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Item 5 of the provisional agenda*

DEVELOPMENT OF DECISION SUPPORT TOOLS

Note by the Executive Secretary

I. INTRODUCTION

1. At its twelfth meeting the Conference of the Parties to the Convention on Biological Diversity (CBD) requested the Executive Secretary to develop in collaboration with relevant organizations, and taking into consideration the proposed assessment of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on invasive alien species, decision support tools for assessing and evaluating the social, economic and ecological consequences of invasive alien species; cost-benefit analyses for eradication, management and control measures; tools for examining the impact of climate change and land-use change on biological invasions (paragraph 9(c) of decision XII/17).

2. Pursuant to this decision, the Executive Secretary issued notification 2015-052 inviting Parties, other Governments and relevant organizations to provide information related to invasive alien species and undertook a review of the information pertaining to paragraph (c) of decision XII/17.

3. The Secretariat received a total of nineteen submissions of information on decision support tools from Parties, other Governments, relevant organizations and experts, as follows: Australia, Belgium, Canada, Colombia, France, Guatemala, New Zealand, Peru, South Africa and the United Kingdom, the United States of America, Commonwealth Scientific and Industrial Research Organization (CSIRO), Estonian Marine Institute (EMI), Instituto de Investigación de la Amazonía Peruana, International Union of Forest Research Organizations (IUFRO), University of Waikato in New Zealand, Group on Earth Observations Biodiversity Observation Network (GEO-BON) and Humboldt Institute in Colombia. The complete list of submissions is accessible in the CBD website at https://www.cbd.int/invasive/iasem-2015-01-submissions/default.shtml.

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

4. With regard to the thematic assessment of invasive alien species through the process of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the assessment is still ongoing.[1] Therefore, the present document does not contain the information from the IPBES process.

5. Based on the information submitted by Parties, other Government and relevant organizations as mentioned in paragraph 3 above and existing international guidance and information, this note enumerates a series of tools that are used by the national authorities and experts for assessing and evaluating social, economic and ecological consequences of invasive alien species; cost-benefit analyses; and tools for examining the impact of climate change on biological invasions in section II. Section III summarizes some possible components of the requested decision support tools, taking into account the information submitted to the Secretariat on biological control, trade in wildlife as pets, aquarium and terrarium species, and as live bait and live food and e-commerce in order to design the decision support tools in response to paragraph 9(c) of decision XII/17.

II. EXISTING TOOLS TO SUPPORT DECISION MAKING

A. Risk Analysis and its components

1. International guidance set by the standard setting bodies recognized by the World Trade Organization the Agreement on Sanitary and Phytosanitary Measures

Pest Risk Analysis for protection of plants and plant products or the environment:

6. The International Plant Protection Convention (IPPC) sets the International Standards for Phytosanitary Measures (ISPMs) for its contracting Parties to apply phytosanitary measures in trade. ISPM 2: 2007[2] provides the framework of Pest Risk Analysis (PRA) within the scope of protection of plants and plant products. Under the ISPMs, "pest" includes any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products, therefore this standard provides a framework that is applicable for analysis on the risk of alien species becoming invasive to any plant species that are in both production and protected environments. The framework of the pest risk analysis is composed of three stages. Stage 1: the identification of an organism or pathway that may be considered for pest risk assessment (initiation); stage 2: pest risk assessment; and stage 3: pest risk management which includes identification of risk reduction measures and risk communication.

7. ISPM 11: 2013[3] contains further details of the PRA to determine if pests are quarantine pests[4]. It describes the integrated processes to be used for risk assessment as well as the selection of risk management options. The supplementary text on environmental risks (risk of biological invasion) is marked with "S1" in ISPM 11: 2013. It also includes details regarding the analysis of risks of plant pests to the environment and biological diversity, including those risks affecting uncultivated/unmanaged

[1] http://www.ipbes.net/images/documents/plenary/fourth/working/4_10/IPBES-4-10_EN.pdf

[2] https://www.ippc.int/static/media/files/publications/en/1323944382_ISPM_02_2007_En_2011-12-01_Refor.pdf

[3] https://www.ippc.int/static/media/files/publications/en/2014/05/12/ispm_11_2013_en_2014-04-30.pdf

[4] 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 (definition described in ISPM 5:2015)

plants, wild flora, habitats and ecosystems contained in the PRA area. The PRA process contains three stages:

(a) Stage 1 (initiating the process) involves identifying the pest(s) and pathways that are of quarantine concern and should be considered for risk analysis in relation to the identified PRA area;

(b) Stage 2 (risk assessment) begins with the categorization of individual pests to determine whether the criteria for a quarantine pest are satisfied. Risk assessment continues with an evaluation of the probability of pest entry, establishment, and spread, and of their potential economic consequences (including environmental consequences – S1);

(c) Stage 3 (risk management) involves identifying management options for reducing the risks identified at Stage 2. These are evaluated for efficacy, feasibility and impact in order to select those that are appropriate;

(d) In addition, in many countries, authorities other than the national plant protection organization (NPPO) have responsibilities under the CBD with regard to plants intentionally introduced for planting. Therefore, risk communication may be particularly important in relation to plants as pests.

The "Guidelines on assessing the risk of non-native animals becoming invasive" for protection of environment, animal or human health, or the economy (World Organisation for Animal Health-OIE):

8. In the framework of the international movement of animals, it is important to analyze both the risk of a non-native animal becoming invasive and the risk of pathogens being introduced with the animal. These different risks should be assessed as separate, sequential and complementary processes. With regard to pathogens, the OIE standard for import risk analysis provide guidance on assessing animal diseases (including zoonosis) risk prior to export/import decisions for terrestrial and aquatic animals[56].

9. The OIE Guidelines for Assessing the risk of Non-native Animals becoming Invasive was developed to address the complementary process of assessing the biological invasion risk of non-native animals. The principal aim of the guidelines is to provide an objective and defensible method of determining whether the animal species imported are likely to become harmful to the environment, animal or human health, or the economy.

10. The risk analysis process is composed of the following four elements:

(a) *Hazard identification:* In the case of trade in non-native animals, the animal under consideration is the hazard. This hazard should usually be identified to the level of species although in some instances identification to the level of genus may suffice while in others, identification to the level of breed, subspecies, hybrid or biotype may be required.
In the case of so-called hitchhiker organisms, the hazard identification involves identifying species which could potentially produce adverse consequences if introduced in association with an imported commodity (animals or animal products) or the vehicle/vessel or container in which it is imported. It is necessary to identify whether each potential hazard is already present in the importing country or area into which the animals are imported. This is not always easy for animals traded widely for a diversity of commercial and private purposes and which may already be present in private collections;

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[5] http://web.oie.int/eng/normes/fcode/en_chapitre_1.2.2.pdf
[6] http://web.oie.int/eng/normes/mcode/en_chapitre_1.2.1.pdf

(b) *Risk assessment with four stages :*

(i) *Entry assessment* - The probability of the entry of each of the hazards (the non-native animals) under each specified set of conditions with respect to amounts and timing, and how these might change as a result of various actions, events or measures;

(ii) *Establishment and spread assessment* - The probability of establishment and spread of the non-native animals is estimated for the local environment with respect to the number, size, frequency and season of escapes or releases;

(iii) *The consequence assessment* - The potential consequences of a given establishment and spread of the animals and estimates the probability of them occurring. The social (e.g. control or eradication cost, potential trade losses, impacts on socio-cultural values) and biological costs (e.g. harm to ecosystems or native species or human health) associated with the effects of invasive non-native species should be considered;

(iv) *Risk estimation* - The results from the entry assessment, establishment and spread assessment, and consequence assessment to produce overall measures of risks associated with the hazards identified at the outset. Thus risk estimation takes into account the whole of the risk pathway from hazard identified to unwanted outcome.

(c) *Risk management with four sub-components:*

(i) *Risk evaluation* -The process of comparing the risk estimated in the risk assessment with *the* Member's appropriate level of protection;

(ii) *Option evaluation* - The process of identifying, evaluating the efficacy and feasibility of, and selecting measures to reduce the risk associated with an importation in order to bring it into line with the Member's appropriate level of protection. The evaluation for feasibility normally focuses on technical, operational and economic factors affecting the implementation of the risk management options but because the assessment of risk from non-native animals must consider socio-cultural aspects, option evaluation must also consider the cultural, ethical and political acceptability of the various risk management options;

(iii) *Implementation* - The process of following through with the risk management decision and ensuring that the risk management measures are in place;

(iv) *Monitoring and review* - The ongoing process by which the risk management measures are continuously audited to ensure that they are achieving the results intended.

(d) *Risk communication*: Risk communication is the process by which information and opinions regarding hazards and risks are gathered from potentially affected and interested parties during a risk analysis, and by which the results of the risk assessment and proposed risk management measures are communicated to the decision-makers and stakeholders in the importing and exporting

countries. It is a multidimensional and iterative process and should ideally begin at the start of the risk analysis process and continue throughout:

(i) A risk communication strategy should be put in place at the start of each risk analysis;

(ii) The communication of the risk should be an open, interactive, iterative and transparent exchange of information that may continue after the decision on importation;

(iii) The principal participants in risk communication include the authorities in the countries and other stakeholders such as domestic environmental and conservation groups, local communities and indigenous peoples, domestic livestock producers and consumer groups;

(iv) The assumptions and uncertainty in the model, model inputs and the risk estimates of the risk assessment should be communicated;

(v) Peer review is a component of risk communication which is carried out in order to obtain scientific critique and to ensure that the data, information, methods and assumptions are the best available.

Risks posed by Ships' Ballast water and Sediments:

11. The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) was adopted in 2004. Once the Convention comes into force, the management of ballast water should comply with the Convention. Numerous guidelines for the ballast water exchange, risk assessment and risk management measures have been developed and made available on the web site of the International Maritime Organization.[7]

2. Examples submitted by Parties, other Governments and Expert

Australian Weed Risk Assessment

12. Australia is well recognized for its Weed Risk Assessment (WRA) system, which is a national, science-based analysis tool for determining the weed potential of a plant species before it is introduced. The WRA is a scoring system that evaluates weed risk based on the biogeography, biology, ecology and plant attributes of the plant proposed for importation. It also considers the risk of social, economic and environmental consequences that may be associated with the import of a plant. The WRA system has been adopted in many countries around the world, including South Africa, who modified and tailored it for its own national needs. The WRA process is now also being adapted for application to import risk assessment of exotic fish. WRA has been adapted in Australia into a post-border weed risk management

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http://www.imo.org/en/OurWork/Environment/BallastWaterManagement/Documents/Compilation%20of%20relevant%20Guidelines%20and%20guidance%20documents%20-%20October%202015.pdf

tool for setting priorities for action for established invasive alien plants and weeds that has been adopted with some modification by the FAO.[8]

Impact risk assessment for protection of the health of the environment in Belgium:

13. Belgium has introduced new risk assessment protocols Harmonia+ and Pandora+, which are available online and address issues not covered by the Invasive Species Environmental Impact Assessment (ISEIA) protocol.[9] The Harmonia+ framework brings together 30 questions that refer to distinct components of invasion. Together, they cover the stages of introduction, establishment, spread and multiple kinds of impacts, referring to the health of the environment (including wild species). Harmonia+ allows for quantitative output on stage-specific and general risks. Given the considerable parallels that exist between invasive alien species and emerging infectious diseases, they additionally created Pandora+, which is a risk analysis scheme for pathogens and parasites. It consists of 13 questions and has the same structure as Harmonia+. Since diseases play a paramount role in biological invasions, results of Pandora assessments may feed into Harmonia + through a slightly adapted, host-specific version named Pandora+. Harmonia+, Pandora and Pandora+ may be used both for prioritization purposes and for underpinning detailed risk analyses, and can be consulted online through http://ias.biodiversity.be.[10]

Canada's screening level risk assessment tool on aquatic invasive species

14. Fisheries and Oceans Canada developed and tested a novel screening level risk assessment tool to provide science advice that identified higher risk aquatic invasive species in Canada. Species' risk scores were compromized of likelihood of invasion and impact of invasion elements, addressing in part the magnitude of ecological consequences of the species that were assessed. The science advice resulting from this process is found in the Canadian Science Advisory Secretariat Science Advisory Report publication.[11]

Risk management tool in the United Kingdom

15. Many countries, including the United Kingdom (UK), use risk assessment - a component of risk analysis - to support decision making. However, this does not provide an assessment of risk management options - an essential component of risk analysis - meaning existing prioritization tools are of limited use. To fill this gap, the UK is currently developing a risk management tool to complete the risk analysis process and support decisions to take management action. The tool follows the principles for risk management set out by the IPPC and OIE and is designed to be compatible with existing risk assessment schemes. It is currently being trialed in the UK with species that have recently arrived or are likely to arrive in the near future (identified via horizon scanning). It follows a similar questionnaire format to the UK and EPPO risk assessment schemes, and comprises a series of questions relating to the effectiveness, practicality, cost, impact and acceptability of eradication, as well as the window of opportunity for eradication and likelihood of reinvasion. These assessments are reviewed and agreed in a consensus workshop of experts. Combined with scores of the risk posed by a species, this assessment of the overall

[8] http://www.fao.org/fileadmin/templates/agphome/documents/Biodiversity-pollination/Weeds/Docs/FAO_procedure_for_post-border_weed_risk_m.pdf.
[9] http://ias.biodiversity.be/documents/ISEIA_protocol.pdf

[10] http://link.springer.com/article/10.1007/s10530-015-0843-1?no-access=true

[11] http://www.dfo-mpo.gc.ca/csas-sccs/publications/sar-as/2015/2015_044-eng.pdf

feasibility of eradication can be used to indicate priorities for action on eradication and the development of contingency plans. Further development of the scheme will take into account preventative and long-term control methods.

B. Cost and benefit analysis

Economic analysis of species (GISP)

16. A Toolkit for the Economic Analysis of Invasive Species[12] provides guide to the application of economic approaches and tools to invasive species. It addresses the issues associated with identifying the factors which cause the spread of invasives, incorporating consideration of invasive species into economic planning and policy-making, and identifying economic tools and measures to support on-the-ground management actions designed to address biological invasions. This tool kit was used in trainings in African region on economic approaches by the Global Invasive Species Programme.

Bioeconomic modeling in Canada

17. Tools like bioeconomic modeling were highlighted in assessing the impact of invasive species on wood supply in Eastern Canada.[13] Such tools provide a new approach in projecting economic impacts of invasive species as well as focuses on impacts of interest to forest industry and forest policy worlds; it assesses invasive alien species impacts versus "business as usual" scenarios.

Biodiversity Valuation Manual

18. The Government of New Zealand developed the Biodiversity Valuation Manual (BVM)[14] to address the imbalance of information between the economy and environment trade-offs, which likely result in underinvestment in the environment. The manual shows how dollar values for biodiversity can be used in decisions. The focus is on biosecurity decisions, and specifically cost benefit analysis, but the manual has a wider application.

Cost-effectiveness ranking approach

19. Cost-effectiveness analysis provides an independent ranking of strategies based on their cost to benefit ratio, where the benefit is not measured in dollar terms, in which a nonfinancial measure of the likely "benefit" of an option is divided by its cost, for enabling more informed and justifiable investments. An application assessing 637 vertebrate wildlife species in the Kimberley region of north-western Australia suggests that the likely functional loss of 45 mammals, birds, and reptiles over the next 20 years can be averted by effectively managing fire, grazing, and invasive species for approximately AU$40 million per year. The method is flexible and it may be useful for delivering transparent guidance for conserving species and ecosystems in other regions.

20. The expert meeting highlighted that a major issue in cost and benefit analysis is the need to improve economic quantification of the value of ecosystem services and the economic value of the impact of invasive species. There is a strong need to involve economists in the valuation of ecosystem services.

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[12] Emerton, L. and G. Howard, 2008, A Toolkit for the Economic Analysis of Invasive Species. Global Invasive Species Programme, Nairobi http://www.issg.org/pdf/publications/GISP/Guidelines_Toolkits_BestPractice/Emerton&Howard_2008_EN.pdf

[13] http://www.forestry.gov.uk/pdf/IUFRO_Shepherdstown_Yemshanov_Sirex_economic_impacts.pdf/$FILE/IUFRO_Shepherdstown_Yemshanov_Sirex_economic_impacts.pdf

[14] http://www.nimmo-bell.co.nz/pdf/ManualRev29411.pdf

Furthermore, when risk is assessed social costs as a consequence of introduction of alien species should be considered. Social costs may include cost of surveillance, containment, control or eradication of invasive alien species in the environment. Indirectly, cost of compensation, loss of trade opportunity, impacts on socio-cultural values are involved in the social costs. Currently, there is no standardized method to assess and evaluate the social costs.

C. Risk prioritization in decision-making

A method for prioritization of risks:

21. An integrated ecological economic modeling and deliberative multi-criteria evaluation (DMCE)[15] is an approach to support participatory decision-making in risk prioritization. The DCME provides a structured approach to identify stakeholders' key concerns in addressing economic, social and environmental dimensions of alien species risk explicitly. Functioning as a platform for risk communication, the DMCE also offers an opportunity for diverse views to enter the decision-making process and for the negotiations of consensus with presentations of ecological and economic modeling to clarify the uncertainty and underlying assumptions on the assessment of alien species and related costs.

Most recently, DMCE terminology has been largely replaced by Structured decision making" (SDM)[16]. See Figure 1 below.

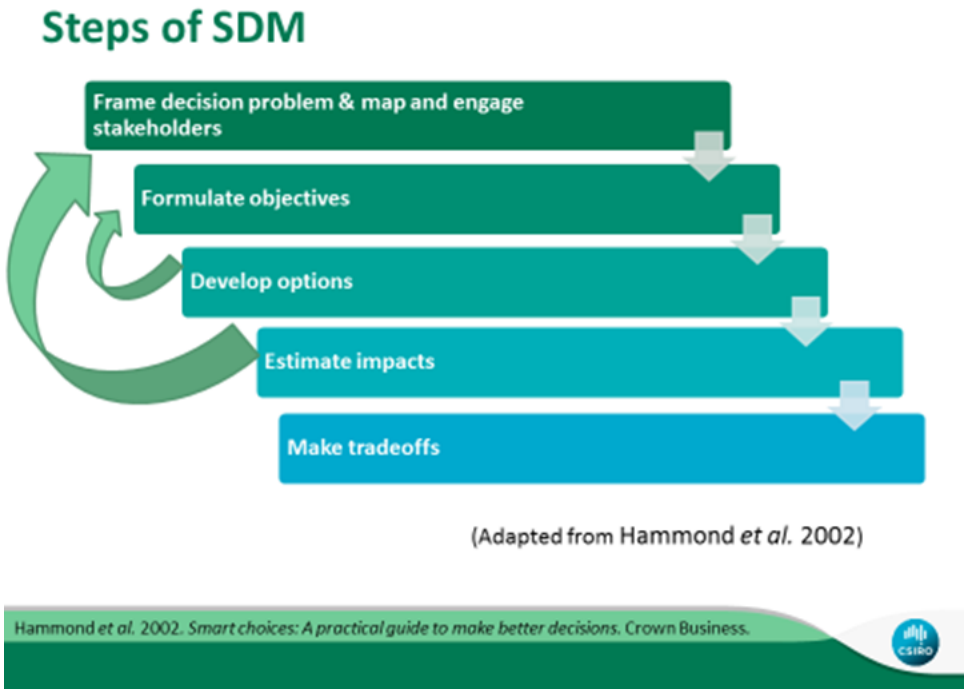

Figure 1. The Steps of SDM

[15] S. Liu et al. An integrated decision-support approach in prioritizing risks of non-indigenous species in the face of high uncertainty : Ecological Economics 70 (2011) 1924–1930

[16] Gregory et al. 2012. Structured decision making: A practical guide to environmental management choices. Wiley-Blackwell.

22. The model facilitated scenario analysis to communicate uncertainty to the participants in the two case studies[17] at the occasions of pre-border risk prioritization and post-border risk prioritization in Australia. It also demonstrated that the DMCE offered an interactive platform where scientific evidence and interpretation of the evidence would be critically discussed and clearly interpreted to the end-users.

23. Historically, some categorical methods, like the Delphi method, have been used as a common tool in the evaluation of invasion risks. This method consists on a structured communication technique or method, originally developed as a systematic, interactive forecasting method which relies on a panel of experts. The use of the Delphi method has enhanced risk analysis process for invasive alien species[18]. However it is noted that this method is most effective if combined with other multiple tools and analysis for the characterization of risks, especially if the is sufficient availability of data and information.

D. Information resources

24. Countries listed a series of databases and online information resources to support decision-making in the management of invasive alien species. For example, the Invasive Species Centre in Canada developed the Forest Invasives Canada[19] Web portal that provides information and news on invasive insects, pathogens, and plants in Canada's forests. This site examines the science behind invasive species in Canada, connects visitors to the most recent management information, and addresses the overall threat of invasive species in their forests.

25. Colombia with their Invermar guide of introduced marine and coastal species, and Guatemala with a list of invasive alien species that contains 1,422 taxa registers in the country, out of which 147 are of high risk (black list), 3 are of moderately high risk, and 1054 are of moderate risk or their effective impact is unknown; 218 species are considered to have no risk.

26. In the case of the United States of America, USDA Agricultural Research Service researchers in Beltsville, Maryland, in collaboration with the USDA Animal and Plant Health Inspection Service developed an interactive online identification key with descriptors and numerous images using light microscopy and low temperature scanning electron microscopy. Since its launch one year ago, more than 123,800 visitors from 180 countries have accessed the web site http://idtools.org/id/mites/flatmites/. This tool has enabled correct identification by farmers, extension agents, State and university researchers, government agencies, and APHIS quarantine specialists in controlling mites and plant diseases vectored by mites.

27. The Global Eradication and Response Database (Gerda)[20] submitted by International Union for Forest Research Organization summarizes incursion response and eradication programmes from around the world. The database reports ecology and management of invasive plants in forest ecosystems in various parts of the world.

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[17] https://www.cbd.int/invasive/doc/meetings/isaem-2015-01/DECISION%20SUPPORT%20TOOLS/other%20organizations/csiro/iasem-org-csiro-dst-02-en.pdf

[18] Kapustka, L, Landis, W., Environmental Risk Assessment and Managament from a Landscape Perspective", 2010

[19] (see http://forestinvasives.ca/)

[20] Kean JM, Suckling DM, Sullivan NJ, Tobin PC, Stringer LD, Lee DC, Smith GR, Flores Vargas R, Fletcher J, Macbeth F, McCullough DG, Herms DA et al. 2015 accessible at http://b3.net.nz/gerda/index.php

28. Another notable online tool mentioned by the Estonian Marine Institute is the "Information system on aquatic non-indigenous and cryptogenic species" (AquaNIS).[21] This tool was designed to assemble, store and disseminate information on non-indigenous species, and assist the evaluation of the progress made towards achieving management goals. AquaNIS is an open-access database consisting of the following four interrelated major blocks: species, introduction events, geography and impacts. The latter block is designed to store evidence of environmental and socio-economic effects. AquaNIS is also equipped with search function to enable to derive specific data and store these in common file formats by users.

29. The Global Invasive Species Information Network (GISIN) is an online tool that was formed to provide a platform for sharing invasive species information at a global level, via the Internet and other digital means. A group of collaborators led by the Unites States Geological Survey are developing the GISIN as a web-based network of databases that are connected by a common set of data types. The resulting network, or GISIN, provides increased access to data and information that will in turn help detect, rapidly respond to and control invasive species.

30. DNA Barcoding technique and its database Barcode of Life Database (BOLD) provide species identification tool. South Africa through, in collaboration with the University of Johannesburg, initiated a Barcoding project in 2005. To date most barcoding research at the African Centre for DNA Barcoding (ACDB) has focused on building the reference library of DNA barcodes for land plants. As a result we now have barcodes for more than 23 000 African plant taxa on the BOLD, these include both native and invasive species. The ACDB is in partnership with the Department of Environmental Affairs' Biosecurity division to identify invasive alien species that threaten biodiversity, which are smuggled in and out of the country through border posts.

31. The Global Invasive Alien Species Information Partnership provides introduced and invasive species occurred globally and presents their valid species names and their geographic distribution searchable by country name. As of October 2015 the information on the occurrences can be retrieved from the major invasive alien species databases, namely CABI Invasive Species Compendium, Global Invasive Species Database and Global Biodiversity Information Facility in an integrated manner.

32. The IUCN initiated a new database envisioning that the data will be integrated into the Global Invasive Species Database. The new database is intended to be used for prioritizing species with invasiveness with high impact on biodiversity that is recorded in various locations. The categorization of impacts on biodiversity is elaborated by experts[22] and this standardized method allows ranking of invasive species in a similar manner to the IUCN Red List.

33. The note by the Executive Secretary on pathways of introduction of invasive species, their prioritization and management (UNEP/CBD/SBSTTA/18/9/Add.1) was considered at the eighteenth meeting of Subsidiary Body on Scientific Technical and Technological Advice. Taking into account the standard pathways category, IUCN has been working on a Pathway Management Tool Database on Parties' practices on management of pathways.

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[21] AquaNIS website: http://www.corpi.ku.lt/databases/index.php/aquanis

[22] Blackburn TM et al. A Unified Classification of Alien Species Based on the Magnitude of their Environmental Impacts. PLoS Biol 12(5): e1001850. doi:10.1371/journal.pbio.1001850 http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.1001850

E. Tools to incorporate spatial and climatic concerns

34. The Australian Government uses spatial and statistical tools to support decision-making relating to the distribution and threat of invasive alien species, including feral animals and weeds. These tools consist mainly of:

(a) A point data dataset consisting of observation data used for direct advice, mapping and to produce distribution models.

(b) Distribution models created from the known location of species, observation points, threat category and number within the region

(c) Non-spatial data consisting of detailed information on each invasive species and identifying threatened species at risk of impact

(d) Remote sensing to delineate change over time in relation to eradication programmes.

35. The information resulting from these tools is used to support a range of programmes. Using tools to model and map native species and ecological communities supports the identification of threatened species potentially impacted by a proposed development.

36. Australia has also focused on the potential impacts of climate and land use change on biological invasions. As such, it utilizes pest risk mapping approaches, where process and climate driven models of species distribution and abundance through climate matching and spatially explicit population dynamic modeling using software such as CLIMEX and DYMEX.[23] It also uses species distribution modeling based on habitat and climate suitability environmental layers and expert elicitation of likely species environmental and climate preferences. This can then be linked to future regional climate model outputs. Finally, the Tool for Assessing Pest or Pathogen Airborne Spread[24] is a novel approach that allows modeling of aerially borne species movement based on current and future expected climate data sets.

F. Other tools to support decisions on prioritization

37. A generic impact scoring system (GISS)[25] [26] is a semi-quantitative scoring system that compares the impact of alien species among members of large taxonomic groups. It can be used to identify the most harmful alien species so that conservation measures to ameliorate their negative effects can be prioritized. GISS primarily allows ranking and prioritization of species according to their impact, but can also be used to establish black lists or warning lists at country level. GISS asks for known impacts in the environment range, e.g. plants or vegetation, on animals, and in the economic range, e.g. agricultural production, animal or forest production and even human infrastructure. However, one consideration for this approach is that GISS, as an impact assessment protocol, includes description of the actual distribution and magnitude of impact, but does not forecast potential distribution and spread, or likelihood

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[23] (see http://harvestchoice.org/tools/climexdymex-pestdiseasemodeling-harvestchoice-modifications).

[24] (see https://tappasstaging.intersect.org.au/login/auth)

[25] Kumschick S, Bacher S, Evans T, Marková Z, Pergl J, Pyšek P, Vaes-Petignat S, van der Veer G, Vilà M, Nentwig W. 2015. Comparing impacts of alien plants and animals in Europe using a standard scoring system. Journal of Applied Ecology 52: 552-561.

[26] http://ec.europa.eu/environment/nature/invasivealien/docs/Final%20report_12092014.pdf

of entry, establishment, and reaction to climate change, therefore does not meet minimum standards for a risk assessment.

38. Furthermore, an additional method for classifying alien taxa in terms of magnitude of their detrimental environmental impacts in recipient areas is the Environmental Impact Classification for Alien Taxa (EICAT).[27] This method can help:

(a) Identify those taxa that have different levels of environmental impact, distinguishing taxa causing impacts of low concern from invasive alien taxa with significant deleterious effects;

(b) Facilitate comparisons of the level of impact by alien taxa among regions and taxonomic groups;

(c) Facilitate predictions of potential future impacts of alien taxa in the target region and elsewhere;

(d) Aid in the prioritization of management actions; and

(e) Aid in the evaluation of management methods.

39. EICAT is envisaged to be used as a tool to gain better understanding of the magnitude of impacts caused by different alien taxa and to inform the prioritization, implementation and evaluation of management policies and actions within existing international agreements and statutes.

40. The Group on Earth Observations (GEOBON) developed a guideline[28] which outlines how the use of Essential Biodiversity Variables (EBVs) as an approach to monitor invasions is feasible, scientifically sound, and policy and management-relevant. EVBs provide the information needed for studying, reporting and managing environmental problems. Using this approach, countries can identify and prioritize invasive alien species and pathways, and report meaningfully on Aichi Target 9. As shown in Figure 1, there are three essential variables for invasive monitoring including: a.) alien species occurrence; b.) alien status of species; and c) impact that a species has on biodiversity and ecosystems.

[27] 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 Distrib., 21: 1360–1363. doi:10.1111/ddi.12379

[28] http://www.geobon.org/Downloads/reports/GEOBON/2015/MonitoringBiologicalInvasions.pdf

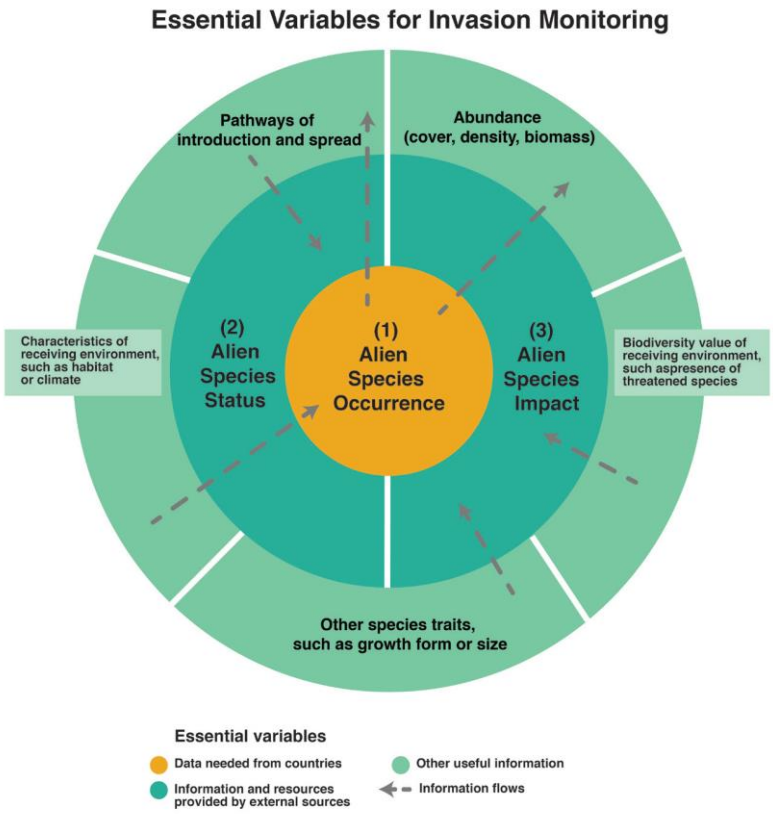

Figure 2

41. GEOBON will be soon formally launching an additional tool called Bon in a Box,[29] which is a set of online tools for monitoring that will facilitate the start or improvement of observation systems of biodiversity. It will offer a set of biodiversity variables which will be scientifically validated, as well as tools for design, and monitoring methods and indications. Bon in a Box aims to serve as a technology transfer mechanism that allows countries access to the most advanced and effective monitoring protocols, tools and software thereby lowering the threshold for a country to setup, enhance or harmonize a national biodiversity observation system.

42. PROMETHEE[30] (Preference Ranking Organization Method for Enrichment Evaluations) also assists prioritization process. This method is an outranking method used in multi-criteria decision analysis that applies thresholds and preferences to performance criteria. It can be easily adapted for group decision aid on several diverse topics. The method allows decision makers to conclude that one alternative outranks the other if there are enough criteria confirming that the first is at least as good as the second. The method requires comparison across alternatives, some of which are not necessarily comparable. Computer programmes with newer standards of outranking have been made available to the public.

[29] http://boninabox.geobon.org/#caja3

[30] http://www.ijesi.org/papers/Vol%202%2811%29/Version-1/F021101028034.pdf

43. An essential component of invasive alien species management is horizon scanning, which consists on the systematic examination of future potential threats and opportunities, leading to prioritization of invasive alien species threats. It is important that countries use this tool to determine the non-native species that are likely to arrive and to evaluate the threat posed if they do arrive and establish themselves in native ecosystems. Pathway (s) by which organism may be introduced should be identified and where appropriate, requirements for rapid response strategies to alert list species should be conveyed to the competent authorities. The benefits of horizon scanning include:

(a) The ability to identify issues that are core to solutions or are not yet dealt with by legislation/policy;

(b) The bringing together of a range of stakeholders (scientists, policy makers, practitioners, journalists, stakeholders) to inform decision making;

(c) Reducing time lags between problem identification and solutions; and

(d) Influencing policy/funding decisions through pressure brought to bear by consensus of critical actions that are required.

44. The NOBANIS European Network on Invasive Alien Species database has been part of several projects, including a pathway assessment and horizon scanning for countries in Northern Europe. The full report can be found at: https://www.nobanis.org/about-nobanis/nobanis-projects/.

III DEVELOPMENT OF DECISION SUPPORT TOOLS

45. As indicated in the information presented in the documents on biological controls (UNEP/CBD/IAS/EM/2015/1/2), trade in wildlife as pets, aquarium and terrarium species, and as live bait and live food (UNEP/CBD/IAS/EM/2015/1/3), e-commerce (UNEP/CBD/IAS/EM/2015/1/4) and the information presented in section II of this document, decision making to manage the issue of invasive alien species occurs at various stages, which include: (i) at the first time of introduction, (ii) when alien species are introduced and established; (iii) at spread and re-introductions. Through these different stages, multiple authorities and stakeholders are involved in the decision-making process. It is important that the decision support tools can cover the all relevant authorities and stakeholders as expected users of the tools.

46. The components of the tools should also guide the decision making throughout the process of: (i) decision on introduction prior to import/trans location; (ii) management at the border including interception; and (iii) post-border management once alien species are established. Under the circumstance of different jurisdictions and the capacity at the national level, the decision support tools may require some options.

47. Note that existing information and capacity to use the information for the assessment and evaluation are necessary for correct management decisions to be made. However, such assumptions and needed tools for capacity development seem to be a separate process to develop from the tools for decision support. The development of decision support tools should discrete such separate needs, envisioning that information sharing and capacity development tools will be developed at some other opportunities with the expertise that feeds necessary guidance into technical and scientific cooperation among Parties, other Governments and relevant organizations.

48. In conclusion the expert meeting suggested that development of decision support tools may require to cover and target the following modules:

(a) Decision support prior to introduction/trans-location of alien species:

(i) Risk analysis (risk assessment, management and communication) on new alien species;
(ii) Spatial and climate approach in risk assessment process;
(iii) Determination of import requirement (risk management);
(iv) National legislation if any regulations to apply;
(v) Public consultation (risk communication);

(b) Decision support for border management
(i) Documentation;
(ii) Inspection and quarantine;
(iii) Clearance;

(c) Decision support to manage post border environment:
(i) Risk assessment on already established alien species;
(ii) Spatial and climate approach;
(iii) Prioritization of risks to manage;
(iv) Cost and benefit analysis on management measures;
(v) Stakeholders consultation (risk communication);
(vi) Detection, response, control or eradication (risk management);
(vii) Evaluation of management;
(viii) Raising public awareness on invasive and potential invasive alien species.

49. The components of decision support tools are often inter-linked. The inter-linked information should be shared and communicated among decision makers at all stages of the decision process (pre-border, border and post border areas) and the information should be appropriately communicated to the relevant stakeholders.

50. The expert meeting concluded that development of decision support tools should be applicable for various decision-making opportunities and specified elements to be included in the development if the Secretariat of the CBD would develop such tools for Parties. These specified elements/modules are as follows:

(a) Prevention is the most important criteria of decision making;

(b) Development of decision support tools are aimed to understand the appropriate use of new management technologies;

(c) Elements of decision making should be clarified prior to development of tools:

(i) what decision are needed to make;

(ii) what inputs and information need to be collected;

(iii) who needs to be consulted and involved;

(iv) what criteria should be used for evaluating options;

(d) Consultation (risk communication) should be made in participatory process with risk producers, risk bearers and risk regulators;

(e) Decision-making process should allow a bypass mechanism to address an emergency to allow timely actions;

(f) External drivers must always be considered in decision-making: political will, sovereign issues, public opposition, and cultural issues.

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