui
7.	<i>Anthemis nobilis</i> L. *	Europe	H	A	M	CL	Ui
8.	<i>Artemisia annua</i> L. *	China, Mediterranean region	S	P	M	CL	Ui
9.	<i>Artemisia drancunculus</i> L.	Eurasia, North America	H	P	M	CL	Ui
10.	<i>Artemisia parviflora</i> Roxb. ex D. Don.	Europe	S	P	Nk	F	Ui
11.	<i>Artemisia vulgaris</i> L.	Europe	S	P	Nk	F	Ui
12.	<i>Artemisia lavandulifolia</i> Nakai.	Europe	H	P	Nk	F	Ui
13.	<i>Aster amellus</i> L.	Europe	H	A	O	CL	O
14.	<i>Aster alpinus</i> L.	Europe	H	A	O	CL	O
15.	<i>Aster chinensis</i> L.	Europe	H	A	O	CL	O
16.	<i>Bidens biternata</i> (Lour.) Merr. & Sheriff.	America	H	A	Nk	W	Ui
17.	<i>Bidens humilis</i> H.B.K.	Tropical America	H	A	Nk	W	Ui
18.	<i>Bidens pilosa</i> L.	Tropical America	H	A	M,V,Fo	W	Ui
19.	<i>Bidens tripartita</i> L.	Eurasia	H	A	Nk	W	Ui
20.	<i>Blumea hieracifolia</i> Hayata.	China	H	A	Nk	_F	Ui
21.	<i>Blumea lacera</i> (Burm. F.) DC.	Tropical America	H	A	M	F	Ui
22.	<i>Bellis perennis</i> L.	Europe	H	A	O	CL	Ui
23.	<i>Calyptocarpus vialis</i> Less.	Mexico	UH	P	Nk	W	Ui
24.	<i>Calendula officinalis</i> L.	Europe	H	A	M,O	CL	O
25.	<i>Carpeceium cernuum</i> Linn.	Europe	H	A	Nk	CL	Ui
26.	<i>Centratherum indicum</i> (Less.) C.E.C.Fisch *	China	H	A	Nk	CL	Ui
27.	<i>Chrysanthemum coccineum</i> Willd. *	Dalmatin	H	A	O	CL	O
28.	<i>Chrysanthemum parthenium</i> (L.) Pers.	Eurasia	H	P	M	CL	Ui
29.	<i>Chrysanthemum segetum</i> L.	Mediterranean Region	H	A	Nk	CL	Ui
30.	<i>Cineraria maritima</i> (L.) L.	South Africa	H	P	M	CL	Ui
31.	<i>Cnicus wallichii</i> Hook. f.	Mediterranean Region	US	A	Nk	W	Ui
32.	<i>Conyza stricta</i> Willd.	Africa	H	A	Nk	F	Ui

33.	<i>Conyza aegyptiaca</i> (L.)Dryand.ex Aiton.	North America	H	A	_ Nk	W	Ui
34.	<i>Conyza bonariensis</i> (S.Moore) Cufod.	Europe	US	A	Nk	W	Ui
35.	<i>Conyza japonica</i> (Thunb) Less. Ex Less.	Indo-malesia	H	A	Nk	W	Ui
36.	<i>Conyza sumatrensis</i> (S.F.Blake) Pruski & G.Sancho.	South America	H	A	Nk	W	Ui
37.	<i>Cotula australis</i> (Sieber ex spreng.) Hook.f.	Australia	UH	A	Nk	WL	Ui
38.	<i>Crassocephalum crepidioides</i> (Benth) S.Moore.	Japan, Philippine	US	A	Ch	RS	Ui
39.	<i>Cirsium vulgare</i> (Savil) Ten.	Europe	US	P	Nk	W	Ui
40.	<i>Chichorium intybus</i> L.	Europe	H	A	M	CL	Ui
41.	<i>Crepis japonica</i> (L.) Benth.	Africa	H	A	Nk	W	Ui
42.	<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob.	America	US	P	Nk	RS	Ui
43.	<i>Coreopsis grandiflora</i> Hogg ex Sweet.	America	H	A	Nk	CL	Ui
44.	<i>Cosmos sulphureus</i> Cav.	Mexico	H	A	O	CL	O
45.	<i>Cosmos bipinnatus</i> Cav.	Mexico	H	A	O	CL	O
46.	<i>Cynara scolymus</i> L.	Mediterranean	US	P	V	CL	Ui
47.	<i>Cyathocline purpurea</i> (Buch.- Ham .ex D.Don) Kuntze.	Indo- Malasia	H	A	O	CL	Ui
48.	<i>Dahlia imperialis</i> Roezl ex Ortgies.	Mexico	S	P	Nk	RS	Ui
49.	<i>Dahlia coccinea</i> Cav.	Mexico	US	P	O	CL	Ui
50.	<i>Dichrocephala latifolia</i> (Lam.)L'Her.ex DC.	South Africa	H	A	Nk	F	Ui
51.	<i>Dichrocephala chrysanthemifolia</i> (Blume.) DC.	Africa	H	A	Nk	F	Ui
52.	<i>Emilia sonchifolia</i> (L.) DC.	Europe, Tropical America	H	A	M,V	F	Ui
53.	<i>Erigeron canadensis</i> L.	North America_	US	A	M	W	Ui
54.	<i>Erigeron linifolius</i> Willd.	South America	US	A	Nk	W	Ui
55.	<i>Erigeron mucronatus</i> DC.	T.America	H	A	Nk	WL	Ui
56.	<i>Galinsoga parviflora</i> Cav.	America	H	A	M,FO	RS	Ui
57.	<i>Gazania rigens</i> (L.) Gaertn.	South Africa	H	A	O	CL	O
58.	<i>Gerbera jamesonii</i> Bolus ex Hook.f.	Africa	H	A	O,C	CL	O
59.	<i>Gnaphalium coactatum</i> Willd.	Tropical America	H	A	Nk	RS	Ui
60.	<i>Gnaphalium uliginosum</i> L.	Europe	H	A	Nk	RS	Ui
61.	<i>Gnaphalium luteo-album</i> L.	America	H	A	Nk	F	Ui
62.	<i>Guizotia abyssinica</i> (L.f.) Cass.	Ethiopia	H	A	O	CL	Ui
63.	<i>Helianthus annuus</i> L.	America	S	A	C	CL	Ui
64.	<i>Helichrysum bractiatum</i> (Venten.)Willd.	Australia	US	A	Nk	W	Ui
65.	<i>Hypochaeris glabra</i> L.	Europe	H	A	Nk	W	Ui
66.	<i>Hypochaeris radicata</i> L.	Europe	H	A	Nk	W	Ui
67.	<i>Lactuca hastata</i> L.	T.America	H	A	Nk	F	Ui
68.	<i>Lactuca sativa</i> L.	Tropical America	H	A	V	CL	Ui
69.	<i>Lagascea mollis</i> Cav.	Central America	H	A	P	W	Ui
70.	<i>Laggera alata</i> Nanth.	Africa	H	A	Nk	W	Ui
71.	<i>Matricaria chamomilla</i> L.	Europe	H	A	M	CL	Ui
72.	<i>Mikania micrantha</i> L.	C. S. America	C	P	Nk	F	Ui
73.	<i>Moonia heterophylla</i> Arn.	Tropical America	US	P	Nk	F	Ui
74.	<i>Montanoa bipinnatifida</i> (Kunth) K. Koch.	Tropical America	T	P	O	CL	O

75.	<i>Parthenium hysterophorus</i> L.	North America	H	A	P	W	Ui
76.	<i>Picris hieracioides</i> Sibth & Sm.	Europe	H	A	Nk	F	Ui
77.	<i>Santolina chamaecyparissus</i> L.	Mediterranean	H	P	M	CL	Ui
78.	<i>Senecio candicans</i> Wall.	Europe	C	P	Nk	F	Ui
79.	<i>Senecio vulgaris</i> L.	N. T. region	H	A	Nk	W	Ui
80.	<i>Siegesbeckia orientalis</i> L.	Africa	US	A	M	RS	Ui
81.	<i>Silybum marianum</i> (L.) Gaertn.	T.America	US	A	M	W	Ui
82.	<i>Sonchus arvensis</i> L.	Mediterranean	H	A	Nk	RS	Ui
83.	<i>Sonchus oleraceus</i> (L.) L.	Mediterranean	H	A	M,V	RS	Ui
84.	<i>Sonchus wightianus</i> DC.	China	H	A	Nk	RS	Ui
85.	<i>Solidago canadensis</i> L.	America	US	P	M	CL	Ui
86.	<i>Spilanthes acmella</i> (L.) L.	Brazil	H	A	Ch, M	W	Ui
87.	<i>Synedrella nodiflora</i> (L.) Gaertn.	America, Mexico	H	A	Nk	W	Ui
88.	<i>Spilanthes calva</i> W.	Brazil	H	A	Nk	W	Ui
89.	<i>Tagetes erecta</i> L.	Mexico	US	A	C	CL	O
90.	<i>Tagetes minima</i> L.	America	H	A	Nk	CL	Ui
91.	<i>Tagetes patula</i> L. *	Mexico	US	A	C	CL	O
92.	<i>Tanacetum cinerariifolium</i> (Trevir.)Sch.Bip.	Europe	US	A	O	CL	Ui
93.	<i>Taraxacum officinale</i> (L.)Wiber.ex F.H.Wigg.	Europe	H	A	M	W	Ui
94.	<i>Tithonia diversifolia</i> (Hemsl) A.Gray.	Mexico	S	P	Nk	RS	Ui
95.	<i>Tithonia rotundifolia</i> L.	North America	S	P	Nk	RS	Ui
96.	<i>Tridax procumbens</i> (L.) L.	Central America	H	A	M,V	W	Ui
97.	<i>Vernonia cinerea</i> (L.) Less.	Africa	H	A	Nk	W	Ui
98.	<i>Wedelia trilobata</i> (L.) Hitchc.	Mexico	H	A	O	CL	O
99.	<i>Xanthium indicum</i> L.	Tropical America	US	A	M	W	Ui
100.	<i>Xanthium strumarium</i> L.	North America	US	A	Nk	W	Ui
101.	<i>Xanthium spinosum</i> L.	South America	US	A	Nk	W	Ui
102.	<i>Youngia japonica</i> (L.) DC.	South America	H	A	Nk	F	Ui
103.	<i>Zinnia elagans</i> L.*	Mexico	H	A	O	CL	O

Life form: H—Herb; C—Climber; US—Undershrub; S—Shrub; T—Tree. Habit: A—Annual; P—Perennial; Uses: Ch—Presence of bioactive chemicals; M—Medicinal; Nk—Not known; O—Ornamental; P—Poisonous plant; V—Vegetable; Habitat: W—Wastelands; CL—Cultivated Land; F—Forests; RS— Road Side; Mode of introduction: O—Ornamental; Ui—Unintentional.

Although invasive aliens are a substantial threat and have several negative impacts, some of these weeds have also proved beneficial to human welfare. The Western Ghats region harbors a large number of ethnic tribes such as the Todas, Irulas, Kothas, Kurumbas, Kattunaikkas, Paniyas, and several others, who largely depend on the surrounding flora for their day-to-day needs. They practice herbal medicine for most of their ailments, utilizing some of the alien weeds of the region; they also collect a number of wild herbs, including some invasive species, as green vegetables. There is no species that is not medicinal. In fact, all species are said to have one or more medicinal properties, some of which are well documented while others remain to be studied, and invasive weeds are no exception. Local villagers and the ethnic tribes throughout the Western Ghats region use many invasive species for various ailments. Some species such as *Ageratum conyzoides* L., *Xanthium indicum* are so extensively used by local people as to

raise doubts whether these weeds should be eradicated or cultivated. Similarly, the obnoxious weed *Parthenium hysterophorus* L., which is considered to be among the worst weeds, has several medicinal and biological properties such as anti-amoebic (Sharma and Bhutani, 1988); anti-tumour (Mukherjee and Chatterjee, 1993); trypanocidal (Talaka *et al.*, 1995); and antimalarial (Anonymous, 2003). It also has herbicidal and antifungal activities and produces parthenin, a toxin proved pharmacologically active against neuralgia and certain types of rheumatism (Sharma and Bhutani, 1988). Another invasive species of the same family, *Xanthium indicum* Koenig, has also shown many medicinal properties. Its achenes are rich in vitamin C; it has cooling, laxative, fattening, anti-inflammatory, anthelmintic, tonic, alexiteric and antipyretic properties; and it improves the appetite and digestive functions, voice, complexion and memory. It cures leucoderma, urinogenital diseases, biliousness, poisonous insect bites,

epilepsy, salivation and fever. The root is considered diuretic and the leaves are taken internally, while being applied externally for itch, abscesses and other cutaneous diseases (Kirtikar and Basu , 1981). It is also used in treating cancer and scrofula. The compositaceous weed, *Bidens biternata* (Lour.) Merr. & Sherif, has diverse ethnobotanical uses particularly in herbal treatments: astringent, anti-haemorrhagic, styptic, urogenital system tonic (diuretic, kidney and bladder tonic, anti-inflammatory), minor anti-microbial activity, neoplastic; it is also used for conjunctivitis, dysentery, haematuria, urethritis, cystitis, benign prostatic hypertrophy, renal urolithiasis, diarrhoea, peptic ulcer, ulcerative colitis, mucoid colitis, haemorrhoids, upper respiratory tract infections/irritations - hay fever, sinusitis, sinus headache due to allergies, infections and pollution, menorrhagia, and vaginal discharges.

Several invasive weeds have proved to be good ornamental plants, some having been introduced purely for ornamental purposes. Many have highly variable colored flowers arranged in dense, compact spikes, useful for hedging and general garden plants when cultivated under manmade conditions. *Erigeron karvinskianus* with its white and pink florets and prostrate branches, if grown in man-made landscapes - particularly on garden embankments - can be pleasing to the eye. Travelers from Europe have introduced exotic species from the places they have visited during their travels, and introduced them by planting in various botanical gardens of their country and some other places. Many of these exotic weeds may not be liked by cattle as their food. Such aliens are not preferred by the cattle which graze in the forest also. The invasive plants normally use the nutrition available in the soil, sunlight and water in the soils by their peculiar ability

to avail these resources in a fast pace. This ability of the invasive plants is more in soil of poor nutritive content (Funk and Vitousek, 2007), like all pioneer species invasive floras produce and disperse multitudinous seeds, By this they are able to exert heavy pressure to native species in the matter of propagation (Lockwood *et al.*, 2005). Flowering and fruiting in a plentiful manner and methods of dispersal by wind and animals provide these invading species an edge over the indigenous floras. By fast and effective methods of seeding and competitive growth, the invasive overtake in number and colonize the fringes of the forests and crop lands. In addition prolific aliens spoil the nature of the native soil and water running out of the habitat and the climate in the habitat. The allelopathic chemicals produced by these exotics suppress the regeneration of understory plants and the crops nearby (Sheeja, 1993, Meenatchi Ammal and Sheeja, 2007).

The overwhelming growth of invasive reduces the abundance of native plants in the community (Hejda *et al.*, 2009). Shortage of foliage is the reason of reduced natural regeneration and suppression. Better planning and early monitoring in required to alleviate this action and will include reporting of the infestations and controlling the spread of the naturalized alien weeds. Best method of stopping further proliferation is removing *enmasse*, flowering tops of the weeds by mechanical or any other practicable means. Various international and national organizations, such as World Conservation Union (WCU, formerly IUCN - International Union for Conservation of Nature and Natural Resources), Convention on Biological Diversity (CBD) and Global Invasive Species Programme (GISP), are concerned with the prevention and control of this global problem.

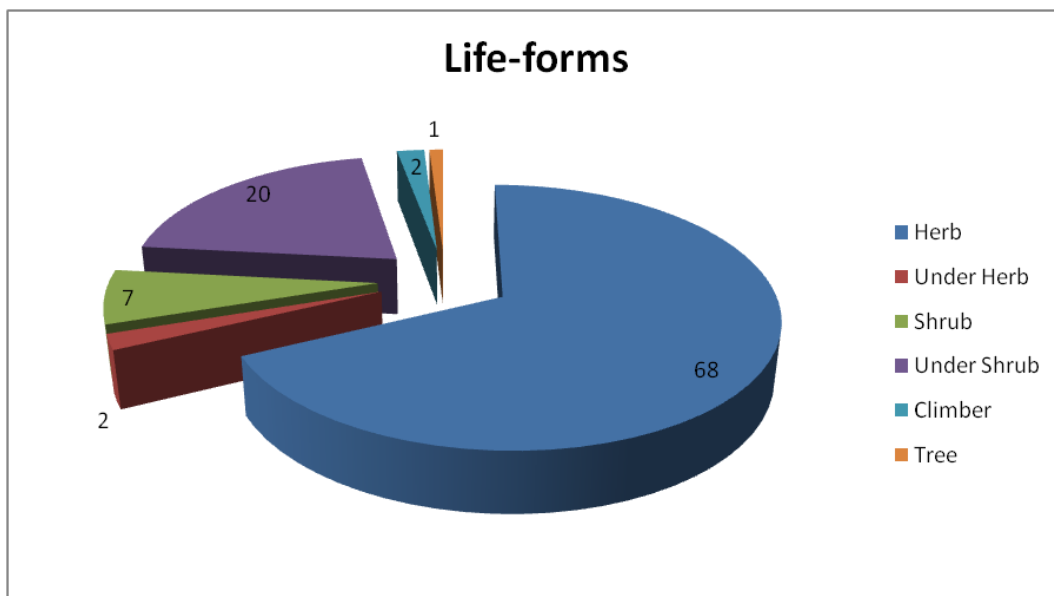


Figure 2. Composition of Habit of invasive alien species recorded in study area

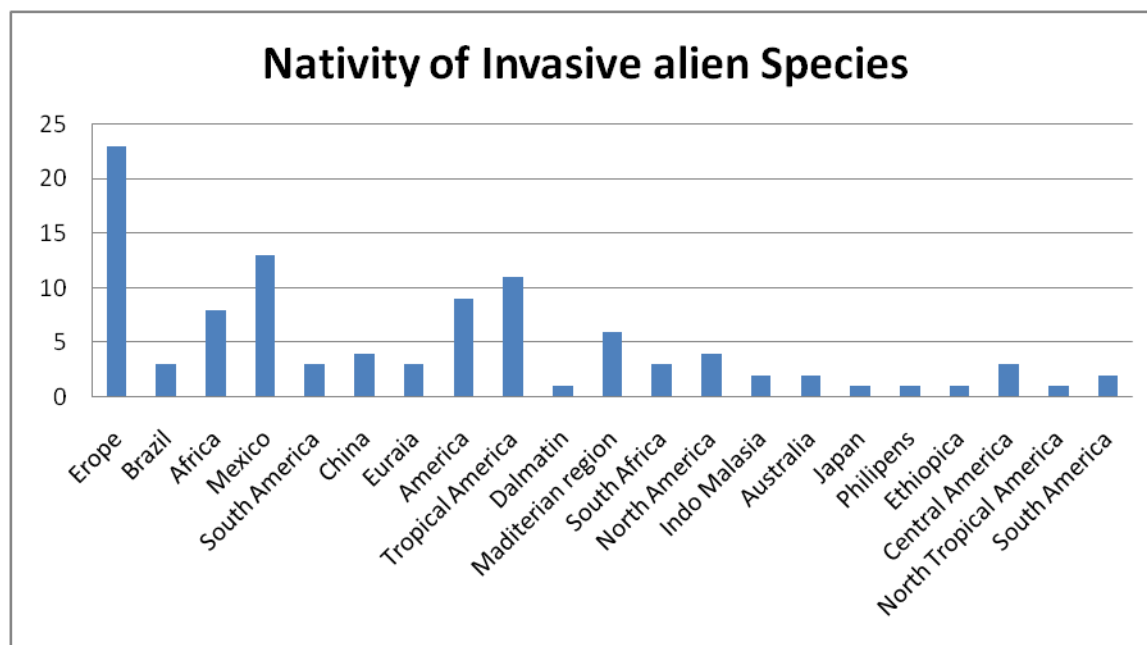


Figure 3. Nativity of alien invasive species inventoried from study area

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