*Bionature,* 36(2) 2016 : 53-69 

# SURVIVAL STRATEGIES AMONG SPECIES IN NATURE. II: INVASIVE SPECIES IN AND AROUND PACHMARHI BIOSPHERE

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**( Accepted 1st July, 2016)**

**Abstract**

Among many Biospheres in India, Pachmarhi biosphere is the most talked about and frequently visited by tourists. The biosphere is one of the most popular biospheres often called as the queen of Satpura ranges and is located at 22 15' -22 28' N latitude and 78-13' 78-26' E longitude ( Fig.1 A). Pachmarhi was once designated as paradise for botanists on account of species richness of Bryophytes and Pteridophytes and the past exhaustive floristic studies have also recorded 101 Angiosperm (flowering plants) families comprising of 452 genera and 778 species (Trees and Shrubs 247+ 531 herbs). Additionally, serene natural beauty of series of three tier forests all around Pachmarhi in the lovely geological contours steeping down in the valleys to plains and high top hills make Pachmarhi a favourite place for a visit. The entire area in and around Pachmarhi is an excellent biological treasure cradling highly versatile fauna in deeper forest areas including tigers, leopards and lot many carnivores. Lately, the concept of Ecotourism and excessive rise in population based business along with too many tourists and related anthropogenic influences have degraded the carpet flora. Invasive species are on rise and about 70% of the land out of major forest area is now covered with invasive plant species which, three decades ago was mainly covered with wild native herbaceous fern flora. This study is in continuation of searching invasive species in Pachmarhi Biosphere and briefly suggests that we can untilize these weeds in a useful way. We have to make efforts to prevent the entry of Invasive species and conserve excellent original flora.

*Key Words:* Invasive species in Biosphere, Strategies for species survival, Medicinal uses of weeds, Adaptations

## INTRODUCTION

An Alien Invasive species (A I S) is one among various threats to the Biodiversity of an area be a forest, a grassland or even an aquatic ecosystem/ wetland etc. Biologically, species can be weeds for "other species in or at a specific niche/habitat more so, when any wild species becomes too aggressive in reproduction and its survival rate exceeds the usual prevalence. Needless to mention, prolific growth in population size of one or more such species in otherwise a balanced ecosystem influences biomass production and biological utility of the particular land mass as a whole. Thus an alien invasive species (AIS) is defined as " a species introduced into a habitat and whose establishment and spreading (due to prolific reproduction) threatens the ecosystem, habitat or species with economic or environmental harm (Mc Neeley, 2001; Callaway and Aschehoug, 2000) Together with habitat destruction, pollution and global climate changes, invasion by exotic species is generally considered one of the main causes of erosion of biological diversity (Olden et al. 2004), although there has been some controversy (Gurevich and Padilla 2004). As a result, many countries have started monitoring, evaluating impacts and eradicating invasive species.

According to recent estimates (Pimental et al, 2001; Adhikari et al, 2015; Manupriya, 2015) nearly half of India's geographical landmass is prone to invasion by alien plant species, as per a new study has reported. This study suggests that 'invasion hotspots' that fall within croplands, rangelands and village biomes must be given immediate attention to control and eradicate such species. Invasive

species, which colonise, spread and invade new territories are considered a threat to local biodiversity and are estimated to trigger annual economic losses amounting to US$ 314 billion in the agriculture and forestry sectors, of which India's share is around US$ 116 billion. Manupriya (2015) refers to studies which have identified ( on the basis of using ecological niche modeling (ENM) and geographical information system (GIS) data most ecologically sensitive regions of India, including the biodiversity hotspots, islands, coastal forests, freshwater swamp forests, mangroves and forest reserves. Incidentally, these coincide with the identified 'invasion hotspots', indicating their vulnerability to alien plant invasion in major areas of Andaman and Nicobar Islands, Andhra Pradesh, Assam, Dadra and Nagar Haveli, Daman and Diu, Goa, Kerala, Manipur, Meghalaya Mizoram, Nagaland, Odisha, Pondicherry, Tamil Nadu, Tripura and West Bengal. These have been labelled with a 'high risk' of invasion. Additionally, some regions, such as the Andaman rainforests, Godavari-Krishna mangroves, Odisha semi evergreen forests and Sundarbans swamps, were found to have more than 90% area climatically suitable for diverse invasive alien plants. Major port towns such as Mumbai, Ratnagiri, Panaji, Nagapattnam, Chennai, Kakinada, Paradip, and Haldia, fell within the identified invasion hotspots, offering avenues for introduction of invasive plants via shipping routes. Rightly so, Manupriya designates this commentary as " Nearly half of India prone to invasive alien plants".

Invasion by a weed is often attributed to several reasons, such as high growth rate, high reproductive potential (even certain sulphur rich aminoacids encourage vegetative reproduction; Khandelwal and Goswami 1986; Khandelwal et al, 1980) adaptive nature and above all interference by resource depletion and allelopathy Allelopathy concerns the effects of one plant on another due to chemicals released by them, or the breakdown products of their metabolites (Willis, 1994). Allelopathy has been suggested as a mechanism for the impressive success of invasive plants by establishing virtual monoculture and may contribute to the ability of particular exotic species to become dominants in invaded plant communities (Hierro, 2003; Kanchan and Jayachandra, 1981and earlier). Allelopathy is expected to be an important mechanism in the plant invasion process because the lack of co-evolved tolerance of resistant vegetation to new chemicals produced by the invader could allow these newly arrived species to dominant natural plant communities (Hierro, 2003). In fact, allelopathic interference is one of the important mechanisms for the successful establishment of invasive exotic species.

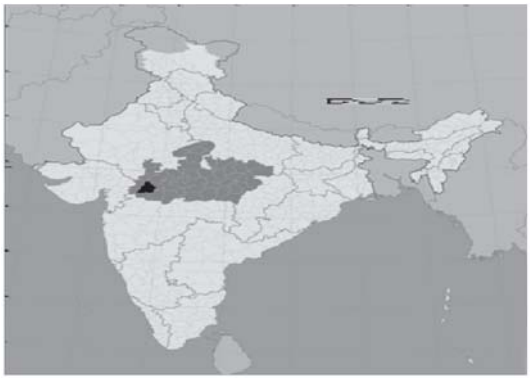

**Fig. 1A - India**


**Fig. 1B - Madhya Pradesh**


**Fig. 1C - Pachmarhi**

## PACHMARHI BIOSPHERE

Madhya Pradesh is enriched with a wide range of topographic and climatic variations which have resulted in a multitude of ecosystems. These ecosystems have in turn contributed to an extremely high level of species diversity in flora and fauna. Keeping these biodiversity rich areas we have 18 (eighteen) biospheres and more than 100 national parks and sanctuaries in the state of Madhya Pradesh. Among these , Pachmarhi biosphere is the most talked about and frequently visited by tourists. The biosphere is one of the most popular biospheres often called as the queen of Satpura ranges and is located at 22 15' -22 28' N latitude and 78-13' 78-26' E longitude ( Fig.1 A). Pachmarhi has been designated as paradise for botanists on account of serene natural beauty of series of three tier forests all around Pachmarhi (very rich herbaceous carpet flora ; dense shrubs and small to tall trees with lush green canopy) in the lovely geological contours steeping down in the valleys to plains and high top hills as the classical symbols of Satpura ranges (Fig. 1A &B ). Early eminent botanists have had made indelible contributions to Indian Botany and put Pachmarhi in the front line among hot spots of India for botanical richness. The species richness of Bryophytes and Pteridophytes in particular have been the most extensively worked out ( Bir and Vasudeva, 1972, 1973; Vasudeva and Bir, 1982, 1992, 1993a, 1993b; Dixit , 1984 and many more) by botanist groups from Ujjain, Allahabad, Patiala, Lucknow. Angiosperm-flora also has been studied extensively and among many of them publications of Botanical Survey of India have been quite exhaustive. Mukerjee (1984) has put a Botanical Survey of India volume incorporating publications from the year 1949 to 1981 wherein 101 Angiosperm (flowering plants) families have been described to comprise of 452 genera and 778 species ( Trees and Shrubs 247+ 531 herbs). The entire area in and around Pachmarhi is an excellent biological treasure cradling highly versatile fauna as well in Central India.

Lately, the concept of Ecotourism has undermined /degraded the botanical value of the biosphere as the human population residing in Pachmarhi and tourists pouring from outside have been increased manifold. Certainly, excessive transport and hotelling business has enormously increased revenue to business class and the governmental agencies but at the same time there have been too many factors operative in damaging the carpet flora of the open land in Pachmarhi. About 70% of the land out of major forest area is now covered with invasive plant species which three decades ago, was mainly covered with wild native herbaceous flora.

This paper obviously intends to present a very sad picture of degradation in natural species. complex within past 30 years and our approach suggests that the ignorance of excessive and prolific growth of many invasive weeds in and around conserved area of biosphere may not safeguard the future of biota within the deeper areas of forest. Lot many plant species have already disappeared from Pachmarhi and many more may succumb to ever increasing aggressive alien invasive species. Hereunder we present our surveyed observations on direct and indirect competition among three aggressive species *Lantana camara, Hyptis suaveolens* and *Stachytarpheta jamaicensis*.

## METHODS

One of us (HKG) has been conducting biodiversity studies in around Hoshangabad - Pachmarhi regions (Fig. 1-C) for more than four decades and several studies on lower group of chlorophyllous plants (Algae, bryophytes, pteridophytes) have been carried out since 1970. In particular, Pachmarhi has been visited nearly 20 times and more than 12 villages around Pachmarhi have been visited onfoot with students over these years to investigate on population genetic parameters on tribal groups. So, genetic aspects of variables of not only plant biodiversity but also animal (particularly regarding frogs and frog allies) and human biodiversity have been explored during these 40 years of affiliation within this Satpura plateau. Relevant approaches and methodologies have been aptly described in many publications which need not be listed here. For nearly two decades attention has been reframed also to search for rare medicinal plants, threatened species as well as invasive species inhabiting biologically indispensible areas such as fresh water lakes/ wetlands/ deeper forests and botanically rich conserved areas (Agarker et al, 1994; Goswami, 2009). In this recent study we have observed a unique, though not very rare phenomenon, of succession of invasive species defining their revised territories by demolishing reproductive performance of their rival invasive species.

## OBSERVATIONS:

### Brief description of invasive weeds:

**(I) *Lantana camara* L**

Earlier visits had always recorded *Lantana camara* weed ( Fig. 2 ) in the outer marginal areas of forests and freely dispersed areas in the country side. As a matter of fact Lantana camara L has been a popular weed not only in India but in other countries also. Basically, *Lantana camara* L is a pantropical weed also affecting pastures and native forests in over 60 countries (Day et al, 2003). The genus has multicoloured flowers and has also been grown in various forms such as ornamental plant , a good protective hedge on account of thorny stem; many rural folk in Indian villages also use it as minor fuel-wood. Wherever it grew, the shrub used to grow prolifically occupying open area by the margins of a forest, open land mass in a village as well as in outer side of the shallow lake. *Lantana* is found throughout India (from North in Jammu to the south in trichmur, on he west coast near Bangalore and in the central part at almost all places in Madhya Pradesh. Such a wide distribution of Lantanas (many variables including chromosomal variables ; polyploids and hybrids: see, Day et al, 2003) is on account of its prolific sexual and vegetative reproductive means; even stems can root at the nodes if fallen or sunk in moist soil. There are many pollinating agents now known besides insects; according to Mathur and Mohan Ram (1986) thrips are more efficient pollinators than butterflies and other insects. Even birds, particularly sunbirds also offer support in pollinating these plants.

*Present distribution and Impact on Biota*

Though we have not noticed Lantanas within the deeper inside areas of forests, but margins and outer exposed land mass is becoming dominated by *Lantana camara*. In Pachmarhi biosphere, mainly at the tourist-spots (eg. Handikho, Bada Mahadeo , Jatashankar etc ) Entire topography appears to be shaken and obliterated which can be noted and realized only by an investigator (HKG) who has been visiting Pachmarhi since 1968-69 and must have studied biological composition of Pachmarhi since then ( about 20 visits so far). *Lantana* infestations has replaced native plant communities and botanical location of rare pteridophytes viz. *Ophioglossum* species (genus often referred as a fern), fern genera *Christella* and *Adiantum* which were frequently encountered

(during August- September) at Handi Kho (Fig.5) open land during (now fenced) are filled up with *Lantana camara and Stachytarpheta jamaicensis*

**(II) *Hyptis suaveolens* Poit)**

*Hyptis suaveolens* belonging to family Lamiaceae, is an annular woody herb with small blue flowers ( Fig. 6). Plants attain the height of about 1 to 1.5 meters. Basically found in Tropical America the species is now growing as an invasive weed in many countries including India. Seed production is too high and often seeds are dimorphic but some plants which are taller (more than 2 meters; Fig. 7) have exhibited seed polymorphism and also show variables in germination (Fig.9 ); some of them germinate after a few months while many germinate as and when moisture becomes available. Since species is a prolific seed producer and dense infestations can yield more than 3000 seeds per square meter forming persistent propagule banks in a short period ( Sharma et al, 2009). Since the seeds are covered with fine cellulosic hairs which swell up on becoming wet (Fig.9) these on shedding can be transported by sticking on any small or larger animal and be suitable dispersed. This seed morphology slightly differs with the seeds mentioned by Sharma et al (2009) as they observed spined burrs (but we consider them fine cellulosic hairs because they swell up and look perfect white covering almost whole part of the seed except the notch; Fig. 9); such a difference may be due to any strain variation of the species or may be they never tried to make them wet and see swollen phase.

This must be helping wider seed dispersal and frequent germination at many other places thereby increasing the density of these plants among other weeds. We have often noticed these plants growing mixed up with *Lantana camara* plants (Fig.7) but always in overwhelming majority overrunning the population growth of *Lantana*. Since *Hyptis* can tolerate dry periods and can germinate in variety of topographic conditions (Sharma et al, 2009) the invasive weed very conveniently occupies the open land slots (Fig.8) having arisen due to drying *Lantana camara* plants. *Lantana* is a perennial weed but does dry out due to scarcity of moisture particularly in Summer. Whether the seedlings seen in drying population of *Lantana* plants are of current season or of seeds dispersed in the last season, we had conducted germination studies in order to assess the dormancy.

*Present distribution and Impact on Biota*

Our field observations conducted during all seasons (Rainy, Winter, Spring and Summer) in and around Bhopal in the circumference of 200kms have suggested beyond doubt that *Hyptis* plants are always seen in three different phases of growth in every season in the same area within a distance of 200 meters. We encounter fresh young plants, see dried plants and also lot many old plants with new leaves and young flowers (Fig 8,13); these observations defy our classical understanding that *Hyptis* is an annual plant. *Hyptis suaveolens* is behaving as a perennial weed like *Lantana* and defeats *Lantana* by overproduction and excessively progressive regeneration by continued cycles of upcoming new young plants. Many areas where we had mainly seen *Lantana camara* plants are now occupied by *Hyptis* populations.

The most unfortunate part of biology of these weeds is that as and when these could find entry at the “gate-land” (as we designate the open land mass outside the fringe area of a forest) the seeds of weeds settle and gradually enter to occupy smaller areas. Within a decade or so as we have observed at many places besides Pachmarhi, where it is known for more than three decades, Mukherjee (1984) had indicated this to be sporadically distributed in the forest areas intermixed with local herbaceous flora. But lately, the initial carpet flora is being replaced by invading weeds thereby minimizing visits of

many insects, butterflies, rodents, squirrels, and a few reptiles. Needless to mention, the carpet flora which mostly consists of ferns and bryophytes in the rainy season and early winters, and whose growth enriches soil with enormous antibacterial organic compounds are getting replaced by plants which utilize soil wealth instead of enriching it. *Hyptis* plants are increasing all around which must be having different allelopathic consequences and invitational influences.

**(III) *Stachytarpheta jamaicensis Vahl syn. S. indica***

*Stachytarpheta cayennensis* (L.C. Rich) Vahl is a weedy (and sometimes perennial) herbaceous plant from the Verbenaceae family commonly called Brazilian tea. Two common very similar species of *Stachytarpheta cayennensis* grow in the tropics and are use interchangeably (and share the same common names) in the herbal medicine systems of many countries.

Erect-diffuse herbs or undershrubs, up to 1 m tall. Leaves 5-10x2.5-3 cm, elliptic, serrate, apex obtuse, base cuneate and decurrent into the petiole, usually rugose. Flowers sessile, in terminal, 10-25 cm long spikes. Calyx 5-6 mm long, tubular, ribbed, 4-toothed. Corolla blue; tube 8-9 mm long, slightly curved, hairy outside; limb c. 8 mm across, oblique; lobes spreading, emarginated. Drupes 3-4 mm long, oblong, ribbed, enclosed in the calyx, breaking into two, 1-seeded pyrenes.

*Present distribution and impact on Biodata*

These plants have covered wide area on Handikho open land from where just two decades ago we had enough distribution of many ferns and smaller pteridophytes like *Ophioglossum costatum*, *O. vulgatum* (not *O. reticulatum*) and *O. nudicaule*. Now we do come across some small patches but in a very localized fashion. At some places (now fenced) *Lantana* has been observed to have mixed sporadic distribution (Fig 5 ).Plants of *Stachytarpheta jamaicensis* however have occupied almost completely the hill area on Rajendra giri where it appears that these plants might have been planted a few decades ago, (on account of its antimalarial usages) and later this species has replaced all other local hernbs. Since this is not a part of natural flora of this area may be due to this reason this species has not been recorded or mentioned in the flora of Botanical Survey of India (1984). Though we do not have exact botanical record of its first find in Pachmarhi but it appears possible that this herb being of great medicinal value, must have been brought to grow here at the time when many top citizens and social luminaries ( even the first President of India Dr Rajenndra Prasad stayed here for sometime) started visiting Pachmarhi (may be, in late 1950s this herb must have been brought by Vaidyas/ local Auyurvedic personnel who used it as a medicinal plant) because this herb helps in curing malaria, lung and breathing troubles and related common ailments.

## DISCUSSION

Our observations will be gaining greater relevance in near future as not only in India but allover the world serious attention has been laid on conservation of biospheres and keeping them protected from biological invasions. And beyond any doubt or confusion, to search and locate-attitude has to be the first step towards this objective.

Together with habitat destruction, pollution and global climate changes, invasion by exotic species is generally considered one of the main causes of erosion of biological diversity (Olden et al. 2004), although there has been some controversy (Gurevich and Padilla 2004). As a result, many countries have started monitoring, evaluating impacts and eradicating invasive species. An important question that arises is what to do when the invasive exotic is a species threatened with extinction within its original occupied distribution. An important question that arises is what to do when an invasive

exotic is a species threatened with extinction within its original distribution and there are few cases in the world illustrating this situation. These species potentially compete with local species for resources and may displace native species or, may in some cases, weaken the gene pool of the native species. The simple eradication of the invasive population could reduce the species' gene pool, and the eradication process might affect local sympatric species. We recommend a program including identification of areas within the natural range where the species is extinct, removal of the causes of extinction in those areas, then gradual removal of the species

**(1) Economic and Medicinal importance of Invasive Weeds**

Most plants are of medicinal uses and some or the other beneficial advantage can always be exploited by the ingenuity of researchers but when it comes to conservation of forest area ecosystem and biodiversity management we can not encourage spreading of the weed in a biosphere. The Man has been evolving by turning menace to wealth but propagating weeds is becoming harmful to our own flora and fauna. Since at many places, the encroachment or presently inhabited area by the invasive species is too large and appears unmanageable it would be extremely wise step to take best use of that weed as well as restrict its further advancing distribution within the biosphere.. One of the best remedies is to exploit the medicinal uses of vegetative parts and regular seasonal pruning can help local economy in villages for poor families.

***Lantana camara***

In certain parts of India where *Lanatana* had grown luxuriantly people have cultivated as a profitable weed. As mentioned above rural folk uses it as a minor fuel while some use it as a fence around their small. There is no specific utility of this weed but recently we have come across a novel utility. Being cared and grown under care these perennial plants attaine a height of even 16 feet making thick tough stem and strong branches with enough tensile strength. Light weight furniture is being made and frequently utilized in upper northern hilly areas near Dehradun in Uttranchal. In some studies in Australia workers have found that lantanas enrich soil with nutrients but at the same time owing to its multicoloured beautiful flowers many insects pests are attracted which may harm the native flora. Like many plants, leaf extracts exhibit antimicrobial properties and have also been used as potential biocide. Aqueous leachate at 2 to 3 % can kill water hyacinth ( *Eichornea*), one of the most troublesome aquatic weed in India and elsewhere. Using it as a weedicide would require a planned experimental approach. The extracted essential oils of lantanas have also been used to treat some skin disorders

***Hyptis suaveolens***

Population increase of *Hyptis* can offer increased chances of utilizing this weed for medicinal purposes. *Hyptis* possesses multiple medicinal properties (Musa et al, 2009; Noudogbessi,Jean-Pierre et al, 2013) being very rich in essential oil contents (Pandey et al, 1982) with many organic compounds like sabinene, eucalyptol, terpinolene etc. Predominance of sabinene is of particular interest as this compound offers support in adapting to hardy situations of a plant. The authors have reviewed world wide studies on extracts of essential oils and catalogued numerous compounds with their quantitative proportions and their effective uses in medicine more effectively in African, Latin America and Australian continents. *Hyptis* suaveolens is an established medicinal herbof enormous potentialities. In traditional medicinal practices (Nantitanon et al, 2007) the essential oil of *Hyptis* has been used as a wound healer and a vital source for

treatment of various infections and ailments as it possesses antimicrobial, antifungal (Pandey et al 1982; see review Noudogbessi, et al, 2013) and antioxidant properties.

Increasing plant populations of *Hyptis* are now under detailed studies more particularly because certain plants attain more than 2 meters in height (maximum height reported earlier is 1.5 m: see Sharma et al, 2009). On one hand this appears to be due to edaphic factors and availability of water/moisture in the smaller ditches of undulating exposed land around the village area and on the other hand this may be due to a genetic mechanism operating within the new variant which might have arisen due to local hybridization within plant populations. There are very contradictory records of prevalence of Hyptis plants. At some places the *Hyptis* plants are standing as dried up community and just nearby (100 meters ) these are seen as regenerating perennial weeds within the same stony stratigraphic situations. In these forest areas *Hyptis* population has already penetrated inside deeper niches among shrubs and trees of the natural forest near Hoshangabad (Figs. 11-13)

***Stachytarpheta jamaicensis***

This weed has a lot of medicinal potential; dried leaves are used as Brazilian tea. Eaten like spinach the leaves are used for intestinal worms, veneral diseases, ulcers and dropsy etc. Decoction of leaves is also used against cardiac troubles in traditional medicinal practices (Ambasta et al, 1986, in CSIR publication 1986).The phytochemical analysis carried out on the leaves of S.jamaicensis showed the presence of secondary metabolites including tannins, saponins and flavonoids (Idu et al, 2007). Crude concentrations of aqueous extracts of leaves showed varying activities on *Bacillus subtilis*, *E.coli*, *Candida albicans, Staphylococcus aureus, Pseudomonas aureginosa, Proteus species and several other microorganisms*. Alcohlic extracts had also exhibited almost similar effects particularly on *Staphylococcus*. This is the major reason that *S. jamaicensis* is considered to be a very effective agent functioning as antacid, antihelmithic analgesic, anti-inflammatory, hypopotensive, sedative, lactogogue, spasmogenic , vasilator etc (Cowan, 1999; Altman et al, 2006; Cano and Volpato, 2004; Idu et al, 2007). These pharmacological characteristics make its best use also as a good medicine for certain respiratory disorders. The leaves of this plant are also one of the most efficient and effective constituents of traditional herbal mixtures in Eastern Cuba. One hundred seventy plant species and other other products are used in 199 formulas, alone being the more complex. *Cocos nucifera* (Arecaceae), *Bidens pilosa* L. (Asteraceae),*Cissus sicyoides* L.(Vitaceae), *Erythroxylum havanense* Jac. (Erythroxylaceae) and *Stachytarpheta jamaicensis* (L.) Vahl. (Verbenaceae) are the species most frequently cited (Cano and Volpato, 2004). *S. jamaicensis* is a globally established medicinal plant of versatile uses (Sulaiman et al, 2007;

Medicinal properties of sister species, *Stachytarpheta cayennensis* (L.C. Rich) Vahl is a weedy (and sometimes perennial) herbaceous plant from the Verbenaceae family also commonly called Brazilian tea. Two common very similar species of *Stachytarpheta cayennensis* grow in the tropics and are use interchangeably (and share the same common names) in the herbal medicine systems of many countries, *Stachytarpheta cayennensis* and *Stachytarpheta jamaicensis*. Ethnobotanically, *Stachytarpheta cayennensis* is used to treat various ailments such as inflammation, pain, fever, hepatic and renal disorder, helminthiasis, constipation,

hypertension, stress and diabetes. The plant is in use in parts of Southern Nigeria and Peru for the treatment of malaria. Phytochemical studies of the plant revealed that it contains alkaloids, Ipolamide, beta hydroxyipolamide and verbascoside, steroids, triterpenes and irridoids. *Stachytarpheta cayennensis* has been reported to be antiinflammtory, antinociceptive, anti ulcerogenic, antidiarrheoal as well as sedative and hypotensive (Okonon et al, 2009). An insignificant in vitro antiplasmodial activity has been reported of the plant in Peru. Very interestingly, antiplasmodial potential of *Stachytarpheta cayennensis* / (may be *jamaicensis*) has also been established as malarial remedy in southern Nigeria.

The effects of *Stachytarpheta jamaicensis* tea on the plasma lipid profile and atherogenic indices were investigated in rabbits (Ikewuch and Ikewuchi, 2009) . The test group received daily, by intra-gastric gavages, 15mg/kg of aqueous extract. The treatment led to significant decreases ($p<0.05$) in plasma levels of total, LDL- and VLDL-cholesterol and triglycerides, and increase ($p<0.05$) in plasma HDL cholesterol level. It also produced significant ($p<0.05$) decreases in the atherogenic indices; cardiac risk ratio, atherogenic coefficient and atherogenic index of plasma. These results suggest the use of *Stachytarpheta jamaicensis* tea in the management of dyslipidemia whether primary or secondary to obesity, diabetes mellitus and hypertension, and by extension, the reduction of the risk of cardiovascular diseases

**2. Competition for resources & Reproductive parameters**

.Several anthropogenic factors have also contributed to the degradation and deterioration of natural habitats and ecosystems and thereby resulting in harmful consequences on species which inhabit them. Such losses have already been known for resulting in rapid massive losses in islands and smaller areas with rich biodiversity pockets

*(I) Lantana :* (Figs 2-5)

Many workers have published on allelopathic influences of *Lantana* in an area where almost entire field has now been filled up with these weeds. Excessive presence of lantanas has another adverse side effects as the bushes offer protective shelter to mosquito and flies (See, Day et al , 2003).

*( II) Hyptis* ( Figs 6-9, 11-12)

Increasing plant populations of *Hyptis* are now under detailed studies more particularly because certain plants attain nearly 03 meters in height (maximum height reported earlier is 1.5 m: see Sharma et al, 2009). On one hand this appears to be due to edaphic factors and availability of water/moisture in the smaller ditches of undulating exposed land around the village area but on the other hand, this may be due to a genetic mechanism operating within the new variant which might have arisen due to local hybridization within plant populations. There are very contradictory records of prevalence of Hyptis plants. At some places the *Hyptis* plants are standing as dried up community and just nearby (100 meters) these are seen as regenerating perennial weeds within the same stony stratigraphic situations (Figs 11,12). In these forest areas *Hyptis* population has already penetrated inside deeper among shrubs and trees of the natural forest near Hoshangabad.

(III) *Stachytarpheta*: ( Figs 10 )

This weed is used as Brazilian tea because of its medicinal properties (Cowan, 1999; Altman et al, 2006; Cano and Volpato, 2004; Idu et al, 2007). This is quite interesting that these herbs are confined to the foot hills of the spot named as “Rajendra giri” in Pachmarhi.

We have tried to search at many other localities during our repeated visits to Pachmarhi but could come across its major concentration only on land area at another spot “Handi Kho”. There have been crowd of different flies and other insects in the area mostly encircling the herb but since intermixed with Lantana and a few more small herbs we can not speculate these to be associated with Stachytarpheta plants. However, peculiar aromatic odour is quite different for various insect fauna.

**(3) Comments on relevant Biological threats**

Many workers have published on allelopathic influences of *Lantana* and other intruders like Parthenium plants on many plant genera inhabiting the growth of many native species which in turn helped Lantanas to overrun the native species (Evans, 1997;Kohil and Rani, 1994; Meiners, et al. 2001; Netsere and Esayas Mendesil, 2011). For many such and other adjuvant factors we now see the entire ground flora almost filled up with these weeds. Excessive presence of lantanas has another adverse side effects as the bushes offer protective shelter to mosquito and flies.

(I) Aggressive *Hyptis* distribution is offering erosion thereby facilitating invasive opportunity for other invaders (Plate 6 )

(Flowers pollinated by insects / honeybees attract regular visits and finally abodes)

Another exceedingly important question that arises is what to do when the invasive exotic is a species threatened with extinction within its original distribution and there are few cases in the world illustrating this situation (Rocha et al, 2011; Rocha and Bergallo,2012) .Obviously, these species aggressively compete with local species for resources and may displace native species or, may in some cases, weaken the gene pool of the native species. The simple eradication of the invasive population could reduce the species' gene pool, and the eradication process might affect local sympatric species. Biologically it becomes imperative to investigate in depth of the possible reasons and intricate problems involved in such an ecological succession. Identification of such areas within the natural range where the species is becoming extinct, removal of the causes of extinction and knowing biological whereabouts of species involved becomes highly challenging. We present hereunder some notes on common invasive weeds of this area along with detailed investigations on species posing specific problems triggering four present endeavour.

(II) Invasive species can invite obnoxious animal species:

**(4) Rare Precautionary benefits of Invasive species:**

Let us turn weed-menace to wealth and assets (Goswami, 2011) : We immediately imagine following two categories of investigations:

**(A) Field work would involve :**

(i) Identification of invasive species

(ii) Become extra cautious of conserving rare or threatened and or, important species with alternate conservational schedules

(iii) Search for alternate protected area in or around the biosphere.

A very commendable step was undertaken during 1980s by the Forest Department of Government of Madhya Pradesh and many details were discussed with the then Forest Officer looking after Pachmarhi Biosphere Late Shri Pantaney with whom I had undertaken several surveys in Ratapani reserved belt for conservation. We are destined to workout in detail the greater biological impact of this alternative conservatory ( Unpublished data).

**(B) *Field and Laboratory investigations must be* combined !**

Some organization, be a university or a research laboratory of the Forest Department should take up to extract chemical compounds from varios parts of invasive plants so as to explore the installation of small chemical and pharmaceutical laboratories. Our present studies have already indicated briefly about these invasive weeds (*Hyptis suaveolens, Lantana camara, Stachytarpheta jamaicensis*) which have been studied and proved to be of useful medicinal values.

The selective use of crude plant extracts has been the oldest ritual in ancient Indian "Ayurveda" as well as in Chinese traditional medicine systems for thousands of years. In modern approaches, we have combined multidisciplinary technologies and have specific chemical compounds extracted and identified for producing very particulate medicines from plant parts. Practically, modern pharmaceutical industry is based on 80 to 90 % biological products. Plants which yield appreciable quality and quantity of polysachharides, steroids, terpenoids, flavnoids, alkaloids and antibiotics are suitable for dragging out drugs for many ailements including cancer treatments. Medicinal plants obviously, are cultivated and cultured world over. Botanically, say a thousand year ago, these were wild and many of them were weeds. Among three types of wild plants, weeds include two categories; but here we would consider only those plant species which grow in an area/vegetation preventing luxurious growth of other native species (INVASIVE SPECIES). Prolific growth in population size of one or more such species in otherwise a balanced ecosystem (forest; grassland, aquatic, or a desert) influences biomass production and biological utility of the particular land mass as a whole. During earlier visit to Hawaii Islands (by HKG) and stay at Hilo and Volcano village in the year 2006 glaring examples were noted about menace from *Hedychium gardneranum* (local name- kahili ginger) and *Tibouchina uroilleana*. These species pose serious obstacles to the other flora; why not explore their pharmaceutical values ?.

In their remarkable study Noudogbessi et al (2013) have exhibited the great potential of oil contents of *Hyptis suaveolens* essential oil which is quite rich in containing sabinene, eucalyptol, terpinolene, phyllocladene etc. All these organic compounds are utilized in preparing many important medicinal drugs.

**Consent for medicinal usages of Weeds**

We need global concern on this matter; must we utilize the prolific reproductive capacity of "invasive genomes" of certain otherwise "wild species of plants and animals". Results of highly aromatic compounds, antimitotic oils etc extracted from several small weeds (*Ophioglossum, Isoetes, Selaginella*,), several aquatic ferns, viz. *Salvinia, Azolla, Marsilea* and many other wild species found on Indian vast land exposures and road side flora. Even aquatic weeds like *Polygonum glabrum, Ceratopteris* spp and certain Chlorophycean algae are very potential plants for anti-cancerous compounds. Biochemists and pharmaceutical scientists are testing antimicrobial and antibiotic assay both by simple and highly prolonged trials. Weeds will have to be made useful because our experience with weeds guides that when any wild species becomes too aggressive in reproduction and its survival rate exceeds the usual prevalence such a species might be gifted with natural awakening (series of mutations ?) of rare and unique DNA sequences (adjudged by DNA blast-approach). In our opinion many other weeds (Goswami,2009; Goswami et al, 2016; Goswami and Ram, 2016) including now widely spreading Hyptis be explored to be a part of small scale industry.

**SUMMARY**

There are hundreds of plant species which grow as “uncalled for” in a particular area/vegetation or ecosystem thereby hampering or preventing luxurious growth of other native species. Biologically, species can be weeds for “other species in or at a specific niche/habitat” more so, when any wild species becomes too aggressive in reproduction and survival rate exceeds the usual prevalence. Needless to mention, prolific growth in population size of one or more such species in otherwise a balanced ecosystem (be a forest; grassland, aquatic, or a desert/xeric ecosystem) influences biomass production and biological utility of the particular land mass as a whole. Thus an alien invasive species (AIS) is defined as “ a species introduced into a habitat and whose establishment and spreading (due to prolific reproduction) threatens the ecosystem, habitat or species with economic or environmental harm (Veitch and Clout, 2002; Mc Neeley, 2001; Olden et al, 2004;)

1. Alien Invasive species (A I S ) is one among various threats to the Biodiversity of an area be a forest, a grassland or even an aquatic ecosystem/ wetland etc.
2. Madhya Pradesh is enriched with a wide range of topographic and climatic variations have resulted in a multitude of ecosystems. These ecosystems have in turn contributed to an extremely high level of species diversity in flora and fauna.
3. Several anthropogenic factors have also contributed to the degradation and deterioration of natural habitats and ecosystems and thereby resulting in harmful consequences on species which inhabit them.
4. Such losses have already been known for resulting in rapid massive losses in islands and smaller areas with rich biodiversity pockets.
5. We must make serious efforts to carry on field surveys to identify invasive species in different ecosystems by the relevant ecosystems experts and biologists. Post holding officials have only to manage funds and facilitate basic needs. Even our aquatic ecosystems (Lakes/ ponds/rivers etc) need time bound surveys for proper care.
6. The time has reached when we must conserve both exsitu and insitu conservation for vulnerable species. IUCN (1998, 2000, 2011 and on regular intervals) have been issuing the world consensus to act for conservation, removal of Invasive species as well as introduction of species so as to maintain biodiversity . Translocations (sensu IUCN 2013) can be effective conservation tools only if they are undertaken with underpinning science to support the actions and outcomes. Translocations are rarely the simple exercise of moving species and/or populations for conservation purposes, the so-called 'gardening approach',rather, behind each translocation there should be a level of pragmatic and focused science to support the actions and to interpret the long-term viability of the action.
7. Regular monitoring for threatened species in an area / biosphere along with precautions for conservation are focal themes of IUCN charter and one of us (HKG) is a member of the council by virtue of contributing acceptable ( at IUCN congress Hawaii Islands; 1st Sept- 10 Sept 2016) suggestions

**REFERENCES**


Adhikari, D. et al. (2015) Modelling hotspots for invasive alien plants in India. PLoS ONE (2015) doi: 10.1371/journal.pone.0134665

Agarker, M. S., Goswami, H. K., et al.(1994) Biology, Management and Conservation of Bhoj Wetland I. Upper Lake Ecosystem in Bhopal. Bionature Monograph (1-119).Catholic Press Ranchi, India

Altman J E, Idu, M., Odia, E A., Omogbai.E K., Amaechina, A O., Ebite, L E. ( 2006) Histopathological effects of Stachytarpheta jamaicensis (L) Vahl. On Wistar rats. Pak.J. Biol.Sci 9: 477 482

Ambasta, et al -C S I R Publication (1986) The Useful Plants of India; Edited by Ambasta et al. New Delhi

Bir, S S and Vaudeva, S.M (1972) Ecological and phytogeographical observations on the pteridophytic flora of Pachmarhi Hills (central India). J.Ind bot. Soc 51:297-304

Bir, S S and Vasudeva, S M (1973) Systematic account of pteridophytes of Pachmarhi Hills (Central India) Pl Sci. 5 : 71-86

Cano, J H, Volpato,G (2004) Herbal mixtures in the traditional medicines of Eastern Cuba. J. Ethnopharmacology. 90: 293-316

Callaway, R.M. and Aschehoug, E.T. (2000). Invasive plants versus their new and old neighbors: a mechanism for exotic invasion. *Science*. **290**: 521523.

Cowan, M. M. (1999) Plant products as antimicrobial agents. Clin. Microbiol Rev. 12: 564-582

Day, M, Wiley, C.J, Playford, J and Zalucki, M.P. (2003) ACAIR Monograph Part I, The Lantana Problem. Pp-2-22; 102

Dixit, R.D.( 1984) A census of The Indian Pteridophytes. Flora of India Series -4. Botanical Survey of India. Howrah/ New Delhi.

Evans, H.C. (1997). Parthenium hysterophorus: A review of its weed status and the possibilities for biological control. Biocontrol: News and Information. **18**(3): 89-98.

Goswami H K (2009) Non Angiospermic plants are also ancient medicinal

plants: conserve and explore them!! Bionature: 29: 95-107

Goswami, H.K. (2011) Editorial Bionature 31.

Goswami, H K and Ram, H K (2016) Survival strategies among species in Nature.I: One invasive species replaces another invasive species. Bionature 36 (1) :43-46

Gurevich J, Padilla DK (2004) Are invasive species a major cause of extinctions? Trends Ecol Evol 19:470474

Goyal, C.P. & Brahma, B.C. 2001. A ray of hope against Parthenium in Rajaji National Park. Indian Forester. **127**(4): 409-414.

Hierro, J.L. & Callaway, R.M. 2003. Allelopathy and exotic plant invasion. Plant and Soil. **256**: 29-39.

*Ikewuch,C. J and Ikewuchi, C C (2009)* Alteration of Plasma Lipid Profiles and Atherogenic Indices by *Stachytarpheta jamaicensis* L. (Vahl) Biokemistry. 21 (2) 1-7

Idu, M., Omogbai, E K I., Aghimien, G E. , Amaechina, F., Timothy, O and Omonigho, S.E (2007) Preliminary phytochemistry, Antimicrobial properties and acute Toxicity of Stachytarpheta jamaicensis (L) Vahl. Leaves. Trends in Medical Research 2 (4) : 193-198 (ISSN 1819-3587)

IUCN (1998) Guidelines for re-introductions. IUCN/SSC Reintroduction Specialist Group, Geneva

IUCN (2000) IUCN guidelines for the prevention of Biodiversity Loss caused by Alien Invasive Species IUCN/SSC

IUCN (2011) IUCN red list of threatened species. International Union for Conservation of Nature and Natural Resources, Switzerland. http://www.redlist.org

Kanchan, S.D and Jayachandra. (1981). Effects of Parthenium hysterophorus on nitrogen-fixing and nitrifying bacteria. Canadian Journal of Botany. **59**: 199-202.

Khandelwal, S. & Goswami, H. K. (1976). Amino acid differentiation in Ophioglossum L. by paper Chromatography. Curr. Sci. 45 (2): 62-63.

Khandelwal, S., Goswami, H. K. & Chatterjee, A. K. (1980). Nitrogen and oil contents in *Ophioglossum* L. *J. Indian bot. Soc*. **59**: 78-80

Kohil, K.K. and Rani, D. (1994). *Parthenium hysterophorus*--a review. *Research Bulletin (Sci.) Panjab University*. **44**: 105-149.

Mc Neeley, J A (2001- Editor) The great Reshuffling Human dimensions of Alien Invasive species . IUCN, Gland

Manupriya (2015) Nearly half of India prone to invasive alien plants. Nature India Sept 2015

Mathur, G. and Mohan Ram, H.Y. (1986). Floral biology and pollination of Lantana camara. Phytomorphology. 36; 79-100.

Meiners,S J, Pickett, S T A and Cadenasso, M. I. 2001 Effects of Plant invasions on the species richness of abandoned agricultural land. Ecography 24: 633-644

Mukherjee, A K. (1984) Flora of India Series 3. Flora of Pachmarhi and Bori Reserves. Govt. of India Publication Botanical Survey of India. Howrah

Musa, A K. Dike, M C and Onu, I. 2009 Evaluation of Nitta (Hyptis suaveolens Poit) seed and Leaf extracts and seed powder for the control of Trogoderma granarium Everts (Coleoptera: Dermestidae) in stored ground nut. America-Eurasian Journal of Agronomy. 2 176-179

Nantitanon, W., Chowwanapoonpohn, S and Okonogi,S. 2007. Antioxidant and antimicrobial activities of *Hyptis suaveolens essential* oil Scientia Pharmaceutica, 75:35-46

Netsere A. and Esayas Mendesil E. (2011) Allelopathic effects of Parthenium hysterophorus L. aqueous extracts on soybean (Glycine max L.) and haricot bean (Phaseolus vulgaris L.) seed germination, shoot and root growth and dry matter production.

Journal of Applied Botany and Food Quality 84, 219 - 222

Noudogbessi, Jean-Pierre; Agbangnan, P; Yehouenou, B; Adjalian, E ; Nonviho, G; Akibou Osseni M; Wotto, V; Figueredo, G; Chalchat, J and Sohounhloue D (2013) Physicochemical properties of *Hyptis suaveolens essential* oil. Int. J. Med. Arom. Plants 3: 191-199

Okokon, J.E., Ettebong,E and Bassey S. Antia (2009) *In vivo* antimalarial activity of ethanolic leaf extract of *Stachytarpheta cayennensis* Indian J Pharmacol. 2008 Jun; 40(3): 111113.

Olden J D et al (2004) Ecological and evolutionary consequences of biotic homogenization. Trends Ecol Evol 19:1824

Pandey DK, Tripathi N N, Tripathi R D and Dixit S N (1982) Fungitoxic and phytptoxic properties of the essential oil of Hyptis suaveolens, Zet Pflanzenkran.Pflanzensch 89:344-349

Pimentel, D. et al. (2001) Economic and environmental threats of alien plant, animal, and microbe invasions. *Agr. Ecosyst*. Environ. 84, 1-20

Rocha, C F D and G. Bergallo, H G (2012) When invasive exotic populations are threatened with extinction . Biodivers Conserv. DOI 10.1007/s10531-012-0392-1

Rocha CFD et al (2011) Invasive vertebrates in Brazil. In: Pimentel D (ed) Biological invasions: economic and environmental costs of alien plant, animal and microbe species. Taylor and Francis, New York,

pp 53103

Sharma, G P , Raizada, P. and Raghuvanshi, A S (2009) Hyptis suaveolens: An emerging invader of Vindhyan plateau, India. Weed Biology and Management 9: 185-191

Sulaiman, M R., Zakaria, Z A, Chiong, H S, Lai, S K, Israf, D A, Azam Shah TM (2009) Antinociceptive and anti-inflamatory effects of Stachytarpheta jamaicensis (L) Vahl (Verbenaceae) in experimental animal models. Med Princ Pract, 18 (4): 272-279

Vasudeva, S M and Bir, S S (1982) Chromosome numbers and evolutionary status of fern and fern allies of Pachmarhi hills (Central India) Aspects of Plant Sciences 6 : 119-181

Vasudeva, S M and Bir, S S (1992) Pteridophytic flora of Pachmarhi hills (Central India) General Account & families : Psilotaceae Isoetaceae. Indian Fern J 9: 153-173

Vasudeva, S M and Bir, S S (1993a) Pteridophytic flora of Pachmarhi hills, Central India II.(Gleicheniaceae-Athyriaceae) Indian Fern J 10: 113-138

Vasudeva, S M and Bir, S S (1993b) Pteridophytic flora of Pachmarhi hills (Central India)

Fern Families : Thelypteridaceae- Marsileaceae . Indian Fern J. 10: 172-205

Veitch CR, Clout MN (ed) (2002) Turning the tide: the eradication of invasive species. Occasional paper of the IUCN species survival commission No. 27,IUCN SSC Invasive Species Specialist Group, Geneva

Willis, R.J. (1994). Terminology and trends in allelopathy. *Allelopathy Journal*. **1**(1): 6-28.

**Evening View of Pachmarhi**

**Fig.2 .Flowers and fruits of Lantana camara**

**Fig.3 Lantana in Mahadeo locality**

**Fig. 4 Lantana bushes have totally occupied carpet area forest margin**

**Fig.5. Lantana mixed up with Stachytarpheta jamaica. Ophioglossum spp and lotmany mosses and Riccia spp were collected in 80s.**

**Fig.6. Young plant of Hyptis with blue flowers**

**Fig.7. Tall Hyptis plants dominating Lantanas**

**Fig.8 Hyptis plants are regenerating appearing as perennial weed**

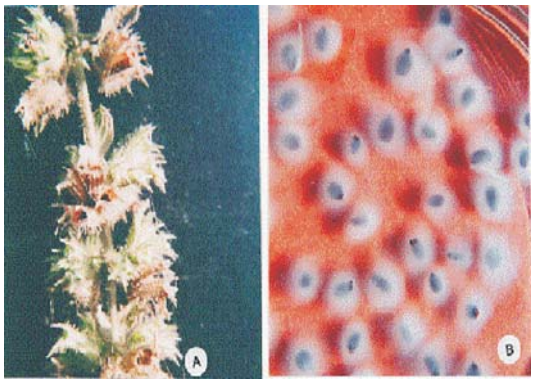

Fig.9 : A . Branch of a dried Hyptis plant showing clustering of spiny fruits with intact seeds, seeds are very conveniently distributed; B. Swollen seeds of Hyptis showing germination in a Petridish moistened with sterile distilled water on filter paper;Note cover of swollen mucilaginous stick all around seeds; certain seeds are round while majority are triangular with prolonged papillae.

**Fig.10. Stachytarpheta jamaicensis with blue flowers**

**Fig.11. Dried plants of Hyptis scattered as carpet flora in the open forest area in Satpura ranges near Budni forest about 80-90 Kms away from Pachmarhi**

**Fig.12 At many places dried plants of Hyptis with a few Lantana shrubs are seen totally within the forest**

**Fig.13 At many places some Hyptis plants regenerate branches with new leaves as perennial weeds while hundreds of dried small bushes of Hyptis (see Fig. 11) are seen scattered as dried carpet flora of the forest**