Kong. Res. J. 4(1) : 148-160, 2017 ISSN 2349-2694
Kongunadu Arts and Science College, Coimbatore.

DOI:10.26524/krj192

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

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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 vegetative 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), Hesperidia (22 species), Pieridae (17 species) recorded respectively (Fig:1).

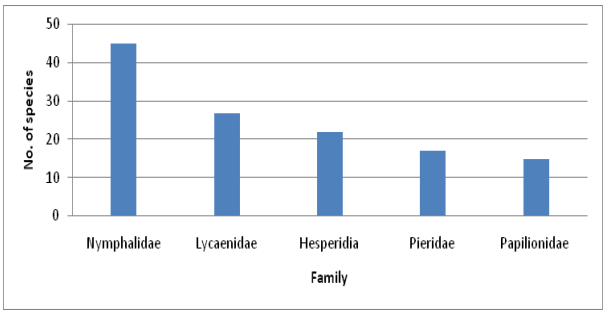


Fig. 1: Family wise abundance in the butterfly species in the Pookode region.

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 *Troides minos, Kallima horsfieldi, Idea malabarica, Curetis siva, Aeromachus pygmaeus, Zipaetis saitis* (Western Ghats and SriLanka), *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 diplotricha, 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 invasia* 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 (Enserink, 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 Fagerstrdm 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 micaranta*and *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 micaranta* (Sahid, 2014)are well documented Organic substances produce by plants as secondary metabolites such as alkaloids, Phenoics , 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 plan 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 *Latana camara.* Bioethanol property of *Lantana camera* (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 *Prospodium 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 Tridnad 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
		Papilionodae (Tailed butterflies)			
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 aristolochiae (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)*			
11	MALABAR BANDED PEACOCK	*Papilio buddha (Westwood)*	R	S2	WE

12	MALABAR BANDED SWALLOWTAIL	*Papilio liomedon (Moore)*	R	S1	WE
13	MALABAR ROSE	*Atrophaneura pandiyana (Moore)*			WE
14	SOUTHERN BIRDWING	*Troides minos (Cramer)*			WE
15	TAILED JAY	*Graphium agamemnon (Linnaeus)*			
		Nymphalidae (Brushfooted butterflies)			
16	BAMBOO TREEBROWN	*Lethe europa (Fabricius)*			
17	BLACK PRINCE	*Rohana parisatis (Westwood)*	R		
18	BLUE NAWAB	*Polyura schreiber (Godart)*	R		
19	SOUTH INDIAN BLUE OAKLEAF	*Kallima horsfieldi (Kollar)*	R	S2	WE
20	BLUE ADMIRAL	*Kaniska canace (Linnaeus)*			
21	BLUE PANSY	*Junonia orithiya (Linnaeus)*			
22	BLUE TIGER	*Tirumala limniace (Cramer)*			
23	CHOCOLATE PANSY	*Junonia iphita (Cramer)*			
24	CLIPPER	*Parthenos sylvia (Cramer)*			
25	COMMON BARON	*Euthalia aconthea (Cramer)*		S2	
26	COMMON BEAK	*Libythea lepita (Moore)*		S2	
27	COMMON BUSHBROWN	*Mycalesis perseus (Fabricius)*			
28	COMMON CASTOR	*Ariadne merione (Cramer)*			
29	COMMON EVENING BROWN	*Melanitis leda (Linnaeus)*			
30	COMMON FIVERING	*Ypthima baldus (Fabricius)*			
31	COMMON FOURRING	*Ypthima huebneri (Kirby)*			
32	COMMON INDIAN CROW	*Euploea core (Cramer)*			
33	COMMON LASCAR	*Pantoporia hordonia (Stoll)*			
34	COMMON MAP	*Cyrestis thyodamas (Boisduval)*			
35	COMMON LEOPARD	*Phalanta phalantha (Drury)*			
36	COMMON NAWAB	*Polyura athamas (Drury)*			
37	COMMON PALMFLY	*Elymnias hypermenstra (Lennaeus)*			
38	COMMON SAILER	*Neptis hylas (Linnaeus)*			
39	COMMON SERGEANT	*Athyma perius (Linnaeus)*			
40	COMMON TREEBROWN	*Lethe rohria (Fabricius)*			
41	CRUISER	*Vindula erota (Fabricius)*	R		
42	DANAID EGGFLY	*Hypolimnas misippus (Linnaeus)*		S1	
43	DARK BLUE TIGER	*Tirumala septentrionis (Butler)*			
44	DARK EVENING BROWN	*Melanitis phedima (Cramer)*			
45	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 atlites (Linnaeus)*			
50	LEMON PANSY	*Junonia lemonias (Linnaeus)*			
51	MALABAR TREE NYMPH	*Idea malabarica (Moore)*	R		WE
52	NIGGER	*Orsotrioena medus (Fabricius)*			
53	RUSTIC	*Cupha erymanthis (Drury)*			
54	SOUTHERN DUFFER	*Discophora lepida (Moore)*	R	S2	WE
55	STRIPED OR COMMON TIGER	*Danaus genutia (Cramer)*			
56	TAMIL CATSEYE	*Zipaetis saitis (Hewitson)*			WE
57	TAMIL YEOMAN	*Cirrochroa thais (Fabricius)*			
58	TAWNY COSTER	*Acraea violae (Fabricius)*			
59	PLAIN TIGER	*Danaus chrysippus (Linnaeus)*			
60	WHITEBAR BUSHBROWN	*Mycalesis anaxias (Hewitson)*			
61	YELLOW PANSY	*Junonia hierta (Fabricius)*			
		Pirridae (Whites and Yellows)			
62	INDIAN CABBAGE WHITE	*Pieris canidia (Sparrman)*			
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 (Carmer)*			
69	LESSER ALBATROSS	*Appias wardi (Moore)*	R	S2	WE
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	S4	
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)*			

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)*		S4	
89	FORGET-ME-NOT	*Catochrysops strabo (Fabricius)*			
90	GRAM BLUE	*Euchrysops cnejus (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)*		S2	
96	MALAYAN	*Magisba malaya (Horsfield)*			
97	MONKEY PUZZLE	*Rathinda amor (Fabricius)*			
98	Line blue sp	*Nacaduba* sp.			
99	PEA BLUE	*Lampides boeticus (Linnaeus)*		S2	
100	PLUM JUDY	*Abisara echerius (Stoll)*			
101	INDIAN RED FLASH	*Rapala iarbus (Fabricius)*			
102	RED PIERROT	*Talicada nyseus (Guerin-Meneville)*			WE
103	SHIVA'S SUNBEAM	*Curetis siva (Evans)*	R		
104	SLATE FLASH	*Rapala manea (Hewitson)*			
105	TINY GRASS BLUE	*Zizula hylax (Fabricius)*			
106	YAMFLY	*Loxura atymnus (Stoll)*			
		Hesperiidae (Skippers)			
07	BUSH HOPPER	*Ampittia dioscorides (Fabricius)*			
108	CHESTNUT BOB	*Iambrix salsala (Moore)*			
109	COMMON BANDED AWL	*Hasora chromus (Cramer)*			
110	COMMON BANDED DEMON	*Notocrypta paralysos (Wood-Mason and de Niceville)*			
111	INDIAN/COMMON DARTLET	*Oriens goloides (Moore)*			
112	COMMON REDEYE	*Matapa aria (Moore)*			
113	COMMON SMALL FLAT	*Sarangesa dasahara (Moore)*			
114	COMMON/CEYLON SNOW FLAT	*Tagiades jepetus (Stoll)*			

115	COMMON SPOTTED FLAT	*Celaenorrhinus leucocera (Kollar)*	
116	COON	*Sancus fuligo (Marbille)*	
117	FULVOUS PIED FLAT	*Psuedocoladenia dan (Fabricius)*	
118	GRASS DEMON	*Udaspes folus (Cramer)*	
119	INDIAN PALM BOB	*Suastus gremius (Fabricius)*	
120	INDIAN GRIZZLED/INDIAN SKIPPER	*Spialia galba (Fabricius)*	
121	DARK PALM DART	*Telicota ancilla (Herrich-Schaffer)*	
122	Unknown Dart	*Potanthus* sp.	WE
123	PYGMY GRASS-/SCRUB-HOPPER	*Aeromachus pygmaeus (Fabricius)*	
124	RESTRICTED DEMON	*Notocrypta curvifascia (C. R. Felder)*	
125	RICE SWIFT	*Borbo cinnara (Wallace)*	
126	DARK SMALL-BRANDED SWIFT	*Pelopidas mathias (Fabricius)*	
127	BROWN AWL	*Badamia exclamationis (Fabricius)*	
128	TAMIL GRASS DART	*Taractrocera ceramas (Hewitson)*	

S1-Scheduled I, Wildlife Protection Act 1972, S2-Scheduled II WPA 1972, S4- Scheduled IV WPA 1972, R- Rare, WE- Westerm Ghat Endemic

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*	Goat Weed	Central America	Low Risk
3	Amaranthaceae	*Alternanthera brasiliana*	Red calico Plant	Latin America	Low Risk
4	Amaranthaceae	*Amaranthus spinosus*	Prickly amaranthus	Central America	Low Risk
5	Iridacea	*Aristea ecklonii*	Blue Star	Africa	No risk
6	Asclepiadaceae	*Asclipias curassavica*	Blood flower	Tropical America	No risk
7	Asteraceae	*Bidens sulphurea*	Sulphus cosmos	North America and Africa	No risk
8	Solanaceae	*Brugmansia arborea*	White angel trumpet	South America	Medium Risk
9	Solanaceae	*Brugmansia Suaveolens*	Angel's Trumpet	Tropical and Subtropical America	No risk
10	Apocynaceae	*Catharanthus roseus*	Periwinkle	Madagascar	No risk
11	Asteraceae	*Centratherum intermedium*	Brazilian Button Flower	South America	No risk
12	Asteraceae	*Chromolaena odorata*	Siam weed	Tropical America	High Risk
13	Melanostomaceae	*Clidemia hirta*	Koster's curse	Tropical and Central America	Low Risk
14	Verbenaceae	*Duranta erecta*	Duranta curse	South America	No risk

15	Acanthaceae	*Hypoestes sanguinolenta*	Measles plant	Madagascar	Medium Risk
16	Lamiacea	*Hyptis suavelolens*	Pignut	Tropical America	Medium Risk
17	Convolvulaceae	*Ipomea cairica*	Railway creeper	Tropical Africa and Asia	High Risk
18	Verbenaceae	*Lantana camara*	Lantana	Central and South America	High Risk
19	Mimosaceae	*Leucaena leucocephala*	Lead tree	Tropical America	Low Risk
20	Onagraceae	*Ludwigia peruviana*	Prim rose tree	North America	Medium Risk
21	Rhamnaceae	*Maesopsis eminii*	Umbrella tree	West and Central Africa	Medium Risk
22	Convolvulaceae	*Merremia vitifolia*	Grape leaf wood rose	Indo Maleshya and China	High Risk
23	Asteraceae	*Mikania micrantha*	Mile-a-minute	South America	High Risk
24	Mimosaceae	*Mimosa diplotricha*	Giant sensitive plant	Tropical America	High Risk
25	Mimosaceae	*Mimosa pudica*	Touch-Me-Not	South America	Low Risk
26	Asteraceae	*Parthenium hysterophorus*	Congress grass	North and South America	Medium Risk
27	Poaceae	*Pennisetum pedicellutum*	Kyasuwa grass	Africa and Asia	Medium Risk
28	Poaceae	*Pennisetum polystachyon*	Mission grass	Tropical Africa	High Risk
29	Solanaceae	*Physalis angulata*	Sunberry	Tropical Africa, Asia, Australia	No Risk
30	Dennstaedticeae	*Pteridium aquilinum*	Broken fern	Tropical America	High Risk
31	Combretaceae	*Quisqualis indica*	Burma creeper	Mynamar	High Risk
32	Ceasalpiniaceae	*Senna occidentalis*	Coffee senna	South America	Low Risk
33	Ceasalpiniaceae	*Senna tora*	Sickle senna	South America	Medium Risk
34	Asteraceae	*Sphagneticola trilobata*	Singapore Daisy	Tropical America	High Risk
35	Asteraceae	*Tithonia diversiflora*	Mexican sunflower	Mexico and Central America	Medium Risk
36	Asteraceae	*Tridax procumbens*	Coat button	Tropical 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

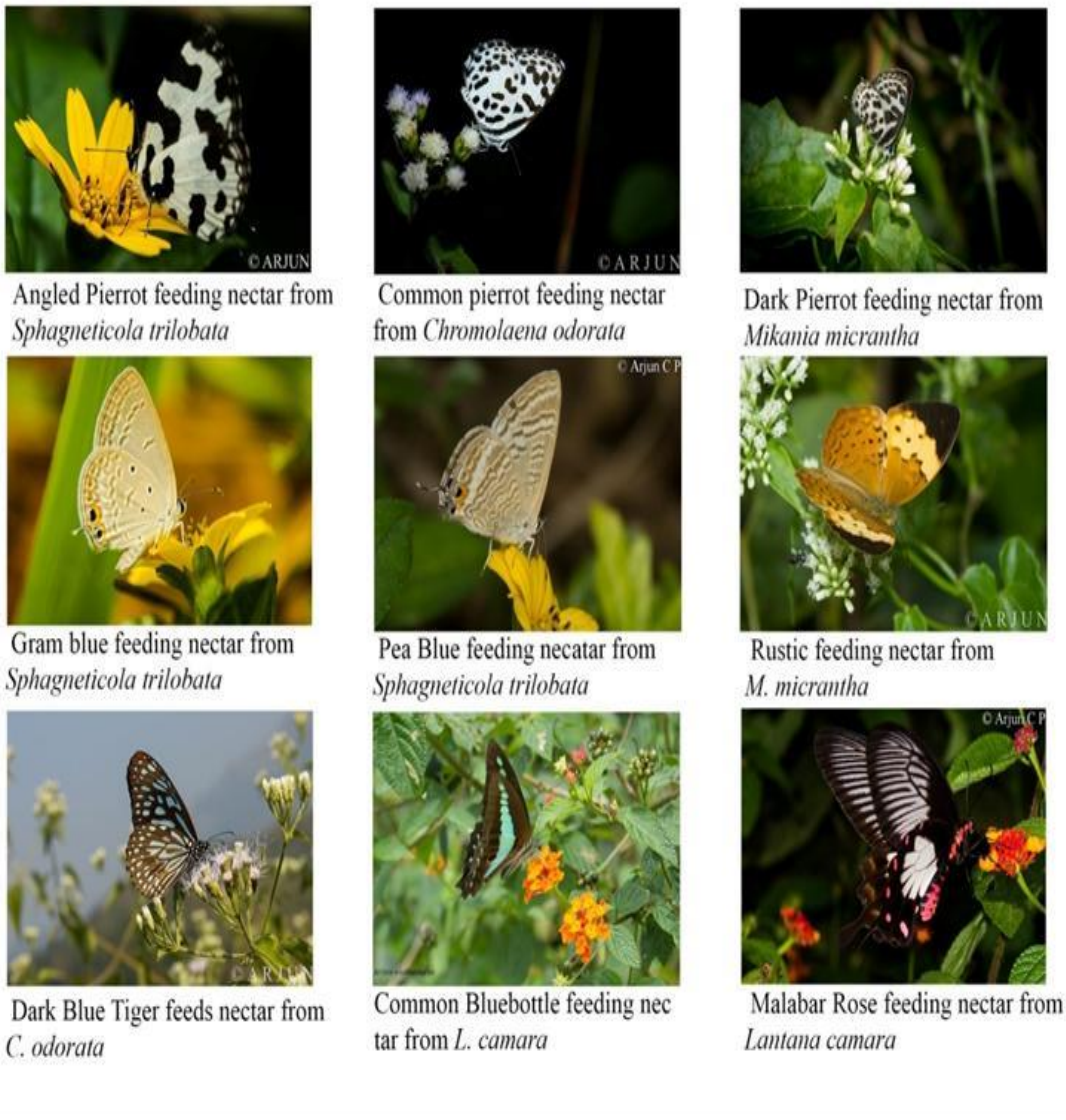
control; they are prevention/ exclusion, early detection, rapid assessment and control/ eradiation. No assessment in the percentage cover of invasive plants was done in the area. Knowledge about the status and range of invasive plant species would help in better management plants. Proper and systematic 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)

ACKNOWLEDGEMENT

We are greatfully to Dr. George Chandy (Director in charge, Centre for Wildlife Studies, CVandAS, Pookode, Wayanad) for the encouragement and Dr. Kalesh Sadasivan (Trivandrum Natural History and Society) for identifying complex species.

Some observation on nectar feeding of butterflies from invasive plants of Pookode region



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