INVASIVE PLANTS - A BOON OR BANE TO THE LEPIDOPTERON FAUNA: CONSERVATION AND MANAGEMENT PLAN SUGGESTIONS

Arjun, C.P1,5, V.K. Anoop2, K.J. Tijo3, T.K. Anoopkumar4 and R. Roshnath4 & 5

1School of Ecological Informatics, Indian Institute of Information Technology and Management- Kerala, Trivandrum, Kerala.
2Department of Zoology, Bharathiar University, Coimbatore, Tamil Nadu.
3Center for Wildlife Studies, Kerala Veterinary and Animal Sciences University, Pookode, Wayanad.
4Central University of Kerala, Kasargod, Kerala. 5Malabar Awareness and Rescue Centre, Kannur, Kerala.

ABSTRACT

Butterfly diversity was recorded from Nov (2013) - May (2014) in Pookode region. A total number of 128 species recorded from the five families; Nymphalidae (46 species) Lycaenidae (28 species), Hesperiidae (22 species), Pieridae (17 species) and Papilionidae (15 species) respectively. During the survey invasive plant species were also recorded. There were 36 species of invasive plants from 18 families identified from the study area. More butterflies were attracted towards nectar offering invasive plants. *Chromolaena odorata*, *Ipomea cairica*, *Lantana camara*, *Merremia vitifolia*, *Mikania micrantha*, *Mimosa diplotricha*, *Pennisetum polystachyon*, *Pteridium aquilinum*, *Quisqualis indica* and *Sphagneticola trilobata* were the major invasive plants found in the Pookode region and their flower attracts butterfly for pollination. Even though nectar offered by the plants are supportive for growth, in long run these species can affect butterfly population by declining native host larval plant species for butterfly reproduction. Invasive species compete with the native flora and reduce its population. Management practices like physical, chemical and modern bio control measures could be used for eradicating of invasive plants. Wise use of invasive plants for other economical purpose such as bio-fuel, medicinal purpose, bio-pesticide and handicraft could be suggested. Successful management of invasive species are needed for conserving Lepidoptera fauna and other native biota of the area.

Keywords: Butterflies, invasive plants, host plants, management practices, conservation.

1. INTRODUCTION

Arthropods occupy half of earth's biodiversity (May, 1992) among these, butterflies fascinate the most. Their interaction with the ecosystem as pollinators and herbivorous are notable (Tiple et al., 2006). They are highly sensitive to solar radiation, temperature and variations in micro habits (Thomas et al., 1998). Anthropogenic disturbance and habitat quality variation (Kocher and Williams, 2000) reflects butterfly lifestyle, because of these reasons butterflies chose good candidate as bio-indicators to access habitat fragmentation, soil degradation and water pollution (Kehimkar, 2000). The Indian subcontinent hosts about 1,504 species of butterflies, and Western Ghat hosts 351species of butterflies (Smetacek, 1992; Gaonkar, 1996; Kunte, 2009; Roy et al., 2010and Tiple, 2011). The amount of the Indian butterflies is one fifth of the world butterflies (Kunte, 2000). The diversity and distribution of a particular species of butterfly is dependent not only on the geography of the area and the ability of the species to move around within it, but also on the ecological demands of the species (Khan et al., 2011).

Many of the butterflies are strictly seasonal and prefer particular set of habitat (Kunte, 1997). Butterflies and plants have intimate relationship, as food source and as larval host plants. (Feltwell, 1986). Butterfly diversity and abundance would be more in that vegetation which offers these. Invasion of invasive species were noted during the survey. Showy flowers of invasive species may draw pollinators (Armbruster and Herzig, 1984). This reduces the reproductive capacity of native plants (Brown 2002).

2. METHODOLOGY

Population survey of Lepidoptera were conducted monthly once between Nov (2013) May (2014) in the campus using line pollard walk method (Pollard, 1977). Survey was conducted from 8.00AM to 11.00 AM during the peak activity of butterflies. Species were identified through direct observation, photographs, eggs, pupa and larval forms with the help of field guides (Wynder-Blyth, 1957; K. Kunte, 2000; Kehimkar, 2008; George M, 2011)
2.1. Study area

Pookode located in Vythiri Panjayath which is southern part of Wayanad District. Pookode has mixed vegetation types including grassland, moist deciduous forest, semi-evergreen forest, plantations, rocky areas and riverine streams. Altitude varies 745-930 meter from the sea level and average temperature is about 25.75°C and annual rainfall is 5318 mm.

Study area hosts several types of vegetation, semi-evergreen patches were found adjacent to plantation (mainly coffee and tea) with large trees in between. Invasive species like Chromolaena odorata and Mikania micrantha were also observed along with the other native vegetation. Scrub land consists of open hilly terrains along with grassland habitat towards the summit of the Pookode region. Grasses such as Cymbopogon citrates and trees like Careya arborea dominate the habitat. Lantana camara and Chromolaena odorata are the dominating invasive species in the scrub land habitat. Riparian habitats run along the streamlets of Vythiri River towards the base of the Pookode where reeds are dominating the vegetation. Sphagneticola trilobata were the major invasive vegetation in riverine habitat.

3. RESULTS AND DISCUSSION

A total number of 128 species (Table.1) recorded from the five families. Nymphalidae (46 species) is the most abundant and Papilionidae (15 species) is the least abundant. Lycaenidae (28 species), Hesperiidae (22 species), Pieridae (17 species) recorded respectively (Fig:1).

![Fig. 1: Family wise abundance in the butterfly species in the Pookode region.](image)

The Pookode region host rich Lepidoptera diversity and abundance. Many of the species recorded in the region are of conservational importance. Fourteen species belongs to scheduled list of Indian Wildlife protection act 1972 Scheduled I; Atrophaneura hector, Papilio liomedon, Hypolimnas misippus, Scheduled II; Papilio Buddha, Kallima horsfieldi, Euthalia aconthea, Libythea lepita, Tanaecia lepidea, Discophora lepida, Appias albino, Spindasis lohita, Lampides boeticus, Scheduled IV; Prioneris sita, Tarucus ananda. 10 species were endemic to the Western Ghats they are Troïdes minos, Kallima horsfieldi, Idea malabarica, Curetis siva, Aeromachus pygmaeus, Zipaetis saitis (Western Ghats and Sri Lanka), Papilio buddha, Papilio liomedon, Discophora lepida, Discophora lepida, Mycalesis patina. Occurrence of Blue Nawab (Polyura schreiber) was a rare record in the state. Hence the area must be conserved for promoting Lepidoptera diversity.

Threats faced by butterflies in the area are urbanization and construction activities leading to habitat fragmentation that force butterflies to settle in narrow habitats causing population decline. Cattle grazing were another threat in the area where larval host plants are grazed by cattle which affect butterfly population (Runquist, 2011). But threats due to invasive plant species were considered higher than the others.

There is an intimate relationship between butterflies and plants (Feltwell, 1986), butterflies needs plants as food source and as larval host plants where as plants need these insects for pollination. Butterflies were found to feed on nectars of invasive plant species like Chromolaena odorata, Ipomea cairica, Lantana camara, Merremia vitifolia, Mikania micrantha, Mimosa diplostichra, Pennisetum polystachyon, Pteridium aquilinum, Quisqualis indica and Sphagneticola trilobata etc. Most of these plants provide nectar throughout the year (Nimbalkar et al., 2011) to the butterflies but none of these invasive plants host butterfly larval forms of single species of butterflies.

Egg laying of Acacia Blue butterfly were observed in Mimosa invasa during the survey. Acheronita styx (Death’s headed hawk moth) laying egg in Lantana camara was reported by Kehimkar, 2000, but prefer less. A total 36 species of invasive plants recorded (Table: 2) from the study area among the plants Chromolaena odorata, Clidemia hirta, Lantana camara, Leucaena leucocephala and Mikania micrantha enlisted in IUCN world 100 worst invaders because of its ability to dominate and devastate native biota (Lowe et al., 2000).

Invasive plants are second largest threat to the biodiversity after habitat destruction (Ensérink, 1999). Many of the invasive species become invades and explore higher than in their native regions. (D’Antonio and Vitousek 1992; Ridenour and...
Callaway 2001; Louda et al., 2003). These invasive species can cause large decreases in the abundances of native species (Braithwaite et al., 1989; Memmott et al., 2000; Grigulis et al., 2001). Invasive species compete with native species in different ways including competition for nutrients (Wardle et al., 1994), Water (Delph 1986), Light (Grace and Wetzel 1981, 1982, Weihe and Neely 1997), space (Agren and Fagerstrøm 1980, Newsome and Noble 1986), competitive release, and predatory release (Rodriguez, 2006). These competitions may reduce the ability of native species to maintain or increase population size (Huenneke and Thomson 1995).

Beyond such vegetative competition, competition for pollinator services by invasive plants may also reduce the reproductive capacity of native plants (Brown, 2002). More butterflies were observed in the areas where high populations of Lantana camara, Mikania micranthand C. odorata were present. An experimental study showed that butterflies are more attracted to amino acid contacting nectar provided by L. camara. (Alm, 1990). Some substances produced by the allelopathic effect of invasive species like Lantana camara, (Sharma et al., 2007, Kumbhar and Patel 2013 Mishra 2013, 2014, Gantayet et al., 2014.). C. odorata and Mikania micrantha (Sahid, 2014)are well documented Organic substances produce by plants as secondary metabolites such as alkaloids, Phenolics, flavonoids, Terpenoids and Glucosinolates are known to inhibit the seed germination, growth and development of other species (Rice,1974; Day et al.,2003)

Showy invasive species may draw pollinators away from native species, decreasing visit quantity (Free, 1968, Waser, 1978a, Gross and Werner 1983, Armbruster and Herzig, 1984) hence pollinations by butterflies and other insects were more in invasive plants thereby improving their propagation. Research shows native species suffers significantly reduced seed set in the presence of an aggressive invading congener when the species share the same kind of pollinators (Brown, 2002).

3.1. Major invasive plants and its invasion in the study area

Lantana was the major invasive plant in the study area. It was introduced as an ornamental plant into many tropical and subtropical world from its native south and Central America during nineteenth and early twentieth century (Mack et al., 2000). Thereafter like all other invasive species Lantana had established causing threat to biodiversity (Hiremath and Sundaram., 2005). It is having high regeneration capacity and can also survive in degraded soils (Bhatt et al., 1994; Rawat et al., 1994). Lantana is exceedingly efficient at nutrient uptake and use, enabling it to grow on highly impoverished soils (Bhatt et al., 1994; Rawat et al., 1994) Lantana may be favored by disturbances such as fire and grazing (Duggin and Gentle 1998; Gentle and Duggin, 1998).

Another important invasive species in the study area was Chromolaena odorata (L.) (Asteraceae). Florets of these plants attract butterflies and form an important nectar source for adult butterflies (Lakshmi and Raju, 2011). A study in Bangladesh showed 55 species of butterflies use this plant as a source of nectar (Shihan and Kabir, 2015). Arrangement of florets provide convenient landing place for butterflies and a butterfly can probe several flowers at a time in single visit (Lakshmi and Raju, 2011). Hexose rich sugar and high amino acid concentration in Asteraceae plants can attract butterflies and other pollinators (Baker and Baker 1983., Galetto and Bernardello, 2003).

Clidemia hirta, commonly called Koster’s Curse which is a native Tropical America listed under IUCN 100 worst invasive species was another invasive species found during the survey. They are densely branched shrub up to 5 m tall, normally between 0.5 and 3 m. C. hirta have pinkish white flowers and dark blue berries. It is an aggressive colonizer which can produce 500 berries which contain 100 seeds per fruit.

Mikania micrantha one among the worst invasive plants of the World which belongs to the family Asteraceae (Lowe et al., 2000). There are of 250 species in this genus Mikania however 4 species are known to be invasive. Among these Mikania micrantha is the only invasive plant in Asia-Pacific region. This is an invading creeper can grow 8-9 cm a day and able to create a thick envelope over the native biota eventually devastate native plants by blocking sunlight and its allelopathic effect. Flowers are good nectar source for many insects including butterflies which accelerate the pollination and spreading of the Mikania.

3.2. Removal and alternative uses of Invasive plant species

Past hundred years about 40 species of pathogens and insects tried on Lantana as bio control agents but none of them can acquire significant effect on Lantana (Sankaran et al., 2010).
Here the importance of biofuel production from *Lantana camara*. Bioethanol property of *Lantana camara* (Ramesh et al., 2010) and its low cost production were identified. An industrial level production of biofuel can make significant control over the Lantana. Further research are needed to identify similar characteristics of other invasive plants.

A management method that involves manual or mechanical means to remove or alter growing conditions of invasive plants are termed physical methods. This method prevent invasive plant establishment, as when soils are frequently hoed or tilled to disturb the soil seed bank and uproot seedlings (Radosevich et al., 1997). After any physical treatment, it is important to inspect tools and equipment and to safe disposal (burning) of invasive plant to prevent propagation to new sites (Holloran et al., 2004). Physical removal or destruction of invasive plants can often be the first, simplest, and most cost effective response to a small new population (Venner, 2006).

Another method involves use of Chemical herbicides to manage invasive plants. Herbicides can efficiently and effectively suppress or kill unwanted plants but should be used judiciously, safely, and in a way that minimizes adverse effects on non-target resources. (D’Antonio et al., 2004)

Biocontrol was a new technological approach towards irradiation of invasive plants. Biological control (or biocontrol) reunites invasive plants with their enemies to restore natural controls and reduce dominance of invasive plants within the plant community. Any plant populations are regulated by their environment and the influence of natural enemies (Crawley 1997). Since no potential enemies are present for invasive species, they flourish in the invaded area. Absence of natural enemies contributes to the invasiveness of some nonnative plants (Keane and Crawley, 2002). Feeding of Lantana leaves by Death faced hawk moth larvae (*Acheronita styx*) is reported (Kehimkar, 2000) which can be used as natural predator of the invasive species. Insect like *Teleonemia scrupulosa* and fungus pathogens *Prosopodium tuberculatum* can create dominance over Lantana in some places (Sankaran et al., 2010). The strong shoots of Lantana can be used for making handicrafts and furniture. A combined effort of bio-control, chemo-control and mechanical control measures is the best method to devastate Lantana of Pookode region.

Importing of *Layothrips mikania* from the Trinidad failed to adapt with the climatic condition of Solomon Islands and Malaysia against *Mikania micrantha*, but the fungal pathogens *Paksinia spegastini* can create serious effect on Mikania. This pathogens can creates disease only to the Mikania is another advantage (Sankaran et al., 2010).

### Table 1. List of Butterflies species recorded in the survey conducted in Pookode region.

| S. No. | Common name          | Scientific name                   | Status     | Wildlife Protection Act 1972 | Western ghat endemics |
|--------|----------------------|-----------------------------------|------------|------------------------------|-----------------------|
| 1      | BLUE MORMON          | *Papilio polymnestor* (Cramer)    |            |                              |                       |
| 2      | COMMON BLUEBOTTLE    | *Graphium sarpedon* (Linnaeus)    |            |                              |                       |
| 3      | COMMON JAY           | *Graphium doson* (C. and R. Felder) |            |                              |                       |
| 4      | COMMON MORMON        | *Papilio polytes* (Linnaeus)      |            |                              |                       |
| 5      | COMMON MIME          | *Chilasa clytia* (Linnaeus)       |            |                              |                       |
| 6      | COMMON ROSE          | *Atrophaneura aristochiae* (Fabricius) |            |                              |                       |
| 7      | CRIMSON ROSE         | *Atrophaneura hector* (Linnaeus)  |            |                              | S1                    |
| 8      | LIME BUTTERFLY       | *Papilio demoleus* (Linnaeus)     |            |                              |                       |
| 9      | PARIS PEACOCK        | *Papilio paris* (Linnaeus)        |            |                              |                       |
| 10     | RED HELEN            | *Papilio helenus* (Linnaeus)      |            |                              | S2                    |
| 11     | MALABAR BANDED PEACOCK | *Papilio buddha* (Westwood)       | R          |                              | WE                    |
MALABAR BANDED SWALLOWTAIL Papilio liomedon (Moore) R S1 WE
MALABAR ROSE Atrophaneura pandiyana (Moore) WE
SOUTHERN BIRDWING Troides minos (Cramer) WE
TAILED JAY Graphium agamemnon (Linnaeus)

Nymphalidae (Brushfooted butterflies)

BAMBOO TREEBROWN Lethe europa (Fabricius)
BLACK PRINCE Rohana parisatis (Westwood) R
BLUE NAWAB Polyura schreiber (Godart) R
SOUTH INDIAN BLUE OAKLEAF Kallima horsfieldi (Kollar) R S2 WE
BLUE ADMIRAL Kaniska canace (Linnaeus)
BLUE PANSY Junonia orithiya (Linnaeus)
BLUE TIGER Tirumala limniace (Cramer)
CHOCOLATE PANSY Junonia iphita (Cramer)
CLIPPER Parthenos sylvia (Cramer)
COMMON BARON Euthalia aconthea (Cramer) S2
COMMON BEAK Libythea lepita (Moore) S2
COMMON BUSHBROWN Mycalesis perseus (Fabricius)
COMMON CASTOR Ariadne merione (Cramer)
COMMON EVENING BROWN Melanitis leda (Linnaeus)
COMMON FIVERING Ypthima baldus (Fabricius)
COMMON FOURRING Ypthima huebneri (Kirby)
COMMON INDIAN CROW Euploea core (Cramer)
COMMON LASCAR Pantoporia hordonia (Stoll)
COMMON MAP Cyrestis thyodamas (Boisdval)
COMMON LEOPARD Phalanta phalantha (Drury)
COMMON NAVAB Polyura athamas (Drury)
COMMON PALMFLY Elymnias hypermenstra (Linnaeus)
COMMON SAILER Neptis hylas (Linnaeus)
COMMON SERGEANT Athyma perius (Linnaeus)
COMMON TREEBROWN Lethe rohria (Fabricius)
CRUISER Vindula erota (Fabricius) R
DANAID EGGFLY Hypolimnas misippus (Linnaeus) S1
DARK BLUE TIGER Tirumala septentrionis (Butler)
DARK EVENING BROWN Melanitis phedima (Cramer)
GLADEYE BUSHBROWN Mycalesis patnia (Moore)

Western Ghats and Sri Lanka
46 GLASSY TIGER  Parantica aglea (Stoll)
47 GREAT EGGFLY  Hypolimnas bolina (Linnaeus)
48 GREY COUNT  Tanaecia lepidea (Butler)  S2
49 GREY PANSY  Junonia atilites (Linnaeus)
50 LEMON PANSY  Junonia lemonias (Linnaeus)
51 MALABAR TREE NYMPH  Idea malabarica (Moore)  R
52 NIGGER  Orsotriena medus (Fabricius)
53 RUSTIC  Cupha erymanthis (Drury)
54 SOUTHERN DUFFER STRIPED OR COMMON TIGER  Discophora lepida (Moore)  R
55 TAMIL CATSEYE  Danaus genutia (Cramer)  WE
56 TAMIL YEOMAN  Cirrochroa thais (Fabricius)
57 TAWNY COSTER  Acraea violae (Fabricius)
58 PLAIN TIGER  Danaus chrysippus (Linnaeus)
59 WHITEBAR BUSHBROWN  Mycalesis anaxias (Hewitson)
60 YELLOW PANSY  Junonia hierta (Fabricius)

Pirridae (Whites and Yellows)

62 INDIAN CABBAGE WHITE  Pieris canidia (Sparman)
63 COMMON ALBATROSS  Appias albina (Boisduval)  S2
64 COMMON EMIGRANT  Catopsilia pomona (Fabricius)
65 COMMON GRASS YELLOW  Eurema hecabe (Linnaeus)
66 COMMON GULL  Cepora nerissa (Fabricius)
67 COMMON JEZEBEL  Delias eucharis (Drury)
68 COMMON WANDERER  Pareronia valeria (Cramer)
69 LESSER ALBATROSS  Appias wardi (Moore)  R
70 GREAT ORANGE TIP  Hebomoia glaucippe (Linnaeus)
71 MOTTLED EMIGRANT  Catopsilia pyranthe (Linnaeus)
72 ONE-SPOT GRASS YELLOW  Eurema andersonii (Moore)
73 PAINTED SAWTOOTH  Prioneris sita (C. and R. Felder)  R
74 PSYCHE  Leptosia nina (Fabricius)
75 SMALL GRASS YELLOW  Eurema brigitta (Cramer)
76 SPOTLESS GRASS YELLOW  Eurema laeta (Boisduval)
77 THREE-SPOT GRASS YELLOW  Eurema blanda (Boisduval)
78 YELLOW ORANGE TIP  Ixias pyrene (Linnaeus)

Lycanidae (Blues)

79 APEFLY  Spalgis epius (Westwood)
| Number | Name                       | Species Name                                      |
|-------|---------------------------|---------------------------------------------------|
| 80    | COMMON ACACIA BLUE        | *Surendra quercetorum*                            |
| 81    | COMMON CERULEAN           | *Jamides celeno* (Cramer)                         |
| 82    | COMMON HEDGE BLUE         | *Acytolepis puspa* (Horsfield)                    |
| 83    | COMMON IMPERIAL           | *Cheritra freja* (Fabricius)                      |
| 84    | COMMON PIERROT            | *Castalius rosimon* (Fabricius)                   |
| 85    | COMMON SILVERLINE         | *Spindasis vulcanus* (Fabricius)                  |
| 86    | DARK CERULEAN             | *Jamides bochus* (Stoll)                          |
| 87    | DARK GRASS BLUE           | *Zizeeria karsandra* (Moore)                      |
| 88    | DARK PIERROT              | *Tarucus ananda* (de Niceville)                   |
| 89    | FORGET-ME-NOT             | *Catochrysops strabo* (Fabricius)                 |
| 90    | GRAM BLUE                 | *Euchrysops cneus* (Fabricius)                    |
| 91    | GRASS JEWEL               | *Freyeria trochylus* (Freyer)                     |
| 92    | INDIAN CUPID              | *Everes lacturnus* (Godart)                       |
| 93    | LESSER GRASS BLUE         | *Zizina otis* (Fabricius)                         |
| 94    | LIME BLUE                 | *Chilades lajus* (Stoll)                          |
| 95    | LONG-BANDED SILVERLINE    | *Spindasis lohita* (Horsfield)                    |
| 96    | MALAYAN                   | *Magisba malaya* (Horsfield)                      |
| 97    | MONKEY PUZZLE             | *Rathinda amor* (Fabricius)                       |
| 98    | Line blue sp              | *Nacadubia* sp.                                  |
| 99    | PEA BLUE                  | *Lampides boeticus* (Linnaeus)                    |
| 100   | PLUM JUDY                 | *Abisara echerius* (Stoll)                        |
| 101   | INDIAN RED FLASH          | *Rapala iarbus* (Fabricius)                       |
| 102   | RED PIERROT               | *Talicada nyseus* (Guerin-Meneville)              |
| 103   | SHIVA’S SUNBEAM           | *Curetis siva* (Evans)                            |
| 104   | SLATE FLASH               | *Rapala maneia* (Hewitson)                        |
| 105   | TINY GRASS BLUE           | *Zizula hylax* (Fabricius)                        |
| 106   | YAMFLY                    | *Loxura atymnus* (Stoll)                          |
|       | **Hesperiidae (Skippers)**|                                                   |
| 107   | BUSH HOPPER               | *Ampittia dioscorides* (Fabricius)                |
| 108   | CHESTNUT BOB              | *Iambrix salsala* (Moore)                         |
| 109   | COMMON BANDED AWL         | *Hasora chromus* (Cramer)                         |
| 110   | COMMON BANDED DEMON       | *Notacrypta paralysos* (Wood-Mason and de Niceville) |
| 111   | INDIAN/COMMON DARTLET     | *Orens goloides* (Moore)                          |
| 112   | COMMON REDEYE             | *Matapa aria* (Moore)                             |
| 113   | COMMON SMALL FLAT         | *Sarangesa dasahara* (Moore)                      |
| 114   | COMMON/CEYLON SNOW FLAT   | *Tagiades jepetus* (Stoll)                        |
### Table 2. List of invasive plants recorded in study area.

| SI NO | Family           | Scientific Name                | Common Name        | Native Place             | Risk Level       |
|-------|------------------|--------------------------------|--------------------|--------------------------|------------------|
| 1     | Asteraceae       | Ageratina adenophore           | Crofton Weed       | Central America          | Medium Risk     |
| 2     | Asteraceae       | Ageratum conyzoides Alternanthera | Goat Weed         | Central America          | Low Risk        |
| 3     | Amaranthaceae    | Alternanthera brasiliana Amaranthus | Red calico Plant | Latin America            | Low Risk        |
| 4     | Amaranthaceae    | Amaranthus spinosus             | Prickly amaranthus | Central America          | Low Risk        |
| 5     | Iridaceae        | Aristea ecklonii Asclepias     | Blue Star          | Africa                   | No risk         |
| 6     | Asclepiadaceae   | curassavica Bidos sulphurea Brugmansia arborea | Blood flower | Tropical America | No risk         |
| 7     | Asteraceae       | Bidens sulphurea Brugmansia Suaveolens Catharanthus roseus | Sulphus cosmos White angel trumpet | North America and Africa | No risk         |
| 8     | Solanaceae       | Angel's Trumpet                | Tropical and Subtropical America | No risk         |
| 9     | Apocynaceae      | Periwinkle                      | Madagascar         | No risk                  |
| 10    | Asteraceae       | Centrtherum intermediate Chromolaena odorata | Brazilian Button Flower | South America | No risk         |
| 11    | Asteraceae       | Siam weed                       | Tropical America   | High Risk                |
| 12    | Melastomaceae    | Clidemia hirta                  | Koster's curse     | Tropical and Central America | Low Risk       |
| 13    | Verbenaceae      | Duranta erecta                  | Duranta curse      | South America            | No risk         |
3.3. Bio pesticides and Fertilizer

Bio pesticide property of *Chromolaena odorata*, *Lantana camara*, plants were already identified. Industrial base production of bio pesticide from these plants may decrease its invasion and provide job to the communities depend on this.

It was reported that the compost of Mikania gives better yields in the paddy fields of Mizoram (Sankaran et al., 2010). Small scale industries could take up such initiatives. Hence removal of invasive weeds for the production of such products can lead to biodiversity conservation and also enhance economy.

3.4. Management

The diversity of butterflies for particular habitats is associated with the availability of larval host plants and adult nectar plants (Shihan and Kabir, 2015). Increase in nectar plant and decline in larval host plants may adversely affect butterfly population.

According to Rejmanek, 2003, three management objectives were suggested to weed
control; they are prevention/exclusion, early detection, rapid assessment and control/eradication. No assessment in the percentage cover of invasive plants was done in the area. Knowledge about the status and range of invasive plant species would help in better management plants. Proper and systematic scientific studies would bring out effective ways to control invasive plants.

Use of Lantana as fencing and ornamental flower in garden should be discouraged. Lantana plants should not be planted in and around the crop fields (Gantayet et al., 2014). Clearing lands with invasive plants, continual follow-up treatment to remove roots and seedlings would be effective way to control invasive plants (Gantayet et al., 2014)

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