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AD HOC TECHNICAL EXPERT GROUP  
ON INVASIVE ALIEN SPECIES  
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**DRAFT ADVICE OR ELEMENTS FOR THE DEVELOPMENT OF TECHNICAL GUIDANCE  
ON MANAGEMENT MEASURES FOR INVASIVE ALIEN SPECIES TO BE  
IMPLEMENTED BY BROAD SECTORS TO FACILITATE ACHIEVING AICHI  
BIODIVERSITY TARGET 9 AND BEYOND**

*Note by the Executive Secretary<sup>1</sup>*

### I. INTRODUCTION

1. In paragraph 5 of decision 14/11 the Conference of the Parties to the Convention on Biological Diversity at its fourteenth meeting established an Ad Hoc Technical Expert Group, with the terms of reference contained in Annex II to the same decision, to meet as needed to ensure timely provision of advice on achieving Aichi Biodiversity Target 9, and, wherever possible, meet back-to-back with other relevant meetings, and requested the Executive Secretary to convene a moderated open online discussion forum to support the deliberations of the Ad Hoc Technical Expert Group.

2. The terms of reference for the Ad Hoc Technical Expert Group stipulated that the Group would address matters that are not covered by the assessment of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Building on the work of the moderated online forum, and knowledge and experience accumulated in various different sectors, the Ad Hoc Technical Expert Group shall provide advice or develop elements of technical guidance on management measures on invasive alien species to be implemented by broad sectors to facilitate achieving Aichi Biodiversity Target 9 and beyond:

(a) Methods for cost-benefit and cost-effectiveness analysis which best apply to the management of invasive alien species;

(b) Methods, tools and measures for identification and minimization of additional risks associated with cross-border e-commerce in live organisms and the impacts thereof;

(c) Methods, tools and strategies for the management of invasive alien species as it relates to prevention of potential risks arising from climate change and associated natural disasters and land use changes;

(d) Risk analysis on the potential consequences of the introduction of invasive alien species on social, economic and cultural values;

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<sup>1</sup> Issued without formal editing.

(e) Use of existing databases on invasive alien species and their impacts, to support risk communication.

3. With reference to the scoping document for a thematic assessment of invasive alien species and their control (deliverable 3 (b) (ii))<sup>2</sup>, the area of the thematic assessment of invasive alien species under the IPBES covers: (a) the concept of invasive alien species; (b) invasive alien species and their impacts; (c) direct and indirect drivers responsible for invasive alien species; (d) the diverse degrees of invasive alien species impacts and occurrences of introduced alien species useful for some sectors; (e) effectiveness of past and current programmes and tools; and (f) future options for the management of invasive alien species.

4. Accordingly, the Executive Secretary convened a moderated online discussion forum on invasive alien species (Online Forum) from 1 May to 30 September 2019 (<https://cbd.int/invasive/forum2/>). The Online Forum was composed of the following sessions with moderators, as below:

(a) Methods for cost-benefit/cost-effectiveness analysis, 1-31 May 2019, moderated by Mr. Peter Robertson (Newcastle University, United Kingdom of Great Britain and Northern Ireland);

(b) Methods, tools, and measures for identification and minimization of risks associated with cross-border e-commerce, 1-30 June 2019, moderated by Ms. Christine Villegas (Canadian Food Inspection Agency, Canada);

(c) Methods, tools and strategies for the management of invasive alien species as it relates to prevention of potential risks arising from climate change and associated natural disasters and land use changes, 1-31 July 2019 moderated by Ms. Shyama Pagad (IUCN-SSC-Invasive Species Specialist Group, New Zealand);

(d) Risk analysis on the potential consequences of the introduction of invasive alien species on social, economic and cultural values, 1-31 August 2019, moderated by Mr. Andy Sheppard (CSIRO, Australia).

5. The cross-cutting subjects, such as databases, existing international standards and guidance relevant to invasive alien species and terminologies used by the different multilateral international agreements processes were discussed in a parallel manner with the sessions under separate threads during the period of the Online Forum.

6. In accordance with paragraph 69 of decision VIII/27 on inconsistency of terminology surrounding invasive alien species, the Online Forum clarified terminology appeared in the examples of tools and methods developed under the processes of different international organizations for the purpose of deliberation on advice for achieving Aichi Biodiversity Target 9 by the Ad Hoc Technical Expert Group. In doing so, the Online Forum envisioned that the process of the Ad Hoc Technical Expert Group under the Convention on Biological Diversity would provide information that is complementary to the assessment process under IPBES.

7. The Online Forum was attended by 98 experts from Australia, Bhutan, Brazil, Canada, Central African Republic, China, Cuba, Cyprus, Czechia, Ecuador, Egypt, Ethiopia, European Union, France, Ghana, India, Indonesia, Iran (Islamic Republic of), Israel, Jamaica, Jordan, Macedonia, Malaysia, Mexico, Nepal (including indigenous peoples and local communities), Netherlands (overseas territory), New Zealand, Nigeria, Norway, Pakistan, Portugal, Congo, Slovakia, South Africa, South Sudan, Spain, Saint Lucia, Suriname, Sweden, Tunisia, Turkmenistan, United Kingdom, Viet Nam, Zimbabwe, United States of America, Euro Group for Animals, Food and Agriculture Organization of the United Nations, International Maritime Organization, International Plant Protection Convention, International Union for

<sup>2</sup> Scoping for a thematic assessment of invasive alien species and their control (deliverable 3 (b) (ii)) IPBES/4/10 [https://www.ipbes.net/system/tdf/downloads/IPBES-4-10\\_EN.pdf?file=1&type=node&id=13183](https://www.ipbes.net/system/tdf/downloads/IPBES-4-10_EN.pdf?file=1&type=node&id=13183)

Conservation of Nature (IUCN), IUCN-Invasive Species Specialist Group and World Customs Organization.

8. The Online Forum collected 258 contributions, providing examples of, and commentaries on the use of existing methods, tools, among others that revealed what type of advice or technical guidance are needed for timely provision of advice on achieving Aichi Biodiversity Target 9, within the scope specifically stipulated in the terms of reference of the Ad Hoc Technical Expert Group (see para, 2 above).

9. The Online Forum and its synthesis report have covered numerous practices and exiting methods and tools and what should be newly developed to respond to the request from the Conference of the Parties was considered. The synthesis report of the Online Forum on Invasive Alien Species is available as an information for the Ad Hoc Technical Expert Group ([CBD/AHTEG/IAS/2019/1/INF/1](http://CBD/AHTEG/IAS/2019/1/INF/1)).

10. Based on the information presented in the synthesis report, and taking into account the previous decisions on invasive alien species, IX/4, X/38, XI/28, XII/16, XII/7, XIII/13 and 14/11, Section II provides information on the suggestions made by the Online Forum and other relevant organizations to provide advice or develop elements of technical guidance on management measures on invasive alien species to be implemented by broad sectors to facilitate achieving Aichi Biodiversity Target 9 and beyond.

11. This document also contains Annexes I – VIII which were produced in close collaboration with the moderators of the Online Forum and relevant international organizations with the rationale described in section II, for consideration by the Ad Hoc Technical Expert Group on invasive alien species.

## **II. SUGGESTIONS MADE BY THE ONLINE FORUM AND OTHER RELEVANT ORGANIZATIONS TO PROVIDE ADVICE OR DEVELOP ELEMENTS OF TECHNICAL GUIDANCE ON MANAGEMENT MEASURES FOR INVASIVE ALIEN SPECIES TO BE IMPLEMENTED BY BROAD SECTORS**

12. This section provides suggestions made by the Online Forum and other relevant organizations for deliberation of the advice or development of elements of technical guidance requested by the Conference of the Parties indicated in Annex II to decision 14/11. Also, terminology surrounding invasive alien species which was clarified through the Online Forum is presented in order to facilitate discussion among the Ad Hoc Technical Expert Group in section II A, below.

### **A. Terminology**

13. For the purpose of facilitating the discussions of the Ad Hoc Technical Expert Group, this section clarifies the following terms related to invasive alien species, based on the exchanges through the Online Forum, in consultation with the moderators of the Online Forum and relevant international organizations which set the international standards relevant to invasive alien species, as follows:

(a) *Invasive alien species*: In accordance with Article 8(h) of the Convention on Biological Diversity,<sup>3</sup> alien species which threaten ecosystems, habitats or species are called invasive alien species. Taking into account the International Plant Protection Convention (IPPC), article II, any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products which do not naturally exist in the area for management are deemed to be invasive alien species, including weeds.<sup>4</sup> Further referring to the World Organisation for Animal Health (OIE) guidelines for assessing risk of non-native animals becoming invasive,<sup>5</sup> an animal that has been introduced and subsequently became established and spread outside its native distribution area and caused harm to the environment, animal or human health, or the economy is called invasive alien species. Also, referring to the glossaries of the Terrestrial Animal Health Code and the Aquatic Animal Health Code under OIE, a biological agent in, or a condition of, an

<sup>3</sup> <https://www.cbd.int/convention/articles/default.shtml?a=cbd-08>

<sup>4</sup> [https://www.ippc.int/static/media/files/publication/en/2019/02/1329129099\\_ippc\\_2011-12-01\\_reformatted.pdf](https://www.ippc.int/static/media/files/publication/en/2019/02/1329129099_ippc_2011-12-01_reformatted.pdf)

<sup>5</sup> <https://www.oie.int/doc/ged/D13931.PDF>

animal or animal product with the potential to cause adverse health effect is a hazard, and the associated risk needs to be considered in the context of invasive alien species. In the terms used in the International Maritime Organization (IMO), harmful aquatic organisms and pathogens and invasive aquatic species are deemed to be invasive alien species and are moved with the ships' ballast water and biofouling;

(b) *Alien species*: In accordance with Annex to decision VI/23<sup>6</sup> of the Conference of the Parties to the Convention on Biological Diversity, "alien species" refers to a species, subspecies or lower taxon, introduced outside its natural past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce;

(c) *Establishment*: In accordance with the annex to decision VI/23<sup>7</sup> of the Conference of the Parties to the Convention on Biological Diversity, "establishment" refers to the process of an alien species in a new habitat successfully producing viable offspring with the likelihood of continued survival.

(d) *Risk analysis*: In accordance with Annex to decision VI/23<sup>7</sup> of the Conference of the Parties to the Convention on Biological Diversity, "risk analysis" refers to: (1) the assessment of the consequences of the introduction and of the likelihood of establishment of an alien species using science-based information (i.e. risk assessment), and (2) the identification of measures that can be implemented to reduce or manage these risks (i.e. risk management), taking into account socio-economic and cultural considerations. Further, taking into account the international standards on phytosanitary measures,<sup>7</sup> the OIE Animal Health Codes<sup>8</sup> and the publication of Food and Agriculture Organization of the United Nations (FAO) on aquaculture,<sup>9</sup> the process of risk analysis is composed of: (i) *hazard identification* to identify an alien organism in the area of assessment; (ii) *risk assessment* on the alien organism threatening biodiversity in the area whether the risk is acceptable or risk reduction measures need to be applied ; (iii) *risk management* to identify the risk reduction measures and the actions to take ; and (iv) *risk communication* as an integral part of the risk analysis process for exchanging information and opinions between risk evaluators, risk managers and other interested parties, including the peoples and community in the area, considering the consequence on social, economic and cultural values in the area;

(e) *Invasive alien species management*: Application of measures to prevent the introduction of, control or eradicate invasive alien species.

## **B. Standards and guidance for safe international trade as essential tools for invasive alien species management**

14. The synthesis report revealed that:

(a) Applying preventive measures on introduction of alien species is required throughout the stages of pre-border, at the border and post-border areas, however its implementation is limited in those countries where collaboration among broad sectors is not well coordinated;

(b) Existing legally binding framework relevant to invasive alien species requires science-based risk analysis and import/export regulations, which seemed to be still challenging for some countries where technical and scientific capacity is limited;

<sup>6</sup> <https://www.cbd.int/decision/cop/default.shtml?id=7197> \* One representative entered a formal objection during the process leading to the adoption of this decision and underlined that he did not believe that the Conference of the Parties could legitimately adopt a motion or a text with a formal objection in place. A few representatives expressed reservations regarding the procedure leading to the adoption of this decision (see UNEP/CBD/COP/6/20, paras. 294-324).

<sup>7</sup> ISPM2 and ISPM 11 <https://www.ippc.int/en/core-activities/standards-setting/ispm2/>

<sup>8</sup> Aquatic Animal Health Code and Terrestrial Animal Health Code, <https://www.oie.int/en/standard-setting/aquatic-code/access-online/> and <https://www.oie.int/en/standard-setting/terrestrial-code/access-online/>

<sup>9</sup> FAO Fisheries and Aquaculture Technical Paper. No. 519, <http://www.fao.org/3/a-i0490e.pdf>

(c) The sanitary and phytosanitary measures are essential for invasive alien species management and highly relevant to deliberation of advices requested by the Conference of the Parties through the meeting of Ad Hoc Technical Expert Group.

15. The Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) of the World Trade Organization and its recognized international standard setting bodies serve various methods and tools for member States to the World Trade Organization to facilitate safe international trade. The regulatory mechanism of application of sanitary and phytosanitary measures under the national legislation needs to be implemented collaboratively by broad sectors, including ministries or agencies overseeing biodiversity, agriculture, forestry, fisheries, trade and transport to prevent introduction of, and control or eradicate invasive alien species.

16. Existing CBD guidance on invasive alien species is voluntary, which does not require legally binding force. However, the soft law approach of the CBD guidance helps fill the gaps among the existing sanitary and phytosanitary standards, for example, the “Measures to Avoid Unintentional Introduction of Invasive Alien Species Associated with Trade in Living Organisms” (Annex I to decision 14/11) with specific risk reduction measures for live organisms consignments minimize the risk of contaminants and stowaway, on top of the conformity with the SPS Agreement under which commodity standards do not exist to date.

17. The other CBD guidance, namely, the “Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species” (Annex to decision VI/23<sup>10</sup>) and 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” (decision XII/16, annex) also help Parties to implement the sanitary and phytosanitary measures that may not have been explicitly covering invasive alien species, for example, pets and ornamental species trade with understanding and application of necessity of keeping them in confined conditions.

18. The sanitary and phytosanitary standards and the CBD guidance provide basis to the development of advice or tools for achieving Aichi Biodiversity Target. Therefore, some explanatory guidance for the national authorities on biodiversity to collaborate with the authorities of the implementation of the SPS Agreement is essential to develop any other advices or technical guidance on invasive alien species management, as well as implementation, thereof. Annex I to this document presents, *draft elements of explanatory guidance on enhancing the use of international standards for sanitary and phytosanitary measures in reference to article 8(h) of the Convention on Biological Diversity* for consideration by the Ad Hoc Technical Expert Group.

### **C. Cost-benefit and cost-effectiveness analysis to support policy decisions**

19. The Online Forum exchanged information on broad range of analyses, including cost-benefit, cost effectiveness analysis undertaken by Parties, and risk analysis (e.g. pest risk analysis, weed risk assessment, how to consider the consequence on cultural values and others in the context of provision of decision support information) for policymakers to take informed decision on invasive alien species management.

20. Under the existing national policy and priority, decision on prioritizing invasive alien species management requires compelling evidence of its benefit and effectiveness compared to the risk and negative impacts posed by invasive alien species. However, available data, knowledge and standardized technology to undertake complex analysis on integral costs in social, economic, environmental,

<sup>10</sup> One representative entered a formal objection during the process leading to the adoption of this decision and underlined that he did not believe that the Conference of the Parties could legitimately adopt a motion or a text with a formal objection in place. A few representatives expressed reservations regarding the procedure leading to the adoption of this decision (see UNEP/CBD/COP/6/20, paras. 294-324).

agricultural and various other aspects appeared to be limited. The cases of multi-criteria analysis have been accumulating, though currently there is no accepted, comprehensive method for this purpose.

21. Consequently, the Online Forum suggested make an advance from advising simple cost-benefit/cost effective analysis to developing a technical guidance on multi-criteria decision support for policy makers using the information on analysed risk and cost-benefit/effectiveness analysis with some case studies. A multi-criteria decision support guidance for policy makers may also help the CBD process to respond to decision XIII/13 on decision support tools, and it makes a meaningful step forward to apply various cost-benefit and cost-effectiveness analysis tools, as well as risk analysis for informed decision making. Annex II to this document presents *draft elements of multi-criteria decision support guidance for policymakers*, for consideration by the Ad Hoc Technical Expert Group.

#### **D. Identification and minimization of additional risks associated with cross-border e-commerce in live organisms and the impacts thereof**

22. E-commerce facilitates global access to goods that would otherwise be difficult to find and purchase. This new transaction of purchases of goods changes the role of the consumer into an importer. An additional risk that spread of invasive alien species crossing national borders and biogeographic boundaries in faster and larger scales is anticipated due to the new and emerging stakeholders being involved in trade in living organisms. E-commerce is not a new pathway under the CBD pathway category (UNEP/CBD/SBSTTA/18/9/ADD1)<sup>11</sup>, though appropriate measures need to be in place to prevent introduction and spread of invasive alien species.

23. A *draft technical consideration on emerging risks associated with e-commerce* is presented in annex III to this document, for consideration by the Ad Hoc Technical Expert Group.

#### **E. Prevention of potential risks arising from climate change and associated natural disasters and land use changes**

24. The Online Forum expressed their concerns with the impact of climate change on distribution of species, and the additional dimension in the management of the threat of biological invasions to address climate change and land-use change were demonstrated.

25. Considering the existing cases and practices presented through the Online Forum, A *draft technical consideration on emerging risks associated with climate change, natural disasters and land use changes* is presented in Annex IV of this document, for consideration by Ad Hoc Technical Expert Group.

#### **F. Risk analysis on the potential consequences of the introduction of invasive alien species on social, economic and cultural values**

26. The Online Forum considered existing tools related to risk analysis in the context of provision of information on risk and impact of invasive alien species to support decision by policy makers, including risk analysis on the potential consequences of the introduction of invasive alien species on social, economic and cultural values. The Online Forum also identified some cases that invasive alien species were managed by indigenous peoples and local communities.

27. Considering the existing risk analysis standards, the risk assessment process must be undertaken with scientific principles (e.g. probability of establishment in an area and spread from the area, and impact on the environment), the Online Forum suggested risk management options and risk communication would serve appropriate process for consideration on the potential consequences on social, economic and cultural values, and inputs from cost-benefit and cost-effectiveness analysis are also relevant to such process. Therefore, elements of multi-criteria decision support guidance for policymakers

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<sup>11</sup> UNEP/CBD/SBSTTA/18/9/Add.1, Pathways of Introduction of Invasive Species, their Prioritization and Management.  
<https://www.cbd.int/doc/meetings/sbstta/sbstta-18/official/sbstta-18-09-add1-en.pdf>



included the consideration on the potential consequences on social, economic and cultural values (see paragraph 21, above in this document and Annex II to this document).

#### **G. Use of existing databases on invasive alien species and their impacts, to support risk communication**

28. The Online Forum highlighted the importance of sharing evidence-based information. Monitoring, reporting and sharing information on already established invasive alien species are advanced in many Parties and such information has been consolidated in a global database, the Global Register of Introduced and Invasive Species<sup>12</sup>. Data on potentially invasive alien species with known impacts on biodiversity and socio-economic and cultural values are increasing under the initiatives called EICAT and SEICAT of the IUCN. However, such information sharing and their use for policy making are still limited, especially in developing countries.

29. Information is essential for applying analytical tools (risk analysis, cost-benefit/cost-effectiveness analysis, establishment/spread/population modelling) and designing effective actions to minimize the impact of invasive alien species requires information on invasive alien species.

30. In order to respond to the information needs by Parties and underpin the effectiveness of other tools, *Draft elements of explanatory guide for scientific community to share the data and data tools on invasive alien species* is presented in Annex V to this document, for consideration by Ad Hoc Technical Expert Group.

#### **H. Pathways management**

31. There was only limited information presented during the Online Forum regarding the management of the pathways (transport-stowaway, transport-contaminants, escapes, corridors). Recalling decision VIII/27, the synthesis report of the Online Forum pointed out the following pathways were not sufficiently discussed or clarified: (i) inter-basin water transfer and navigational canals; (ii) international development assistance; (iii) emergency relief, aid and response; (iv) air transport; (v) tourism; and (vi) scientific research among Parties. Further consideration may be needed in the CBD process, referring to the CBD pathway categories (UNEP/CBD/SBSTTA/18/9/Add.1)<sup>13</sup> and existing international regulatory framework relevant to invasive alien species (decision IX/4 A). Further inputs from broader sectors on these ways of introduction of alien species, if any tools became available since 2016 when decision VIII/27 was adopted. The Ad Hoc Technical Expert Group may initiate this process, as appropriate.

32. Taking into account the importance of pathway management to address the matters related to e-commerce and to achieve Aichi Biodiversity Target 9 with implementation by broad sectors, this section provides information on the advance during the inter-sessional period since the fourteenth meeting of the Conference of the Parties, together with the suggestions of the Online Forum.

33. Regarding the management of ship-mediated transport, in particular prevention, the Online Forum recognized a global regulatory framework under the International Maritime Organization on ballast water and biofouling (The International Convention for the Control and Management of Ships' Ballast Water and Sediments and the guidelines; The Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species).

34. In response to paragraph 13(a) of decision 14/11 the Secretariat of the Convention on Biological Diversity informed on the environmentally hazardous nature of living organisms to the United Nations Economic and Social Council (ECOSOC) Sub-Committee of Experts on the Transport of Dangerous Goods (TDG Sub-Committee) at its 55<sup>th</sup> session towards globally harmonized measures on transport of

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<sup>12</sup> Global Register of Introduced and Invasive Species (GRIIS). <http://griis.org>

<sup>13</sup> UNEP/CBD/SBSTTA/18/9/ADD1, Pathways of Introduction of Invasive Species, their Prioritization and Management. <https://www.cbd.int/doc/meetings/sbstta/sbstta-18/official/sbstta-18-09-add1-en.pdf>

living organisms.<sup>14</sup> The TDG Sub-Committee noted the request from the Conference of the Parties to the Convention on Biological Diversity to explore the inclusion of environmentally hazardous living organisms into chapter 2.9, class 9 to prevent the introduction of invasive alien species. It was recommended to resume consideration of this subject at the forthcoming session. Experts on biological invasions were invited to join that session and to provide more detailed information on possible risk and hazard.<sup>15</sup>

35. Taking into account the progress on pathway management tools above, *draft advice to address the issue of invasive alien species as environmentally hazardous articles among the officials in transport, border controls and the stakeholders of trade in living organisms* is presented in Annex VI to this document, for consideration by Ad Hoc Technical Expert Group.

### **I. Existing capacity of Parties**

36. Although the Online Forum identified numerous tools useful for invasive alien species management, the Online Forum pointed out that using existing tools appropriately and efficiently on the ground is yet a challenge in resource limited countries. Understanding of technical and scientific aspect of the tools, as well as rapid and accurate species identification capacity are necessary to conduct invasive alien species management (e.g. risk analysis, border control, post-border monitoring, reporting and addressing the impact of climate and other environmental changes on invasive alien species).

37. Capacity development in taxonomy, ecology, genetics, pathology, geography and other advanced technologies is urged in many parts of the world. In addition, note that continuing research activities are needed to improve existing tools, or some tool require research activities as a prerequisite element of the tool. The Online Forum suggested to identify the requirements of knowledge, facility and equipment as well as essential skills to utilize the tools for the work on the ground.

38. There is also a need to identify what type of capacity building activities are important for the effective application of tools in some resource limited countries and how international collaboration can help transfer and maintain the technical and technological skills in the countries where capacity development is needed.

39. Taking into account the capacity development needs in the above, *draft elements of training guide to fulfill the capacity required for application of tools* is presented in Annex VII to this document, for consideration by Ad Hoc Technical Expert Group.

### **J. Publication on Best Practices on invasive alien species management**

40. Further, the Online Forum suggested publication of best practices of invasive alien species management, especially on tools with advanced technologies and the required technical capacity to apply such tools. The purpose of such publication is to learn how to apply various tools that have already been available for broad sectors, rather than developing a new tool only targeting biodiversity conservation community from scratch.

41. *Draft elements of publication of best practices of invasive alien species management* is presented in Annex VIII to this document, explaining the key components of a best practice management approach, for consideration by Ad Hoc Technical Expert Group.

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<sup>14</sup> UN/SCETDG/55/INF.46 Environmentally hazardous articles (living organisms).

<http://www.unece.org/fileadmin/DAM/trans/doc/2019/dgac10c3/UN-SCETDG-55-INF46e.pdf>

<sup>15</sup> ST/SG/AC.10/C.3/110 Report of the Sub-Committee of Experts on the Transport of

Dangerous Goods on its fifty-fifth session. <http://www.unece.org/fileadmin/DAM/trans/doc/2019/dgac10c3/ST-SG-AC.10-C.3-110e.pdf>



**K. Expected outcome of the Ad Hoc Technical Expert Group meeting**

42. Finally, the outcomes of the Ad Hoc Technical Expert Group on Invasive Alien Species will be a report of the meeting with refined draft advices or elements of technical guidance to be implemented by broad sectors to facilitate achieving Aichi Biodiversity Target 9 and beyond. The draft advices or elements of technical guidance will be further considered by the Subsidiary Body on Scientific, Technical and Technological Advice at its twenty-fourth meeting.

*Annex I*

**DRAFT ELEMENTS OF EXPLANATORY GUIDANCE ON ENHANCING THE USE OF  
INTERNATIONAL STANDARDS FOR SANITARY AND PHYTOSANITARY MEASURES IN  
REFERENCE TO ARTICLE 8(h) OF THE CONVENTION ON BIOLOGICAL DIVERSITY**

**INTRODUCTION**

1. The Agreement of Application of Sanitary and Phytosanitary Measures under the World Trade Organization, its standard setting organizations' provisions and the guidance under the Convention on Biological Diversity provide the basis for development of tools and methods to manage invasive alien species. Any other facts e.g. increasing opportunities of e-commerce, cross-border transport, climate and other environmental changes are also be relevant to application of measures under the multi-lateral agreements mentioned above. How to apply the international standards set for sanitary and phytosanitary measures in mutually supportive manner with the Convention on Biological Diversity and its guidance on invasive alien species management is very important basis for prevention of introduction and spread of invasive alien species by broad sectors.

**I. EXISTING INTERNATIONAL AGREEMENTS AND STANDARDS**

**A. World Trade Organization**

2. The World Trade Organization (WTO) is the only global international organization dealing with the rules of trade between nations. At its heart are the WTO agreements, which have been signed by most of the world's trading nations.

3. The WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) explicitly recognizes the right of governments to take measures to protect human, animal and plant health, as long as these measures are based on science, are necessary for the protection of health, and do not unjustifiably discriminate among foreign sources of supply.

4. The SPS Agreement provides for three different types of precautions to protect health. First, the process of risk assessment and determination of acceptable levels of risk implies the routine use of safety margins to ensure adequate precautions are taken to protect health. Second, as each country determines its own level of acceptable risk, it can respond to national concerns regarding what are necessary health precautions. Third, the SPS Agreement clearly permits the precautionary taking of measures when a government considers that sufficient scientific evidence does not exist to permit a final decision on the safety of a product or process. This also permits immediate measures to be taken in emergency situations. There are many examples of bans on the production, sale and import of products based on scientific evidence that they pose an unacceptable risk to human, animal or plant health. The SPS Agreement does not affect a government's ability to ban products under these conditions.

5. For the purposes of the SPS Agreement, sanitary and phytosanitary measures are defined as any measures applied:

- (a) To protect human or animal life from risks arising from additives, contaminants, toxins or disease-causing organisms in their food;
- (b) To protect human life from plant- or animal-carried diseases;
- (c) To protect animal or plant life from pests, diseases, or disease-causing organisms;
- (d) To prevent or limit other damage to a country from the entry, establishment or spread of pests.

6. These include sanitary and phytosanitary measures taken to protect the health of fish and wild fauna, as well as of forests and wild flora.

7. The international standards that are recognized by the SPS Agreement and which are applicable for protecting biodiversity include the International Plant Protection Convention (IPPC) and the World Organization for Animal Health (formerly the Office International des Epizooties (OIE)).

### **B. The International Plant Protection Convention**

8. The International Plant Protection Convention (IPPC) is an international treaty that aims to secure coordinated, effective action to prevent and to control the introduction and spread of pests of plants and plant products, and to promote appropriate measures for their control. The IPPC was adopted in 1951; it provides a framework and a forum for international cooperation, harmonization and technical exchange between its 183 contracting parties (member countries).

9. IPPC has broad scope on pests and any alien species that is injurious to plants, or that by risk analysis is shown to be potentially injurious to plants, either directly or indirectly (via other components of ecosystems) can be addressed by phytosanitary measures. The IPPC extends to protecting the integrity not only of cultivated plants in agro-ecosystems, but also issues related to non-native plants that have been imported and planted for forestry, amenity, habitat management or ecosystem restoration, and native plants in any ecosystems, whether “man-made” or not. Economic importance may be evaluated based on a harmful impact on crops, or on the environment, or on some other specific value, such as recreation, tourism, or aesthetics.

#### **Box 1. Key definitions under the International Plant Protection Convention**

##### **CBD definitions**

- (a) **alien species:** A species, subspecies or lower taxon, introduced outside its natural past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce
- (b) **invasive alien species:** An alien species whose introduction and/or spread threaten biological diversity

##### **a. IPPC definitions (ISPM 5: Glossary of phytosanitary terms)**

- (c) **pest:** Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products
- (d) **quarantine pest:** A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled

*The IPPC definition of a quarantine pest covers much, but not all, of what is considered as an invasive alien species under the CBD. Both definitions cover any organism that is injurious to plants and that has an environmental impact (threatens biological diversity). Both definitions prescribe in different words that the environmental impact results from the organism's introduction and/or spread. It can be argued that most quarantine pests are invasive alien species and that those invasive alien species which are directly or indirectly injurious to plants are quarantine pests. One marked difference between the definitions is that quarantine pests do not necessarily threaten biological diversity. For example, they may affect only agricultural or horticultural plants that are alien species in their own right.*

10. International Standards for Phytosanitary Measures (ISPMs) are standards adopted by the Commission on Phytosanitary Measures (CPM), which is the governing body of the International Plant Protection Convention (IPPC). The IPPC is the only standard setting organization for plant health recognized by the World Trade Organisation, and provides the basis for phytosanitary measures applied in international trade by the Members of the WTO under the Agreement of Application of Sanitary and

Phytosanitary Measures. Standard setting is a core component of the IPPC (Article X) and is a major focus for the IPPC Community, in addition to implementation and capacity development.

11. ISPM 1: Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade<sup>16</sup>, explains the CPM and provides general guidance to National Plant Protection Organizations (NPPOs) related to the establishment, implementation and monitoring of phytosanitary measures, and to the administration of official phytosanitary systems. It describes the rights and obligations of contracting parties to the IPPC and describes phytosanitary principles for the protection of plants that are embodied in the IPPC and elaborated in its ISPMs. It also covers principles related to the protection of plants, including cultivated and non-cultivated/unmanaged plants, wild flora and aquatic plants, those regarding the application of phytosanitary measures to the international movement of people, commodities and conveyances, as well as those inherent in the objectives of the IPPC.

12. There are currently a total of 42 adopted ISPMs<sup>17</sup>, plus a large number of phytosanitary treatments and diagnostic protocols for specific pests and several guides, manuals and training materials to support implementation of the ISPMs available on the IPPC website. The texts of the ISPMs are available at: <https://www.ippc.int/core-activities/standards-setting/ispms>

13. These ISPMs cover a wide range of topics, including: pest risk analysis, surveillance, phytosanitary pest status, pest reporting, regulated pest lists, pest eradication, export certification, import control, inspection and emergency measures. There are also a number of ISPMs that are specific to the international movement of regulated articles, such as: biological control agents, wood packaging material, wood, seeds, growing media in association with plants, processed products, and used vehicles, machinery and equipment.

### **C. The World Organization for Animal Health**

14. The World Organization for Animal Health (formerly the Office International des Epizooties (OIE)) establishes standards, guidelines and recommendations pertaining to animal health. In the framework of the international movement of animals, it is important to analyse both the risk of a non-native animal becoming invasive and the risk of pathogens being introduced with the animal. Examples of the OIE work related to invasive alien species include the following:

#### **(a) The OIE Guidelines for assessing the risk of non-native animals becoming invasive<sup>18</sup>**

15. Trade is responsible for the movement of large numbers of live animals, comprising a wide diversity of species, around the world. Although the majority of these animals are not intended for release into the natural environment, some are, and others either escape or are subsequently released when their owners no longer wish to care for them. Trade in live animals thus plays a major role in facilitating invasions by non-native species world-wide. Because of the potential for non-native animals to become invasive, science-based risk analysis should be conducted before decisions are made with respect to the proposed importation of non-native animal species into a country or area. Risk analysis is also an important tool when considering the risks posed by so-called ‘hitchhiker’ organisms which may be associated with imported commodities or the vehicle/vessel or container in which they are imported.

16. The principal aim of assessing the risk of non-native animals becoming invasive is to provide importing countries with an objective and defensible method of determining whether such imported animal species are likely to become harmful to the environment, animal or human health, or the economy.

#### **(b) The OIE Terrestrial Animal Health Code, Section 2, Chapter 2.1 Import risk analysis**

<sup>16</sup> ISPM 1: <https://www.ippc.int/en/publications/596/>

<sup>17</sup> List of adopted ISPMs: <https://www.ippc.int/en/publications/626/>

<sup>18</sup> <https://www.oie.int/scientific-expertise/specific-information-and-recommendations/invasive-alien-animal-species/>

17. This OIE standard for import risk analysis covers the potential movement of pathogens with the importation of terrestrial animals and animal products.

**(c) The OIE Aquatic Animal Health Code, Section 2, Chapter 2.1 Import risk analysis**

18. This OIE standard for import risk analysis covers the potential movement of pathogens with the importation of aquatic animals and animal products.

**II. NATIONAL AUTHORITIES RESPONSIBLE FOR APPLYING INTERNATIONAL STANDARDS**

19. The WTO SPS Agreement explicitly recognizes the right of governments to take measures to protect human, animal and plant health, as long as these measures are based on science, are necessary for the protection of health, and do not unjustifiably discriminate among foreign sources of supply. The national authorities responsible for regulating imports and exports under the SPS Agreement are the National Plant Protection Organization (for plants and plant products) and the National Veterinary Authority (for animals and animal products). These national authorities have sovereign authority to prescribe and adopt sanitary and phytosanitary measures to protect animal and plant health within their territories and to determine their appropriate level of protection.

20. The WTO member countries are responsible for developing and applying appropriate national measures based on the international standards, guidelines and recommendations that have been developed by the International Plant Protection Convention (IPPC) and the Office International des Epizooties (OIE). Member countries may require measures which result in higher standards if there is scientific justification or if the measures are based on an assessment of risks. Governments are required to notify other countries of any new or changed sanitary and phytosanitary requirements which affect trade, and to respond to requests for information on new or existing measures and to explaining how they apply their animal and plant health regulations.

21. The National Plant Protection Organization and Veterinary Authority are the responsible for establishing the legislative authorities necessary to allow them to develop and apply national sanitary and phytosanitary measures. Each country needs the legal basis, capacity and resources to support prevention, early detection, rapid response and eradication of the species under the national legislation to protect plant (including fungi and algae) and animal health.

22. These national authorities are also responsible for developing and applying sanitary and phytosanitary measures to regulate imports and exports in order to prevent the introduction and spread of pests and pathogenic agents (which may include invasive alien species of the national concern). These national measures must align with international standards, unless there is technical justification for not doing so. The process of aligning national measures with international standards offers a mechanism for harmonizing national sanitary and phytosanitary measures around the world.

23. The 20 National Plant Protections Organization and Veterinary Authorities are most often located under the ministry/department of agriculture within a country. However, other national and regional ministries/departments, such as environment, forestry, oceans and fisheries may also have a mandate for invasive alien species and protecting biodiversity.

24. Improved cooperation and information-sharing between all the relevant ministries and departments within a country on issues related to invasive alien species is extremely important. Enhanced collaboration between government partners could be expected:

(a) To result in more effective use of existing international standards, regulatory frameworks, tools and resources;

(b) To clarify overlapping responsibilities and gaps between areas of work; and

(c) To effectively coordinate activities in order to prevent the introduction of invasive alien species, and control or eradicate established invasive alien species.

### **III. ENHANCING THE USE OF INTERNATIONAL STANDARDS**

25. The application of SPS measures to regulate import/export of alien organisms at the national level requires close collaboration between the national authorities and other relevant ministries and departments. Some countries set joint jurisdiction on import requirement for alien organisms among relevant ministries and agencies, including the National Plant Protections Organization and the Veterinary Authorities.

26. National Plant Protections Organization and the Veterinary Authorities should be encouraged to establish strong partnerships with national, regional and local governments that also have a mandate for invasive alien species in order to prevent the introduction of invasive alien species and to support early detection, rapid response and effective management. This partnership could include collaboration in setting national priorities, completing risk assessments, carrying out surveillance, developing response plans and information sharing.

27. Countries should develop a coordinated national response to minimize incursions and impacts of invasive alien species. This could include strengthening and coordinating existing programs, identifying and filling gaps with new initiatives, and building on the strengths and capacities of partner organizations at the national, regional and local levels.

28. A large number of the international standards that are recognized by the SPS Agreement are applicable for protecting biodiversity. These sanitary and phytosanitary measures should be applied more widely, not only in the context of agriculture, but also to protect the health of fish and wild fauna, as well as of forests and wild flora.

29. A number of guides, manuals and training materials have been developed to build capacity and support implementation of international standards. These materials should be used to increase awareness and build capacity among partner organizations to address the issue of invasive alien species.

30. Build capacity among developing countries and provide resources for implementing existing international guidelines and standards and developing a regulatory framework to address the risks associated with invasive alien species.



*Annex II*

**DRAFT ELEMENTS OF MULTI-CRITERIA DECISION SUPPORT GUIDANCE FOR  
POLICYMAKERS**

**A. Background on the needs of multi-criteria decision support guidance**

1. With the rising number of invasive alien species globally, and their increasing impacts, there is a need for increased management to reduce and mitigate these effects.
2. A key requirement of Aichi Target 9 is to prioritize invasive alien species for prevention and management action. However, prioritising effective invasive alien species management poses multiple challenges: (i) the number of species and circumstances to consider is large and increasing; (ii) the existing information on their ecology, impacts and management may be scarce and uncertain; (iii) the opportunities for effective management are often time and scale-limited, and (iv) the necessary time, resources and expertise are often in short supply.
3. Tools are needed to help guide prioritisation and management decisions, taking into account these challenges. The assessment of the costs and financial benefits of management are clearly important, and methods are already available to support these, such as cost-benefit and related analyses. However, cost-benefit analysis is less effective when large numbers of species need to be rapidly assessed and where detailed information is often lacking. Including consideration of biodiversity, animal welfare and public acceptability in cost-benefit analyses is also problematic as, although possible, these are often difficult to represent in simple financial terms.
4. Methods should be able to rapidly compare between different alternatives, prioritising the different choices faced by a manager or decision maker; for example, which species to deal with first, which method to choose, or when to select eradication or long-term management as the goal?
5. Methods also need to include the effects of time and scale on these choices, what works well at a small scale during the early stages of a species' establishment may be very different from what is useful over large areas. In this annex we describe the use of multi-criteria methods to assess the feasibility of management as part of risk management, and how this approach can then support wider prioritisation and decision-making.

**B. Multi-criteria methods**

6. Multi-criteria decision-making techniques offer possible solutions to a number of these problems. These modelling and methodological tools are designed to find optimal solutions to complex problems where assessment criteria or data are measured in different currencies. They can also be used when only incomplete or imprecise information is available, or where expert opinion is used. The key is to break down a decision into its different components and to then produce an assessment of the importance of each. For example, when choosing to buy a second-hand car, before making a decision you might consider cost, comfort, safety, attractiveness, mileage, damage, reputation of the seller and fuel economy. These criteria are measured in a range of currencies, cannot practically be combined into simple economic terms and include an element of judgement. The approach also needs to be simple enough to rapidly compare between a number of different choices to support a rational decision. Clearly structuring complex problems and explicitly evaluating multiple criteria allows the comparison of alternate options and supports more informed and better decisions.
7. In the related fields of human, animal and plant health, risk assessment (what is the risk of something happening and having an impact?) is used alongside risk management (what can reasonably be done to reduce the risk?) as part of a wider risk analysis framework to guide the prioritisation of action. For invasive alien species, there is a need to better consider risk management if our management objectives are to be realistic and achievable. This paper suggests that risk management based on a multi-

criteria approach provides a rapid method to improve invasive alien species prioritisation and management decision making.

**C. A case study of a multi-criteria method to guide invasive alien species prioritisation and management**

8. An example of a multi-criteria method is described below<sup>19</sup>. This applied a multi-criteria approach to invasive alien species risk management and used it to assess the feasibility of eradicating different invasive alien species from Great Britain, and to then prioritize them for management action. This method involves four stages to compare between different cases; setting the scenario; setting the management method and objective; undertaking the assessment; and prioritising for action:

**Setting the Scenario** – The opportunities for management vary depending on the stage of the invasions process, and the area over which a species has been found. The first step was to describe these. A scenario was produced which described the species and its' distribution/abundance in the area of concern;

(a) **Setting the Management Method and Objective** – This section described the objective of management (prevention, eradication or long-term management) and then described the method to be applied to achieve this. In this example the management objective was eradication in each case and included a description of the method considered most likely to be used effectively. There are other alternatives that can be introduced at this stage, for example comparing different management methods to achieve the same objective, but this was outside the scope of the paper;

(b) **Undertaking the Assessment** – These descriptions of Scenarios and Management options were then sent to a range of experts with experience of the species or management approach. They were asked to assess them under a range of different criteria, using published evidence where possible, but including expert judgement where necessary. They were asked to produce semi-quantitative responses (scores of 1-5 with guidance for each criterion) and confidence scores (low, medium, high) to assess each scenario/management case under five key criteria:

- (i) Effectiveness
- (ii) Practicality
- (iii) Cost
- (iv) Impact (of management)
- (v) Acceptability

Two supplementary criteria were also considered which may not be needed in all cases:

- (i) Window of opportunity for management
- (ii) Likelihood of re-invasion.

9. Finally, the experts were asked to provide an overall assessment of the feasibility of applying the management method to the species to achieve the desired objective (using a score of 1-5). Multiple experts scored each case and then undertook a consensus building exercise to produce a single agreed score.

10. **Prioritization for Action:** the previous sections produce information on the overall feasibility of management. To use this for prioritisation, these results were then combined with information from the species risk assessments to identify those where there were both significant risks, and the prospect for effective management. This combination of risk assessment (what is the probability of impact) with risk management (what can reasonably be done) forms part of the wider risk analysis approach. This method

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<sup>19</sup> Booy, O., Mill, A.C., Roy, H.E., Hiley, A., Moore, N., Robertson, P., Baker, S., Brazier, M., Bue, M., Bullock, R. and Campbell, S., 2017. Risk management to prioritise the eradication of new and emerging invasive non-native species. *Biological Invasions*, 19(8), 2401-2417.

has now been adopted as the GB Non-native Risk Management (NNRM) scheme and is used to help prioritize invasive alien species for management at a national scale.

#### **A. Future applications and developments**

11. Multi-criteria methods are already widely used to support invasive alien species decision making – for example through the risk assessment process. By breaking problems down into their different components they can assess decisions in a transparent and rational manner, they can be rapidly applied to large numbers of cases, and by using expert opinion they can still be applied where published information is lacking. There is scope to use them more widely to support decision making to answer questions such as how to prioritize species for management, when to choose between prevention, eradication or long-term management objectives, how to produce rapid assessments of large numbers of species, or how to compare the feasibility of different management options?

12. Multi-criteria methods can be used in circumstances where more detailed, but data-hungry approaches such as cost-benefit analysis, may be impractical. For example, where large numbers of alternatives need to be rapidly assessed, where published information is lacking or where issues cannot readily be monetized. On the other hand, multi-criteria approaches often operate in the absence of published data, raising concerns over the use of opinion or unsubstantiated information. The way in which multiple criteria are combined to support an overall conclusion can also be problematic and is often based on pragmatism rather than a validated approach. Nevertheless, multi-criteria methods and cost-benefit analysis complement each other, for example an initial prioritisation based on a large number of options may be undertaken using a multi-criteria approach, but the proposed priorities may then be more fully assessed using a more rigorous approach such as cost-benefit before resources are committed.

13. Multi-criteria methods to support invasive alien species prioritisation, risk management and decision making need to be developed further. Opportunities for development include:

(a) There is considerable variation in the methods and approaches to prioritisation and decision making used in different countries - reviewing the strengths and weaknesses of other approaches to this issue would be valuable;

(b) Risk management as part of a larger risk analysis process is widely used in other fields, such as plant health - increased dialogue with experts from these fields would help to develop best-practice;

(c) The case study described here only considered eradication as the objective - other considerations will be needed when applying the approach to different management questions;

(d) Cases where multi-criteria methods have been applied to invasive alien species management decision making are still limited - more trials and applications would help refine the approach;

(e) Where possible, published quantitative data should be used to underpin decision making – can we better identify and access key information, for example on the costs and objectives of successful management programmes?

*Annex III*

**DRAFT TECHNICAL CONSIDERATIONS ON EMERGING RISKS ASSOCIATED WITH E-COMMERCE**

**INTRODUCTION**

1. The increasing popularity of e-commerce is changing the traditional way of doing business, shifting from high-value, bulk consignments shipped business to business towards more business to consumer and consumer to consumer transactions and increasing the volume of small parcels that are transported by postal and express courier services rather than marine/air/rail or truck freight with well-established import controls. E-commerce also facilitates global access to goods that would otherwise be difficult to find and purchase and changes the role of the consumer to importer and consumer, but who lacks the knowledge or experience to ensure import requirements are being met.

**D. Existing international resources to address risks associated with cross-border e-commerce**

*1. World Trade Organization (WTO)*

2. The World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) explicitly recognizes the right of governments to take measures to protect human, animal and plant health, as long as these measures are based on science, are necessary for the protection of health, and do not unjustifiably discriminate among foreign sources of supply. The SPS Agreement applies to all international trade, including cross-border e-commerce.

*2. International Plant Protection Convention (IPPC)*

3. There are currently 42 adopted International Standards for Phytosanitary Measures (ISPMs) available on the IPPC website. While all ISPMs apply to e-commerce trade, ISPM 20: Guidelines for a phytosanitary import regulatory system,<sup>20</sup> is perhaps the most relevant. A country's phytosanitary import regulatory system is intended to prevent the introduction of quarantine pests with imported commodities and other regulated articles, regardless of the means used to order or transport the goods.

4. In 2014, the Commission on Phytosanitary Measures (CPM-9) adopted R-05: Recommendation on: Internet trade (e-Commerce) in plants and other regulated articles.<sup>21</sup> This document includes a number of recommendations aimed at National Plant Protection Organizations (NPPOs) and Regional Plant Protection Organizations (RPPOs).

5. In March 2019, the Secretariats of the International Plant Protection Convention (IPPC) and the World Customs Organization (WCO) entered into a joint three-year workplan which identifies several major areas for bilateral cooperation, including cross-border e-commerce.

*3. World Customs Organization (WCO)*

6. In June 2018, the WCO adopted the Framework on Cross-Border E-Commerce, which sets out 15 global standards. In August 2019, the WCO published an e-commerce package<sup>22</sup> which includes this Framework as well as Technical Specifications to the Framework of Standards on Cross-Border e-Commerce and other tools to facilitate implementation of the Framework.

7. The Technical Specifications document identifies several key safety and security issues associated with e-commerce trade, including: living organisms, invasive alien species, pests, pathogens

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<sup>20</sup> ISPM 20: <https://www.ippc.int/en/publications/602/>

<sup>21</sup> CPM R-05: <https://www.ippc.int/en/publications/84232/>

<sup>22</sup> WCO e-commerce package : <http://www.wcoomd.org/en/topics/facilitation/instrument-and-tools/frameworks-of-standards/ecommerce.aspx>

and products derived from animals, plants and fungi that may carry the risk of biological invasions in importing countries; CITES plants and animals; and phytosanitary and sanitary risks.

8. The Technical Specifications document also states that national customs administrations, in cooperation with other relevant government agencies, should prepare and regularly update a list of prohibited and restricted goods in their respective countries and should make this list easily available to all relevant stakeholders.

#### *4. Priority goals to address additional risks*

- (a) Reduce the risk of introduction and spread of invasive alien species via e-commerce;
- (b) Ability to target high-risk shipments for compliance verification;
- (c) Facilitate the movement of low-risk legitimate shipments.

#### *5. Impact of e-commerce*

(a) Increasingly large numbers of low-value individual parcels/consignments are moving internationally via express carriers and postal services with limited data / cargo information that are not necessarily subjected to the same level of scrutiny as other forms of trade;

(b) A strong demand from buyers/consumers, brokers and carriers for prompt release of goods and high-speed delivery in a very competitive market;

(c) Increased likelihood for distribution of products not approved for use in the country of import or difficulty in authenticating product quality and safety or package contents.

#### *6. Other challenges with e-commerce*

(a) Consumers are able to purchase a huge range of goods, including live organisms and plants, from anywhere in the world and have it delivered directly to their door;

(b) A lack of awareness about import/export requirements among e-commerce stakeholders that include many new and occasional sellers and buyers/consumers;

(c) A lack of clear information about import/export requirements in a format that is more accessible or geared to e-commerce stakeholders;

(d) Difficulty identifying specific e-commerce stakeholders (e.g. individual buyers/consumers and vendor websites);

(e) Lack of communication and collaboration between the national border agencies of exporting and importing countries;

(f) Lack of communication and collaboration between national border agencies and e-commerce stakeholders (including vendors, platforms, brokers, postal unions and courier services);

(g) Lack of communication and collaboration between national border agencies and other government departments and agencies;

(h) Current risk management procedures for low-value e-commerce shipments are usually highly manual, resource intensive and performed in real-time at the border.

#### *7. Considerations*

(a) Approaches that are successful in mitigating risks associated with cross-border e-commerce trade may also prove to be applicable domestically to address the risks associated with e-commerce exports, imports and domestic movement crossing the biogeographic boundaries by local traders;

(b) Countries are at different stages of addressing cross-border e-commerce trade challenges and have varying priorities and capacity for managing the associated risks;

(c) Incorrect declarations, fraud and illicit trade are ongoing issues but could compound the risks associated with the already challenging e-commerce trade due to the perceived lack of regulatory oversight, lack of information provided or required for packages/consignments, or lack of knowledge and experience on the participants' side in following proper procedure and meeting import requirements.

## **E. Suggested advice**

### *1. Legislation, regulations and requirements*

9. Review of existing legislation, regulations and policies to verify that e-commerce trade is included or make changes as needed to ensure enforcement actions can be taken.

10. Ensure import/export requirements are up-to-date, clear and available electronically or accessible to e-commerce stakeholders. This can be accompanied with additional guidance and best practices to assist e-commerce stakeholders comply with the requirements.

11. Establish legal and policy frameworks that allow for the electronic exchange of data between all parties involved in the international supply chain and use this data to triage packages and determine the level of inspection needed (risk-based inspection).

### *2. Data and technology*

12. Gather data using specially designed web tools to monitor compliance and to evaluate the efficacy of activities that are implemented to mitigate risks associated with e-commerce. The data collected using such tools should be used to inform risk-based inspections and determine if investigation or enforcement action is needed.

13. Advance Electronic Data: ensure data quality (accuracy and adequacy of the data received). This can be linked to the proper labelling and identification of items on packages used when shipping.

14. Apply non-intrusive inspection (NII) technologies and risk-based interventions using modern methods of data analytics to facilitate legitimate e-commerce and, at the same time, identify and stop illicit trade. Devices such as drones, e-nose, scanners and sniffer dogs can efficiently detect prohibited and restricted articles moving through the express courier and postal systems.

### *3. Education and awareness*

15. Increase awareness among international organizations and e-commerce stakeholders about import/export requirements and what can be done to minimize the risk of introduction and spread of invasive alien species in association with e-commerce trade.

16. Countries should identify stakeholders and potential partners who are in the e-commerce supply chain, including: vendors, platforms, buyers/consumers, brokers, and carriers and to disseminate specific communication and awareness materials geared to each group.

17. Develop and implement new training and tools to facilitate appropriate level of monitoring and inspection in e-commerce markets. This includes developing guidance on the issuance of warnings, notices and other enforcement actions when non-compliances are found.

### *4. International cooperation*

18. Collaborate at all levels of government, both nationally and internationally to share information, technology and expertise.

19. Prepare guidance to assist national border agencies in responding to non-compliance, considering that both domestic and international actions may be required to respond effectively.



20. Improved collaboration between national border agencies may provide opportunities to link existing security initiatives with biosecurity risk management and targeted (risk-based) inspections. This will also provide a mechanism for timely information-sharing among national border agencies and between the national border agency and other relevant ministries/departments on issues related to cross-border e-commerce trade.

21. Build capacity among developing countries and provide resources for implementing existing international guidelines and standards and developing a regulatory framework to address the risks associated with e-commerce.

22. Expand the concept of Authorized Economic Operators (AEO; trusted trader) to cross-border e-commerce. Establish a programme for postal operators, express carriers and large e-platforms which would result in a lower frequency of inspections.

*Annex IV*

**DRAFT TECHNICAL CONSIDERATION ON EMERGING RISKS ASSOCIATED WITH  
CLIMATE CHANGE, NATURAL DISASTERS AND LAND USE CHANGES**

**A. Impacts of climate change and other environmental changes on biological invasions**

1. Climate change and Land-use interactions at various stages of biological invasions were considered and potential responses enumerated. The additional dimension added in the management of the threat of biological invasions due to climate change and land-use change are demonstrated in Figures 1 & 2 in this document. Climate change, for example, is aiding increased rates of spread of alien species.<sup>23</sup> Increased disturbance due to land use change facilitates establishment of alien species. Corresponding potential management responses have been listed.
2. Generally, under climate change species distributions will move towards to the zones where are in higher latitudes or with increasing altitude up mountain ranges. With the changes in species composition at any given locality the area may lead to altered ecological communities which as increasing native species are affected and are likely to reduce community resilience to invasive alien species.
3. Invasive alien species will similarly have altered distributions, but in general, being well adapted ecological disturbance, are likely to be advantaged over native species. Thus, native communities with specific biogeographic characteristics e.g. alpine communities, regionally unique communities at the polar edge of landmasses, or complex communities such as marine reefs will be particularly vulnerable to climate change and changing invasive species distributions.
4. Climate change may favour C4 invasive grasses over C3 native grasses as carbon dioxide levels increase. Not all invasive species will benefit from climate change as some too may be less abundant under particular changing climates. Where conditions are likely to get harsher under climate change (e.g. increasing droughts) the native communities may still be better adapted to such changes as introduced species.
5. Species in native communities that have small or isolated populations on islands or mainland islands such as mountain tops will be particularly vulnerable with no-where to move to. In Australia there is already evidence that the introduced red fox is now found higher up in the Australian alps coming into greater contact with endangered native small alpine marsupial populations likely to cause increased predation.
6. In Australian savannas already being invaded by high biomass African grasses causing altered fire regimes will see these altered regimes become more extreme under future hotter climates which when combined with invasive alien predators is likely to see many more native animals joining the lists of threatened and endangered species.
7. With climate change comes increasing sea levels which lead to increasing flooding particularly salt water incursions, into what were non-saline wetland habitats important for wildlife. These will be prone so salt tolerant invasive alien species.
8. Furthermore, climate change is also associated with extreme weather events like cyclones. Tropical rainforests are not only biogeographically prone to cyclones, but cyclone damage opens the community to forest disturbance adapted invasive alien species such as exotic vines which not only smother the regenerating forests, but can wick fires up into the damaged canopy which are already leading to declining rainforest areas.

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<sup>23</sup> Thiney, U.; Banterng, P.; Gonkhamdee, S.; Katawating, R. (2019) Distributions of Alien Invasive Weeds under Climate Change Scenarios in Mountainous Bhutan. *Agronomy* 2019, 9, 442; doi:10.3390/agronomy9080442

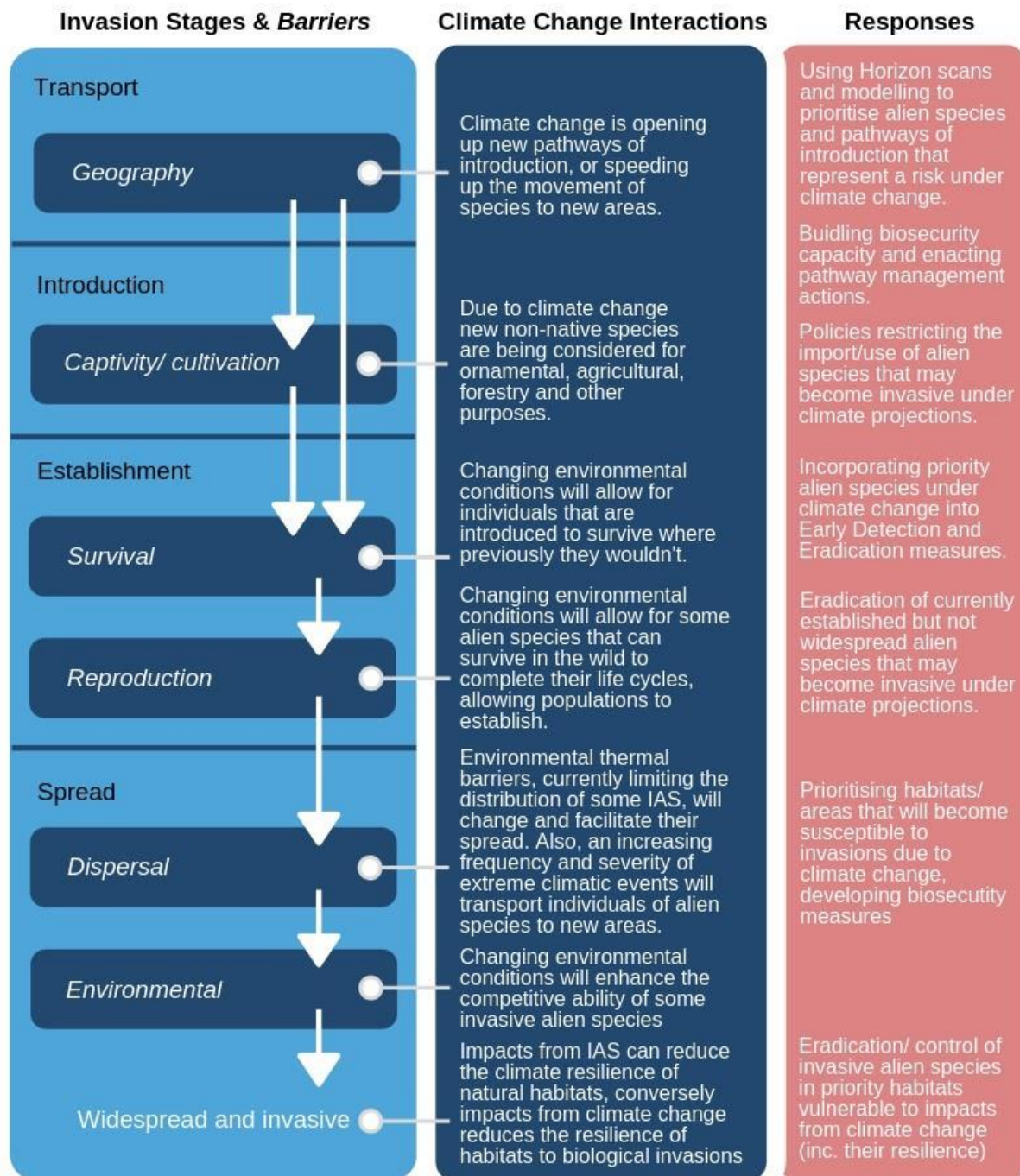
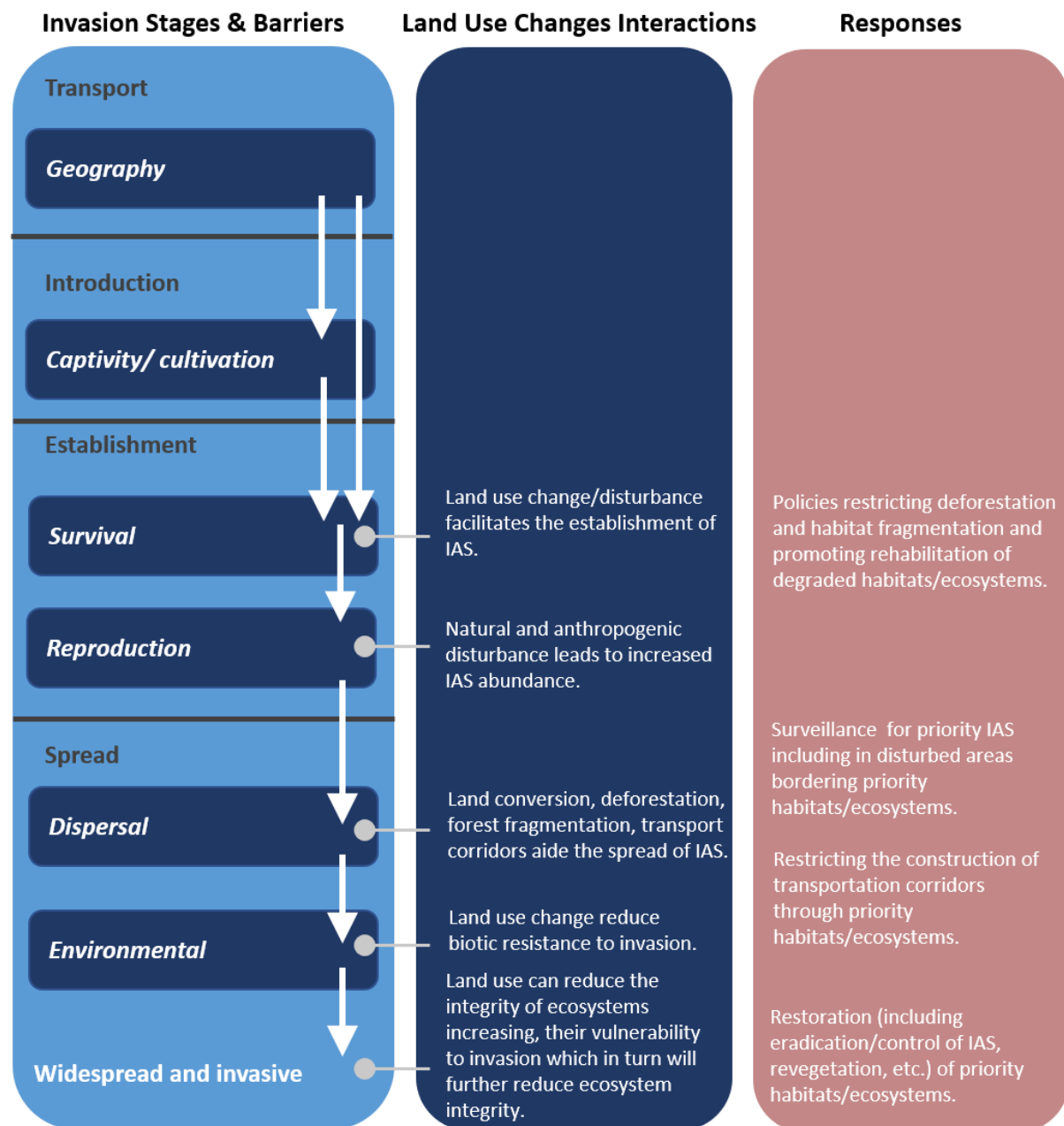


Figure 1. Climate change interactions at various stages of biological invasions, from introduction to impacts, and potential responses inspired from Walther et al. 2009 and Blackburn et al. 2011



**Figure 2. Land use change interactions at various stages of biological invasions, from introduction to impacts, and potential responses inspired from Walther et al. 2009, Blackburn et al. 2011 and With 2002**

9. Example of some early work on modelling from Australia including case studies:

(a) Kriticos, D.J., Crossman, N.D., Ota, N. & Scott, J.K. (2010) Climate change and invasive plants in South Australia. Report for the South Australian Department of Water, Land and Biodiversity Conservation. CSIRO Climate Adaptation Flagship, Canberra, Australia. 92pp

(b) <https://publications.csiro.au/rpr/download?pid=csiro%3AEP092039&dsid=DS3>

## **B. Planning and response**

10. Managing invasive alien species under climate change becomes an even greater challenge. New prioritization actions are required:

- (a) Development of climate change relevant invasive alien species risk assessment protocols for prioritising management targets (e.g. fire enhancing weeds, vines, saline tolerant invaders);
- (b) Develop revised prioritized surveillance lists of invasive alien species based on potential for impact interactions with climate change;
- (c) Research and development into invasive alien species likely to increase under CO<sub>2</sub> levels, hotter fire regimes, higher salt water incursions and higher extreme event frequency;
- (d) Identification of the most vulnerable locations and native communities;
- (e) Understanding ecological thresholds for community resilience/collapse under climate change;
- (f) The degree to which native species may also become threats to more climate vulnerable native species under climate change;
- (g) Prioritizing actions invasive alien species related under climate change (see Table 1).

11. Example government reviews and management plans include:

- (a) Government of Canada. (2008). Integrating Climate Change into Invasive Species Risk Assessment Risk Management Workshop Report. Ottawa, Canada: PRI Project Sustainable Development. Retrieved from [http://publications.gc.ca/collections/collection\\_2008/policyresearch/PH4-47-2008E.pdf](http://publications.gc.ca/collections/collection_2008/policyresearch/PH4-47-2008E.pdf);
- (b) Australian Biodiversity Advisory Committee. (2006). Climate Change and Invasive Species – A review of interactions – Australian workshop report: <https://www.pestsmart.org.au/climate-change-and-invasive-species-a-review-of-interactions/>;
- (c) U.S. EPA. Effects Of Climate Change On Aquatic Invasive Species And Implications For Management And Research (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-08/014. (2008). <https://cfpub.epa.gov/ncea/risk/recorddisplay.cfm?deid=188305>;
- (d) Sweden: [https://www.artdatabanken.se/globalassets/ew/subw/artd/2.-var-verksamhet/publikationer/29.-artdatabankens-risklista/rapport\\_klassifisering\\_av\\_frammande\\_arter2.pdf](https://www.artdatabanken.se/globalassets/ew/subw/artd/2.-var-verksamhet/publikationer/29.-artdatabankens-risklista/rapport_klassifisering_av_frammande_arter2.pdf).

**Table 1. Examples of the types of invasive alien species under climate change activities that can be prioritized and undertaken in terms of low and high cost versus low and high benefit.**

BENEFITS		Community awareness of how IAS interact with extreme events e.g. “transformer spp.”	Invest in Prevention & Control
	High	<p>Risk assess currently permitted species as emerging threats under climate change (e.g. extreme events)</p> <p>National Policy/Strategies</p> <ul style="list-style-type: none"> <li>(a) Tropical fire prone C4 grasses</li> <li>(b) Biofuel biosecurity</li> <li>(c) Extreme event preparedness + IAS</li> </ul> <p>Develop local IAS – climate change threat abatement plans.</p>	<p>National/local programmes for identification and removal of climate change increase IAS</p> <p>Remove feral mammals on islands to help create climate refuges for native species</p> <p>Develop native fauna recovery plans (long-term management of invasive predator control)</p> <p>Environmental hygiene plans for climate change emergency crews</p> <p>Environmental stewardship programmes for lands adjacent to</p>

		Remove Zoos and exotic plant botanical gardens from areas prone to extreme events	protected areas
	Low	Ignoring IAS in community climate change adaptation strategies	Mitigate climate change. Poorly planned IAS eradication programmes
		Low	High
	COSTS		

*Note:* There are many activities that can be undertaken that are low cost but potentially high benefit.



*Annex V*

**DRAFT ELEMENTS OF EXPLANATORY GUIDE FOR SCIENTIFIC COMMUNITY TO  
SHARE THE DATA AND DATA TOOLS ON INVASIVE ALIEN SPECIES**

**A. Features of invasive alien species data resources**

1. Key data to monitor biological invasions include (1) alien species occurrence and status both its native and known introduced range (2) extent of invasion and impact that a species has on biodiversity and ecosystems.<sup>24</sup>
2. Associated data on species taxonomy and identification, ecology of species including habitat, lifecycle stages pertinent to invasions stages, dates of introduction, type of introduction and pathways of introduction and secondary spread are of crucial importance in the management of this threat. These data serve a suite of stakeholders ranging from policymakers, government and biosecurity related officials to practitioners and communities.
3. Global, regional, national and local level data tools some covering all taxonomical groups and some specific are available to stakeholders. The information below is a list of key data components and data tools that provide this type of data and information and a list of key databases with a brief description:
  - (a) Species and related taxonomy and identification EXPAND each of the points and provide links to tools? Examples of key data tools that provide this type of information are the Global Biodiversity Information Facility (GBIF) (<https://www.gbif.org/>); World Register of Marine Species (WoRMS) (<http://www.marinespecies.org/>); FishBase (<https://fishbase.org/>); Plant List (<http://www.theplantlist.org/>); The Reptile Database (<http://www.reptile-database.org/>); AlgaeBase (<https://www.algaebase.org/>);
  - (b) Ecology of species including habitat, lifecycle stages etc. Examples of key data tools that provide this type of information are the Global Invasive Species Database (GISD) (<http://www.iucngisd.org/gisd/>); CABI Invasive Species Compendium (ISC) (<https://www.cabi.org/isc/>); FishBase (<https://fishbase.org/>);
  - (c) Native range of species and known introduced range. Examples of key data tools that provide this type of information are the Global Invasive Species Database (GISD) (<http://www.iucngisd.org/gisd/>); Global Register of Introduced and Invasive Species (GRIIS) (<http://www.griis.org/>); CABI Invasive Species Compendium (ISC) (<https://www.cabi.org/isc/>); FishBase (<https://fishbase.org/>); European Alien Species Information Network (EASIN) (<https://easin.jrc.ec.europa.eu/easin/#>); Pacific Islands Ecosystems at Risk (PIER) (<http://www.hear.org/pier/>);
  - (d) Biological status in introduced range including abundance, occurrence (extent of spread) and invasiveness. Examples of key data tools that provide this type of information are the Global Invasive Species Database (GISD) (<http://www.iucngisd.org/gisd/>); Global Register of Introduced and Invasive Species (GRIIS) (<http://www.griis.org/>); CABI Invasive Species Compendium (ISC) (<https://www.cabi.org/isc/>); FishBase (<https://fishbase.org/>); European Alien Species Information Network (EASIN) (<https://easin.jrc.ec.europa.eu/easin/#>); Pacific Islands Ecosystems at Risk (PIER) (<http://www.hear.org/pier/>); World Register of Introduced Marine Species (WRiMS) (<http://www.marinespecies.org/introduced/>);

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<sup>24</sup> McGeoch, M.A. and Squires, Z. (2015) An Essential Biodiversity Variable approach to monitoring biological invasions: Guide for Countries. GEO BON Technical Series 2, 13 pp.  
<http://www.geobon.org/Downloads/reports/GEOBON/2015/MonitoringBiologicalInvasions.pdf>

(e) Dates of introduction or first report. Examples of key data tools that provide this type of information Global Invasive Species Database (GISD) (<http://www.iucngisd.org/gisd>); Global Register of Introduced and Invasive Species (GRIIS) (<http://www.griis.org/>); World Register of Introduced Marine Species (WRiMS) (<http://www.marinespecies.org/introduced/>); Database on Introductions of Aquatic Species (DIAS) (<http://www.fao.org/fishery/dias/en>);

(f) Type of introduction- intentional or unintentional. Examples of key data tools that provide this type of information are the Global Invasive Species Database (GISD) (<http://www.iucngisd.org/gisd>); Global Register of Introduced and Invasive Species (GRIIS) (<http://www.griis.org/>); CABI Invasive Species Compendium (ISC) (<https://www.cabi.org/isc>); FishBase (<https://fishbase.org/>); European Alien Species Information Network (EASIN); Pacific Islands Ecosystems at Risk (PIER) (<http://www.hear.org/pier/>); World Register of Introduced Marine Species (WRiMS) (<http://www.marinespecies.org/introduced/>); Database on Introductions of Aquatic Species (DIAS) (<http://www.fao.org/fishery/dias/en>);

(g) Pathways of introduction and spread. Examples of key data tools that provide this type of information are the Global Invasive Species Database (GISD) (<http://www.iucngisd.org/gisd>); Global Register of Introduced and Invasive Species (GRIIS) (<http://www.griis.org/>); CABI Invasive Species Compendium (ISC) (<https://www.cabi.org/isc>); FishBase (<https://fishbase.org/>); European Alien Species Information Network (EASIN); Pacific Islands Ecosystems at Risk (PIER) (<http://www.hear.org/pier/>); World Register of Introduced Marine Species (WRiMS) (<http://www.marinespecies.org/introduced/>); Database on Introductions of Aquatic Species (DIAS) (<http://www.fao.org/fishery/dias/en>);

(h) Mechanisms of impact, outcomes of these impacts and ecosystem services impacted. EICAT, SEICAT. Examples of key data tools that provide this type of information are the Global Invasive Species Database (GISD) (<http://www.iucngisd.org/gisd>); Global Register of Introduced and Invasive Species (GRIIS) (<http://www.griis.org/>); CABI Invasive Species Compendium (ISC) (<https://www.cabi.org/isc>).

## **B. Examples of databases on alien species and invasive alien species**

4. The below shows a list of global databases on alien species and invasive alien species:

(a) **IUCN Invasive Species Specialist Group- Global Invasive Species Database (GISD)**

Presents data and information in the form of species profiles, focus is on alien and invasive species that have environmental impacts

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

(b) **CABI Invasive Species Compendium (ISC)**

Presents data and information in the form of species profiles, focus is both on weeds, pests and diseases of agriculture and those that have environmental impacts. Also, offers a function of conducting Horizon scanning exercises <<https://www.cabi.org/isc/>>

(c) **IUCN Invasive Species Specialist Group- Global Register of Introduced and Invasive Species (GRIIS)**, presents annotated and verified checklists of introduced and invasive species. Checklists are available at GRIIS.org (both draft and verified), published through the Integrated Publishing Tool of the Global Biodiversity Information Facility (GBIF) and available as part of country profiles of the Convention on Biological Diversity. GRIIS is a product of the Global Invasive Alien Species Information Partnership (GIASI Partnership)

<<http://www.griis.org/>>

<<https://www.gbif.org/dataset/0c0ac27f-c7cb-4a1a-b5d7-6d9a386b2c53>>

5. The below shows examples of Regional and sub-Regional databases:

(a) **Pacific Islands Ecosystems at Risk (PIER)** presents data in the form of species factsheets with distribution records; provides listings and descriptions of plant species that threaten ecosystems of the Pacific islands. Also listed are many other invasive and potentially invasive plant species present in and around the Pacific region <<http://www.hear.org/pier/>>;

(b) **European Alien Species Information Network (EASIN)** is an initiative of the Joint Research Centre of the European Commission. It facilitates the exploration of existing Alien Species information from a variety of distributed information sources through freely available tools and interoperable web services, compliant with internationally recognized standards. <<https://easin.jrc.ec.europa.eu/easin/#>>;

(c) **The European Network on Invasive Alien Species (NOBANIS)** was established as a network initiated with funding by the Nordic Council of Ministers. One of the main goals is to provide tools for implementing the precautionary approach against the unintentional dispersal of invasive alien species. It also establishes regional cooperation to aid countries in eradication, control and mitigation of these species. The NOBANIS network has a national focal point in each of the participating countries - Austria, Belarus, Belgium, Czechia, Denmark, Estonia, Faroe Islands, Finland, Germany, Greenland, Iceland, Ireland, Latvia, Lithuania, the Netherlands, Norway (incl. Svalbard and Jan Mayen), Poland, Slovakia, Sweden and the European part of the Russian Federation. The network has grown over time, and more countries are expected to join in the future;

(d) **East and South European Network for Invasive Alien Species (ESENIS)** is a regional data portal on invasive alien species that provides data from the East and South European countries. Includes species information, first findings, distribution, risk assessment, management information, regulation and guidance. Members include Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Georgia, Greece, Italy, Hungary, Kosovo, North Macedonia, Montenegro, Serbia, Slovenia, Romania, Turkey and Ukraine;

(e) **Caribbean Invasive Alien Species Network (CIASNET)** is the culmination of the efforts of many scientists; national; regional and international organisations is a collaborative effort to address the issue invasive alien species in the Caribbean. It documents some of the key actions to addressing this issue in a way that promotes the actions. It will also give details on a range of IAS of importance to the Caribbean while highlighting the people and organisations that are pioneering the work with these species that can potentially threaten our health and livelihoods; disrupt both intra-regional and international trade and impact our environment by threatening native and endemic Caribbean biodiversity. It is intended that this will be a one stop shop for information on invasive alien species in the Caribbean;

<<http://www.ciasnet.org/ciasnet-org/>>

(f) **European and Mediterranean Plant Protection Organization (EPPO)** is an intergovernmental organization responsible for cooperation in plant health within the Euro-Mediterranean region. Founded in 1951 by 15 European countries, EPPO now has 52 members (shown in green on the map). Its objectives are to protect plants, by developing international strategies against the introduction and spread of pests which are a threat to agriculture, forestry and the environment, and by promoting safe and effective pest control methods. Following the terms of the International Plant Protection Convention (IPPC), EPPO is a Regional Plant Protection Organization and thus participates in global discussions on plant health. EPPO is a standard-setting organization which has produced many Standards in the areas of plant protection products and plant quarantine. These Standards constitute recommendations that are addressed to the National Plant Protection Organizations of EPPO member countries <<https://www.eppo.int/>>.

6. The below shows examples of taxon-specific and topical databases containing information on invasive alien species:

(a) **FishBase** is a global biodiversity information system on non-fish marine organisms. It provides key facts on population dynamics for 200 major commercial fish, by having a wide range of information on all species currently known in the world: taxonomy, biology, trophic ecology, life history, and uses, as well as historical data reaching back to 250 years. You can query FishBase by country for introduced species, <https://www.fishbase.de/search.php>;

(b) **SeaLifeBase** is a global biodiversity information system on non-fish marine organisms. It provides information on commercially important/exploited, threatened, invasive and charismatic species <https://www.sealifebase.ca/>;

(c) **Global Naturalized Alien Flora (GloNAF)**

GloNAF is a living database project about alien plant species, <https://glonaf.org>;<sup>25</sup>

(d) **The Global Avian Invasions Atlas (GAVIA)** is a database of alien bird distributions worldwide <https://www.kaggle.com/figshare/the-global-avian-invasions-atlas>;<sup>26</sup>

(e) **World Animal Health Information System (WAHIS)** provides a comprehensive range of information including:

- (i) Immediate notifications and follow-up reports submitted by Country / Territory Members notifying exceptional epidemiological events current in their territory
- (ii) Six-monthly reports stating the health status of OIE-listed diseases in each Country / Territory.
- (iii) Annual reports providing health information and information on the veterinary staff, laboratories and vaccines, etc.

[https://www.oie.int/wahis\\_2/public/wahid.php/Wahidhome/Home](https://www.oie.int/wahis_2/public/wahid.php/Wahidhome/Home)  
[https://www.oie.int/wahis\\_2/public/wahidwild.php#](https://www.oie.int/wahis_2/public/wahidwild.php#).

7. Data content for these data tools come from a variety of sources which includes: from national governments, scientists and researchers, practitioners and even citizen science. With the advancements in communication technology much data is captured and available in real time (see Early Detection and Distribution Mapping System (EDDMaPS) <https://www.eddmaps.org/>).

8. Open access to data and seamless integration of these data between data tools and availability of the data to stakeholders is imperative for better management and monitoring of this threat.

9. The global level data tools such as the GISD, GRIIS and CABI ISC provide a suite of key data types required by stakeholders. CABI ISC also offers users a Horizon scanning tool (beta) (<https://www.cabi.org/publishing-products/horizon-scanning-tool/>), a decision support aid to help users identify potential invasive species threats to a country, state or province. However, some gaps exist in terms of better availability and access to some data types in formats that are easy to use by stakeholders. One example is data and information on pathways of introduction and spread and tools and management measures available to manage prevention of introduction.

10. Increased interaction between data generators, data providers and experts are proving a valuable aspect of improving quality of data. One example is the development of country checklists for the GRIIS. Data is verified by a global network of country editors that primarily includes scientists and researchers working actively on invasions biology in their countries; officials from National Departments of

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<sup>25</sup> van Kleunen M. et al. (2015) Global exchange and accumulation of non-native plants. *Nature* 525: 100–103

<sup>26</sup> Dyer, E. E., Redding, D. W. & Blackburn, T. M. The Global Avian Invasions Atlas-a database of alien bird distributions worldwide. *bioRxiv* doi:dx.doi.org/10.1101/090035 (2016)

Environment are also country editors ensuring national engagement in this process. This engagement with country experts has greatly improved the quality of data and its currency.

11. Emerging initiatives such as EICAT focused on magnitude of impacts, Horizon scanning and the undertaking of risk assessments are decision support tools that are well served by the availability and access to good quality and current data.

### **C. Guidelines for appropriate uses of the Environmental Impact Classification of Alien Taxa**

12. Under this section a new data initiative to classify biological invasion impact of alien species on biodiversity.

13. The Environmental Impact Classification of Alien Taxa (EICAT) protocol has been developed to compare the severity and type of environmental impacts of alien taxa in a simple, transparent and evidence-based manner.<sup>27,28</sup> It is in the process of being adopted as a standard by the International Union for the Conservation of Nature (IUCN):<sup>29</sup>

(a) There are three main elements of any EICAT assessment:

- (i) The protocol used to perform EICAT assessments (EICAT protocol),<sup>27,28,29</sup>
- (ii) Data collected and assessed using the EICAT protocol (EICAT data),<sup>30</sup>
- (iii) Classifications per taxon using the data collected with the EICAT protocol (EICAT classifications). Distinguishing these three main aspects is important for the guidelines for appropriate use, as different applications would take advantage of different aspects of EICAT.

(b) The EICAT protocol has been applied to a broad variety of taxonomic groups, mainly for research purposes. This includes the following: birds,<sup>31</sup> amphibians,<sup>31</sup> reptiles,<sup>32</sup> some gastropods,<sup>33</sup> some marine fish,<sup>34</sup> bamboos,<sup>35</sup> some mammals.<sup>36</sup> These studies demonstrate that EICAT is

<sup>27</sup> Blackburn, T.M., Essl, F., Evans, T., Hulme, P.E., Jeschke, J.M., Kühn, I., Kumschick, S., Mrugała, A., Marková, Z., Nentwig, W., Pergl, J., Pyšek, P., Rabitsch, W., Ricciardi, A., Richardson, D.M., Sendek, A., Vilà, M., Wilson, J.R.U., Winter, M., Genovesi, P. and Bacher, S., 2014. A unified classification of alien species based on the magnitude of their environmental impacts. *PLoS Biology* 12(5): e1001850.

<sup>28</sup> Hawkins, C.L., Bacher, S., Essl, F., Hulme, P.E., Jeschke, J.M., Kühn, I., Kumschick, S., Nentwig, W., Pergl, J., Pyšek, P., Rabitsch, W., Richardson, D.M., Vilà, M., Wilson, J.R.U., Genovesi, P. and Blackburn, T.M., 2015. Framework and guidelines for implementing the proposed IUCN Environmental Impact Classification for Alien Taxa (EICAT). *Diversity and Distributions*, 21, 1360-1363.

<sup>29</sup> <https://www.iucn.org/theme/species/our-work/invasive-species/eicat>

<sup>30</sup> Evans, T., Kumschick, S. and Blackburn, T.M., 2016. Application of the Environmental Impact Classification for Alien Taxa (EICAT) to a global assessment of alien bird impacts. *Diversity and Distributions*, 22, 919-931.

<sup>31</sup> Kumschick, S., Measey, G.J., Vimercati, G., de Villiers, F.A., Mokhatla, M.M., Davies, S.J., Thorp, C.J., Rebelo, A.D., Blackburn, T.M. and Kraus, F., 2017. How repeatable is the Environmental Impact Classification of Alien Taxa (EICAT)? Comparing independent global impact assessments of amphibians. *Ecology and Evolution*, 7, 2661-2670.

<sup>32</sup> Kraus, F., 2015. Impacts from invasive reptiles and amphibians. *Annual Review of Ecology, Evolution, and Systematics*, 46, 75-97.

<sup>33</sup> Kesner, D. and Kumschick, S., 2018. Gastropods alien to South Africa cause severe environmental harm in their global alien ranges across habitats. *Ecology and Evolution*, 8, 8273-8285.

<sup>34</sup> Galanidi, M., Zenetos, A. and Bacher, S., 2018. Assessing the socio-economic impacts of priority marine invasive fishes in the Mediterranean with the newly proposed SEICAT methodology. *Mediterranean Marine Science*, 19(1), 107-123.

<sup>35</sup> Canavan, S., Kumschick, S., Le Roux, J.J., Richardson, D.M. and Wilson, J.R., 2019. Does origin determine environmental impacts? Not for bamboos. *Plants, People, Planet*, 1(2), 119-128.

<sup>36</sup> Hagen, B. and Kumschick, S., 2018. The relevance of using various scoring schemes revealed by an impact assessment of feral mammals. *Neobiota*, 38, 37-75.

applicable across a wide range of taxa and habitats. None of these assessments have been reviewed and signed off by the EICAT Authority to date due to these formal processes still being developed, but this step will be a necessary requirement for them to be accepted and published by the IUCN and to ensure consistent application of the protocol.

14. Table 1 below outlines the potential applications of EICAT for invasive alien species management.

**Table 1. Examples of appropriate and inappropriate applications for invasive alien species management**

Types of uses	Appropriate uses	Inappropriate uses
<i>Policy and legislation</i>		
International/national/sub-national legislation and policy	EICAT can inform the development of: - International and National strategies to manage biological invasions - International, national, regional, and local regulations on alien and invasive species	Putting an alien taxon on a regulated list just because of its EICAT classification
International agreements	Guiding and informing decisions in international conventions and agreements, including: Convention on Biological Diversity; Sustainable Development Goals (SDG); International Plant Protection Convention (IPPC); World Organisation for Animal Health (OIE).	Automatically banning an alien species from trade because of its EICAT classification
<i>Development planning and environmental review</i>		
Regional and national resource management and development	Using EICAT data to inform natural resource management at various scales	Relying solely on information from EICAT for local planning
Site-level planning and Environmental Impact Assessment	EICAT can be used to feed into site level evaluation and EIA	Relying solely on information from EICAT to do site-level planning without taking local conditions into account
<i>Conservation planning</i>		
Informing conservation action for native species	EICAT data can provide important information on native species threatened by alien species	Managing an alien taxon solely based on its impact on a specific native species. Additional relevant data sources need to be considered for any management
Risk-assessment of alien species	EICAT data and classifications can be used to inform risk-assessment procedure	EICAT classification alone should not be used to evaluate the level of risk posed by an alien species. A higher tier classification (MO or higher) of a taxon does not necessarily imply a risk for the target area



<b>Types of uses</b>	<b>Appropriate uses</b>	<b>Inappropriate uses</b>
Informing management of alien species	EICAT data and classifications can feed into prioritisation of alien taxa for management	EICAT classification alone should not be used to justify management actions against an alien taxon. A higher tier classification (MO or higher) of a taxon does not necessarily warrant or require any action
Prioritising management of areas threatened by biological invasions	EICAT data and classifications can feed into area prioritisation	The presence of a taxon classified with EICAT in an area does not necessarily warrant any action, even if the taxon has an upper tier impact of Moderate or higher. Area specific conditions with regards to the alien taxon need to be taken into account, as well as the local impact (actual and potential) and the features of the area to be protected. In some cases, managing an alien taxon will not restore the required features of an area
<i>Monitoring and evaluation</i>		
Evaluating the state of invasion and monitoring changes in the state of invasion	EICAT can be used as an indicator for the impact of biological invasions	
Measuring the effectiveness and impact of control activities	The EICAT protocol can be used to assess information on impacts of a certain population of an alien species before and after control measures have been implemented at a site. The resulting data can show the effectiveness of control measures, and the resilience of a system with regards to the impacts caused	Management at a local scale does not necessarily lead to a decrease in the impacts of a species at a global scale. Furthermore, the global impact classifications as supported by the IUCN are not suitable to reflect changes in impacts due to management actions, as they consist of the maximum impact ever recorded.

<b>Types of uses</b>	<b>Appropriate uses</b>	<b>Inappropriate uses</b>
Documenting species with low impacts	EICAT does not only allow for the classification for severe impacts, but it ranges from classifying evidence on no and low impacts on native species (MC and MN respectively) up to high impacts. This should encourage the publication of results of taxa which had low impacts on the recipient systems.	Species which are classified as causing impacts of Minor (MN) or Minimal Concern (MC) magnitude should not automatically be considered as safe. These low impacts could be found for several reasons, for example: i) the alien species genuinely does not pose a threat to cause high impacts, ii) the introduced populations have not had the opportunity to cause high impacts due to e.g. lag times or low propagule pressure, iii) no population of the alien species has been documented to have high impacts even though they are causing high impacts (lack of data for higher magnitude impacts)
Documenting extirpation or eradication	The EICAT protocol can be used to classify studies on impacts or legacy effects after an alien taxon has been removed and can facilitate the understanding of whether these impacts are reduced after removal.	EICAT data should not be used as supporting evidence for a successful eradication
<i>Scientific research</i>		
Informing species-specific studies	Use gaps identified in the information on impacts of specific species, or lack thereof (e.g., species classified as Data Deficient), to guide research	EICAT classifications do not replace field studies – in turn, field studies are needed to populate EICAT
Informing research on multiple species and invasion processes	Using EICAT data to show patterns and trends related to alien and invasive species impacts, including potential future threats	
Predicting impacts of alien species	EICAT data can feed into trait-based studies and	EICAT classifications cannot be used to predict impacts of a taxon in a new area
<i>Education, communication and awareness raising</i>		
Education	Informing academic work across educational levels, for example school assignments, undergraduate essays and dissertations	

Types of uses	Appropriate uses	Inappropriate uses
Media	Promoting knowledge on alien and invasive species, their impacts on native biodiversity, biodiversity conservation issues, risks to biodiversity	
Fund-raising	Providing a solid evidence-base for funding proposals to engage in work on alien and invasive species and conservation of native biodiversity	

*Note:* The structure and content of this table are based on the Guidelines for appropriate uses of IUCN Red List data (see IUCN, 2016. Guidelines for appropriate uses of IUCN Red List Data. Version 3.0. Adopted by the IUCN Red List Committee).

### SUGGESTED ADVICE

15. The capacities to act upon and control invasions differs greatly between countries<sup>37</sup>, not defined. Standardizing and globalising the process of impact assessment within a framework such as EICAT can aid countries with less monetary or human resources to develop policies and priorities for tackling biological invasions based on the known impacts of invasions.

16. However, the EICAT does not replace the formal risk analysis processes by Parties, referring to the existing international standards, guidelines, recommendations or other guidance relevant to invasive alien species.

17. Parties to the Convention may use the records of the EICAT to find a level of hazardous impact posed by an alien species, for the purpose of classification of, and considering appropriate labeling on a consignment of living organisms to inform all stakeholders involved in trade, transport and possession and use of alien species.

<sup>37</sup> Early, R., Bradley, B.A., Dukes, J.S., Lawler, J.J., Olden, J.D., Blumenthal, D.M., Gonzalez, P., Grosholz, E.D., Ibañez, I., Miller, L.P. and Sorte, C.J., 2016. Global threats from invasive alien species in the twenty-first century and national response capacities. *Nature Communications*, 7, 12485.

*Annex VI*

**DRAFT ADVICE TO ADDRESS THE ISSUE OF INVASIVE ALIEN SPECIES AS ENVIRONMENTALLY HAZARDOUS ARTICLES AMONG THE OFFICIALS IN TRANSPORT, BORDER CONTROLS AND THE STAKEHOLDERS OF TRADE IN LIVING ORGANISMS**

**INTRODUCTION**

1. Dangerous goods are subject to transport, workplace, storage, consumer and environment protection regulations, to prevent accidents to persons, property or the environment, to other goods or to the means of transport employed. Under the United Nations systems, a mechanism for the harmonization of hazard classification criteria and communication tools, and for transport conditions for all modes for transport at the ECOSOC Sub-Committee of Experts on the Transport of Dangerous Goods (TDG Sub-Committee).
2. At its 55<sup>th</sup> session of the TDG Sub-Committee environmentally hazardous articles (living organisms) were considered. The TDG Sub-Committee invited experts on invasive alien to the 56<sup>th</sup> session to continue this work.

**SUGGESTED ADVICE**

- (a) Experts on invasive alien species to provide evidence on the impacts and assessed risks on alien species to the Secretariat of the Convention on Biological Diversity to prepare an informal document to explain on: (i) the issue of invasive alien species in the environment and biodiversity in details; (ii) risk to transport sector and the community in the destination, as well as countries of transition for the consignment containing living organisms; and submit the document to the 56<sup>th</sup> session of the TDG Sub-Committee in 2020;
- (b) Taking into account the range of impacts on biodiversity, experts on invasive alien species to advise on classification on transport consignments containing living organisms;
- (c) The Inter-agency Liaison Group on Invasive Alien Species to present the information prepared by the action in (a) and (b) above at its 56<sup>th</sup> session of the TDG Sub-Committee;
- (d) The Subsidiary Body on Scientific Technical and Technological Advice to consider the transport of living organisms in confined condition and globally harmonized communication tool on the risk of biological invasions targeting broad sectors.

*Annex VII*

**DRAFT ELEMENTS OF TRAINING GUIDE TO FULFILL THE CAPACITY REQUIRED FOR  
APPLICATION OF TOOLS**

**INTRODUCTION**

1. Given the circumstance that existing international regulatory framework related to invasive alien species calls for measures based on scientific evidence. To apply such measures development of technical and scientific capacity in broad sectors is vital to address the issue of invasive alien species.
2. Existing technical and scientific expertise can be found in broad sectors, including academics. Coordination of existing expertise and sharing responsibilities and facility available within the country or through international cooperation can help fast and effective capacity development to apply new technologies.
3. Technical skills for identification of taxa and knowledge on ecological behavior of the organisms concerned are fundamental to apply any tools to address the issue of invasive alien species, e.g. identifying alien species, assessing their invasion risk, advising on risk reduction options and undertaking early detection, monitoring and reporting on any invasive alien species occurrences.
4. International cooperation in capacity development should be enhanced under the United Nations system and relevant international organizations.

**SUGGESTED ELEMENTS**

5. Advice on setting a training programme at the national or regional level inviting broad sectors, especially academics and scientific expert organizations within a country or region. Training programme may include the following elements:
  - (a) How to incorporate invasive alien species management in National Biodiversity Strategies and Action Plans as a priority;
  - (b) How to communicate and implement the training programme with implementation supporting bodies (e.g. UNEP, UNDP, CABI and other partner organizations to the Convention on Biological Diversity);
  - (c) Proposal writing training to initiate a training programme taking into account the financial mechanism for the implementation of the Convention on Biological Diversity or any relevant international fund for capacity development (e.g. Global Environment Facility, Standard Trade Development Facility);
  - (d) Advice on evaluation of existing capacity in taxonomy, ecology, invasion biology to apply international standards for regulatory organizations under the national government;
  - (e) Technical manuals written in plain language for broad sectors for their continuing learning:
    - (i) Taxonomic identification of organisms, e.g. DNA barcoding;
    - (ii) How to apply sanitary and phytosanitary measures to prevent spread of invasive alien species (see also Annex I to this document);
    - (iii) How to use shared information on invasive alien species for national policy setting and implementation;
    - (iv) How to apply classical biological control agents against invasive alien species (e.g. CBD Technical Series No.91);

- (v) Multi-criteria decision support manual for policy makers (see also Annex IV to this document);
- (vi) Model regulatory act on invasive alien species with shared responsibility among broad sectors to implement;
- (vii) Management manuals for broad sectors to communicate on invasive alien species among different stakeholders, including indigenous peoples and local communities;
- (viii) How to manage financial portfolios of programmes and sustain capacity development for a long-term.

*Annex VIII*

**DRAFT ELEMENTS OF PUBLICATION OF BEST PRACTICES FOR INVASIVE ALIEN SPECIES MANAGEMENT**

1. In this annex, the key components of a best practice management approach are highlighted and illustrated. A number of key generic and specific (invasive alien species type and management approach) best practice management publications are listed and annotated.

**A. How to develop a best practice management plan**

2. Understanding best practice for any particular action comes from a number of key collective activities:

(a) Engage all stakeholders in management best practice development, and where there is a geographic context, include local and indigenous communities to co-develop best practice management to ensure all value sets and viewpoints are considered;

(b) Review the relevant published literature (scientific publication internet search);

(c) Review of the grey literature – information available on the web through agency websites (keyword general internet search);

(d) Access to expert knowledge – identifying key experts with relevant diverse skills and backgrounds and collating knowledge either through a questionnaire, structured interviews or via a facilitated expert elicitation workshop;

(e) Uncertainty analysis – investigates the uncertainty of all aspects that are used in decision-making around management actions in which imprecise knowledge is used and the contexts of decision making vary. Uncertainty analysis aims to quantify and explicitly state areas of uncertainty in management actions ([https://en.wikipedia.org/wiki/Uncertainty\\_analysis](https://en.wikipedia.org/wiki/Uncertainty_analysis));

(f) Plan implementation - with a goal of understanding and developing best practice through an Adaptive Management Approach or an *Active Adaptive Management Approach*.

(i) “*Adaptive Management* also known as adaptive resource management (ARM) or adaptive environmental assessment and management (AEAM), is a structured, iterative process of robust decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring. Adaptive management is a tool which should be used not only to change a system, but also to learn about the system. Because adaptive management is based on a learning process, it improves long-run management outcomes. The challenge in using the adaptive management approach lies in finding the correct balance between gaining knowledge to improve management in the future and achieving the best short-term outcome based on current knowledge. This approach has more recently been employed in implementing international development programmes” ([https://en.wikipedia.org/wiki/Adaptive\\_management](https://en.wikipedia.org/wiki/Adaptive_management));

(ii) “Active Adaptive Management explicitly incorporates learning as part of the objective function, and hence, decisions which improve learning are valued over those which do not.

**Case study: Considering the social dimension of invasive species adaptive management**

Marshall et al. (2011)<sup>38</sup> considered the social dimensions of buffel grass management in central Australia. Buffel grass (*Cenchrus ciliaris*) is highly prized by many pastoralists in Australia as an introduced pasture grass for livestock but it also has significant and deleterious environmental

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<sup>38</sup> Marshall, N.A., Friedel, M., van Klinken, R.D. and Grice, A.C., 2011. Considering the social dimension of invasive species: the case of buffel grass. *Environmental Science & Policy*, 14(3), 327-338.

impacts. Identifying management strategies that minimize environmental impacts yet support production benefits is crucial for achieving sustainable outcomes. Management of negative impacts depends on the support and co-operation of people who regard the species as an asset. Marshall et al. developed and operationalized a framework for assessing social and economic dependency on buffel grass and the capacity of pastoralists to change their buffel grass management. By interviewing 85 pastoralists across four diverse regions in Australian rangelands they understood how pastoralists are dependent on buffel grass to varying degrees. The social and economic components of this dependency were associated with pastoralists capacity to adapt attitudes towards managing buffel grass and their perceptions of acceptable management strategies on grazing lands and on public land of high environmental value such as National Parks. Building strong social networks amongst buffel grass stakeholders was a priority for the development of sustainable best practice buffel grass management strategies. This study suggested five dimensions to consider when assessing invasive alien species dependency:

- formal and informal networks (social capital),
- values and attitudes to the invasive alien species,
- flexibility to new approaches,
- financial status,
- current environmental practices and attitudes

and four dimensions for adaptive capacity:

- perceptions of risk associated with adapting invasive alien species management strategies
- capacity to cope with changes in invasive alien species management
- capacity to reorganize land management practices
- level of interest in the environmental costs and benefits of invasive alien species.

## **B. Annotated existing international best practice management plan handbooks, toolkits, guidelines relevant for invasive alien species**

### *1. General land management best practice management publications*

(a) *The Conservation Handbook: Research, Management and Policy*. Sutherland WJ, John Wiley & Sons, 2008. This handbook aims to provide clear guidance on the implementation of conservation techniques. The wide range of methods described include those for ecological research, monitoring, planning, education, habitat management and combining conservation with development. Nineteen case studies illustrate how the methods have been applied. While the book does not explicitly address invasive alien species management, the best practice approaches identified and the need to record where and how conservation management is effective present a foundation for how invasive alien species management should be approached;

(b) *Habitat Management for Conservation: A Handbook of Techniques*. Ausden M, Oxford University Press, 2007. Habitat management is commonly used to maintain and enhance biodiversity benefits of many areas of semi-natural habitat where natural processes no longer create suitable conditions for desired species. This practical handbook describes the general principles and techniques of managing and creating habitats throughout the world, describing general principles of managing land for biodiversity conservation. This includes decision-making, mitigating the damaging effects of climate change, and monitoring the success of management. There are habitat specific chapters: grasslands, shrublands, forests, scrub, freshwater wetlands, coastal habitats, arable land, urban areas and gardens, highlighting key decisions that need to be made, describing and comparing the effectiveness of individual



management techniques. It emphasizes the need to adapt past management techniques while introducing new ones;

(c) *Ecological restoration for protected areas: principles, guidelines and best practices.* Cairns S, Dudley N, Hall C, Keeneleyside K & Stolton S, *Best Practice Protected Area Guidelines Series IUCN*, (vol 18), 2012. This publication provides guidance for terrestrial, marine and freshwater protected area managers on the restoration of natural and associated values of protected areas. It introduces key concepts and provides advice on underlying principles and guidelines, technical best practices, and implementation processes. It addresses both system and site levels of restoration of natural and associated values of protected areas to address ecosystem fragmentation and maintain well-connected protected area systems. It includes many examples and several case studies that illustrate on-the-ground experiences with ecological restoration in and around protected areas across the globe;

(d) *Cost- effective ecological restoration.* *Restoration Ecology*, 23(6), pp.800-810. Kimball S, Lulow M, Sorenson Q, Balazs K, Fang YC, Davis SJ, O'Connell M & Huxman TE, 2015. This paper presents cost- effectiveness analysis of terrestrial restoration methods to determine how practitioners may restore the highest native plant cover per dollar spent. It records costs of 120 distinct methods and described success in terms of native versus non- native plant germination, growth, cover, and density. An index of cost- effectiveness (% native cover per dollar spent on restoration) is developed and evaluates success of multiple methods, given environmental variation across topography and multiple years. A decision- making trees to guide practitioners through established phases of restoration—*site preparation, seeding and planting, and maintenance* is also developed;

(e) *A checklist for ecological management of landscapes for conservation.* *Ecology letters*, 11(1), pp.78-91. Lindenmayer D, Hobbs RJ, Montague- Drake R, Alexandra J, Bennett A, Burgman, M, Cale P, Calhoun A, Cramer V, Cullen P & Driscoll D, 2008. This paper assesses six major themes in the ecology and conservation of landscapes, identifying 13 important issues that need to be considered in developing approaches to landscape conservation. The importance of landscape mosaics, interactions between vegetation cover and configuration, maintaining a capacity to recover from disturbance and managing landscapes in an adaptive framework are recognized and influenced by landscape context, species assemblages and management goals.

## 2. *Invasive alien species best practice management publications*

(a) *Invasive Alien Species: a Toolkit of Best Prevention and Management Practices.* Wittenberg R & Cock MJ eds., CABI. 2001. This book is associated with the Global Invasive Species Programme (GISP) established to address concerns with alien invasive species, formulated in the Convention on Biological Diversity. The book provides tools to improve prevention and management of biological invasions assembled by a team of international experts. It includes a) case studies from around the globe, with some emphasis on islands; b) a focus on biodiversity, but with some consideration of traditional agriculture, and c) advice on national management plans, including risk analysis;

(b) *What can decision analysis do for invasive species management? Risk Analysis: An International Journal*, 24(4), pp.859-868 Maguire LA, 2004. Paper applies decision analysis into an invasive alien species context considering uncertain outcomes, multiple and conflicting objectives, and many interested parties with differing views on both facts and values. It describes the importance of social values and preferences that must inform invasive species management. It contextualizes risk analysis with the complexities of invasive alien species social values and scientific knowledge to help invasive species management responsive to both good science and public values. The case study is feral pigs in Hawaiian ecosystems;

(c) *Guidelines for addressing invasive species in protected areas.* In *Plant invasions in protected areas* (pp. 487-506). Springer, Dordrecht, Genovesi P & Monaco A, 2013. This book chapter reviews best practice cases to propose broad set of guidelines to deal with invasive alien species,

discussing the challenges and opportunities in protected areas. Recommendations are provided on all aspects related to invasive species, from raising awareness within the public and decision makers, to developing staff capacity, encouraging responsible behaviour, implementing prevention actions, improving the ability to react promptly to new incursions, developing surveillance and monitoring frameworks, and integrating invasive species into broader management plans;

(d) *Invasive Species Management: a Handbook of Principles and Techniques*. Oxford University Press, Clout MN & Williams PA eds., 2009. This book provides strategies for managing such species at successive invasion stages, from prevention at the border to control of major infestations. It then describes the general tools and approaches that are recommended for successful management of particular groups of invasive organisms in a range of environments. In each case, the ecological basis and practical requirements of invasive alien species management are addressed.

3. *Invasive alien species best practice management publications for particular management approaches or particular invasive alien species types*

(a) *Australian Weed Management Systems*. RG and FJ Richardson. Sindel BM ed. 2000. This book explains the principles of managing invasive plant populations to demonstrate how these principles are being, could be, or should be applied in practice, in multiple habitat contexts. It reviews across multiple chapters general principles and best practices for a range of invasive plant management individual and integrated approaches;

(b) *The Importance of Weeds in Plant Biosecurity*. In: *The Handbook of Plant Biosecurity*. Springer, Dordrecht Gordh G & McKirdy S eds. pp 613-654, Sheppard AW, Koop AL & Hill R, 2014. This book chapter offers a policy focus describing, a) the Weed Risk Assessment approach and its increasing adoption and the importance of recognising future weed threats in the context of climate change, b) how to know when to eradicate invasive plants versus contain outbreaks, c) integrated and adaptive management options in the specific context of the long-term perennial impacts of weeds, with a particular focus on biological control. A selection of case histories are used to illustrate the complexity and diversity of issues that surround management of invasive plants in the context societal values;

(c) *Detecting and Responding to Alien Plant Incursions*. Cambridge University Press, Wilson JR, Panetta FD & Lindgren C, 2016. This book explores how to detect and respond to alien plant incursions, summarising the most current literature, providing practical recommendations and reviewing the conditions and processes necessary to achieve prevention, eradication and containment;

(d) *Eradication of invasive species: progress and emerging issues in the 21st century*. In: *Invasive species management. A handbook of principles and techniques*. Clout MN & Williams PA eds. Oxford University Press, Oxford, pp.47-60. Parkes JP & Panetta FD, 2009. This book chapter is a definitive guide to global eradication attempts up until 10 years ago. This reviews the successes and failures of the management strategy of eradication—the permanent removal of entire discrete populations. The impediments to eradication success are discussed, and how some of the lessons learnt during this process have contributed to the other strategies (prevention and sustained control) are summarized;

(e) *Application of Biological Control for the Management of Established Invasive Alien Species Causing Environmental Impacts*. Sheppard AW, Paynter Q, Mason P, Murphy S, Stoett P, Cowan P, Brodeur J, Warner K, Villegas C, Shaw R, Hinz H, Hill M & Genovesi P, eds. Technical Report for the IUCN and CBD. IUCN SSC Invasive Species Specialist Group, 2018. This technical report prepared by a team of international experts assembled after a CBD invasive alien species expert meeting came through the Global Invasive Alien Species Information Partnership and compiled information from countries, scientific institutions, and other relevant organizations, to produce an evidence-based assessment of best practice use of classical biological control (CBC) for the management of established invasive alien species that threaten biodiversity and ecosystem services. The report supports the CBD declaration at COP 14 that CBC is a useful approach from managing invasive alien species;

(f) *Requirements for biological control: an ecological perspective. Biocontrol News and Information*, 7(1), pp.7-16. Cock MJW, 1986. The paper reviews the prerequisites for a classical biological control programme from an ecological viewpoint to provide guidelines for making decisions as to when it is appropriate to implement and how to proceed. It is emphasized that the practice of biological control is an aspect of applied ecology. Detailed studies on the population dynamics of pests (arthropods and weeds) before and after the introduction of natural enemies are essential if biological control is to develop into a predictive science, though most programmes are constrained by a lack of funds and manpower;

(g) *Guidelines on information requirements for import and release of invertebrate biological control agents in European countries. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources*, 1(001). Bigler F, Bale JS, Cock MJW, Dreyer H, Greatrex R, Kuhlmann U, Loomans AV & Van Lenteren JC, 2005. These guidelines compile several international documents providing guidance to industry, biocontrol practitioners and competent national regulatory authorities on the regulatory framework for the import and release of invertebrate biological control agents biological control agents;

(h) *Fire management and invasive plants: a handbook*. US Department of the Interior, US Fish & Wildlife Service. Brooks M & Lusk M, 2009. This manual provides practical guidelines for fire managers to effectively integrate invasive plant management activities into their fire management programs. This manual is designed to help land managers bridge the gap between fire and invasive alien species management, and in particular give fire managers the tools they need to integrate invasive plant management strategies into the fire planning process;

(i) *Adaptive management experiments in vertebrate pest control in New Zealand and Australia Wildlife Society Bulletin*, 34(1), pp.229-236. Parkes JP, Robley A, Forsyth DM & Choquenot D, 2006. This paper reports on the processes used to set up the first adaptive management trials in pest control in New Zealand or Australia elucidating benefits and costs of the different strategies used to control the 2 pests. It provides guidance when managers have uncertainty about optimal control strategies.

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