The IPBES Assessment on Invasive Alien Species: Methods, Findings, and Research and Communication Gaps

Presented to the CBD Training Course for Pacific Small Island Developing States on Invasive Alien Species, Apia, Samoa, 15-17 July 2025

Dr. Peter Stoett, Dean & Professor, Ontario Tech University, Canada

#InvasiveAlienSpecies Assessment

UN environment programme

unesco

Food and Agriculture Organization of the United Nations

UNDP

Science-policy interfaces

- social processes that encompass relations between scientists and other actors in the policy process, and that allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making
- policy-relevant but not policy-prescriptive: solution-oriented assessments, while allowing decisionmakers to balance competing priorities
- large-scale assessments involve many scientific disciplines and knowledge holders from diverse regions, though true equality is still a goal
- Intergovernmental Panel on Climate Change (IPCC), the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), and the Global Environment Outlook (GEO), chemicals and plastics to come

IPBES Assessment on IAS:
Developed over 4 years (2019-2023)

3 Authors meetings (Tsukuba, online, & Aarhus), 3 IPLC meetings (Montreal, online, online), 1 SPM authors meeting (Chile), IPBES Plenary meeting (Bonn)
2 External reviews (60,000 comments)
1 Additional review by governments

Over 13,000 documents reviewed in depth
Various values and knowledge systems considered, drawing on scientific and grey literature, and information from indigenous and local knowledge:

- 3 dialogue workshops (Montreal and online),
- a call for contributions, and collaboration with ILK experts and holders within the expert team and as contributing authors, extensive literature review

#InvasiveAlienSpecies Assessment

Produced by a multidisciplinary team of 86 experts and many contributing authors

86 nominated experts from 47 countries, encompassing all regions and many disciplines

About 200 contributing authors

Near gender-parity achieved

Supported by a management committee
Technical support unit based in Japan (Institute for Global Environmental Strategies, IGES)

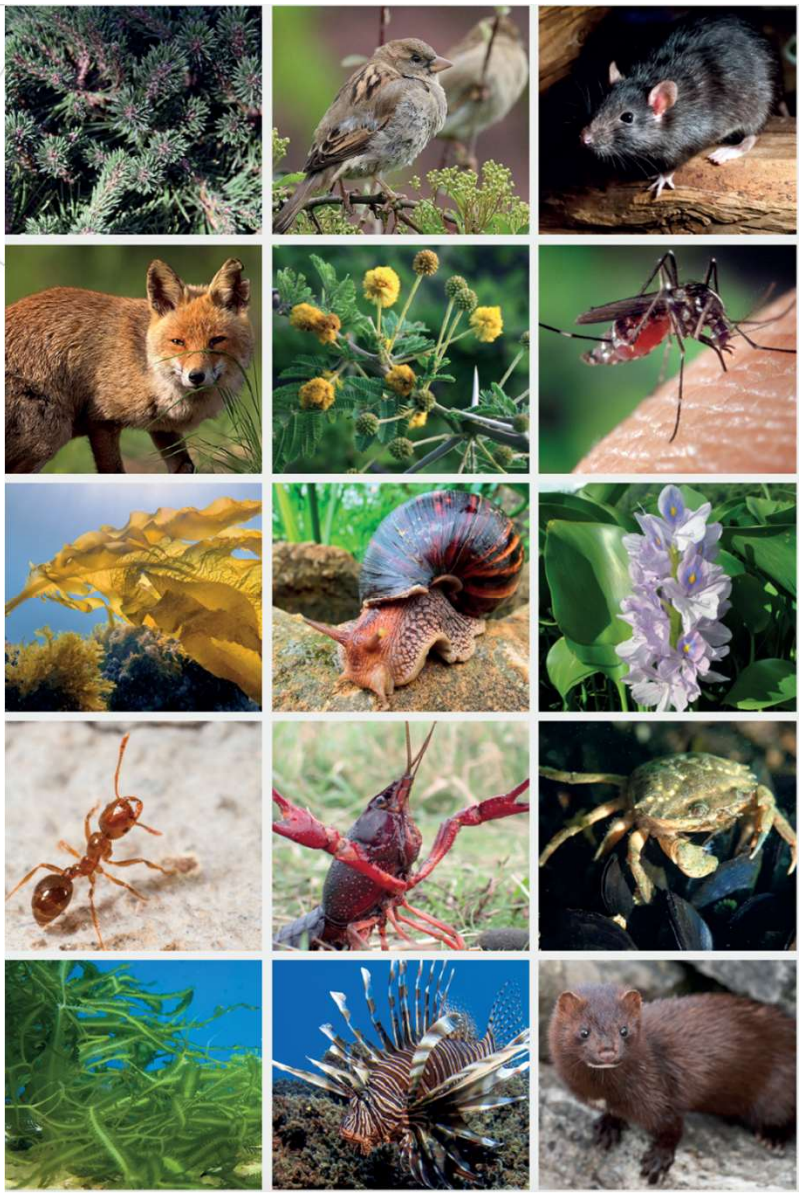
#InvasiveAlienSpecies Assessment

Structure of the Assessment

- **Chapter 1** introduces the concept of invasive alien species; the risks posed to marine, terrestrial and freshwater ecosystems; the IPBES conceptual framework; cross-cutting themes (good quality of life, Indigenous and local knowledge, and scenarios and models)
- **Chapter 2** assesses **past, current and future trends** in the spread, pathways, evolutionary change and distribution of invasive alien species;
- **Chapter 3** presents the **direct and indirect drivers** responsible for the introduction, spread, abundance and dynamics of invasive alien species;
- **Chapter 4** assesses the **impacts** of invasive alien species on nature and nature's contributions to people and good quality of life;
- **Chapter 5** evaluates the effectiveness of past and current programmes and tools for the global, national and local **prevention and management**
- **Chapter 6** presents policy options and strategies, integrated governance

1 ■ What are invasive alien species?

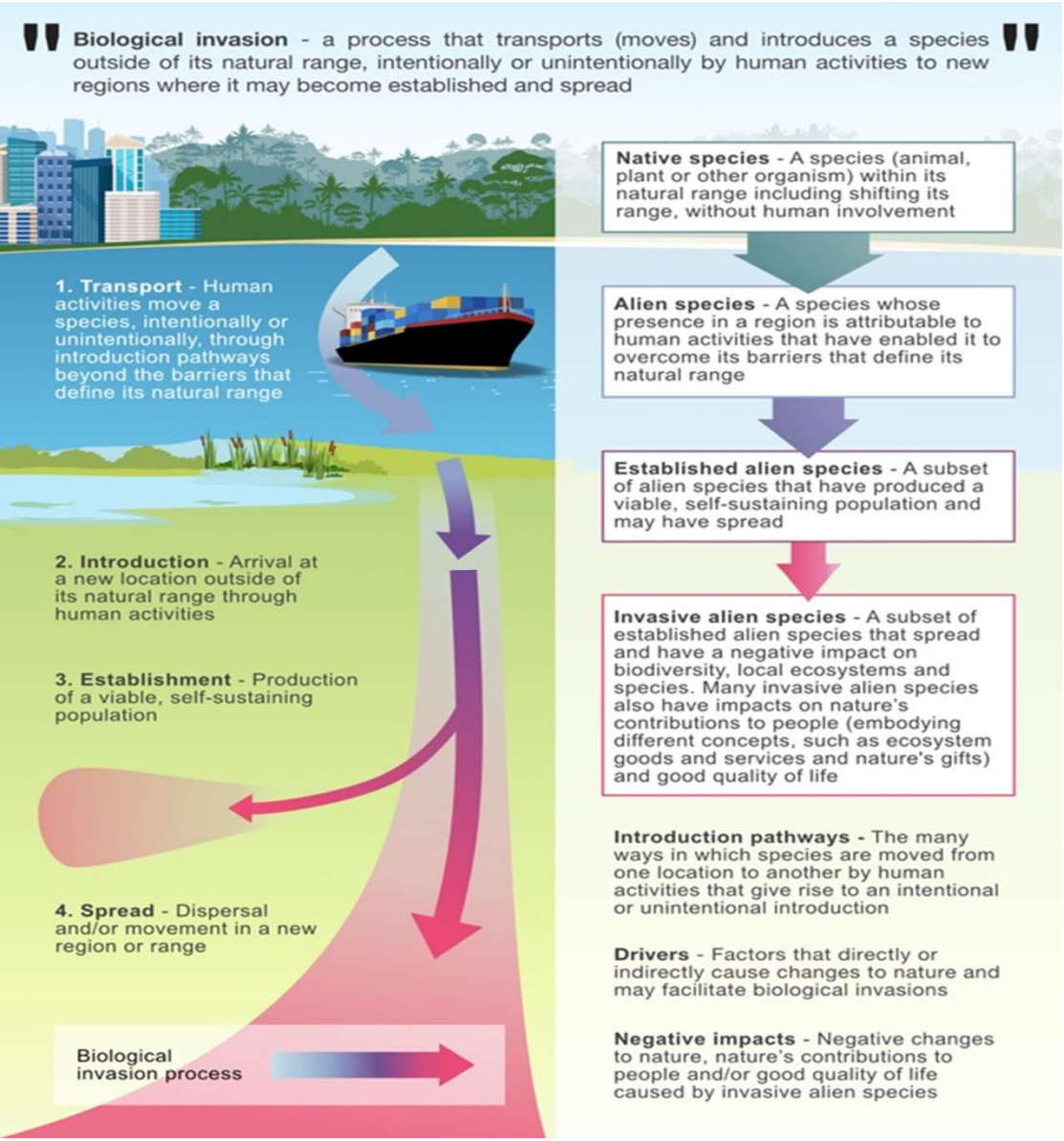
Invasive alien species are one of the 5 major drivers of biodiversity loss



Alien species are animals, plants, and other organisms that have been introduced by human activities to new regions

Invasive alien species are a subset of alien species, known to have established and spread with negative impacts on nature. Many invasive alien species also have impacts on people

#InvasiveAlienSpecies Assessment



"Biological invasions" is a term used to describe the process involving the intentional or unintentional transport or movement of a species outside its natural range by human activities and its introduction to new regions, where it may become established and spread.

2. Main findings of the report

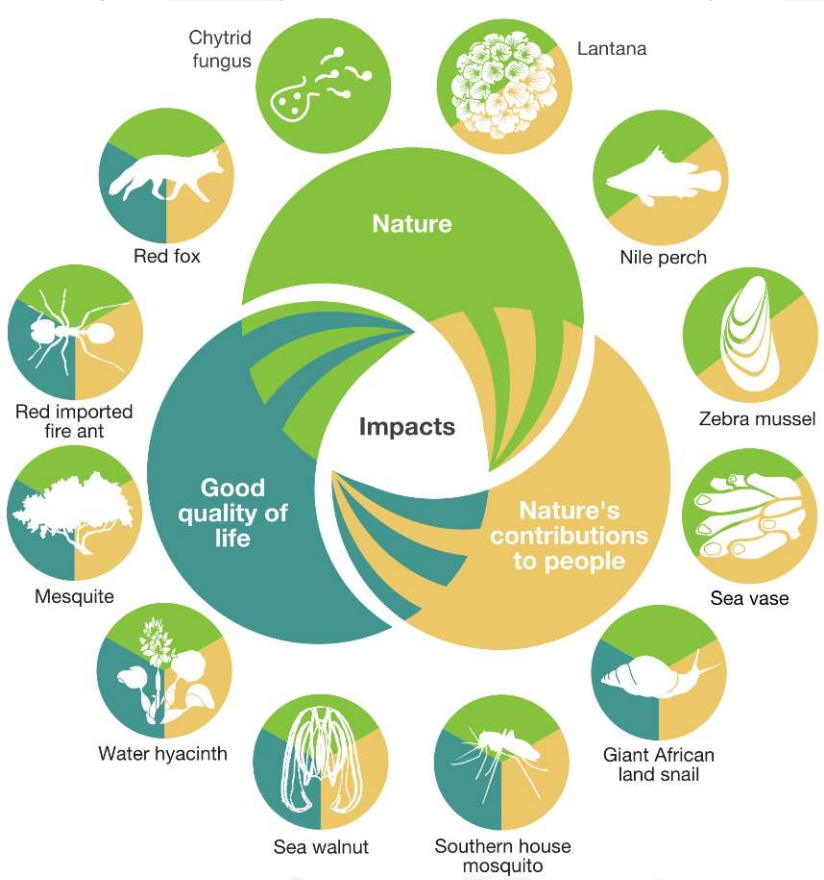
People and nature are threatened by invasive alien species in all regions of Earth

37,000 established alien species have been introduced by human activities worldwide

200 new alien species every year

3,500 invasive alien species, with negative impacts on nature, and also on people

More than 2,300 invasive alien species are found on lands of Indigenous Peoples across all regions of Earth

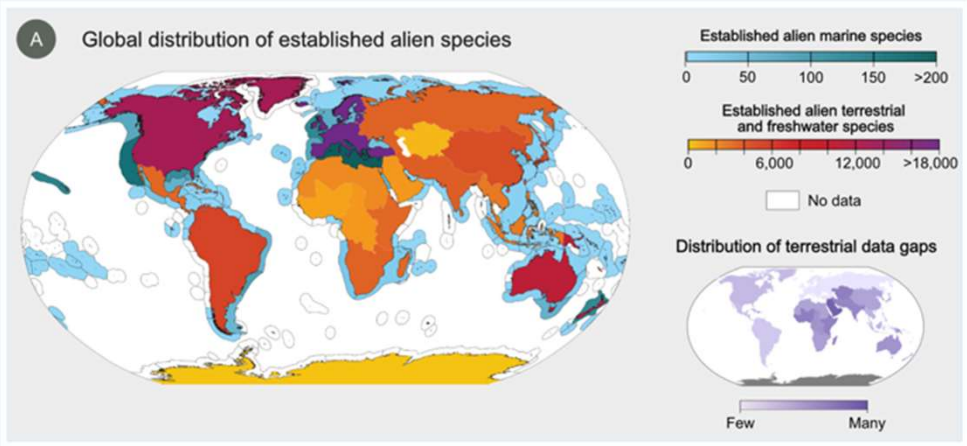


#InvasiveAlienSpecies Assessment

Invasive alien species are a global threat

Impacts from invasive alien species are reported in the Americas (34%), Europe and Central Asia (31%) and Asia-Pacific (25%), with fewer reported in Africa (7%)

Some areas, despite being protected for nature conservation or being remote, are also vulnerable to the negative impacts of invasive alien species.



75% of negative impacts are reported from the terrestrial realm, especially temperate and boreal forests and woodlands and cultivated areas

14% from the freshwater realm, especially from inland surface waters/waterbodies

10% from the marine realm, especially from shelf ecosystems

#InvasiveAlienSpecies Assessment

Invasive alien species cause dramatic and, in some cases, irreversible changes to nature across all regions of Earth

- 60% of global extinctions have been caused, solely or alongside other drivers, by invasive alien species
- 16% of global extinctions have been caused solely by invasive alien species
- 1,215 documented local extinctions of native species have been caused by invasive alien species
- 85% of documented impacts on nature are negative

#InvasiveAlienSpecies Assessment

What are the mechanisms of impacts on nature?

And also through hybridization, transmission of disease, parasitism, poisoning/toxicity, bio-fouling or other direct physical disturbance, chemical, physical, structural impact on ecosystem and indirect impacts through interactions with other species

#InvasiveAlienSpecies Assessment

Invasive alien species are a major cause of biodiversity loss on islands

- 20% of all impacts are reported from islands
- 90 per cent of documented global extinctions with invasive alien species as one of the major causes are reported from islands
- The number of alien plants exceeds the total number of native plants on more than one quarter of islands
- Islands are also vulnerable to climate change, which can increase the rate of establishment and spread of many invasive alien species

#InvasiveAlienSpecies Assessment

How do invasive alien species impact people?

- Economies, food security, water security, human health and cultural identities are profoundly and negatively affected by invasive alien species

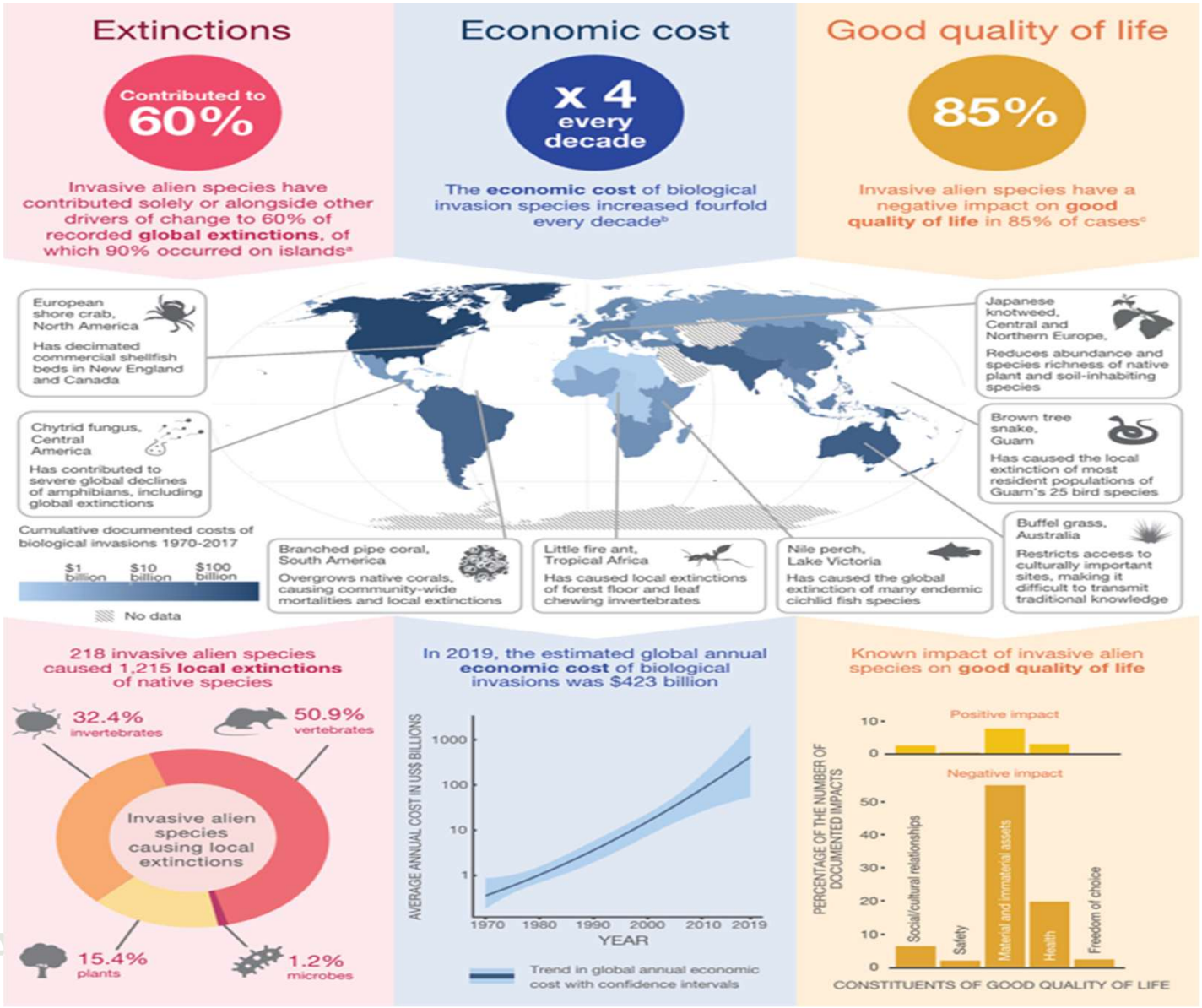
- 80% of documented impacts on nature's contributions to people are negative, with food supply being by far the most frequently reported impact

- In 2019, global annual costs of biological invasions were estimated to exceed $423 billion. 92 per cent accrue from the negative impact of invasive alien species on nature's contributions to people or on good quality of life, while only 8 per cent is related to management expenditures of biological invasions.

#InvasiveAlienSpecies Assessment

People with the greatest direct dependence on nature, including Indigenous Peoples and local communities, may be disproportionately affected by invasive alien species.

- Invasive alien species can add to marginalization and inequity, including, in some contexts, gender- and age-differentiated impacts
- More than 2,300 invasive alien species are found on lands of Indigenous Peoples across all regions of Earth
- Invasive alien species negatively affect the autonomy, rights and cultural identities of Indigenous Peoples and local communities through the loss of traditional livelihoods and knowledge, reduced mobility and access to land, and increased labour to manage the invasive alien species


Extinctions
Contributed to 60%
Invasive alien species have contributed solely or alongside other drivers of change to 60% of recorded global extinctions, of which 90% occurred on islands[a]
Economic cost
x 4 every decade
The economic cost of biological invasion species increased fourfold every decade[b]
Good quality of life
85%
Invasive alien species have a negative impact on good quality of life in 85% of cases[c]
European shore crab, North America
Has decimated commercial shellfish beds in New England and Canada
Chytrid fungus, Central America
Has contributed to severe global declines of amphibians, including global extinctions
Cumulative documented costs of biological invasions 1970-2017
$1 billion
$10 billion
$100 billion
No data
Branched pipe coral, South America
Overgrows native corals, causing community-wide mortalities and local extinctions
Little fire ant, Tropical Africa
Has caused local extinctions of forest floor and leaf chewing invertebrates
Nile perch, Lake Victoria
Has caused the global extinction of many endemic cichlid fish species
Japanese knotweed, Central and Northern Europe,
Reduces abundance and species richness of native plant and soil-inhabiting species
Brown tree snake, Guam
Has caused the local extinction of most resident populations of Guam's 25 bird species
Buffel grass, Australia
Restricts access to culturally important sites, making it difficult to transmit traditional knowledge
218 invasive alien species caused 1,215 local extinctions of native species
32.4% invertebrates
50.9% vertebrates
Invasive alien species causing local extinctions
15.4% plants
1.2% microbes
In 2019, the estimated global annual economic cost of biological invasions was $423 billion
AVERAGE ANNUAL COST IN US$ BILLIONS
1000
100
10
1
1970 1980 1990 2000 2010 2019
YEAR
Trend in global annual economic cost with confidence intervals
Known impact of invasive alien species on good quality of life
Positive impact
Negative impact
PERCENTAGE OF THE NUMBER OF DOCUMENTED IMPACTS
Social/cultural relationships
Safety
Material and immaterial assets
Health
Freedom of choice
CONSTITUENTS OF GOOD QUALITY OF LIFE

Current policies have been insufficient in managing biological invasions and preventing and controlling invasive alien species

Although most countries (80%) have targets for the management of biological invasions within their national biodiversity strategies and action plans

83% of countries do not have national legislation or regulations directed specifically toward the prevention and control of invasive alien species.

Nearly half of all countries (45%) do not invest in management of invasive alien species

#InvasiveAlienSpecies Assessment

A few numbers on impacts

of global species extinctions have been caused, solely or alongside other drivers, by invasive alien species

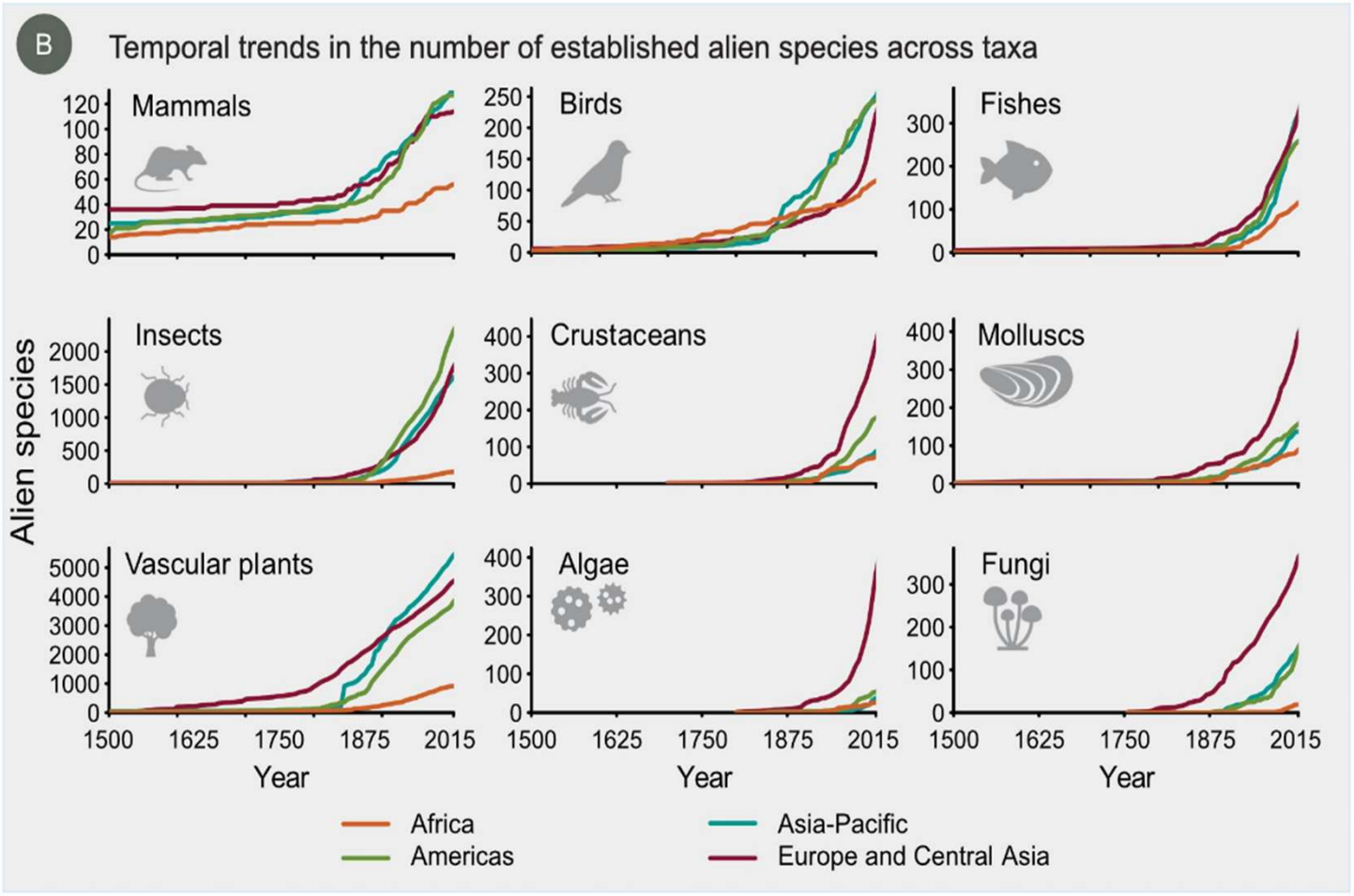
is the estimated global annual costs of biological invasions in 2019.

of impacts on nature and good quality of life are negative

of impacts on nature's contributions to people are negative

#InvasiveAlienSpecies Assessment

The threats from invasive alien species are increasing significantly regardless of taxa or region



#InvasiveAlienSpecies Assessment

Invasive alien species and other drivers of change have complex interactions

Other drivers of change such demographic, economic, and land- and sea-use change are increasing and can amplify the threats and impacts of invasive alien species

Climate change will also be a major cause of future increases in the risk of invasive alien species; IAS will also be a driver of climate change

#InvasiveAlienSpecies Assessment

People at the heart of the problem…

Many human activities facilitate the transport, introduction, establishment and spread of invasive alien species

If things remain unchanged, by 2050 the total number of alien species globally is expected to be about one-third higher than in 2005.

Economic activities, particularly global trade, increasingly facilitate the transport and introduction of invasive alien species

- There is a strong link between the volume of commodity imports and the number of invasive alien species in a region, and patterns in the global spread of species mirror shipping and air traffic networks
- Biosecurity measures at international borders have not kept pace with the growing volume, diversity and origins of global trade and travel
- Projected growth in international trade and movement of people, including tourism, will lead to further pressure on border inspection regimes and could soon overwhelm the biosecurity capability of most countries

#InvasiveAlienSpecies Assessment

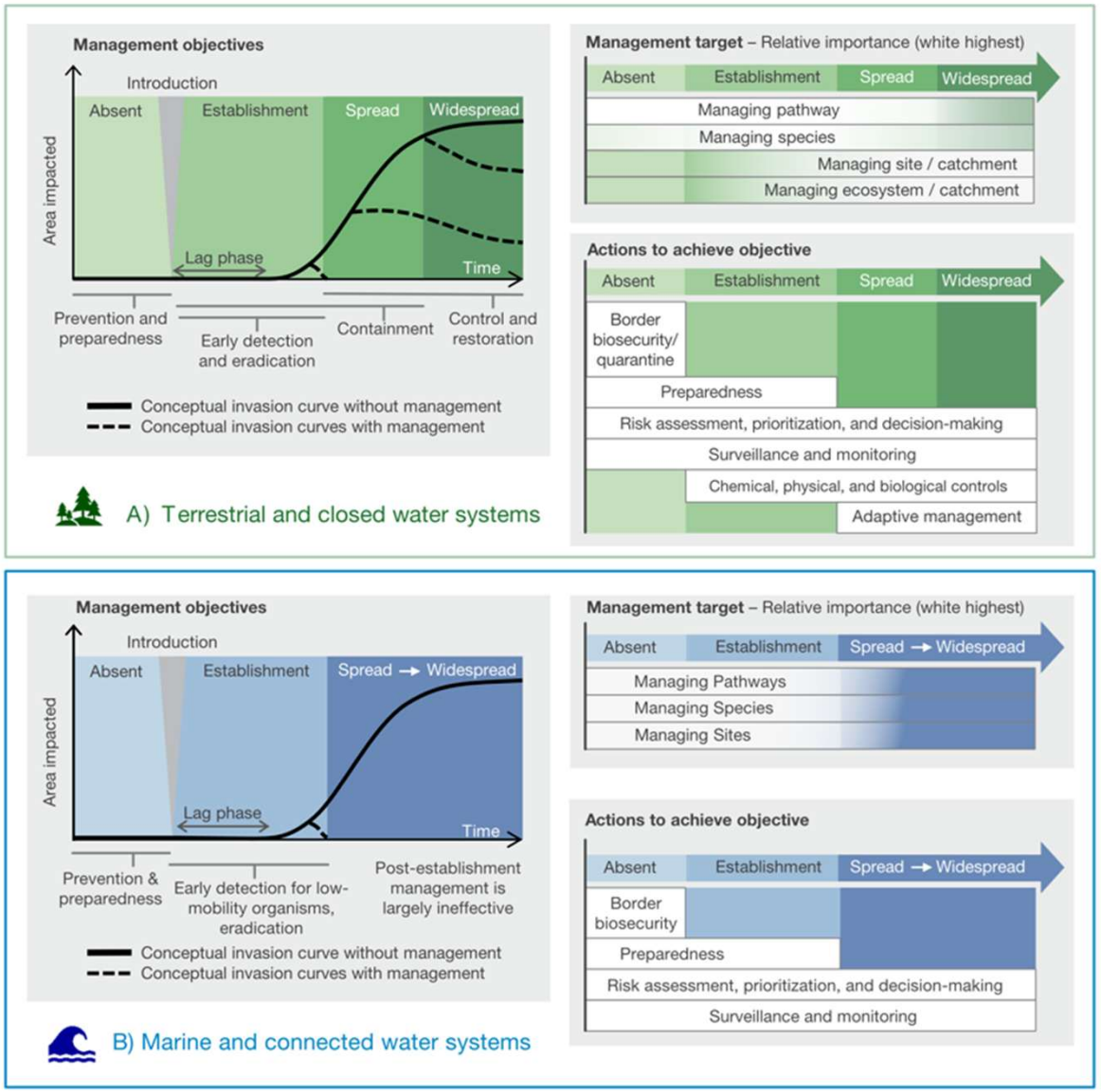
… But people are also at the heart of solutions

Biological invasions and their adverse impacts can be prevented and mitigated through effective management

There are 3 management options:

(a) management of pathways of introduction and spread of invasive alien species;
(b) management of target invasive alien species at either local or landscape scales; and
(c) site-based or ecosystem-based management.

Conceptual diagram of management-invasion continuum



Prevention and preparedness are the most cost-effective options

- Prevention can be achieved through pathway management, including strictly enforced import controls, pre-border, border and post-border biosecurity, and measures to address escape from confinement.

- Prevention is particularly important on islands, and it is also critical in marine and connected water systems, where most attempts at eradicating or containing invasive alien species have mostly failed.

- Sustained and adequate funding, capacity building, technical and scientific cooperation and transfer of technology, monitoring, quarantine and inspection facilities are necessary for effective prevention measures.

#InvasiveAlienSpecies Assessment

Other management options can also be effective

- Eradication has been successful, especially for small and slow-spreading populations of invasive alien species, especially in isolated ecosystems
- Containment and control can be an effective option for invasive alien species that cannot be eradicated for various reasons in terrestrial and closed water systems, but most attempts in marine and connected water systems have been largely ineffective
- The recovery of ecosystem functions and nature's contributions to people can be achieved through adaptive management, including ecosystem restoration in terrestrial and closed water systems

Engagement and collaboration with stakeholders and Indigenous Peoples and local communities improves outcomes of management actions for biological invasions,

particularly where there are conflicting perceptions of the value of invasive alien species and the ethics of management options

Management actions also benefit from sharing and collaboration across knowledge systems

Preventing and controlling invasive alien species can strengthen the effectiveness of policies designed to respond to other threats to biodiversity and contribute to achieving several Sustainable Development Goals

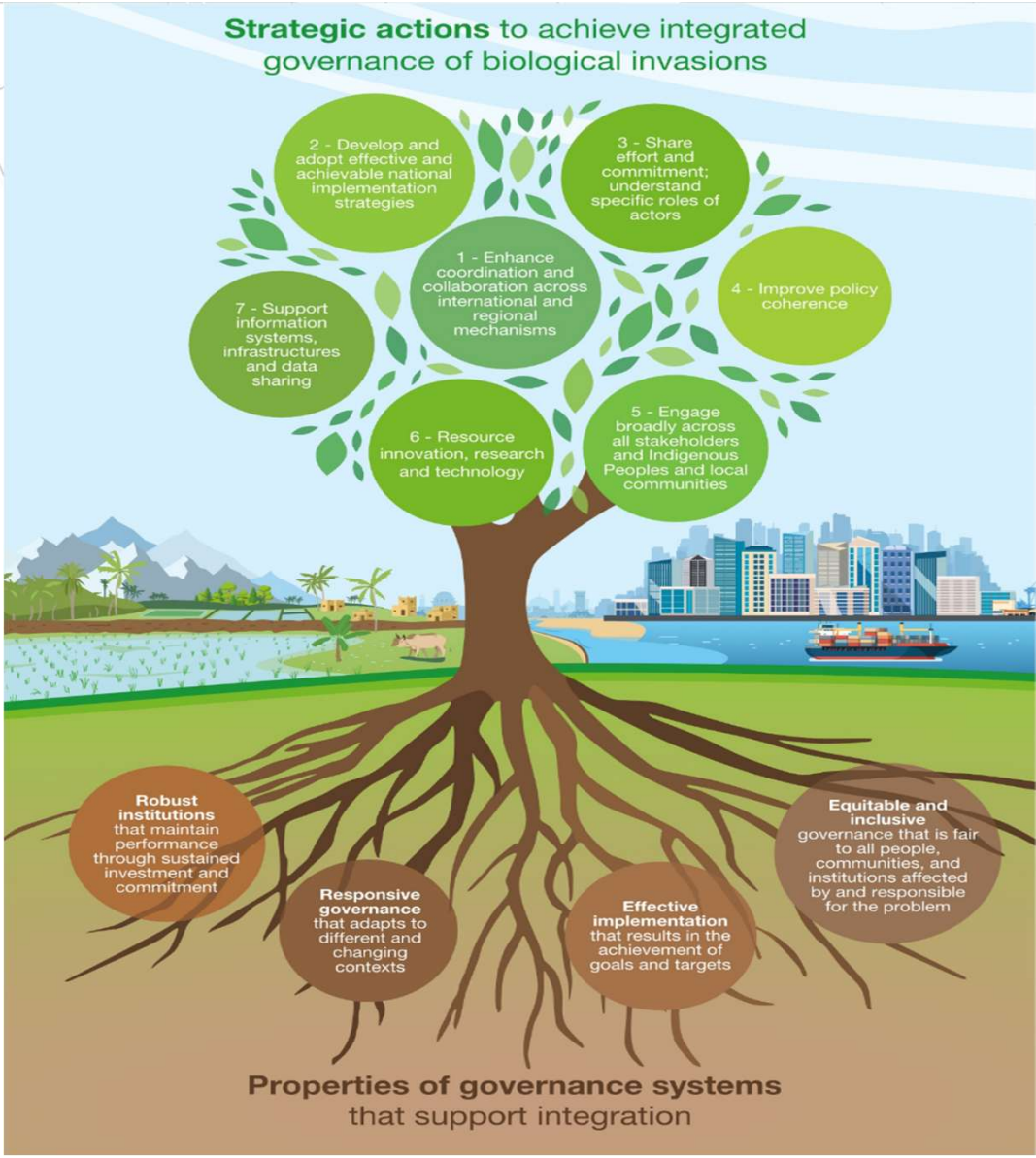
such as marine biodiversity (Goal 14) and terrestrial biodiversity (Goal 15), food security (Goal 2), sustainable economic growth (Goal 8) and sustainable cities (Goal 11), as well as climate change (Goal 13) and health and wellbeing (Goal 3).



In December 2022, Governments have agreed to

“Eliminate, minimize, reduce and or mitigate the impacts of invasive alien species on biodiversity and ecosystem services by identifying and managing pathways of the introduction of alien species, preventing the introduction and establishment of priority invasive alien species, reducing the rates of introduction and establishment of other known or potential invasive alien species by at least 50 per cent by 2030, and eradicating or controlling invasive alien species, especially in priority sites, such as islands” Kunming-Montreal Global Biodiversity Framework, Target 6.

#InvasiveAlienSpecies Assessment




Effective management of Invasive Alien Species
Strategic actions
Enhance coordination and collaboration across international and regional mechanisms
Develop and adopt effective and achievable national implementation strategies
Improve policy coherence
Share effort and commitment; understand specific roles of actors
Engage broadly across all stakeholders and Indigenous Peoples and local communities
Resource innovation, research and technology
Support information systems, infrastructures and data sharing
Stages, levels and scales
Across stages of biological invasion
From individuals to ecosystems
Across temporal and spatial scales
Across levels of governance
Management actions
Border bio-security
Preparedness
Risk analysis, prioritisation, and decision making
Surveillance and monitoring
Chemical, physical and biological controls
Adaptive management including access to modern tools and enhancing capacity to deploy them
Outcomes
Ambitious progress in biological invasion management
Prevention and control of invasive alien species with significant long-term benefits for people and nature
Increased effectiveness of policies and actions designed to respond to other drivers including climate change and land- and sea-use

Pacific Island context: marine

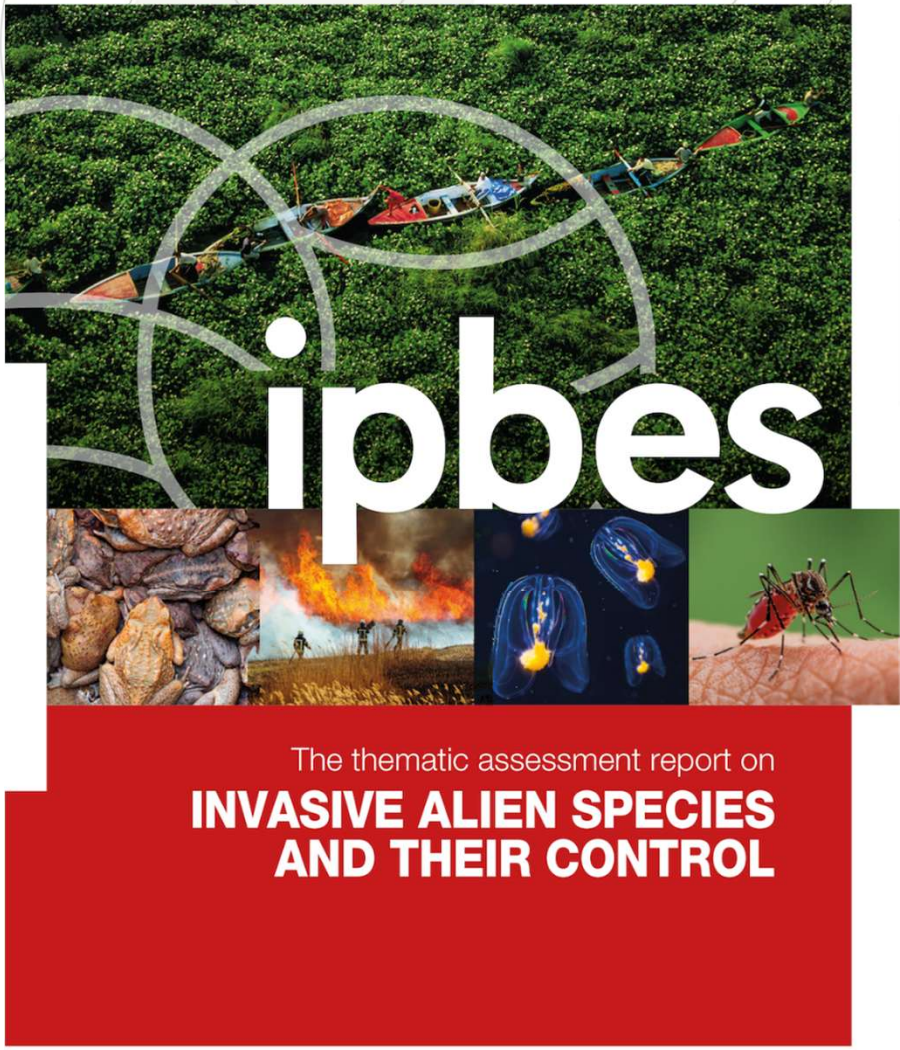
- The knowledge of marine bioinvasions of the Pacific Island Countries and Territories is scattered and dispersed in diverse publications.
- Surveys in Pago Pago Harbor (American Samoa) recognized 17 marine alien species, 40 marine alien species were detected in Guam, and 11 alien species in Malakal harbour, Palau.
- Most alien species were associated with transport in ballast water or biofouling, and the number of intentional introductions for aquaculture purposes are low in Australia and New Zealand but high across the Pacific Islands countries.
- Many introduction attempts have been conducted in the past 50 years in the south Pacific Ocean, with at least 38 alien species originating from small scale fisheries or aquaculture activities.

Invasive plants

- The most dramatic increase in the cumulative number of alien plant species is recorded for Oceania, including Australia, New Zealand, and the Pacific Islands.
- Introduction rates peaked in around 1900, followed by a decline and a re-acceleration in the mid-twentieth century.
- The trends for other Asia-Pacific sub-regions are similar to that for Oceania but they have markedly lower absolute numbers of established alien species per time period.

There is compelling evidence for immediate and sustained action

With sufficient resources and long-term commitment, preventing and controlling invasive alien species are attainable goals that will yield significant long-term benefits for people and nature.



#InvasiveAlienSpecies Assessment

ipbes

3 Expected impacts of the Report

The findings of the invasive alien species assessment are expected to contribute to achieving international targets on biological invasions:

- Target 6 of the Kunming-Montreal Global Biodiversity Framework

- Support implementation of the Sustainable Development Goals of the 2030 Agenda for Sustainable Development, especially Goal 15

Photo by IISD/ENB

#InvasiveAlienSpecies Assessment

The invasive alien species Report will support sharing of information within and across countries, international organizations, companies, related associations, and others

The Report will also support capacity building globally, especially in countries with limited infrastructure

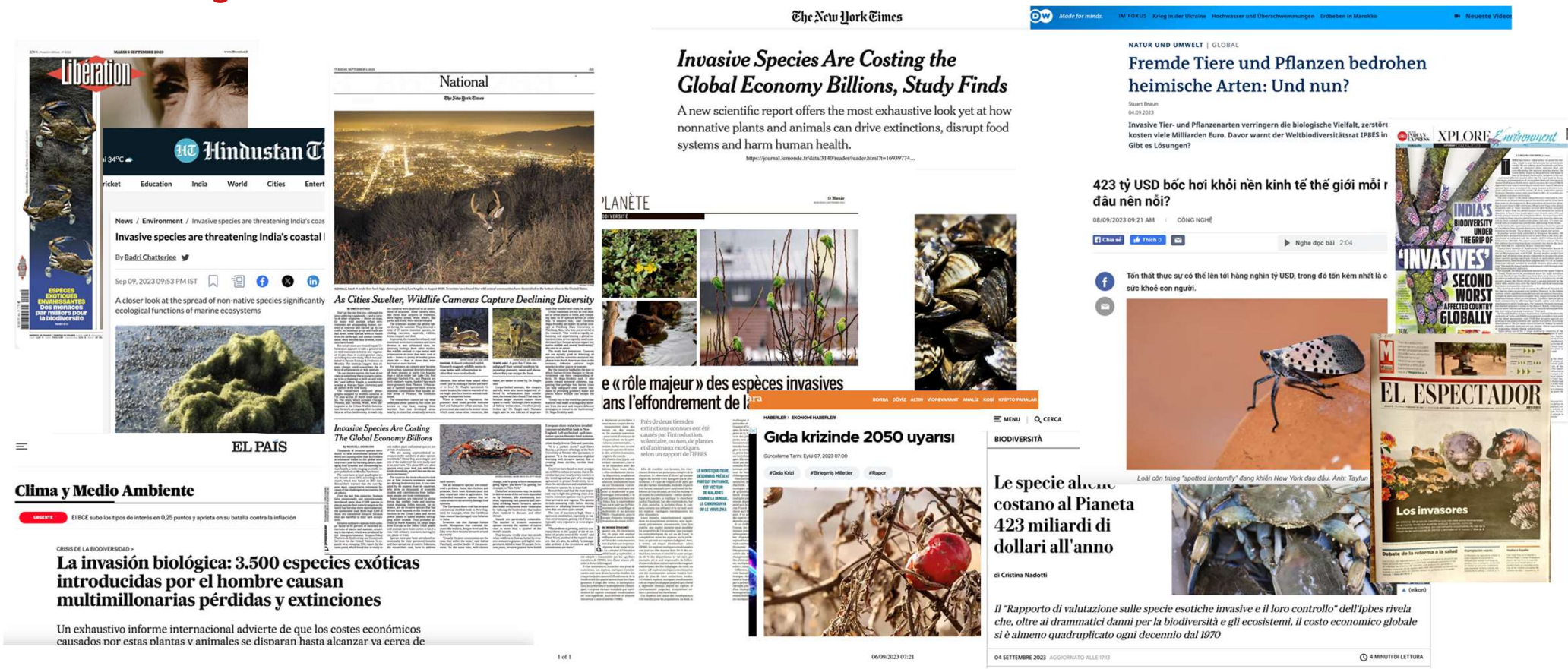
#InvasiveAlienSpecies Assessment

NEWS | 11 SEPTEMBER 2023

GBIF ramps up support of information needed to tackle invasive alien species

New task group to address data challenges revealed by IPBES assessment, national needs for tracking progress toward reducing impacts of invasive alien species

Media coverage



#InvasiveAlienSpecies Assessment

Media articles in ~ 50 languages in over 100 countries

Preliminary uptakes and impacts

Communication on the issue of biological invasions: revision of a national communication strategy to align with the language from the Assessment (Belgium), official communication (Chile, France), translation of the summary for policymakers (South Korea, Japan – in progress)

Presentations and events organized by Japan, the UK, Finland, France, Norway, CABES (Africa), EU Parliament, BES-Net, UNDP, Argentine Society of Ecology, and many others

Presence in policy fora: CBD SBSTTA-25

Action from a science network: A new GBIF task group will address the need for improved access to better data and information on invasive alien species

Action from the private sector: development of an Impact Pathway for invasive alien species (to be piloted from 1 December by ~30 international companies such as BASF, Bayer, Holcim, SAP, BNP Paribas etc.)

Funding opportunities: AU$2.2M for the control of Buffel Grass in South Australia

#InvasiveAlienSpecies Assessment

Register impacts at: https://www.ipbes.net/impact-tracking

5. Gaps in Knowledge and Communications

#InvasiveAlienSpecies Assessment

Identification, classification, and analysis of gaps

1. Gaps were identified across all chapters except Chapter 1 “Introduction” using a two-step survey:
   - Each chapter CLAs were asked to report max 10 of most important gaps from their chapter perspective (i.e., impacts, drivers, etc.)
   - All authors were asked to evaluate relevance of gaps (scale 1-5) for improving understanding, taking actions, costs and challenges
2. Gaps were categorized and classified into:
   - Implementation challenge (financial and scientific)
   - Potential gains (for taking actions and improving knowledge)
3. Synthetized in Chapter 6 and in Table SPM.A1

Photos by Claudio Concha Avello

Overview of gaps

Lack of knowledge:

1. Regional (species and impacts) (everywhere but particularly in developing economies)
2. Taxonomic (particularly microbes and invertebrates)
3. Aquatic environments
4. Processes (interaction of drivers, models & scenarios)

Lack of standards and instruments:

5. Governance (design of integrated governance, effective collaboration, IPLC)
6. Management (control and monitoring) (aquatic systems, climate change, guidelines, IPLC)
7. Lack of international standards (terminology, language)

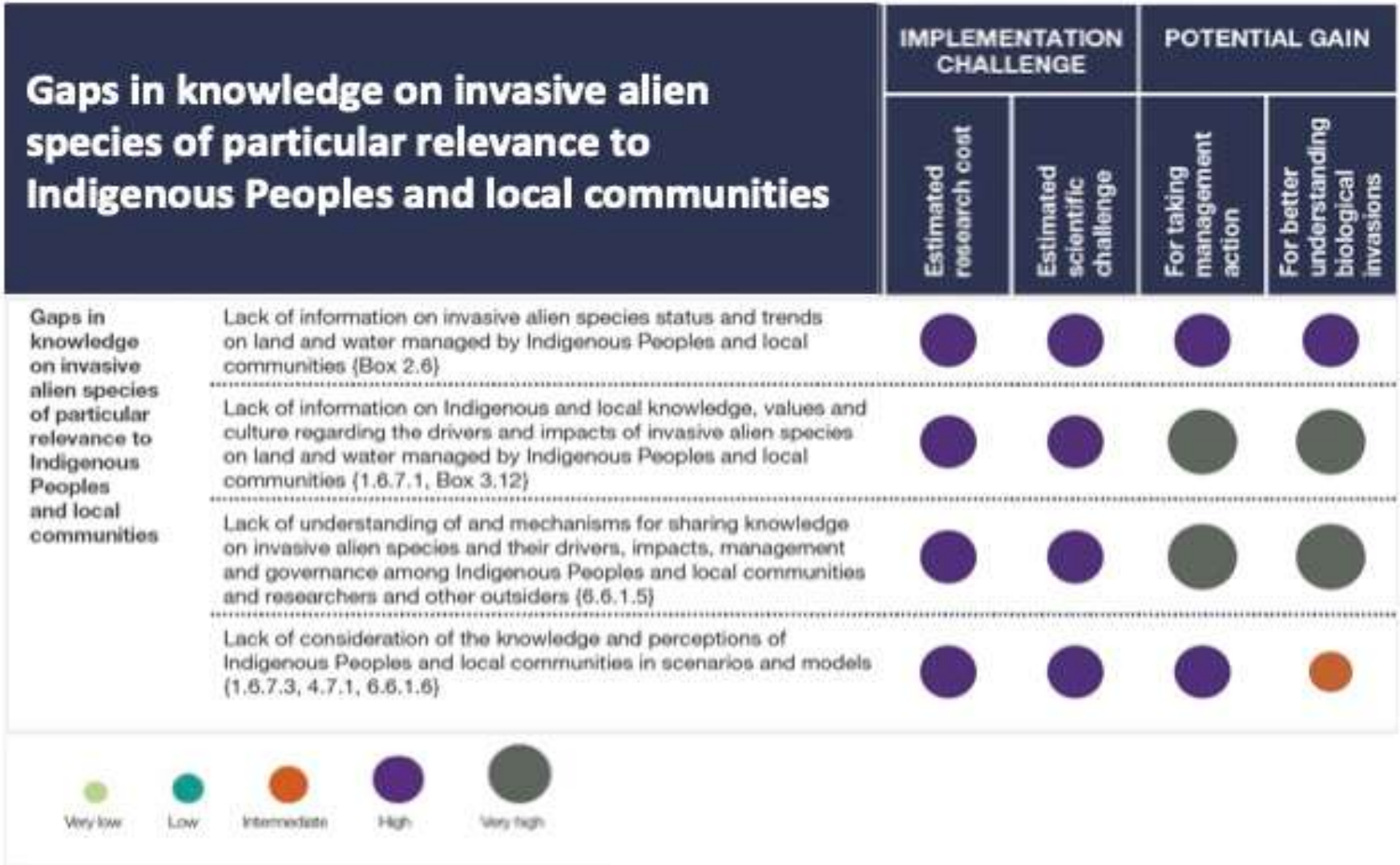
Specific gaps identified in the Assessment

- Incomplete or lack of inventories of invasive alien species in marine, tropical and Arctic ecosystems
- Lack of understanding of the drivers facilitating biological invasion for some animal groups (notably invertebrates), fungi and microbes
- Poor understanding of drivers facilitating biological invasions in aquatic and marine systems Lack of data and knowledge of the drivers facilitating biological invasions in sub-Saharan Africa, tropical Asia and South America

- Lack of information on the role of indirect drivers, especially governance and sociocultural drivers, in affecting biological invasions
- Lack of integration of data and knowledge sources on impacts across languages
- Lack of inventories at fine scales and for specific taxon and biome contexts to support decision makers in determining when to implement species-led and site-based management (or both)
- Lack of control options for marine invasive alien species and invasive microbial fungal pathogens of plants and animals

- Lack of agreed-upon methods of supporting management decision-making for invasive alien species with both positive and negative impacts
- Lack of methods of managing pathways for invasive alien species arriving as contaminating invasive alien species, or through shipping containers, e-commerce (legal/illegal), biofouling or ports, and across land borders and along trade supply chains
- Lack of biological invasion research that includes social dimensions to generate socially relevant additional data and knowledge, better inform management and policy and build trust between sectors of society

- Policy for new and emerging technological innovations for invasive alien species management to support effective development and implementation and prevent or manage risks
- Research and design of economic options, including the tailoring of ambient taxes and analyses and indicators to assist private companies
- Lack of information on invasive alien species status and trends on land and water managed by Indigenous Peoples and local communities
- Understanding the on-the-ground experiences of stakeholders and Indigenous Peoples and local communities and their engagement in invasive species management and governance and related network analysis


Gaps in knowledge on invasive alien species of particular relevance to Indigenous Peoples and local communities
IMPLEMENTATION CHALLENGE
POTENTIAL GAIN
Estimated research cost
Estimated scientific challenge
For taking management action
For better understanding biological invasions
Gaps in knowledge on invasive alien species of particular relevance to Indigenous Peoples and local communities
Lack of information on invasive alien species status and trends on land and water managed by Indigenous Peoples and local communities {Box 2.6}
Lack of information on Indigenous and local knowledge, values and culture regarding the drivers and impacts of invasive alien species on land and water managed by Indigenous Peoples and local communities {1.6.7.1, Box 3.12}
Lack of understanding of and mechanisms for sharing knowledge on invasive alien species and their drivers, impacts, management and governance among Indigenous Peoples and local communities and researchers and other outsiders {6.6.1.5}
Lack of consideration of the knowledge and perceptions of Indigenous Peoples and local communities in scenarios and models {1.6.7.3, 4.7.1, 6.6.1.6}
Very low
Low
Intermediate
High
Very high

Strengthening the information value of IAS indicators

- Invest in the on-ground monitoring systems needed to deliver up to date information on the identity, spread and impacts of invasive alien species; and on the implementation and effectiveness of responses, including the implementation and effectiveness of management actions;
- Complete the research needed to support robust scientific formulations of indicators, the metrics on which they based, how they are modelled and interpretation of the uncertainty associated with them;
- Establish a stable partnership to support invasion indicators that has the scientific expertise, data and analytic capacity and resourcing necessary to sustain these indicators over the long-term;
- Support the open infrastructures, data sources and collation processes required to aggregate and inform invasive alien species indicators, such as GBIF and the Global Register for Introduced and Invasive Species that jointly provide the data foundational to informing on invasive alien species;
- Assess and progress the extent to which each indicator can be downscaled and expressed at country level and the extent to which they are suitable for use at a national scale

Communications gaps

- **SPM D29:** Public understanding of the risks associated with invasive alien species is particularly important for preventing new introductions.
- Engagement of the general public *via* citizen science platforms, awareness campaigns and community-driven eradication campaigns also contributes to establishing shared responsibilities for managing biological invasions
- Surveillance for detecting invasive alien species through citizen science and social media provides broader security by empowering and engaging the public.
- Communication is an effective tool for inspiring collective action by supporting the co-design of management actions, knowledge exchange and enhanced partnerships among stakeholders and researchers … It can also enable alignment of resource managers' responses with national plans and policy priorities.
- An effective communications strategy considers the most appropriate timing, media and channels/interfaces for the target audience.

CITIZEN SCIENCE

- Commonly recorded parameters in citizen science initiatives are species name, geographic coordinates, photographs, species abundance and habitat description; from these primary data, several essential biodiversity variables (EBVs) such as species distribution, population abundance, phenology, demographic traits, migratory behaviours and disturbance regimes have been derived
- Citizen science has been successfully used in spatio-temporal distribution mapping of invasive alien species, prediction of species' suitable climatic niches, early detection, and understanding animal behaviour and plant phenology
- But the biggest benefit is public engagement/buy-in at a serious level


ipbes
Thank you!
Fa’afetai!
fa’afetai
#InvasiveAlienSpecies Assessment

ipbes