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Item 5 of the provisional agenda\*

**PROGRESS TOWARD PATHWAYS PRIORITIZATION IN COMPLIANCE TO  
AICHI TARGET 9**

*Note by the Executive Secretary*

1. The Executive Secretary is circulating herewith, for the information of participants in the twentieth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), an information document from the Invasive Species Specialist Group of the International Union for Conservation of Nature (ISSG-IUCN) on the above captioned subject.
2. The information is being made available in the form and language in which it was received by the Secretariat.

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\* UNEP/CBD/SBSTTA/20/1/Rev.1.

## Progress toward pathways prioritization in compliance to Aichi Target 9

### *IUCN SSC Invasive Species Specialist Group (IUCN-ISSG)*

*(compiled by: Riccardo Scalera, Piero Genovesi, Olaf Booy, Franz Essl, Jonathan Jeschke, Philip Hulme, Melodie McGeoch, Shyama Pagad, Helen Roy, Wolf-Christian Saul, John Wilson)*

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### **Background**

In decision XII/17 (e), the Conference of Parties of the Convention on Biological Diversity called upon Parties and invited other Governments to consider “*Identifying and prioritizing pathways of introduction of invasive alien species, taking into account, inter alia, information on the taxa, the frequency of introduction, and the magnitude of impacts, as well as climate change scenarios*” (i.e. “*when developing or updating and implementing their national or regional invasive alien species strategies, to consider, on a voluntary basis and in conjunction with the items listed in decision VI/23\**”).

The decision further encourages Parties and other Governments to consider (d) “*Making use of the categorization of pathways of introduction of invasive alien species, considerations for their prioritization and the overview of available tools for their management as contained in the note by the Executive Secretary on pathways of introduction of invasive species, their prioritization and management*”.

Specifically, the decision refers to the document UNEP/CBD/SBSTTA/18/9/Add.1 “*Pathways of introduction of invasive species, their prioritization and management*” (agreed to at the twelfth Conference of Parties in view of the achievement of the Aichi Biodiversity Target 9) which therefore represents a key reference tool for the categorization of invasive alien species (IAS) pathways, and the objective toward the adoption of a shared terminology, possibly at the global scale.

The twelfth Conference of Parties also invited “*the Invasive Species Specialist Group of the International Union for Conservation of Nature and other technical partners to continue and complete the work on pathway analysis, and to continue to develop a system for classifying invasive alien species based on the nature and magnitude of their impacts*”.

The aim of this document is to provide a basis for assessing the work done to implement decision XII/17 above, and a discussion in relation to the achievement of the Strategic Plan for Biodiversity 2011–2020 and the Aichi Targets “*Living in Harmony with Nature*” (UNEP/CBD/COP/DEC/X/2). Specifically, this report reviews progress towards reporting requirements in compliance with Aichi Target 9, according to which “*By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment*”.

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\* One representative entered a formal objection during the process leading to the adoption of this decision and underlined that he did not believe that the Conference of the Parties could legitimately adopt a motion or a text with a formal objection in place. A few representatives expressed reservations regarding the procedure leading to the adoption of this decision (see UNEP/CBD/COP/6/20, paras. 294-324).

## Introduction

The underlying approach for a unified system to categorize introduction pathways of invasive alien species (IAS) (as proposed in the document UNEP/CBD/SBSTTA/18/9/Add.1) focuses on how pathways can be regulated and managed to enhance the prevention of invasions. The system of IAS pathways categorization proposed by the CBD (hereinafter CBD pathways categorization) is the result of an early attempt to provide countries with tools for the identification and prioritization of IAS pathways carried out by the Invasive Species Specialist Group of IUCN's Species Survival Commission (IUCN SSC-ISSG), in collaboration with the UK's Centre for Ecology and Hydrology (CEH), CAB International (CABI) and other partners, within the framework of the CBD related Global Invasive Alien Species Information Partnership (GIASIPartnership). The system is based on the framework developed by Hulme et al. (2008)<sup>1</sup> and an analysis of key data sources, such as the IUCN SSC-ISSG Global Invasive Species Database (GISD), the Invasive Species Compendium (ISC) of CABI, Delivering Alien Invasive Species Inventories for Europe (DAISIE) and key peer-reviewed literature.

In short, the CBD pathways categorization distinguishes intentional and/or unintentional introductions, and the introduction mechanism as either the importation of a commodity, the arrival of a transport vector, the establishment of an anthropogenic dispersal corridor, or the natural spread from a region where the species is itself alien (see table 1 below). These mechanisms can further be divided into six main groups: Release; Escape; Transport-Contaminants; Transport-Stowaway; Corridors; and Unaided (natural dispersals).

**Table 1: Categorization of pathways for the introduction of alien species (from UNEP/CBD/SBSTTA/18/9/Add.1 )**

	Category	Subcategory
<b>Movement of COMMODITY</b>	<b>RELEASE IN NATURE</b>	Biological control Erosion control/ dune stabilization (windbreaks, hedges, ...) Fishery in the wild (including game fishing) Hunting in the wild Landscape/flora/fauna "improvement" in the wild Introduction for conservation purposes Release in nature for use (other than above, e.g., fur, transport, medical use) Other intentional release
	<b>ESCAPE FROM CONFINEMENT</b>	Agriculture (including Biofuel feedstocks) Aquaculture / mariculture Botanical garden/zoo/aquaria (excluding domestic aquaria) Pet/aquarium/terrarium species (including live food for such species ) Farmed animals (including animals left under limited control) Forestry (including reforestation) Fur farms Horticulture Ornamental purpose other than horticulture Research and <i>ex-situ</i> breeding (in facilities)

<sup>1</sup> Hulme, P.E., Bacher, S., Kenis, M., Klotz, S., Kuhn, I., Minchin, D. et al. (2008) Grasping at the routes of biological invasions: a framework for integrating pathways into policy. *Journal of Applied Ecology*, 45, 403–414.

		<p>Live food and live bait</p> <p>Other escape from confinement</p>
	<b>TRANSPORT – CONTAMINANT</b>	<p>Contaminant nursery material</p> <p>Contaminated bait</p> <p>Food contaminant (including of live food)</p> <p>Contaminant on animals (except parasites, species transported by host/vector)</p> <p>Parasites on animals (including species transported by host and vector)</p> <p>Contaminant on plants (except parasites, species transported by host/vector)</p> <p>Parasites on plants (including species transported by host and vector)</p> <p>Seed contaminant</p> <p>Timber trade</p> <p>Transportation of habitat material (soil, vegetation,...)</p>
<b>VECTOR</b>	<b>TRANSPORT STOWAWAY</b>	<p>Angling/fishing equipment</p> <p>Container/bulk</p> <p>Hitchhikers in or on airplane</p> <p>Hitchhikers on ship/boat (excluding ballast water and hull fouling)</p> <p>Machinery/equipment</p> <p>People and their luggage/equipment (in particular tourism)</p> <p>Organic packing material, in particular wood packaging</p> <p>Ship/boat ballast water</p> <p>Ship/boat hull fouling</p> <p>Vehicles (car, train, ...)</p> <p>Other means of transport</p>
<b>SPREAD</b>	<b>CORRIDOR</b>	<p>Interconnected waterways/basins/seas</p> <p>Tunnels and land bridges</p>
	<b>UNAIDED</b>	<p>Natural dispersal across borders of invasive alien species that have been introduced through pathways 1 to 5</p>

The importance of the document UNEP/CBD/SBSTTA/18/9/Add.1 “*Pathways of introduction of invasive species, their prioritization and management*” lies on the key assumption that for ensuring a consistent and effective prioritization of IAS pathways and the identification of the most appropriate measures for their management, a standard categorization system to identify such pathways is required. A common terminology for pathways is crucial also to enable comparison of data across countries and over time. Furthermore it could also facilitate the assessment of the risks posed by pathways.

As the level of detail required in pathway classification will depend on the management goal<sup>2</sup>, a number of subcategories are also proposed. This categorization is thus a practical tool for the management of IAS pathways as it should support the identification of the best management response (also summarized in Essl et al. 2015<sup>2</sup>).

<sup>2</sup> Essl F, Bacher S, Blackburn TM, Booy O, Brundu G, Brunel S, Cardoso A-C, Eschen R, Gallardo B, Galil B, García-Berthou E, Genovesi P, Groom Q, Harrower C, Hulme PE, Katsanevakis S, Kenis M, Kühn I, Kumschick S, Martinou AF, Nentwig W, O’Flynn C, Pagad S, Pergl J, Pyšek P, Rabitsch W, Richardson DM, Roques A, Roy HE, Scalera R, Schindler S, Seebens H, Vanderhoeven S, Vilà M, Wilson JRU, Zenetos A and Jeschke JM. 2015. Crossing frontiers in tackling pathways of biological invasions. *BioScience*, 65: 769–782.

By focusing regulations on the pathway rather than on individual introductions the authorities in North America have seen large reductions in the rates of new introduction to the Great Lakes<sup>3,4</sup>. This turned an incredibly complex problem of trying to assess and manage all the risks, to one that was tractable<sup>5</sup>.

### **Assessing priority pathways: preliminary results and future challenges**

Horticultural and pet and aquarium escapees are the most frequent pathways by which IAS are introduced and spread, as revealed by the application of the CBD pathways categorization to 500 IAS in the Global Invasive Species Database<sup>6</sup>. However, analyses focusing on specific regions (and/or a selection of taxa only) may lead to a different emphasis on particular pathways. For example, a risk assessment of pathways into the Antarctic found high propagule loads for fresh produce, infrastructure development activities, and entrainment on the clothing of visiting tourists and scientists<sup>6</sup>. Freshwater invertebrate introductions into the US are predominantly associated with ballast water, whereas fish introductions are largely via aquaria and aquaculture<sup>6</sup>.

Importantly different taxa tend to be introduced in different ways. In an analysis from South Africa, Faulkner et al. (2016)<sup>7</sup> found that most alien and invasive vertebrates and plants were deliberately introduced and subsequently escaped captivity or cultivation, but that introduced invertebrates tended to either have been deliberately introduced and released or unintentionally introduced as contaminants or stowaways. However, there was substantial uncertainty. Over a half of all taxa the pathway classification could not be determined. This is likely to be a feature for many countries. The pathway can be inferred, but not known with certainty.

The relevance of pathways is usually scale-dependent and what seems to be the highest priority at the global level might be not at the local level, and vice-versa<sup>2</sup>. This is well documented from an analysis of pathway data made at the global, regional and national levels (on the basis of the IUCN SSC-ISSG Global Invasive Species Database, the DAISIE European database, and the Great Britain Non-Native Species Information Portal, respectively) presented at the 12<sup>th</sup> CBD COP<sup>8</sup>. For example, the data show that while escape is the most frequent means of introduction of alien species at global, regional and national levels, corridors are a more frequent pathway of introduction in Europe than globally due to the high number of marine species that arrived into the Mediterranean basin by Lessepsian

<sup>3</sup> Bailey SA, Deneau MG, Jean L, Wiley CJ, Leung B *et al.* 2011. Evaluating efficacy of an environmental policy to prevent biological invasions. *Environm Sci Techn* 45: 2554-2561. DOI: 10.1021/es102655j

<sup>4</sup> Drake DAR, Chan FT, Briski E, Bailey SA, MacIsaac HJ. 2014. Assemblage structure: an overlooked component of human-mediated species movements among freshwater ecosystems. *J Limnol* 73: 112–9. DOI: <http://dx.doi.org/10.4081/jlimnol.2014.802>

<sup>5</sup> Woodford, D., MacIsaac, H., Richardson, D.M., Mandrak, N., Wilgen, B.W.v., Wilson, J.R.U. & Wey, O.L.F. (in prep.) Confronting the wicked problem of managing invasive species.

<sup>6</sup> McGeoch, M.A., Genovesi, P., Bellingham, P.J., Costello, M.J., McGrannachan, C. & Sheppard, A. 2016. Prioritizing species, pathways, and sites to achieve conservation targets for biological invasion. *Biological Invasions* 18, 299-314. Doi: 10.1007/s10530-015-1013-1 (Open Access)

<sup>7</sup> Faulkner, K.T., Robertson, M.P., Rouget, M. & Wilson, J.R.U. 2016. Understanding and managing the introduction pathways of alien taxa: South Africa as a case study. *Biological Invasions*, 18, 73–87.

<sup>8</sup> Analysis on Pathways for the Introduction of Invasive Alien Species: Updates. UNEP/CBD/COP/12/INF/10 <https://www.cbd.int/kb/record/meetingDocument/101167>

migrations. It is also important to understand difference in how pathways allow dispersal into a region from how pathways operate to allow dispersal within a region<sup>7</sup>. For example, the pest fruit fly *Bactrocera dorsalis* (syn. *Bactrocera invadens*) appears to have been introduced to East Africa from Sri Lanka<sup>9</sup>. It has since spread rapidly throughout much of sub-Saharan Africa. It is crucially important to understand both how it was initially introduced, and how it has spread further within Africa.

A recent attempt to prioritize pathways for IAS has been done at the regional level in Europe, and particularly in the Nordic and Baltic region, along with Iceland and the Faroe Islands<sup>10</sup>. In this study the NOBANIS database has formed the basis for the pathway analysis, and each country updated their national data with relevant information available using relevant literature and articles and by consulting national experts. Besides the identification of the human activities known to have caused the introduction of IAS occurring in the target region, the taxonomy, impacts and origin of the introduced species, along with the changes in patterns of introductions over time, were also investigated. In particular, the prioritization method used in this study considered as a key parameter the number of “door knocker” species (species not yet recorded, but suspected at high risk of arrival) identified by the *ad hoc* horizon scanning exercise<sup>6</sup>, and the pathways associated to such species. The pathway analysis, carried out at the regional level in the Nordic and Baltic countries, showed that the main pathway of introduction was horticulture, followed by agriculture, transport, forestry and ballast water and sediments, but there were variations between regions. A prioritized list of pathways of concern was presented, along with guidelines and general recommendations on measures to control pathways of interest in the regions and advice on an early warning system. The main recommendation of the study is that in the continuing work towards reducing alien introductions, it is important to improve our understanding of the pathways of introduction of IAS.

This is consistent with the results of another specific analysis done in Denmark, focusing on over 2,700 introduced species<sup>11</sup>. In this case pathways of introduction were identified on the basis of the categories defined in the NOBANIS database from which most data were retrieved, e.g. taking into account the pathways of introduction, the mode of entry, and the type of introduction for each species. Additionally, the impact of each species was analyzed on the basis of the Harmonia<sup>+</sup> guidelines. The study confirmed the generalized lack of knowledge on pathways of introduction for many species.

The potential to conduct sound analysis using pathway data in major databases<sup>12</sup> is limited by the disparate terminology to describe the same pathway, and in most cases also by differences in the scope and intention of these databases, i.e. temporal and spatial scale, taxonomic groups, and environments<sup>2</sup>. Saul et al. (*in prep.*) investigated the implications of such differences for the prevention of introductions and for prioritization of pathways in management and surveillance, by collating pathway information from two of the main global datasets: GISD (updated version<sup>13</sup>) and DAISIE<sup>14</sup>. In conclusion, the available pathway

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<sup>9</sup> Drew, R.A.I., Tsuruta, K. & White, I.M. 2005. A new species of pest fruit fly (Diptera : Tephritidae : Dacinae) from Sri Lanka and Africa. *African Entomology*, 13, 149-154.

<sup>10</sup> NOBANIS 2015. Invasive Alien Species: Pathway Analysis and Horizon Scanning for Countries in Northern Europe. Norden. Publication no.517. Pag. 232.

<sup>11</sup> Madsen, C. L., Dahl, C. M., Thirslund, K. B., Grousset, F., Johannsen, V. K. and Ravn, H. P. 2014. Pathways for non-native species in Denmark. Department of Geosciences and Natural Resource Management, University of Copenhagen, Frederiksberg. 131 pp.

<sup>12</sup> Katsanevakis, S. & Roy, H.E. 2015. Alien species related information systems and information management. *Management of Biological Invasions*, 6, 115–117.

<sup>13</sup> <http://www.iucngisd.org/gisd/>

databases may have limited value in combatting biological invasions given the high uncertainty with which species are often assigned to a pathway, and the retrospective approach in assignments, which may be invalid where the importance of different pathways shifts over time<sup>15</sup>. This emphasizes the need of a forward looking approach based on projected changes in trade, transport and tourism rather than on retrospective analyses. Also, to address the uneven distribution of information on pathways, data might need to be extrapolated from regions where comprehensive documentation is available, to areas where the documentation is not as clear.

Another constraint on the potential for sound assessments of pathway risks (e.g. to predict relevant trends) is the complexity of the network which may characterize the target pathway. In general the key information needed for the analysis is rarely available for more than a few specific pathways and for a very limited number of species. Such variables are also difficult to measure given their very dynamic nature. There have been significant changes in historical pathways, e.g. decline in the fur trade and the rise in exotic pets (e.g. Wilson et al. 2009<sup>16</sup>). But specific pathways will also depend on trade flows and follow political patterns, e.g. the likely very rapid increase in trade from the USA to Cuba. Thus, the assessment of pathway risks needs to rely rather on proxies for propagule pressure<sup>2</sup>. This entails the risk of underestimating the species and areas<sup>3</sup> with the highest invasion risk, which must always be taken into account when planning management actions.

The importance of pathways over space and time may vary because of complex interactions between the environment and socio-economic factors, e.g. depending on the functional traits of the introduced species, trade routes, and other factors, which might have major implications in terms of management and effective prevention of future invasions<sup>2, 15, 17</sup>.

Assigning the entry or spread of alien species to specific pathways may be subject to various levels of uncertainty, and while in some cases there is excellent evidence supporting the global significance of some pathways, such as ballast and pet trade, for some areas/pathways there are important gaps e.g. the only available may be based on expert assumption rather than evidences, or in some cases the exact pathway responsible for a particular introduction may simply be unknown<sup>2</sup>.

## **The way ahead**

The application of the unified system to categorize introduction pathways of IAS proposed in the document UNEP/CBD/SBSTTA/18/9/Add.1 has indeed improved the understanding on the most relevant vectors and activities of introduction of IAS, as shown by the preliminary results presented in this document.

However, the opportunities to prioritize pathways in a comprehensive and consistent way (and compare the results across space and time) are currently limited by the quality and reliability of the data available, and the lack of a standard methodology. Both factors are

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<sup>14</sup> <http://www.europe-aliens.org>

<sup>15</sup> Hulme, P. E. 2015. Invasion pathways at a crossroad: policy and research challenges for managing alien species introductions. *Journal of Applied Ecology*. 52, 1418–1424

<sup>16</sup> Wilson, J.R.U., Dormontt, E.E., Prentis, P.J., Lowe, A.J. & Richardson, D.M. 2009. Something in the way you move: dispersal pathways affect invasion success. *Trends in Ecology & Evolution*, 24, 136-144.

<sup>17</sup> Saul W.C., Roy H.E., Booy O., Carnevali L., Chen H.J., Genovesi P, Harrower C.A., Pagad S., Pergl J., Jeschke J.M. Linking major databases to assess patterns in introduction pathways of alien species (in prep.)

strictly linked to the management or legislative requirements to which they are tied.

The quality of alien species pathways data may depend greatly on the databases and their scope. In general, as stressed in the document presented at the 12<sup>th</sup> CBD COP<sup>8</sup>, in order to permit a prioritization of pathways other schemes comprising additional detail should be nested on the CBD pathways categorization proposed in UNEP/CBD/SBSTTA/18/9/Add.1.

All data providers and relevant institutions should therefore consider adopting the standard categorization, complementing the system with more detailed levels of description of pathways depending on the specific focus of the different datasets or institutions.

There are several examples of efforts for identifying and prioritizing pathways of introduction of IAS to enhance more effective prevention measures. The European Union provides an extensive case study of pathways prioritization and management. Further to the adoption of Regulation (EU) no. 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species (herein referred to as “EU regulation on IAS”), the EU has formally identified the EASIN catalogue as the official database for the implementation of the EU Regulation on IAS. In relation to the use of EASIN, the European Commission has currently launched a study to align the assignment of pathways of introduction for each species according to the CBD pathways categorization. This will be further facilitated by the contribution of the experts which are part of the IUCN SSC-ISSG network, as well as the network developed through the COST Action ALIEN Challenge TD1209, an initiative involving directly over 34 countries and over 100 experts from Europe and beyond (which will last only until 2017). This COST Action aims at facilitating enhanced knowledge gathering and sharing through a network of experts, providing support to a European IAS information system which will enable effective and informed decision-making in relation to IAS. An overarching priority will be to identify the needs and formats for alien species (AS) information by different user groups and specifically for implementation of EU 2020 Biodiversity Strategy (see for example Objective 2: Review of pathways and priority species aligning with Strategic Goal B, target 9 of the CBD COP 10 decision X/2).

### ***Development of a standard methodology to prioritize pathways***

As pointed out in the document presented at the 12<sup>th</sup> CBD COP<sup>8</sup>, prioritization goes well beyond the identification of the most frequent pathways of introduction of alien species, and should be extended to the definition of potential or realized impacts, and other criteria, such as feasibility of management, the likelihood of management success for a given level of investment (cost-effectiveness) and social preference. For example, regarding the impact associated with a given pathway, it is important to consider both the number of individuals of a species transported and successfully introduced including the number of introduction events, the number of different species transported and introduced, and the actual impacts of all the individual alien species introduced by such pathway<sup>2</sup>. This kind of analysis requires the availability of information on both species pathways and species impact. For the latter it might be complemented through the data derived from the use of the dedicated scheme which is being developed and tested to categorize the species impact. This scheme (Environmental Impact Classification for Alien Taxa, EICAT) provides a transparent, standardized, and effective approach that can be applied to a diverse range of taxa (across plants and animals) and differing types and quality of available evidence<sup>18,19</sup>. EICAT is now being refined for

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<sup>18</sup> Blackburn, T.M., Essl, F., Evans, T., Hulme, P.E., Jeschke, J.M., Kühn, I., Kumschick, S., Marková, Z., Mrugała, A., Nentwig, W., Pergl, J., Pyšek, P., Rabitsch, W., Ricciardi, A., Richardson, D.M., Sendek, A., Vilà, M., Wilson, J.R.U.,

Aichi Target 9 and as it undergoes testing and further development is likely to be widely adopted.

### ***Management of pathways and legislation requirements***

There are several points that need to be taken into account for management purposes. From a management perspective, intentional introductions, either legal or illegal, can be prevented through some kind of regulatory approach (including more effective enforcement of regulations), or by voluntary tools such as codes of conduct. On the other hand, unintentional introductions need in general to be dealt with some (pro) active management approach addressing the relevant pathways. Saul et al. (*in prep.*)<sup>17</sup> point out that many high-impact IAS seem to be introduced both intentionally *and* unintentionally, which highlights the need to ensure the implementation of a sound regulatory approaches combined with effective management of the relevant pathways. Economic drivers such as tourism, the pet trade and infrastructure projects will accelerate IAS introductions, particularly in emerging economies and that mitigation requires ‘polluter pays’ legislation combined with improved policy enforcement and compliance<sup>15</sup>. Furthermore, policymakers require new risk analysis tools to predict the hazards posed by species with no prior invasion history, the vulnerability of native biodiversity to emerging diseases, and the components of regional species pools that become invasive following connection via corridors. It is also essential to acknowledge the dynamic nature of invasions and recognize that the importance of different pathways changes over time and new pathways emerge.

Additionally, pathways should be classified in terms of how easy they are to regulate and what the nature of the risks are involved. For example in a recent assessment, intentional introductions of invertebrates (identified as bioweapons) pose a poorly understood but potentially major and very hard to manage risk<sup>21</sup>.

It is evident that the sound management of biological invasions might need to be based on a well integrated approach: on this regard an interesting case study is provided by the South Africa’s National Strategy on Biological Invasions, that explicitly separates species-based, pathway-based, and area-based management.

Critical future issues for the sound management of each of the six major pathway categories are outlined in a recent work of Hulme (2015)<sup>15</sup> to identify the policy challenges and underpinning science required for resolution. Moving forward opportunities also exist for optimizing management effectiveness of IAS by integrating information on priority pathways with information on priority species and sites<sup>3</sup>.

### ***Management plans for IAS pathways***

In relation to the options available for the management of introduction pathways, some guidance is being provided by the Bern Convention through the proactive collaboration with a

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Winter, M., Genovesi, P. & Bacher, S. 2014. A Unified Classification of Alien Species Based on the Magnitude of their Environmental Impacts. *PLoS biology*, **12**, e1001850.

<sup>19</sup> Hawkins, C.L., Bacher, S., Essl, F., Hulme, P.E., Jeschke, J.M., Kühn, I., Kumschick, S., Nentwig, W., Pergl, J., Pyšek, P., Rabitsch, W., Richardson, D.M., Vilà, M., Wilson, J.R.U., Genovesi, P. & Blackburn, T.M. 2015. Framework and guidelines for implementing the proposed IUCN Environmental Impact Classification for Alien Taxa (EICAT). *Diversity and Distributions*, n/a–n/a.

<sup>20</sup> <https://sites.google.com/site/wfwplanning/strategy/National%20IAS%20Strategy.pdf?attredirects=0&d=1>

<sup>21</sup> Kumschick, S., Devenish, A., Kenis, M., Rabitsch, W., Richardson, D.M. & Wilson, J.R.U. (in press) Intentionally introduced terrestrial invertebrates: patterns, risks, and options for management. *Biological Invasions*. Doi: 10.1007/s10530-016-1086-5

dedicated Group of Experts on Invasive Alien Species<sup>22</sup>. In particular, a number of codes of conduct addressing specific pathways have been finalized, also with the contribution of the relevant stakeholders. Such voluntary tools have also been formally endorsed by all Parties of the Bern Convention through specific resolutions.

The Bern Convention is currently finalizing also a guidance document on how to draft management plans and action plans for IAS pathways to governments and national authorities from across Europe and beyond (it is addressed to all Member States of the Council of Europe, possibly including also neighboring countries)<sup>23</sup>. This document aims at providing a general framework of what a comprehensive action plan for managing IAS pathways should look like, including detailed instructions on contents as well as examples of best practices. The objective is to develop a practical tool for both the authorities and relevant experts who have to draft such management/action plans and the administrators who have the responsibility to validate and implement them. This is expected to further promote the prioritization of pathways to be targeted through specific management measures.

The work done within the scope of the Bern Convention fits well with the provisions to be implemented within most of its Parties, particularly the EU and its Member States further to the adoption and entry into force of the EU regulation on IAS. In fact, one of the key provisions of the EU regulation on IAS, i.e. art. 13, specifically requires Member States to develop action plans for the management of pathways (including the analysis of pathways, and the identification of priority pathways) within fixed deadlines. This provision is also aimed at the achievement of task 5 of the Biodiversity Strategy, which fully reflects the text of the above mentioned Aichi Target 9.

## Recommendations

To ensure the effectiveness of management initiatives and to monitor the results of the enforced responses in relation to IAS pathways, CBD Parties, national, regional and global institutions, and the scientific community should consider:

1. Adopt and further promote the system of IAS pathways categorization proposed by the CBD, as a common terminology is crucial to enable comparison of data across countries and over time, to facilitate the assessment of the risks posed by pathways, and to identify the best management responses.
2. Carry out national or regional assessments aimed at the prioritization of pathways, taking into account the results and the methods summarised in the present document, and enforce prevention action plans based on the results of such prioritization.
3. In the context of pathways prioritization, consider complementing the system of IAS pathways categorization presented by the CBD with more detailed levels of description of pathways depending on the specific focus of the different datasets or institutions (e.g. develop more detailed subcategories, at the country or local level, or for specific pathways).
4. Carry out comprehensive and consistent assessments of priority pathways suitable for

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<sup>22</sup> <http://www.coe.int/en/web/bern-convention/on-invasive-alien-species>

<sup>23</sup> Scalera R, 2015. Guidance for governments concerning invasive alien species pathways action plans. Convention on the conservation of European wildlife and natural habitats. T-PVS/Inf (2015) 24 (First draft) <https://wcd.coe.int/com.instranet.InstraServlet?command=com.instranet.CmdBlobGet&InstranetImage=2828404&ScMode=1&DocId=2321234&Usage=2>

different taxa, different environments and different geographic scales, ensuring the consistency with a commonly shared terminology.

5. Consider the extrapolation of data from regions where comprehensive documentation is available, to assess the situation in areas where the documentation is not as clear.
  6. Consider developing a forward looking approach based on projected changes in trade, transport and tourism rather than on retrospective analyses.
  7. Continue investing resources to developing and circulating new knowledge on alien species and pathways, particularly through the existing relevant tools such as the IUCN Global Invasive Species Database, the Invasive Alien Species Pathways tool (under development) and the Global Register of Introduced and Invasive Species implemented within the GIASIPartnership, as appropriate.
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