

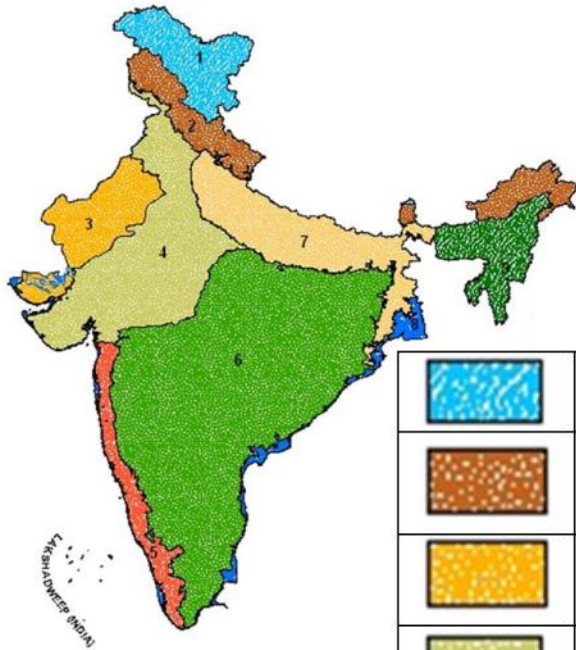









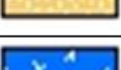
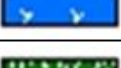

# Ecology Invasive Species and Forest Types



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**Dehradun**  
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# Threats to Biodiversity



	1: Trans-Himalaya	Livestock pressure, Tourism, Exotic plantations, Medicinal plants & NTFP extraction, Poaching, Human-animal conflict, Border strife, Climate change.
	2: Himalaya	Climate change, Deforestation, Invasive species, Medicinal plants & NTFP extraction, Fire, Land use change, Development & urbanisation, Mining, Hydropower development, Tourism, Pollution & eutrophication.
	3: Desert	Invasive species, Land use change, Livestock pressure, Human population pressure, Mining, Border strife.
	4: Semi-Arid	Land use change, Mining, Livestock pressure, Poaching.
	5: Western Ghats	Deforestation, Invasive species, Exotic plantations, Encroachment, Mining, Medicinal plants & NTFP extraction, Livestock pressure, Poaching, Fire, Pathogen load & disease transmission, Climate change.
	6: Deccan Peninsula	Deforestation, Invasive species, Development & urbanisation, Mining, Conflict (insurgency), Pathogen load & disease transmission.
	7: Gangetic Plain	Deforestation, Invasive species, Development & urbanisation, Mining, Land use change, Pollution & eutrophication, Livestock pressure, Human population pressure.
	8: Coasts	Climate change, Pollution, Development & urbanisation, Mining, Tourism, Aquaculture, Invasive species.
	9: North East	Deforestation, Agriculture (shifting cultivation), Mining, Hydropower development, Hunting, Conflict (Border strife and insurgency), Climate change.
	10: Islands	Climate change, Invasive species, Development & urbanisation.

# Chital in Andamans









# Invasive species

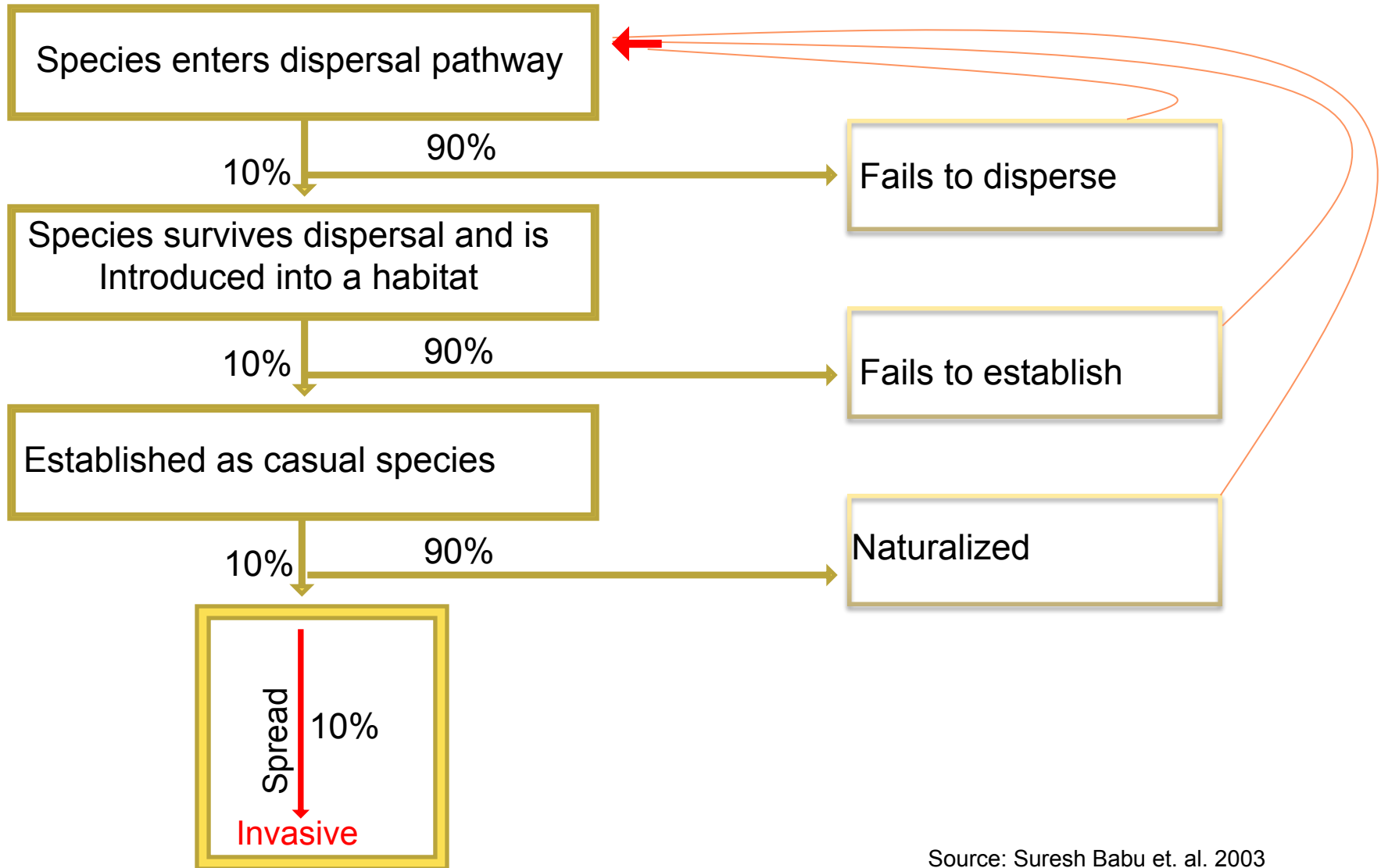
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**IAS are also commonly referred to as invasive, aliens, exotics or non indigenous species. IAS are species, native to one area or region, that have been introduced into an area outside their normal distribution, either by accident or on purpose, and which have colonized or invaded their new home, threatening biological diversity,**

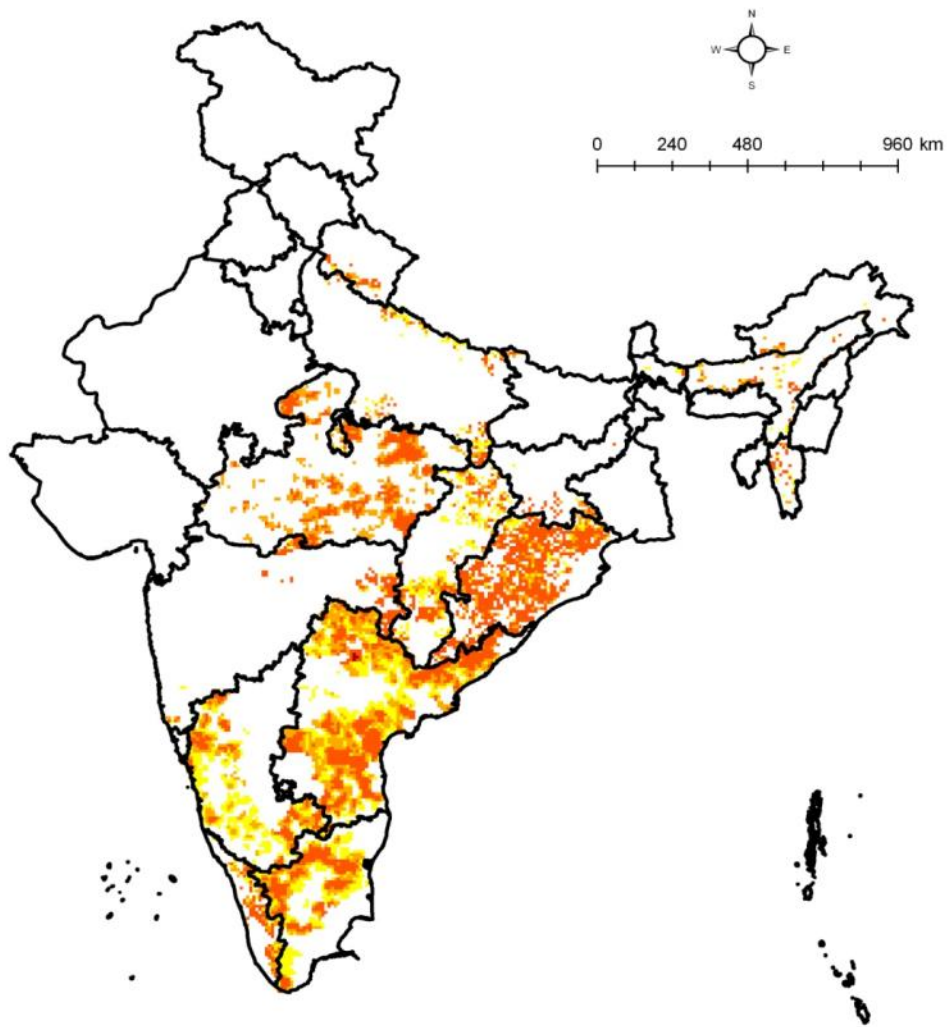


# Are all Alien Species Invasive?



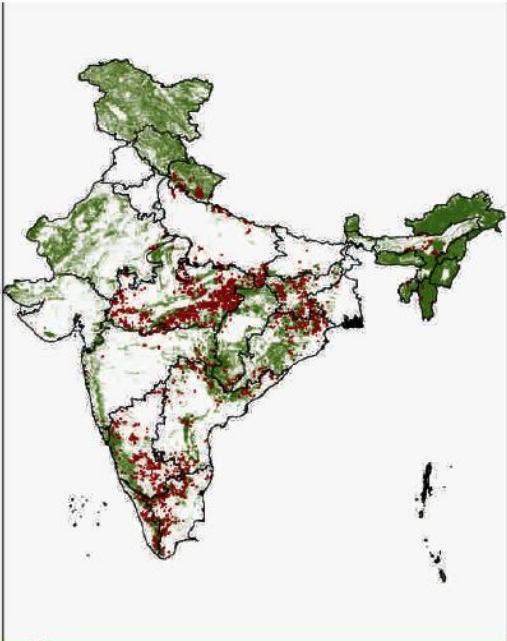


# Distribution & Relative Abundance of Weeds in Tiger Occupied States

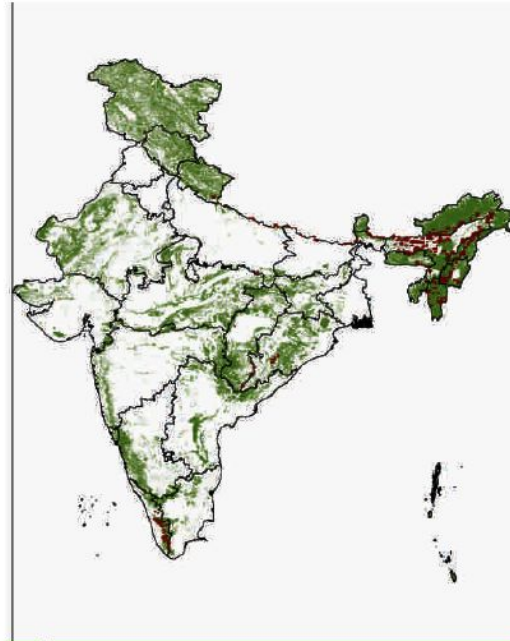


## Legend





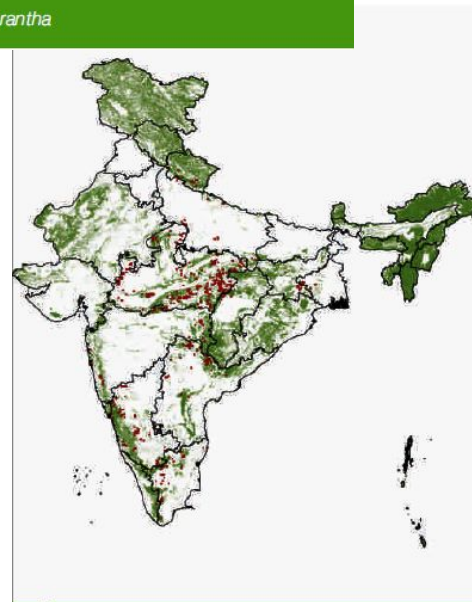
a *Lantana camara*



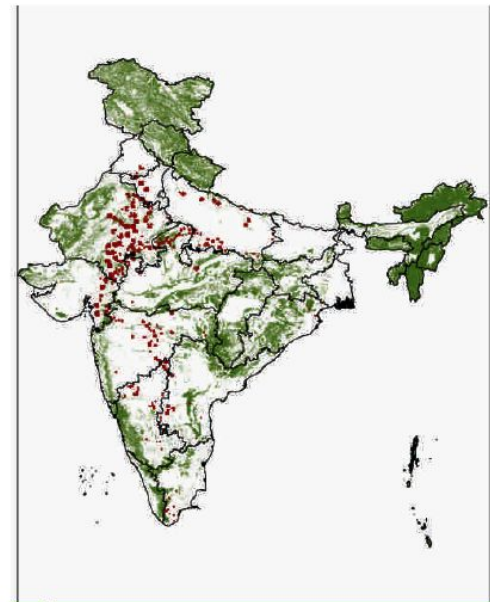
b *Mikania micrantha*



© Jarvin M. Ghani ©



c *Parthenium hysterophorus*



d *Prosopis juliflora*

Vegetation cover  
 Invasive species presence

## Chemical control

- Impractical to cover vast tracts infested with *Lantana* and also not cost-effective, potential hazard to the native biota and environment.

## Biological control

- Limited foraging ability of the insects; variety-specific behaviour of the biocontrol agent, performance of the biocontrol agent is affected by climate, biocontrol agents may also affect native species.

## Biological control Experiments

36 insect spp. released in 33 countries to control *Lantana camara*

Cactus moth (*Cactoblastis cactovororum*) introduced from South America into Queensland in 1920s to control prickly pear cactus (*Opuntia* spp.)

*Septoria* spp. from Ecuador into Hawaii in 1997 to control *Lantana camara*

*Puccinia spegazzinii* (isolate W 1761) of Trinidad origin imported into India to control *Mikania micranth* – under study in Kerala and Assam

# New management strategy On the basis of critical assessment of the biological and ecological attributes of lantana

---

- **(i) its removal by cut rootstock method,**
- **(ii) weeding of saplings from beneath the trees used for perching by generalist birds that disperse the seeds throughout their home range and from surface drainage channels originating from the area covered by such trees and**
- **(iii) ecological restoration of weed-free landscapes, preferably to the grassland, or forest communities according to the needs of stakeholders to prevent re-invasion of the same species or secondary invasion by**



**a**



**b**

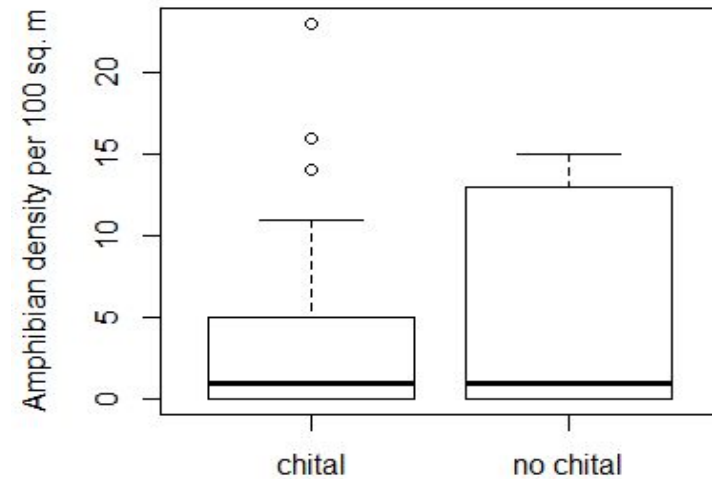
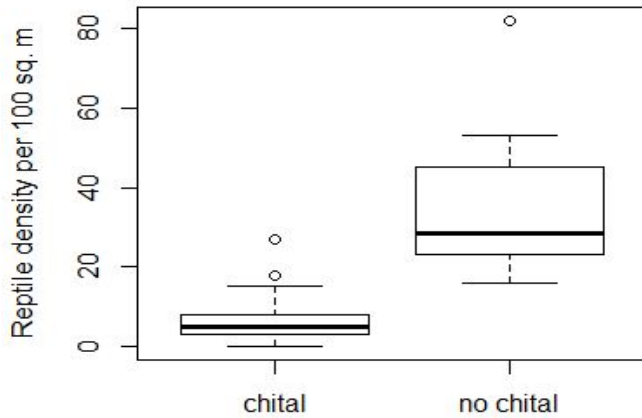
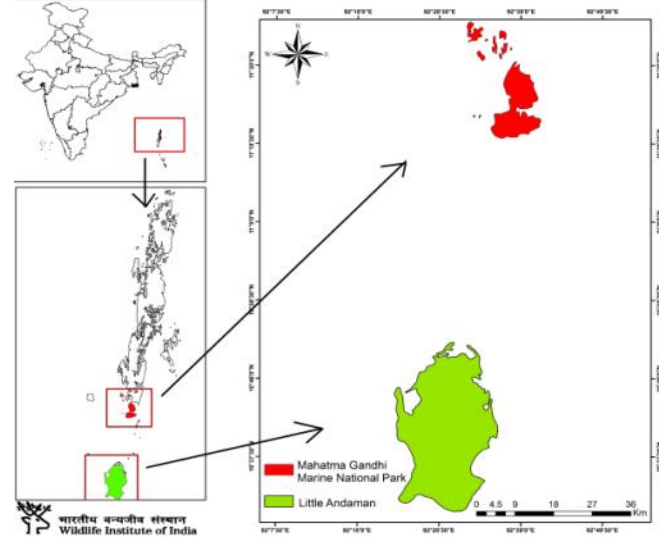
*a, coppicing zone at the transition between stem base and root.  
b, Lantana removed by cutting the rootstock below the coppicing zone.*











A box plot illustrating the difference in reptile density per bound plot between islands with and without chital ( $F = 40.75$ ,  $p < 0.001$  (significant), Effect size ( $\eta^2$ ) = 0.58) in Andaman Islands. Island without chital showed higher reptile density per bound plot

A box plot illustrating amphibian density per bound plot in islands with and without chital in Andaman Islands. No difference between these two categories of islands was observed ( $F = 0.35$ ,  $p = 0.559$ , Effect size ( $\eta^2$ ) = 0.01).

# Lantana eradication in Sukhna Wildlife Sanctuary, U.T. Chandigarh

## Restoration & Biodiversity

More than 50% of the forest area in Sukhna Wildlife Sanctuary was highly infested with lantana weed. Lantana camara is one of the most common and worst weed which is perhaps the most obnoxious in the Shivalik hills and the forests around Chandigarh city. It was posing a serious threat to the 'Biodiversity' of our forests. It is a very hardy weed and grows fast in comparison to the indigenous plant species in wildlife sanctuary and other forest area. Wild growth of lantana had choked all natural regeneration in the forests and thus had adverse impact on the biodiversity of wildlife sanctuary. Lantana eliminates all kind of undergrowth and damages the trees also.



Considering the adverse impact of 'Lantana' on the ecology of Sukhna Wildlife Sanctuary and other forest area, Forest Department of Chandigarh Administration had chalked out a 7 year's schedule in March, 2001 to make sanctuary & other forests of U.T. Chandigarh free from 'Lantana'. By 2008-09, the entire Wildlife Sanctuary and other forest area have already been freed from lantana. This is a unique example of the eradication of Lantana from forests. The department has ensured that lantana does not appear again on the site already cleared of it. This has been a very successful project and good results are visible on the ground. The regeneration of indigenous species like Bansa, Ratti, Karipatta, Giloe, Karaunda and other tree species is appreciable. For the last

four years, there has been good flowering and fruiting in trees like Ber, Dhak (Palas), Karaunda etc. Good grazing grounds for wildlife have also been developed after removal of lantana and thus, there is overall improvement in the wildlife habitat of the sanctuary. Lantana removal has thus proved to be a great boon to the restoration of floral and faunal biodiversity of Sukhna Wildlife Sanctuary. 'Forest fire' threat to the forests has also been reduced due to removal of lantana.



# Eradication and monitoring of invasive fishes

Invasive African cat fish *Clarias gariepinus* were posing threat to birds and other wildlife especially aquatics of the Park.

Park Management successfully initiated eradication of this species from the Park but it needs to be continued for longer period.



# Eradication and monitoring of invasive plants

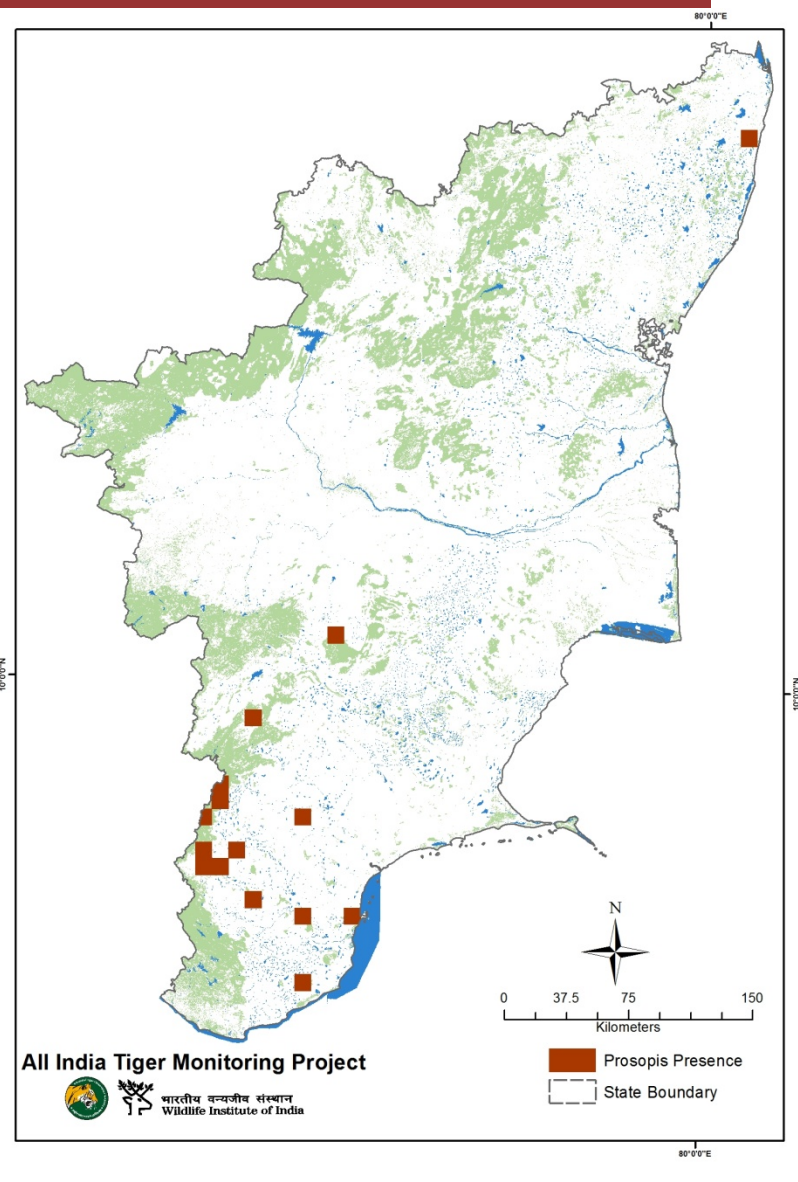
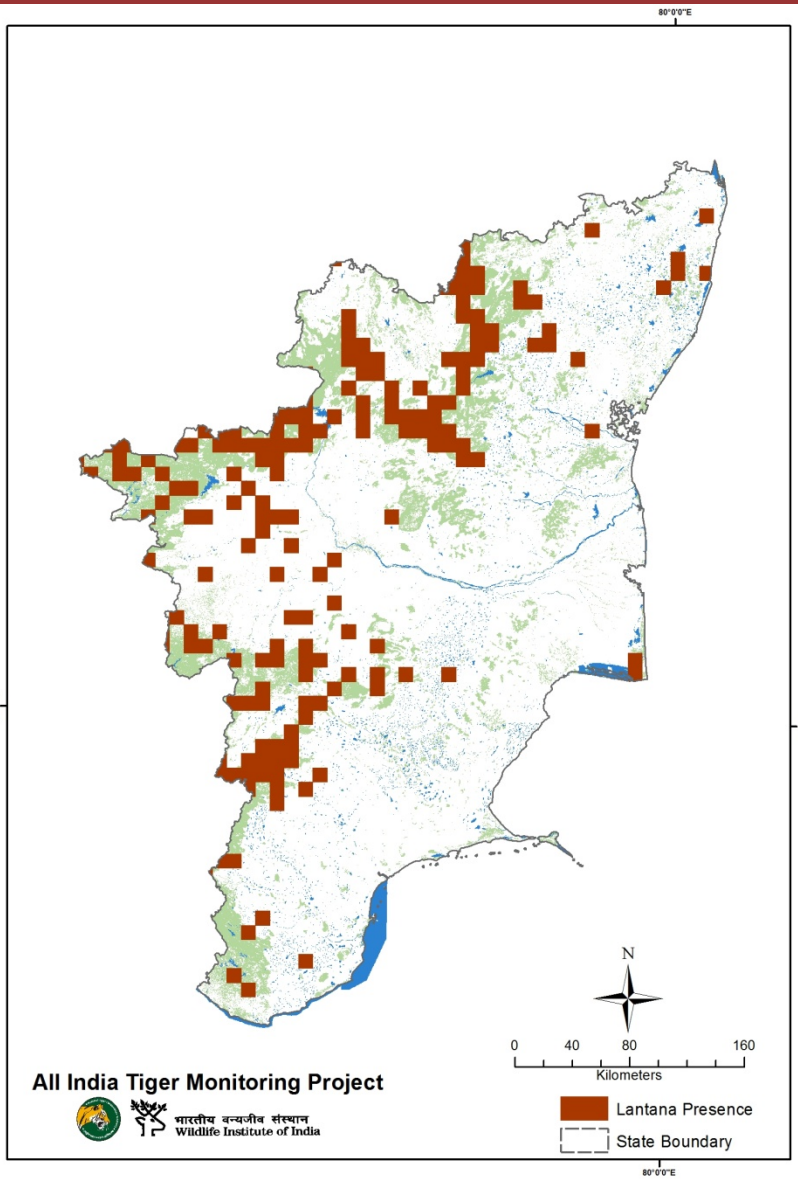




**Study on Ecological & Socio-economic impact of invasive species, *Prosopis juliflora* and *Lantana camara*, and their removal from forest, common and fallow land of Tamil Nadu**



# Presence of Lantana and Prosopis recorded during All India Tiger Monitoring Programme in Tamil Nadu



*Driest environment settings of southern zone favored more P. juliflora than other agro-climatic zones that are comparatively wet.*

*The impact of Prosopis in the forested landscapes of Tamil Nadu, especially in Sathyamangalam Tiger Reserve seemed to be adversely affecting the distribution of native biodiversity.*

*Dry zone of Tamil Nadu where the groundwater level-soil moisture conditions, humidity and temperature under the canopy cover were better in the habitats dominated by P. juliflora but in the forested landscapes these environmental factors were comparatively lesser*

*P. juliflora was observed to be allelopathic that discouraging other plants from growing around them and seems to be toxic to other biotas in ways that allow the invasives to monopolize the space, sunlight, and nutrients at the exclusion of other species.*





- *Although, alien invasive species such as P. juliflora and L. camara are adversely affecting the native biodiversity especially in the Western Zone and Cauvery Delta but it has livelihood values in the Southern Zone especially Ramanathpuram and adjoining districts of Tamil Nadu.*
- *Economic analyses also revealed that the benefits of the P. juliflora invasion in the southern zone are higher than the costs. However, some aspects such as increased risk of water table and long-term ecological changes were not examined, thus making the total economic valuation incomplete.*
- *The study concludes that complete eradication of P. juliflora and L. camara is inevitable in the forested landscapes and Protected Areas of Tamil Nadu. However, the study recommends that sustainable management and control of P. juliflora may be a better solution than eradication in the Southern Zone*

*Kappaphycus alvarezii*



78°07' 11.82" E

79°32' 45.49" E

9°18' 58.47" N

9°19' 27.24" N



**21 Islands of Gulf of Mannar**

- |                       |                            |
|-----------------------|----------------------------|
| 1. Shingle Island     | 12. Poovarasampatti Island |
| 2. Krusadai Island    | 13. Valimunai Island       |
| 3. Pullivasal Island  | 14. Anaipar Island         |
| 4. Poomarichan Island | 15. Nallathanni Island     |
| 5. Manoliputti Island | 16. Puluvinichalli Island  |
| 6. Manoli Island      | 17. Upputhanni Island      |
| 7. Hare Island        | 18. Kariyachalli Island    |
| 8. Mulli Island       | 19. Vilanguchalli Island   |
| 9. Valai Island       | 20. Koswari Island         |
| 10. Thalaiyari Island | 21. Vaan Island            |
| 11. Appa Island       |                            |

78°07' 07.38" E

79°32' 26.83" E

8°39' 40.39" N

8°41' 28.89" N

# Gulf of Mannar Reef Areas







**The exotic seaweed, *Kappaphycus alvarezii* invaded in the reef areas in Gulf of Mannar**



**Smothering effect on coral colonies, that leads to mortality of entire colony**

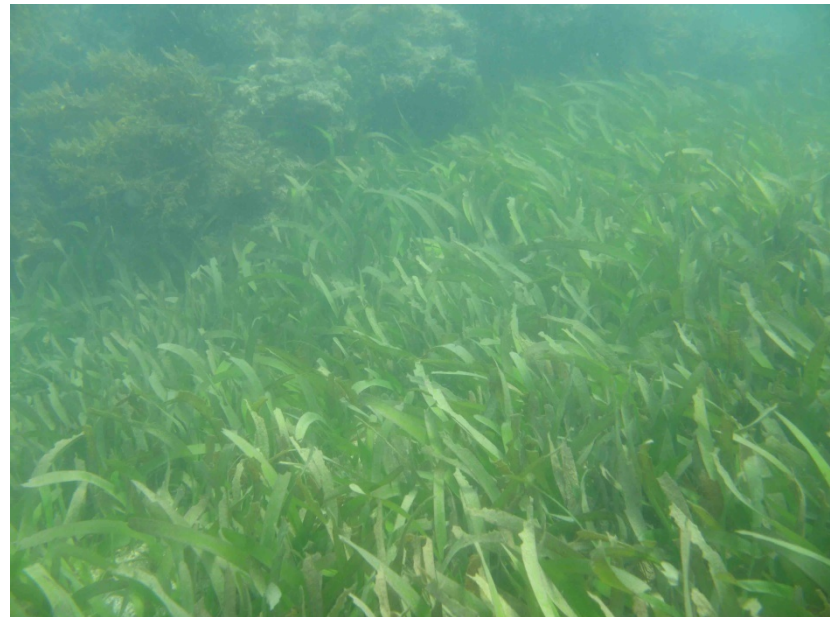
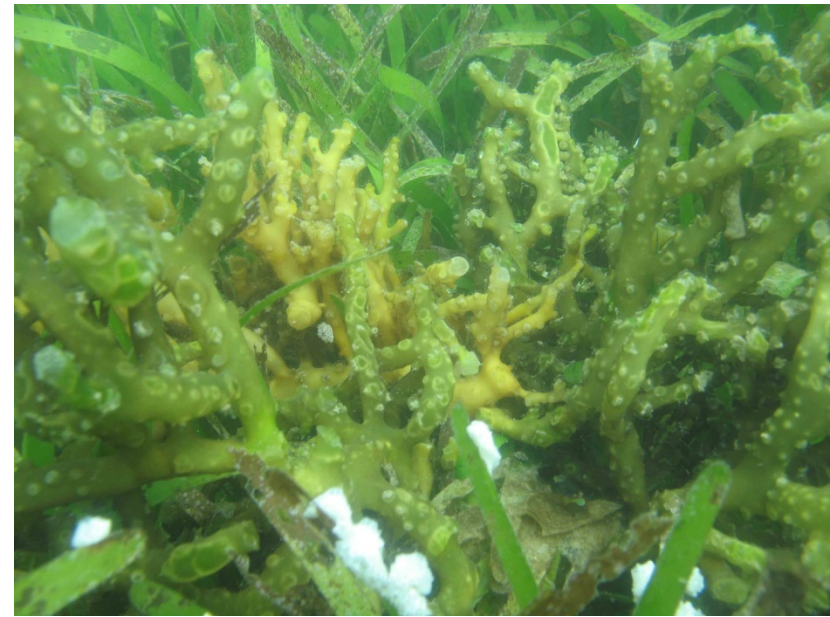






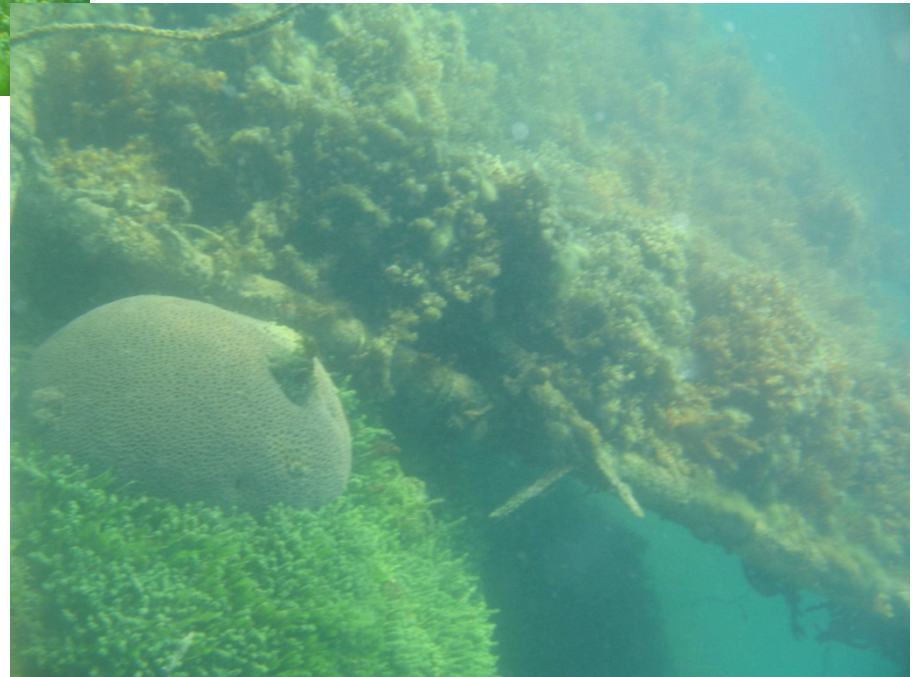
***Kappaphycus* cultivation in Palk Bay reduces light penetration which is highly essential to seagrass growth & health**

***In addition, Kappaphycus cultivation in Palk Bay reduces health of the environment and so loss of native fauna and flora***





In Palk Bay, where seagrass beds are abundant along with corals, *Kappaphycus* cultivation leads to ecological imbalance





Project

Vote System

The 100

10 Candidates

Your Vote

The **100<sup>th</sup>**  
of the Worst  
Invasive Alien Species

**Brown trout , *Salmo trutta fario***



**Snow trout , *Schizothorax richardsonii***





Native

Invasive

Cool water

Habitat ?

Cold water

Mid altitude

Range ?

High altitude

Herbivore

Diet?

Carnivore

Winters

Spawning period ?

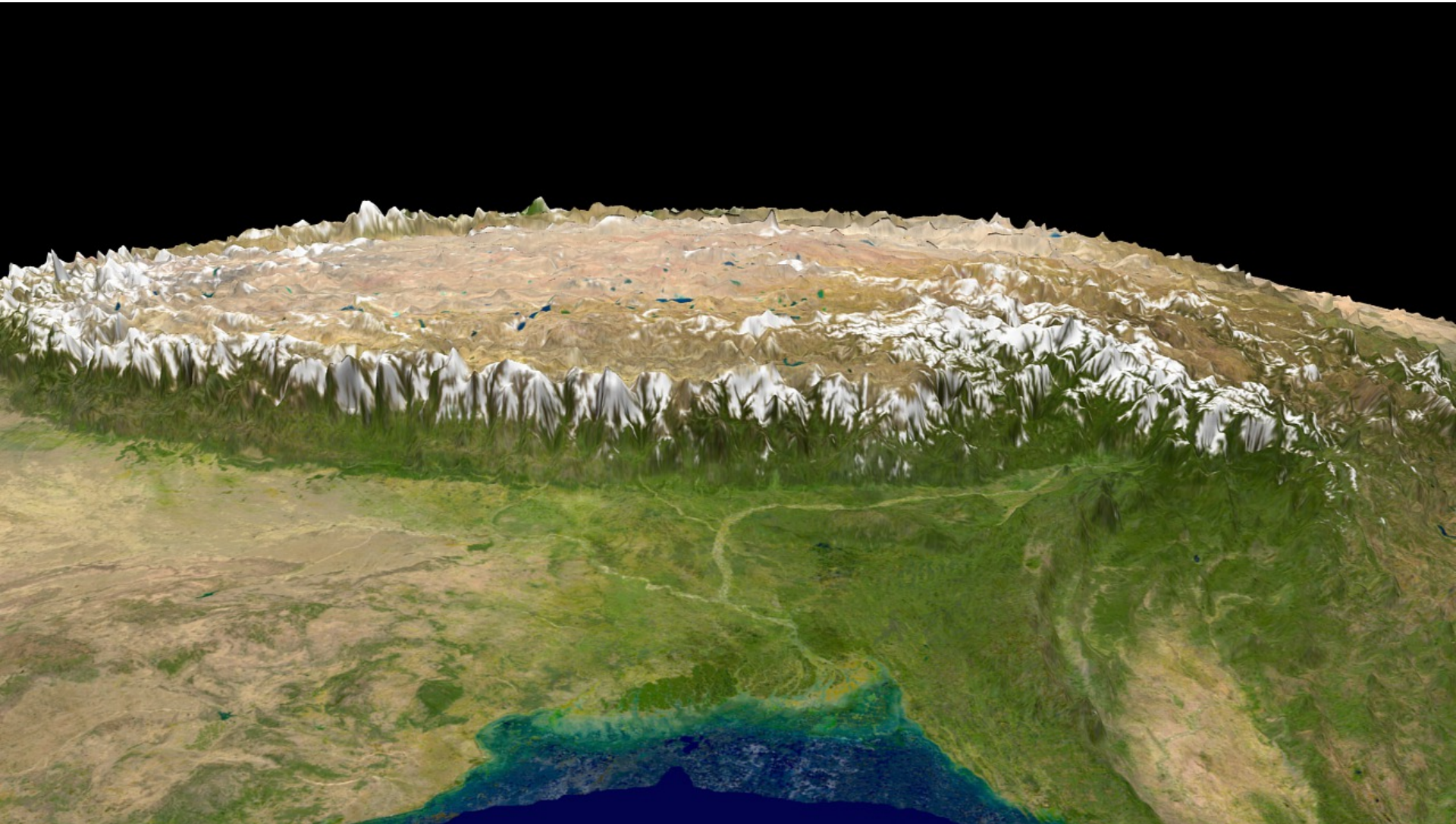
Throughout

No

Stocking ?

Yes

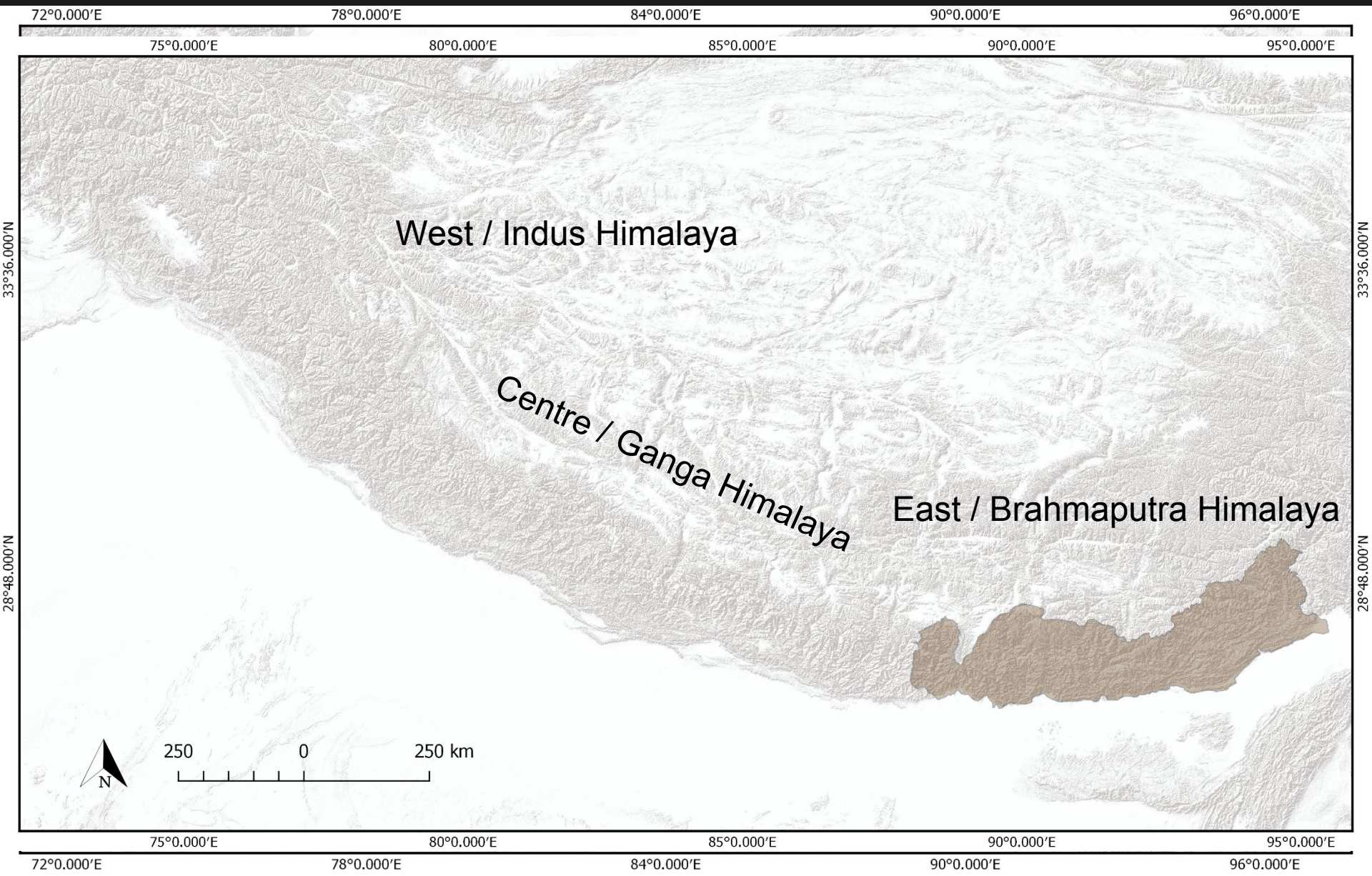
# **Climate Wars:** Ensemble Forecasts Predict Unpromising Future for Himalayan Coldwater Ichthyofauna





- Determining the habitat suitability of native snow trout and non-native brown trout in the Himalayan riverscapes
- Assessing their range shifts and spatial overlaps in future environmental conditions
- Understanding the role of life history traits in their future competitive interactions






# Occurrence Records





## Introduced, invaded and forgotten: allopatric and sympatric native snow trout life-histories indicate brown trout invasion effects in the Himalayan hinterlands

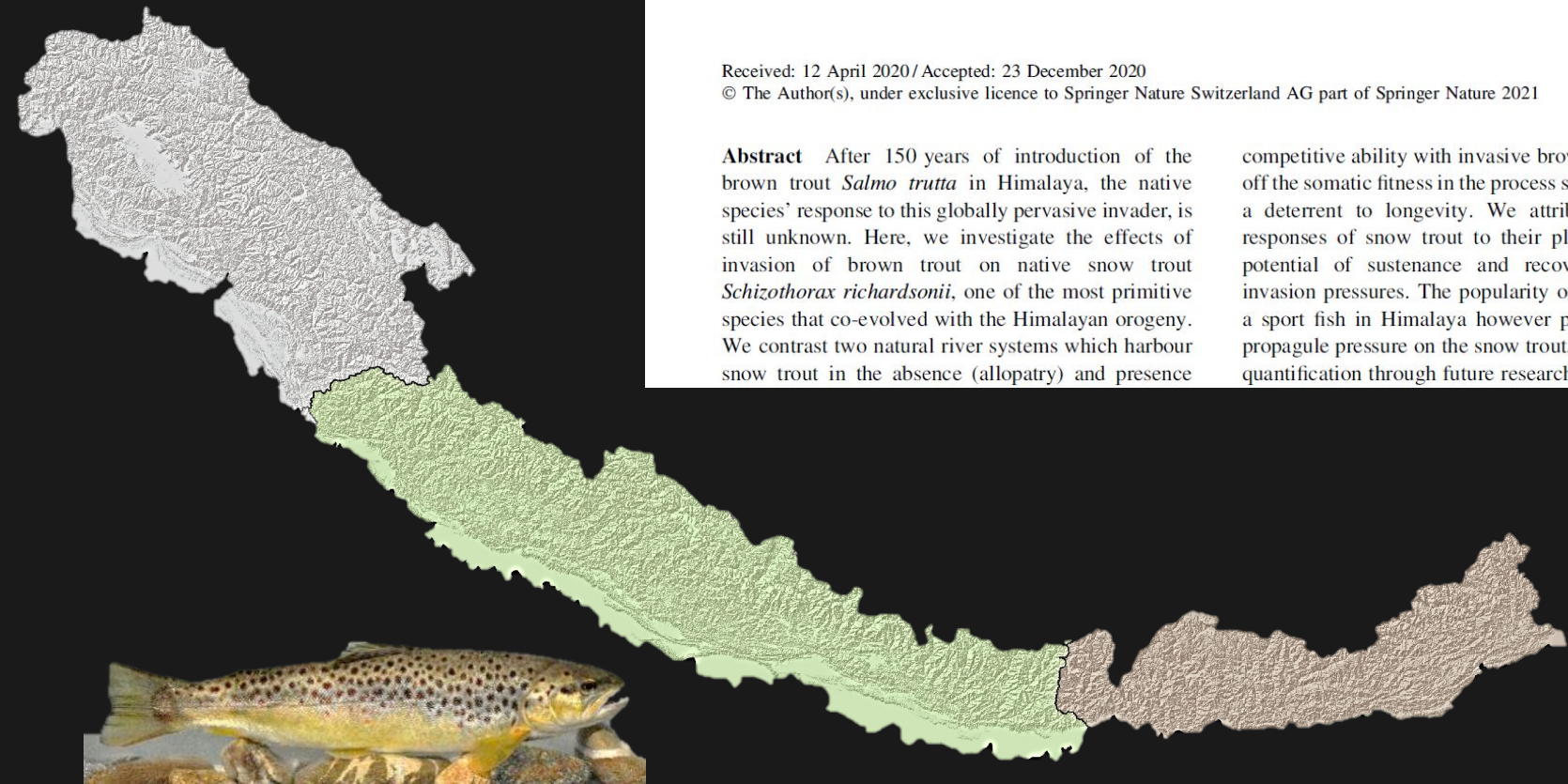
Aashna Sharma · Vineet Kumar Dubey · Jeyaraj Antony Johnson ·  
Yogesh Kumar Rawal · Kuppusamy Sivakumar 

Received: 12 April 2020 / Accepted: 23 December 2020

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**Abstract** After 150 years of introduction of the brown trout *Salmo trutta* in Himalaya, the native species' response to this globally pervasive invader, is still unknown. Here, we investigate the effects of invasion of brown trout on native snow trout *Schizothorax richardsonii*, one of the most primitive species that co-evolved with the Himalayan orogeny. We contrast two natural river systems which harbour snow trout in the absence (allopatry) and presence

competitive ability with invasive brown trout, trading off the somatic fitness in the process seemingly acts as a deterrent to longevity. We attribute the plastic responses of snow trout to their plausible inherent potential of sustenance and recovery from high invasion pressures. The popularity of brown trout as a sport fish in Himalaya however poses extraneous propagule pressure on the snow trout, which warrants quantification through future research.



# Successful invaders

- **Large native range**
- **Abundant in native range (but not always)**
- **Broad diet (generalist, omnivore)**
- **prolific breeder**
- **associated with man**
- **successfully adaptable in a wide range of environmental conditions**



# Impacts

- Next to the deforestation (habitat destruction), introduced species are the major threat to the preservation of biodiversity.
- It can profoundly alter ecosystem structure and function.
- E.g. in Western Ghats, Shola grasslands have been modified by with the invasion of aggressive black wattle (*Acacia mearnsii*, introduced here for tannin industry).
- Acceleration of soil erosion rate: Himalayan tahr in South Africa
- Alteration of hydrological cycles: Invasive fungus *Phytophthora cinnamomi* killing Eucalyptus in



# Impact

- Large number of species extinct from Islands due to Invasive. In Islands, Amphibians, reptiles and birds are more vulnerable than mammals.
- Predation: e.g. Trout, Cat, Dog, brown tree snake etc.,
- Browsing and grazing: e.g. Goat, Spotted deer, elephant.,
- Hybridization (Genetic contamination): Turtle dove, Egret, pigs, carps,
- Food competition: exotic carp and native carp, sparrows, bulbuls.,
- Nest site competition: Parrot nest site encroached by introduced honeybee
- Introduction of disease: Avian malaria, cholera, pox.



# Predation - Crown-of-Thorn Starfish

*Acanthaster planci*



# Management

- **Mechanical control**
- **Chemical control**
- **Biological control**
- **Prevention**





# So far, No Policy on Invasive Species in India

- National Wildlife Action Plan
- National Biodiversity Strategy and Action Plan
- PA / Site Specific Management Plan

Government of India  
Ministry of Environment Forest and Climate Change  
(Wildlife Division)  
\*\*\*

## ADVISORY FOR DEALING WITH IMPORT OF EXOTIC LIVE SPECIES IN INDIA AND DECLARATION OF STOCK

### Background

Exotic live species are animal or plant species moved from their original range (location) to a new one. These species are introduced to a new location most often by people.

Considering the significance of import and export of exotic live species, this Ministry is issuing an advisory to streamline the process for import and possession of exotic live species in India. The following are proposed:

- Developing an inventory of exotic live species in India through Voluntary Disclosure Scheme to streamline CITES compliance.
- Procedure for Import of exotic live species.
- Registration/Declaration of progenies of the imported exotic live species,
- The processes under this Advisory shall be dealt online through the Parivesh Portal.

### I. Developing an inventory of exotic live species in India through Voluntary Disclosure Scheme.

- a) The phrases "exotic live species" used in this advisory shall be construed to mean only "the animals named under the Appendices I, II and III of the Convention of International Trade in Endangered Species (CITES) of Wild Fauna and Flora" for the purpose of this advisory and does not include species from the Schedules of the Wild Life (Protection) Act 1972.
- b) It is stated through this advisory that the declarer would not be required to produce any documentation in relation to the exotic live species if the same has been declared within six months of the date of issue of the advisory. For any declaration made after 6 months of the date of issue of this advisory, the declarer shall be required to comply with the documentation requirement under the extant laws and regulations.
- c) A period of 6 months (from the date of the order) may be given for voluntary disclosure for those who are in possession of exotic live species in the country.

## Nature Nurtures... Conserve Nature

Together we can build a frame work that  
nourishes and not depletes our natural assets...

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***Thank You !***

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