Global plant invasions on the rise

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Outline

Overview

Drivers of plant invasion

Invasion of the world's continents

Invasive plant impacts

Strategies to slow the invasion

Overview

- global plant invasions are clearly on the rise, exacerbated by globalization and global climate change

Clements, D., Upadhyaya, M., Joshi, S., Shrestha, A. (Eds.) 2021. Global Plant Invasions. Springer Nature https://www.springer.com/gp/book/9783030896836

Overview

- many global issues in ascendance at this point in world history
- the SARS-CoV-2 pandemic serves as a strong wakeup call on the risks associated with globalization
- worldwide mean annual cost of biological invasions reached $162.70 billion USD annually by 2017, with no signs of levelling off (Diagne et al. 2021, *Nature*)

Overview

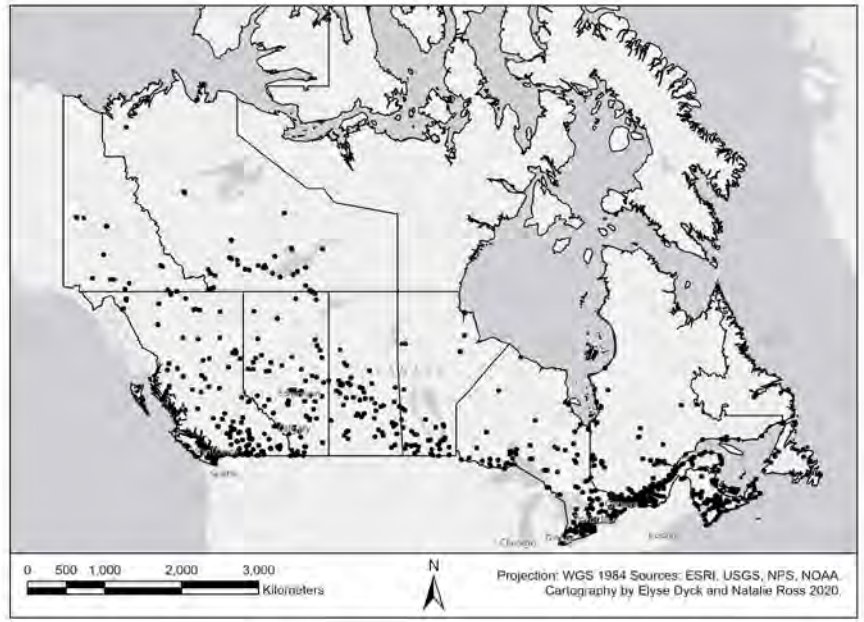
Plant invasions often feature 3 phases:

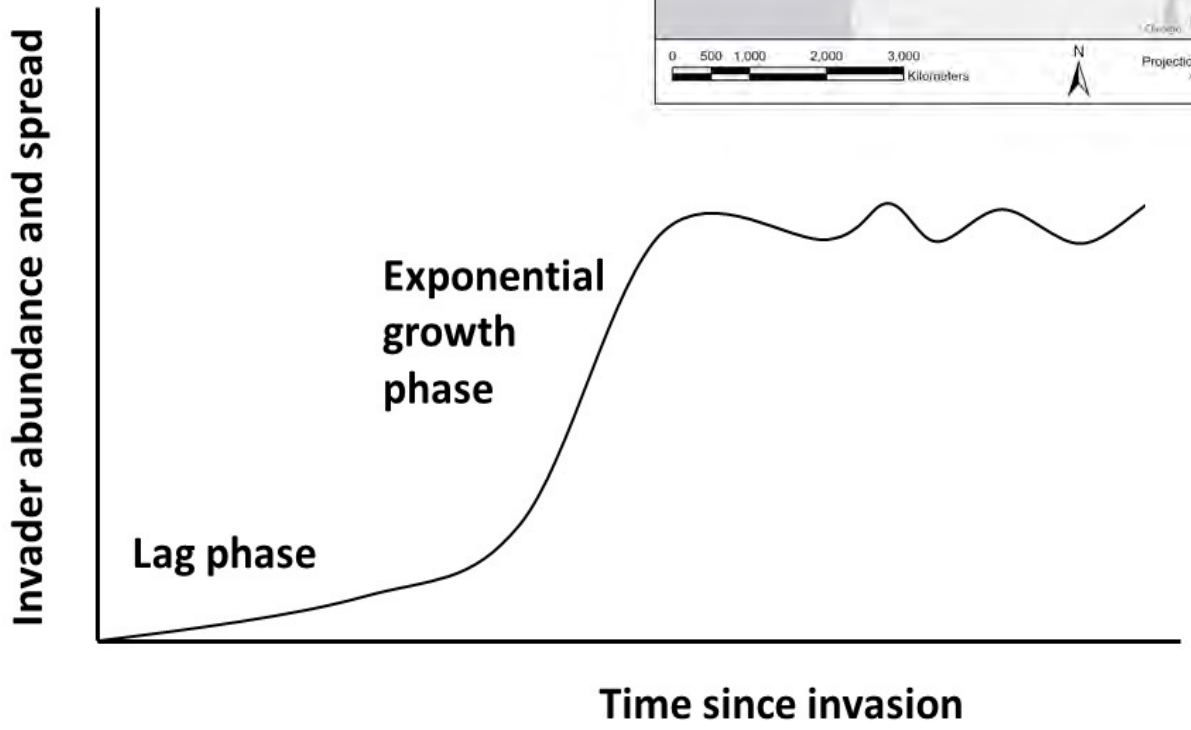
1) lag phase

2) exponential growth

3) establishment

Capsella bursa-pastoris



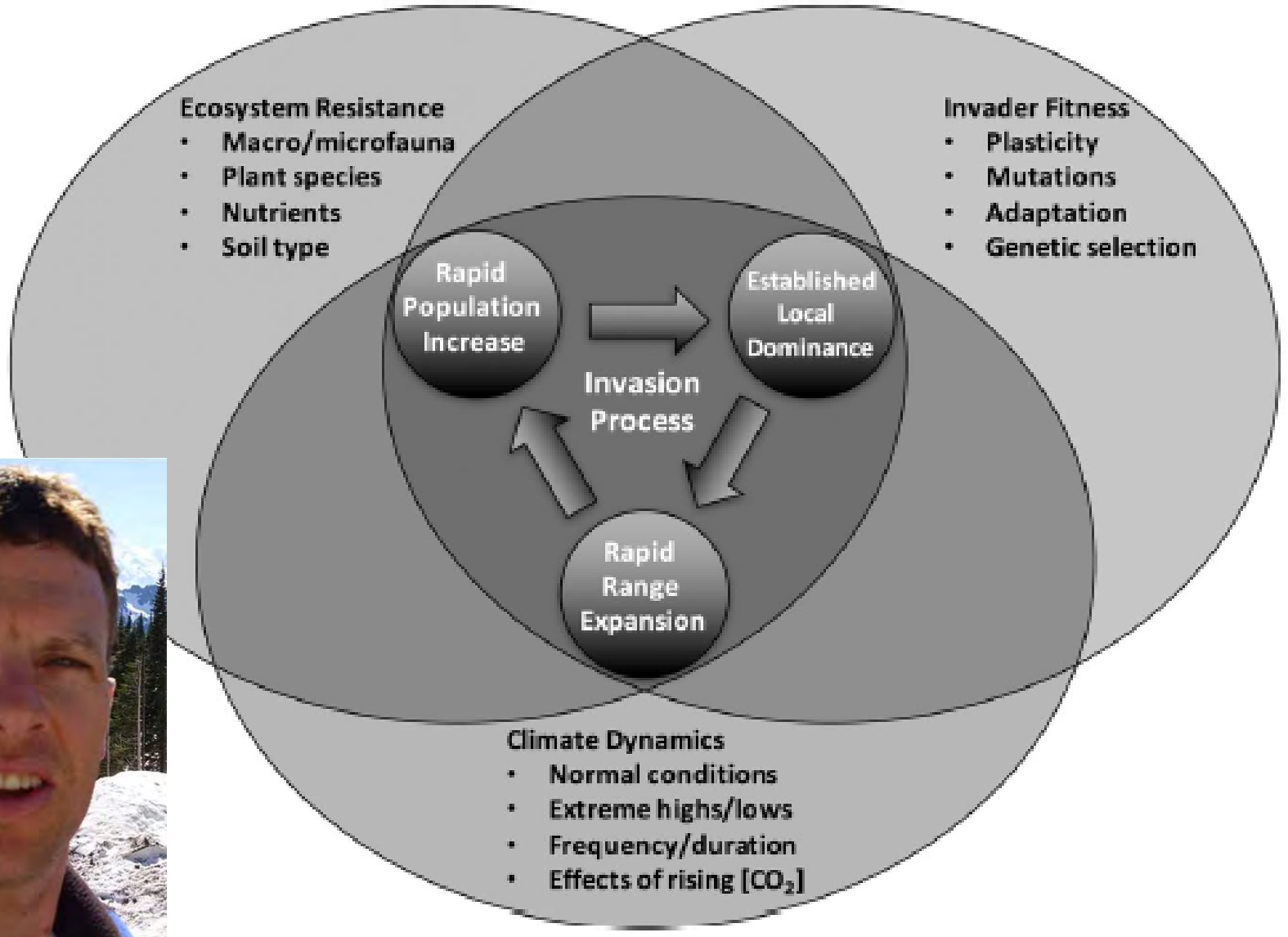


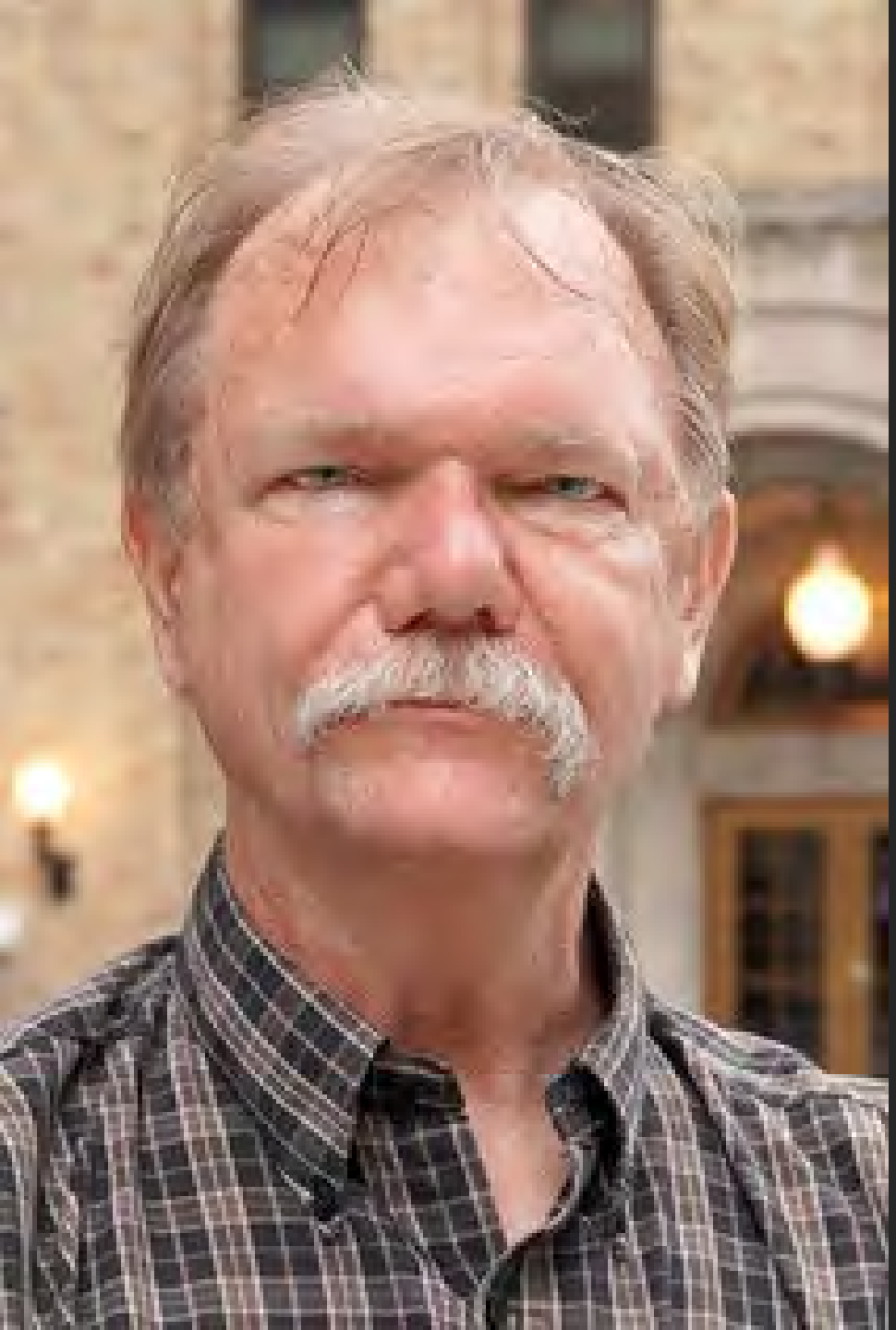
Drivers of plant invasion

Three key factors:

1) ecosystem resistance
2) invader fitness
3) climate dynamics

(Young et al. 2017, *Inv. Plant Sci. Manage.*)





Drivers of plant invasion

"Although climate change and invasive species are each recognized as meaningful threats to ecological function, biodiversity, and agronomic systems, there is increasing awareness of ongoing linkages between these phenomena that will alter our understanding of their impacts."

Lewis H. Ziska

Chapter 4, *Global Plant Invasions*

Drivers of plant invasion

various mechanisms enable weeds to adapt to the pressures of climate change (Clements & Jones 2021; *Agronomy*)

WORLD CONTINENT MAP

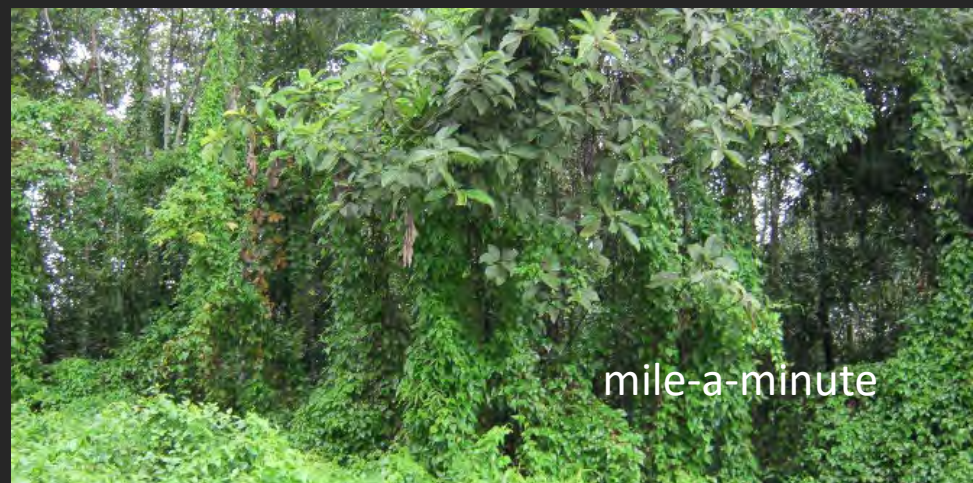
Robinson Projection

Invasion of the world's continents: Asia

- world's largest continent, 30% of the planet's surface; a broad target for invading plants
- invasions increasing in step with economic growth and globalization; management efforts falling behind
- well-known global invaders like lantana (*Lantana camara*), mile-a-minute (*Mikania micrantha*), and common water hyacinth (*Eichhornia crassipes*)


common water hyacinth


lantana


mile-a-minute

Invasion of the world's continents: Australia

- world's smallest continent
- Europeans arrived just 130 years ago but now 30,000 alien plant species, 3,027 naturalized
- cactuses "textbook examples" of plant invasions
- Australia has a wealth of experience dealing with invasive plants such as cactuses and Paterson's curse

Invasion of the world's continents: Europe

- formerly, Europe thought of as more of a source than a receiver of invasive plants but now…
- most naturalized species from other parts of Europe, 1926 (of 4,139) from other continents
- top-ranking invasive species: silver wattle (*Acacia dealbata*), lantana, kudzu (*Pueraria lobata*), and common water hyacinth


silver wattle (invasoros.pt)

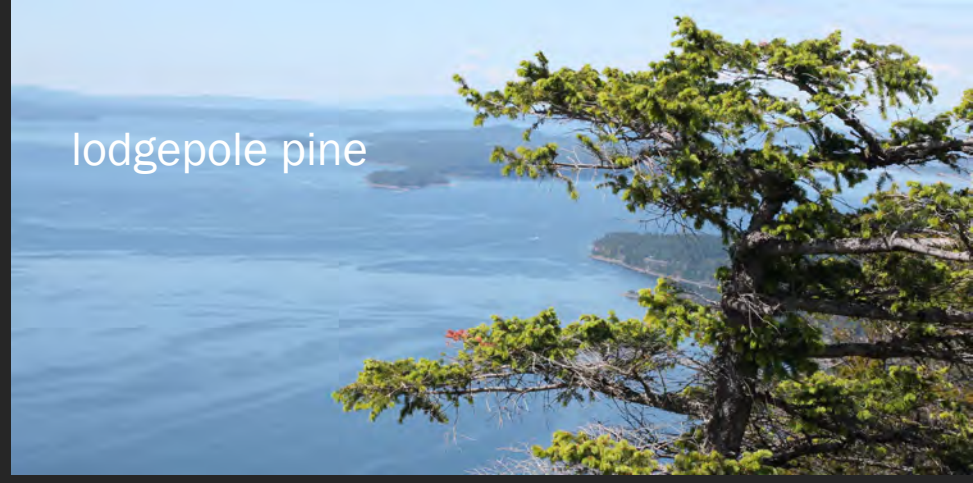

kudzu (bugwood.org)

Invasion of the world's continents: North America

- North America boasts highest number of naturalized plants of any continent, 5958 species
- some arrived with European colonists centuries ago, but many still on the increase
- e.g., knotweeds (*Reynoutria* spp.), kudzu, yellow starthistle (*Centaurea solstitialis*), cheatgrass (*Bromus tectorum*), ventenata (*Ventenata dubia*), and purple loosestrife (*Lythrum salicaria*)

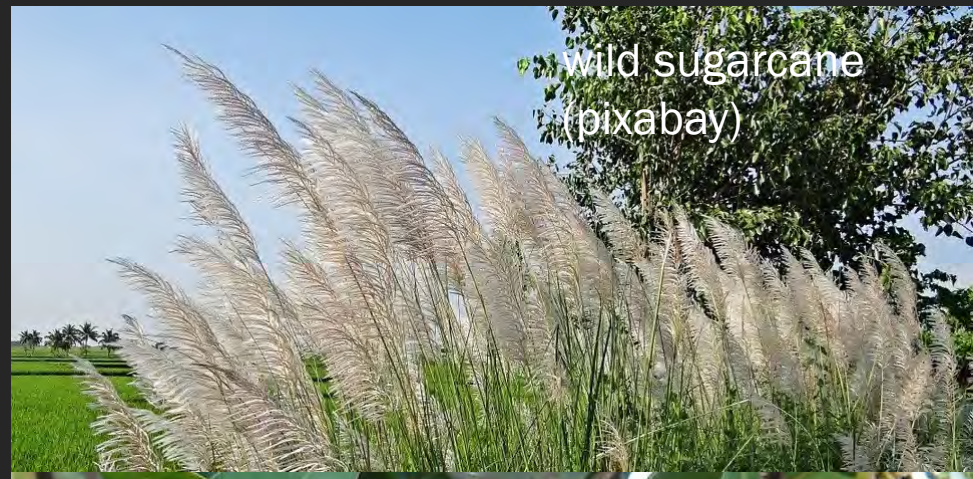
Invasion of the world's continents: South America

- has at least 2677 known naturalized non-native plants
- abundant native plant diversity threatened by impacts of invasive plants such as lodgepole pine (*Pinus contorta*), mesquite (*Prosopis glandulosa*), and gorse (*Ulex europaeus*)



Invasion of the world's continents: Central America

- fewer known naturalized plant species than South America, but at 1,628, the non-native plant taxa is substantial
- some serious invasive species such as wild sugarcane (*Saccharum spontaneum*), rose apple (*Syzygium jambos),* and guinea grass (*Panicum maximum*)

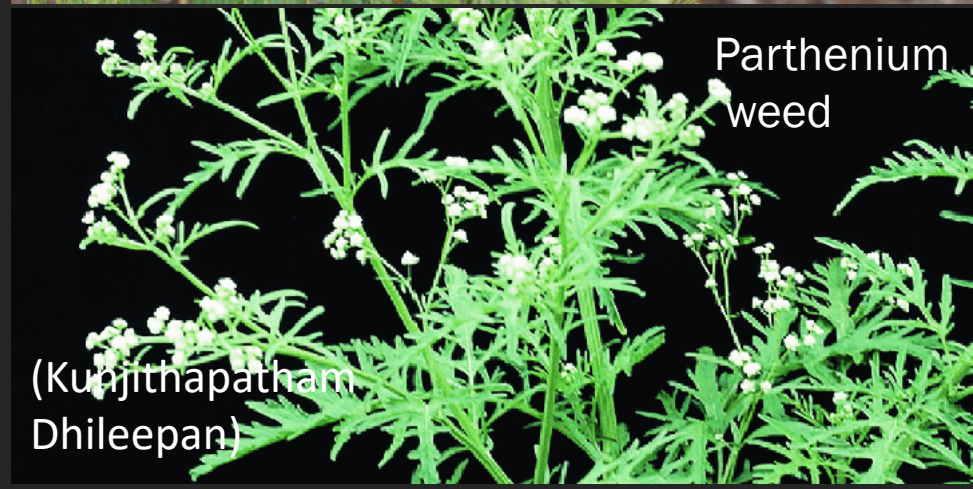

wild sugarcane
(pixabay)


rose apple
(University of Florida)


Guinea grass
(Eduardo Chacón)

Invasion of the world's continents: Africa

- second largest continent in both area and population; 1139 naturalized plant species in South Africa alone
- however, 50 or fewer naturalized plant species for Djibouti, Gambia, Malawi, and Niger
- includes transformer species such as lantana, common water hyacinth, prickly pear, giant sensitive plant (*Mimosa pigra*), leacaena (*Leucaena leucocephala*) and parthenium weed (*Parthenium hysterophorus*)



Invasion of the world's continents: Islands

- oceanic islands comprise less than 5% of land mass but host more than 25% of the world's plant diversity
- island floras with high rates of endemism extremely vulnerable to invasive plants, such as Miconia (*Miconia calvescans*), strawberry guava (*Psidium cattleianum*), or African tulip tree (*Spathodea campatulata*) in Hawai'i

Invasion of the world's continents: Mountains

- mountain habitats very sensitive to effects of invasive species
- the remoteness and inaccessibility of mountain landscapes present unique challenges e.g., Siam weed (*Chromolaena odorata*) Himalayas or Himalayan balsam (*Impatiens glandulifera*)

Siam weed in Nepal
(Chudamani Joshi)

Himalayan balsam
(Canada)

Invasive plant impacts

- are invasive plants really that bad?
- we are getting better at gathering evidence via better quantification of both environmental (e.g., IUCN analyses) and socioeconomic impacts (e.g., InvaCost database)

Strategies to slow the impacts

- innovative tools to slow plant invasions (e.g., application of roundup ballistically from helicopters using modified paintball guns, in Maui, Hawai‘i vs. Miconia)
- such new technologies cannot operate without support from governmental and non-governmental agencies from local, to national to international levels
- biosecurity is key – Meyerson et al. (2022) call for “Better global biosecurity and biosecurity awareness”

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Chapter 14: Biotic and Economic Impacts of Plant Invasions	Rajesh Rai, Srijana Joshi, and David R. Clements
Chapter 15: Advances in the Management of Invasive Plants	Katharina Dehnen-Schmutz and Ana Novoa
Chapter 16: Working Towards Global Invasive Species Strategies	Laura A. Meyerson, Aníbal Pauchard, Giuseppe Brundu, James T. Carlton, José L. Hierro, Christoph Kueffer, Maharaj K. Pandit, Petr Pyšek, David M. Richardson, and Jasmin G. Packer
Chapter 17: A future planet of weeds?	Daniel Simberloff