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AD HOC TECHNICAL EXPERT GROUP MEETING
ON ADRESSING THE RISKS ASSOCIATED WITH
THE INTRODUCTION OF ALIEN SPECIES AS
PETS, AQUARIUM AND TERRARIUM SPECIES,
AS LIVE BAIT AND LIVE FOOD
Geneva, 16-18 February 2011

ADDRESSING THE RISKS ASSOCIATED WITH THE INTRODUCTION OF ALIEN SPECIES AS PETS, AQUARIUM AND TERRARIUM SPECIES, AND AS LIVE BAIT AND LIVE FOOD

Note by the Executive Secretary

I. INTRODUCTION

1. Pursuant to decision VII/13 of the Conference of the Parties (COP) to the Convention on Biological Diversity (CBD), the first Ad Hoc Technical Expert Group (AHTEG) on invasive and alien species (IAS) was established by the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) to clarify the gaps and inconsistencies in the international regulatory framework that are significantly hindering countries' efforts to manage threats arising from the introduction, establishment and spread from invasive alien species. This first AHTEG met from 16 to 20 May 2005 in Auckland, New Zealand and reported to SBSTTA on gaps and inconsistencies in the international regulatory framework in relation to IAS (UNEP/CBD/SBSTTA/11/INF/4), focusing on the known major pathways for the spread of IAS, and taking into account past efforts of relevant organizations and initiatives that have considered the issue.

2. In the report of the first AHTEG on Invasive Alien Species (UNEP/CBD/SBSTTA/11/INF/4), it was indicated that no specific international standards exist that address risks of invasions associated with trade in pets and aquarium species (such as fish, reptiles or insects) that are not pests of plants under the IPPC, or that address risks of invasions associated with live bait and live food. The pathway of introduction of pets as accompanying animals for military operation was treated as a different category in the report.

3. In its decision VIII/27, the Conference of the Parties urged Parties and other Governments to take measures, as appropriate and consistent with their national and international obligations, to control import or export of pets, aquarium species, live bait and live food and plant seeds that pose risks as invasive alien species, identified as one of the gaps in the international regulatory framework. Plant seeds are covered by phytosanitary measures under IPPC, and SBSTTA, at its fourteenth meeting, amended the text to read as follows: introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food.

4. To date, no international standards or guidelines exist that specifically address risks associated with introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food, that are not pests of plants under the International Plant Protection Convention (IPPC). Live animals in

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these categories (for instance fish, reptiles, or insects introduced as pets or live bait), some of which pose risks of invasions, are not covered by the mandates of the World Organisation for Animal Health (OIE), except in the case of some pathogens which may infect amphibians, nor by other international regulatory frameworks.

5. The Conference of the Parties in its decision IX/4 A requested SBSTTA to consider the establishment of an AHTEG to suggest means, including practical guidance, for addressing the risks associated with the introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food.

6. In its decision X/38, the Conference of the Parties established an AHTEG for considering the ways and means to prevent the impacts and minimize the risks associated with the introduction of IAS as pets, aquarium and terrarium species, and as live bait and live food, in consideration of the severe impacts caused by IAS to global biological diversity. The terms of reference for this AHTEG, annexed to decision X/38, are as follows:

(a) Suggest ways and means, including, *inter alia*, providing scientific and technical information, advice and guidance, on the possible development of standards by appropriate bodies that can be used at an international level to avoid spread of invasive alien species that current international standards do not cover, to address the identified gaps and to prevent the impacts and minimize the risks associated with the introduction of invasive alien species as pets, aquarium and terrarium species, as live bait and live food, with the present terms of reference;

(b) Identify and consider relevant, specific, and concrete tools, voluntary codes of practice, methodologies, guidance, best-practice examples and instruments, including possible regulatory mechanisms, for addressing the risks associated with the introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food, including for:

(i) Controlling, monitoring, and prohibiting, where appropriate, export, import and transit, at local, national, and regional levels, taking into account national legislations, where applicable;

(ii) Controlling internet trade, associated transport, and other relevant pathways;

(iii) Developing and utilizing risk assessments and risk management;

(iv) Developing and utilizing early-detection and rapid response systems;

(v) Regulating the export, import and transit of potentially invasive alien species traded as pets likely to be released;

(vi) Public awareness-raising and information dissemination;

(vii) Transboundary and where appropriate, regional cooperation and approaches;

(c) Consider ways to increase the interoperability of existing information resources including databases and networks, of use in conducting risk and/or impact assessments and in developing early-detection and rapid response systems.

7. The Executive Secretary, with the generous financial assistance from the Government of Spain, is convening a meeting of this second AHTEG on Invasive Alien Species from 16 to 18 February 2011 at International Environment House in Geneva. This note is prepared to assist participants in the AHTEG in their deliberations.

8. Different definitions exist for invasive alien species. The terms ‘alien species’ and ‘invasive alien species’ will be used for the discussion by the AHTEG. Other terms listed in box 1 of this document, should be used only within the context of the organization which sets international standards.

BOX 1. Terminology related to invasive alien species, as defined by different organizations*

Alien species (CBD)
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.

Invasive alien species (CBD):
An alien species whose introduction and/or spread threaten biological diversity.
(For the purposes of the guiding principles, the term "invasive alien species" shall be deemed the same as "alien invasive species" in decision V/8 of the Conference of the Parties to the CBD).

Pest (IPPC):
Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products

Hazard (OIE Aquatic Animal Health Code):
Any pathogen that could produce adverse consequences on the importation of a commodity

Hazard (OIE Terrestrial Animal Health Code):
A biological, chemical or physical agent in, or a condition of, an animal or animal product with the potential to cause an adverse health effect

*Entries adapted from http://www.cbd.int/invasive/terms.shtml

9. In section II of this document, the examples of species not covered by the existing regulatory framework, which might have been introduced as pets, aquarium and terrarium species, as live bait and live food, are listed and appropriate bodies are suggested, to be agreed with the relevant organizations in consultation with the AHTEG. Under agenda item 3.1, the Group may consider the listed species as the examples of species which fell into the identified gap. The Group may amend or delete the species, as appropriate.

10. Section III highlights issues related to the multiple stakeholders and pathways involved in the introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food, including internet trade of pets and other live species. The AHTEG may consider a guideline to cover all stakeholders listed in this section. If necessary and appropriate, the AHTEG will be invited to further identify gaps and inconsistencies to address the risks associated with the introduction of pets, aquarium and terrarium species, and as live bait and live food, in order to fulfil the discussion under agenda item 3.2.

11. Section IV summarizes specific and concrete tools to use in conducting risk and/or impact assessments and in developing early-detection and rapid response systems, including information resources. This section may provide information for consideration of ways to increase the interoperability of existing information resources, which will be discussed under agenda item 3.3.

12. Section V provides best-practice examples at national and regional levels and voluntary codes of practice, methodologies, guidance and other programmes to address the risks of introduction of alien species as pets, aquarium and terrarium species, as live bait and live food. The information presented in this section may be considered by the Group under agenda item 3.3.

13. Section VI describes the existing international bodies which set international standards or guidelines in relevance to IAS. The information presented in this section may be considered by the Group under agenda item 3.3.

14. Finally, section VII highlights some considerations that may be appropriate in developing guidelines by the international bodies identified.

II. SPECIES WHICH CAN BE INTRODUCED AS PETS, AQUARIUM AND TERRARIUM SPECIES, AND AS LIVE BAIT AND LIVE FOOD, THAT ARE NOT CONTROLLED BY EXISTING INTERNATIONAL STANDARDS

15. The Conference of the Parties in its ninth meeting, reaffirming the need to address the gaps and inconsistencies identified by the Ad Hoc Technical Expert Group on Gaps and Inconsistencies in the International Regulatory Framework in Relation to Invasive Alien Species (UNEP/CBD/SBSTTA/11/INF/4) and considered in decision VIII/27, invited IPPC to continue its efforts to expand, within its mandate, its actual coverage of IAS which impact on biodiversity, including in aquatic environments (paragraph 2 of decision IX/4 A).

16. The Conference of the Parties invited the International Committee of the World Organisation for Animal Health (OIE) to note the lack of international standards covering invasive alien species, in particular animals, that are not pests of plants under the International Plant Protection Convention, and to consider whether and how it could contribute to addressing this gap, including for example by:

(a) Expanding the OIE list of pathogens to include a wider range of diseases of animals, including diseases that solely affect wildlife; and

(b) Considering whether it may play a role in addressing invasive animals that are not considered as causative agents of diseases under OIE and whether, for this purpose, it would need to broaden its mandate.

17. The Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) of the World Trade Organization (WTO) applies to all sanitary and phytosanitary measures which affect international trade. The SPS Agreement identifies IPPC as the reference organization developing international standards for plant health (phytosanitary) measures. The IPPC allows contracting Parties to analyze risks to their national plant resources and each Party provides **information on regulated pests** and issuance of phytosanitary regulations. The information on the pests regulated by each Party collectively shows the plant pests currently covered in the framework of the IPPC.

18. The SPS Agreement designates OIE as the international organization responsible for drafting standards and guidelines on risk analysis related to animal health and zoonoses. The World Animal Health Information System provides the **list of diseases notifiable to OIE**, which constitutes the list of species that OIE currently covers within its mandate.

19. Technically, any species listed officially in the information on regulated pests of plants or the list of notifiable animal diseases are controlled within the existing standards of IPPC or OIE, and the national authorities designated for the SPS Agreement are obliged to follow the procedures.

20. In an attempt to identify species that are not covered by either the OIE list or the list of pests regulated by Parties to the IPPC, the following information sets were compared:

(a) Taxa listed by OIE as notifiable animal diseases;

(b) Taxa listed by Parties to IPPC as regulated pests; and

(c) Taxa listed as of July 2010 in the Global Invasive Species Database, compiled by the Invasive Species Specialists Group (ISSG) of the Species Survival Commission (SCC) of the World Conservation Union (IUCN), accessed at http://www.issg.org/database/welcome/[1].

21. A list was compiled comprising taxa that were listed in (c) but not in (a) or (b). A subset of taxa from this list was then reviewed to consider whether or not they can be introduced as pets, aquarium and terrarium species, and as live bait and live food.

22. The taxa in this subset, corresponding common names and presumptive introduction category are indicated in the table in annex I of this document.

23. Some species that can be considered livestock currently remain in this table due to their risk of becoming feral and threatening biodiversity in environments vulnerable to invasive alien species, such as islands.

24. Note that the coverage and quality of the information contained in annex I should be treated as a starting point for identifying priority species to be controlled or managed by possible international recommendations that the AHTEG will consider. Any amendment or deletion based on scientific evidence, including evidence on ecological and socio-economic factors, should be accepted during and after the meeting and until the finalization of the report.

III. MULTIPLE STAKEHOLDERS AND PATHWAYS IN THE INTRODUCTION OF ALIEN SPECIES AS PETS, AQUARIUM AND TERRARIUM SPECIES, AND AS LIVE BAIT AND LIVE FOOD

25. The introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food, has been identified as a significant pathway, involving multiple stakeholders, for the introduction of IAS (UNEP/CBD/SBSTTA/11/INF/4). Pathways are defined as the means by which species are transported from one location to another (National Invasive Species Council's Pathways Ranking Guide http://www.invasivespeciesinfo.gov/). They can be natural e.g., wind currents, or man-made i.e., those which are enhanced or created by human activity, and are either intentional or unintentional means of introductions.

26. Targeting specific gaps not currently addressed in the international regulatory framework is considered to be the most comprehensive approach to mitigating the introduction of IAS. There is now an urgent need to introduce a framework for this regulatory gap, specifically with respect to internet trade, postal and express delivery services, either by strict regulations or by voluntary guidelines.

27. Introduction of pets, aquarium and terrarium species, and live bait and live food involves multiple stakeholders including industry. The stakeholders exist in exporting countries, transporting services, border controls, importing countries, retailers and end-users. The following are possible stakeholders involved in the flow of species introduction:

Exporter or producer countries

(a) Collectors or catchers of wild species;

(b) Professional and amateur breeders of pets, aquarium and terrarium species;

[1] The ISSG website includes the following disclaimer: "ISSG makes every effort to provide and maintain accurate, complete, useable, and timely information on our Web pages. However, some data and information accessed through these pages may, of necessity, be preliminary in nature and presented prior to final review. These data and information are provided with the understanding that they are not guaranteed to be correct or complete. Users are cautioned to consider carefully the provisional nature of these data and information before using them for decisions that concern personal or public safety or the conduct of business that involves substantial monetary or operational consequences. Conclusions drawn from, or actions undertaken on the basis of, such data and information are the sole responsibility of the user."

(c) Producers of live food plants and animals;

(d) Industries related to pets, aquarium and terrarium species, live bait and live food;

(e) National authorities responsible for CITES or other international agreements;

Intermediate pathways

(a) Industries related to trade in pets, aquarium and terrarium species, live bait and live food;

(b) Internet market managers;

(c) Private market owners;

(d) International transporters, including postal service, shipping companies, civil aviation services, other shipping industries;

Border controls

(a) International bodies which set standards or guidelines;

(b) Customs and quarantine officials at national and international levels;

Importer countries

(a) Domestic transporters, including postal service, shipping companies, civil aviation services, other shipping industries;

(b) Retailers for pets, aquarium and terrarium species, live bait and live food;

(c) End-users, such as pet and livestock owners;

(d) Other users, such as restaurants and game fishing industries;

(e) National and regional plant protection organizations;

(f) National environmental, agricultural crop, livestock, forest and fishery authorities;

(g) Local communities;

(h) Experts in veterinary medicine, taxonomy and other relevant sciences for early detection and rapid response to escape and releases.

28. While a number of possible actions have been proposed for addressing the general gap in the international regulatory framework for invasive alien animal species that are not pests of plants under IPPC, the following options were identified by the first AHTEG on Invasive Alien Species in 2005 in order to address particular aspects of the pathways involving introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food:

(a) Raise awareness with consumers, including through the industry and through internet sites that facilitate transactions or that may otherwise be visited by consumers of pet and aquarium species;

(b) Consideration of the issue by the International Postal Union and express delivery services;

(c) Codes of practice developed by industry, including to address disposal and discard;

(d) Development of requirements or guidance by regional or national organizations;

(e) National controls (e.g., permit systems) on import and potentially on export (e.g., if requested to do so by the Government of the importing country where that country does not have adequate controls in place itself). The AHTEG report also mentioned that there has been an increase in such trade due to internet-based transactions (UNEP/CBD/SBSTTA/11/INF/4).

29. The number of internet users is rapidly approaching 2 billion, making it a globally accessible and convenient way of trade and opening up new and unmarked pathways of trade at an unprecedented pace (GISP, 2004). Coupling this remarkable ease of access with a growing global curiosity and appetite for the exotic, it is not surprising that the number of exotic and rare, live plants and animals traded via the internet is increasing at an alarming rate - in almost all cases without any consideration to the environmental and socio-economic consequences of this movement of live species across the globe.

30. Indirectly related to this specific pathway are the means of transportation e.g., civil aviation, shipping, etc., together with the method of conveyance, e.g., sea containers. There are numerous conveyances that serve as pathways for IAS. These include shipping vessels, floating timber, equipment and machinery, household goods, packaging and containers, and waste materials. For some of these pathways, such as floating timber, human activities may not create new pathways for introductions, but may rather augment the rate of introductions or affect the timing of introductions and thereby increase the risk of spread and establishment of IAS. These movements are often treated as if they were natural, but they are within the scope of invasive alien species under the Convention on Biological Diversity because they are indirectly caused by human activities.

31. The sources of traded species and their uses include a wide range of animal species, different social communities and a broad geographic range. Some species of animals in the pet trade have been taken from the wild by local and foreign collectors. Brokers in various countries (primarily Asian, African and Latin American) then supply wild-caught animals to customers outside of their natural range. The main importing countries include Europe, Japan, the United States of America and Canada.

32. Captive-bred wild animals are also found in the pet trade and domestic pet markets; they include large sized cats, wolves, foxes, bears, primates, hedgehogs, flying squirrels, capybaras, kangaroos.

33. Both wild-caught and captive-bred animals can be vectors of emerging infectious diseases. The Centers for Disease Control in the United States of America indicates that in addition to birds, West Nile virus (WNV) has been known to infect camels, cattle, sheep, mountain goats, cats, bats, chipmunks, skunks, squirrels, domestic rabbits, dogs, and humans. The introduction of wild species as pets, aquarium and terrarium species could be associated with risk for epidemics of zoonoses.

34. It is notable that OIE placed ranavirus, a virus that can affect amphibians, and *Batrachochytrium dendrobatidis* (Bd), a chytrid fungus also affecting amphibians, on its list of notifiable diseases; both have recognized impacts on the international trade in amphibians and the health of populations in the wild.

35. Cross-breeds, such as "wolf-dogs", "felid hybrid" (hybrids between species in Felidae, cat family), "zedonks" (hybrids between zebra and donkey), "louhan" (cross hybridized cichlid) and other alien genotypes are sold through extensive networks of amateur animal keepers, professional breeders, dealers and private zoos. These alien genotypes are advertised in magazines and on the internet and transported to the users.

36. According to the American Pet Products Association, the expenditure in pets and pet products in the United States alone was estimated at $US 47.7 billion in 2010. According to the Global Invasive Species Programme (GISP)[2], the pet trade includes the import of two million exotic animals, nearly half of which are imported wildlife. Exotic pets, including rodents, reptiles and amphibians, can be purchased in pet stores, by mail order catalogue and – at a rapidly increasing rate – via the internet.

[2] http://www.gisp.org/publications/brochures/FactsheetInternetPathway.pdf

37. There is also a huge and rapidly increasing market in European Union Member States for non-native pets. For example, the European Union is the largest global importer of reptiles.[3]

38. The range of species openly available for purchase on the internet includes a variety of protected species. Many countries have strict regulations in place to control the import of live organisms through regular channels but such regulations generally do not deal with internet sales. The United States Department of Agriculture, for example, set up an Internet Surveillance Project, which includes an Agricultural Internet Monitoring System (AIMS). Countries should also take into account the obligations under Article 3 of the Convention on Biological Diversity, which states that States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

39. The policy of the largest internet marketplace, eBay Inc., prohibits any kind of trade in live animals.[4] However, the followings are exceptions: (i) aquarium or pond fish, snails or similar creatures, (ii) lobsters, crabs, shellfish and other similar creatures that are live when sold but intended for human consumption, and (iii) live insects, crickets and worms used as bait or as food for pets.

40. While many countries have quite strict regulations in place to control the import of live organisms through regular channels, existing national regulations for IAS do not always deal with postal and express delivery services, nor with internet sales of pets, and aquarium and terrarium species. In addition, the policies of internet markets have omitted introduction pathways as live bait and live food from restrictions. Moreover, internet trading makes it easier for illegal sales to go undetected and thus significantly increases the risk of transfer of potentially invasive species, including diseases. As the internet market has already been growing very rapidly, there is a need to introduce some form of regulation of internet sales of live material. An international approach to prevent the introduction of IAS by internet trade should be considered as a matter of urgency (UNEP/CBD/SBSTTA/14/16/Rev.1).

41. Livestock may also become accidentally invasive, with uncontrolled dispersal and establishment resulting in harm to natural biodiversity.

42. Risks to biodiversity posed by livestock are:

(a) Risk of becoming feral, thereby competing with wildlife and potentially introducing animal diseases;

(b) Competition with local wild herbivores for access to feed, water and space;

(c) Impacts on local populations' genetic resources through interbreeding, altering natural balances and threatening specific traits;

(d) Potentially becoming vectors of diseases transmissible to humans or to other livestock.

43. In addition, livestock are one of the major drivers of land-use change (deforestation, destruction of riparian forests, drainage of wetlands), whether for livestock production itself or for feed production, thereby modifying or destroying the ecosystems that are the habitats of various wild species.

44. Livestock may contribute to climate change, which in turn has a modifying impact on ecosystems and species. Terrestrial and aquatic ecosystems are affected by emissions from livestock into the

[3] www.iar.org.uk/news/2007/downloads/exotic-pet-factsheet.pdf

[4] http://pages.ebay.com/help/policies/wildlife.html

environment (discharge of nutrients and pathogens into marine and freshwater ecosystems, ammonia emissions, acid rain). These impacts vary widely between livestock production systems.

45. To address the risks associated with introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food, the Conference of the Parties to the Convention on Biological Diversity:

(a) *Encourages* relevant Government departments, consumer protection groups, industry, trade and shipment organizations, and other relevant organizations such as the Universal Postal Union and the Global Express Association, to raise awareness with consumers, including through internet sites that facilitate transactions or may otherwise be visited by consumers, and to further study, as appropriate, current safe disposal measures for imported alien species, with a view to considering development of guidance or codes of practice regarding trade in pets, aquarium species and plant seeds, in particular disposal and discard of such species (paragraph 52 of decision VIII/27);

(b) *Urges* Parties and other Governments to take measures, as appropriate and consistent with their national and international obligations, to control import or export of pets, aquarium species, live bait and live food that pose risks as invasive alien species (paragraph 53 of decision VIII/27);

(c) *Further urges* Parties and other Governments to take action, as appropriate and consistent with their national and international obligations, to prevent and minimize introductions of known invasive species into the wild, including through measures addressing disposal and discard of such species (paragraph 54 of decision VIII/27);

(d) *Invites* relevant organizations, including the Global Invasive Species Programme, and, as appropriate, Parties and other Governments, to support the development and implementation of voluntary schemes, certification systems and codes of conduct for relevant industries and stakeholder groups including specific guidelines to prevent the introduction of, and manage, potentially invasive commercially important species (including plants, pets, invertebrates, fish, and aquarium/terrarium species) (paragraph 23 of decision IX/4 B);

(e) *Invites* Parties, other Governments and relevant organizations to support awareness-raising programmes at all levels for decision makers and practitioners in the freshwater, marine and terrestrial environment sectors, in particular in agriculture, aquaculture and forestry, and in the horticulture trade and pet trade, and more generally, in the transportation, trading, travel and tourism sectors that are potential pathways of biological invasions (paragraph 27 of decision IX/4 B).

46. In summary, the Conference of the Parties to the Convention on Biological Diversity has urged controls on the introduction of alien species above and has crafted ways to invite multiple stakeholders to (i) develop and implement regulatory mechanisms at national and regional levels in accordance with international agreements, such as the SPS Agreement of the WTO, and (ii) apply non-regulatory mechanisms such as voluntary schemes, certification systems and codes of conduct for relevant industries and stakeholder groups to fill the gap.

47. Note that the previous AHTEG on Invasive Alien Species, held in 2005, reported that the introduction of alien species through (i) *ex-situ* breeding programmes or (ii) aquaculture/mariculture are specific and separate introduction pathways, distinct from the introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food. However, the ways and means, including standard setting or guideline development by relevant international organizations such as CITES and FAO, might be applicable for some of the species shown in annex I.

IV. CONCRETE TOOLS AND INFORMATION SYSTEMS

A. Risk analysis: overview

48. The following provides relevant information on risk analysis and its component parts.

49. Risk analysis involves an evaluation of the likelihood of entry, establishment and/or spread of an alien species in a given area, along with associated potential ecological and economic consequences. Risk analysis also takes into account possible management options to mitigate identified risks.

50. The use of risk analysis to officially determine the acceptability and/or conditions of introductions of alien species into a territory presupposes the existence of a legal or regulatory basis for relevant authority. Thus, risk analysis systems are frequently grounded in broader legislation that defines the system for proposing introductions, relevant authorities, enforcement measures, etc. It should be noted that industry, academia, research centres, and other non-governmental and intergovernmental organizations may also apply risk analysis methodologies to address risks associated with introductions of alien species relevant to their own programmes.

51. Definitions and models of risk analysis vary. Box 2 in this document summarizes some definitions of risk analysis and risk assessment according to different standard-setting bodies.

52. Risk analysis generally includes a number of stages or components, including initiation, risk assessment, risk management and risk communication, which all feed into a decision by the appropriate authority on the acceptability of a risk and under what circumstances or conditions. In the context of invasive alien species, risk analysis can be conducted to assess the potential invasiveness of an alien species, including those proposed for intentional introduction as well as those unintentionally introduced through a range of pathways. Pathway risk analysis is a tool applied to pathways or vectors through which potentially invasive alien species, and associated pathogens or diseases, are traded or moved (e.g., internet trade, postal and express delivery services). Examples include the U.S. National Invasive Species Council's Pathways Ranking Guide, the Guidelines for Conducting Pathway Risk Analysis currently being drafted as a regional standard by the North American Plant Protection Organization, and a pathway risk assessment tool under development by the Invasives Information Network of the Inter-American Biodiversity Information Network (IABIN I3N).

53. Rapid risk assessment or risk screening is another tool that has been developed to quickly evaluate whether a species presents a low, high or indeterminate risk. Such an initial screen can help authorities prioritize proper response to newly detected alien species in an early warning rapid response framework, or prioritize species that may require immediate attention from a regulatory perspective as well as a more in depth risk assessment prior to making a final decision about introductions and/or imports.

54. Models of decision-making based on an analysis of risks vary and are constantly evolving; however, common components generally include the following steps:

Initiation

(a) Identification of the alien species (or pathway) and geographic area of concern for evaluating levels of risk;

Risk Assessment

(b) Identification of adverse effects from the introduction and establishment of an alien species,

(c) Evaluation of the likelihood of these adverse effects, including potential levels of exposure (propagule pressure);

(d) Evaluation of the consequences or magnitude of impacts should these adverse effects be realized;

(e) Estimation of overall risk posed by the alien species based on evaluation of the likelihood and consequences of introduction and establishment;

(f) Identification of areas of uncertainty in establishing the level of risk.

This process can be performed with a series of questions that look at a species' characteristics, past history of invasiveness, identification of comparable bioclimatic conditions in the receiving territory, etc. Annex II includes a sample of questions that might be asked during a risk assessment.

Risk Management

(g) Identification of risks;

(h) Evaluation of management strategies' ability to reduce identified risks;

Risk Communication

(i) Communication with the relevant authority on assessed risks, including necessary risk management strategies;

Decision-making

(j) Decisions by the relevant authority, considering various factors as appropriate (including cost of control and cost of eradication if establishment occurs), on whether to allow introduction(s) and on required risk management measures. These decisions should consider the risk tolerance (sometimes referred to as the acceptable level of protection), which is the level of risk that a jurisdiction is willing to accept; and

(k) Communication of the decision to relevant implementing agencies and stakeholders.

55. In Australia, pre-import screening and environmental assessments are conducted prior to introduction of all live animals, including ornamental fishes and reptiles. A national legislated list of animals and plants suitable for live import has been established, and species that are not on the list cannot legally be imported. Proposals to import animals not currently allowed for import as pets or for other purposes have to be first assessed in terms of their potential impact on the Australian environment. Proposals to import unlisted ornamental finfish for commercial and non-commercial purposes, or for other purposes, also have to be assessed in terms of their potential impact on the Australian environment.

56. Risk analysis processes, embodied in the Cartagena Protocol on Biosafety, the International Plant Protection Convention standards related to pest risk analysis and the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) under the World Trade Organization (WTO), generally require that they are science-based, transparent, replicable and use the best available information.

57. Risk analyses are dependent on the availability of and access to relevant information. The development, maintenance and interoperability of national, regional and international databases and information systems underpin this process.

Box 2. Terminology related to risk as defined by different organizations*

Risk (OIE Aquatic Animal Health Code):
The likelihood of the occurrence and the likely magnitude of the consequences of an adverse event to public, aquatic animal or terrestrial animal health in the importing country during a specified time period

Risk (OIE Terrestrial Animal Health Code):
The likelihood of the occurrence and the likely magnitude of the consequences of an adverse event to animal or human health in the importing country during a specified time period, as a result of a hazard

Risk analysis (CBD):
(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) To 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

Risk analysis (OIE Terrestrial Animal Health Code):
The process composed of hazard identification, risk assessment, risk management and risk communication

Risk assessment (WTO):
The evaluation of the likelihood of entry, establishment or spread of a pest or disease within the territory of an importing Member according to the sanitary or phytosanitary measures which might be applied, and of the associated potential biological and economic consequences; or the evaluation of the potential for adverse effects on human or animal health arising from the presence of additives, contaminants, toxins or disease-causing organisms in food, beverages or feedstuffs

Risk communication (OIE Aquatic Animal Health Code):
The interactive exchange of information among risk assessors, risk managers and other interested parties

Pest risk analysis (IPPC):
The process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it

Pest risk assessment for quarantine pests (IPPC):
Evaluation of the probability of the introduction and spread of a pest and of the associated potential economic consequences

Pest risk management for quarantine pests (IPPC):
Evaluation and selection of options to reduce the risk of introduction and spread of a pest

*Entries adapted from http://www.cbd.int/invasive/terms.shtml

58. In certain cases where sufficient information is not available to determine the level of risk, decision-makers may choose to make a preliminary decision regarding the introduction of a particular species or regulation of a pathway until further information is available. Such provisional measures are reflected in the WTO's SPS Agreement as well as the precautionary approach under the Cartagena Protocol on Biosafety. It has also been recognized that due to lack of capacity, it may be necessary to

make decisions using risk assessments based on limited data and information. This suggests the need for capacity-building in risk assessment and sharing of relevant information as top priorities.

59. Other species risk analysis models and tools include:

(a) ICES Code of Practice on the introductions and Transfers of Marine Organisms;

(b) IPPC International Standards for Phytosanitary Measures No. 2 Framework for Pest Risk Analysis and No. 11 Rev.1 Pest Risk Analysis for Quarantine Pests including Analysis of Environmental Risks, as well as related training materials;

(c) NAPPO – Guidelines for Conducting Pathway Risk Analysis (draft regional standard);

(d) IABIN I3N – species and pathway risk analysis tools;

(e) Australia – Import Risk Analysis Handbook; list of specimens suitable for live import; Weed Risk Assessment

(f) New Zealand – Animal Import Risk Analysis Handbook;

(g) United Kingdom – standard methodology to assess the risks from non-native species considered possible problems to the environment;

(h) United States of America – Pathways Ranking Guide; Training and Implementation Guide for Pathway Definition, Risk Analysis and Risk Prioritization;

(i) Climate-habitat matching software, e.g., MaxEnt.

60. For management and other tools for implementation at the national level, the following tools are available:

(a) GISP Toolkit for best prevention and management practice

(b) GISP Toolkit for the Economic Analysis of Invasive Species

(c) GISP Toolkit for developing legal and institutional frameworks for invasive alien species

(d) IUCN Guide to designing legal and institutional frameworks for alien invasive species

(e) Global Invasive Species Programme-Invasive Species Training Courses.

B. Practical risk screening methods recommended by the expert workshop held in Indiana in 2008

61. In accordance with paragraph 8 of decision IX/4 A, Parties, other Governments and relevant organizations are invited to submit to the Executive Secretary examples of best practices for addressing the risks associated with the introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food. Information has been made available in the areas of risk analysis and risk screening, including inputs from the Expert Workshop on Preventing Biological Invasions: Best Practices in Pre-import Risk Screening for Species of Live Animals in International Trade (University of Notre Dame, Indiana, USA, 9-11 April 2008) also referenced in the above decision.

62. The expert workshop strongly endorsed the need for conducting science-based risk assessments, appropriate to the specific context, before decisions concerning the proposed importation of live, non-native animal species, together with their associated parasites and pathogens.

63. Due to lack of capacity, it may be necessary to make decisions using risk assessments based on limited data and information, thus the need for capacity-building in risk assessment was identified as a top priority.

64. The workshop also noted that the actual decision concerning whether or not a specific non-native species could be imported is not a part of the risk assessment although the risk assessment is used as the basis for a decision by a relevant authority. In this context, assessment of the risks to biodiversity and the

environment is an important input to decision- making. Decision makers may have to consider additional matters such as national policy and cost-benefit considerations.

65. The workshop proposed a risk assessment approach for the import of live alien animal species and their parasites or pathogens as shown in annex II of this document, which is based on the common set of risk assessment questions and approaches now used successfully in many countries. The approach is also consistent with international risk assessment frameworks developed for other purposes such as IPPC, WTO-SPS Agreement and OIE, and the International Council for the Exploration of the Sea (ICES).

66. It should be noted that risk assessment is an evolving methodology that is being improved and revised continuously.

C. Information resources and their use for risk assessment and early detection and warning systems

67. Addressing the risk that alien species imported as pets, aquarium and terrarium species, live bait and live food establish themselves in the wild or in agricultural or aquacultural zones and become invasive, requires prevention (i.e., regulation of imports, based on risk assessment), as well as early warning and rapid response if prevention fails. To ensure effective prevention, risk assessment and early warning, the prompt circulation of reliable information on different aspects, including taxonomy and biology of the species, records of invasiveness, geographic patterns, management options, etc., is crucial.

68. In order to assess the key informatics standards and tools required for assessing and addressing the risks associated with the introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food, it is critical to first identify the existing systems in place in various regions of the world. Such assessment would provide a foundation to build on existing achievements as well as a basis for identifying potential gaps.

69. A review of existing international systems revealed that measures to protect native biodiversity from biological invasions are far less developed than frameworks addressing risks of introducing alien agents in the phytosanitary and veterinary sectors. It should be noted that many regions have developed information systems that could significantly improve the ability to detect new incursions, identify invaders, assess the risks of the incursion and identify a proper response.

70. Existing systems provide information on some or all of these key components (not an exhaustive list):

(a) *Species information* provides invasive alien species information and extensive taxonomic references (e.g., synonyms);

(b) *Geographical scope information* comprises distribution maps of past and present distribution, including native range and invaded areas;

(c) *Observation data*, mostly in the form of primary biodiversity data (e.g., observation of given taxa in a given location at a particular point in time);

(d) *Risk assessment information* covers information such as probability of entry, establishment, spread, impacts (economical, health, ecosystems…) etc.;

(e) *Guidelines and best practices*, from species factsheets, guidelines on performing risk assessments, regulations catalogues, literature surveys, best practices on recording and sharing observation data, etc.;

(f) *Registers of experts* provide inventories of existing experts at country, regional and global levels with information about their level of expertise in various domains;

(g) *Early warning systems* exist in the form of black-lists (lists of invasive species with evident risks to the environment, economy or human well-being), watch-lists (species not yet observed in a given area or territory or present in a limited range posing some potential risks), alert lists (lists of

species where a monitoring effort is recommended) and pest reporting (on occurrence, outbreaks, and spread of pests), with the purpose of communicating immediate or potential danger to other countries, in particular to neighbouring countries and trading partners. It should be noted that currently this is only done for pests of plants covered by IPPC; National Plant Protection Organizations (NPPOs) have the responsibility of collecting pest information by surveillance and of verifying the pest records thus collected. Pest reports should contain information on the identity of the pest, location, pest status, and nature of the immediate or potential danger. They should be provided without undue delay, preferably through electronic means, through direct communication, openly available publication and/or the International Phytosanitary Portal (IPP). At present, most early warning systems are implemented at a national scale but these could be scaled down to a local scale and up to regional and international scales, as appropriate.

71. Information systems to take into consideration, but not exclusively, are:

(a) Global-scale databases (e.g., GISD, CABI Invasive Species Compendium (ISC), Global Register of Invasive Species, GISIN, GBIF);

(b) Regional scale databases (e.g., DAISIE, NOBANIS);

(c) Identification tools (e.g., AdventOI, species fact sheets provided by GISD, ISC, DAISIE, etc.);

(d) Risk assessment tools (e.g., DAISIE, expert registers);

(e) Best practices for management options (e.g., fact sheets provided for example by GISD, ISC, DAISIE, NOBANIS, EPPO, etc.);

(f) The clearing-house mechanism under the CBD;

(g) Domestic Animal Diversity Information System (DAD-IS) of the FAO;

(h) WIEWS of the FAO, e.g., for information on the area of forest affected by woody IAS;

(i) FishBase.

72. Existing challenges faced by these information systems can be listed as follow:

(a) Specificity in terms of species coverage (e.g., related to the mandate of the information systems);

(b) Lack of sufficient and accurate information on given species (e.g., references, observation data, etc.).

V. BEST-PRACTICE EXAMPLES AT NATIONAL AND REGIONAL LEVELS, VOLUNTARY CODES OF PRACTICE, METHODOLOGIES, GUIDANCE AND OTHER PROGRAMMES

73. In paragraph 8 of decision IX/4 A, Parties, other Governments and relevant organizations are invited to submit to the Executive Secretary examples of best practices for addressing the risks associated with the introduction of alien species as pets, aquarium and terrarium species, and as live bait and live food. The followings are some examples of best practices and instruments that Parties have applied to address the risks.

A. National legislation and programmes with controlled species lists developed by the competent authorities

74. For most of the processes which establish lists of species to be controlled, (i) appropriate quarantine measures and management of the introduced organisms and (ii) cross-sectoral coordination are important to effective control. For example, the Aquatic Nuisance Species Task Force in the United States,

the Non-Native Species Programme Board for Great Britain and the Canary Islands Initiative of Spain took an intergovernmental/ministerial approach, and involved the science community and industry.

75. In Australia, a national strategy, called *"A Strategic Approach to the Management of Ornamental Fish in Australia"*, was approved in 2006 by all governments in the country through the Natural Resource Management Ministerial Council. The strategy is being implemented by the Ornamental Fish Management Implementation Group in close consultation with industry and other stakeholders.

76. Scientifically-based models for risk assessment on establishment of exotic vertebrates in a new environment where a species is introduced, including information and guidelines, were published by the Australian Government. They are used by state policy officials and wildlife managers to reduce the risk that new exotic species establish themselves and cause harm to the environment.

77. The strategic approach to the management of ornamental fish in Australia includes the establishment of a nationally recognized noxious species list, new management frameworks for the ornamental sector, better communication with stakeholders and a public awareness campaign on the dangers of releasing fish where they can get into waterways, and management of species that are no longer wanted.

78. With regard to live bait and live food, Australia does not permit the import of live bait and does not permit the importation of live rodents (e.g., mice or rats) as pets or as live food for other animals.

79. In the United Kingdom, the Great Britain Non-Native Species Programme Board developed a risk analysis mechanism which uses a generic risk assessment methodology to assess the risk posed by all alien species. The generic risk assessment methodology that is used was developed by a consortium led by the Central Science Laboratory. The format is based on the European Plant Protection Organization's risk assessment methodology. The Great Britain Non-Native Risk Analysis Panel, which has expertise in entomology, plants, fish, animal diseases, marine and economics, reviews the results of risk assessments conducted by experts to ensure consistency of approach and accuracy of content. Comments made by the panel are sent back to the risk assessor to address or rebut. This process is often repeated several times until the panel is satisfied with results of the risk assessment prior to introduction of non-native species.

80. In Canada, in most parts of the country it is illegal to release any aquatic organisms into the wild without a permit. In addition to the national legislation regulating release of aquatic organisms, the Fish Rescue Program, a joint effort involving various bodies (the Royal Ontario Museum, the Toronto Zoo, the Canadian Association of Aquarium Clubs, the Ontario Government, the Pet Industry Joint Advisory Council, the Ontario Federation of Anglers and Hunters, and Fisheries and Oceans Canada) developed a programme which makes aquarium owners aware of the dangers of releasing pets or plants into the wild and facilitates finding homes for unwanted aquarium pets.

B. Voluntary programmes

81. The Council of Europe (CoE) and the European and Mediterranean Plant Protection Organization (EPPO) have prepared a Code of Conduct on Horticulture and Invasive Alien Plants. It enlists the cooperation of the horticulture trade and industry and associated professionals, encouraging them to adopt good practices in (a) raising awareness on this topic among professionals, (b) preventing the spread of alien invasive species already present in Europe, and (c) preventing, reducing and controlling possible introductions of alien invasive species into European and Mediterranean countries.

82. The National Invasive Species Strategy for The Bahamas set a Voluntary Code of Conduct for Pet Stores, Breeders and Dealers and a Voluntary Code of Conduct for Pet Owners. In these voluntary codes, pet stores, breeders and dealers should conduct risk assessment prior to the introduction of alien species, and they should work with local experts and stakeholders to determine which species are either currently invasive or potentially invasive. Pet owners should seek information on which species are invasive in the country using information sources existing in zoos, aquaria, pet stores, and from ecologists, conservationists and government agencies. If the decision is taken to own an invasive species,

the pet owner has to ensure that it is contained and controlled through confinement to his/her property and through reproductive control.

83. In the United States of America, a national initiative, Habitattitude™, was developed by the ANS Taskforce and its partner organizations, the Pet Industry Joint Advisory Council, the U.S. Fish and Wildlife Services and the NOAA National Sea Grant College Program. This voluntary programme involves the pet and aquarium trade and the nursery and landscape industry. Habitattitude™ developed campaign materials to increase awareness about invasive alien species among industries and consumers, including pet owners. Habitattitude ™ also provides information on the federal and state regulations that govern actions relating to the movement of live species.

C. Practices of aquarium industries

84. Ornamental Fish International (OFI), an association of aquarium-species trade industries, held a one-day conference in Singapore in conjunction with an international trade fair, "Aquarama", in May 2009, focusing on improving awareness of the risks for fauna and flora associated with the ornamental fish and plants trade. The topic of invasive alien species was presented to the aquarium industry worldwide for the first time. In addition, the over 4,400 trade visitors at Aquarama were exposed to the message on the risks of invasion.

85. The Ornamental Aquatic Trade Association (OATA) has produced *Biosecurity and the Ornamental Fish Industry: Future Proofing the Industry*, a publication that includes up-to-date information and a self-assessment biosecurity questionnaire for its members. OATA also produces and disseminates outreach materials, such as booklets, websites, and plastic bags in which animals and plants are taken home from pet shops, to educate pet-shop owners and consumers regarding the environmental risks associated with ornamental fish[5] and aquatic plants.

86. Under the Code of Conduct[6] developed by OATA, advice on the care and maintenance of aquatic organisms is made available and consumers are advised not to release or dispose of aquatic organisms in the wild. Numerous campaign materials for this are available on the OATA website.

87. In the UK the pet industry, for instance through OATA, is actively engaged in the review of policies related to invasive alien species. It also participates in relevant work groups, including the Media and Communication Working Group of the GB Non-native Species Secretariat, which is working to improve public awareness on invasive alien species (e.g., through the "Be Plant Wise"[7] campaign).

D. Regional approach

88. At the regional level, the Council of Europe is in the process of establishing a European Code of Conduct on Companion Animals and Invasive Alien Species, aimed at encouraging the pet industry to adopt voluntary measures to prevent unwanted introduction and release of invasive alien species into the wild. The code is intended to promote awareness of invasive alien species and inform the public on which species are native to an area and which are not, and to disseminate the message that members of the public should never release pets to the wild as it may compromise their welfare and may be cruel. The code also proposes solutions for reporting and rapid response to companion animals released into the wild.

89. Several island countries of the Pacific have aquarium trade management plans to regulate the aquarium trade, and some also have biosecurity/biosafety policies/legislation. Currently, Tonga and Vanuatu have formal aquarium fishery management plans. Palau provides an example of the types of regulations applied in many countries of Micronesia. Palau does not have any regulations specifically for

[5] http://www.ornamentalfish.org/aquanautconservation/petfishbelong.php

[6] http://www.ornamentalfish.org/association/code/Code.pdf

[7] http://beplantwise.direct.gov.uk/index.html

pets. Anyone wishing to import an animal (including fish, and other aquarium organisms) and/or plant (which could also include aquarium plants) must apply for an import permit, according to published regulations. These regulations also apply to importation of live bait – milkfish are commonly imported for this purpose –, and require that they be certified free of tilapia or other species of fish. Various lists (e.g., CABI, PIER, OIE, etc.) and other resources (e.g., PestNet, Aliens-L) are used to inquire about potential invasiveness. If the organism is known to be invasive, a permit will not be granted. If it is known not to be invasive, there still may be restrictions on import due to disease and pest risks, and in these cases conditions for import will be applied. If inadequate information is available, the application may be referred to the Import Review Committee, which can recommend that a risk analysis be conducted at the importer's expense. Since the Import Review Committee was created a couple of years ago, no applications have been referred to it and no risk analyses have been performed. In recent times, permits have been denied to import hamsters and rabbits into Palau due to potential invasiveness.

90. The South Pacific Regional Environment Programme (SPREP) developed a draft Invasive Species Strategy for the Pacific Islands in 2000. This was followed by fourteen Pacific island State governments who incorporated it into an action strategy for the Pacific islands region and reflected it in their National Biodiversity Strategies and Action Plans, with clear goals and targets. The strategies and action plans for IAS include (i) improvement of port quarantine, (ii) raising public awareness, (iii) pilot programmes of eradication and control, (iv) management plan for marine and terrestrial IAS, and (v) monitoring of IAS.

VI. THE INTERNATIONAL BODIES WHICH SET STANDARDS OR GUIDELINES

A. Under the SPS agreement of the World Trade Organization

91. The Agreement on the Application of Sanitary and Phytosanitary Measures of the World Trade Organization (the SPS Agreement) establishes basic rules for food safety and animal and plant health standards. Its standard-setting bodies are the Codex Alimentarius, OIE, and IPPC, respectively.

92. The Codex Alimentarius develops food standards, guidelines and related texts such as codes of practice under the Joint FAO/WHO Food Standards Programme. The main purposes of this programme are to protect the health of the consumers and to ensure fair trading practices in the food trade. The mandate of the Codex Alimentarius considers human health. Its relevance to setting standards for safeguarding biodiversity from IAS is not included in its mandate.

93. The OIE covers diseases that are listed by OIE, some of which may be considered to be invasive species, depending on the definition of this term. The OIE mandate does not cover invasive species that are not agents of listed diseases. Any change to this mandate (e.g., to provide for OIE to set standards to prevent the global spread of IAS), would need to be formally adopted by Members.

94. The IPPC provides International Standards for Phytosanitary Measures (ISPMs) for safeguarding plant resources. The IPPC Secretariat is developing a discussion paper on the application of IPPC standards to the aquatic environment, for consideration by the Commission for Phytosanitary Measures, regarding plant pests which can be invasive in aquatic environments.

95. Application of IPPC standards to the aquatic environment, to cover aquatic invasive plant species and plant pests, is under discussion for the standard-setting process.

96. In consultation with interested stakeholders, OIE might examine the OIE criteria for disease listing and the availability of relevant expertise, to consider whether organisms causing diseases in wildlife are adequately considered.

97. The OIE will explore options for developing a paper examining the possibility of broadening its mandate to address animals that are potentially invasive; OIE could have a comparative advantage since it provides advice to organizations that regulate the international movement of animals.

98. In theory, any WTO member could initiate a discussion in the Committee on Sanitary and Phytosanitary Measures regarding national measures taken to address risks from invasive alien species associated with international trade, or regarding gaps in the mandates of the standard-setting organizations referenced in the Agreement on the Application of Sanitary and Phytosanitary Measures.

B. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

99. The purpose of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Although CITES is legally binding, it does not take the place of national laws. Rather, it provides a framework to be respected by each CITES Party; each Party has to adopt its own domestic legislation to ensure that CITES is implemented at the national level.

100. In response to paragraph 11 of decision IX/4 A, CITES continues its collaboration with the Convention on Biological Diversity to explore additional means to address invasive alien species of relevance to international trade in CITES-listed species, including (i) CITES's legally-binding regulatory scheme for ensuring that trade is legal, sustainable and traceable, (ii) the CITES trade database; (iii) the Information and Knowledge Management Initiative for assisting States-Parties with multilateral environmental agreements, (iv) national policy and legislative support provided to CITES Parties, and (v) cooperation within the Biodiversity Liaison Group as well as the Environment Management Group.

101. Under Resolution Conf. 9.24 (Rev. CoP14) on *Criteria for amendment of Appendices I and II*, adopted by the Conference of the Parties to CITES, high vulnerability to threats from alien invasive species (such as hybridization, disease transmission, depredation or habitat alteration) are considered as extrinsic, aggravating factors which might cause a species with a small wild population and restricted area of distribution, or which has exhibited a marked decline in its population size, to be eligible for inclusion in Appendix I or II of the Convention.

102. Under Resolution Conf. 12.10 (Rev. CoP14) on *Guidelines for a procedure to register and monitor operations that breed Appendix-I animal species for commercial purposes*, Parties to CITES are urged, prior to the establishment of captive-breeding operations for exotic species, to undertake an assessment of the ecological risks, in order to safeguard against any negative effects on local ecosystems and native species.

103. Under Resolution Conf. 13.10 (Rev. CoP14) on *Trade in alien invasive species*, it is recommended that Parties to CITES: (i) consider the problems of invasive species when developing national legislation and regulations that deal with the trade in live animals or plants; (ii) consult with the Management Authority of a proposed country of import, when possible and when applicable, when considering exports of potentially invasive species, to determine whether there are domestic measures regulating such imports; and (iii) consider the opportunities for synergy between CITES and the Convention on Biological Diversity and explore appropriate cooperation and collaboration between the two conventions on the issue of introductions of alien species that are potentially invasive.

104. Taking into account the fact that some of the CITES-listed species are invasive alien species in importing countries, the Management Authority of Parties to the CITES may list the species which carry the risk of invasion and apply measures to the potentially invasive species.

105. In the European Union region, CITES is implemented with Council Regulation 338/97 and implementing Commission Regulation 865/06 (now about to be revised to reflect outcomes of CoP15). The Annexes to Regulation 338/97 mirror CITES Appendices, but they also include, in Annex A, B and C, many European species that are not included at all in the CITES Appendices. Moreover the European Union regulations set more strict measures, and article 3.2 of Regulation 338/97 includes the possibility of listing "*(d) species in relation to which it has been established that the introduction of live specimens into the natural habitat of the Community [now Union] would constitute an ecological threat to wild species of fauna and flora indigenous to the Community*". In this context four invasive alien pet species

have been listed in the past in Annex B (*Oxyura jamaicensis*, *Chrysemys picta*, *Trachemys scripta elegans* and *Rana catesbeiana*). Following this listing, and according to the provision of article 4.6 of the Regulation 338/96, the import of live specimens of these species was suspended.

106. In the periodic revision of the Annexes, the European Union is now considering also the inclusion of three invasive or potentially invasive alien pet species of squirrels (*Sciurus carolinensis*, *Callosciurus erytherus* and *Sciurus niger*).

C. The Food and Agriculture Organization of the United Nations

107. The FAO is composed of various statutory bodies, such as the Committee for Agriculture, the Committee for Fisheries, the Committee for Forestry and the Commission on Genetic Resources for Food and Agriculture, dealing with sectoral and cross-sectoral issues of agricultural biodiversity. Of relevance to the issue of invasive alien species, the FAO implements the Convention on Biological Diversity's Programme of Work on Agricultural Biodiversity, is involved in implementation of other programmes and cross-cutting initiatives of the Convention on Biological Diversity, and leads the International Pollinator Initiative. The FAO has led global assessments on plant and animal genetic resources and is currently working on forest and aquatic genetic resources assessments. The FAO's global databases provide up-to-date information on the status of genetic resources for food and agriculture, including information on alien species. The FAO member countries, through the Commission on Genetic Resources for Food and Agriculture, have adopted A Global Plan of Action for Plant Genetic Resources and a Global Plan of Action for Animal Genetic Resources, both addressing, among others, introduction of unsuitable genetic materials. The FAO could explore bringing the issue of IAS more to the attention of its bodies.

108. The FAO Secretariat could explore bringing the issue of IAS to the attention of the Committee on Fisheries (COFI) (February 2011) and its Sub-Committees on Aquaculture and Fish Trade, for consideration and guidance of Members. One option could be to review and update relevant provisions of existing FAO Technical Guidelines under the Code of Conduct for Responsible Fisheries (CCRF), including the "Precautionary approach to capture fisheries and species introductions"(FAO 1996)[8], "Aquaculture development. 3. Genetic resource management" (FAO 2008)[9], and other relevant material, for harmonization and more comprehensive coverage addressing aquatic animal introductions for aquaculture and fisheries, in all environments.

109. At the twenty-ninth session of COFI, the members recognized the need to address the possible impacts of biosecurity measures on livelihoods, especially of the rural poor. Many members requested that FAO develop technical guidelines on species introductions and incorporate biosecurity in the preparation of the "FAO Technical Guidelines on Responsible Fisheries: Recreational Fisheries".

110. In addition, the Network of Aquaculture Centres in Asia-Pacific (NACA), as a member of the Coordinating Working Party on Fishery Statistics, Aquaculture Working Group, reemphasized the need for aquaculture statistics to cover the production of ornamental fishes, an important source of livelihood for small-scale producers in many countries, and that relevant statistical standards should be developed. In response to the reemphasis above, the FAO Secretariat reminded COFI members that the primary focus of FAO was on food production but that incorporation of statistics on ornamental fish could be considered if reliable data were available.

111. The Cook Islands, on behalf of the Pacific Island Members of COFI present at COFI's twenty-ninth session, asked for an FAO interregional technical cooperation project to strengthen cooperation

[8] FAO 1996. Precautionary approach to capture fisheries and species introductions. FAO Technical Guidelines for Responsible Fisheries. No. 2. Rome, FAO. 54 pp. Also available at http://www.fao.org/docrep/003/w3592e/w3592e00.htm

[9] FAO. 2008. Aquaculture development. 3. Genetic resource management. FAO Technical Guidelines for Responsible Fisheries. No. 5, Suppl. 3. Rome, FAO. 125 pp. Also available at http://www.fao.org/docrep/011/i0283e/i0283e00.htm

among aquaculture networks. The delegate of the Cook Islands also requested FAO to develop technical guidelines for the use of alien species in aquaculture.

112. Therefore, the FAO COFI seems to be a candidate for setting technical guidelines related to alien species aquaculture, and for some database development incorporating statistics on ornamental fish.

VII. TOWARDS DEVELOPMENT OF INTERNATIONAL GUIDELINES

113. Under the Convention on Biological Diversity, 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[10]) provides all Governments and organizations with guidance for developing effective strategies to minimize the spread and impact of IAS. The Guiding Principles are legally non-binding and they can be amended and expanded through the processes of the Convention on Biological Diversity as we learn more about this problem and effective solutions to it.

114. According to Article 3 of the Convention on Biological Diversity, States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

115. Among the international organizations that set international standards or guidelines related to IAS, the process of expanding each organization's coverage or mandate may take some time to be approved by the governing bodies of the organizations. The IPPC may consider covering plant pests in aquatic environments and the OIE is examining the possibility of expanding its mandate.

116. The Codex Alimentarius Commission develops standards, guidelines and related texts such as codes of practice under the Joint FAO/WHO Food Standards Programme. The risk of invasion of live species as live bait and live food to biodiversity is currently outside the scope of the Codex Alimentarius as its mandate is limited to human health.

117. The Global Plan of Action for Plant Genetic Resources and the Global Plan of Action for Animal Genetic Resources cover the introduction of unsuitable genetic material for food and agriculture, and more room could be given to prevent their introduction.

118. Suggested elements of the guidelines may include:

(a) Identification of prioritized species to be controlled by exporting and importing countries;

(b) National or regional regulatory frameworks on exporting live species as pets, aquarium and terrarium species, and live bait and live food;

(c) National or regional regulatory framework for importing pets, aquarium and terrarium species, and live bait and live food, including pre-import risk screening for live species;

(d) Standard setting for containment for live species transportation;

(e) Ways and means applicable by industry/markets (including the internet market) for live species trade;

[10] 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 legitimatly 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).

(f) Developing and utilizing early-detection and rapid response systems;

(g) Improved interoperability of the information related to invasive alien species;

(h) Public awareness on invasive alien species, especially for the end-users of live species;

(i) Capacity development for the implementation of the above.[11]

[11] **Acknowledgement.** This document was compiled in collaboration with the FAO, the IPPC, the Global Invasive Species Programme, IUCN-SSC-ISSG, GBIF and NISC in USA. The Secretariat of the Convention on Biological Diversity especially thanks Dr. Sarah Simons, Dr. Piero Genovesi, Mr. Samy Gaiji and Dr. Stanlay W. Burgiel for submission of up-to-date information and suggestions, and Dr. Kohich Goka, Dr. Jamie Reaser, Mr. Keith Davenport, Dr. Melanie Josefsson and others for reviewing this document. The Secretariat also thanks Mr. Ashvin Ramassamy and Ms. Anita Ogaa for the retrieval and sorting of information in Annex 1 of this document.

Annex I

EXAMPLES OF SPECIES THAT ARE NOT CONTROLLED BY THE EXISTING INTERNATIONAL REGULATORY FRAMEWORK

Group	*Species name*	Common name	Introduction pathway	Suggestion on guideline/ standard setting*
FISHES	*Channa argus*	snakehead	live food	
	Channa marulius	great snakehead	live food	
	Corbicula fluminea	Asian clam	ballast/ bait/ aquarium trade	
	Ctenopharyngodon idella	grass carp	food	
	Cyprinus carpio	common carp	sport fishing/ ornamental purposes	
	Glyptoperichthys gibbiceps	leopard pleco	pet/aquarium trade	
	Gymnocephalus cernuus	Ruffe	ballast/ contaminated live bait	
	Hypophthalmichthys molitrix	silvercarp	aquaculture/ live food	
	Lates niloticus	Nile perch	fisheries/ food	
	Limnoperna fortunei	golden mussel	live food/ ballast	
	Littorina littorea	common periwinkle	live food/ ballast	
	Lutjanus kasmira	common bluestripe snapper	sport fishing/ food	
	Misgurnus anguillicaudatus	oriental weatherfish	food/ aquarium trade	
	Molothrus bonariensis	shiny cowbird	pet trade	
	Mytilus galloprovincialis	Mediterranean mussel	live food/ ballast	
	Orconectes rusticus	rusty crayfish	live bait	
	Orconectes virilis	northern crayfish/ virile crayfish	live bait/ aquarium trade	
	Oreochromis mossambicus	Mozambique tilapia	aquaculture/ aquarium trade	
	Oreochromis niloticus	Nile tilapia	live food/ aquaculture	
	Phalloceros caudimaculatus	dusky millions fish	aquarium trade	
	Poecilia reticulata	guppy	aquarium trade	
	Pomacea canaliculata	apple snail/ channeled apple snail/ golden apple snail/ golden kuhol/ miracle snail	live food/ pet trade	
	Pterois volitans	red lionfish	aquarium trade/ ballast	
	Pterygoplichthys anisitsi	southern sailfin catfish	live food/ aquarium trade	
	Pterygoplichthys multiradiatus	sailfin catfish	live food/ aquarium trade	
	Pterygoplichthys pardalis	Amazon sailfin catfish	live food/ aquarium trade	
	Styela plicata	pleated sea squirt	live food/ ballast/ hull fouling	

Group	*Species name*	Common name	Introduction pathway	Suggestion on guideline/ standard setting*
	Tilapia mariae	black mangrove cichlid/ Niger cichlid/ spotted tilapia/ tiger cichlid	aquarium trade	
	Xiphophorus hellerii	green swordtail	aquarium trade	
OTHER ANIMALS	*Acridotheres tristis*	Calcutta myna/ common myna/ house myna/ Indian myna/ Indian mynah	pet trade/ zoo escapes	
	Anas platyrhynchos	canard colvert/ mallard	ornamental purposes	
	Anolis distichus (synonym)	bark anole/ Hispanolian gracile anole	pet trade	
	Anolis equestris	chipojo/ Cuban knight anole/ iguana/ knight anole/ large Cuban anole	pet trade	
	Anolis leachi	Antiguan anole/ Barbuda bank tree anole/ panther anole/ Warwick lizard	pet trade	
	Anolis maynardi	Little Cayman green anole/ Maynard's anole	pet trade	
	Anolis porcatus	Cuban green anole	pet trade	
	Axis axis	axis deer/ chital/ Indian spotted deer	live food trade	
	Boa constrictor imperator	Boa/ Central American boa/ Colombian boa/ Colombian redtail boa/ Common boa constrictor/ Common northern boa	pet trade/ internet sales/ postal services	
	Caiman crocodilus	common caiman/ narrow snouted spectacled caiman/ spectacled caiman/ tinga	pet trade	
	Canis lupus	Gray wolf/ domesticated gray wolf	pet trade	
	Carijoa riisei	Branched pipe coral/ orange soft coral/ snowflake coral	aquarium trade/ ornamental purposes/ hull fouling	
	Chamaeleo jacksonii	Jackson’s chameleon	pet trade	
	Columba livia	carrier pigeon/ feral pigeon/ feral rock pigeon/ rock dove pigeon	live food trade	
	Daphnia lumholtzi	water flea	pet trade/ ship	

Group	*Species name*	Common name	Introduction pathway	Suggestion on guideline/ standard setting*
	Felis catus	cat/ domestic cat/ feral cat/ house cat	pet trade	
	Gallus gallus	domestic fowl/ feral chicken/ wild chicken/ wild junglefowl	live food trade	
	Hemidactylus frenatus	Asian house gecko/ bridled house gecko/ Chichak/ common house gecko	pet trade	
	Iguana iguana	common iguana	pet trade	
	Leuciscus idus	golden orfe	aquarium trade/ ornamental purposes	
	Lithobates catesbeianus (=Rana catesbeiana)	bullfrog/ North American bullfrog	pet trade	
	Norops garmani	iguana/ Jamaica giant anole/ Jamaican anole/ large green anole	pet trade	
	Osteopilus septentrionalis	Cuban Treefrog/ Giant Tree-frog/ Marbled Tree-toad	pet trade/ horticulture	
	Pacifastacus leniusculus	Californian crayfish/ Pacific crayfish/ signal crayfish	live food trade	
	Procambarus clarkia	Louisiana crayfish/ red swamp crayfish	live food trade	
	Python molurus bivittatus	Burmese python	pet trade/ internet sales/ postal services	
	Streptopelia decaocto	Eurasian collared-dove/ Indian ring-dove	pet trade	
	Styela plicata	leathery tunicate/ pleated sea squirt/ sea squirt/ solitary ascidian	live food trade/ ship ballast water/ hull fouling	
	Trachemys scripta elegans	red-eared slider/ red-eared slider terrapin	pet trade	
	Varanus indicus	ambon lizard/ flower lizard/ George's island monitor/ Indian monitor/ Indian monitor lizard/ kalabeck monitor/ mangrove monitor/ Pacific monitor	pet trade/ biological control	
	Xenopus laevis	African clawed frog/ clawed frog/ clawed toad/ common platanna/ upland clawed frog	pet trade	
	Zosterops japonicus	Japanese white-eye	pet trade	

Group	*Species name*	Common name	Introduction pathway	Suggestion on guideline/ standard setting*
PATHOGENS	*Myxobolus cerebralis*	whirling disease	pet/aquaculture disease-causing parasite	OIE
	Yersinia pestis	bubonic plague	pet trade	OIE
PLANTS & PESTS	*Abelmoschus moschatus*	fautia/ musk/ musk mallow/ okra	garden ornament	
	Acanthus mollis	Artist's acanthus/ bear's breech/ bear's breeches/ oyster plants/ sea-dock/ sea-holly	garden ornament	
	Agapanthus praecox	African-lily/ common agapanthus/ lily of the Nile	ornamental purposes	
	Agave americana	agave/ American agave/ American aloe/ American century plant/ American-aloe/ century plant/ maguey/ spreading century plant/ yucca	garden ornament	
	Alliaria petiolata	garlic mustard plant/ garlic root/ hedge garlic/ Jack-by-the-hedge/ Jack-in-the-bush/ mustard root/ poor man's mustard/ sauce-alone	food/ medicinal purposes	
	Alternanthera sessilis	common roadside weed/ joyweed	horticulture	
	Ampelopsis brevipedunculata	creeper/ porcelainberry/ wild grape	floating vegetation/ ornamental purposes	
	Angiopteris evecta	giant fern/ king's fern/ mule's fern/ mule's-foot fern/ oriental vessel fern	ornamental purposes	
	Ardisia elliptica	shoebutton ardisia	ornamental purposes	
	Butomus umbellatus	flowering rush/ grassy rush/ water gladiolus	ornamental purposes/ ship ballast	
	Caesalpinia decapetala	cat's claw/ Mauritius thorn/ Mysore thorn/ shoofly/ thorny poinciana/ wait-a-bit	ornamental purposes	

Group	*Species name*	Common name	Introduction pathway	Suggestion on guideline/ standard setting*
	Cestrum nocturnum	lady of the night/ night cestrum/ night jessamine/ night queen/ night-blooming jasmine/ night-flowering cestrum/ night-flowering jasmine/ queen of the night	ornamental purposes	
	Crassula helmsii	Australian stonecrop/ Australian swamp stonecrop/ New Zealand pygmyweed/ swamp stonecrop	aquarium plant/ pond plant	
	Cryptostegia grandiflora	India rubber vine/ palay rubbervine/ purple allamanda/ rubber vine	ornamental purposes	
	Cynanchum rossicum	dog-strangling vine/ European swallow-wort/ pale swallow-wort	ornamental purposes	
	Cytisus scoparius	broomtops/ common broom/ European broom/ Irish broom/ Scotch broom	ornamental purposes	
	Dioscorea oppositifolia	Chinese yam/ cinnamon vine	ornamental purposes	
	Dipogon lignosus	Australian pea/ chookhouse vine/ dolichos pea/ dunny creeper/ lavatory creeper/ mile-a-minute/ okie bean/ purple dolichos	ornamental purposes	
	Elaeagnus angustifolia	Russian-olive	ornamental purposes	
	Elaeagnus umbellata	autumn elaeagnus/ autumn-olive/ silverberry	ornamental purposes	
	Euonymus alata	burning bush/ winged burning bush/ winged euonymus	ornamental purposes	
	Euonymus fortunei	emerald'n Gold/ gaiety/ wintercreeper	ornamental purposes/ internet sales	
	Eleutherodactylus planirostris	greenhouse frog	nursery trade	
	Gunnera manicata	Brazilian giant rhubarb/ Brazilian giant-rhubarb/ Brazilian rhubarb/ Chilean rhubarb/ giant gunnera/ giant rhubarb/ poor man's umbrella	ornamental purposes/ internet sales	

Group	*Species name*	Common name	Introduction pathway	Suggestion on guideline/ standard setting*
	Hedera helix	English Ivy	ornamental purposes	
	Hygrophila polysperma	East Indian hygrophila/ hygro/ Indian swampweed/ Miramar weed	aquarium trade	
	Hypericum perforatum	amber/ common St. John's wort/ gammock/ goatsbeard/ goatweed/ herb john/ racecourse weed/ rosin rose/ St. John's grass	ornamental purposes	
	Impatiens glandulifera	Himalayan balsam/ Indian balsam/ Washington orchid	ornamental purposes	
	Landoltia punctata	dotted duckmeat/ dotted duckweed/ giant duckweed	aquarium trade	
	Leucaena leucocephala	horse tamarind/ wild tamarind/ jumbie bean/ lead tree/ leucaena	internet sales	
	Ligustrum robustum	Ceylon Privét/ Sri Lankan privet/ tree privet	ornamental purposes	
	Limnocharis flava	sawah-flower rush/ sawah-lettuce/ velvetleaf/ yellow bur-head	aquarium trade	
	Linaria vulgaris	butter and eggs/ flaxweed/ greater butter and eggs/ Jacob's ladder/ ramsted/ wild snapdragon/ yellow toadflax	ornamental purposes	
	Lygodium japonicum	Japanese climbing fern	ornamental purposes	
	Melia azedarach	chinaberry/ Indian lilac/ margosa tree/ Persian lilac/ pride-of-India/ Sichuan pagoda-tree/ syringa berrytree/ umbrella tree/ white cedar	ornamental purposes	
	Merremia tuberosa	Brazilian jalap/ ceylon morning glory/ Hawaiian wood rose/ Spanish woodbine/ wood rose/ yellow morning-glory	horticulture	

Group	*Species name*	Common name	Introduction pathway	Suggestion on guideline/ standard setting*
	Miconia calvescens	bush currant/ miconia/ purple plague/ velvet tree	ornamental purposes	
	Miscanthus sinensis	chinese fairy grass/ chinese silver grass/ eulalia/ eulalia grass/ japanese silver grass/ maiden grass/ miscanthus/ pampas grass/ plume grass	ornamental purposes	
	Najas minor	brittle naiad/ brittle waternymph/ European naiad/ minor naiad/ slender naiad/ slender-leaved naiad/ spiny-leaf naiad	aquarium trade/ hull fouling	
	Orthezia insignis	Croton bug/ Krew bug/ Lantana blight	nursery trade	
	Technomyrmex albipes	white-footed ant/ white-footed house ant	nursery trade	
	Xylosandrus mutilatus	camphor shoot beetle/ camphor shot-borer	nursery trade/ solid wood packaging material	

* To be agreed with the relevant organizations in consultation with the AHTEG

Annex II

RISK-ASSESSMENT QUESTIONS FOR IMPORTS OF LIVE ALIEN ANIMALS, DATA NEEDS, AND CAPACITY NEEDS FOR THE APPROACHES LISTED. ANNOTATIONS ON THESE QUESTIONS, INFORMATION AND DATA NEEDS, AND CAPACITY NEEDS ARE PROVIDED BELOW, LISTED BY QUESTION NUMBER [12]

Questions	Information and data needs	Capacity needs
1. What is the taxon, identified to the most detailed level possible?	Standardized Global Species Checklist or globally unique identifier	Taxonomic expertise; library resources or access to web-based taxonomic keys; identification tools
2. What are the circumstances of the proposed importation?	Importer declaration of intent and any proposed or potential mitigation of invasiveness risk	See Question 7
3. What is the history of invasiveness of this taxon anywhere? **3a**. . . . of its pathogens or parasites? (Note: pathogens and parasites should be considered in subsequent questions but for purposes of brevity/simplicity this is not mentioned further in the table)	Information and data on invasiveness of taxon in other areas; occurrence of pathogens and parasites, and their invasiveness in other areas; data on whether the species has ever been imported anywhere before	Experience interpreting scientific information on invasiveness; expertise in pathogens and parasites regarding possible shifts in hosts and vectors; data quality control; clear definition of invasiveness
4. To what extent are the environmental conditions for persistence of this taxon present anywhere in the area of concern?	Maps of the occurrence of the taxon (or point data); at a minimum, maps of climatic match or other environmental attributes; ideally computerized data layers of climate and taxon occurrence	At a minimum, the ability to compare maps of climatic or other environmental information across areas; ideally the ability to apply computer-based models of climate or other environmental matching
5. What is the probability of establishment and spread of this taxon anywhere in the area of concern?	Biological information and data related to establishment and spread; ideally information on the traits used in available statistical models or models to be developed	Statistical models (and the ability to apply them, as above) built on history of establishment and/or spread of similar taxa in similar ecosystems; expert judgment
6. What is the potential impact of this taxon anywhere in the area of concern?	Biological information and data related to impact; ideally input data on the traits of the taxon for available statistical models or models to be developed; additional assessment data may include asset/land use maps and/or data within the potential range	Statistical models built on history of impact of similar taxa in similar ecosystems; expert judgment
7. What mitigation options are available and appropriate? Iterate throughout the risk assessment process considering how mitigation could change the answers to Questions 1-6.	Information on mitigation options and their feasibility and likely effectiveness based on past practices and the capacity within the country to apply them	Experience with mitigation; infrastructure to assure feasibility and long-term maintenance of mitigation implementation; inspection, compliance and enforcement infrastructure (whether within a regulated or self-regulated framework), containment technology; surveillance and contingency planning
8. Provide results of the risk assessment to decision-makers.	Context of the proposed import together with answers to questions above and a concluding assessment of risk	Expertise in risk communication

[12] The table and annotations are taken from UNEP/CBD/COP/9/INF/32/Add.1

Question 1. Identification of the taxon should be to the lowest level feasible, including population and genetic structure where relevant. Identification of its potential pathogens/parasites may also be relevant.

Question 2. By which pathways and vectors will the taxon be introduced? What is the intended use of the taxon, and what unintended uses might develop? The answers to these questions may help set priorities for risk assessment among taxa proposed for importation, particularly where resources are limited. For example, knowledge of intended use could help prioritize work across multiple risk assessments by separating those uses that might obviously be riskier (e.g., where direct release into the environment is intended, or where the likelihood of escape or release from confinement and/or propagule pressure could be high) than others (e.g., where a small number of animals is intended to be kept in strict confinement) These aspects would be more fully documented and explored under Question 7.

A risk assessment may be carried out with the aim to provide a basis for a decision on whether or not an alien species should be listed as an "invasive alien species," "unwanted organism" or other specific determination for national regulatory purposes, without there being a proposal or application for import of the alien species. In such cases, question 2 may be of little relevance to the risk assessment.

Question 3. Each country conducting a risk assessment needs to determine what it means by "invasive". Existing databases on species invasiveness may be a valuable resource for answering this question, but definitions of "invasive" used by databases may not always be consistent with those of the country conducting the risk assessment. Available databases should therefore be interpreted carefully, with appropriate attention to data reliability and relevance.

The most relevant data on invasiveness will be for other areas that are ecologically similar to the potential area of introduction. The lack of history of invasiveness does not imply that risk is low unless it is known that the taxon was introduced in large numbers and/or established and nevertheless failed to become invasive. That is, one possible explanation for lack of information on invasiveness is that the taxon has not previously been introduced in sufficient numbers or under conditions suitable for escape, establishment, and spread. It is also possible that relevant information has not been made public yet or that relevant databases have not been updated due to limited resources.

Pathogens and parasites should be considered. In many cases the risk assessment for associated pathogens and parasites will depend not only on the alien animal species being considered, but on precisely where it would be coming from -- as this would change the mix of pathogens and parasites that would need to be considered. How this would be addressed in practice may depend on data availability, technical capacities, or other variables.

If compelling evidence exists that the risk of invasiveness of the taxon is high, then question 3a may become moot. In that case a jurisdiction with limited capacity might choose to make a decision to restrict or prohibit import based on the answer to Question 3, without considering parasites and pathogens.

Question 4. Where possible, biotic interactions, as well as maps of climate and other physical and chemical conditions (e.g., water quality for aquatic taxa), would be considered. Ideally, such information would exist in data layers in a computerized Geographic Information System (GIS).

Parasites and pathogens should be considered, as explained under the annotation for Question 3.

Question 5. Depending on the taxonomic group, traits included in a statistical model to predict establishment might include fecundity and other life-history characteristics, body size, behavior and diet. An increasing number of statistical models to predict establishment and/or spread are available in some parts of the world for fishes, mollusks, reptiles and amphibians, birds and other taxa. See annotation for Question 2: intended and unintended uses may affect the probability of spread by anticipated and unanticipated transportation modes. If modelling potential spread is relevant to a risk assessment, an increasing array of diffusion and network modelling approaches are available. However, such models of spread require substantial technical capacity, data on the dispersal capacity of the taxon, and data on the movements of transportation modes (airline traffic, land-based transportation, and boat and ship traffic patterns) on which the taxon might "hitchhike".

Parasites and pathogens should be considered, as explained under the annotation for Question 3.

Question 6. Each country conducting risk assessments needs to determine what it means by "impact," which might include positive or negative consequences that are biological (including biodiversity, ecosystem and wildlife health) or economic (including human health, agriculture or livelihoods). An increasing number of statistical models to predict impact are available for some parts of the world, e.g., for fishes, mollusks, birds and other taxa.

Parasites and pathogens should be considered, as explained under the annotation for Question 3.

Question 7. Depending on the country's policy, risk assessment might first be conducted without considering any mitigation ("unrestricted risk"), with mitigation being a relevant factor considered in making a final decision on importation. Or, risk assessment may include consideration of how risk would be changed by implementation of mitigation options and alternative management practices. Results would be provided under step/question 8 to the relevant authority to make a decision about whether and under which management conditions importation would be allowed.

Management practices that might be considered as part of the assessment will depend on the taxon, capacity regarding resources and infrastructure, policy frameworks, and inspection and enforcement capacities (whether voluntary or regulatory). Such management practices might include permitting systems that can restrict use and/or mandate additional management steps; containment methods; surveillance and contingency plans; limitation of the number of individuals imported (controlling propagule pressure); importation of only one sex in sexually reproductive taxa; sterility of organisms or other genetic modification to reduce survival in nature; regulatory, educational programs for consumers; and sanitary practices to reduce infestation by pathogens/parasites.

Parasites and pathogens should be considered in their own right for mitigation as explained under the annotation for Question 3.

Question 8. The results of the assessment should acknowledge uncertainty (and quantify it or categorize it where possible). The risk-assessment process ends when the assessment results are provided to the relevant decision-making authority that is empowered to make a decision whether or not importation is allowed – and, if so, appropriate restrictions or conditions.