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GUIDANCE FOR GOVERNMENTS CONCERNING INVASIVE ALIEN SPECIES PATHWAYS ACTION PLANS

- FINAL DRAFT -

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SUMMARY

This report is aimed at providing Member States of the Council of Europe, namely their governments and national authorities, with a guidance document to develop action plans for the management of IAS pathways. Similarly to other voluntary tools developed by the Bern Convention, this guidance document is not intended to be prescriptive.

The report includes three sections: an introduction, a description of the policy and legal context, and the actual guidelines on how to draft an ideal action plan for dealing with IAS pathways.

INTRODUCTION

This report is aimed at providing governments and national authorities with a general framework of what a comprehensive action plan for managing invasive alien species (IAS) pathways should look like, including detailed instructions on contents as well as examples of best practices. In particular, given the scope of the Bern Convention - which brings together governments from across Europe and beyond - this guidance tool is addressed to all Member States of the Council of Europe, possibly including also neighbouring countries. The focus is thus intended on IAS pathways in Europe and beyond.

The objective is fully in line with the Convention on Biological Diversity (CBD) decision of COP 12 (XII/17) which encourages CBD Parties to "*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*". It also contributes to help the achievement of the Aichi target 9 of the CBD, 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*".

The idea of a guidance document to help national authorities to develop action plans for the management of IAS pathways builds on the need to provide countries with some technical support for the practical implementation of the Regulation on IAS adopted within the European Union (EU), namely Regulation (EU) N° 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"). 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.

In this context, it is worth to point out that while the document builds on a number of previous works on the issue, a key reference tool for the categorisation of IAS pathways is the CBD document UNEP/CBD/SBSTTA/18/9/Add.1 "Pathways of introduction of invasive species, their prioritization and management" agreed to at the last COP12 (in view of the achievement of the Aichi Biodiversity Target 9).

Notably, a previous draft of the present guidance document prepared for the Council of Europe, inspired the information paper "*Progress toward pathways prioritization in compliance to Aichi Target 9*" UNEP/CBD/SBSTTA/20/INF/5 (Scalera et al. 2016) developed by the Invasive Species Specialist Group of the International Union for Conservation of Nature (ISSG-IUCN). The document was circulated by the Secretariat of the CBD at the 20th meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) held in Montreal, Canada, on 25-30 April 2016. The aim was 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). This was fully in line with the twelfth Conference of Parties, which 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".

Scope and aim

This work is addressed to countries and regions which are looking for guidance on how to draft management plans and action plans for IAS pathways. Thus 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. Although the need of such guidance was inspired by the provisions of the EU regulation on IAS, the interest of this work is not to be considered limited to the EU Member States. This fits well with the Bern Convention role to further outside the EU the innovation of the EU Regulation on IAS, and represents another step in the process led by the Council of Europe in drafting key IAS related documents over the years, by stressing the added value of ensuring a harmonised approach also with other EU neighbouring countries. The added value of this work is in fact the contribution to the definition of a process aimed at producing, approving, monitoring and updating documents to support the implementation of the EU Regulation on IAS. For this purpose, this document builds on other guidance documents on how to draft action plans and management plans, e.g. for example on species and habitat of conservation concern (see FACE and BirdLife International 2011), and how to design relevant projects (e.g. see the application brochures pertaining the LIFE programme[1]).

In fact, as pointed out by Essl et al. (2015), so far only a few comprehensive pathway-focused policies have been developed at the international and regional level, and even at the national level, only a handful of countries have implemented introduction pathway policies comprehensively. Thus, this guidance document might promote the further development of tools to effectively plan the management of IAS pathways. Additionally, the standardisation of a pathway action plan layout and process allows any aspect of the plan for different countries or pathways to be compared. This may for instance assist with development of early warning and rapid response systems, as well as surveillance programmes, in all Member States.

As other similar voluntary tools developed by the Bern Convention, this guidance document is not intended to be prescriptive. However, it can be a valid decision support tool for those countries where the implementation of pathways action plans is mandatory, like those within the EU. On the other hand, also other non-EU countries, particularly those at the EU borders, may benefit from this guidance document. In fact it may facilitate the adoption of a harmonised approach when dealing with the problems related to IAS management, thus increasing the opportunities for possible collaboration between EU and non-EU countries on the issue, and relevant synergies. The Council of Europe and the EU are well known for being characterised by "*different roles, shared values*". In this context the EC fully recognised the "added value" in cooperating with the Council of Europe on the issue, as the work being carried out by the Bern Convention and its group of expert on IAS can be both complementary and innovative on same aspects (for instance the Council of Europe works more on voluntary instruments while the EC is more focused on hard laws, checking the implementation by its MSs of the relevant legislation).

Identification, prioritisation and management of IAS pathways

As pointed out in the European Strategy on IAS (Genovesi and Shine, 2004) developed by the Bern Convention, the introduction of species beyond their natural range is rising sharply (Butchart et al., 2010), due to increased transport, trade, travel and tourism and the unprecedented accessibility of goods resulting from globalisation. These activities provide vectors and pathways for live plants, animals and biological material to cross those biogeographical barriers that would usually block their movement and spread. For the purposes of the European Strategy on IAS:

- "pathway" means, as applicable:
  - ✓ *the geographic route by which a species moves outside its natural range (past or present);*
  - ✓ *the corridor of introduction (e.g. road, canal, tunnel); and/or*
  - ✓ *the human activity that gives rise to an intentional or unintentional introduction.*

[1] http://ec.europa.eu/environment/life/funding/life2015/index.htm

- "vector" means the physical means or agent (i.e. aeroplane, ship) in or on which a species moves outside its natural range (past or present).

For a discussion about the concepts of "pathways" and "vectors" – which in this guidance document will be used as synonyms – please refer to Richardson et al. (2001).

Given the multitude of IAS pathways and the relatively variable impact they have depending on the temporal and spatial context and other variables (not to mention the complexities linked to the existence of multiple pathways responsible for individual alien species) it is necessary to prioritize those pathways with the greatest impact on biodiversity and possibly which are expected to be the most resource effective to address.

A key assumption for ensuring a consistent and effective prioritisation of IAS pathways and the identification of the most appropriate measures for their management, is the availability of a standard categorization system to identify such pathways. In other terms, the objective should be the adoption of a shared terminology, possibly at the global scale. A common terminology would be crucial also to allow the comparison of data across countries and across the years, as reported within a CBD document discussed at SBSTTA 18[2].

In the SBSTTA 18 document mentioned above, a unified system to categorize IAS pathways is proposed. The underlying approach, based on Hulme (2008), focuses on how pathways can be regulated and managed to enhance the prevention of invasions. 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).

As the level of detail required in pathway classification will depend on the management goal (see Essl et al. 2015), a number of subcategories are also proposed. This categorisation is thus functional to the sound management of IAS pathways as it should support the identification of the best management response (also summarized in Essl et al. 2015).

2 UNEP/CBD/SBSTTA/18/9/Add.1 https://www.cbd.int/doc/meetings/sbstta/sbstta-18/official/sbstta-18-09-add1-en.pdf

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

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

The use of a standard pathway categorization has been explicitly encouraged at the 12th CBD COP held at Pyeongchang (Republic of Korea, 6-17 October 2014) with its Decision *XII/17 "Invasive alien species: review of work and considerations for future work"* addressed *to* all CBD Parties. In particular the COP "*Calls upon Parties and invites other Governments, 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) "M*aking 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*".

This categorisation system is the result of an early attempt to provide countries with tools allowing 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 work was based on the framework developed by Hulme et al. (2008) 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 some key peer-reviewed literature.

In the context of pathways prioritization, as recommended within the information paper UNEP/CBD/SBSTTA/20/INF/5, the system of IAS pathways categorization presented by the CBD should be complemented with more detailed levels of description of pathways depending on the specific focus of the different datasets or institutions (e.g. by developing more detailed subcategories, at the country or local level, or for specific pathways, and considering primary and secondary dispersal to better describe the occurrence of introductions through multiple pathways).

Assessing priority pathways: preliminary results and future challenges

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 the SBSTTA document UNEP/CBD/SBSTTA/20/INF/5. 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 strictly linked to the management or legislative requirements to which they are tied.

The possibility to perform a sound analysis of the pathway data contained in major databases is definitely affected by the disparate terminology to describe a same pathway, and in most cases also by the different scope in terms of spatial scale, taxonomic groups, and environments (see Essl et al. 2015). 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 dataset: GISD (updated version) and DAISIE. The available pathway 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 (Hulme 2015). 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 a sound assessment of pathway risks (e.g. to predict relevant trends) is the complexity of the network which may characterise the target pathway. In general the key information needed for the analysis are rarely known 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 pathways across the years, e.g. decline in the fur trade and the rise in exotic pets (e.g. Wilson et al. 2009). But specific pathways will also depend on trade flows and follow political patterns (an example is 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 (Essl et al. 2015). This entails the risk of underestimating the species and areas with the highest invasion risk, which therefore must be always taken into account when planning management actions.

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 be simply unknown (Essl et al. 2015). Critical future issues for the sound management of each of the six major pathway categories are outlined in a recent work of Hulme (2015) to identify the policy challenges and underpinning science required for resolution.

There is no standard methodology to prioritise pathways, but as pointed out in a document presented at the 12th CBD COP[3], 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 to a given pathway, it is important to consider both the number of individuals of a species transported and successfully established (including the number of introduction events), and the actual impact of the individual alien species introduced by such pathway (Essl et al. 2015). 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 (see Blackburn et al., 2014, Hawkins et al. 2015) 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. EICAT is now being refined for Aichi Target 9 and as it undergoes testing and further development is likely to be widely adopted.

Thus, as stressed in a document presented at the 12th meeting of the CBD COP[4] in order to carry out a prioritization of pathways other schemes comprising additional detail should be nested on the standard categorisation proposed in UNEP/CBD/SBSTTA/18/9/Add.1, and all data providers and relevant institutions should consider adopting the standard categorization, integrating the system with more detailed levels of description of pathways depending on the specific focus of the different datasets or institutions.

Some authors have argued that the application of the EICAT methodology to marine species is particularly challenging, as the impact of invasive species in the sea is rarely known (Ojaveer et al 2014, Ojaveer et al 2015). However, pilot testing of the application of EICAT is being undertaken also for marine species.

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 (McGeoch et al, 2016). 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 scientists6. Freshwater invertebrate introductions into the US are predominantly associated with ballast water, whereas fish introductions are largely via aquaria and aquaculture (McGeoch et al, 2016).

It is important to highlight that different taxa tend to be introduced in different ways. In an analysis from South Africa, Faulkner et al. (2016) 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

3 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

4 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

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.

A recent attempt to prioritise 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 (NOBANIS 2015). 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 alien species occurring in the target region, the taxonomy, invasiveness and origin of the introduced species, along with the changes of the introductions over time, were also investigated. In particular, the prioritisation 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, 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 prioritised 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.

Not surprisingly this complies with the results of another specific analysis done in Denmark, focusing on over 2.700 introduced species (see Madsen et al. 2014). 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 analysed on the basis of the Harmonia^{+} guidelines. The Danish study confirmed the generalised lack of knowledge on pathways of introduction for many species.

From a management perspective, while intentional introductions of IAS can be prevented through some kind of regulatory approach (including voluntary tools such as codes of conduct), unintentional introductions need to be deal with some (pro)active management approach addressing the relevant pathways. Saul et al. (in prep.) have pointed 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 approach combined with effective management of the relevant pathways. In any case, there are several points that need to be taken into account for management purposes. In this context, the importance of a regional approach (including at the basin level for freshwater and marine alien species) is key to ensure priority pathways are appropriately managed. This is particularly evident for marine alien species, whose proper management is affected by important geographical, taxonomical and impact data gaps (Galil et al., 2016).

The relevance of pathways is usually scale-dependent (Essl et al. 2015) and what seems to be the highest priority at the global level might be not at the local, and vice-versa. This is well documented from an analysis of pathway data made at the global, regional and national levels (on the basis of the IUCN-ISSG Global Invasive Species Database, the DAISIE European database, and the Great Britain Non-Native Species Information Portal, respectively) presented at the 12th meeting of the CBD COP[5]. For example, the data show that while escape is the highest contribution on introduction of alien species at global, regional and national levels, corridors are a more frequent pathway of introduction in Europe than globally or at the GB scale, due to the high number of marine species arrived into the Mediterranean basin by Lessepsian 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[7]. For example, the pest fruit fly *Bactrocera dorsalis* (syn. *Bactrocera invadens*) appears to have been

5 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

introduced to East Africa from Sri Lanka (Drew et al., 2005). 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.

Other key issues concerning research and management of introduction pathways, namely pathway classification, application of pathway information, management response, and management impact, have been recently discussed by Essl et al. (2015). The importance of IAS introduction 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 species interested, trade routes, and other factors, which might have major implications in terms of management and effective prevention of future invasions (Essl et al. 2015, Saul et al. in prep.).

POLICY AND LEGAL CONTEXT

The importance of the threat of IAS and relevant pathways is reflected in a range of international, regional and national laws and agreements. The objective of this section is not to provide a comprehensive listing of such policy and legislation, but only a brief summary of a selection of the more pertinent tools, including at the European and EU level.

The Convention on Biological Diversity

The international agreements related to invasive alien species are primarily stipulated in Article 8h of the 1992 Convention on Biological Diversity (CBD), which states "*Each contracting Party shall, as far as possible and as appropriate, prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species*". The CBD Articles are legally binding to Parties, thus they are expected to translate Article 8h into the national legislation. In 2002, at the 6th meeting of the CoP to the CBD, a specific Decision VI/23 was adopted. This Decision contains Guiding Principles in its annex to help Parties implement this requirement, and Parties, other Governments and relevant organizations were urged to promote and implement the Guiding Principles. This Decision also urges Parties, other governments and relevant organizations to develop IAS strategies and action plans at national and regional level and to promote and implement the CBD Guiding Principles. The need to identify and manage IAS pathways is explicitly addressed, particularly in relation to the Guiding principle 11, on Unintentional introductions, according to which "*Common pathways leading to unintentional introductions need to be identified and appropriate provisions to minimize such introductions should be in place. Sectoral activities, such as fisheries, agriculture, forestry, horticulture, shipping (including the discharge of ballast waters), ground and air transportation, construction projects, landscaping, aquaculture including ornamental aquaculture, tourism, the pet industry and game-farming, are often pathways for unintentional introductions. Environmental impact assessment of such activities should address the risk of unintentional introduction of invasive alien species. Wherever appropriate, a risk analysis of the unintentional introduction of invasive alien species should be conducted for these pathways*".

At the 10th COP meeting a Strategic Plan for Biodiversity with 20 headline targets for 2020 was set out (Aichi Biodiversity Targets). The mission of the Strategic Plan is to "*take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being, and poverty eradication. To ensure this, pressures on biodiversity are reduced, ecosystems are restored, biological resources are sustainably used and benefits arising out of utilization of genetic resources are shared in a fair and equitable manner; adequate financial resources are provided, capacities are enhanced, biodiversity issues and values mainstreamed, appropriate policies are effectively implemented, and decision-making is based on sound science and the precautionary approach.*"

In this context, Target 9 states: "*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*". This target highlights the importance to ensure a special focus on the management of the introduction pathways of alien species. Specifically,

as report in the Quick guide to the Aichi Biodiversity Targets[6] this target globally requires that pathways are identified in order to be effectively addressed. Depending on ecosystems there are likely to be a number of different pathways for the introduction of alien species. Common pathways are related to transport activities (ballast water, boat hulls and shipping containers), the accidental or intentional introduction of species from agricultural or aquaculture activities and the escape of species from confined conditions which eventually enter a new environment. In most countries there are likely to be several invasive alien species established as well as multiple pathways for the introduction of additional invasive alien species. Major pathways vary between countries; therefore countries will need to well identify them in order to manage such pathways effectively. Given the limited resources that exist to address this threat and the timeframe for the implementation of the Strategic Plan, governments will need to prioritize the pathways, and invasive alien species they wish to address. Once the pathways for the introduction of invasive alien species have been identified and prioritized, actions will need to be taken to prevent the risk of new alien species becoming established.

At its 12th meeting the COP adopted the "*Guidance on Devising and Implementing Measures to Address the Risks Associated with the Introduction of Alien Species as Pets, Aquarium and Terrarium Species, and as Live Bait and Live Food*" (annex to decision XII/16). The guidance is voluntary for Parties, other Governments and relevant organizations, as well as all actors along the value chain of pets, aquarium and terrarium species, and live bait and live food in devising and implementing measures, at national, regional, subregional and other levels, to address the risks associated with the broad range of introduction pathways of the live organisms that are used as pets and others as indicated..

The guidance contains measures for prevention, responsible conducts, risk assessment including risk of escape of live organisms from confined conditions, information sharing and consistency with applicable international obligations, for example, the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) of the World Trade Organization (WTO), and the standard-setting organizations recognized by this agreement, as well as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). With regard to consignments of pet, aquarium and terrarium species, live bait or live food, clear indication of taxa of the commodity and any relevant requirements on confinement, handling and transport should be indicated. The consignments may be labelled as a potential hazard to biodiversity unless the species has been shown to be safe for import to the particular country or biogeographical region within the country in question.

The UNECE Convention on Environmental Impact Assessment in a Transboundary Context (EIA) and Protocol on Strategic Environmental Assessment (SEA)

The Espoo (EIA) Convention sets out the obligations of Parties to assess the environmental impact of certain activities at an early stage of planning. It also lays down the general obligation of States to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries. Since its entry into force in 1997 as a regional instrument under the auspices of United Nations Economic Commission for Europe (UNECE), the Espoo Convention has supported countries to develop national environmental impact assessment (EIA) procedures and has forged international cooperation to prevent, manage and mitigate adverse environmental impacts. A Protocol on Strategic Environmental Assessment (SEA) entered into force in 2010 and the SEA requires its Parties to evaluate the environmental consequences of their official draft plans and programmes. SEA is undertaken much earlier in the decision-making process than project environmental impact assessment (EIA), and it is therefore seen as a key tool for sustainable development. The Protocol also provides for extensive public participation in government decision-making in numerous development sectors. Currently (June 2016) 45 Parties to the Espoo Convention and 28 Parties to the SEA protocol are listed[7]. The Protocol is open for accession by any United Nations member States though the Protocol was developed under the UNECE. There seems to be a potential that the SEA supports countries to make decisions on pathways management, globally.

6 https://www.cbd.int/doc/strategic-plan/targets/compilation-quick-guide-en.pdf
7 http://www.unece.org/env/eia/welcome.html

The IPPC, OIE and WTO standards

There are a number of international organisations and agreements recognising the need to adequately address IAS pathways through standards, guidelines, and recommendations among which the International Plant Protection Convention (IPPC), and the World Organization for Animal Health (OIE), which are recognised as standard-setting bodies within the framework of the World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures (WTO-SPS Agreement).

The OIE maintains Animal Health Codes and early warning systems to prevent the spread of notifiable diseases pathogenic to animals and humans through international trade in animals and to promote animal welfare. Its primary focus is on livestock pathogens but some diseases affecting native wildlife are also listed (e.g. two highly invasive amphibian pathogens). For example OIE has published guidelines to perform pathogen import risk analyses (Chapters 2.1 of both the Terrestrial Animal Health Code[8] and the Aquatic Animal Health Code[9]) and, in cooperation with the IUCN and the Species Survival Commission, has published the Guidelines for Wildlife Disease Risk Analysis[10].

The IPPC aims to prevent spread and introduction of pests of plants and plant products through sanitary and phytosanitary measures, and as such applies primarily to quarantine plant pests in international trade. Pest is a broad enough term to cover IAS threatening plants in the wild environment. The IPPC Commission on Phytosanitary Measures has adopted a number of relevant International Standards for Phytosanitary Measures (ISPMs) – many of which are explicitly listed among the guidance document for the management of the target pathways (see below) – with the objective to harmonise the measures to be taken at the national, although decision making is decentralised to country level. Further to a formal cooperation with the CBD, the IPPC has explicitly addressed the risk of IAS impact on biodiversity when developing or revising standards to address pathway and vector risks in pest risk analysis (PRA). The European and Mediterranean Plant Protection Organization (EPPO) is an IPPC regional plant protection organisation and develops regional phytosanitary measures, including a dedicated work programme and expert panel for invasive alien plants.

Guidelines on ballast water management and biofouling

The International Convention for the Control and Management of Ships' Ballast Water and Sediments (the Ballast Water Management Convention, BWM) is one of the most substantial measures introduced to regulate an introduction pathway on environmental grounds. This convention - adopted only in 2004 - aims at reducing the impact of IAS introduced as stowaways in the marine environment, by regulating the treatment of ballast water. Nevertheless it remains yet unratified (the entry into force will be 12 months after ratification by 30 States, representing 35% of world merchant shipping tonnage, but as of June 2016, 51 Member States ratified the BWM Convention representing less than 34.87% of the tonnage). These delays reflect the difficulty and complexity of implementing international, legally binding pathway policies (see Essl et al. 2015). Several articles and regulations of the Ballast Water Management Convention refer to a very significant volume of guidelines and other supporting instruments to the Convention developed by the Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO), a specialized agency of the United Nations (required guidelines have been developed since some time now and we do currently have).

The Guidelines on biofouling set by the IMO represent another set of recommendations of particular interest in this context. Biofouling is the accumulation of various aquatic organisms on ships' hulls. The 2011 Guidelines for the Control and Management of Ships' Biofouling to minimize the transfer of invasive aquatic species (resolution MEPC.207(62)), are supplemented by the 2012 guidance for minimizing the transfer of invasive aquatic species as biofouling (hull fouling) for

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8 http://www.oie.int/international-standard-setting/terrestrial-code/access-online/

9 http://www.oie.int/international-standard-setting/aquatic-code/access-online/

10 World Organisation for Animal Health (OIE) & International Union for Conservation of Nature (IUCN) (2014). – Guidelines for Wildlife Disease Risk Analysis. OIE, Paris, 24 pp. Published in association with the IUCN and the Species Survival Commission.

recreational craft (MEPC.1/Circ. 792). To improve the way that the risks related to this pathway are addressed as scientific and technological advances are made, the guidelines may be further refined according to the Guidance for evaluating the 2011 guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species (MEPC.1/Circ.811).

Another example of relevant voluntary guidance, jointly developed by the International Maritime Organization (IMO), the International Labour Organization (ILO) and the United Nations Economic Commission for Europe (UNECE), is the 2014 Code of Practice for Packing of Cargo Transport Units[11] (CTU Code), which addresses the handling and packing of cargo transport units for transportation by sea and land through a non-mandatory global code of practice.

The Bern Convention

In 2003 a specific strategy to deal with Invasive Alien Species at the European level (Genovesi and Shine 2004) was adopted by the Council of Europe. The *European Strategy on IAS* – as it will be called hereafter - is aimed at providing guidance to help Bern Convention Parties in their efforts to identify and prioritise key actions to be implemented at the national and regional level. The identification of priority pathways and their management is indeed a key action to prevent the introduction of new IAS into and within Europe. It also supports the implementation of early warning and rapid response systems to detect new incursions.

More in detail, for "Strengthening national policy, legal and institutional frameworks" in relation to the pathways and vectors, the *European Strategy on IAS* has explicitly identified the need to "Develop action plans to address specific problems identified e.g. for priority IAS, pathways and vectors, vulnerable sites, ecosystems, etc." (see action 3.3.2.). The aim is for Parties to "have specific strategies and action plans in place to address all aspects of IAS prevention and mitigation". In fact the *European Strategy on IAS* also highlights the need for "Subregional co-operation" at the European level according to which Parties should "Promote dialogue between countries, sectors and key institutions in the same subregion, where not already established, to harmonise strategic direction and develop common approaches to shared IAS pathways and problems" (Genovesi and Shine 2004).

The European Strategy on IAS is only one of the main products of the specialised "Group of experts on Invasive Alien Species" established in 1992 by the Standing Committee to the Bern Convention. In fact, in addition to regularly monitor the implementation of the IAS Strategy, since 2009 the Group has focussed its work on the identification and prioritisation of pathways, and started preparing targeted Codes of Conduct to address these. So far the Standing Committee has endorsed Codes of Conduct on IAS and activities such as horticulture, zoos and aquaria, botanic gardens, hunting, pets or recreational fishing. Other codes are under development, including on plantation forestry and recreational boating. These codes of conduct are a useful tool for increasing awareness on the impact of IAS and federating the efforts of a wide range of stakeholders (including the business sector) through voluntary, sound and specific measures.

The following recommendations refer to the codes formally adopted by the Standing Committee to the Bern convention:

- Recommendation No. 170 (2014) on the European Code of Conduct on Recreational Fishing and Invasive Alien Species;
- Recommendation No. 166 (2013) on the European Code of Conduct on Hunting and Invasive Alien Species;
- Recommendation No. 161 (2012) on the European Code of Conduct for Zoological Gardens and Aquaria on Invasive Alien Species;
- Recommendation No. 160 (2012) on the European Code of Conduct for Botanic Gardens on Invasive Alien Species;
- Recommendation No. 154 (2011) on the European Code of Conduct on Pets and Invasive Alien Species;

[11] http://www.imo.org/en/OurWork/Safety/Cargoes/CargoSecuring/Pages/CTU-Code.aspx

- Recommendation No. 134 (2008) on the European Code of Conduct on Horticulture and Invasive Alien Plants.

Another recommendation, although not related to a code of conduct, is worth being mentioned for the importance on the topic targeted by this document:

- Recommendation No. 141 (2009) on potentially invasive alien plants being used as biofuel crops.

The value of such tools is widely recognised by a number of other international organisations. For example, at its last meeting in December 2014 the Standing Committee of the Bern Convention welcomed very much the EU intervention on IAS (see text below) and invited the Secretariat to explore, in coordination with the European Commission, possible initiatives of work in the field. This was further formalised through Recommendation N°179 (2015) on action to promote and complement the implementation of EU Regulation 1143/2014 on invasive alien species. Indeed there are interesting innovations in the EU Regulation on IAS that could be of use for Non-EU states - through the Bern Convention - and also some work (particularly on pathways, information systems or other) that could be planned together.

In particular, according to Recommendation N°179 (2015) the Standing Committee of the Bern Convention noted that important contributions could be made through technical work, including the development of guidance, in coordination with the European Commission and other relevant bodies as appropriate, regarding several aspects of the implementation of Regulation 1143/2014, including:

- assistance with the performance of risk assessments in accordance with Article 5 of the Regulation,
- guidance on the identification of priority pathways and the design of priority pathway action plans, as required under Article 13 of the Regulation,
- guidance on the design and operation of the surveillance systems required under Article 14 of the Regulation,
- guidance concerning the restoration of ecosystems impaired by invasive alien species in accordance with Article 20 of the Regulation, and
- the enhancement of the information support system operating under Article 25 of the Regulation.

This justifies the present work, aimed at providing to Member States some guidance document on how to draft, establish and implement action plans in a coordinated way by end of 2016 (by that time also the list of species of Union concern might be available, thus allowing a more specific approach if required).

The EU Regulation no. 1143/2014 on Invasive Alien Species

As a follow up of the *European Strategy on IAS*, some European countries have been developing their own national strategies, including the related legal and technical tools for implementation. In this context, also the EU has recently adopted a dedicated legislation. The EU Regulation on IAS is actually one of the greatest achievements in line with the ambitious Communication from the Commission "Our life insurance, our natural capital: an EU biodiversity strategy to 2020" (COM(2011) 244) adopted by the European Commission in 2011 to halt the loss of biodiversity and ecosystem services in the EU by 2020. The 'EU Biodiversity Strategy to 2020' contains six main targets, and 20 actions to help the EU to reach this goal. In fact "*this strategy proposes filling this gap with a dedicated EU legislative instrument which could tackle outstanding challenges relating inter alia to IAS pathways, early detection and response and containment and management of IAS*". In particular, according to Target 5 "*By 2020, Invasive Alien Species and their pathways are identified and prioritised, priority species are controlled or eradicated, and pathways are managed to prevent the introduction and establishment of new IAS*".

The EU Regulation on IAS entered into force on 1st January 2015. This Regulation is based on the CBD Guiding Principles of prevention, prioritisation and coordination and seeks to address the problem of IAS in a comprehensive manner. The objective is to protect native biodiversity and ecosystem services, as well as to minimize and mitigate the human health or economic impacts that

these species can have. The core of the system is an open "list of IAS of Union concern" for which a general ban from the EU, including introduction, transport, trade, keeping, breeding and release into the environment, is established (but the regulation also provides for a system of authorizations and permits to allow certain activities based on IAS). Not only article 7 restrictions apply, but also all other obligations, notification and rapid eradication or management. However, not all obligations will always apply to all listed species: if a given species is not traded, then the trade ban will not apply – but should the same species become a new traded commodity, then the ban on its trade will apply. Similarly, if a species is absent from a MS, then that MS will not have a management obligation, simply because that species is not there. However, should that species suddenly appear then that MS will have to notify and apply a rapid eradication measure? If this fails, the management obligation will apply.

The list, which is currently being developed by the EC through discussion with Member States, shall be based on risk assessments which satisfy certain conditions set out under Article 5(1) of the Regulation (e.g. see also Roy et al. 2014) and should be regularly updated and reviewed at least every six years. The decision process basically relies on a Committee composed by representatives from Member States, and a "Scientific forum" composed of representatives of the scientific community nominated by the Member States with the role of providing advice. The Scientific Forum meets once or more times a year and provides an opinion on each risk assessment, amongst other tasks.

Member States shall establish within 18 months a surveillance system for IAS of Union concern, and will be obliged to notify new incursions, and to immediately apply eradication (within 3 months after alert notification), when feasible and not disproportionally costly. Additionally, within 18 months Member States shall have in place effective management measures for IAS of Union concern that are widespread in their territory. Effective structures for official controls (border controls, goods entry points) should be already fully functioning.

The EU regulation on IAS includes some innovative pathways-related provisions, such as the provisions of art. 13, according to which "*Member States shall, within 18 months of the adoption of the Union list carry out a comprehensive analysis of the pathways of unintentional introduction and spread of invasive alien species of Union concern*" and "*Within three years of the adoption of the Union list, each Member State shall establish and implement one single action plan or a set of action plans to address the priority pathways*".

To this regard see also art. 11 on IAS of regional concern native to a Member State, and art. 22 on cooperation and coordination in relation to species of Member States concern. As pointed out by Essl et al. (2015) the near-abolition of border inspections between EU countries will be a major challenge for regulating these pathways. Nevertheless, the Regulation represents a significant improvement in the coordination, implementation, and consistency of pathway management across the EU.

Also, the EU Regulation on IAS foresees that all risk assessments for the identification of the species of Union concern include a description of the main pathways (art.5). To be noticed that the list of IAS of Union concern does not cover IAS that are native to some parts of the Union but invasive to others, but the Regulation provides Member States with the possibility to develop lists of IAS of Member State concern, applying stringent measures to regulate them (see art.23). The Regulation allows Member State to identify, from their national list of invasive alien species of Member State concern, species native or non-native to the Union that require enhanced regional cooperation. Such regional cooperation will be facilitated by the EC.

Other relevant "mild" obligations are also foreseen for Member States, including the requirement to enhance cooperation at the international scale. For example, Member States shall make every effort to ensure coordination with other concerned states, when practical and appropriate, and shall endeavour to cooperate with third countries. Additionally, Member States should ensure coordination and cooperation for what concerns action plans on pathways, exchange of best practices on management, and public awareness programs. Effective communication and engagement of the society are indeed key elements for an effective implementation of the regulation.

The EU Regulation does not foresee any specific financial mechanisms to support its implementation, and explicitly encourages the application of the Polluter Pays Principle. Furthermore, Member States must provide for penalties if the regulation is not correctly applied. By the way, some source of funding for the implementation of the relevant activities may be available from the EU, e.g. in relation to the potentialities of the LIFE programme, which will soon include also indicators for monitoring the project performances, including a set of indicators on IAS and their pathways (see for example the 2015 call of preparatory projects[12] specifically dedicated to IAS risk assessments). Also other EU financing instruments can provide funding for the implementation of the IAS policy, such as rural and regional development funding, as well as research funding.

Examples of other regional and national policies and legislations

Examples of effective policy and legislation on IAS pathways are available for some countries and regions. For instance, in New Zealand the Biosecurity Act 1993 explicitly foresees the realization of national and regional pathways management plans. Sections 79 to 100 are particularly relevant and can be of interest for inspiration to similar policy initiatives. In New Zealand, the implementation of regulations towards specific IAS pathways was considered to be connected with the subsequent decrease in numbers of IAS (Rabitsch et al. 2013).

Similarly, in Japan, the adoption of the Invasive Alien Species Act, enforced since 2005, resulted on the immediate decrease in the number of imported specimen, that has been of 47.3% of mammals, 70.8% for birds, 38% for reptiles, 84.2% or amphibians, and 11.5% for ornamental fish (Goka 2010, Goka et al. 2008, Mizutani & Goka 2010).

Also in Australia, consistently with the national and state government policy on existing biosecurity regime, a number of practical and effective ways of dealing with the problem of IAS pathways are considered (see the 2007 Invasive Alien Species Matrix[13]).

In the European Union, it seems that the Regulation (EC) No 708/2007 of 11 June 2007 concerning use of alien and locally absent species in aquaculture, had a clear impact in the incidence of new aquaculture-related introductions in Europe, which has clearly declined, suggesting the effectiveness of management measures (Essl et al. 2015, Katsanevakis et al. 2013).

At the country level, the GB Invasive Non-native Species Strategy (Defra et al. 2015), calls for the development of Pathway Action Plans for priority pathways of introduction of Invasive non-native (alien) species (INNS), to be developed in partnership with relevant stakeholders (Key Action 3.3 of the GB Strategy). The first example of these Pathway Action Plans, is the Zoos Pathway Action Plan[14], which was developed on the basis of the Council of Europe's Code of Conduct on Zoos and Aquaria.

Other countries have legislation in place addressing the problem of IAS pathways, for example in relation to the pet trade and the consequent release of exotic animals released/dumped into the wild by owners who are no longer able or willing to care for their pets. In fact to prevent this problem Positive (white) Lists of mammal species (including only those that can be sold and kept as pets) have been adopted in Belgium (Royal Decree, 2009) and the Netherlands (Ministerial Decree nr. WJZ/15008282, 2015). According to the precautionary principle (as set forth in principle 15 of the 1992 Rio Declaration on Environment and Development and in the preamble of the CBD) and based on sound risk assessments, this kind of legislation may ensure that only species that cannot become invasive can be traded as pets. The positive list is a preventive model at its core: it is meant to address the exotic pets' pathway avoiding all these potential and not always predictable problems due to the spread of IAS (such as transmission of diseases, disruption of habitats, hybridisation and competition with indigenous species). The positive list approach has received support from the European Court of Justice (Andibel ruling, 2008)

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12 http://ec.europa.eu/environment/life/funding/life2015/index.htm#preparatory

13 Invasive Alien Species Matrix https://www.cbd.int/doc/submissions/ias/ias-au-2007-en.pdf

14 see http://www.nonnativespecies.org/index.cfm?sectionid=135

A useful tool with examples of opportunities for enhancing cooperation among the biodiversity-related conventions at national and regional levels is the Sourcebook published by UNEP (2015).

GUIDELINES FOR IAS PATHWAYS ACTION PLANS

An ideal action plan for IAS pathways should contain the following sections:

- Description of the target pathway.
- Policy and legal background.
- Aims and strategies.
- Identification of key stakeholders.
- Foreseen measures.
- Time schedule.
- Financial planning.

It is clear, however, that the structure proposed above should be considered flexible enough to allow for different types of pathways.

For clarity purposes, it is advisable to draft a single plan for each pathway, even though there are connections and interactions between different (multiple) pathways. As the focus of an action plan should be on single pathways, even if some target species of special concern may benefit from addressing different pathways, it is advisable to draft one single plan for each relevant pathway.

The text of the full plan should be kept as concise and **s**imple as possible, and at the same time comprehensive and exhaustive. The language should be clear, precise, and easily understandable, possibly also by the laypeople and the general public (the risk to fall into specialist jargon should be definitely avoided). The plan should be written in full sentences, without any abbreviations unless necessary (too many unfamiliar abbreviations can make a document incomprehensible). For the same reason the use of metaphors, parallelisms, "artistic" comments should be avoided. The vocabulary should be carefully selected, e.g. by going for simple, straightforward phrasing, and vague statements (sentences starting with terms such as "may be", "seems to" or "appears") should be limited as much as possible, as they may give the impression of the plan being based on poor knowledge and generic expertise. In relation to this, to ensure the use of best available data and data sources, it is recommended that all references are always explicitly mentioned in the plan.

Pre-planning phase

A specific Pre-planning phase should always be considered. This phase is very important for the organisation of the process leading to the definition of a comprehensive plan. The pre-planning phase is important for the whole management of the process, and as such requires the definition of a planning team with the appropriate skills and expertise to be established under the responsibility of the Member States authorities. The selection of the planning team is therefore a fundamental step to ensure the successful development of the plan, hence the professional profiles and functions to be covered have to be carefully evaluated depending on the working language(s), the target pathways, the objectives of the plan, the resources available, etc.

The following aspects should be taken into account during the pre-planning phase:

- A checklist of subjects to be considered;
- Time-table and milestones of the planning process;
- Data gathering and administration;
- Data availability and access (and major knowledge/information gaps);
- Analysis of the information and its quality;
- Analysis of the benefits and costs of the plan (including an analysis of risks);

- Assessment of anticipated costs of implementing the plan and relevant funding sources;
- Facilitation of the planning process;
- Drafting of documents;
- Editing and technical improvement of the documents;
- Initial identification of relevant stakeholders (it can determine the approach to follow on the further development of the plan as regards their involvement and consultations);
- Identification of persons and stakeholders who would be affected by the plan either positively or negatively (including an assessment of extent of relevant problems);
- Identification of consultation and coordination requirements (e.g. including with stakeholders);
- Consultation methods (including timing);
- Partnership approach and ownership of the plans (whether other actor and stakeholders should be involved in the development of the plan);
- Coordination at international level (it is important that plans developed in different countries for the same pathway are consistent).

In principle, the pathways action plans should be as specific as possible and very focused in their recommendations so as to be used as blueprints for pathway management to be implemented directly by the competent authorities and local stakeholders, if appropriate.

Description of the target pathway

In this section, all available key information on the target pathway in the country (as well as within the broader region) should be described and discussed. A spatio-temporal analysis of the data aimed at highlighting recent trends should be included too (either in the target countries or in other countries). As far as possible it is important to add all available quantitative details, particularly about the situation which the pathway action plan is starting from. A clear baseline against which to measure the impact of the measures foreseen is needed to assess the efficacy of the plan. Therefore, if no sufficient baseline information regarding the impact of the pathway is available, it is important to consider the collection of the relevant data and their analysis within a dedicated preparatory measure to be included in the plan.

In particular, the following points should be considered:

- Analysis, assessment and discussion of impact and risks of associated IAS (most data should be available from the studies leading to the prioritisation of the target pathway);
- Identification of the problems to be addressed by the plan (e.g. species or habitats of conservation concern being threatened, possibly including transmission of pathogens and diseases);
- Evaluation of the data needed for the identification of the best management options;
- Available data sources (discussion of limits and potentialities of each);
- Knowledge of the key gaps and inconsistencies in the information available (suggestions for future research themes to promote);
- Discussion of socio-economic data related to the target pathways and the associated human activities (the action plan should be sensitive to local traditions).

This section is about the quality of the information available about the problem related to the specific pathway targeted. For the development of a scientifically based action plan, the availability of comprehensive, updated and reliable source of information is pivotal. Given the primary importance of the use of the best available data, the data collection procedures should be described and if possible standardised. For example, the quality of the data sources should be discussed too, e.g. by assessing

the level of confidence of the information reported. To this regard, it is worth assessing the limits and potentialities of EASIN as the reference Information support system in relation to the implementation of the EU Regulation on IAS (art.25) as well as any other key source of data, such as GISD, DAISIE, NOBANIS, etc.

The analysis of data should be facilitated by the interchange of standardised data between European countries, including from the EU Member States and beyond, and could benefit from the extrapolation of data from other regions.

An advanced standardisation of the way that pathways are identified, prioritised, and managed (including the way that relevant data are collected, stored and analysed) would definitely favour the implementation of the pathways action plan.

Policy and legal background

This section should include a clear reference to all relevant legislation/policy, and an exhaustive discussion of the provisions which would be affected by the implementation of the pathway action plan. The primary users of the plan are the relevant Member States environmental authorities to whom the plan is needed to clarify the means to manage IAS pathways and fulfil their obligations under the relevant policy and legislation as appropriate.

For this reason, the analysis of the relevant legislation at the global, regional, national and local levels, should be made with the objective to ensure the sound implementation of the pathway action plan.

In fact it is necessary to guarantee that the pathway action plan is fully compatible with the plans of other bodies, e.g. by integrating the roles of the relevant statutory bodies, and of course by properly involving all competent authorities.

In particular it is recommended to provide a detailed description of the following information:

- Policy and legal background (at the global, regional, national and local level, as appropriate);
- Process and procedures for development, approval, review and revision of the pathway action plan (including a discussion of strengths and weaknesses of the current provisions, as well as suggestions for improvements);
- Pathway management responsibilities (a clear review of all competent authorities acting at the appropriate level). This point should provide a clear answer to the basic question: who is the pathways action plan written for?

Aims and strategies

The overall objective(s) of the pathway action plan, along with the specific objectives of each single measure, should be always clearly identified and explicitly discussed. The ultimate objective of an IAS pathway action plan is obviously the sound implementation of the relevant IAS related policy and legislation, such as the European strategy on IAS, the EU Regulation on IAS, or any other relevant national legislation. Yet, a more clear and detailed identification of the objectives will help the planning and design of the most appropriate measures to ensure the prevention of further introductions of alien species and invasive alien species through the target pathway (and solving or at least mitigating the associated problems).

In general, aims and objectives should be:

- Quantified, clear and consistent, without ambiguity;
- Achievable within a given timeframe (inclusive of both long-term and short-term goals);
- Realistic in the context of available resources and finance;
- Understandable by policy makers, decision takers, stakeholders, target audience, general public, etc.

- Possibly (at least partly) negotiable with the key stakeholders, and if appropriate with the general public too (e.g. a formal system of appeal against elements in a plan may be considered).

The objectives should be part of a clear and consistent logical framework, which the effectiveness of the entire plan will depend on (aims can be more ambitious provided the relevant strategies are clear). For example, the link between the (threat from the) target pathway and the objectives, the measures planned and the expected results in relation to the identified **impact**, should be clear and logical. For this purpose the following logical steps should be considered:

- The identification of sound and realistic **objectives** is facilitated by the sound and comprehensive description of the target pathway.
- The **impact** of the target pathway is sufficiently known and the present situation is described in such a way (or will be promptly studied and analysed, as appropriate) that it will be later possible to compare the situation further to the implementation of the plan by way of measurable indicators (if possible).
- The full spectrum of **measures** that will enable the achievement of (all) the objectives are well defined and quantified. The measures should all be necessary, and their scope and scale clearly justified.
- The **results** to be achieved through the implementation of the full plan, as well from the single measures, should be clearly described and well defined in terms of progress towards preventing further alien species introductions through the target pathway (thus in relation to the set objectives). The expected results should also be concrete, realistic and possibly quantified (particular attention should be given to avoid that results are formulated as a repetition of the actions foreseen and/or the objectives).
- The **stakeholders** to be involved in the implementation of the foreseen measures, and/or from whom to gain support for the implementation of the plan, are well defined and justified (reasons why they are relevant for addressing the problem linked to the target pathway should be clearly identified).
- The performance **indicators** that will enable to measure the success of the plan are well defined. These indicators must be regularly monitored and evaluated during the implementation of the plan.
- In principle, the plan should be designed so as to ensure that the proposed measures are sustainable and that continuity and permanence of the relevant results are ensured. To this purpose, the plan should optimise the benefits both for nature conservation and for the involved/affected stakeholders. Furthermore, the plan should include all other goals for IAS pathways-related management (e.g. including transferability and replicability of the plan and its results, awareness raising).

Identification of key stakeholders

Ideally a pathway action plan should be useful to address and possibly involve directly all stakeholders whose actions may support the implementation of the plan and contribute to preventing the (unintentional) introduction of alien species through the target pathway. In fact in many cases it is likely that environmental authorities alone cannot achieve the goals of the plans without the direct involvement of the key stakeholders (entities, organisations, authorities, persons, groups of persons etc. that have an interest in the targeted pathway, including landowners and land managers).

Thus the plan should be drafted taking into account that it can be a useful tool for such stakeholders for the purpose of informing and empowering their own policies and actions, including as guidance for their prioritisation and planning of activities.

All relevant stakeholders should be precisely identified and defined (both qualitatively and quantitatively). To this purpose the name and role of each main stakeholders should be provided. Given the fundamental role of their support and involvement, it is important to avoid describing the

stakeholders only in terms of broad categories. For example, the precise identification of stakeholders can help planning in detail the activities required for their proper involvement and consultation, which in fact should be always ensured among the key measures of the plan.

The opportunities and need to involve some stakeholders through their active participation in the implementation of the plan should also be taken into account. In fact the plan shall foresee appropriate actions to guarantee the direct involvement of well-identified and appropriate stakeholders in the implementation of relevant measures, including landowners and land managers. To verify whether the plan is involving (all) the right stakeholders, it would be useful to briefly discuss why involving them would ensure the sound implementation of the foreseen measures and of the plan as a whole.

Foreseen measures

The plan should provide a clear explanation of what measures need to be carried out and what technical and financial means will be utilised to reach the objectives indicated. It is important to ensure that there is a clear link between the proposed measures and the plans' objectives, and that all the proposed measures are actually necessary to reach the objectives. Any measure not directly contributing to the achievement of the set objectives should be not considered as part of the plan.

The foreseen measures should be always concrete and practical, and the reason behind their identification should always be transparent in order to link without doubts to the relevant impacts (why are they needed?) and the objectives (what are they planned for?). The description of the proposed measures should be clear, concise, unambiguous and self-comprehensible, possibly without any need to further reference documents. Also, an exhaustive description should be included for each measure regarding what exactly will be done, how this will be done, where and by whom.

The measures to be implemented should also be prioritized in order of importance, as appropriate, and should be listed by order of their starting date. In particular, two sets of measures are to be considered:

A. specific measures depending on the IAS pathway targeted;
B. common measures for all management/action plan for IAS pathways.

As described in detail in a next section, the measures to be considered common to all pathways (thus to be included in any management/action plan for pathways) include:

- Management of the plan
- Preparatory actions
- Consultation with key stakeholders
- Monitoring the progress of the measures
- Monitoring the success of the plan
- Surveillance
- Review and revision of the plan
- Communication and awareness raising activities

Data about timing of the foreseen measures (start date, duration, etc.), and budget (required resources, available funding sources, etc.) should also be clearly defined and discussed.

A. *Specific measures depending on the IAS pathway targeted*

This section is about the core actions planned in relation to each specific target pathway, and should include a discussion of the difficulties and technical constraints, which might affect their implementation, along with the appropriate contingency plans to overcome the relevant risks.

The measures to be planned largely depend on the target pathways and the specific context (geographic, socio-economic, etc.), therefore they will not be described in detail. Yet, some examples of relevant documents to be taken into account at this stage are provided. Some of the measures which

could be appropriate for the different pathways are already summarised in the mentioned CBD document UNEP/CBD/SBSTTA/18/9/Add.1. They are reported below - and duly integrated with further references to best practices and other guidance documents - under the headings of the main six main groups of target pathways: Release; Escape; Transport-Contaminants; Transport-Stowaway; Corridors; and Unaided (natural dispersals).

The following Standards by the International Plant Protection Convention[15] are common to all pathways:

- ISPM 1: 2006. Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade (originally adopted in 1993, revised in 2006);
- ISPM 2: 2007. Framework for pest risk analysis (originally adopted in 1995, revised in 2007);
- ISPM 4: 1995. Requirements for the establishment of pest free areas;
- ISPM 5: 2012. Glossary of phytosanitary terms (updated as needed)
  - Supplement 2 *Guidelines on the understanding of potential economic importance and related terms including reference to environmental considerations* (2003)
  - Appendix 1 *Terminology of the Convention on Biological Diversity in relation to the Glossary of phytosanitary terms* (2009)
- ISPM 6: 1997. Guidelines for surveillance;
- ISPM 11: 2013. Pest risk analysis for quarantine pests (originally adopted in 2001, revised in 2004 and 2013);
- ISPM 14: 2002. The use of integrated measures in a systems approach for pest risk management;
- ISPM 17: 2002. Pest reporting;
- ISPM 18: 2003. Guidelines for the use of irradiation as a phytosanitary measure;
- ISPM 19: 2003. Guidelines on lists of regulated pests;
- ISPM 21: 2004. Pest risk analysis for regulated non quarantine pests;
- ISPM 22: 2005. Requirements for the establishment of areas of low pest prevalence;
- ISPM 28: 2007. Phytosanitary treatments for regulated pests;
- ISPM 32: 2009. Categorization of commodities according to their pest risk;
- ISPM 34: 2010. Design and operation of post-entry quarantine stations for plants;
- ISPM 36: 2012. Integrated measures for plants for planting.

The same general validity across all pathway categories applies to the OIE Guidelines for assessing the risks of non-native animals becoming invasive.

In this context is worth mentioning that a key document is also represented by "The Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that threaten Ecosystems, Habitats and Species" (the Guiding Principles) annexed to decision VI/23* of the CBD, which provide all Governments and organizations with guidance for developing effective strategies to minimize the spread and impact of invasive alien species. In particular, the Guiding Principles highlight the importance of identifying pathways of introduction of invasive species in order to minimize such introductions, and call to assess the risks associated with such pathways.

Here follows a description of the measures to be considered for each of the pathway's category and subcategory listed in the document UNEP/CBD/SBSTTA/18/9/Add.1.

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15 https://www.ippc.int/en/core-activities/standards-setting/ispms/

- *Release in Nature*

The management of the deliberate release pathway may require to be regulated by specific legislation and supported by the implementation of best practices and other voluntary tools, such as codes of conduct and other guidance documents. As for other pathways, management of the release pathway may require cooperation of key stakeholders and the support of the general public.

In general, in order to minimise the risk of invasiveness, a release should be backed up by a dedicated risk assessment. A review of the international standards for risk assessment methodologies is available in Roy et al. (2014). The study was aimed at the identification of the minimum standard criteria for risk assessment in accordance to the EU Regulation on IAS, which in fact are a good and comprehensive basis for risk assessments to be considered for evaluating the impact of alien species released in nature.

The release of species for initiatives related to assisted colonization (also known as assisted migration or managed relocation) should be duly considered in this context (see Hulme 2015).

A selection of key guidance documents for each pathway category is provided below (in addition to the ISPM documents already mentioned above).

Biological control	IUCN Guidelines for Reintroductions and Other Conservation Translocations ISPM 3: 2005. Guidelines for the export, shipment, import and release of biological control agents and other beneficial organisms (originally adopted in 1996, revised in 2005);
Erosion control/ dune stabilization (windbreaks, hedges, …)	
Fishery in the wild (including game fishing)	FAO Technical Guidelines for Responsible Fisheries No. 13 on recreational fisheries Bern Convention Recommendation No. 170 (2014) on the European Code of Conduct on Recreational Fishing and Invasive Alien Species
Hunting in the wild	Bern Convention Recommendation No. 166 (2013) on the European Code of Conduct on Hunting and Invasive Alien Species
Landscape/flora/fauna "improvement" in the wild	IUCN Guidelines for Reintroductions and Other Conservation Translocations
Introduction for conservation purposes	IUCN Guidelines for Reintroductions and Other Conservation Translocations
Release in nature for use (other than above, e.g., fur, transport, medical use)	IUCN Guidelines for Reintroductions and Other Conservation Translocations
Other intentional release	IUCN Guidelines for Reintroductions and Other Conservation Translocations

- *Escape from confinement*

Similarly to the previous one, the management of this pathway requires that the risk of escape of an alien species is properly assessed, along with the relevant consequences. The risk assessment has to demonstrate that such risk is not significant and that the relevant species is not invasive). The management of the escape pathway requires strong involvement and support from the relevant stakeholders, and also in this case the role of the general public is pivotal to ensure the prevention of further introductions.

Agriculture (including Biofuel feedstocks)	Bern Convention Recommendation No. 134 (2008) on the European Code of Conduct on Horticulture and Invasive Alien Plants Bern Convention Recommendation No. 141 (2009) on potentially invasive alien plants being used as biofuel crops ISPM 25: 2006. Consignments in transit; ISPM 21: 2004. Pest risk analysis for regulated non-quarantine pests;
Aquaculture / mariculture	Standards by FAO (a) Fisheries and Aquaculture Technical Paper 519/1, "Understanding and applying risk analysis in aquaculture"; (b) Technical Guidelines for Responsible Fisheries: • No. 13. Recreational Fisheries; • Aquaculture development No. 2. Precautionary approach to capture fisheries and species introductions. • Aquaculture development. 4. Ecosystem approach to aquaculture; • Aquaculture development. 5. Use of wild fish as feed in aquaculture; • Aquaculture development 6. Use of wild fishery resources for capture-based aquaculture. ISPM 25: 2006. Consignments in transit; ICES Code of Practice on the Introduction and Transfer of Marine Organisms.
Botanical garden/zoo/aquaria (excluding domestic aquaria)	Bern Convention Recommendation No. 161 (2012) on the European Code of Conduct for Zoological Gardens and Aquaria on Invasive Alien Species Bern Convention Recommendation No. 160 (2012) on the European Code of Conduct for Botanic Gardens on Invasive Alien Species ISPM 25: 2006. Consignments in transit;
Pet/aquarium/terrarium species (including live food for such species)	CBD decision XII/17 Management of risks associated with introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food, and related issues. Bern Convention Recommendation No. 154 (2011) on the European Code of Conduct on Pets and Invasive Alien Species ISPM 25: 2006. Consignments in transit;
Farmed animals (including animals left under limited control)	ISPM 25: 2006. Consignments in transit;
Forestry (including reforestation)	Bern Convention Code of conduct on Plantation Forestry and IAS: T-PVS/Inf(2015)01 ISPM 25: 2006. Consignments in transit;
Fur farms	ISPM 25: 2006. Consignments in transit;
Horticulture	Bern Convention Recommendation No. 134 (2008) on the European Code of Conduct on Horticulture and Invasive Alien Plants ISPM 25: 2006. Consignments in transit;
Ornamental purpose other than horticulture	Bern Convention Recommendation No. 134 (2008) on the European Code of Conduct on Horticulture and Invasive Alien Plants ISPM 25: 2006. Consignments in transit;
Research and ex-situ breeding (in facilities)	ISPM 25: 2006. Consignments in transit;
Live food and live bait	CBD decision XII/17 Management of risks associated with introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food, and related issues. ISPM 25: 2006. Consignments in transit;
Other escape from confinement	ISPM 25: 2006. Consignments in transit; IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units: 2014

- *Transport – Contaminant*

The contaminant pathway is closely related to the regulation of international trade, therefore its management is strictly dependent on the international standards, which play an important role in ensuring the prevention of alien species introductions (e.g. through border controls and quarantine procedures) while avoiding any unnecessary and undue trade disruption. However, important gaps exist in this context, which in fact the pathways management plans should address as effectively as possible. Examples of important gaps in border regulations concern the pathogens and parasites contaminants imported and disseminated through the wild pet trade, which are recognized as a significant factor in the emergence and spread of zoonotic diseases (see Hulme 2015).

Contaminant nursery material	ISPM 25: 2006. Consignments in transit;
Contaminated bait	CBD decision XII/17 Management of risks associated with introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food, and related issues. ISPM 13: 2001. Guidelines for the notification of non-compliance and emergency action. ISPM 25: 2006. Consignments in transit; ISPM 33: 2010. Pest free potato (*Solanum* spp.) micropropagative material and minitubers for international trade.
Food contaminant (including of live food)	CBD decision XII/17 Management of risks associated with introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food, and related issues. ISPM 28: 2007. Phytosanitary treatments for regulated pests; ISPM 30: 2008. Establishment of areas of low pest prevalence for fruit flies (Tephritidae); ISPM 25: 2006. Consignments in transit; OIE Aquatic Animal Health Code, OIE Manual of Diagnostic Tests for Aquatic Animal, OIE Terrestrial Animal Health Code; OIE Manual of Diagnostic Tests for Terrestrial Animals
Contaminant on animals (except parasites, species transported by host/vector)	CBD decision XII/17 Management of risks associated with introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food, and related issues. OIE Aquatic Animal Health Code, OIE Manual of Diagnostic Tests for Aquatic Animal, OIE Terrestrial Animal Health Code; OIE Manual of Diagnostic Tests for Terrestrial Animals ISPM 25: 2006. Consignments in transit;
Parasites on animals (including species transported by host and vector)	CBD decision XII/17 Management of risks associated with introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food, and related issues. OIE Aquatic Animal Health Code, OIE Manual of Diagnostic Tests for Aquatic Animal, OIE Terrestrial Animal Health Code; OIE Manual of Diagnostic Tests for Terrestrial Animals ISPM 25: 2006. Consignments in transit; ISPM 25: 2006. Consignments in transit; Bern Convention Draft Recommendation No. xx/2015 on the prevention and control of the *Batrachochytrium salamandrivorans* chytrid fungus
Contaminant on plants (except parasites, species transported by host/vector)	ISPM 13: 2001. Guidelines for the notification of non-compliance and emergency action. ISPM 21: 2004. Pest risk analysis for regulated non-quarantine pests; ISPM 25: 2006. Consignments in transit; ISPM 31: 2008. Methodologies for sampling of consignments. ISPM 33: 2010. Pest free potato (*Solanum* spp.) micropropagative material and minitubers for international trade. ISPM 36: 2012. Integrated measures for plants for planting.

Parasites on plants (including species transported by host and vector)	ISPM 13: 2001. Guidelines for the notification of non-compliance and emergency action. ISPM 25: 2006. Consignments in transit; ISPM 31: 2008. Methodologies for sampling of consignments.
Seed contaminant	OECD schemes for the varietal certification of seeds ISPM 13: 2001. Guidelines for the notification of non-compliance and emergency action. ISPM 25: 2006. Consignments in transit; ISPM 31: 2008. Methodologies for sampling of consignments.
Timber trade	ISPM 25: 2006. Consignments in transit;
Transportation of habitat material (soil, vegetation,…)	ISPM 13: 2001. Guidelines for the notification of non-compliance and emergency action. ISPM 25: 2006. Consignments in transit.

- *Transport - Stowaway*

The focus on carriers is key to a sound management of the stowaway pathway, aimed at reducing the risks from transport vectors

Angling/fishing equipment	ISPM 25: 2006. Consignments in transit;
Container/bulk	ISPM 25: 2006. Consignments in transit;
Hitchhikers in or on airplane	ICAO draft Guidelines for preventing the transport and introduction of invasive alien species by air ISPM 25: 2006. Consignments in transit;
Hitchhikers on ship/boat (excluding ballast water and hull fouling)	Bern Convention Code of conduct on Recreational Boating and IAS: T-PVS/Inf(2015)19 ISPM 25: 2006. Consignments in transit;
Machinery/equipment	ISPM 13: 2001. Guidelines for the notification of non-compliance and emergency action. ISPM 25: 2006. Consignments in transit;
People and their luggage/equipment (in particular tourism)	ISPM 13: 2001. Guidelines for the notification of non-compliance and emergency action. ISPM 25: 2006. Consignments in transit;
Organic packing material, in particular wood packaging	ISPM 13: 2001. Guidelines for the notification of non-compliance and emergency action. ISPM 15: 2009. Regulation of wood packaging material in international trade (originally adopted in 2002, revised in 2009, Annex 1 and 2 revised in 2013); ISPM 25: 2006. Consignments in transit;
Ship/boat ballast water	Ballast Water Management Convention and related set of IMO Guidelines ISPM 25: 2006. Consignments in transit;
Ship/boat hull fouling	Guidelines by the International Maritime Organization: • Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic species (resolution MEPC.207(62)) • Guidance for minimizing the transfer of invasive aquatic species as biofouling (hull fouling) for recreational craft (circular MEPC.1/Circ.792) • Guidance for evaluating the 2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species (circular MEPC.1/Circ.811) ISPM 25: 2006. Consignments in transit;
Vehicles (car, train, …)	ISPM 25: 2006. Consignments in transit;
Other means of transport	ISPM 25: 2006. Consignments in transit;

- *Corridor*

The management of the corridors pathway requires the implementation of an effective early detection and rapid response system to detect the species occurrence and spread. Risk assessments and dedicated environmental impact assessments of the relevant infrastructures are required too.

Corridors themselves are human infrastructures and as such they are considered as a pathway. Nevertheless, as the further spread of IAS may happen naturally across corridors (thus even in the absence of human mediated means of transport) it is necessary to consider the realisation of physical barriers. For example, the Suez channel could be managed by regulating the water salinity, or with a system of locks.

In this context it is worth to mention the possible contribution of the UNECE Convention on Environmental Impact Assessment in a Transboundary Context (EIA) and Protocol on Strategic Environmental Assessment (SEA), which provide for a high level of protection of the environment, including health, by:

(a) Ensuring that environmental, including health, considerations are thoroughly taken into account in the development of plans and programmes;

(b) Contributing to the consideration of environmental, including health, concerns in the preparation of policies and legislation;

(c) Establishing clear, transparent and effective procedures for strategic environmental assessment;

(d) Providing for public participation in strategic environmental assessment; and

(e) Integrating by these means environmental, including health, concerns into measures and instruments designed to further sustainable development.

Interconnected waterways/basins/seas	Protocol on Strategic Environmental Assessment (SEA)
Tunnels and land bridges	Protocol on Strategic Environmental Assessment (SEA)

- *Unaided*

For the management of the natural spread from neighbouring regions, the main tool is an effective system of monitoring and surveillance for early detection and rapid response to evidence of species occurrence and spread. Horizon scanning exercises are useful tools to help focus on the most imminent threats (“door knocking” species) at the appropriate spatial and temporal scale. Of course, the main pathway to address is the one which is responsible for the entry of a species in the first place/country, but in any case it is necessary to evaluate how the species will then spread naturally (e.g. see *Vespa velutina*).

It is worth pointing out that more can be done and should be done to understand the "unaided" pathway. Most of the alien species that will cause problems in Europe in the near future are already present somewhere in the continent, and many of them will be spread around, e.g. by birds (Green 2015). More should be done to predict which species are spread in this way, and which will be the precise route of spread, etc. For example, key bird migration sites might be priorities for monitoring within an early warning system.

Natural dispersal across borders of invasive alien species that have been introduced through pathways 1 to 5	

B) ***Common measures for all management/action plan for IAS pathways***

The measures that are to be considered common to all IAS pathways management/action plan are those usually needed to ensure the sound implementation of all plans, regardless of their specific focus. On this regard, the following categories of measures are suggested:

- Management of the plan
- Preparatory actions
- Consultation with key stakeholders
- Monitoring the progress of the measures
- Monitoring the success of the plan
- Surveillance
- Review and revision of the plan
- Education, dissemination of information and public awareness

Such categories are not listed in order of importance, and not even in chronological order. Most of the measures need to be carried out across the entire duration of the plan and in some cases, e.g. the communication and surveillance activities, even beyond.

- *Management of the plan*

The management structure in charge of the implementation of the plan should be clearly identified, and well organised, in order to ensure that the implementation of the proposed activities is regularly checked and controlled by the responsible body. To this aim, the decision chain should be clear and effective, and a management chart should be provided if appropriate. A plan Coordinator should be clearly identified.

For any individual proposed measure it is advisable to identify and designate only one single responsible body for its implementation. If the same measure is implemented by several actors, it is advisable that only one of them is designated as responsible for this measure, or that this measure is split into several actions and each separate action is assigned to a single responsible.

Other elements to be considered in the action plan are:

- Roles and responsibilities of key stakeholders.
- Detailed consultation process with key stakeholders (commencing as early as possible).
- Training of staff responsible for the implementation of the plan and other stakeholders
- Co-operation and co-ordination with other competent authorities in the country and beyond.
- Implementation outside the country boundaries to ensuring the success of the foreseen measures may be necessary.

The need for scientific and technical support to be provided by experts on IAS issues (including policy and legislation) must be duly assessed and envisaged (e.g. methods of monitoring and assessment of pathways should be defined through *ad hoc* research).

- *Preparatory actions*

As a general principle, it is worth to consider all preparatory actions needed to produce practical recommendations and/or information that can be implemented, possibly within the duration of the plan (e.g. elaboration of technical blueprints, collection and analysis of baseline information, request of authorisations and permit procedures, licences, stakeholder consultations, etc.). Studies specifically supporting measures addressing the objective of the plan should be considered too. Although the implementation of the plan will usually be under the responsibility of the competent authorities, some

authorisations and permits might be needed to implement the foreseen measures, including to obtain the required support from the (involved) stakeholders. This could be a major constraint affecting the successful implementation of the whole plan if not duly taken into account.

- *Consultation with key stakeholders*

Consultation with key stakeholders and other "actors" may thus be essential at both the country level or the regional/global level. Consultation should be done at various stages in the production/implementation of the plan, and in general it is not recommended either to present the stakeholders with a fully finalised plan, nor to approach them so early that it is not possible to clearly say what is that the plan is intended to do, at least in outline.

- *Monitoring the progress of the measures*

In order to ensure the sound implementation of the plan, appropriate procedures to measure both the progress and the success of the different actions should be included. The progress of the proposed measures should be monitored according to the plan (scope of the measures, objectives, timetable etc.) e.g. by means of specific progress indicators to be assessed by the plan Coordinator on a regular basis. Gathering data about the progress in implementation of the plan should be properly organised. The progress of the different measures should be monitored and evaluated throughout the duration of the plan. This may include regular meetings with the competent authorities, the bodies responsible for each action, the key stakeholders, etc.

- *Monitoring the success of the plan*

The pathway action plan should be implemented, otherwise is meaningless. Monitoring the implementation of the plan as a whole is an essential requirement and should be a key regular task of the plan Coordinator. The success (or impact) of the plan, should be measured by assessing whether the proposed measures have any effect towards contributing to the objective of preventing further introductions of alien species in the country.

Monitoring of the overall impact of the plan (e.g. in terms of prevention of further introductions of alien species) should be clearly distinguished from the monitoring of the progress of the proposed measures.

The monitoring 'methodologies' should be simple and cost effective. They should be described in the plan, and should have the right approach (prior inventory as status quo ante, indicators, controls, status ex post) and the necessary rigour, to lead to the acquisition of meaningful information and results. In particular, it will be fundamental to assess whether the plan will be able to provide a significant (and sustainable) contribution to solving the problem related to the target pathway.

For this purpose, it might be essential to monitor the pathway in order to understand the effects of the relevant management actions. Additionally, monitoring activities should evaluate the presence/absence of a (target) alien species, in terms of both early detection/interception (before its establishment in the wild), and occurrence in the wild (with either established or not established populations). All data collected on the pathway should be compatible with the reference information systems (EASIN? GISD?).

As pointed out by Essl et al. (2015) it has proven difficult to demonstrate a direct link between a specific management implementation and subsequent changes in establishment rates, e.g. because of lack of baseline information, and other interacting factors such as increasing trade, etc. Therefore, if necessary, some preliminary studies should be considered among the preparatory actions, particularly in case baseline information is not yet available at the start of the implementation of the plan.

- *Surveillance*

Monitoring activities usually entails surveillance, which is a critical element of pathways management. Surveillance activities, as defined within the Bern Convention Strategy on IAS, are aimed at identifying alien species new to the country, and as such are a fundamental component of any early warning system encompassing early detection and rapid response. For this reason the Bern Convention Strategy on IAS suggests that Member States should have comprehensive and cost-effective surveillance procedures in place, by implementing the following key actions:

- Making best use of existing capacity (including involvement of stakeholders), establish procedures to collect, analyse and circulate information on IAS, including identification keys for different taxonomic groups.
- Set up an Early Warning System and organise regular surveillance of high-risk areas such as:
  - ✓ main entry points for commercial/tourist arrivals (airports, ports, harbours, open moorings, train stations) and areas frequently visited by tourists;
  - ✓ entry points for spontaneous spread (coasts, border crossings of water systems shared with neighbouring countries, etc.);
  - ✓ areas adjacent to containment facilities for potential IAS;
  - ✓ highly disturbed areas (land clearance, construction, storm damage) and areas where disturbance is regularly occurring (roads, railways etc.); and
  - ✓ isolated ecosystems and ecologically sensitive areas.

This measure is particularly relevant for priority alien species with high risk of invasion, e.g. all those preliminarily identified through an ad hoc horizon scanning exercise (see Roy et al. 2015).

- *Review and revision of the plan*

Monitoring activities may trigger the review of the measures foreseen in the pathway action plan. For this reason, specific mechanisms should be foreseen for the reorientation of proposed measures should the monitoring and evaluating show this is necessary. For example, dedicated contingency plans could be envisaged, as well as a form of adaptive management.

The exercise of reviewing and revising a plan stimulates better implementation. Adaptive management can be an extremely useful tool for moving toward the success of the plan when uncertainty exists regarding the best options for the management of the target pathway, or the effectiveness of the foreseen management measures. Methodologically adaptive management relies on "learning by doing," and then adapting accordingly. This process provides feedback to ensure that measures are effective and minimizes surprises if additional steps become necessary, i.e. because an agreed-upon objective is not reached. However, given the current experience with conservation action plans and particularly the slow process of review and updating (see also FACE and BirdLife International, 2011), the adaptive management should not be used as an excuse to delay the implementation of urgent measures.

The technical process of updating the information contained in the plan during a regular plan review, which results of external processes or of plan implementation, may require the analysis of the plans' overall performance measured against the current trends of introduction through the target pathway. In any case, the review of the plan should be done on a regular basis, in accordance with the shelf life of the document (i.e. 10 years).

In general, the revision of the plan could be undertaken at any time when there is enough evidence from monitoring of the implementation of the plan that the short and/or long-term objectives of the plan are not likely to be met. A revision can be triggered also by the accumulation of substantial new data or in major change in circumstances of the plans implementation. If monitoring of the trends of introductions through the target pathway indicates that despite of the best efforts in implementing the plan, alien species continues to arrive, then a revision of the plan may be necessary.

- *Education, dissemination of information and public awareness*

Communication and dissemination activities include both dissemination actions to spread information about the plan itself, and awareness raising campaigns addressing the problem linked to the spread of alien species through the target pathway and the relevant impacts. Examples of the key communication tools are:

- Website
- Networking activities

- Media work (press articles, TV spots etc.)
- Workshops, seminars, conferences
- Production of brochures, booklets, films, etc.

Each communication measure must identify the target audience and the means to be utilised to reach it. The key messages should be refined to suit the different target audiences and their respective level of awareness of the issue. Information and communication campaigns usually require time before the target audience is adequately informed and changes behaviour with a visible impact on the problem targeted.

Hence the "target audience" represents the audience (general public, citizens, researchers, NGO's and other organisations, landowners and land managers, etc.) addressed by specific measures, e.g. in this case by awareness and communication activities. This audience must be precisely identified and defined (both qualitatively and quantitatively) in the plan, particularly such audience who is directly concerned by or be responsible for the pathways and vectors addressed by the plan (in which case the plan should explain how the scope of the target audience was defined). The foreseen monitoring activities must include the measurement of the impact of the foreseen measures on this target audience. The identification of the target audience must be well justified, in view of reaching the plan's objectives, and realistic (for example, it may be not realistic to target all EU citizens). All available quantitative and qualitative information, should be provided wherever possible. To verify whether the foreseen measures are addressing the right audiences, it would be useful to briefly discuss why addressing them would help preventing further introduction of alien species through the target pathway.

The participation in, and the organisation of, networking and information platforms related to the objectives of the action plan (including at international level where justified) should be considered as fundamental activities for the dissemination of the results of the plan, information exchange activities etc. aimed at ensuring an efficient transfer of know-how and experience in order to foster its replication in similar contexts.

Education and communication measures should include, depending on the objectives of the plan, the following types of action:

- Information and awareness raising activities regarding the action plan to the target audience and stakeholders. These actions should aim at facilitating the implementation of the proposed measures, thus should be started at an early stage of the plan;
- Public awareness and dissemination actions aimed at publicising the action plan and its results both to the general public and to other stakeholders that could usefully benefit from the plan's experience;
- More technical dissemination actions aimed at transferring the results and lessons learnt from pilot/demonstration measures to those stakeholders that could usefully benefit from the plan's experience and implement themselves the measures demonstrated in the project. These actions should in general begin only once the method/technique being tested has been evaluated. They should continue for a sufficiently long period so that the results and lessons learnt are extensively disseminated before the end of the plan.

The role of communication to a wide audience is to provide a simple and clear storyline to explain and put in the right context the available data and information. While reporting scientific data and information on IAS pathways and their impact is becoming increasingly common, popular information targeting the laypeople often remains fragmented, biased, or overly complex. Often IAS related information is reported in scientific publication and technical reports. However, such publications are often less easy to access and to understand for the laypeople than simple storylines. It is therefore necessary to present the available information within a simple, clear and logical approach. Simplicity is central to an efficient communication, and the main aim should always be to avoid including too much information at once. Thus, compelling storylines should be alternated with stimulating anecdotes and harder facts, to ensure that both the rational and emotional components of

the readership are reached. It is known that the effectiveness of communication depends on the ability of the message to catch the attention and to be understood by its target audience and relevant stakeholders. Therefore, messages should be designed to suit the specific educational, and intellectual characteristics of each group of intended audiences.

Other points to be addressed:

- Public participation (including in decision making and planned actions);
- Citizen science.

Time schedule

A detailed time schedule for the plan as a whole and for each measure should be provided, including a clear definition of both the duration and the validity of the plan.

Regarding the plan periods, time limits of 5-10 years are generally recommended (e.g. in species action plans or site management plans). Before the end of the validity period, the plan should be subject to a major review.

In relation to the timing of the single measures, safety margins and time buffers should be duly considered, e.g. to pre-empt the risk of underestimating the time needed for eventual authorisations and permits (see under preparatory actions).

Financial planning

Precise costs estimates should be included in the plan. The cost for the plan as a whole and for each measure should be clearly indicated. A detailed budget breakdown should also be included where appropriate, e.g. in the case of complex and very expensive actions.

In the case of measures that do not need any specific budget (e.g. the work of civil servant involved in the planning of the activities), an explanation of the reasons for this choice should be provided, in order to assess whether there is any risk that the measure will not be implemented as required.

An analysis of the actual (and potential) source of funding should be also included.

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APPENDIX A - TEXT OF ARTICLES EXCERPTED FROM THE EU REGULATION ON IAS

A large proportion of invasive alien species are introduced unintentionally into the Union. It is therefore crucial to manage the pathways of unintentional introduction more effectively. Action in this area should be gradual, given the relatively limited experience in this field. Action should include voluntary measures, such as the actions proposed by the International Maritime Organisation's Guidelines for the Control and Management of Ships' Biofouling, and mandatory measures. Action should build on the experience gained in the Union and in Member States in managing certain pathways, including measures established through the International Convention for the Control and Management of Ships Ballast Water and Sediments adopted in 2004. Accordingly, the Commission should take all appropriate steps to encourage Member States to ratify that Convention.

Art. 5 - All risk assessments shall include a description of the potential pathways of introduction and spread of the species, both intentional and unintentional, including where relevant the commodities with which the species is generally associated;

Art 11 - Invasive alien species of regional concern which are native to a Member State shall not be subject to the provisions of Articles 13, 14, 16, 17, 19, 20 and 24 in the territory of that Member State. Member States to which those species are native shall cooperate with the Member States concerned for the assessment of the pathways in accordance with Article 13 and, in consultation with the other Member States, may adopt relevant measures to avoid further spread of those species in accordance with the procedure referred to in Article 22(1).

Article 13

Action plans on the pathways of invasive alien species

1. Member States shall, within 18 months of the adoption of the Union list carry out a comprehensive analysis of the pathways of unintentional introduction and spread of invasive alien species of Union concern at least in their territory, as well as in their marine waters as defined in point (1) of Article 3 of Directive 2008/56/EC, and identify the pathways which require priority action ('priority pathways') because of the volume of species or of the potential damage caused by the species entering the Union through those pathways.

2. Within three years of the adoption of the Union list, each Member State shall establish and implement one single action plan or a set of action plans to address the priority pathways it has identified pursuant to paragraph 1. Action plans shall include timetables for action and shall describe the measures to be adopted and, as appropriate, voluntary actions and codes of good practice, to address the priority pathways and to prevent the unintentional introduction and spread of invasive alien species into or within the Union.

3. Member States shall ensure coordination with the aim of establishing one single action plan or a set of action plans coordinated at the appropriate regional level in accordance with Article 22(1). Where such regional action plans are not established, Member States shall establish and implement action plans for their territory and as far as possible coordinated at the appropriate regional level.

4. The action plans referred to in paragraph 2 of this Article shall include, in particular, measures based on an analysis of costs and benefits, in order to:

(a) raise awareness;

(b) minimise contamination of goods, commodities, vehicles and equipment by specimens of invasive alien species, including measures to tackle transportation of invasive alien species from third countries;

(c) ensure appropriate checks at the Union borders, other than the official controls pursuant to Article 15.

5. The action plans established in accordance with paragraph 2 shall be transmitted to the Commission without delay. Member States shall review their action plans and transmit them to the Commission at least every six years.

Article 22

Cooperation and coordination

3. Member States may also apply provisions, such as those referred to in paragraph 1 of this Article, to ensure coordination and cooperation with other relevant Member States as regards invasive alien species of Member State concern identified in national lists adopted in accordance with Article 12(1). Member States may also establish mechanisms for cooperation at the appropriate level for those invasive alien species. Such mechanisms may include exchange of information and data, action plans on pathways and exchange of best practice on management, control and eradication of invasive alien species, early warning systems and programmes related to public awareness or education

Article 23

More stringent national rules

Member States may maintain or lay down more stringent national rules with the aim of preventing the introduction, establishment and spread of invasive alien species. Those measures shall be compatible with the TFEU and be notified to the Commission in accordance with Union law.

Article 25

Information support system

The Commission shall progressively establish an information support system necessary to facilitate the application of this Regulation.

2. By 2 January 2016 that system shall include a data support mechanism interconnecting existing data systems on invasive alien species, paying particular attention to information on the invasive alien species of Union concern, so as to facilitate the reporting pursuant to Article 24.

The data support mechanism referred to in the first subparagraph shall become a tool to assist the Commission and the Member States in handling the relevant notifications required by Article 16(2).

3. By 2 January 2019, the data support mechanism referred to in paragraph 2 shall become a mechanism for exchanging information on other aspects of the application of this Regulation.

It may also include information on invasive alien species of Member State concern, and on pathways, risk assessment, management and eradication measures, when available.

Article 24

Reporting and review

1. By 1 June 2019, and every six years thereafter, Member States shall update and transmit to the Commission the following:

(d) the action plans referred to in Article 13(2);

3. By 1 June 2021, the Commission shall review the application of this Regulation including the Union list, the action plans referred to in Article 13(2), the surveillance system, customs controls, eradication obligation and management obligations, and submit a report to the European Parliament and to the Council, which may be accompanied by legislative proposals for the amendment of this Regulation, including changes to the Union list. That review shall also examine the effectiveness of the implementing provisions on invasive alien species of regional concern, the need for and the feasibility of, including species native to the Union in the Union list and whether further harmonisation is needed to increase the effectiveness of the action plans and measures undertaken by the Member States.

APPENDIX B - LIST OF ABBREVIATIONS

BWM: Ballast Water Management Convention
CABI: Centre for Agriculture and Biosciences International
CBD: Convention on Biological Diversity
CEH: Centre for Ecology and Hydrology
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora
COP: Conference of Parties
CTU Code: Code of Practice for Packing of Cargo Transport Units
DAISIE: Delivering Alien Invasive Species Inventories for Europe
EASIN: European Alien Species Information Network
EC: European Commission
EIA: environmental impact assessment
EICAT: Environmental Impact Classification for Alien Taxa
EPPO: European and Mediterranean Plant Protection Organization
EU: European Union
GIASIPartnership: Global Invasive Alien Species Information Partnership
GISD: Global Invasive Species Database
IAS: invasive alien species
ICES: International Council for the Exploration of the Sea
ILO: International Labour Organization
IMO: International Maritime Organization
INNS: Invasive non-native species
IPPC: International Plant Protection Convention
ISC: Invasive Species Compendium
ISPM: International Standards for Phytosanitary Measures
ISSG: Invasive Species Specialist Group
IUCN: International Union for Conservation of Nature
LIFE: financial instrument for the environment
MEPC: Marine Environment Protection Committee
MS: Member State
NOBANIS: European Network on Invasive Alien Species
OECE: Organisation for Economic Co-operation and Development
OIE: World Organization for Animal Health
PRA: pest risk analysis
SBSTTA: Subsidiary Body on Scientific, Technical and Technological Advice
SEA: Strategic Environmental Assessment
SSC:Species Survival Commission

SPS Agreement: Agreement on the Application of Sanitary and Phytosanitary Measures

UNECE: United Nations Economic Commission for Europe

UNEP: United Nations Environment Programme