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Invasive alien species

Activities undertaken in collaboration with the Inter-Agency Liaison Group on Invasive Alien Species

Note by the Secretariat

I. Introduction

1. The present document covers activities undertaken by the Secretariat of the Convention on Biological Diversity in response to requests made by the Conference of the Parties in paragraph 10 of decision 16/18 on invasive alien species, including that to further strengthen collaboration among relevant organizations through the Inter-Agency Liaison Group on Invasive Alien Species, with a view to supporting the implementation of Target 6 of the Kunming-Montreal Global Biodiversity Framework. Pursuant to the request, collaboration through the Liaison Group continued, and the Group held its fourteenth meeting on 29 and 30 April 2025. The outputs of the Liaison Group are outlined below.

II. Activities undertaken by the Inter-Agency Liaison Group on Invasive Alien Species in response to subparagraph 10 (a) of decision 16/18

A. Capacity-building and awareness-raising

2. Further to subparagraph 10 (a) of decision 16/18, the Secretariat, in collaboration with the Liaison Group, held an information webinar and a training course and developed awareness-raising materials on the topic of invasive alien species, as described below.

Information webinar

3. The event was held on 26 March 2025.[1] In total, 374 participants registered for the webinar, with 185 attending. The webinar was aimed at raising awareness of existing tools and resources to support the implementation of Target 6 of the Framework and highlighting the importance of international collaboration and networking. Several members of the Liaison Group, including representatives of the International Union for Conservation of Nature, CABI, the International

* CBD/SBSTTA/27/1.
[1] See www.cbd.int/invasive/current/Webinars.shtml for a recording of the event.

Maritime Organization and the World Organisation for Animal Health, partnered with the Secretariat to deliver presentations, showcasing the tools and guidance available to Parties to support them in the implementation of Target 6.

Training course

4. The Secretariat, in collaboration with the International Union for Conservation of Nature and the Secretariat of the Pacific Regional Environment Programme, and with financial support from the Government of Japan, through its Japan Biodiversity Fund, the Government of Denmark and the European Union, held a training course for Pacific small island developing States on invasive aliens in Apia, from 15 to 17 July 2025. The training course was aimed at supporting Parties in achieving the implementation of Target 6 of the Framework by providing an overview of available tools and guidance on invasive alien species, identifying the capacities and needs of Parties in the region to implement Target 6 and highlighting the relevance of the long-term work of island States on invasive alien species. Documents related to the event can be found on the website of the Convention.[2]

Awareness-raising materials

5. Awareness-raising materials were developed with financial support from the European Union on the following topics: invasive alien species and e-commerce; climate change and invasive alien species; socioeconomic impacts of invasive alien species and invasive alien species and tourism. The materials are available on the website of the Convention.[3]

B. Improve access to data and information on invasive alien species

6. In response to subparagraph 10 (a) (v) of decision 16/18, the Secretariat and the Liaison Group also collaborated on strengthening collaboration with relevant sectors to improve access to data and information on invasive alien species. In that respect, a report on how access to data and information can be improved to support Parties in making progress towards Target 6 of the Framework was produced, with financial support from the Government of Japan, through its Japan Biodiversity Fund, and the European Union. The report outlines a series of elements through which data accessibility can be assessed and contains case studies of information needs related to invasive alien species for tourism and trade. It also provides a series of recommendations on how data accessibility can be improved, including through recommendations for national and global data providers and aggregators. The report is presented in the annex to the present document in the form and language in which it was received by the Secretariat.

[2] At www.cbd.int/meetings/IAS-OM-2025-01.
[3] At www.cbd.int/invasive/trainingias.

Annex*

Data and information sharing for the management of invasive alien species

This document has been developed with the generous support from the European Union and Government of Japan, through the Japan Biodiversity Fund, and with support from members of the Inter-Agency Liaison Group on Invasive Alien Species.[1]

* The present annex is being issued without formal editing.

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I. Data and information sharing for the management of invasive alien species

This report focuses on how access to data and information can be improved to support Parties in making progress towards Target 6 of the Kunming-Montreal Global Biodiversity Framework. It also identifies a series of elements through which data accessibility can be assessed and provides case studies on the information needs related to invasive alien species for tourism and trade. Finally, it provides a series of recommendations on how data accessibility can be improved, including through recommendations for national and global data providers and aggregators. The report considers among other things, information from the Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystems Services[2] (hereafter referred to as The Assessment).

1. The importance of data and information sharing for the management of invasive alien species

1.1. Why is data important to address invasive alien species?

The need to access data and information[3] to address threats posed by invasive alien species (IAS) has been acknowledged in several decisions of the Conference of the Parties to the Convention on Biological Diversity (CBD), including in decision 16/18[4], which recognises that increasing the availability and accessibility of information, means of implementation and addressing major knowledge gaps on biological invasions, would result in more robust and effective policy instruments and management actions. The voluntary guidance annexed to the above-mentioned decision also stresses in various ways the important role of accessing data and information for several actions such as, among others, multi-criteria analysis and identification and minimization of risks associated with cross-border e-commerce.

Actions towards Target 6 of the Kunming-Montreal Biodiversity Framework (Box 1) also have specific data and information needs, including for identifying and prioritising IAS and pathways of introduction that need targeted responses. Understanding which management actions are likely to be effective for different objectives and over different geographic scales also requires access to robust data and information. Standardised and accessible data also enables the establishment of baselines and the monitoring of progress towards global and nationally determined targets and goals, and of management interventions. It is not just 'data' that is needed to inform such measures; other types of knowledge are also important, such as access to management best practices and species identification guides, or traditional ecological knowledge from indigenous peoples and local communities with their free prior and informed consent,[5] which can all improve the effectiveness of responses. However, while many data, literature, and other information sources are available, they are often not easily accessible by those who need them. Data is dispersed across many different global, regional, national, and sub-national online platforms in different formats, languages, and using different data standards. Publications are in different languages, and a lot of information is not published with open access rights. In addition, data that is mobilised often does not flow to those who need it in a timely manner in order to effectively inform decision-making, prioritisation, and actions such as rapid response.

Improving data accessibility and sharing to inform research and actions is seen as a challenge across biodiversity conservation in general.[6] However, due to the global nature of biological invasions and the

[2] IPBES (2023). Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Roy, H. E., Pauchard, A., Stoett, P., and Renard Truong, T. (eds.). IPBES secretariat, Bonn, Germany. DOI: https://doi.org/10.5281/zenodo.7430682.

[3] Data is often defined as 'raw' facts, values or figures that are meaningless on their own. It can be quantitative (e.g. numbers, measurements) or qualitative (species names, labels). Information is data that has been processed, organised, or presented to provide context and meaning, often to inform decision-making.

[4] CBD/COP/DEC/18/18 Invasive alien species https://www.cbd.int/doc/decisions/cop-16/cop-16-dec-18-en.pdf.

[5] Free, prior and informed consent" refers to the tripartite terminology of "prior and informed consent", "free, prior and informed consent" and "approval and involvement".

[6] See for example, Binley, A. D., Vincent, J. G., Rytwinski, T., et al. (2024). Making the most of existing data in conservation research. Perspectives in Ecology and Conservation, 22(2), 122-128. https://doi.org/10.1016/j.pecon.2023.11.004 and Buxton, R.

need for collaborative international and regional responses, there is an acute need to increase the accessibility of data and information on IAS through international data platforms. In addition, the data requirements for addressing IAS are unique, requiring information on species native and alien ranges, introduction pathways, degree of establishment, impact mechanisms, and any management actions undertaken.[7] Due to the dynamic temporal and geographic nature of biological invasions, data and information can quickly become out of date, requiring regular updating to ensure that it is fit for purpose. Similarly, there is a need for fast dissemination of information and data, especially for early detection and rapid response programs.[8]

Box 1. Kunming-Montreal Global Biodiversity Framework Target 6 on invasive alien species.[9]

Eliminate, minimize, reduce, and or mitigate the impacts of invasive alien species on biodiversity and ecosystem services by:

i. Identifying and managing pathways of the introduction of alien species
ii. 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
iii. Eradicating or controlling invasive alien species, especially in priority sites, such as islands

1.2. Data and information to support invasive alien species management and T6

Informing the implementation of actions under Target 6 of the Framework requires more than just accessing data or information (e.g. on the distribution and impacts of IAS) from online databases. Information from publications such as scientific literature, management, codes of conduct, best practices, community reports, and identification guides is also required. In addition, the use of analytical tools such as risk assessments, horizon scanning, or species distribution modelling can use the data and information to provide robust evidence to support decision-making. Automated workflows can also improve the efficiency, reproducibility, repeatability, and speed at which data and information are made accessible to the required end user groups.

A broad range of stakeholder groups require access to data and information on IAS, including national government agencies, indigenous peoples and local communities, civil society organizations, sub-national governments, the private sector, and international organizations. The type of information needed by these actors can vary depending on their specific needs and the actions they are undertaking. This information may include best practices for IAS management, pre-border data on imports to support risk-based controls, identification guides, inspection protocols, and more.

The Invasive Alien Species Toolkit for Target 6 of the Kunming-Montreal Global Biodiversity Framework (hereafter referred to as the CBD IAS Toolkit)[10] sets out a series of guiding questions that can be used to identify what data and information are needed to develop actions for Target 6 (Figure 1). Using these questions, Table 1 presents a summary of the key data, information, and analytical tools needed to inform national-level actions for Target 6. It also identifies examples of information sources that can meet these

T., Bennett, J. R., Reid, A. J., et al. (2021). Key information needs to move from knowledge to action for biodiversity conservation in Canada. Biological Conservation, 256, 108983. https://doi.org/10.1016/j.biocon.2021.108983.

[7] Groom, Q.J., et al. (2019) Improving Darwin Core for research and management of alien species. *Biodiversity Information Science and Standards* 3: e38084. https://doi.org/10.3897/biss.3.38084.

[8] Groom, Q.J., et al. (2017). Seven Recommendations to Make Your Invasive Alien Species Data More Useful. *Frontiers in Applied Mathematics and Statistics*, *3*, 265016. https://doi.org/10.3389/fams.2017.00013.

[9] The breakdown of Target 6, as well as the emphasis on certain phrases, are the authors' own.

[10] Convention on Biological Diversity and International Union for Conservation of Nature (IUCN). (2024). Invasive Alien Species Toolkit for Target 6 of the Kunming-Montreal Global Biodiversity Framework. The Secretariat of the Convention on Biological Diversity. https://www.cbd.int/invasive/cbdtoolkit.

needs. Please see the CBD IAS Toolkit for a more comprehensive list of relevant information sources to support actions for Target 6.

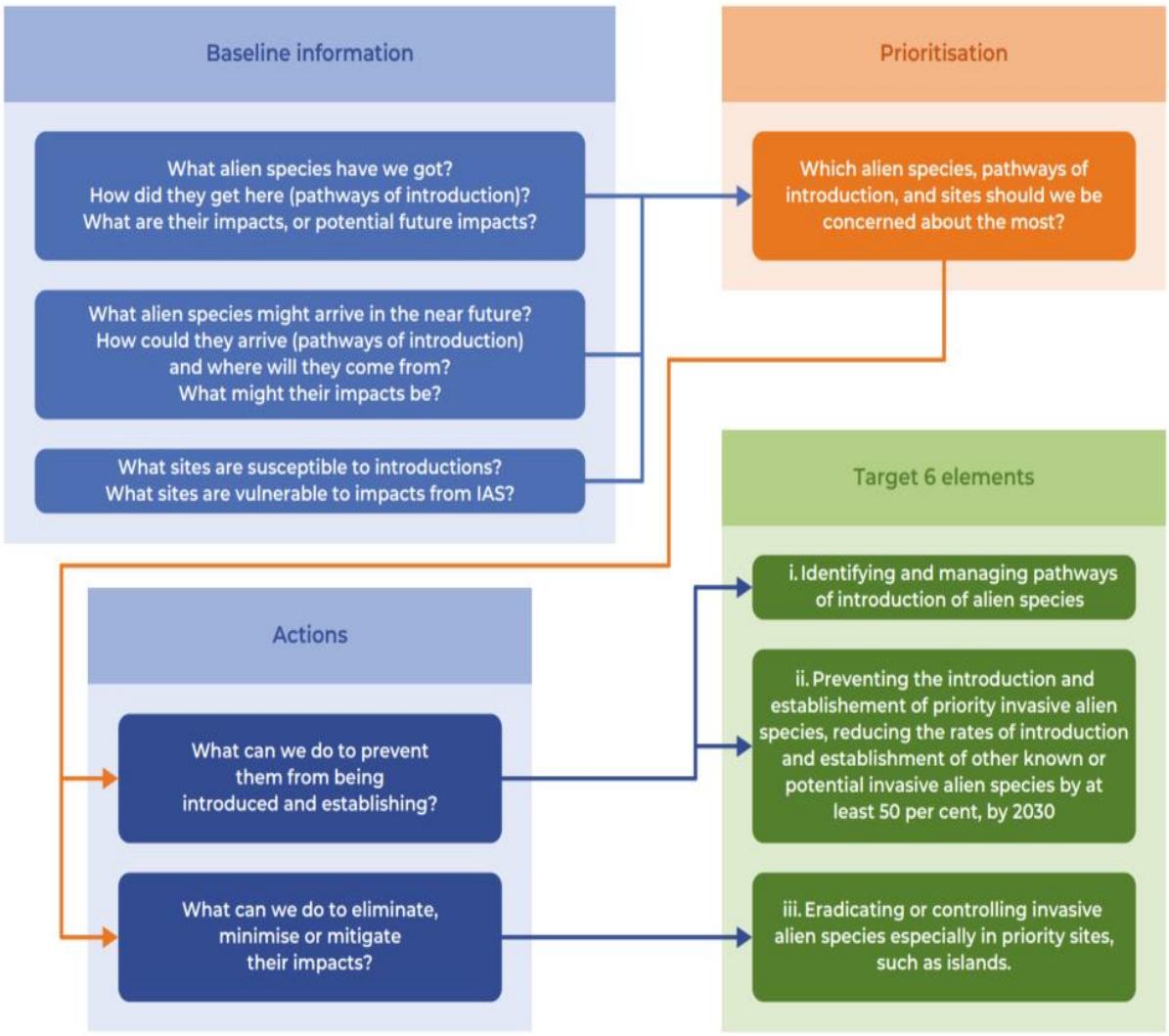

Figure 1. What do we need to know for Target 6? The questions (in blue) can guide and inform the development of actions to address the three elements of Target 6 (in green). Taken from CBD IAS Toolkit (CBD and IUCN, 2024)

Table 1. Data and information needs for Target 6 of the Kunming-Montreal Global Biodiversity Framework

Actions to support progress towards Target 6	**Data and information needs**	**Examples of available sources of data and information** Produced through the Inter-Agency Liaison Group on Invasive Alien Species and other relevant sources. Potential national sources are also mentioned. *Please see the CBD IAS Toolkit for additional resources.*
Target 6 element – Baseline information		
What alien species have we got, how and when did they get here (pathways of introduction), and what are their impacts?		
Identifying which alien species are currently introduced and established in a country, and which may be invasive, is usually done through a 'checklist'. The use of standardised vocabulary, such as Darwin Core terminology,[14] is useful. Knowing which alien species are established (not just introduced) is also required for reporting on the Kunming-Montreal Global Biodiversity Framework´s headline indicator for Target 6.[15]	Information on species taxonomy, common names, degree of establishment, invasive status, date of introduction, and pathways of introduction. Additional information can include synonyms, distribution, abundance, habitat and ecology, and magnitude and mechanism of impacts.	**IALG-IAS:** CABI Compendium: Invasive Species;[16] Global Biodiversity Information Facility (GBIF);[17] Global Register of Introduced and Invasive Species (GRIIS);[18] IUCN Global Invasive Species Database (GISD);[19] and the International Plant Protection Convention (IPPC) List of Regulated Pests.[20] **Other**: Global Alien Species First Record Database;[21] the Global Impacts Dataset of Invasive Alien Species (GIDIAS);[22] and World Register of Introduced Marine Species (WRiMS).[23] **National sources:** May include national biodiversity checklists, citizen science, environmental-DNA data, and knowledge from indigenous peoples and local communities.

[14] Groom, Q.J., et al. (2019) Improving Darwin Core for research and management of alien species. *Biodiversity Information Science and Standards* 3: e38084. https://doi.org/10.3897/biss.3.38084.
[15] McGeoch, M.A., et al. (2023). Invasion trends: An interpretable measure of change is needed to support policy targets. *Conservation Letters*, *16*(6), e12981. https://doi.org/10.1111/conl.12981.
[16] CABI Compendium: Invasive species https://www.cabidigitallibrary.org/product/QI.
[17] GBIF https://www.gbif.org/ and GBIF GRIIS https://www.gbif.org/dataset/search?project_id=GRIIS.
[18] Global Register of Introduced and Invasive Species (GRIIS) https://griis.org/.
[19] IUCN Global Invasive Species Database (GISD) https://www.iucngisd.org/gisd/.
[20] IPPC regulated Pest List https://www.ippc.int/en/countries/jamaica/reportingobligation/2014/03/regulated-pest-list/.
[21] Seebens, H., et al. (2017). No saturation in the accumulation of alien species worldwide. *Nature Communications*, *8*(1), 1-9. https://doi.org/10.1038/ncomms14435.
[22] Bacher, S., et al. (2025). Global Impacts Dataset of Invasive Alien Species (GIDIAS). *Scientific Data*, *12*(1), 1-10. https://doi.org/10.1038/s41597-025-05184-5.
[23] Costello, M.J., et al. (2025). World Register of Introduced Marine Species (WRiMS). https://www.marinespecies.org/introduced/.

What alien species might arrive in the near future, how could they arrive (pathways of introduction), and what might their impacts be?		
Identifying species that are likely to arrive in the near future can be achieved through a horizon scan approach[24] that identifies species risk of introduction, establishment, spread, and impacts. Quantitative approaches such as predictive modelling (e.g. climate matching and habitat matching) can support horizon scans and the identification of likely invaders.	This requires information on IAS presence in neighbouring countries and other relevant countries, such as those with strong trading relations. It also requires knowledge of the species habitat and climate needs, pathways of introduction, and evidence of impacts. Modelling approaches require having models of spread and introduction available.	**IALG-IAS:** CABI Compendium: Invasive Species, and Horizon Scanning Tool;[25] GBIF; GRIIS; IUCN GISD, and Environmental Impact Classification for Alien Taxa (EICAT);[26] and IPPC List of Regulated Pests. **Other:** GIDIAS; and InvaCost database on costs associated with IAS.[27] **National sources**: Interception data, trade data such as trade patterns, and which species are in trade, and established alien species checklists from neighbouring countries.
What sites are susceptible to introductions and establishments, or vulnerable to impacts from invasive alien species?		
Identifying sensitive and susceptible sites is needed to inform where early detection and management actions may be required. Susceptible sites are those at high risk of being invaded (e.g. islands), whereas sensitive sites are places where there would be severe consequences to biodiversity if IAS were to establish. In addition, sites that are entry points of introductions (such as ports, airports, important border crossings, big cities) also need to be identified, while these are not susceptible sites per se, they are sites where prevention could be most effective.	Identification of these sites requires information on natural and semi-natural habitats, their conservation importance, and proximity to areas of human activities. Information on IAS distributions can also inform which sites may be susceptible to invasions from already established IAS.	**IALG-IAS:** IUCN Red List of Threatened Species,[28] IUCN Red List of Ecosystems,[29] and IUCN World Heritage Outlook;[30] Key Biodiversity Areas (KBAs);[31] and Protected Planet[32]. **National sources:** May include sites of national conservation importance, species and ecosystems of conservation concern, IAS distribution data (incl. species distribution modelling), spatial data on land use and human activities, and knowledge from indigenous peoples and local communities.

[24] For example for the European Union, see Roy, H. E., et al. (2019). Developing a list of invasive alien species likely to threaten biodiversity and ecosystems in the European Union. *Global Change Biology*, *25*(3), 1032-1048. https://doi.org/10.1111/gcb.14527.
[25] CABI Horizon scanning Tool https://www.cabi.org/HorizonScanningTool/.
[26] IUCN Environmental Impact Classification for Alien Taxa, https://ipbes.net/policy-support/tools-instruments/environmental-impact-classification-alien-taxa-eicat.
[27] Diagne, C., et al. (2020). InvaCost: Economic cost estimates associated with biological invasions worldwide.. figshare. Dataset. https://doi.org/10.6084/m9.figshare.12668570.v5
[28] IUCN Red List of Threatened Species™ https://www.iucnredlist.org/.
[29] IUCN Red Listo f Ecosystems https://www.iucnrle.org/.
[30] IUCN World Heritage Outlook https://worldheritageoutlook.iucn.org/.
[31] Key Biodiversity Areas https://www.keybiodiversityareas.org/.
[32] UN WCMC and IUCN Protected Planet https://www.protectedplanet.net/en.

Target 6 element – Prioritisation		
Which alien species, pathways of introduction, and sites should we be concerned about the most?		
Undertaking systematic evidence-based risk assessments to evaluate the potential for IAS to be introduced, established, spread, and cause negative impacts. A risk assessment supports the prioritisation of which IAS may require policy or management interventions.	It requires information on IAS invasion history and pathways, habitat, ecology and climate requirements, native range, evidence of impacts to the environment (and ideally to socio-economic impacts).	**IALG-IAS:** CABI Compendium: Invasive Species, Horizon Scanning Tool, and CABI PRA Tool[33]; IUCN GISD and EICAT, and IUCN Red List of Threatened Species. **Other:** Socio-Economic Impact Classification for Alien Taxa (SEICAT);[34] GIDIAS; Risk assessments undertaken by other countries with similar habitats and climate[35]. **National sources:** May include information from across government departments (e.g. border control, plant health, trade), and information on IAS impacts and distribution.
An analysis of the pathways of introduction will allow for those that have resulted in the most IAS introductions (or greatest negative impacts) in the past, or will likely do so in the future, to be identified and prioritized. Additionally, for some pathways, the consideration and prioritisation of species 'routes' may also be beneficial.	This requires information on current and potential IAS, their pathways of introduction, and impacts from the current and future IAS (see checklists above). However, additional information to support prioritisation can be useful, including trade volumes and patterns, and tourism numbers and location.	**IALG-IAS:** CABI Compendium: Invasive Species; IUCN GISD and EICAT; and GRIIS. **National sources:** May include information from across government departments in relation to pathway 'volume' (e.g. trade, tourism, transport), specific routes, and on IAS impacts.
Prioritizing sites for early detection and rapid response requires identifying which sites are both highly sensitive and susceptible to IAS.[36]	This requires spatial information on the sensitive and susceptible sites, distribution of existing IAS, the location of areas of human activities, and on species and ecosystems of conservation concern.	**IALG-IAS:** IUCN Red List of Threatened Species, IUCN Red List of Ecosystems, KBAs, Protected Areas. **National data sources:** May include lists of susceptible sites such as ports and airports, sites of national conservation importance, species and ecosystems of conservation concern, IAS distribution data (incl. species distribution modelling), spatial data

[33] CABI PRA Tool https://www.cabi.org/PRA-tool

[34] Bacher, S., et al. (2018). Socio-economic impact classification of alien taxa (SEICAT). *Methods in Ecology and Evolution*, *9*(1), 159-168. https://doi.org/10.1111/2041-210X.12844

[35] For example, see the Pacific Island Ecosystem at Risks (PIER) http://www.hear.org/pier/, and the risk assessment produced for the EU https://environment.ec.europa.eu/topics/nature-and-biodiversity/invasive-alien-species_en

[36] See, for example, Clarke., D.A., Clarkey, R.H., and McGeoch, M.A. 2025. How to Identify Priority Sites for Invasive Alien Species Policy and Management. *Diversity and Distributions*. https://doi.org/10.1111/ddi.13970

		on land use and human activities, and knowledge from indigenous people and local communities.
Undertaking risk management to assess the availability and feasibility of management actions to eradicate, control, or contain specific IAS. This approach can also cover pathway management and other preventative measures.	It requires information on management effectiveness and costs, and ideally also on their side effects, welfare impacts, and social acceptability.[37]	**IALG-IAS:** IUCN resources on IAS management and surveillance, and pathway management,[38] IUCN GISD; and CABI IAS compendium. **Other data:** Evidence from other countries and peer-reviewed literature on the effectiveness and costs of management measures. **National data sources:** May include information from across government departments and from other groups, including indigenous peoples' and local communities, and civil society organisations on approaches used and their costs and effectiveness.
Target 6 element - 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		
What can we do to prevent them from being introduced and establishing?		
Management of priority pathways and enacting legislation to prevent or reduce the number of introductions. Pathways (and specific routes) can be targeted for management through the development and implementation of pathway action plans. These can cover both pathways of introduction into a country and pathways of secondary spread once the species is present. In addition, legislation can be enacted to	The information needed depends upon the pathway, however, access to information on best practices, codes of conduct, awareness-raising materials, and knowledge of key stakeholder groups is likely to be needed.	**IALG-IAS:** The 2023 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species of the International Maritime Organization (IMO),[39] Ballast Water Management Convention and associated guidance;[40] International Standards for Phytosanitary Measures (ISPMs),[41] and Sea Container Cleanliness Guidance[42] of the IPPC; IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units;[43]

[37] For example, as done for Great Britain, see Booy, O., Mill, A.C., Roy, H.E. *et al.* Risk management to prioritise the eradication of new and emerging invasive non-native species. *Biol Invasions* **19**, 2401–2417 (2017). https://doi.org/10.1007/s10530-017-1451-z, and the European Union, see Booy, O., Robertson, P. A., Moore, N., *et al.* (2020). Using structured eradication feasibility assessment to prioritize the management of new and emerging invasive alien species in Europe. *Global Change Biology*, *26*(11), 6235-6250. https://doi.org/10.1111/gcb.15280

[38] IUCN resources on prevention and pathways, identification and surveillance, and management https://iucn.org/our-work/topic/invasive-alien-species/invasive-alien-species-external-resources

[39] International Maritime Organization. (2023). 2023 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species. https://www.imo.org/en/OurWork/Environment/Pages/Biofouling.aspx

[40] International Maritime Organization. Ballast Water Management Convention and associated guidance https://www.imo.org/en/OurWork/Environment/Pages/BallastWaterManagement.aspx

[41] International Plant Protection Convention Secretariat, ISPMs https://www.ippc.int/en/core-activities/standards-setting/ispms/

[42] International Plant Protection Convention Secretariat, Sea Container Cleanliness guidance https://www.ippc.int/en/centre-of-excellence/phytosanitary-system/sea-containers/

[43] CTU Code https://www.imo.org/en/ourwork/safety/pages/ctu-code.aspx

mandate action such as biosecurity controls for IAS and establish obligations such as banning the import or keeping of certain IAS.		IUCN resources on pathway management; [44] standards on animal health and zoonoses[45] of the World Organisation for Animal Health (WOAH); and the World Trade Organisations (WTO) E-ping Sanitary and Phytosanitary (SPS) and Technical Barriers to Trade (TBT) Platform[46]. **Other data:** Approaches taken in other countries (e.g. pathway action plans, legislation, sector-specific codes of conduct). **National data sources:**
Implementing effective border security ('biosecurity') to reduce the risk of intentional and unintentional introductions across many pathways of introduction.	Information needed to support border security authorities in taking a 'risk based' approach includes knowledge of high-risk commodities, and timely access to information and certificates on goods and commodities being imported. Access to identification guides for regulated and high-risk IAS, and inspection protocols may also be needed.	**IALG-IAS:** IUCN resources on identification and surveillance;[47] and resources from CABI. **National data sources:** May include customs data and information, resources and knowledge from existing biosecurity teams (e.g. plant health), and access to expertise to support in the identification of IAS from institutes and academia.
Developing early detection and rapid response (EDRR) capacity. An effective surveillance system to detect new alien species with the capacity to eradicate new incursions before they become widely established is essential to prevent future impacts.	Information needed to support EDRR include timely access to data on new incursions and guidance on how to eradicate. This information can be mobilised through active (e.g. monitoring) or passive surveillance (e.g. citizen science). In addition, best practices for surveillance and eradication of high-risk IAS at	**IALG-IAS:** IUCN GISD, IUCN resources on IAS management and surveillance[49]; CABI Compendium, and CABI Pest Alerts[50] **Other data:** Examples of EDRR protocols from other countries[51] and data on IAS incursions from neighbouring countries. **National data sources:** May include access to data on new incursions through citizen science initiatives, or via active surveillance programmes that focus on

[44] IUCN resources on prevention and pathways, identification and surveillance, and management https://iucn.org/our-work/topic/invasive-alien-species/invasive-alien-species-external-resources.
[45] World Organisation for Animal Health standards https://www.woah.org/en/what-we-do/standards/.
[46] WTO E-ping platform https://eping.wto.org/.
[47] IUCN resources on prevention and pathways, identification and surveillance, and management https://iucn.org/our-work/topic/invasive-alien-species/invasive-alien-species-external-resources.
[49] IUCN resources on prevention and pathways, identification and surveillance, and management https://iucn.org/our-work/topic/invasive-alien-species/invasive-alien-species-external-resources.
[50] CABI Pest Alerts, email alerts containing recent literature reports for a specific country or region. https://plantwiseplusknowledgebank.org/pestalert-signup
[51] For example, see Pacific Invasive Ant Toolkit EDRR https://piat.org.nz/index.php?page=early-detection-and-rapid-response, US department of the Interior EDRR approach https://www.doi.gov/invasivespecies/early-detection-and-rapid-response.

	susceptible and sensitive sites. Automated workflows[48] can speed up the accessibility of such information to relevant authorities.	the environment and wildlife (including environmental DNA).
Target 6 element - eradicating or controlling invasive alien species especially in priority sites, such as islands		
What can we do to eliminate, minimise or mitigate their impacts?		
Undertake management actions to eliminate, minimise, or mitigate the impacts of currently established IAS, especially in priority sites. There are three broad objectives, with eradication as the first option to consider, followed by containment and control. Site or landscape management and restoration measures can also be undertaken.	Information is needed on available management options and their effectiveness and costs, ideally across different objectives. Also, knowledge of their side effects, welfare impacts, and social acceptability is useful. Information on how climate change will affect IAS and management responses can also be beneficial. Knowledge of key stakeholders is also important to inform timely engagement.	**IALG-IAS:** IUCN resources on IAS management and surveillance, IUCN GISD; CABI Compendium, and CABI Books. **Other data:** IAS management best practices from other countries, examples in peer-reviewed literature. **National data sources:** May include information from across government departments and from other groups, including indigenous peoples and local communities, and civil society organisations on approaches used and their costs and effectiveness.
Implementation of standardised monitoring to track IAS and their impacts, and the effectiveness of management measures targeting pathways and IAS. This will inform an adaptive management approach. Monitoring is also important for the development of indicators to track progress, both at the global level (e.g. the Target 6 headline indicator on the rate of establishment), but also for any nationally derived indicators.	Information is needed on the types of standardised data to be collected for the monitoring of IAS introductions, establishments, spread, and impacts; of pathways to monitor the success of prevention (e.g., biosecurity inspections); and of the effectiveness and costs of management actions.	**IALG-IAS:** GRIIS; IUCN GISD and EICAT; CABI Compendium, and CABI Books. **Other data:** Species Populations Essential Biodiversity Variables (EBVs) for invasive alien species.[52] **National data sources:** remote sensing data.

[48] For example GBIF Alert which is an open source tool demonstrates how to use GBIF.org as a system for notifying users of newly available occurrence records for any species or location of interest. https://gbif-alert-demo.thebinaryforest.net/.

[52] GEO BON Essential variables for invasive species monitoring https://invasionevs.com/.

2. Elements through which data and information accessibility can be improved

2.1. Key elements of data and information accessibility

The open data movement has expanded data accessibility, aiming to enhance the efficiency of science and management by making data available for everyone to use and share.[53] Making IAS data and resources open and accessible, following the Findable, Accessible, Interoperable, and Reusable (FAIR) data principles,[54] will reduce duplication of effort and improve transparency of management.

To adhere to these principles, data should be **findable** by both machines and humans. This can be achieved by publishing data with a DOI (digital object identifier), ensuring metadata are well described and that databases have suitable search filters. Data from multiple sources can be compiled by data aggregators (for example, GBIF), which allows data to be found at a single source. Ensuring sources can be easily located by search engine optimisation and through ease of translation into multiple languages will also improve visibility. Global datasets should describe the conditions by which data are **accessible**, by both humans and machines, including through the use of Application Programming Interfaces (APIs) that allow software to communicate with each other. Transparency of authorisation of access is important, for example, there is a difference between the free tools available in the CABI Horizon Scanning Tool compared with the premium (subscription) version. In addition, some data may not be made available for legitimate reasons, such as the sharing high-resolution data on the occurrences of sensitive records.

Data and resources to address IAS particularly benefit from being **interoperable,** as this allows harmonisation of records from a wide range of platforms, including from national to international, and the integration of additional data, which is critical for analysis of associated drivers and threats (for example, via the IUCN Red List of Threatened Species™). Key elements to ensure interoperability are the use of agreed common terminology and language (for example, definitions under the CBD and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services), and the use of recognised standards. The Darwin Core data standard[55] has recently been updated to include IAS-specific information and terminology[56] (see Table 2). By adhering to globally accepted standards, data will become more reliable and robust, and monitoring systems can become automated. A key aim of open and shareable data is making it **reusable**, through appropriate licensing and usage rights, for others across the community and to facilitate scientific and technical cooperation and technology transfer. This can be beneficial for all as new tools, workflows, and resources become available, and is critical for preventing duplication of effort and increasing efficiency.

Incorporating diverse knowledge systems brings greater legitimacy of knowledge and experience, which can lead to context-relevant decision-making. Accessing and bridging different knowledge involves creating data and information flows through engagement with relevant stakeholders, and indigenous peoples and local communities. Data collation and curation should abide by the Collective Benefit, Authority to Control, Responsibility, and Ethics (CARE)[57] principles when accessing and incorporating traditional knowledge.

Key accessibility gaps exist in the availability of shared resources to inform the prioritisation and management of biological invasions. For example, there is currently no central repository for completed species risk assessments or records of what management options are available and their effectiveness and

[53] Molloy, J.C. (2011). The Open Knowledge Foundation: Open Data Means Better Science. PloS Biology. 9(12): e1001195. https://doi.org/10.1371/journal.pbio.1001195

[54] Wilkinson, M., Dumontier, M., Aalbersberg, I. *et al.* (2016). The FAIR Guiding Principles for scientific data management and stewardship. *Sci Data* **3**, 160018. https://doi.org/10.1038/sdata.2016.18

[55] Darwin Core data standard is maintained by Darwin Core maintenance group. It includes a glossary of terms intended to facilitate the sharing of information about biological diversity by providing identifiers, labels, and definitions. Darwin Core is primarily based on taxa, their occurrence in nature as documented by observations, specimens, samples, and related information - https://www.tdwg.org/standards/dwc/#darwin-core-list-of-terms

[56] Groom, Q.J., et al. (2019). Improving Darwin Core for research and management of alien species. *Biodiversity Information Science and Standards* 3: e38084. https://doi.org/10.3897/biss.3.38084

[57] RDA. (2019). International Indigenous Data Sovereignty IG. Research Data Alliance. https://www.rd-alliance.org/groups/international-indigenous-datasovereignty-ig

costs for different species. Some information may be published in scientific journals or grey literature, but not all is open access, nor easily findable. There have been efforts to synthesize some of this information,[58] and options for this may improve with the advance of Artificial Intelligence (AI) and Large Language Models (LLMs), but having open, accessible, and findable resources will improve the robustness and reliability of information.

Critically, awareness amongst stakeholders of the available data and information is needed. This can be achieved through the establishment of a hub or clearing house to promote and signpost available IAS data and information resources and facilitate familiarisation with appropriate terminology and data standards.

Table 2. Data components to consider when developing an inventory or checklist of alien and invasive alien species. Data components and descriptors in italics are optional. Taken from the CBD IAS Toolkit Flyer on the use of international data standards.

Data component	Descriptor	Data Standards
Geographic location such as country, island, protected area, lake etc.	Geographic location which is the subject of the inventory or checklist.	Use of the ISO Code;[59] Darwin Core.
Species name (including sub species, varieties, forms where relevant)	Scientific name.	Darwin Core [note that GBIF and Catalogue of Life[60] are working on a harmonised taxonomy].
Taxonomic status (if the scientific name is an accepted name or synonym)	Use of or alignment to a standardised backbone taxonomy	Darwin Core, Humbolt Extension[61], Extended catalogue of Life
Higher taxonomy	Kingdom, Phylum, Class, Order, Family.	Darwin Core.
Habitat or Environment	Terrestrial, freshwater, brackish, marine or host.	Darwin Core; IUCN Red List Habitat Classification scheme,[62] Global Ecosystem Typology.[63]
Occurrence status	If the species is present, absent, eradicated or if its presence is uncertain. These data should be spatially and temporally bounded.	Darwin Core; GRIIS.
Provenance or Origin	If the species is alien, cryptogenic (of uncertain origin), or a native | alien (native to the country and introduced by humans outside its native range in that same country).	Darwin Core; GRIIS.
Native range	The native range of the species (natural distribution area).	World Geographical Scheme for Recording Plant Species Distribution[64] (WGSRPD), UN geoscheme[65] for other species.

[58] For example, Conservation Evidence https://www.conservationevidence.com/
[59] ISO Codes https://www.iso.org/iso-3166-country-codes.html
[60] Catalogue of Life https://www.catalogueoflife.org
[61] Darwain Core Humbolt extension https://www.tdwg.org/community/osr/humboldt-extension/
[62] IUCN Red List Habitat Classification Scheme https://www.iucnredlist.org/resources/habitat-classification-scheme
[63] IUCN Global Ecosystem Typology https://global-ecosystems.org/
[64] World Geographic Scheme for Recording Plant Distributions https://www.tdwg.org/standards/wgsrpd/
[65] Standard country or area code for statistical use https://unstats.un.org/unsd/methodology/m49/

Data component	Descriptor	Data Standards
Invasiveness	Status – invasive (If the species has displayed any negative impacts in that country).	GRIIS; Darwin Core.
Degree of establishment	The stage in the invasion process a species has reached.	Darwin Core.
Date of introduction or first report	*This data is useful to map trends of species introductions and is often used for policy indicators and Target 6 headline indicator.*	GRIIS; Darwin Core.
Pathways of introduction	*If the species was introduced intentionally or unintentionally and the type of introduction pathway.*	Convention on Biological Diversity Hierarchical pathway schema,[66] Darwin Core.
Impact data including mechanisms of impact and outcome of the impact	*Mechanisms can include predation, hybridisation resulting in outcomes such as population decline.*	The Environmental Impact Classification for Alien Taxa (EICAT), Socio-economic impact classification of alien taxa (SEICAT).
Citation or Reference	Source of data	Darwin Core standards (preferably DOI).
Date of recording	To record the history of any modifications made.	Darwin Core standards.
Other data	Other data can include whether the species is currently under management.	

2.2. An analysis of the accessibility of existing key international data sets

There are several key internationally compiled datasets that hold key data and information outlined in Table 1. These include datasets hosted by members of the Inter-Agency Liaison Group on IAS: CABI Compendium: Invasive Species; GRIIS, IUCN GISD and EICAT, IUCN Red List of Threatened Species™; and two additional key datasets, the Global Alien Species First Record Database,[67] and GIDIAS[68] which are well described and used in the preparation of the Assessment. Datasets are becoming increasingly available through host repositories and through data aggregators such as GBIF which facilitates i) the mobilisation of national data ii) interoperability of the related but different data sources and iii) the development of indicators, workflows and resource, such as Essential Biodiversity Variables (EBVs); to increase the analysis an interpretation of the data for research, policy, and management. Table 3 provides an overview of the key accessibility components for Open and FAIR access of the IAS-specific datasets run by members of the IALG-IAS and highlights future needs to address gaps.

The GRIIS; IUCN GISD, and GBIF were the most commonly referred to resources during the Online Forum on Invasive Alien Species organised by the CBD Secretariat in 2025 .[69] Participants considered these as important sources of information to inform their work on invasive alien species as these, along with CABI Compendium: Invasive Species, and GloNAF, provide access to data on species, impacts, and pathways.

[66] UNEP/CBD/SBSTTA/18/9/Add.1 Pathways of introduction of invasive species, their prioritization and management https://www.cbd.int/doc/meetings/sbstta/sbstta-18/official/sbstta-18-09-add1-en.pdf

[67] https://ourworldindata.org/grapher/global-first-records-of-established-alien-species

[68] https://springernature.figshare.com/articles/dataset/Global_Impacts_Dataset_of_Invasive_Alien_Species_GIDIAS_/27908838

[69] Online forum on invasive alien species 2025 https://www.cbd.int/invasive/current/forum2025

Table 3: Key accessibility features of datasets and repositories of invasive alien species data.

Repository/data aggregator	Data and information held (including analysis tools and workflows)	Scope of the available data and functionality	Findable	Accessible Features	Interoperable: Use of Global Standards for data components	Reusable: Usage rights/ licencing	Gap/Needs
GBIF – data aggregator www.gbif.org/	• GRIIS Checklists ○ EBV Data Portal[70] ○ BON in a BOX[71]	Global, regional, national and subnational species checklists and occurrence datasets.	All datasets are identified by Digital Object Identifiers (DOIs). A range of filters are available for searching and downloading of data via GBIF portal and open APIs.[72] Some automated data quality routines are applied to data to improve data quality through interpretation and attributions of flags and issues.[73] Filters include Establishment means, Degree of Establishment, and Pathway.[74]	The GBIF Portal API provides a machine readable interface (REST (Representational State Transfer) and JSON (JavaScript Object Notation)) and use the Integrated Publishing Toolkit (IPT) as trusted data repository	○ Darwin Core ○ Ecological Metadata Language is a metadata standard that records information about ecological datasets in a series of modular and extensible XML document type ○ The Biological Collection Access Service, commonly referred to as BioCASe,[75] is an international network linking biological collections data from natural history museums, botanical/zoological gardens and research institutions. The BioCASe protocol relies on the Access to Biological Collections Data (ABCD) data exchange standard, which TDWG also administers	GBIF require creative common data licenses (CC0, CC BY, or CC BY-NC). Provenance available from the GBIF portal.	• Improved spatial resolution of available records. • Pathway categories are now indexed but this needs socialised with data providers. • Automatic tagging of all invasive species lists for easy identification
CABI www.cabi.org/	CABI Compendium includes 8,500 datasheets on invasive species. 2,600 of these are detailed, were written by experts and peer reviewed. Coverage is of all taxa, excluding pathogens of humans. Datasheets contain	Global Distribution Data Species Relational Data (linkages with related datasheets, such as host-pest relationships, threatened species	DOI for each datasheet. CABI Compendium is made freely available to the National Plant Protection Organizations of 115	No API currently Bulk data extracts are provided in a CSV format, which requires a data sharing agreement and payment in some instances.	CABI is using Geonames as the geographic framework to support the recording and plotting of distribution records on the map.	Distribution data can be downloaded under a CC-BY-NC-SA license from datasheets in the Invasive	• CABI is mapping its pathway categories against the 2014 CBD pathways schema so

[70] GEOBON EBV Data Portal https://portal.geobon.org/datasets
[71] BON in a BOX https://boninabox.geobon.org/about
[72] GBIF API Reference https://techdocs.gbif.org/en/openapi/
[73] GBIF Data Processing https://techdocs.gbif.org/en/data-processing/
[74] Groom et al. 2019. Improving Darwin Core for research and management of alien species. Biodiversity Information Science and Standards 3.e38084 https://doi.org/10.3897/biss.3.38084
[75] https://www.biocase.org/

Repository/data aggregator	Data and information held (including analysis tools and workflows)	Scope of the available data and functionality	Findable	Accessible Features	Interoperable: Use of Global Standards for data components	Reusable: Usage rights/ licencing	Gap/Needs
	information on taxonomy, identification, biology, habitat, pathways of introduction, impacts, relationships with other species, options for surveillance, management and prevention, as well as images and maps. CABI Compendium data are used in the decision support tools: • Horizon Scanning Tool • Pest Risk Analysis Tool, • The Invasive Species Discovery Tool	affected, natural enemies, pathogens vectored) Invasive Species Discovery Tool[76] enables lists of species to be created, filtering by: Distribution Taxonomy Habitat Risk and Impact Factors Pathway of introduction	low- and middle-income countries. It is also available to lower-income countries as part of the research4life[77] offering, and as a benefit to CABI Member countries. The Invasive Species and related datasheets are accessible by subscription for most users, alongside the rest of CABI Compendium (covering animal health and production, crop protection, forestry, horticulture and aquaculture). Premium access (paid subscription) is necessary for the PRA Tool and additional plant host filters in the CABI Horizon Scanning Tool.		At this time, the Compendium taxonomic hierarchy is under revision and will be aligned with the GBIF Backbone Taxonomy.	Species channel of CABI Compendium. Advanced searches of invasive species datasheets can be done using associated tools. Results from these tools can be exported as CSV files and the data are subject to a CC-BY-NC-SA 4.0 license.	that these standard categorizations can be applied in datasheets and the Horizon Scanning Tool.
GRIIS **https://griis.org/**	▪ Checklist datasets of known alien (introduced) and invasive species. The coverage of GRIIS is global including countries that are Party to the CBD, non-party countries and all overseas territories of countries, e.g. those of the Netherlands, France, and the United Kingdom. ▪ Limited numbers of checklists have also been	Data includes records of known alien (introduced) species including the following annotations, species taxonomy, habitat, occurrence status, provenance, invasive status, dates of introduction, pathways of introduction, impact	Currently no integrated search functionality for checklists from the GRIIS website but published GRIIS checklists are made available through GBIF where they are allocated DOIs.	GRIIS Checklists are published on the GBIF portal. GRIIS data is also available through the species page on GBIF. A list of countries where the species is known to be alien or invasive is listed. GRIIS checklists are also downloadable from a dedicated GRIIS website (griis.org)	• GBIF is used as the taxonomic backbone • ISO codes are used for locations • Darwin Core is used using the available extensions (species profile, species distribution, pathway) • Pathway terms based on the CBD pathway schema	Open access	• Aim to provide most recent data, including newly identified alien species incursions. • Increased networking with national governmental departments working on

[76] Invasive Species Discovery Tool https://www.cabidigitallibrary.org/journal/cabicompendium/isdt#/
[77] research4life https://www.research4life.org/

Repository/data aggregator	Data and information held (including analysis tools and workflows)	Scope of the available data and functionality	Findable	Accessible Features	Interoperable: Use of Global Standards for data components	Reusable: Usage rights/ licencing	Gap/Needs
	developed for areas of high biodiversity value such as islands and protected areas.	mechanism and source of data.					invasive species issues and supporting their data needs. • Expansion of country expert networks covering all aspects such as taxon groups, habitat type.
IUCN ISSG GISD - Global Invasive Species Database **www.iucngisd.org/gisd/**	• Information about alien and invasive species that negatively impact biodiversity • Covers all taxonomic groups from micro-organisms to animals and plants • Ecology of the species, its impacts and management, a comprehensive bibliography and a list of expert contacts • Includes global assessments of the magnitude of impact using the IUCN EICAT standard.	Species accounts for 1096 IAS. With EICAT assessments for 210 IAS. Advanced Searches on the GISD can be carried out using the following parameters: • Taxonomy • Location • Environment System • Pathway of Introduction • Threatened Species • Impact (EICAT assessment) Management	GISD species accounts do not currently have DOIs.	Integration with allied databases such as the IUCN Red List of Threatened Species – however, this is not through the use of API. EICAT impact ratings linked to Wikipedia pages.	• ISO country codes • Species Codes • IUCN Red List species codes • WDPA (World Database of Protected Areas) codes • ISO country codes • EICAT	Free to access, search and download	• Increase findability and interoperability through development of DOIs and APIs for species accounts. • EICAT assessments and GISD accounts for the 3,500 IAS identified through the Assessment

2.3. Key data and information gaps for Target 6 of the Kunming-Montreal Global Biodiversity Framework and challenges for improving accessibility

Addressing Target 6 of the Framework requires collation and analysis of baseline data and trends of species occurrence, impacts, and management (see Table 1). Generating the data products that are needed to do this at a global scale requires regular and reliable up-to-date information. The Assessment highlighted where data are not flowing into global datasets, including for some regions (notably for large parts of Africa and central Asia), taxonomic groups (for example, invertebrates and micro-organisms), and ecosystems (for example, marine),[78] and stresses how increased collaboration is needed to fill these gaps. Decision16/18 also recognized that improvements to data collection in Africa, Asia, Latin America and the Caribbean, and the Pacific region were needed. In some cases, data does not exist at all, in other cases, the data flow is slow, or is impeded by a lack of standardisation or use of automated workflows and APIs. Open licensing of data[79] by data providers is important to ensure that data are available for reuse by the community.

Data and information on IAS are available across several data resources and platforms (Table 1), and it is acknowledged that these should be free and open source (Decision 16/18). However, end users need to know which data source is best for their needs and if there are any constraints or limitations on their use from different sources. A single portal that describes all available IAS data and information resources and facilitates the sharing of case studies and best practices, in multiple languages, could be of value. The data sources reviewed (Table 3) are clear in documenting the scope and scale of the available data and information, but the adherence to FAIR data principles varied. Most datasets and repositories use English as the main language; online translation capabilities are improving, but few resources are available in multiple languages. End users need to know who the data providers and data controllers are, as these are the points of contact for clarification and changes. It is often unclear how maintenance of datasets and repositories are managed and where the ongoing resource requirements to sustain this will be met. Time and resource needs will vary with the age of platforms and level of interoperability already achieved and the volume of data or records to standardise. At a national level having the data infrastructure and platforms can be a considerable investment but the benefits of a unified approach that is well integrated with other biodiversity monitoring is well documented.[80]

For Target 6 there is a need to integrate IAS data with information about priority sites. Data resolution can be variable, resulting in uncertainty in distributional information. For example, a country record doesn't mean a species is necessarily abundant or widespread or even established in the wild, as records can refer to species in captivity or botanical gardens. The ability to regularly update occurrence and distribution information is also needed as biological invasions and their management are dynamic, therefore, systems need to be agile, and work needs to be done to reduce the time lag between field data recording and availability to decision makers. Use of citizen science data collection[81] increases the ability to incorporate records into surveillance and monitoring systems, but requires the use of timely workflows for verification, especially to incorporate records into early warning systems. Automation of data collation and analysis workflows relies on the use of agreed terminology and standards, and in a machine-readable format, however, not all available data meet these requirements. Retrospective application of standards to large extant datasets can be costly and time-consuming. An important first step has been gathering and assessing

[78] Seebens, H., et al. (2023). Chapter 2: Trends and status of alien and invasive alien species. In: Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Roy, H. E., Pauchard, A., Stoett, P., and Renard Truong, T. (eds.). IPBES secretariat, Bonn, Germany. DOI: https://doi.org/10.5281/zenodo.7430725

[79] For example, through Creative Commons https://creativecommons.org/share-your-work/cclicenses/

[80] Sankaran, K.V. et al. (2023). Chapter 5: Management; challenges, opportunities and lessons learned. In: Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Roy, H. E., Pauchard, A., Stoett, P., and Renard Truong, T. (eds.). IPBES secretariat, Bonn, Germany. DOI: https://doi.org/10.5281/zenodo.7430733

[81] For example, research grade data on introduced species is available through platforms such as iNaturalist https://www.inaturalist.org/

reports on IAS impacts for 3,353 species in the new Global Impacts Dataset of Invasive Alien Species[82], which contains machine-readable records of impact type and magnitude. But there remains significant work to conduct comprehensive EICAT and SEICAT assessments for these IAS with reported impacts, and for all 37,000 alien species identified in the Assessment.

There is no single source for accessing information on management effectiveness, IUCN GISD and CABI Compendium: Invasive Species hold some information for some species, but many best practice assessments are in grey or peer-reviewed literature. Some case studies have been collated[83] but more synthesis on what management actions work in what contexts is needed, particularly to support Parties that struggle with insufficient financial, technical, and human resources. Data and information contained in academic publications are often not openly accessible, and even when they are the publishing process can lead to delays in data being in the public domain. Open-access pre-publishing archives are increasingly available but not routinely used. Increasing the awareness of routes to report new records and findings and the importance of this to the community needs clear messaging.

Data and information needs and accessibility will differ according to the end user, for example, a customs authority that needs to detect and prevent IAS introductions, to a local authority that needs to remove IAS from priority sites. Different sectors will also have specific information and data needs. As an example, below we highlight the key information needs and opportunities to improve accessibility of this information for the tourism and trade sectors to take action to support Target 6.

Information needs for the tourism sector

Tourism is one of the world's largest and fastest-growing economic sectors, with 1.4 billion international travellers in 2024 generating a record USD 2.0 trillion in export revenues—accounting for 6% of global exports and 23% of global trade in services.[84] While this global movement of people, vehicles, and goods fuels economic growth, it also poses a significant risk for the unintentional spread of IAS to new environments, threatening biodiversity, ecosystems, and the tourism sector itself. The highest risk comes from passengers, who may unknowingly carry alien species or pathogens[85] on food, sports equipment, luggage, clothing or footwear. This can lead to the introduction of new IAS into a country or facilitate the spread of existing IAS due to recreational activities. Some IAS can also be beneficial for tourism, for example, salmon and trout and recreational fishing.[86]

Many sites that are important for biodiversity, and sensitive to impacts from IAS are also popular for tourists and tourism facilities, like the Galapagos,[87] making them susceptible to introductions. In fact, the abundance and richness of alien species are significantly higher in sites where tourist activities take place.[88] For example, there are over 250 natural World Heritage Sites (WHS) that are established to protect the world's most outstanding natural heritage, and they receive over 100 million visitors a year.[89] These sites are also under increasing pressures, including from IAS, which

[82] Bacher, S., et al. (2025). Global Impacts Dataset of Invasive Alien Species (GIDIAS). *Scientific Data*, *12*(1), 1-10. https://doi.org/10.1038/s41597-025-05184-5

[83] For example, the Database on Island Invasive Species Eradications https://diise.islandconservation.org/

[84] World Tourism Organization (2025), World Tourism Barometer, volume 23, issue 2, May 2025, UN Tourism, Madrid, DOI: https://doi.org/10.18111/wtobarometereng

[85] Hulme, P.E., et al. (2023). Chapter 3: Drivers affecting biological invasions. In: Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Roy, H. E., Pauchard, A., Stoett, P., and Renard Truong, T. (eds.). IPBES secretariat, Bonn, Germany. DOI: https://doi.org/10.5281/zenodo.7430727

[86] Hall, C. M. (2015). Tourism and biological exchange and invasions: a missing dimension in sustainable tourism? *Tourism Recreation Research*, *40*(1), 81–94. https://doi.org/10.1080/02508281.2015.1005943

[87] Toral-Granda, M.V., et al. (2017). Alien species pathways to the Galapagos Islands, Ecuador. *PLOS ONE*, *12*(9), e0184379. https://doi.org/10.1371/journal.pone.0184379

[88] Anderson, L. G., Rocliffe, S., Haddaway, N. R., & Dunn, A. M. (2015). The Role of Tourism and Recreation in the Spread of Non-Native Species: A Systematic Review and Meta-Analysis. *PLOS ONE*, *10*(10), e0140833. https://doi.org/10.1371/journal.pone.0140833

[89] UNESCO. Natural World Heritage Sites https://whc.unesco.org/en/natural-world-heritage/#threatened-paradise

are the second most prevalent threat to natural WHS, following climate change.[90] Tourism establishments can also pose a risk, through their construction, and operations including the importing of goods, machinery and horticultural plants. A survey of non-native plants of the Serengeti-Mara ecosystem, of the 245 alien species recorded, 212 were intentionally introduced into gardens of tourist facilities in the Masai-Mara National Reserve, 23 of which had become invasive in the wider ecosystem.[91]

IAS can also have impacts upon tourism, and the economy of areas that depend upon it. An example is *Rugulopteryx okamurae*, an algae that has spread across the southern European coastline leading to severe ecosystem disruption and displacement of native species.[92] As a 'beach-cast' algae large volumes of biomass are deposited on the beaches of municipality of Tarifa Spain, which causes a bad smell, disagreeable aesthetics and difficulties for recreation activities, requiring local authorities to regularly remove the algae costing an estimated EUR 245,593 per year.[93]

There are places where the tourism sector has taken positive action on IAS, both to the benefit of nature and tourism. One example is on the Seychelles Islands, where three private islands with tourist resorts successfully eradicated rats.[94] This work was funded by the tourism sector and implemented in collaboration with civil society organizations. Following on from the eradications, all islands developed biosecurity measures and undertook reintroductions and habitat restoration measures and have integrated this work into the tourism experience.

Information needs

The tourism sector needs access to information to support awareness-raising activities and the implementation of measures to prevent the introduction of IAS across their operations. In addition, information is needed to help inform tourists themselves to facilitate changes in their behaviour and perceptions.

To empower tourism operators to take meaningful action against IAS, they first need to understand the impacts IAS have on both biodiversity and the tourism sector itself. This includes recognizing how their facilities and operations may contribute to the introduction and spread of IAS and knowing what practical measures they can adopt to reduce or avoid these risks. To encourage widespread engagement, information should be communicated in a clear, accessible language and format and disseminated through trusted sources. While general guidance is useful[95], real change is more likely to happen when the information is tailored to the specific context, i.e. location, type of tourism activities, and introduction pathways relevant to each operator. For example, providing information on priority IAS in the regions where operators work — how those species arrived, especially if via tourism — can make the issue more tangible and actionable. Equally important is helping operators understand which of their practices are high-risk, for example, the use of horticultural plants that could become invasive, or promoting recreational activities in ecologically sensitive areas vulnerable to IAS. Clear guidance on how to respond if new IAS are detected — by either operators or tourists— is also vital, especially in biodiversity-rich areas like protected areas, which often

[90] Osipova, E., et al. (2020). IUCN World Heritage Outlook 3: A conservation assessment of all natural World Heritage sites, November 2020. Gland, Switzerland: IUCN. https://portals.iucn.org/library/sites/library/files/documents/2020-035-En.pdf

[91] Witt, A.B.R., et al. (2017). A preliminary assessment of the extent and potential impacts of alien plant invasions in the Serengeti Mara ecosystem, East Africa. *Koedoe* 59(1), a1426. https://doi.org/10.4102/koedoe.v59i1.1426

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[95] For example, World Tourism Organization (2024) Nature Positive: Travel and tourism in action https://www.e-unwto.org/doi/epdf/10.18111/9789284425020

double as popular tourist destinations. This intersection provides a unique opportunity: engaging tourists and tourism staff in citizen science efforts for early detection and reporting of IAS.

The tourism sector also plays a key role in raising awareness among tourists to help prevent the introduction and spread of IAS. This starts before arrival by encouraging travellers to clean shoes, clothes and equipment in advance and avoid bringing food, seeds, or other biological materials. For example, see the USDA 'don't pack a pest' campaign.[96] Working closely with national government departments such as customs, plant health, and environmental agencies is essential to ensure accurate and consistent messaging about IAS. Many tourist activities carry a particularly high risk of spreading existing IAS. For instance, international tourists may visit several protected areas within a short period of time,[97] and recreational anglers or water-based sports often move between multiple waterbodies with equipment, increasing the chance of unintentional spread. While core messages, such as the importance of cleaning equipment between sites, can remain consistent, awareness-raising efforts should be tailored to specific locations and activities. This requires clear, targeted information about priority IAS in each area, their impacts, and practical steps tourists can take to reduce the risk of spreading them. Existing awareness campaigns can serve as valuable models to inform the development of materials across the tourism sector, such as the "check–clean–dry" campaigns for aquatic recreation,[98] "Play-Clean-Go" for outdoor activities[99] and EU "Beware of aliens" campaign which has material for forest visitors and anglers.[100]

Information needs for international trade

Global trade in goods/merchandise is higher than it has ever been and is now valued at 24 trillion USD (c. 23% of global gross domestic product (GDP)).[101] The volume of world trade in goods is now roughly 45 times higher than it was in 1950, with an average increase of 4% per year since 1995. In addition, there has been an increase in regional trade agreements that encourage the free movement of goods across borders, bypassing many import controls that would have previously existed.[102] Such large volumes of global trade, primarily transported by shipping container freight, represent a major risk for the introduction of alien species, including from plants and animals being traded, and the vessels and containers ('vectors') transporting them that may harbour IAS. Trade, therefore, covers many pathways of introduction, such as intentional release for fisheries, escape from horticulture, contaminants of seeds or timber imports, and stowaways in shipping containers, packing materials, or as fouling on ship hulls. There is a clear association between the rise in the number of new alien species recorded ('1st records') and the percentage contribution international imports make to global GDP.[103] Global trade patterns and routes are also changing in response to development and climate change, which can expose countries to new alien species.[104] The growth of e-commerce is also

[96] USDA Don't pack a pest campaign https://www.dontpackapest.com/
[97] Hulme, P.E. (2024). Networks of risk: international tourists as a biosecurity pathway into national parks. *Biol Invasions* **26**, 4317–4330. https://doi.org/10.1007/s10530-024-03448-6
[98] Check – Clean – Dry campaigns e.g. Great Britain https://www.nonnativespecies.org/what-can-i-do/check-clean-dry; Republic of Ireland https://invasives.ie/biosecurity/check-clean-dry; New Zealand https://www.mpi.govt.nz/outdoor-activities/boating-and-water-activities-preventing-the-spread-of-pests-weeds-and-diseases/check-clean-dry/
[99] PlayCleanGo Stop Invasive Species In Your Tracks campaign https://playcleango.org/
[100] European Commission Beware of Aliens campaign https://easin.jrc.ec.europa.eu/easin/bewareofaliens
[101] Evolution of trade under the WTO: handy statistics https://www.wto.org/english/res_e/statis_e/trade_evolution_e/evolution_trade_wto_e.htm#fnt-1
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[104] Bradley, B.A., et al. (2012). Global change, global trade, and the next wave of plant invasions. *Frontiers in Ecology and the Environment*, *10*(1), 20-28. https://doi.org/10.1890/110145

providing additional challenges in relation to the trade in potentially invasive plants[105] and animals[106] as online trade is difficult to monitor and regulate.

To mitigate risks associated with intentional introductions via international trade, countries have adopted legislation that either bans priority IAS from being in trade, or lists species that are allowed to be traded, referred to as a 'positive list'[107] which is often focused on exotic pet animals. In addition, and especially to prevent the unintentional introduction of alien species, countries have implemented biosecurity practices such as border quarantine and inspections, primarily to protect agriculture. As IAS have broad-scale impacts across sectors, it would be beneficial to consider cross-sectoral and integrated approaches such as One Health and One Biosecurity, where relevant national authorities responsible for identifying and managing risks to the environment and biodiversity, agriculture, and human health are working together.[108] However, due to the volume of trade, only a fraction of imported commodities and containers can realistically be inspected and are therefore not 100% effective[109] highlighting the need for additional surveillance measures to detect new incursions at an early stage.

There are international agreements with associated standards and guidance that aim to manage some of the trade-related pathways of introduction. In relation to the marine environment, the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) has been in force since 2017, and the International Maritime Organization (IMO) has published the 2023 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species. In relation to plant and animal health, the World Organisation for Animal Health (WOAH)[110] and the International Plant Protection Convention (IPPC)[111] are the standard-setting bodies under the World Trade Organization´s Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement).[112] The IPPC also has published guidance on sea container supply chains and cleanliness to minimise pest contamination.[113] However, a gap exists within the international SPS regulatory framework related to invasive alien animals that are neither plant pests nor WOAH-listed pathogens and parasites.[114]

Information needs

To reduce the risk of the introduction and establishment of IAS via the trade sector, information and data is needed to inform the implementation of a broad spectrum of measures, including risk assessments to help prioritise IAS and justify trade regulatory safeguards, inspection controls to detect IAS at borders, vector management to prevent transport of IAS, and early detection and rapid response to prevent establishment of incursions of alien species.

To increase the effectiveness of trade regulatory safeguards, access to information and awareness-raising materials on regulated species by key sectors and the public is required. In addition, information on IAS that are regulated in different countries would also be useful to support pre-

[105] Humair, F. et al. (2015). E-commerce trade in invasive plants. *Conservation Biology*, *29*(6), 1658-1665. https://doi.org/10.1111/cobi.12579

[106] Toomes, A. et al. (2023). A snapshot of online wildlife trade: Australian e-commerce trade of native and non-native pets. *Biological Conservation*, *282*, 110040. https://doi.org/10.1016/j.biocon.2023.110040

[107] Cerri, J., et al. (2022) Blacklists do not necessarily make people curious about invasive alien species. A case study with Bayesian structural time series and Wikipedia searches about invasive mammals in Italy. *NeoBiota* 71: 113-128. https://doi.org/10.3897/neobiota.71.69422

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[109] Hulme, P.E. (2021). Unwelcome exchange: International trade as a direct and indirect driver of biological invasions worldwide. *One Earth*, *4*(5), 666-679. https://doi.org/10.1016/j.oneear.2021.04.015

[110] WOAH standards https://www.woah.org/en/what-we-do/standards/

[111] IPPC international Standards for Phytosanitary Measures (ISPMs) https://www.ippc.int/en/core-activities/standards-setting/isp

[112] WTO Sanitary and Phytosanitary measures https://www.wto.org/english/tratop_e/sps_e/sps_e.htm

[113] IPPC Sea container supply chains and cleanliness. https://www.ippc.int/en/core-activities/capacity-development/sea-containers/

[114] STDF. (2013). International trade and invasive alien species. https://standardsfacility.org/sites/default/files/STDF_IAS_EN_0.pdf

border measures by raising awareness with exporters, and possibly e-commerce platforms, so that they know which species cannot be exported to a particular country.

To support customs authorities in taking a risk-based approach and targeting inspections where they are most needed, information on which commodities are a high risk, and any specific commodity-IAS associations (e.g. plants with soil and ants) is required. This also necessitates the timely flow of import declarations, certificates of origin, and plant health certificates, prior to the goods arriving in the country. The accurate labelling of goods is also critical, and for trade in live plants and animals, labelling to a species level would greatly assist in informing authorities of the import of regulated or potential IAS pre-border. Customs also need access to identification guides and surveillance protocols for both regulated IAS and priority IAS that are likely to be traded or imported as a contaminant of commodities, along with access to expertise to support species identification. There will be an increasing need for information and data to support the use of novel technologies for inspections, for example, the use of molecular bio-surveillance (environmental DNA) to identify regulated and other IAS in containers and commodities.[115]

3. How data accessibility can be improved

Wallace et al. (2020) propose a set of guiding principles to improve information sharing among IAS information systems in the United States of America. Many of their recommendations, while focused on national data accessibility, are also relevant to the global context. For example, rather than developing a single information system, they recommend promoting interfaces among existing systems that will enable them to become interoperable, to foster access, and to deliver to end users or applications. Their proposed actions to achieve this include: a campaign to mobilise information into publicly accessible data systems; maintaining a selection of data aggregators through which relevant data can be shared; establishing data sharing agreements between key data providers; mobilising occurrence data into data aggregators with appropriate analytical and decision support tools; use of a shared and comprehensive taxonomic system; the use of data standards; and encourage and sharing information on management options.

There are several opportunities, based on the FAIR principles, to improve the accessibility of data and information on IAS through existing global systems (see Figure 2).

Firstly, the use of **globally accepted data and metadata standards** and classification schemes[116] should be promoted and adopted across global and national data providers. This will strengthen interoperability between data providers and with data aggregators, improve accessibility as data can be scaled up from national datasets into regional and global datasets (and vice versa), and facilitate the development and sharing of automated workflows and modelling to support decision-making processes. It will also allow data to be comparable from across regions and time, for example, on the establishment of alien species, or the magnitude of IAS impacts, enabling the application of indicators to monitor change and track progress towards global targets, including the rate of establishment headline indicator for Target 6 of the Framework.

Data providers, at a national and global level, and academics should be encouraged to make data available in a timely manner and under **open licenses** to improve reusability and accessibility and increase the speed at which data and information are made available. Open licences allow the data to be shared, updated, and improved by others, customised for new purposes, and for derivatives to be created. However, there may be instances where data privacy is needed,[117] also, some data providers use data licencing as a way to generate income needed to support the maintenance and expansion of datasets.

Data providers should also publish data and information with a **DOI** where appropriate, as it provides a unique identifier and permanent web-link ensuring access over time, and as they are registered with

[115] Milián-García, Y. *et al.* Uncovering the hidden within shipping containers: molecular biosurveillance confirms a pathway for introducing multiple regulated and invasive species. *Biol Invasions* **27**, 91 (2025). https://doi.org/10.1007/s10530-025-03549-w
[116] Including, Darwin core, IUCN EICAT, CBD pathways, impact mechanisms, see Table 2.
[117] For example, sensitive data requiring the reduction of location resolution.

metadata, it makes them more findable through search engines. The use of **Search Engine Optimisation,** including the full use of metadata fields, succinct page titles, and correct use of keywords[118] will also improve the findability of datasets.

One key challenge is the **language barrier**, for example, 98% of scientific peer-reviewed literature is published in English.[119] While having a common language is useful for scientific and technical communication, it creates major barriers in both accessing and publishing data and information for those who speak other languages. Costs of translations can be high, however, this barrier is being addressed through the increasing effectiveness of online translation tools, and the rapid development of Artificial Intelligence tools to translate documents and generate automated subtitles that can support real-time interpretation between languages.

The role of **Artificial Intelligence and Large Language Models (LLMs)** should also be investigated to see how they can support the filling of data gaps, modelling, and workflows to improve the availability and accessibility of data and information. For example, this could be through text mining to generate information on IAS, their impacts, distribution, pathways, and management, through predictive modelling to identify future IAS, or by supporting early detection by processing social media or citizen science posts.

Data providers and aggregators, at both national and global levels, should be encouraged to use **Application Programming Interfaces (APIs)** to support interoperability with other datasets. This will allow users to automatically access up-to-date data, rather than having to manually retrieve them via downloads. Using APIs increases the speed at which data can be used, for example, to support early warning systems at a national level or update global checklists of alien species. They also support innovative use of data through the development of new tools such as automated workflows, mobile applications, and analysis and data visualizations.

It is recommended that global data providers and aggregators take a **strategic and collaborative approach to meeting data provision needs for Target 6,** for example, through the adoption of data sharing or mobilisation agreements and partnerships. In addition, given that the lack of resources is a major challenge for global IAS data providers, a joint resource mobilisation approach is needed to address data gaps, improve data accessibility, and jointly build automated workflows to facilitate data flow between data providers, including from national level to global datasets.[120]

Making IAS data more accessible across global and national IAS data providers, in particular through the adoption of data standards, use of open access licences and APIs, will also facilitate collaboration and data sharing with other sectors.

However, making data and information 'more FAIR' will only solve part of the problem of increasing their uptake to inform IAS policy and practice. To ensure that accessible data is not being 'under-used' they need to **suit the needs of the end user groups**, whether this is for research, policy, or practice. This includes by filling in key data gaps.[121] To ensure that data meets the needs of end users, there needs to be engagement between the global data providers and their users, such as policy makers, academics, civil society organizations, indigenous peoples and local communities, and national data providers. This could result in the development of separate interfaces for different user groups (or provide stakeholder-specific awareness-

[118] UK Government. Search Engine Optimisation for data publishers: Best practice guide https://www.gov.uk/government/publications/search-engine-optimisation-for-publishers-best-practice-guide/search-engine-optimisation-seo-for-data-publishers-best-practice-guide#:~:text=What%20it%20means%20*%20Enhance%20all%20textual,of%20people%20finding%20and%20using%20your%20data.

[119] Ramírez-Castañeda, V. (2020). Disadvantages in preparing and publishing scientific papers caused by the dominance of the English language in science: The case of Colombian researchers in biological sciences. *PLOS ONE*, *15*(9), e0238372. https://doi.org/10.1371/journal.pone.0238372

[120] For example, the GBIF Alert System developed by the Research Institute for Nature and Forest (INBO) https://www.gbif.org/news/EQgUzZ4YA75BSeLs1naI9/belgian-built-gbif-alert-system-wins-the-2023-ebbe-nielsen-challenge#gbifalert

[121] Binley, A.D., et al. (2024). Making the most of existing data in conservation research. *Perspectives in Ecology and Conservation*, *22*(2), 122-128. https://doi.org/10.1016/j.pecon.2023.11.004

raising materials to promote data and information uptake), and the development of novel tools to display data and information to increase accessibility to non-experts, and to support analysis and modelling, such as the sharing of code so that low capacity countries can replicate tools and workflows.

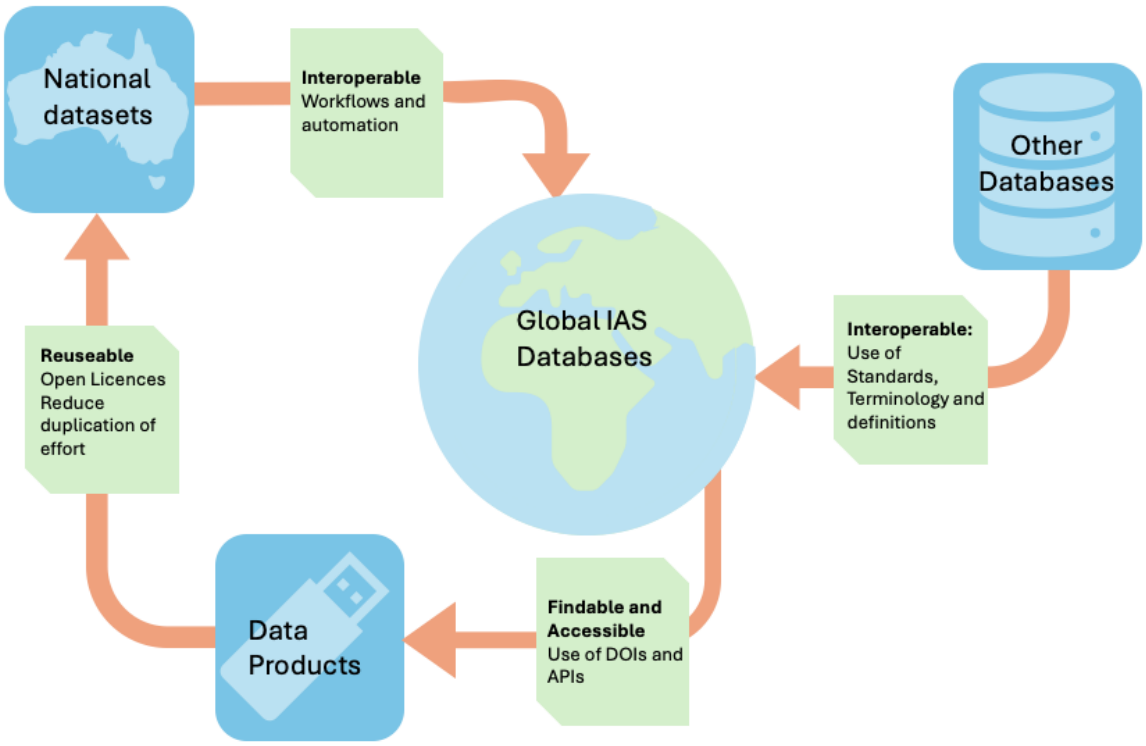

Figure 2. Infographic on improving national data provision and flow to international datasets

4. Conclusions and recommendations

The following recommendations are proposed for the Convention on Biological Diversity and the Inter-Agency Liaison Group on Invasive Alien Species on how they can support global efforts in improving the accessibility of data and information on IAS:

No new single invasive alien species data portal is needed, instead we recommend the use of the Convention on Biological Diversity´s website[122] as a 'hub' or central clearing house. This could serve as a single point of entry for Parties, and other relevant institutions and stakeholders, where they could be 'sign-posted' to data and information relevant for meeting Target 6 of the Framework. However, this will require resources and dedicated management of the site.

To improve the accessibility of data and information for Target 6, it is essential to identify and establish key collaborations and partnerships. These can be strengthened through formal agreements, such as Memoranda of Understanding (MoUs). Partnerships should include key data providers and aggregators from the Inter-Agency Liaison Group on Invasive Alien Species, as well as other relevant institutions, with the aim of:

- **Increasing the accessibility of data and information**. For example, updating existing global datasets so that they conform to global standards (e.g. Darwin core, pathways of introduction, EICAT), establishing API's so that data can be interoperable between datasets, and the development of automated workflows and tools to support transfer of data from national to global datasets (e.g. on alien species checklists).

[122] Convention on Biological Diversity Website on Invasive Alien Species https://www.cbd.int/invasive

- **Filling key data gaps.** For example, data on IAS management effectiveness and costs, on IAS invertebrates and micro-organisms, viruses and pathogens, and on the marine environment. In addition, completing species accounts with EICAT and SEICAT assessments on the magnitude of impacts within the IUCN GISD for the 3,500 IAS identified through The Assessment, improving data flow for large parts of Africa and central Asia into global datasets, sharing of IAS risk assessments, and exploring how AI and LLMs can be used to support filling of data gaps and making it accessible across languages.
- **Ensuring that data are meeting end-user needs.** For example, engagement with key sectors, such as tourism and trade, governments, civil society organisations, and indigenous peoples and local communities to understand their needs and develop relevant outputs, tools, and interfaces to support their uptake and use of data and information. Engagement should include capacity building to support the sharing of data from these sectors and groups back into global datasets. There also needs to be targeted awareness-raising activities on the data and information available, and how they can support the implementation of measures towards Target 6.
- **Support indicator development and implementation.** For example, supporting Parties with workflows for developing national indicators linked to the Target 6 headline indicator on rate of establishment, and by increasing access to data on country checklists from GRIIS, and the Global Alien Species First Record Database.

In order for global IAS data providers and aggregators to deliver on the above aims to support actions towards Target 6, **there is an urgent need for increased and sustained resourcing**. However, this needs to be undertaken through a collaborative approach across the key data providers and aggregators so that donors can invest in a broad strategic vision of improving data accessibility, filling key data gaps, and ensuring that data are suitable for end users.

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