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LETTER TO THE EDITOR

Overwhelming evidence galvanizes a global consensus on the need for action against Invasive Alien Species

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On 4 September 2023, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) released the most comprehensive global synthesis of the current knowledge on the biological invasion process and the impacts of invasive alien species, i.e., the Thematic Assessment Report on Invasive Alien Species and their Control (hereafter IPBES-IAS assessment, IPBES 2023a). This assessment includes data and knowledge from existing databases, peer-reviewed and gray literature, and knowledge from Indigenous Peoples and local communities to gain a global perspective on biological invasions across regions, ecosystems, and taxa (Figs. 1, 2). Here we place the IPBES-IAS assessment in the continuum of invasion science and policy history, describe the assessment process, and discuss the results.

While Charles Darwin introduced a remarkable number of concepts relevant to invasion science (Ludsin and Wolfe 2001) and Charles Elton earned

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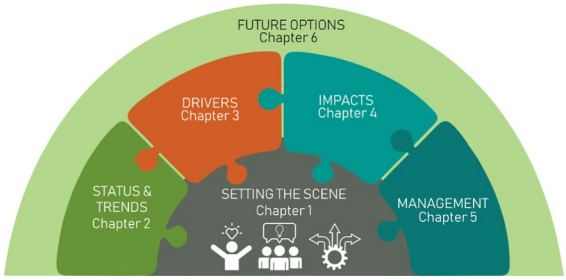

Fig. 1 Structure and topics covered in the IPBES-IAS assessment including chapters 1–6 and with three cross-cutting themes across chapters: (1) Indigenous and local knowledge systems, (2) good quality of life including human health, and (3) scenarios and modeling of trends (Figure modified from Chapter 1) (1: https://doi.org/10.5281/zenodo.7430723; 2: https://doi.org/10.5281/zenodo.7430725; 3: https://doi.org/10.5281/zenodo.7430727; 4: https://doi.org/10.5281/zenodo.7430731; 5: https://doi.org/10.5281/zenodo.7430733; 6: https://doi.org/10.5281/zenodo.7430747)

distinction as the 'father of invasion biology' (e.g., Richardson and Pyšek 2007), the field of invasion science did not emerge until the 1980s when the Scientific Committee on Problems of the Environment conferences were held in Stellenbosch, South Africa and Ottawa, Canada (Simberloff 2011). The many scientific developments in the intervening decades led the 2002 Convention on Biological Diversity to adopt non-binding guiding principles for the prevention of impacts caused by invasive alien species.[1] Notably, in 2023 this IPBES-IAS assessment achieved the first global consensus among governments and scientists on the threats and impacts posed to nature, people, and the economy by invasive alien species.

The IPBES process

The work programme of IPBES includes the delivery of assessments of knowledge on biodiversity and ecosystem services and their interlinkages, including comprehensive thematic, global, and regional assessments of topics related to biodiversity. Every IPBES assessment is produced according to the guidelines for the production of assessments agreed by governments[2] beginning with the approval of a scoping document and culminates in approval of the assessment by the member States of IPBES. An assessment of invasive alien species and their control was requested by IPBES member States in 2014. Two years later, IPBES member States approved a scoping report for the IPBES-IAS assessment[3] that established definitions, objectives, geographic coverage, and the assessment focus. The IPBES-IAS assessment process was then launched in 2019, following the seventh session

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[1] https://www.cbd.int/kb/record/decision/7197.

[2] https://www.ipbes.net/guide-production-assessments.

[3] https://ipbes.net/sites/default/files/ipbes-6-inf-10_en.pdf.

of the IPBES Plenary. The IPBES Multidisciplinary Expert Panel and Bureau then selected three co-chairs,14 coordinating lead authors, 69 lead authors, and 12 review editors nominated by Governments and organizations. An additional 199 invited contributing authors made specific topical contributions (Fig. 2).

The power and outreach of the IPBES Thematic Assessment on Invasive Alien Species and their Control

The six chapters collate evidence on the status, trends, drivers, and impacts of invasive alien species worldwide and evaluate management and policy solutions. The IPBES-IAS assessment also highlights the required changes in governance systems that are fundamental because biological invasions are a grand societal challenge that demands integrated governance that extends beyond a narrow scientific perspective. While scientists are at times criticized for a lack of engagement with public and private decision makers, stakeholders, and rights holders, this assessment demonstrates the opposite (Fig. 2). The global media covered the assessment's release in 50 languages across 123 countries reaching billions of people—numbers that speak to the relevance and outreach of the IPBES-IAS assessment to communities around the world.

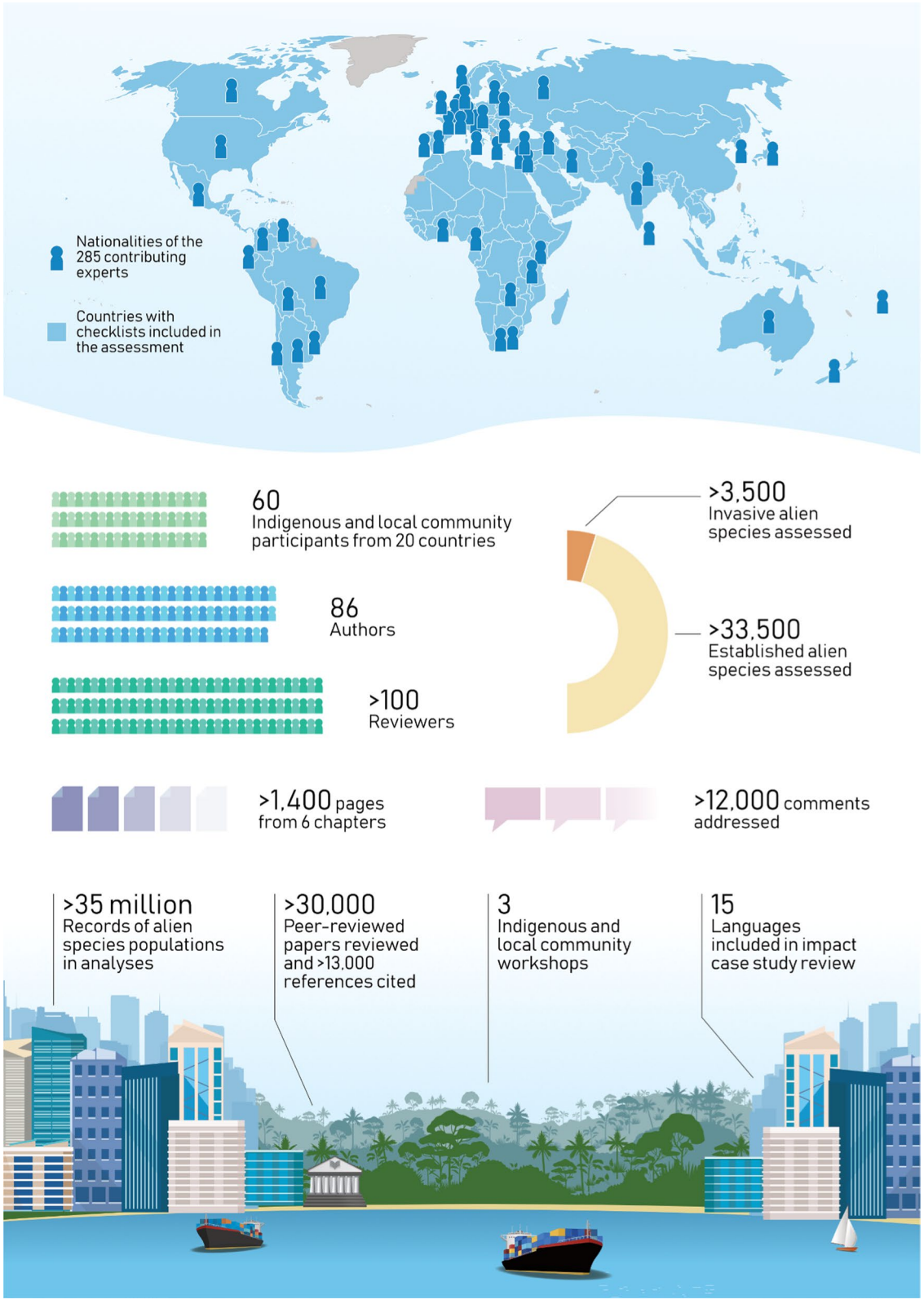
During the four-and-a-half-year process, the assessment underwent multiple rounds of external review by scientists, government representatives, Indigenous Peoples and local communities, NGOs, students, and private citizens, resulting in thousands of comments that the authors addressed. The resulting assessment consists of two main parts: a summary for policymakers (SPM) and six chapters (Fig. 1). The tenth session of the IPBES Plenary (IPBES-10) took place over five days in Bonn, Germany, in 2023 and was attended by member States, observers and experts. The IPBES-IAS assessment was approved by the 143 IPBES member States at their tenth Plenary session (IPBES 10). The SPM was considered in detail at the plenary and was ultimately approved by the IPBES member States before the plenary close (IPBES 2023b). While chapters and appendices were not negotiated, member States were invited to accept them and did so for this assessment.

Summary of key findings

Key findings that emerged from the IPBES-IAS assessment are summarized here, but we urge readers to further explore and use the full richness of data and information in the assessment. The evidence documented makes clear that people and nature are experiencing serious negative impacts from invasive alien species in all regions of the world (Fig. 3), including a marked worsening of inequities in some cases. Biological invasions are promoted by a wide range of human activities in all ecosystems, including global trade and travel, which drive the transport and introduction of invasive alien species, and land-use, sea-use, and climate change, which facilitate invasive alien species establishment and spread. These drivers require urgent and targeted attention to prevent and reduce biological invasions. Prevention remains the most cost-effective action to reduce and manage biological invasions; failing that, preparedness, eradication, containment and control, and adaptive management can reduce the numbers and impacts of invasive alien species. For example, while 20% of all documented invasive alien species impacts are reported from islands, the good news is that 88% of attempted eradications on nearly 1000 islands have been successful, especially for invasive alien vertebrates. Integrated governance, an approach that merges context-specific applications of the same strategic actions across and within countries and sectors, can limit the global problem of invasive alien species. Even so, while 80% of countries currently have targets related to managing invasive alien species in their national biodiversity plans, 45% do not invest in the management of biological invasions. The Global Biodiversity Framework (GBF)[4] offers a strategic opportunity to update national frameworks to prevent and control invasive alien species, which will contribute to achieving many GBF goals and several Sustainable Development Goals (SDGs).[5]

[4] https://www.cbd.int/doc/decisions/cop-15/cop-15-dec-04-en.pdf.

[5] https://sdgs.un.org/goals.


Nationalities of the 285 contributing experts
Countries with checklists included in the assessment
60
Indigenous and local community participants from 20 countries
86
Authors
>100
Reviewers
>3,500
Invasive alien species assessed
>33,500
Established alien species assessed
>1,400 pages from 6 chapters
>12,000 comments addressed
>35 million
Records of alien species populations in analyses
>30,000
Peer-reviewed papers reviewed and >13,000 references cited
3
Indigenous and local community workshops
15
Languages included in impact case study review

◂**Fig. 2** The power of the assessment in numbers. *Top*: map of the countries with alien species checklists included in the assessment (light blue) and the nationalities of the contributing experts. *Middle*: numbers of Indigenous Peoples and local community members that participated in three Indigenous and local knowledge dialogue workshops, number of authors, number of reviewers in the three open external reviews processes, number of established alien species and the subset that are documented invasive alien species, length of the six chapters of the assessment, and number of comments addressed. *Bottom*: numbers of records of alien species included in analyses, number of documents analyzed, and references cited, number of Indigenous and local knowledge dialogue workshops, and number of languages included in the impact case studies reviewed (https://www.ipbes.net/sites/default/files/inline-files/IPBES_IAS_1stILKDialogue_Report_final_forWeb.pdf, https://www.ipbes.net/sites/default/files/inline-files/IPBES_IAS_2ndILKDialogue_FOD_Report_FINAL_ForWeb.pdf, https://www.ipbes.net/sites/default/files/2023-02/IPBES_IAS_3rdILKDialogue_SPM-SOD_Report_FinalForWeb2.pdf)

A call to action

The IPBES-IAS assessment highlights data gaps and the uneven distribution of available information across regions, taxa, and ecosystems. Despite these gaps, we currently have enough information to reduce the risk of biological invasions and mitigate the negative impacts of invasive alien species. Gaps and lack of knowledge do not justify inaction, no matter the number of invasive alien species reported. For example, evidence in the assessment shows that in some cases even a single species can cause dramatic impacts over large areas. Far from being a weakness, the gaps identified in the assessment present avenues to strategically mobilize existing data and knowledge to improve management options, suggest

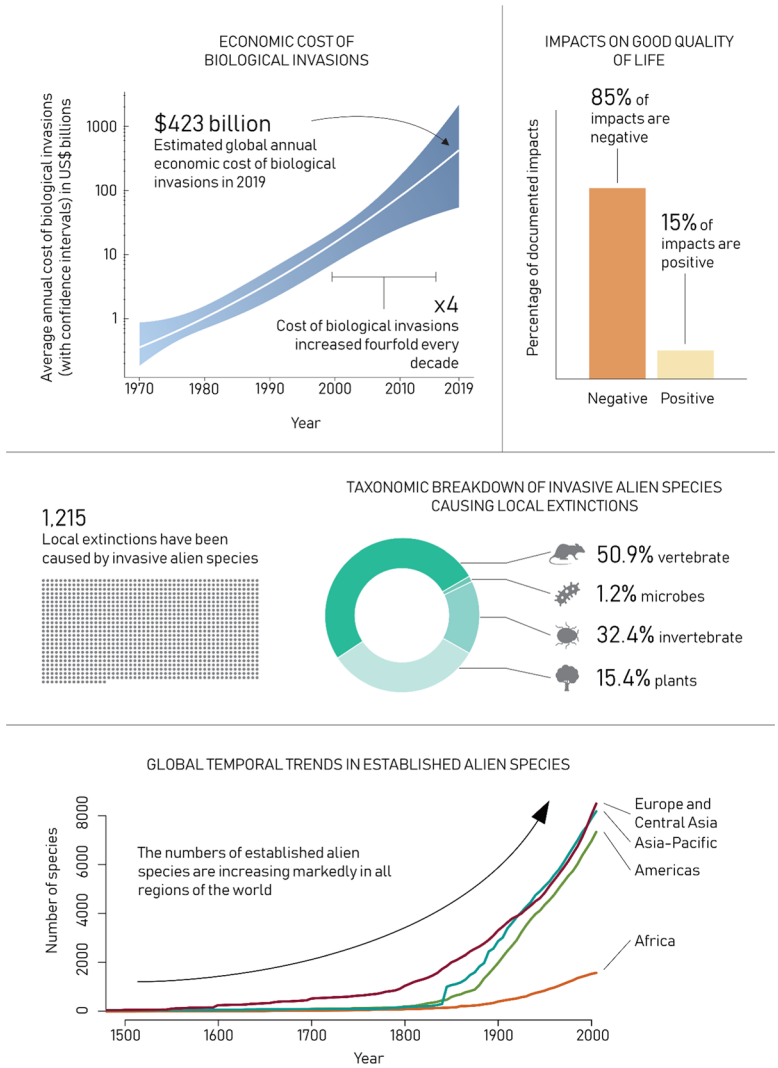


Fig. 3 Examples of impacts of invasive alien species. *Top left*: increase in the economic cost of biological invasions per decade since 1970. *Top right*: percentage of cases of negative and positive impacts of invasive alien species on good quality of life (e.g., human health, safety and security, social and cultural relationships). *Middle left*: documented cases of local extinctions owing to invasive alien species. *Middle right*: taxonomic breakdown of invasive alien species as documented causes of native species local extinctions. *Bottom panel*: trends in established alien species by region

new research for social and natural scientists, identify funding opportunities for governments, business, and foundations, and tackle wicked problems in need of interdisciplinary approaches.

While invasion science will undoubtedly continue to advance, the impacts of invasive alien species are well-supported by thoroughly documented information that leaves no uncertainty as to their negative consequences and the urgent need for immediate action. Existing decision-support tools and technologies should be shared broadly and applied to manage and address biological invasions collaboratively. Furthermore, actions must extend beyond the lens of invasion science to the very fundamentals of how environmental change and society itself are governed. Through this landmark IPBES-IAS assessment, invasion scientists past and present have laid the foundations for evidence-based action to address interlinked global environmental changes. The ongoing work of invasion researchers, both specialized and multidisciplinary, will be essential to continue to encourage and facilitate the translation of this science into action, providing concrete ways to significantly reduce current and future impacts of invasive alien species to nature and to human livelihood.

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