



Diversity and distribution of exotic and alien plant species in Angul district of Odisha, India

Sandeep Kumar Nayak and Kunja Bihari Satapathy[✉]

Post-Graduate Department of Botany, Utkal University, Vani Vihar, Bhubaneswar - 751 004, Odisha, India

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ABSTRACT

An exhaustive floristic survey was carried out during 2013-2015 in the Angul district of Odisha state to assess the diversity and distribution of exotic and alien plant species. The study revealed the occurrence a total of 124 species of flowering plants belonging to 92 genera under 42 families. Of these, trees, shrubs, climbers and herbs are represented by 2, 14, 3 and 105 species respectively. Asteraceae was the most speciose family with 20 species followed by Amaranthaceae (9 spp.), Convolvulaceae (7 spp.), Euphorbiaceae (7 spp.), Caesalpinaceae (7 spp.) and Fabaceae (7 spp.). *Chromolaena odorata*, *Hyptis suaveolens*, *Parthenium hysterophorus*, *Alternanthera philoxeroides*, *Eichhornia crassipes* and *Lantana camara* were found to be the most dominant and aggressive alien weeds of the district. Most of the exotics and alien weeds reported from the district were found to be native of Tropical America, and Tropical Africa and only few from the Asiatic region.

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1. Introduction

Invasive alien plant species are the species whose introduction or spread threatens the environment, the economy of society, human health and biodiversity of a region. Biological invasions by alien species are widely recognized as a significant component of human caused global environmental change which results a significant loss in the economic value, biological diversity and change in the functioning of invaded ecosystem beyond its home range that establishes, naturalizes and spreads (Williamson, 1996). Introduction of these species may occur accidentally or through their being imported for a limited purpose and subsequently escaping or deliberately on a large scale (Levine, 1989). Many people introduce exotic species into new habitats for economic reasons (McNealy, 2001) and most cases of invasiveness can be linked to the intended or unintended consequences of economic activities. In many continental areas 20% or more of the plant species are now non-indigenous. On many islands the proportion of non-

indigenous plant species is 50% or more (Randall and Marinelli, 1997). Invasive alien plants are a problem of global significance, causing impacts running into billions of dollars annually. In South Africa, at least 161 species cause serious problems in natural and semi-natural systems (Henderson, 1995); these plants may spread and come to dominate large areas in just a few years. The loss due to invasive species in United States estimated to be ~\$125-150 billion each year and 25% of U.S agriculture gross national product is lost due to foreign pests and weeds (McNeely et al., 2001). Exotic plants can spread rapidly because of our mobile society and the intentional transportation of ornamental and forage plants (Randall and Marinelli, 1997).

India is a biodiversity rich country with different climate, soil, topography and vegetation which encourages different alien plants to proliferate extensively. Inventory of exotics and invasive alien plants of India has been done by several workers in different parts of the country (Reddy, 2008; Wagh & Jain, 2015; Chandrasekhar, 2012; Singh and

[✉] Corresponding author; Email: kbsbotuu@gmail.com

Mahammed, 2015). In Odisha, 131 species of alien plant species have been identified in Dhenkanal district of Odisha (Nayak and Satapathy, 2015) and 80 from Utkal University campus, Bhubaneswar (Satapathy *et al.*, 2016). In the present study, an account of 124 species of alien plant species of Angul district of Odisha belonging to 92 genera and under 42 families has been provided.

2. Materials and methods

2.1 Study area

Angul, a centrally located district in the state of Odisha, covers a geographical area of 6232 sq. km and lies between 20° 31' N and 20° 40' N Latitude and 84° 15' E and 85° 23' E Longitude. The climate of the Angul district is hot and dry sub-humid type with an average annual rainfall of 1696 mm. The average minimum and maximum temperatures are 19.6°C and 33.3°C respectively. The relative humidity generally varies from 31 to 88%. The forest coverage of the district is 3336.63 sq. km. (<http://angul.nic.in/>)

2.2 Methods

The present study was conducted in Angul district during 2013-15 to document the diversity and distribution of exotic and alien plant species including invasive ones. Interaction with local inhabitants was made to collect information regarding the uses of these Invasive Alien plant Species (IAPS) by them. Plant samples were collected and photographed from their natural habitats including agricultural lands, wetlands, roadside and forest areas of the district and identified in consultation with “The Flora of Orissa” (Saxena and Brahmam, 1994-1996) and other available literature. Collected plant specimens were preserved as herbarium specimens following standard field and herbarium methods in the Herbarium of the Post Graduate Department of Botany, Utkal University, Bhubaneswar.

Review of literature on invasive and alien plant species throughout the world (Mooney and Drake, 1987; Heywood, 1989; Cox, 1999; D’Antonio and Vitousek, 1992; Drake *et al.*, 1989; Huxel, 1999; Mooney, 1999; Almeilla and Freitas, 2001; Cowie, 2001; McNeely *et al.*, 2001; Reddy *et al.*, 2008) was helpful to throw light on the history of invasion, spread and harmful effects of alien weeds especially those occurring in Angul district of Odisha. The country of origin of the species were determined based on the work of Vavilov (1951), Matthew (1969), Maheswari and Paul (1975), Nayar (1977), Hajra and Das (1982), Sharma (1984), Saxena (1984), Reddy and Raju (2002) and Reddy, and Reddy (2004).

3. Results and Discussion

The exhaustive floristic survey of Angul district revealed the occurrence of 124 invasive alien plant species belonging to 92 genera and under 42 families. Habit-wise analysis revealed that the herbs were represented by 105 species (84.6%) followed by shrubs (14), climbers (03) and trees (02) (Table 2 & Figure-1). Among the 42 families, Asteraceae was the dominant family with 20 (47.6%) species followed by Amaranthaceae (09), Convolvulaceae (07), Euphorbiaceae (07), Caesalpiniaceae (07), Fabaceae (07), Poaceae (05), Solanaceae (05), Cleomaceae (04), Mimosaceae (03), Asclepiadaceae (03), Cyperaceae (03), Lamiaceae (03), Malvaceae (03), Tiliaceae (02) etc. These top fifteen families contributed 90 species which is 72.58% of the total species listed. The genus *Cassia* has the maximum number of species (7) followed by *Ipomoea* (6 species), *Alternanthera* (4 species), *Cleome* (4 species), and *Ludwigia* (3 species) (Table-1). The most invasive and troublesome species recorded from the district were *Chromolaena odorata*, *Hyptis suaveolens*, *Parthenium hysterophorus*, *Alternanthera philoxeroides*, *Eichhornia crassipes* and *Lantana camara*. The Invasive Alien Plant Species (IAPS) of Angul district were found growing in all kinds of ecosystems like forests, agricultural fields, waste and fallow lands, gardens and road-sides. It was also noted that more than half of alien plant species are growing luxuriantly, spreading rapidly and getting naturalized to newer areas and habitats.

Out of the 124 species now listed, 27 were identified as invasive weeds of wetland habitats including *Aeschynomene americana*, *Alternanthera paronychioides*, *Alternanthera philoxeroides*, *Cassia alata*, *Cyperus difformis*, *Cyperus iria*, *Echinochloa colona*, *Echinochloa crusgalli.*, *Eclipta prostrata.*, *Eichhornia crassipes*, *Gnaphalium polycaulon*, *Grangea maderaspatana*, *Ipomoea carnea*, *Ludwigia adscendes*, *Ludwigia octovlavis*, *Ludwigia perennis*, *Monochoria vaginalis*, *Pistia stratiotes*, *Salvinia molesta* *Sesbania bispinosa* and *Typha angustata* (Table-1). Similarly, aliens like *Lantana camara*, *Chromolaena odorata*, *Parthenium hysterophorus*, *Alternanthera* species etc. have invaded the forest floors and wastelands badly affecting the growth of indigenous species. It was observed that fast growing exotic trees like *Acacia auriculiformis*, *Cassia siamea*, *Acacia mangium*, *Grevillea pteridifolia* etc. have been introduced in the locality to meet the increasing demand of firewood or as avenue plants.

Analysis of relevant literature on country of origin and distribution of alien plant species of Angul district, it is observed that that maximum number of species were from tropical America and tropical Africa (Table-2). These alien

Table 1

List of invasive alien plants of Angul district, Odisha

S.N.	Species	Family	Habit	Nativity
1.	<i>Acanthospermum hispidum</i> DC.	Asteraceae	Herb	Brazil
2.	<i>Aerva javanica</i> (Burm.f.) Juss. ex Schult.	Amaranthaceae	Herb	Trop. America
3.	<i>Aeschynomene americana</i> L.	Fabaceae	Herb	Trop. America
4.	<i>Ageratum conyzoides</i> L.	Asteraceae	Herb	Trop. America
5.	<i>Alternanthera paronychioides</i> St. Hill	Amaranthaceae	Herb	Trop. America
6.	<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	Amaranthaceae	Herb	Trop. America
7.	<i>Alternanthera pungens</i> Kunth	Amaranthaceae	Herb	Trop. America
8.	<i>Alternanthera sessilis</i> (L.) DC.	Amaranthaceae	Herb	Trop. America
9.	<i>Amaranthus spinosus</i> L.	Amaranthaceae	Herb	Trop. America
10.	<i>Antigonon leptopus</i> Hook. & Arn.	Polygonaceae	Climber	Trop. America
11.	<i>Argemone mexicana</i> L.	Papaveraceae	Herb	Trop. Central & South America
12.	<i>Bidens pilosa</i> L.	Asteraceae	Herb	Trop. America
13.	<i>Blainvillea acmella</i> (L.) Philipson	Asteraceae	Herb	Trop. America
14.	<i>Blumea lacera</i> (Burm. f.) DC.	Asteraceae	Herb	Trop. America
15.	<i>Blumea obliqua</i> (L.) Druce	Asteraceae	Herb	Trop. America
16.	<i>Borassus flabellifer</i> L.	Arecaceae	Tree	Trop. Africa
17.	<i>Calotropis gigantea</i> R. Br.	Asclepiadaceae	Shrub	Trop. Africa
18.	<i>Calotropis procera</i> (Ait.) R. Br.	Asclepiadaceae	Shrub	Trop. Africa
19.	<i>Cannabis sativa</i> L.	Cannabaceae	Herb	Central Asia
20.	<i>Cardiospermum halicacabum</i> L.	Sapindaceae	Climber	Trop. America
21.	<i>Cassia absus</i> L.	Caesalpiaceae	Herb	Trop. America
22.	<i>Cassia alata</i> L.	Caesalpiaceae	Shrub	West Indies
23.	<i>Cassia hirsuta</i> L.	Caesalpiaceae	Herb	Trop. America
24.	<i>Cassia obtusifolia</i> L.	Caesalpiaceae	Herb	Trop. America
25.	<i>Cassia pumila</i> Lam.	Caesalpiaceae	Herb	Trop. America
27.	<i>Cassia tora</i> L.	Caesalpiaceae	Herb	Trop. South America
28.	<i>Catharanthus pusillus</i> (Murr.) G. Don	Apocynaceae	Herb	Trop. America
29.	<i>Celosia argentea</i> L.	Amaranthaceae	Herb	Trop. Africa
30.	<i>Chenopodium album</i> L.	Chenopodiaceae	Herb	Europe
31.	<i>Chloris barbata</i> Sw.	Poaceae	Herb	Trop. America
32.	<i>Chromolaena odorata</i> (L.) King & Robins.	Asteraceae	Herb	Trop. America
33.	<i>Chrozophora rotterli</i> (Geis.) Juss. ex Spreng.	Euphorbiaceae	Herb	Trop. Africa
34.	<i>Cleome gynandra</i> L.	Cleomaceae	Herb	Trop. America
35.	<i>Cleome monophylla</i> L.	Cleomaceae	Herb	Trop. Africa
36.	<i>Cleome rutidosperma</i> DC.	Cleomaceae	Herb	Trop. America
37.	<i>Cleome viscosa</i> L.	Cleomaceae	Herb	Trop. America
38.	<i>Conyza bipinnatifida</i> Wall.	Asteraceae	Herb	Trop. America
39.	<i>Corchorus aestuans</i> L.	Tiliaceae	Herb	Trop. America
40.	<i>Crotalaria pallida</i> Ait.	Fabaceae	Herb	Trop. America

41.	<i>Crotalaria retusa</i> L.	Fabaceae	Herb	Trop. America
42.	<i>Croton bonplandianum</i> Baill.	Euphorbiaceae	Herb	Temperate South America
43.	<i>Cryptostegia grandiflora</i> R.Br.	Asclepiadaceae	Herb	Madagascar
44.	<i>Cuscuta chinensis</i> Lam.	Cuscutaceae	Herb	Mediterranean
45.	<i>Cuscuta reflexa</i> Roxb.	Cuscutaceae	Herb	Mediterranean
46.	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Herb	Trop. Africa
47.	<i>Cyperus difformis</i> L.	Cyperaceae	Herb	Trop. America
48.	<i>Cyperus iria</i> L.	Cyperaceae	Herb	Trop. America
49.	<i>Datura innoxia</i> Mill.	Solanaceae	Shrub	Trop. America
50.	<i>Datura metel</i> L.	Solanaceae	Shrub	Trop. America
51.	<i>Digera muricata</i> (L.) Mart.	Amaranthaceae	Herb	SW Asia
52.	<i>Echinochloa colona</i> (L.) Link	Poaceae	Herb	Trop. South America
53.	<i>Echinochloa crusgalli</i> (L.) Beauv.	Poaceae	Herb	Trop. South America
54.	<i>Eclipta prostrata</i> (L.) Mant.	Asteraceae	Herb	Trop. America
55.	<i>Eichhornia crassipes</i> (Mart.) Solms	Pontederiaceae	Herb	Trop. America
56.	<i>Emilia sonchifolia</i> (L.) DC.	Asteraceae	Herb	Trop. America
57.	<i>Euphorbia heterophylla</i> L.	Euphorbiaceae	Herb	Trop. America
58.	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Herb	Trop. America
59.	<i>Evolvulus nummularius</i> (L.) L.	Convolvulaceae	Herb	Trop. America
60.	<i>Fuirena ciliaris</i> (L.) Roxb.	Cyperaceae	Herb	Trop. America
61.	<i>Galinosoga parviflora</i> Cav.	Asteraceae	Herb	Trop. America
62.	<i>Gnaphalium pensylvanicum</i> Willd.	Asteraceae	Herb	Trop. America
63.	<i>Gnaphalium polycaulon</i> Pers.	Asteraceae	Herb	Trop. America
64.	<i>Gomphrena serrata</i> L.	Amaranthaceae	Herb	Trop. America
65.	<i>Grangea maderaspatana</i> (L.) Poir.	Asteraceae	Herb	Trop. South America
66.	<i>Hyptis suaveolens</i> (L.) Poit.	Lamiaceae	Herb	Trop. America
67.	<i>Impatiens balsamina</i> L.	Balsaminaceae	Herb	Trop. America
68.	<i>Indigofera astragalina</i> DC.	Fabaceae	Herb	Trop. America
69.	<i>Indigofera linnaei</i> Ali	Fabaceae	Herb	Trop. Africa
70.	<i>Ipomoea carnea</i> Jacq.	Convolvulaceae	Shrub	Trop. America
71.	<i>Ipomoea eriocarpa</i> R.Br.	Convolvulaceae	Herb	Trop. Africa
72.	<i>Ipomoea hederifolia</i> L.	Convolvulaceae	Herb	Trop. America
73.	<i>Ipomoea obscura</i> (L.) Ker-Gawl.	Convolvulaceae	Herb	Trop. America
74.	<i>Ipomoea pes-tigridis</i> L.	Convolvulaceae	Herb	Trop. East Africa
75.	<i>Ipomoea quamoclit</i> L.	Convolvulaceae	Herb	Trop. America
76.	<i>Jatropha curcas</i> L.	Euphorbiaceae	Shrub	Trop. America
77.	<i>Jatropha gossypifolia</i> L.	Euphorbiaceae	Shrub	Brazil
78.	<i>Lantana camara</i> L.	Verbenaceae	Herb	Trop. America
79.	<i>Leonotis nepetiifolia</i> (L.) R. Br.	Lamiaceae	Herb	Trop. Africa
80.	<i>Leucaena leucocephala</i> (Lam.) de Wit	Mimosaceae	Tree	Trop. America
81.	<i>Ludwigia adscendes</i> (L.) Hara	Onagraceae	Herb	Trop. America
82.	<i>Ludwigia octovlavis</i> (Jacq.) Raven	Onagraceae	Herb	Trop. Africa

83.	<i>Ludwigia perennis</i> L.	Onagraceae	Herb	Trop. Africa
84.	<i>Malachra capitata</i> (L.) L.	Malvaceae	Herb	Trop. America
85.	<i>Martynia annua</i> L.	Martyniaceae	Herb	Trop. America
86.	<i>Mecardonia procumbens</i> (Mill.) Small	Scrophulariaceae	Herb	Trop. North America
87.	<i>Melilotus alba</i> Desv.	Fabaceae	Herb	Europe
88.	<i>Melochia corchorifolia</i> L.	Sterculiaceae	Herb	Trop. America
89.	<i>Mikania micrantha</i> Kunth	Asteraceae	Climber	Trop. America
90.	<i>Mimosa pigra</i> L.	Mimosaceae	Shrub	Trop. North America
91.	<i>Mimosa pudica</i> L.	Mimosaceae	Herb	Brazil
92.	<i>Mirabilis jalapa</i> L.	Nyctaginaceae	Herb	Peru
93.	<i>Monochoria vaginalis</i> (Burm. f.) Presl.	Pontederiaceae	Herb	Trop. America
94.	<i>Nicotiana plumbaginifolia</i> Viv.	Solanaceae	Herb	Trop. America
95.	<i>Ocimum canum</i> Sims	Lamiaceae	Herb	Trop. America
96.	<i>Opuntia stricta</i> (Haw.) Haw.	Cactaceae	Herb	Trop. America
97.	<i>Oxalis corniculata</i> L.	Oxalidaceae	Herb	Europe
98.	<i>Parthenium hysterophorus</i> L.	Asteraceae	Herb	Trop. North America
99.	<i>Passiflora foetida</i> L.	Passifloraceae	Herb	Trop. South America
100.	<i>Pedaliium murex</i> L.	Pedaliaceae	Herb	Trop. America
101.	<i>Peperomia pellucida</i> (L.) Kunth	Piperaceae	Herb	Trop. South America
102.	<i>Pistia stratiotes</i> L.	Araceae	Herb	Trop. America
103.	<i>Portulaca oleracea</i> L.	Portulacaceae	Herb	Trop. South America
104.	<i>Portulaca quadrifida</i> L.	Portulacaceae	Herb	Trop. America
105.	<i>Prosopis juliflora</i> (Sw.) DC.	Mimosaceae	Shrub	Mexico
106.	<i>Ruellia tuberosa</i> L.	Acanthaceae	Herb	Trop. America
107.	<i>Saccharum spontaneum</i> L.	Poaceae	Herb	Trop. West Asia
108.	<i>Salvinia molesta</i> D. S. Mitch.	Salviniaceae	Herb	Brazil
109.	<i>Scoparia dulcis</i> L.	Scrophulariaceae	Herb	Trop. America
110.	<i>Sesbania bispinosa</i> (Jacq.) Wight	Fabaceae	Shrub	Trop. America
111.	<i>Sida acuta</i> Burm.f.	Malvaceae	Herb	Trop. America
112.	<i>Solanum torvum</i> Sw.	Solanaceae	Shrub	West Indies
113.	<i>Solanum viarum</i> Dunal	Solanaceae	Herb	Trop. America
114.	<i>Sonchus asper</i> Hill	Asteraceae	Herb	Mediterranean
115.	<i>Spermacoce hispida</i> L.	Rubiaceae	Herb	Trop. America
116.	<i>Stachytarpheta jamaicensis</i> (L.) Vahl	Verbenaceae	Herb	Trop. America
117.	<i>Synadenium grantii</i> Hook. f.	Euphorbiaceae	Shrub	Trop. America
118.	<i>Synedrella nodiflora</i> (L.) Gaertn.	Asteraceae	Herb	West Indies
119.	<i>Tribulus terrestris</i> L.	Zygophyllaceae	Herb	Trop. America
120.	<i>Tridax procumbens</i> L.	Asteraceae	Herb	Trop. Central America
121.	<i>Triumfetta rhomboidea</i> Jacq.	Tiliaceae	Herb	Trop. America
122.	<i>Typha angustata</i> Bory. & Choub.	Typhaceae	Herb	Trop. America
123.	<i>Urena lobata</i> L.	Malvaceae	Shrub	Trop. Africa
124.	<i>Xanthium indicum</i> L.	Asteraceae	Herb	Trop. America

Table 2

Regions of nativity of invasive alien plant species of Angul district

Sl. No.	Region of Nativity	No. of Species
1.	Tropical America	76
2.	Tropical Africa	13
3.	Tropical South America	08
4.	Brazil	04
5.	Europe	03
6.	Tropical North America	03
7.	West Indies	03
8.	Mediterranean	03
9.	Central America	01
10.	Tropical Central South America	01
11.	Tropical East Africa	01
12.	Peru	01
13.	Mexico	01
14.	Temperate South America	01
15.	Madagascar	01
16.	West Asia	01
17.	South West Asia	01
18.	Tropical West Asia	01
19.	Central Asia	01

Table 3

Habit-wise distribution of invasive alien plant species in Angul district of Odisha

Sl. No.	Habit	No. of Species
1	Herb	105
2	Shrub	14
3	Climber	3
4	Tree	2

species were mostly from Tropical America (76 spp.), Tropical Africa (13 spp.), Tropical South America (8 spp.), Brazil (4 spp.), Europe (3 spp.), Tropical north America (3 spp.), West Indies (3 spp.) and Mediterranean region (3 spp.). However, one species each was native to Tropical Central America, Mexico, Tropical Central South America, Tropical East Africa, Peru, Temperate South America, Madagascar, West Asia, South West Asia, Central Asia and Tropical West Asia. (Table-2)

4. Conclusion

The invasive alien plant species of Angul district of Odisha pose great threat to the indigenous flora of the region. Due to their competitive advantage over native species in terms of seed dispersal and plant establishment, colonization in new and hostile habitats, ecological adaptability to a range of ecosystems and micro-climates, they have rapidly invaded

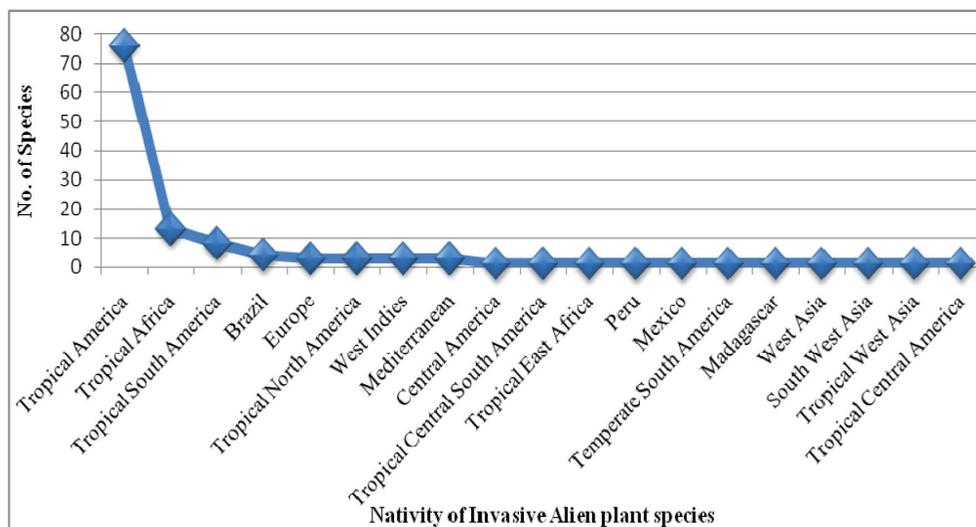


Fig. 1: Origin of invasive alien plants in Angul district of Odisha

the wastelands, crop fields, forest floors, village thickets, road sides and eliminated the native elements at several habitats. Weed invasion in agricultural fields is a matter of concern leading to considerable loss to the farmers in terms of requirement of additional manpower for weed control and reduction in crop productivity. However, many of the

alien species are economically important as source of food, feed, medicine and could be used as valuable resources. Importantly, the ecological impact of exotics and alien weeds on local biodiversity and human health need to be assessed at regional and national level.

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