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International Trade and Invasive Alien Species

WTO OMC

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Abbreviations and Acronyms

AAHS	Aquatic Animal Health Services
ANS	Aquatic Nuisance Species Task Force (USA)
AusAID	Australian Agency for International Development
APHIS	Animal and Plant Health Inspection Service (United States Department of Agriculture)
CABI	Centre for Agricultural Bioscience International
CBD	Convention on Biological Diversity
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement
CITES	Convention on the International Trade in Endangered Species of Wild Fauna and Flora
COP	Conference of Parties (of the CBD)
CPM	Commission on Phytosanitary Measures (of the IPPC)
DAISIE	Delivering Alien Species Inventory in Europe
FAO	Food and Agriculture Organization of the United Nations
EPPO	European and Mediterranean Plant Protection Organization
EAC	East African Community
GEF	Global Environment Facility
GISD	Global Invasive Species database
GISP	Global Invasive Species Programme
GMO	Genetically modified organism(s)
IAEA	International Atomic Energy Agency
IAS	Invasive alien species
ICAO	International Civil Aviation Organization
IHR	International Health Regulations
IITA	International Institute of Tropical Agriculture
IMO	International Maritime Organization
IPPC	International Plant Protection Convention
IRSS	Implementation Review and Support System (of the IPPC)
ISPM	International standard on phytosanitary measures
ISSG	Invasive Species Specialist Group (of IUCN)
IUCN	International Union for the Conservation of Nature and Natural Resources
LVEMP	Lake Victoria Environmental Management Project
NAPPO	North American Plant Protection Organization
NISC	National Invasive Species Council (of the USA)
NPPO	National Plant Protection Organization
OIE	World Organisation for Animal Health
PCE	Phytosanitary Capacity Evaluation
PPPO	Pacific Plant Protection Organization
PRA	Pest Risk Analysis
PVS	Performance of Veterinary Services
RPPO	Regional Plant Protection Organization
SPC	South Pacific Commission
SPS	Sanitary and phytosanitary
SPS Agreement	Agreement on the Application of Sanitary and Phytosanitary Measures
STDF	Standards and Trade Development Facility

SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice (of the CBD)
TNC	The Nature Conservancy
UNCED	United Nations Conference on Environment and Development
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environmental Programme
UNDP	United Nations Development Programme
USDA	United States Department of Agriculture
VS	Veterinary Services
WB	World Bank
WHO	World Health Organization
WTO	World Trade Organization

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Executive summary

1. Invasive alien species (IAS) – species which may be introduced into new ecosystems via intentional or unintentional introductions – are a major threat to biological diversity. In many cases, they can also have devastating consequences for human health, agricultural productivity and trade. The economic cost of IAS is estimated at hundreds of billions of dollars annually to economies worldwide.

2. Increasing travel, trade, and tourism have facilitated intentional and unintentional movement of species beyond natural geographical barriers. Many of these alien species have become invasive. Trade is one of the main pathways through which IAS can be introduced. Intentional introductions of IAS can occur through trade in new plant species and animals, while unintentional introductions are often linked to trade in agricultural commodities, as well as transportation and shipping.

3. Given the potentially devastating impacts of IAS, the Convention on Biological Diversity (CBD) requires countries, as far as possible and appropriate, to prevent their introduction or to control or eradicate them if they are introduced. While IAS are considered as a cross-cutting issue applicable to all aspects of the Convention, the CBD does not set standards on how to regulate IAS. Nevertheless, the focus on IAS in the CBD is very relevant to the work of two international standard-setting bodies, notably the International Plant Protection Convention (IPPC) and the World Organisation for Animal Health (OIE), which are recognized as standard-setting bodies under the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) of the World Trade Organization.

4. The IPPC's coverage of IAS corresponds to pests of plants and plant products, reflecting its mission to protect cultivated and wild plant resources, including aquatic ones, from the spread and introduction of plant pests. The IPPC's governing body has adopted a number of recommendations highlighting the relationship between IAS and quarantine pests, and the role of the IPPC with regard to IAS. In particular, the IPPC views that IAS which are plant pests or quarantine pests are subject to IPPC provisions. As such, the IPPC and its ISPMs are directly relevant to the implementation of Article 8(h) of the CBD. Contracting parties to the CBD can therefore make effective use of IPPC standards to regulate IAS that are (directly or indirectly) pests of plants, and to address biodiversity issues (such as the protection of wild flora) by enhancing plant protection laws and policies.

5. While the OIE does not, *per se*, specifically address IAS-related risks presented by animals and has not, to date, developed particular standards related to IAS, the OIE has issued guidelines related to the risk of non-native animals becoming invasive. Moreover, three OIE-listed diseases are recognized by the CBD as IAS that threaten biodiversity. However, a gap exists within the international SPS regulatory framework related to invasive animals that are neither plant pests nor OIE-listed pathogens and parasites. There may therefore be potential for setting standards and providing advice relevant to IAS that are animals if the objectives of the OIE were expanded to address impacts other than those directly resulting from the interaction between a pathogen and the host animal. In this context, OIE Member Countries may consider the establishment of a specific definition of "animal health" for the purpose of the OIE Terrestrial and Aquatic Animal Health Codes.

6. Measures to prevent the introduction of IAS may, by their nature, be very trade restrictive. While the SPS Agreement does not include specific reference to IAS, it provides an international legal basis for all sanitary and phytosanitary measures that affect international trade. This includes pests, diseases, sanitary and phytosanitary issues, many of which are alien species. Close alignment between the CBD and the SPS Agreement, as well as with the IPPC and OIE, is therefore essential to help achieve the objectives of these instruments, without restricting trade unnecessarily (Lopian, 2005). Efforts have been made over the last decade to develop and enhance cooperation between the Secretariats responsible for the CBD, the SPS Agreement, the IPPC, the OIE, as well as with other related organizations working at a global/regional level. Considerable synergies can be obtained from further enhancing international cooperation and collaboration on IAS, including with regard to capacity building efforts targeted at developing countries.

7. In most countries, environmental authorities are responsible for the prevention and control of IAS, while SPS-related functions are generally handled by trade and/or agricultural authorities. Cooperation between relevant national authorities – including ministries and departments responsible for agriculture, phytosanitary services, veterinary services, trade and the environment – is therefore a prerequisite to effectively establish and implement legal frameworks for the prevention, control and management of IAS and to avoid duplication and overlap. Countries should assess, monitor and manage species that may be invasive (and that may directly or indirectly affect plants or plant products, or that are diseases of animals) in accordance with the relevant IPPC and OIE standards, guidelines and

recommendations. Making use of existing SPS procedures and systems, including for phytosanitary and veterinary border control and quarantine, offers an effective and cost-effective approach to prevent the introduction of IAS. In addition, the involvement of all relevant stakeholders, including the private sector, research and academia, civil society and local communities, is also likely to further enhance the impact of such efforts.

8. Effective SPS systems are a necessary foundation for IAS capacity. Strengthening the capacity of existing SPS authorities can contribute to national capacity to respond to and manage IAS-related risks. The majority of trade-related IAS can be managed effectively by operational national SPS systems comprising, *inter alia*, border controls, quarantine, control and eradication measures, and risk assessment. In some countries, SPS systems are well-equipped to address the majority of trade-related IAS. However, many developing countries, and particularly least-developed countries, require substantial additional resources and support to strengthen their SPS systems.

9. Given the extent and diversity of needs faced, and the number of organizations that play a role in the area of IAS, capacity building efforts should be based on a collaborative, inter-disciplinary and cross-cutting approach. In many cases, working at a regional level is likely to be most meaningful, cost-effective and sustainable given the ease with which IAS can cross borders. Carrying out in-depth needs assessments, using the official capacity evaluation tools developed by the IPPC and OIE, provides a valuable basis on which countries can formulate capacity building investment programmes, focused on both the SPS and IAS areas, and secure resources for targeted follow-up.

10. In July 2012, the Standards and Trade Development Facility (STDF), in collaboration with the IPPC, the OIE and the WTO, organized a seminar on the relationship between international trade and IAS, and the linkages between the international organizations and legal instruments concerned. The seminar was successful in raising awareness about the mutually-beneficial goals of the CBD and the SPS Agreement, and the contribution of the two relevant standard-setting organizations (IPPC, OIE) under the SPS Agreement. In particular, it highlighted the importance of: (i) effective SPS systems in helping to protect against the entry of harmful species, including pests, diseases and other IAS; and (ii) collaboration between the SPS and the CBD "communities" at the global, regional and national level.

11. This desk study was prepared for the STDF seminar and further revised based on its conclusions and recommendations. It reviews and analyses key concepts and principles relevant to IAS and international trade in the context of the CBD and the SPS Agreement, as well as in relation to the IPPC and the OIE. It also considers various initiatives to enhance capacities for managing the entry and spread of IAS (including plant pests and animal diseases), reviews common challenges and good practices, and makes a number of targeted recommendations.

1. Introduction

1. The United Nations Conference on Environment and Development (UNCED), commonly known as the "Earth Summit", was held in Rio de Janeiro in June 1992. One of its major results was the signing of the Convention on Biological Diversity (CBD), which focuses on the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits from the use of genetic resources. The CBD identified "Invasive Alien Species" (IAS) as a major factor in the loss of biodiversity (see Box 1) based on their capacity to out-compete or prey on native species and subsequently cause a degradation of the biodiversity in the area of their introduction. The risks and damages caused by IAS can be massive, especially for fragile island ecosystems (CBD, 2010). Besides the obvious environmental impacts, IAS may cause economic damages through yield losses or control costs and may adversely affect animal and/or human health (e.g. zoonoses or plants with allergenic properties).

Box 1	**CBD definitions**
ALIEN SPECIES: a species, subspecies or lower taxon, introduced outside its natural past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce **INVASIVE ALIEN SPECIES**: an alien species whose introduction and/or spread threaten biological diversity (CBD, 2002)	

2. The rise of introductions of IAS beyond their natural ranges has been attributed to increased trade, transport, travel and tourism associated with globalization. These are the major pathways by which live plants, animals and biological material cross bio-geographical barriers that would usually block their way (Shine, 2005). In particular, international trade in agricultural and horticultural goods plays a potentially important role in distributing plants and animals beyond the borders of their indigenous habitats.

3. Analysing possible pathways for IAS, a working group of the National Invasive Species Council (NISC) and the Aquatic Nuisance Species (ANS) Task Force in the USA differentiated three major pathway categories: (i) transportation related pathways; (ii) living industry pathways; and (iii) miscellaneous pathways (NISC, 2006). According to this categorization, "transportation related pathways" includes all the various pathways related to transportation of people and goods, such as modes of transportation, military transports and travel as well as other shipping processes and tourism. The category of "living industry pathways" includes all the various pathways associated with living organisms and/or their products (such as the movement of plants and animals and/or their products for food or non-food purposes) and is a major reason for the introduction of IAS. The category of "miscellaneous pathways" incorporates sub-pathways that cannot clearly be attributed to the first two categories. It includes introductions related to the movement of bio-control agents and the natural spread of IAS (NISC, 2006).

4. IAS may be introduced into new ecosystems through these pathways via deliberate introductions of new species or unintentional introductions. Intentional introductions of new species have historically been associated with trade in new plant species, trade in terrestrial and aquatic animals, or the use of biological control (bio-control) agents to control pests (e.g. insects, weeds and plant diseases) using living organisms. In some cases, however, the deliberate release of bio-control agents into a predetermined and intended habitat can have unanticipated and negative consequences, typically where host-switching or non-target effects occur. Unintentional introductions of IAS are usually associated with modes of transportation and shipping, and with trade in agricultural commodities. They are characterized by the presence of a contaminating organism on the transport or shipping devices or in the commodity itself, or by the presence of pests or diseases in animals or pests in plants.

5. The CBD includes provisions to restrict the international movement of IAS. Article 8(h) (see Box 2) requires contracting parties to prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species. To assist contracting parties to minimize the spread and impact of IAS, in 2002 the governing body of the CBD – known as the Conference of Parties (COP) – adopted a set of non-binding *Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species* (CBD, 2002). The purpose of these guiding principles is to assist governments in combatting IAS as an integral component of conservation and economic development. In 2010, the COP approved the "Aichi Biodiversity Targets", which are relevant for IAS. In particular, target 9 recommends that "by 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment" (CBD, 2010).

Box 2	Convention on Biological Diversity, Article 8(h)

Article 8. In-situ Conservation

Each Contracting Party shall, as far as possible and as appropriate: ...

(h) Prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species; ...

(CBD, 2002)

6. The CBD's coverage of IAS corresponds to the work of two international standard-setting bodies recognized under the World Trade Organization's (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement). This concerns the International Plant Protection Convention (IPPC)[1] in relation to pests of plants and plant products (see Box 3) and the World Organisation for Animal Health (OIE)[2] in relation to animal diseases. Based on the IPPC's mission to protect both cultivated and wild plant resources, including aquatic ones, from the spread and introduction of plant pests, its coverage extends to the protection of the environment, which gives rise to considerable overlaps with CBD provisions on IAS.

Box 3	IPPC definitions

[PLANT] PEST: any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products

QUARANTINE PEST: a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled

(FAO, 1997)

7. The OIE's mandate has expanded to encompass new animal health issues such as role of wildlife in disease spread, animal welfare, food safety risks arising from animals and infectious disease issues at the human-animal interface (Kahn, 2010). However, the OIE does not, *per se*, specifically address IAS-related risks presented by animals and has not, to date, developed standards related to IAS. Nevertheless, it has issued guidelines related to IAS and three OIE-listed animal health diseases are recognized by the CBD as IAS that threaten biodiversity. In this context, Decision IX/4 of the CBD Conference of Parties (COP) 9 (May 2008) invited the OIE to note the lack of international standards on IAS, in particular animals that are not pests of plants covered by the IPPC.

8. In addition to the CBD, the SPS Agreement and the standards of the IPPC and OIE, a number of other international regulations and conventions – such as the Convention on the International Trade in Endangered Species of Wild Fauna and Flora, the Bern Convention and the International Health Regulations – are relevant for different aspects of IAS (see Annex 1). Similarly, a large number of international and non-profit organizations are involved in efforts focused on the prevention, control and/or eradication of IAS, including capacity building (see Annex 2). Several have developed recommendations or guidance on pest/animal movements related to IAS. While some of this work is binding on countries, much is voluntary. The number of conventions and organizations that are relevant to the prevention, control and eradication increases both the importance and challenge of ensuring of synergies and coherence in order to avoid overlaps and gaps. The Inter-Agency Liaison Group on Invasive Alien Species was established to facilitate such cooperation (see para 22). In addition to the need for effective inter-agency and inter-disciplinary cooperation at the global level, collaboration is essential among national authorities responsible for different aspects of IAS.

9. Measures to prevent the introduction of IAS may, by their nature, be very trade restrictive. Close alignment between the CBD and the WTO SPS Agreement, as well as among other relevant international organizations, is therefore beneficial to help achieve the objectives of these instruments without restricting trade unnecessarily (Lopian, 2005). The relationship between international trade and IAS, and the linkages between the international organizations and legal instruments concerned, was the focus of a seminar organized by the Standards and Trade Development Facility (STDF), in collaboration with the IPPC, the OIE and the WTO, on 12-13 July 2012. The seminar was successful in raising awareness about the mutually-beneficial goals of the CBD and the SPS Agreement, and the contribution of the two relevant standard-setting organizations (IPPC, OIE) under the SPS Agreement. In particular, the seminar

1 The IPPC is an international plant health agreement, established in 1952, that aims to protect cultivated and wild plants by preventing the introduction and spread of pests. The Secretariat of the IPPC is provided by the Food and Agriculture Organization of the United Nations (FAO). For more information, see: http://www.ippc.int/

2 The OIE is an intergovernmental organization founded in 1924 to combat the spread of animal diseases and improve animal health worldwide. For more information, see: http://www.oie.int

demonstrated the importance of: (i) effective SPS systems in helping to protect against the entry of harmful species, including pests, diseases and other IAS; and (ii) collaboration between the SPS and the CBD "communities" at the global, regional and national level.

10. This desk study was prepared for the STDF seminar and further revised based on its conclusions and recommendations. Chapter 1 is the introduction. Chapter 2 reviews and analyses key concepts and principles of relevance to IAS and international trade, notably in the context of the CBD and the SPS Agreement. Chapters 3 and 4 discuss IAS in the context of the IPPC and the OIE, respectively. Chapter 5 reviews various other initiatives designed to build national and/or regional capacities for managing the entry and spread of IAS, including pests and diseases, and discuses common challenges and good practices. Chapter 6 presents the conclusions, including a number of targeted recommendations. A number of case studies are included to complement the analysis.

2. Invasive Alien Species in the context of the WTO SPS Agreement

11. Food safety, animal and plant health measures (sanitary and phytosanitary or SPS measures) that are not required for achieving legitimate health objectives can be very effective tools for protecting domestic production from international competition. Indeed, given their technical complexity, such SPS measures are often difficult to challenge. This chapter analyses the relevance of measures related to the control of the entry, spread and establishment of IAS through international trade in the context of the SPS Agreement. It examines key CBD provisions and guiding principles related to IAS in terms of their compatibility with the SPS Agreement. This comparison is not intended as a legal interpretation of the agreements in question. Rather, it serves to determine how provisions related to IAS in the CBD, and their practical implementation, relate to the SPS Agreement. The analysis focuses on how IAS are addressed in the SPS Agreement, harmonization with international standards, the precautionary approach and issues related to governance and transparency.

12. The SPS Agreement sets out the basic rules on how governments can apply SPS measures. It seeks to strike a balance between the rights of governments to protect health by ensuring that food is safe for consumers and protecting plant health and animal health, while ensuring that such measures do not constitute disguised restrictions on trade. While the SPS Agreement does not specifically use the term "IAS", the establishment and/or spread of IAS falls under the definition of SPS measures. Annex A of the SPS Agreement defines "SPS measures" as including "any measure applied to prevent or limit other damage within the territory of the Member from the entry, establishment or spread of pests", in addition to measures taken to protect human, animal and plant life or health from risks arising, inter alia, from "pests" (see Box 4). The terms "animal" and "plant" in the SPS Agreement include wild fauna and wild flora, and "pests" includes weeds. Since "other damage" may include environmental damage caused by pests, measures applied to prevent or limit other damage within the territory from the entry, the establishment or spread of IAS falls under the definition of an SPS measure.

Box 4	**Definition of Sanitary or Phytosanitary Measure in the WTO SPS Agreement**

Any measure applied:

a. to protect animal or plant life or health within the territory of the Member from risks arising from the entry, establishment or spread of pests, diseases, disease-carrying organisms or disease-causing organisms;

b. to protect human or animal life or health within the territory of the Member from risks arising from additives, contaminants, toxins or disease-causing organisms in foods, beverages or feedstuffs;

c. to protect human life or health within the territory of the Member from risks arising from diseases carried by animals, plants or products thereof, or from the entry, establishment or spread of pests; or

d. to prevent or limit other damage within the territory of the Member from the entry, establishment or spread of pests.

(WTO, 1995)

13. The legal scope of the SPS Agreement with regard to the protection of biodiversity was analysed in a WTO dispute focused on GMO legislation. Although the panel findings are case specific to this dispute (WTO, 2006), they nevertheless concluded that protecting "biodiversity" from certain risks falls under the scope of the SPS Agreement. In this context, protecting biodiversity was not only attributed to the definition of "protecting the territory from other damage" but also in relation to protecting animal or plant life from risks, such as preventing negative effects on the dynamics of populations of species in the receiving environment.

2.1. Harmonization with international standards

14. Article 3 of the SPS Agreement (see Box 5) encourages WTO Members to base their measures on international standards, guidelines and recommendations, where they exist, as a means to facilitate harmonization, defined as the "the establishment, recognition and application of common sanitary and phytosanitary measures by different Members" (WTO, 1995). By harmonizing SPS measures with international standards, food safety and animal and plant health protection can be achieved without unduly restricting international trade. To achieve harmonization, the SPS Agreement encourages governments to apply national SPS measures that are consistent with international standards, guidelines and recommendations developed by three standard-setting bodies. These bodies – the so-called "Three Sisters" – are the Codex Alimentarius Commission for food safety, the IPPC for plant health and the OIE for animal health, including zoonotic diseases. No other organizations or bodies have been designated as relevant standard-setting organizations in the context of the SPS Agreement.

Box 5	**SPS Agreement, Article 3, Harmonization**

1. To harmonize sanitary and phytosanitary measures on as wide a basis as possible, Members shall base their sanitary or phytosanitary measures on international standards, guidelines or recommendations, where they exist, except as otherwise provided for in this Agreement, and in particular in paragraph 3.

(WTO, 1995)

15. The CBD is not a standard-setting organization and does not provide standards on how to regulate IAS. It depends upon the scientific advice and standard-setting work provided by other organizations. Some gaps have been identified in this context. In particular, the Ad Hoc Technical Expert Group (AHTEG) on Gaps and Inconsistencies in the International Regulatory Framework in Relation to Invasive Alien Species has noted the existence of a general gap in the international regulatory framework related to the lack of international standards addressing "animals that are IAS but are not pests of plants under the International Plant Protection Convention" (CBD, 2005). This gap has a significant impact on the efforts of the SPS Agreement towards harmonization, and makes it impossible for WTO Members to apply Article 3.1 of the SPS Agreement to IAS that are animals and not pests of plants. No international standard-setting body exists for setting international standards, guidelines and recommendations for animals that are IAS but not pests of plants.

2.2. Precautionary approach

16. The precautionary approach in CBD's guiding principle 1 (see Box 6) refers to the Rio Declaration and to the preamble of the CBD, which lays down that "... where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat" (CBD, 1992). It allows for trade restrictions to be taken where there is a lack of scientific certainty regarding risks posed to biodiversity by IAS. The SPS Agreement does not have a similar provision. Article 2.2 specifies that "members shall ensure that any sanitary or phytosanitary measure is applied only to the extent necessary to protect human, animal or plant life or health, is based on scientific principles and is not maintained without sufficient scientific evidence, except as provided for in paragraph 7 of Article 5" (WTO,1995). This appears to be a contradiction between the two Agreements.

Box 6	CBD, Guiding principle 1: Precautionary approach

Given the unpredictability of the pathways and impacts on biological diversity of invasive alien species, efforts to identify and prevent unintentional introductions as well as decisions concerning intentional introductions should be based on the precautionary approach, in particular with reference to risk analysis, in accordance with the guiding principles below. The precautionary approach is that set forth in principle 15 of the 1992 Rio Declaration on Environment and Development and in the preamble of the Convention on Biological Diversity.

The precautionary approach should also be applied when considering eradication, containment and control measures in relation to alien species that have become established. Lack of scientific certainty about the various implications of an invasion should not be used as a reason for postponing or failing to take appropriate eradication, containment and control measures.

(CBD, 2002)

17. An analysis of living modified organisms in the context of the SPS Agreement found that while the precautionary principle finds some reflection in Article 5.7 (see Box 7), "insufficient scientific evidence" is not the same as "scientific uncertainty", and these two terms represent different concepts (Spreij, 2007). The same analysis further noted that the inconclusiveness of scientific evidence cannot, in itself, justify the application of Article 5.7 and that scientific uncertainty always exists. The IPPC takes a similar approach and specifies in Article VII.2a that phytosanitary measures shall not be taken without technical justification, which is understood as a pest risk analysis. The IPPC also recognizes that the availability of full scientific evidence is not always possible and one of the international standards on phytosanitary measures[3], specifically ISPM 11[4], makes provision for uncertainties in the PRA process (Lopian, 2005). The apparent contradiction between the IPPC and the CBD, however, becomes less evident on closer inspection. The use of the terms "significant reduction" and "lack of full scientific certainty" in the CBD's precautionary approach seems to imply that certain knowledge should be available.

Box 7	SPS Agreement, Article 5.7

In cases where relevant scientific evidence is insufficient, a Member may provisionally adopt sanitary or phytosanitary measures on the basis of available pertinent information, including that from the relevant international organizations as well as from sanitary or phytosanitary measures applied by other Members. In such circumstances, Members shall seek to obtain the additional information necessary for a more objective assessment of risk and review the sanitary or phytosanitary measure accordingly within a reasonable period of time.

(WTO, 1995)

18. The compatibility of the CBD precautionary approach with Article 5.7 of the SPS Agreement cannot be exhaustively analysed in an abstract legal examination and will ultimately have to be judged on a case-by-case basis. On the one hand, it may be possible to obtain exact and sufficient scientific evidence to justify an SPS measure in relation to food safety issues such as maximum residue levels. On the other hand, it may be almost impossible with current knowledge to judge the effects of an organism on a complex ecosystem. For example, soil is a very complex system that comprises a variety of microhabitats. One gram of soil may harbour up to 10 billion micro-organisms of possibly thousands of different species. As less than 1% of microorganisms observed under the microscope is cultivated and characterized, soil ecosystems are to a large extent uncharted (Torsvik and Øvreås, 2002). To analyse theoretically the impact of introduced organisms into such a system is a task that is virtually impossible without making judgements and assumptions of a precautionary character. Nevertheless, the inherent difficulty in judging ecosystems and their responses or reactions to introductions such as pests or diseases is very much part of the risk analysis process. By carrying out proper risk analysis, according to IPPC and OIE guidelines, decision-makers would comply with the provisions of the SPS Agreement concerning scientific justification and still apply precautionary approaches.

3 All ISPMs are available at: https://www.ippc.int/standards

4 ISPM 11: Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms.

2.3. Governance and transparency

19. An important aspect in analysing the SPS Agreement and the CBD in relation to IAS is governance at the national and international level, as well as notification requirements. The SPS Agreement does not specify who is responsible for its implementation at the national level. The only provisions related to governance are contained in Annex B, paragraphs 3 and 10, which specifies that Members are obliged to establish an "Enquiry Point" and "Notification Authority", which are responsible, respectively, for providing relevant documents and answers to all reasonable questions, and implementing notification procedures. At the national level, ministries of foreign affairs, trade, agriculture and health may be involved in implementing SPS requirements and fulfilling transparency obligations, as well as veterinary, phytosanitary and food safety authorities.

20. Similarly, the CBD does not specify which institution is responsible for implementation at the national level. Contracting parties are required to establish a "National Focal Point", which is usually based within environmental ministries. With regard to IAS, COP decision VI/23 recommends cooperation with national stakeholders at all levels of government and the private sector. It further encourages countries to collaborate with their trading partners and countries in the region and beyond to address threats posed by IAS to biological diversity in ecosystems that cross international boundaries, as well as threats to migratory species (CBD, 2002).

21. Close cooperation at the national level between authorities responsible for SPS issues and environmental authorities that deal with IAS matters is essential to fulfil the notification requirements of the SPS Agreement. Annex B of the SPS Agreement (see Box 8) requires WTO Members to notify other Members of SPS measures at an early stage if these measures may have a significant effect on trade, if no international standard exists, or if the measures are not substantially the same as those provided in an international standard. The SPS notification procedures allow other Members to comment on SPS measures before they are adopted. Measures designed to prevent the spread or introduction of IAS and falling under the definition of an SPS measure must, therefore, be communicated to the WTO Secretariat. In practice, these measures may be taken by environmental authorities that may not be fully aware of the SPS Agreement and its related transparency obligations. Effective coordination among national authorities responsible for IAS and SPS matters is therefore essential to fulfil these obligations fully.

Box 8	**SPS Agreement, Annex B, Notification procedures**

5. Whenever an international standard, guideline or recommendation does not exist or the content of a proposed sanitary or phytosanitary regulation is not substantially the same as the content of an international standard, guideline or recommendation, and if the regulation may have a significant effect on trade of other Members, Members shall:

(a) publish a notice at an early stage in such a manner as to enable interested Members to become acquainted with the proposal to introduce a particular regulation;

(b) notify other Members, through the Secretariat, of the products to be covered by the regulation together with a brief indication of the objective and rationale of the proposed regulation. Such notifications shall take place at an early stage, when amendments can still be introduced and comments taken into account;

(c) provide upon request to other Members copies of the proposed regulation and, whenever possible, identify the parts which in substance deviate from international standards, guidelines or recommendations;

(d) without discrimination, allow reasonable time for other Members to make comments in writing, discuss these comments upon request, and take the comments and the results of the discussions into account.

(WTO, 1995)

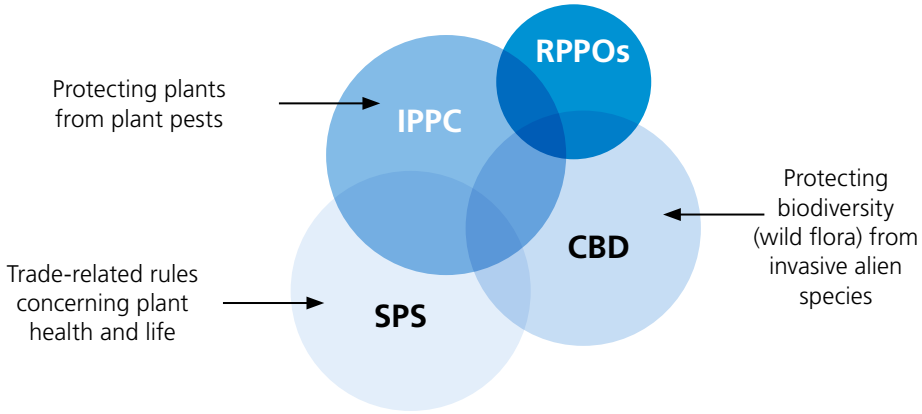
22. Coordination between authorities dealing with IAS and SPS matters should not be limited to the national level but should also take place at an international level (Lopian, 2005). The Inter-Agency Liaison Group on Invasive Alien Species facilitates cooperation among relevant international organizations in supporting measures to "prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species". The WTO and CBD Secretariats, the IPPC and the OIE, are among the members of this group, which meets regularly to share information on activities related to IAS and reflect on how best to create synergies. In February 2011, the group recognized the need for more awareness among the SPS, trade and biodiversity communities and encouraged the STDF to organize a seminar on this topic.

3. Invasive Alien Species in the context of the IPPC

23. The relationship between the CBD and the IPPC in relation to IAS centres on the link between IAS and quarantine pests. The CBD defines an alien species as "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" and describes an invasive alien species as "an alien species whose introduction and/or spread threaten biological diversity". The IPPC defines a [plant] pest as "any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products" and a quarantine pest as "a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled".

24. The CBD and IPPC definitions of IAS and quarantine pest both cover any organism that is injurious (directly or indirectly) to plants and that has an environmental impact (threatens biological diversity). Both definitions describe in different words the environmental impact resulting from the organism's introduction and/or spread. In this context, it should be considered that for the IPPC, "economic impacts" also include environmental impacts. One difference between the two definitions is the notion of "official control". Quarantine pests, as defined by the IPPC, must be officially controlled – IAS as defined by the CBD need not. Based on these similarities and the relationship between IAS and quarantine pests, in 2001 the IPPC's governing body adopted a number of recommendations highlighting the relationship between IAS and quarantine pests and the role of the IPPC with regard to IAS (see Box 9). The IPPC decided that IAS that are plant pests, absent or limited in distribution and subject to official control, should be considered as quarantine pests that are subject to the IPPC provisions. On this basis, the IPPC and its ISPMs are directly relevant to implementing Article 8(h) of the CBD (IPPC, 2001).

Fig. 1: Overlapping mandates of international and regional organizations



from Lopian (2005)

Box 9	Three IPPC recommendations on IAS

"… species that may be invasive and that directly or indirectly affect plants or plant products or that may be used as biological control agents should be assessed, monitored and managed if necessary according to IPPC provisions and standards."

"… species that are identified under [the] paragraph [above] and that are absent (not present) from an area (or if present, are limited in distribution and subject to official control) should be considered quarantine pests and should be subjected to measures according to IPPC provisions and standards."

"… the implementation of [the] IPPC including its provisions and standards is directly relevant to the national implementation of Art. 8(h) and other relevant articles and activities of the CBD and the further development of the CBD work programme on alien species. Furthermore it is directly relevant and overlaps with the apparent intention of the Interim Guiding Principles of the CBD".

(IPPC, 2001)

25. The commonalities in the mandates of the IPPC and the CBD with regard to IAS have implications for other international and regional organizations (see Fig.1). As described in the previous chapter, countries that establish phytosanitary import requirements must comply with the SPS Agreement, in addition to the IPPC and CBD provisions. This requires synergies between these three international frameworks to ensure consistency in the interpretation and implementation of their provisions related to IAS. It further underlines the need for cooperation with Regional Plant Protection Organizations (RPPOs), which also contribute to the objectives and activities of both the CBD and IPPC. For instance, the North American Plant Protection Organization (NAPPO) and the European and Mediterranean Plant Protection Organization (EPPO) undertake extensive IAS related activities, particularly regarding risk analysis of IAS.

26. Efforts have been made over the last decade to develop and enhance cooperation between the IPPC and the CBD. For instance, in 2003 the IPPC and the CBD, in cooperation with the former Federal Biological Research Centre for Agriculture and Forestry in Germany, organized an international workshop on identifying and managing IAS-related risks using the IPPC framework. During this event, participants developed an understanding of how far IPPC provisions and standards can be used to prevent the introduction of IAS, and identified activities relevant to IAS for the IPPC (IPPC, 2005). In 2004, FAO and the CBD Secretariat signed a Memorandum of Cooperation for the IPPC and CBD Secretariats (FAO, 2004). A joint work programme for the two Secretariats has been agreed (IPPC, 2010)[5] and progress made, as discussed below, in developing guidance on how IAS, which are also quarantine pests of plants, should be regulated under the IPPC framework.

3.1. Promoting harmonized language and common terminology

27. As an international standard-setting body, the IPPC has developed standardized language and terms to facilitate the appropriate interpretation and implementation of ISPMs, which provide the benchmarks for phytosanitary measures under the SPS Agreement. Given differences in the understanding of concepts, such as "control", "official", "introduction" or "establishment", among countries, the IPPC developed a "Glossary of phytosanitary terms" (ISPM 5, IPPC, 2011) to enhance clarity and consistency in the interpretation and use of these terms by its contracting parties. This phytosanitary glossary currently contains over 200 globally-agreed phytosanitary definitions, which are intended, inter alia, to facilitate the development and implementation of phytosanitary legislation and regulations, the implementation of official phytosanitary controls and information exchange among countries.

28. The CBD, and its guiding principles on IAS, also include certain definitions to provide clarity. Seven definitions have been developed by the CDB, notably "alien species", "invasive alien species", "introduction", "intentional introduction", "unintentional introduction", "establishment" and "risk analysis" (CBD, 2002). Yet a comparison of the CBD and IPPC definitions reveals some significant differences. Some commonly-used terms, such as "introduction" and "establishment", are defined differently by the CBD and IPPC. This makes it difficult for phytosanitary experts to fully comprehend CBD provisions and guidance concerning IAS, and similarly for environmental experts to fully grasp phytosanitary concepts and strategies.

29. While efforts have been made to harmonize the language used by the CBD and IPPC, it has not been possible, to date, to agree on common definitions of key terms. New terminology could not be added to the IPPC Glossary given the belief that the CBD terminology is based on concepts that differ from those of the IPPC, so that similar terms have very distinct meanings. As such, the IPPC decided to include, for information purposes, an explanation in its Glossary regarding how CBD terms differ from the IPPC's terminology rather than using the CBD terms and definitions directly. In 2009, the IPPC included an appendix in its Glossary explaining CBD terms in the IPPC context (IPPC, 2011). This is expected to make it easier for phytosanitary authorities to implement CBD provisions correctly when combatting the introduction and/or controlling the spread of IAS using phytosanitary frameworks and structures.

3.2. Legislative frameworks for IAS that are quarantine pests

30. The CBD recommends that its contracting parties and other governments review and develop relevant policies and legislation to address the threats related to IAS (see Box 10). Since IAS are not a new environmental challenge, many organisms currently labelled as IAS have long been regulated under other legal frameworks including phytosanitary legislation. Indeed, most countries already have functional legislative frameworks and infrastructural arrangements for phytosanitary purposes. Utilizing these existing national frameworks and structures for IAS would enable national authorities to optimise cost/benefit considerations. In 2005, the IPPC's governing body adopted several recommendations targeting the overlap between IAS and pest-related activities. These included recommendations to contracting parties to

5 See: https://www.ippc.int/publications/joint-work-programme-cbd-and-ippc-secretariats

use IPPC standards and phytosanitary measures to regulate IAS that are (directly or indirectly) pests of plants, and to address biodiversity issues (such as the protection of wild flora) by enhancing plant protection laws and policies. Plant protection services were also recommended to participate in broader national strategies to address risks arising from IAS (see Box 11).

Box 10	**CBD, Excerpts from COP Decision VI/23**

The COP:

"……..

Urges Parties and other Governments, in implementing the Guiding Principles, and when developing, revising and implementing national biodiversity strategies and action plans to address the threats posed by invasive alien species, to:

a. …….

b. …….

c. Review, in the light of the Guiding Principles, relevant policies, legislation and institutions to identify gaps, inconsistencies and conflicts, and, as appropriate, adjust or develop policies, legislation and institutions;……..".

(CBD, 2002)

Box 11	**Three IPPC recommendations related to IAS legislation**

"…[contracting parties and NPPOs, as appropriate] enhance plant protection laws and policies, where needed, to include the protection of wild flora and biodiversity from pests of plants (including plants that are invasive alien species)".

"…[contracting parties and NPPOs, as appropriate] promote the IPPC and participate in broader national strategies to address threats to biodiversity posed by invasive alien species, so that maximum advantage can be taken of existing structures and capacities under the IPPC".

"…[contracting parties and NPPOs, as appropriate] reinforce efforts to apply and utilize relevant ISPMs and related phytosanitary measures to address threats to biodiversity posed by invasive alien species that are pests of plants (including plants that are invasive alien species)".

(IPPC, 2005b)

31. At the national level, plant protection legislation and institutions have been used for some time (including prior to the above-mentioned IPPC recommendations) to address biodiversity risks by IAS that are pests. For instance, in the USA prompt actions were taken to address the risks posed by IAS to biodiversity, involving the National Plant Protection Organization (NPPO) (USDA/APHIS). Executive Order 13112, signed in 1999, aimed to develop common goals and strategies, and establish good communication among government agencies involved in IAS. This included the establishment of the National Invasive Species Council (NISC) with the mandate to "… see that the Federal agency activities concerning invasive species", including the activities of the NPPO, "are coordinated, complementary, cost-efficient, and effective, relying to the extent feasible and appropriate on existing organizations addressing invasive species…." (USA, 1999). An important objective of this Order was the use of existing structures and capacities to achieve maximum advantage.

32. Cooperation between relevant national-level authorities is a prerequisite for establishing and implementing legal frameworks for the prevention, control and management of IAS. This includes cooperation related to the establishment of border/import control and quarantine structures and measures, as discussed below. In most cases, environmental legislation does not provide the necessary legal basis on which to establish border control and quarantine measures. By comparison, phytosanitary policies and legislation – which aim to prevent the introduction of organisms using import controls and to prevent the spread of organisms with control and quarantine measures – offer a sound foundation on which to develop and implement such measures. Countries should therefore make effective use of existing phytosanitary instruments, with some adjustments if required, to control and manage the introduction and spread of IAS.

3.3. Border control and quarantine

33. The establishment and implementation of border control and quarantine measures is the most important proactive action that countries can take to prevent or limit the introduction of quarantine pests or IAS via imported commodities and other regulated articles. Measures that prevent the introduction of an organism are normally less expensive and much more cost-effective than measures aiming to eradicate the same organism once it is introduced.

34. The CBD's guiding principle 7 recommends states to implement border controls and quarantine measures to minimize the risk of introducing alien species that are, or could become, invasive (see Box 12). These quarantine measures should be based on risk assessment, and existing appropriate government bodies should be strengthened, as necessary, to implement the measures.

Box 12	CBD, Guiding principle 7: Border control and quarantine measures

1. States should implement border controls and quarantine measures for alien species that are or could become invasive to ensure that:
   a. Intentional introductions of alien species are subject to appropriate authorization (principle 10);
   b. Unintentional or unauthorized introductions of alien species are minimized.
2. States should consider putting in place appropriate measures to control introductions of invasive alien species within the State according to national legislation and policies where they exist.
3. These measures should be based on a risk analysis of the threats posed by alien species and their potential pathways of entry. Existing appropriate governmental agencies or authorities should be strengthened and broadened as necessary, and staff should be properly trained to implement these measures. Early detection systems and regional and international coordination are essential to prevention.

(CBD, 2002)

35. Provisions concerning quarantine measures and border control represent the main substance of the IPPC. In particular, Articles V and VII deal with phytosanitary certification and requirements for imports, while several ISPMs provide practical guidance related to border controls and quarantine measures.[6] ISPM 34[7] sets out general guidelines for the design and operation of post-entry quarantine stations for holding imported consignments of plants (mainly for planting) in confinement in order to verify whether they are infested with quarantine pests. This corresponds to the three-stage hierarchical approach laid down in the CBD's guiding principle 2, which aims to minimize the risk and spread of IAS by giving preference to the prevention of their introduction. In the event of an introduction, early detection and rapid action (e.g. eradication) are recommended. If this fails, the third stage is containment and control.

36. In recent years, the IPPC has shifted focus towards the development of more pest or commodity-specific standards that help countries to establish useful pest or commodity-specific import requirements. The first and most prominent of these commodity standards is ISPM 15[8], which sets out minimum treatment requirements for wood packaging material used in transporting commodities of all types. Experiences in the implementation of ISPM 15 underline the benefits of a proactive approach to establish border control and quarantine regimes that prevent the introduction and dispersal of pests and IAS through wood packaging material (see Case Study 1).

Case Study 1	Asian longhorn beetle (*Anoplophora glabripennis*)

The Asian longhorn beetle is considered an invasive species in Europe and North America based on the risk it presents to many species of broadleaf trees. It arrived in North America in the 1980s and Europe after 2000 (Sage, 2001), most likely via infested wood packing material (IPPC, 2012). Since then, it has attacked and killed many species of living, healthy hardwood trees, which form a major component of forests and urban landscapes in Europe and North America. In response, phytosanitary authorities in Europe and North America established phytosanitary measures to limit the pest's introduction and spread. Primary actions aimed to prevent introduction of the pest via wood packaging material and dunnage (i.e. loose wood used to protect goods and their packaging and to stop cargoes from shifting during transit) through the implementation of ISPM 15. Several other commodities were also regulated (e.g. dried branches, wood, bark, logs, lumber, pulpwood, wood and bark chips) by a number of countries. The strategy adopted to prevent the introduction of the Asian longhorn beetle through import restrictions is fully compatible with the CBD's guiding principle 7 (see Box 12).

37. The IPPC is currently developing similar standards, including on minimizing pest movement by sea containers and conveyances, as well as in air containers. Once adopted, these standards are expected to have a significant impact on limiting the unintentional dispersal and introduction of pests/IAS through the movement of containers. They will

6 The most important are: ISPM 1: Principles of plant quarantine as related to international trade; ISPM 7: Export certification systems; ISPM 12: Guidelines for phytosanitary certificates; ISPM 13: Guidelines for the notification of non-compliance and emergency action; ISPM 14: The use of integrated measures in a systems approach for pest risk management; and ISPM 20: Guidelines for a phytosanitary import regulatory system.

7 ISPM 34: Design and operation of post-entry quarantine stations for plants.

8 ISPM 15: Regulation of wood packaging material in international trade.

constitute an effective tool for preventing the unintentional spread of all IAS, including animals, since containers that are cleaned or disinfected according to the IPPC standard will also prevent the introduction of IAS such as the brown tree snake (*Boiga irregularis*) or the Giant African Land Snail (*Achatina fulica*).

3.4. Pest risk analysis

38. In accordance with Article 5 of the SPS Agreement, the establishment of technically-justified border control and quarantine measures requires a pest risk analysis (PRA) to be conducted in cases where no relevant ISPMs exist. Border control and quarantine measures related to IAS also need to comply with this requirement. Since the IPPC was perceived as a convention to protect only cultivated plants, efforts have been undertaken to address the protection of wild flora and biodiversity, in particular through standards on PRA, notably ISPM 2[9] and ISPM 11.[10]

39. The PRA process provides a technical tool for identifying appropriate phytosanitary measures. It consists of three stages: (i) initiation; (ii) pest risk assessment; and (iii) pest risk management. PRA is applied to pests of cultivated plants and wild flora in accordance with the scope of the IPPC. ISPM 11 has been revised to take account of the threats to biodiversity from IAS that are plant pests. It includes details regarding the analysis of risks from plant pests for the environment and for biological diversity, including those risks affecting uncultivated/unmanaged plants, wild flora, habitats and ecosystems contained in the PRA area (see Case Study 2). An annex to ISPM 11 specifies that "the full range of pests covered by the IPPC extends beyond pests directly affecting cultivated plants. The coverage of the IPPC definition of plant pests includes weeds and other species that have indirect effects on plants, and the Convention applies to the protection of wild flora" (IPPC, 2004b).

Case Study 2	**Common ragweed (*Ambrosia artemisiifolia L.*)**

Native to North America, common ragweed arrived in Europe in the 19th century together with cereals and possibly also clover. Large populations of this weed currently exist in some European countries, particularly in Croatia and Hungary and in parts of Austria, France, Italy and Switzerland. In other countries (notably Poland, Lithuania and Germany), it has occurred only rarely and, in general, has not survived. Common ragweed prefers open spaces and generally grows on waste grounds (e.g. along roadsides, building sites, storage areas and dumps). It is resistant to herbicides and its long seed germination capacity (over 30 years) makes control difficult. It is known to reduce yields in the cultivation of maize, wheat, sunflowers, millet, peanuts, soy, beans and potatoes. It also plays a role as a secondary host for organisms that are harmful to cultivated plants (e.g. fungal pathogens that are harmful to sunflowers). In addition to its indirect effect on plants, pollen from common ragweed can cause severe allergies in humans (BVL, 2008).

In 2001, Poland conducted a PRA, according to the EPPO PRA Guideline which is based on the IPPC standard, to determine if common ragweed should be regulated (Karnkowski, 2001). The PRA concluded that common ragweed is a quarantine pest (IAS), which should be regulated. In 2007, the European Food Safety Authority (EFSA) analysed the PRA carried out in Poland and issued an opinion. However, the EFSA Panel on Plant Health concluded that the Polish PRA did not provide sufficient evidence to assess, on a scientifically sound basis, whether common ragweed qualifies as a quarantine pest for Poland (EFSA, 2007).

40. The IPPC's risk analysis tool covers a wide range of organisms that directly or indirectly affect plants, and consequently the environment. As such, it provides government authorities – including environmental authorities – with a powerful instrument to assess the risks to biodiversity and the environment in their countries in a consistent manner that is compatible with the SPS Agreement. Management options based on such risk assessment would be in accordance with the SPS Agreement. Complying with the IPPC standards on PRA, several Regional Plant Protection Organizations (including EPPO and NAPPO) regularly undertake activities to assess the risks associated with invasive plants.

9 ISPM 2: Framework for Pest Risk Analysis.

10 ISPM 11: Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms.

3.5. Intentional introduction

41. Establishing phytosanitary systems to prevent the introduction of IAS that are plant pests focuses mainly on their unintentional introduction as infecting or infesting organisms. Globally, most introductions of IAS have occurred because of so-called "hitch-hikers" that attach themselves to a mode of living or non-living transport. However, intentional introductions can also result in unwanted invasions. The CBD's guiding principle 10 recommends that intentional introductions should take place only after they have been evaluated and authorized (see Box 13). A risk assessment should be part of the evaluation and the authorization should be based on the precautionary principle. In addition, the burden of proof that a proposed introduction is unlikely to threaten biological diversity is with the proponent of the introduction or assigned, as appropriate, by the recipient state (CBD, 2002).

Box 13	**CBD, Guiding principle 10: Intentional introduction**

1. No first-time intentional introduction or subsequent introductions of an alien species already invasive or potentially invasive within a country should take place without prior authorization from a competent authority of the recipient State(s). An appropriate risk analysis, which may include an environmental impact assessment, should be carried out as part of the evaluation process before coming to a decision on whether or not to authorize a proposed introduction to the country or to new ecological regions within a country. States should make all efforts to permit only those species that are unlikely to threaten biological diversity. The burden of proof that a proposed introduction is unlikely to threaten biological diversity should be with the proposer of the introduction or be assigned as appropriate by the recipient State. Authorization of an introduction may, where appropriate, be accompanied by conditions (e.g. preparation of a mitigation plan, monitoring procedures, payment for assessment and management, or containment requirements).
2. ……..

(CBD, 2002)

42. The IPPC covers requirements in relation to imports, particularly through Article VII, which addresses the intentional import of pests and regulated articles for research, education or other specific uses. In cases of intentional import, special and adequate safeguards should be established to prevent the "escape" of the pest. While the IPPC did not initially address risks related to the intentional introduction of plants which are planted in an intended habitat and from which they may escape, this was since remedied through an amendment to ISPM 11 (focused on an assessment system applied to the potential spread from "intended habitats" to "unintended habitats" that would in fact become endangered areas around the intentional habitat). As such, the risks of introducing plants for planting and the potential escape of these into the environment are now addressed.

43. ISPM 3[11] is particularly relevant to the intentional introduction of IAS. It describes the responsibilities of government authorities, importers and exporters in relation to the importation of biological control agents capable of self-replication (including parasitoids, predators, parasites, nematodes, phytophagous organisms and pathogens such as fungi, bacteria and viruses), as well as sterile insects and other beneficial organisms (such as mycorrhizae and pollinators). Risks exist related to intentional introductions including situations where bio-control agents may go "native" (see Case Study 3). The cactus moth (*Cactoblastis cactorum* Berg*)* provides an example of a bio-control agent which was widely introduced to control invasive prickly pear cacti (*Opuntia* sp.). While in some countries the cactus moth was introduced with very positive results, in other cases, there have been unintended, negative consequences. For instance, as described in Case Study 4, following the cactus moth's "escape" from the Caribbean to Florida, it is currently the most important IAS threatening the biodiversity of cacti in Mexico and the USA.

Case Study 3	**Bio-control agent "goes native"**

The thistle-head weevil (*Rhinocyllus conicus*) is a very effective bio-control agent for musk or nodding thistle (*Carduus nutans L*). It was released in North America in 1968 to control invasive thistles like musk thistle (Arnett et al., 2002). However, rather than "sticking" to its intended target host, it expanded its range. As a result, it is now likely to drive several species of native thistle (including some threatened species) to extinction (Steward, 2005). In 2000, APHIS (USDA) revoked all permits for interstate shipment of thistle-head weevil.[1]

1 http://invasives.wsu.edu/biological/rhinocyllusconicus.htm

11 ISPM 3: Code of conduct for the import and release of biological control agents.

Case Study 4 Controlling the cactus moth in Mexico and the USA

The cactus moth, native to South America, preys on cacti species in the genus prickly pear cactus (IUCN, 2008). Its gregarious caterpillars feed internally in the cactus stems. In the 1920s, the cactus moth was identified as an effective biological control agent for prickly pear cacti, which were introduced into Australia and causing enormous environmental damage. The spectacular success of the cactus moth as a bio-control agent in Australia subsequently led to its use in other parts of the world, including South Africa (1933), Hawaii (1950) and the Caribbean island of Nevis (1957). The insect now occurs throughout the Caribbean.

In 1989, this bio-control agent turned from "friend into foe" when it was detected for the first time on the Florida Keys in the USA. From there, the cactus moth spread along the coast to South Carolina, and was subsequently identified in parts of Alabama (2004), Mississippi (2008) and Louisiana (2009) (USDA/APHIS, 2012). The arrival of the cactus moth in the USA was of concern to plant protection authorities in Mexico. Mexico and the USA are home to many indigenous prickly pear cacti (some endangered), which are an essential part of the desert ecosystem and of great conservation value. The prickly pear cacti also have great economic importance in Mexico as animal feed, a source of coloring agents (cochineal red), and for human consumption. Prickly pears are cultivated on a total area of 360,000 ha in Mexico. It was feared that the introduction of the cactus moth into Mexico, as well as its further spread within the USA, could result in serious economic and environmental damage (NAPPO, 2001). As such, the Mexican plant protection service established survey and monitoring programmes to detect incursions of cactus moth into Mexico.

The USDA's Animal and Plant Health Inspection Service (APHIS) joined forces with the Agricultural Research Service (ARS), among others, to prevent the westward spread of the cactus moth. A national detection network was established by the Department of the Interior's (DOI), Geological Survey (USGS) to provide the earliest possible sightings of the pest. In 2005, the National Invasive Species Council (NISC) issued a public announcement outlining actions against cactus moth (NISC, 2005). Direct control measures were applied to prevent further westward spread into Texas and Mexico's north-east. In addition, APHIS put in place regulations to prevent the spread of cactus moth by trade and the movement of host material, including interstate movement. To track its spread and identify established populations, monitoring tactics were developed. Cooperation amongst several agencies was key to the success of the cactus moth monitoring and eradication campaign (USDA/APHIS, 2012).

In 2006, the Plant Health Directorate of the National Service for Agri-Food Health, Safety and Quality (SENASICA) in Mexico detected the cactus moth on Isla Mujeres, 9km from the mainland in south-eastern Mexico (NAPPO, 2006). In 2007, a further finding of cactus moth was reported on Isla Contoy, also off the Yucatan Peninsula. SENASICA launched an eradication campaign in close cooperation with the USDA-ARS, and the Joint FAO/International Atomic Energy Agency (IAEA) Division of Nuclear Techniques in Food and Agriculture, which resulted in the eradication the cactus moth using an integrated approach, including the area-wide application of sterile insect techniques (FAO/IAEA, 2008). Extensive monitoring of adjacent mainland cactus plants revealed no additional infestations. In February 2009, based on surveillance activities, the period equivalent to three biological cycles without pest detections was reached, and in accordance with ISPM 8,[1] Mexico declared its freedom from the cactus moth (IAEA, 2009).

NAPPO facilitated the launch of a joint cooperative USA-Mexico Cactus Moth Programme in 2006. Funding for research was provided by APHIS, ARS and SENASICA. This included the establishment of an office and staff in Florida dedicated to monitoring and controlling Gulf Coast cactus moth. APHIS (with financial assistance from Mexico) currently continues to fund research on improving the cactus moth pheromone, evaluating the pheromone in mating disruption, and identifying an Argentine natural enemy of the cactus moth as a potential classical biological control agent. In addition, APHIS and Mexico are supporting the maintenance of a small mass rearing cactus moth colony in Florida that could be re-initiated as a sterile insect rearing colony if an SIT programme is warranted against a new cactus moth outbreak in Mexico.

Experiences with the cactus moth programme in the USA and Mexico highlight the importance and benefits of good cooperation and collaboration between neighbouring countries which share the same IAS risks in order to find more efficient and cost-effective solutions to control and eradication. They also point to the value of international support and coordination to enhance cost-efficiency, knowledge sharing and replicability.

1 ISPM 8: Determination of pest status in an area

3.6. Managing the impacts of IAS that are quarantine pests

44. While any sensible IAS strategy aims to prevent the introduction of IAS/pests, prevention is not possible in all cases. When prevention fails and IAS/pests are introduced, management measures are required. Measures for eradication, containment and/or control of IAS that have been introduced are of considerable importance to the CBD. The CBD's guiding principles 12, 13, 14 and 15 set out measures to mitigate the effects of an introduced IAS/pest (see Box 14).

Box 14	CBD Guiding Principles that address mitigation

Guiding principle 12: Mitigation of impacts

"Once the establishment of an invasive alien species has been detected, States, individually and cooperatively, should take appropriate steps such as eradication, containment and control, to mitigate adverse effects. ….."

Guiding principle 13: Eradication

"Where it is feasible, eradication is often the best course of action to deal with the introduction and establishment of invasive alien species. The best opportunity for eradicating invasive alien species is in the early stages of invasion, when populations are small and localized; hence, early detection systems focused on high-risk entry points can be critically useful while post-eradication monitoring may be necessary. …."

Guiding principle 14: Containment

"When eradication is not appropriate, limiting the spread (containment) of invasive alien species is often an appropriate strategy in cases where the range of the organisms or of a population is small enough to make such efforts feasible. Regular monitoring is essential and needs to be linked with quick action to eradicate any new outbreaks. ……"

Guiding principle 15: Control

"Control measures should focus on reducing the damage caused as well as reducing the number of the invasive alien species. Effective control will often rely on a range of integrated management techniques, ……"

(CBD, 2002)

45. The IPPC also recommends, wherever possible, preventing the introduction of IAS/plant pests. In cases where a pest enters a "new" area, eradication is normally the first response of NPPOs. ISPM 9[12] provides detailed guidance to develop pest eradication programmes, which usually involve surveillance, containment and treatment, and/or control measures. Surveillance is of paramount importance since it provides crucial knowledge on the location of pests/IAS and enables NPPOs to verify whether or not the pest in question has been eradicated. ISPM 6[13] provides specific guidance on surveillance, including the components of survey and monitoring systems for pest detection. It also provides a source of information for use in pest risk analyses, the establishment of pest free areas and the preparation of pest lists.

46. Where eradication fails, national authorities generally try to contain the pest/IAS outbreak. Containment is defined by the CBD as "limiting the spread" of an IAS. The IPPC defines containment as "application of phytosanitary measures in and around an infested area to prevent spread of a pest". Containment normally implies the application of constant eradication or control measures to prevent the further spread of an organism. Another approach to containment is to establish a pest free area, which is designed to maintain an area, free from the pest in question, within an infested zone. Establishing pest free areas facilitates trade in accordance with Article 6 of the SPS Agreement. The IPPC's ISPM 4[14] and ISPM 29[15] provide guidance on how to establish and obtain formal recognition for pest free areas. Case study 4 on control of the cactus moth in Mexico and the USA provides a good illustration of how ISPMs can be implemented to eradicate and/or contain a pest.

47. One difference between the CBD's guiding principles and the IPPC is related to the control of IAS or pests, which usually aims to slow the spread of an organism or keep it at low pest prevalence. For the CBD, IAS which have been introduced and have a wide distribution should be controlled. According to the IPPC, a quarantine pest is a pest of potential economic importance, which is not yet present in an area or present but not officially controlled. In the context of the IPPC, while pests that are widely-distributed may be controlled, they must not necessarily be submitted to official controls. This difference is important for the involvement of plant health authorities in the control of IAS. Although plant health authorities can doubtlessly make an effective contribution to preventing the introduction and spread of IAS, when it comes to controlling widely-distributed IAS their resources may not be sufficient, or they may establish other priorities.

12 ISPM 9: Guidelines for pest eradication programmes.

13 ISPM 6: Guidelines for surveillance.

14 ISPM 4: Requirements for the establishment of pest free areas.

15 ISPM 29: Recognition of pest free areas and areas of low pest prevalence.

4. Invasive Alien Species in the context of the OIE

4.1. Defining animal health as it relates to IAS

48. The SPS Agreement recognizes the OIE as the official body for standard-setting in the area of animal health, including for IAS that are OIE-listed animal diseases (i.e. all major trans-boundary animal and zoonotic diseases). The OIE has developed Guidelines for assessing the risk of non-native animals becoming invasive.[16] However, the OIE does not have standards for animals that are IAS.

49. A clear definition of IAS is fundamental to an informed discussion on the role of the OIE in relation to IAS. The future role of the OIE with regard to IAS may depend in part on the definition of animal health. Health is not explicitly defined by the OIE, the SPS Agreement or the CBD. Historically, international standards have focused on defining animal health as the absence of specific disease-causing agents in the animal and/or in its source population. However, the WHO abandoned the definition of human health as the absence of disease over half a century ago and replaced it with the notion of health as "a complete state of physical, mental and social well-being, and not merely the absence of disease or infirmity". Meeting the latter definition requires a person to be able to satisfy his/her needs for daily living, cope with changes in the environment and realize his/her goals (Awefeso, 2012). An analogous definition could be applied to animals. Critics argue that such a definition creates an unattainable standard (e.g. "complete well-being") that could include every aspect of life. Such criticism illustrates the need to reflect on what is meant by health, and the boundaries around health roles and responsibilities, when examining responsibilities for IAS and animal health.

50. The relationship between biological diversity and animal health is particularly relevant to this paper. Biological diversity is defined in Article 2 of the CBD as "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". Biodiversity includes the variety that exists in wild, agricultural and companion animals, as well as variety in microorganisms, and should not therefore be confused with "wildlife".

51. The discussion of biodiversity and animal health centres around two themes: (i) biodiversity as a contributor to health; and (ii) animal health status and its adverse effects on biodiversity. Biodiversity can be considered the "raw material" for healthy animal populations. It allows for flexibility in natural systems. More diverse and varied animal populations have a wider portfolio of "options" that allow them to deal better with changes and stresses (a key feature of health). A varied biological system also provides a diverse food web that in turn serves as the basis for nutrition and habitat for animals (another determinant of health). Biodiversity supports ecosystem functions and the services they provide, such as clean water and crop pollination, to support animal health. The WHO recognizes the important contribution of biodiversity as a determinant of human health.

52. The almost exclusive preoccupation with infectious diseases in animal health standards means that discussions of the impacts of animal health on biodiversity focus largely, if not solely, on introduced or emerging infectious diseases and their associated pathogens. Pathogens are considered by some to be the most important invasive species.[17] Both the CBD and the Global Invasive Species Programme (GISP) recognize some pathogens as IAS. However, in reality there are many ways an IAS can affect a disease situation without introducing a pathogen. Modifications of the biodiversity in an animal's habitat can affect the probability of transmission of existing pathogens.

4.2. Invasive alien animals: A source of introduced pathogens

53. Introduced pathogens may cause catastrophic disease outbreaks or they may produce more persistent, subtle infections that render native species more susceptible to predation and less able to reproduce successfully. Infectious diseases are increasingly recognized as playing an important role in ecological processes (Altizer et al, 2003). For example, one species might have a competitive advantage over another simply by harbouring a parasite to which it has adapted and transmitting it to a more susceptible species. The introduction of the North America grey squirrel into Europe provides an illustration. This squirrel also introduced a virus that does not kill native red squirrels but

16 http://www.oie.int/fileadmin/Home/eng/Our_scientific_expertise/docs/pdf/OIEGuidelines_NonNativeAnimals_2012.pdf

17 Managing the Global Risk of Invasive Species. Submission by Diversitas / Global Invasive Species Programme (GISP) to the CBD In-Depth Review of Invasive Alien Species. http://www.cbd.int/doc/submissions/ias/ias-diversitas-risk-2007-en.pdf

makes them sick and reduces their ability to compete, while at the same time having little or no effect on its normal host, the grey squirrel. Conversely, an introduced species (e.g. European mussels introduced to South Africa) may be resistant to a native disease that controls the endemic animal population. In this case, the introduced species has an obvious competitive advantage.

54. There are several examples where trans-located pathogens have been associated with significant losses of wildlife (Daszak *et al*, 2000). For example, a fungal disease in frogs (*amphibian chytridmycosis*) has emerged globally, causing large-scale decline and local extinction in some frog populations. Seen as one of the major threats to the global frog population, spread of this pathogen has been linked to international trade in a species of African frog. The native European crayfish was made locally extinct due to the crayfish plague, which was introduced when American crayfish were brought to Europe. Introduced insects have served as sources of disease for other native insects and, at times, led to the extinction of the latter. Epidemics from introduced pathogens have been linked to the disappearance of species of rodents, lizards and birds, especially on islands. Potential effects of pathogens on biodiversity were highlighted by the CBD, which noted that, "There are links between the HPAI H5N1 virus [i.e. avian influenza virus], biodiversity loss and the Millennium Development Goals, in particular the goals relating to poverty eradication." (UNEP/CBD/COP/8/INF/47). The CBD includes three OIE-listed diseases (avian influenza, *Batrachochytrium dendrobatidis*, and rinderpest) as IAS in their 2009 document, *Invasive alien species. A threat to biodiversity*.

55. Estimating the full environmental and economic cost of IAS is difficult due to the challenge of identifying all invasions, lack of understanding of impacts and problems in distinguishing IAS effects from other social and ecological changes (see Case Study 5). However, estimates of the economic impacts of IAS on animal agriculture are extraordinarily high. Some of the best-documented impacts of IAS on agriculture and economies derive from the movement of animal pathogens. A conservative estimate of the costs of introduced livestock diseases in the USA is US$3 billion annually. The wool industry in Australia suffers losses of US$228 million per year from introduced insects and mites (Pimental et al. 2001). Feral pigs, introduced and spread outside their native habitats in Eurasia and Africa, have been implicated as the source of numerous diseases (including foot and mouth, rabies, tuberculosis and brucellosis) in countries where they have been introduced. Introduced pigeons have been implicated as sources of important avian diseases that can threaten poultry production and trade (Pimental et al. 2001). Rinderpest, also known as cattle plague, contributed to the fall of the Roman Empire, the conquest of Europe by Charlemagne, the French Revolution, extensive famines in Sub-Saharan Africa and impeded agricultural development in China in the 1940s. Originating during ancient times in central Asia, this virus invaded and spread across Europe and Africa accompanying various military campaigns. Somewhere between 75 and 225 million deaths occurred in native wildlife species in Africa after the introduction of rinderpest in the 1880s.

Case Study 5 The introduction of cats and rats in the Pacific Islands

Intentional introductions of new animals (i.e. trade in pets or aquatic species), as well as unintentional introductions (e.g. rodents in shipping vessels), cause significant threats to biodiversity. Since many small island states lack large agricultural economies, they are often considered as low risk for the introduction of typical animal diseases affecting farm animals. However, their unique ecology and biodiversity puts them at high risk for the effects of other introduced species, such as cats and rodents. In several islands, cats and rodents are on the list of species to be eradicated.

Bats are the only mammals native to the Pacific Islands. The introduction of domestic cats and rodents has resulted in significant animal health and public health impacts.[1] Cats have been responsible for the extinction of 14% of birds, mammals and reptiles since their introduction. They have created public health risks linked to bites and the transmission of cat-associated infections (e.g. toxoplasmosis and rabies). Cats also harbour infections of concern to wildlife (e.g. toxoplasmosis and feline immunodeficiency virus). Rodents are considered responsible for the largest number of extinction and ecosystem changes on islands.[2] They are the biggest contributor to seabird extinction worldwide.[3] They damage crops and impact native plants, and represent a source of pathogens and vectors for wildlife, domestic animals and people.[4,5]

While there may be little sympathy for rats and mice when it comes to IAS eradication, controlling cats is more controversial given their status as pets. Efforts to address threats to biodiversity should therefore take account of cultural, ethical and societal concerns, as well as economic and ecological views. The ability to network across similar countries and share experiences on how to implement eradication programmes within a socio-ecological content can increase the efficiency of IAS management.

1 http://pacificscience.files.wordpress.com/2011/09/pac-sci-early-view-66-2-6.pdf
2 http://onlinelibrary.wiley.com/doi/10.1111/j.1523-1739.2007.00755.x/full
3 http://onlinelibrary.wiley.com/doi/10.1111/j.1523-1739.2007.00859.x/full
4 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2631882/pdf/11747690.pdf
5 http://www.nri.org/projects/ecorat/docs/MN96Chapter1.pdf#page=77

56. Introduced insects or other animals can also serve as vectors that transmit infections from one animal to another. The translocation of mosquitoes provides an example. In February 2012, a new species of mosquito (*Culex modestus*) was reported to have arrived in the United Kingdom.[18] This mosquito can transmit the West Nile virus, which not only can cause death and disease in people but was also responsible for large-scale wild bird die-offs after the virus was introduced into North America. The introduction of this new mosquito species into the United Kingdom creates conditions suitable for establishing the West Nile virus if the virus is subsequently introduced. Other mosquito species that have been trans-located internationally by trade and transport of goods are important vectors of public health diseases (see Case Study 6).

Case Study 6 The role of trade and travel in spreading zoonotic diseases

Dengue represents a major concern for public health, primarily in tropical and sub-tropical regions. It is the fastest spreading mosquito-borne viral disease, with a 30-fold increase in global incidence over the past 50 years. The WHO estimates that 50–100 million dengue infections occur each year, and that almost half the world's population lives in countries where dengue is endemic. The mosquito, *Aedes aegypti*, is the primary vector responsible, and has evolved to live in and around urban human habitation. The last dengue epidemic in Europe reportedly occurred in Greece from 1926-28 with high mortality rates. Since the 1990s, the rapid spread in Europe and North America of the tiger mosquito (*Aedes albopictus*), a secondary dengue vector in Asia, has created new concerns. The tiger mosquito has become increasingly established in Europe, where the threat of dengue outbreaks now exists. Local transmission of dengue was reported for the first time in France and Croatia in 2010. Imported cases were detected in several other European countries. The introduction of the tiger mosquito is linked primarily to global trade in used tyres (a breeding habitat) and other goods (e.g. lucky bamboo). The tiger mosquito's spread is facilitated by its tolerance to below-freezing temperatures, and the ability of its eggs to withstand desiccation, hibernate and take shelter in micro-habitats.

Chikungunya is another arbo viral disease, spread by mosquitoes, whose spread is facilitated by human travellers. A major outbreak of Chikungunya occurred in the islands of the Indian Ocean from February 2005 onwards. Many imported cases in Europe were associated with this outbreak, mostly in 2006 when the Indian Ocean epidemic was at its peak. A large outbreak of Chikungunya subsequently occurred in India in 2006 and 2007. Several other countries in Southeast Asia were also affected. In 2007, following a visit to India, an Italian traveller became infected with the Chikungunya virus. This traveller later became the source of infection for 205 locally-acquired cases in Italy, which were spread by bites from the invasive tiger mosquito.[1] This illustrates how the impacts of an IAS may not immediately be apparent. Indeed, in some cases, they may only be manifested when the ecological or epidemiological conditions change.

Growing global trade and travel continue to increase the public health risks associated with IAS. In this context, developing strategies and plans to address the risks faced, including through improved surveillance and control initiatives is important. More and improved collaboration with the private sector (manufacturers and exports) would also be useful to better understand, assess and monitor how trade contributes to the spread of IAS.

(Velayudhan, 2012)

1 http://wwwnc.cdc.gov/travel/yellowbook/2012/chapter-1-introduction/perspectives-the-role-of-the-traveler-in-translocation-of-disease.htm

4.3. Animal pathogens, animal disease and IAS

57. Several IAS of high concern are pathogens, and some of these are already considered in the OIE's mandate and standards (Table 1). Some are linked to widespread economic effects (e.g. foot and mouth disease), some are important public health concerns (e.g. West Nile virus) and others are major drivers of species decline (e.g. *Batrachochytrium*). Five pathogens or insects that spread pathogens can be found in the top 100 list of IAS in the Global Invasive Species Database (GISD) and the Delivering Alien Species Inventory in Europe (DAISIE) database (*Plasmodium relictum,* Rinderpest virus*, Aedes albopictus*, *Anguillicola crassus*, and *Aphanomyces astaci*).

18 Report on ProMed Feb 9, 2012.

Table 1: Examples of pathogens described as IAS in the Global Invasive Species Database and DAISIE project

Bacteria	Virus	Unicellular Parasite	Fungal	Other
Pasteurella multocidia	Foot and Mouth disease virus*	*Myxobolus cerebralis*	*Batrachochytrium dendrobatidis**	*Aphanomyces astaci**
Yesinia pestis	West Nile virus*	*Plasmodium relictum*		*Anguillicola crassus*
Vibrio cholera	Avian Influenza*			Chronic Wasting Disease prion
	Rinderpest virus*			
	Newcastle disease virus*			
	Bagaza virus			
	Beak and feather Disease virus			
	Avian Pox			

* Pathogen listed by the OIE in 2011-2012

58. Food web relationships can affect the distribution and abundance of parasites and pathogens (Marcogliese, 2002; Ostfeld and Holt, 2004). In addition, there is evidence that parasites can affect the distribution and abundance of aquatic insects and amphipods that may be food for other species (Moore, 1995; Marina et al., 2005) and that an animal's access to specific prey species can affect its parasite status (Bailey and Margolis, 1987; Berube and Curtis, 1986). New competitive interactions that might arise from introductions or invasions can magnify differences in habitat and food selection, resulting in segregation of animals and thus different exposures to different pathogens. Changes in animal distributions cause variations in animal densities that will affect disease transmission and introduce more uncertainty in disease risk models (Reno, 1998). Host genetic diversity, which can be affected by IAS, plays an important role in a population's ability to resist the effect of a disease. Disease outbreaks can create genetic "bottlenecks" and generate selective pressures that alter population gene frequency.

4.4. IAS impacts on animal health other than through disease

59. While the animal health community is generally most concerned about the effects of infectious and parasitic diseases, discussions in the biodiversity and conservation spheres highlight many other effects of introduced species on animal health. Native animals can be directly affected by predation, competition for food, changes in habitat and genetic impacts from introduced species – all of which influence primary determinants of animal health (see Case Study 7).

Case Study 7 Examples of the effects of introduced aquatic species

The impact of introduced aquatic species on local ecosystems and native animals is illustrated in the examples below:

- Grass carp (*Ctenopharyngodon idella*) was introduced in many parts of the world for both food and aquatic vegetation control. However, it also often removes aquatic vegetation that provides food, shelter and reproductive habitat for several local species (Crosetti, 2012).
- Many aquatic species compete for food resources, habitat, spawning grounds, etc. with local species. Introduced tilapia competes successfully with many native species because of their short generation time, fast growth rate, wide environmental tolerances, aggressive behaviour, and omnivorous feeding ability. For instance, in the Philippines and the Pacific Islands, brackish-water populations of Mozambique tilapia (*O. mossambicus*) have displaced local species. The Japanese carpet shell (*Ruditapes Philippinarum*) was introduced in the Mediterranean in 1983 from the Far East. At present it makes up most of the Mediterranean clam production, after having displaced in some areas the endemic species, the grooved carpet shell (*Ruditapes decussatus*) (Crosetti, 2012).
- In China, invasive freshwater fish have changed local ecosystems by modifying species composition, population structure and food chains. In Yunnan Province, where pollution, overfishing, land reclamation and other human associated impacts have had an impact on fish, the spread of introduced fish has compounded these stressors and been correlated with local extinctions and population reductions of the remaining native fish.

60. The introduction of the Brown Tree Snake is an often cited example of the effects of an IAS in the animal world. First introduced to Guam shortly after World War II, this IAS has since been directly linked to the local extinction (extirpation) of several native species of birds (8), lizards (3), and mammals (2 bats). A type of comb jelly, most likely trans-located with ship's ballast waters, is a major predator of zooplankton, pelagic fish eggs and larvae. It has been associated with declining fish stocks, with resultant ecological and economic impacts. While there remains debate about the attributable effects and specific mechanisms of IAS ecological impacts, there is sufficient evidence that the well-being and health of local species can be affected by mechanisms in addition to that of introducing a pathogen. Although the two perspectives (animal health affected by infectious diseases and animal health affected by ecological interactions) are poorly integrated in an academic and in a regulatory sense, there is little disagreement that both perspectives are valid and require consideration when managing IAS risks.

4.5. Measures to control SPS and IAS risks based on OIE standards and recommendations

61. Since 1924 the OIE has published health standards covering diseases and pathogenic agents. The most important are the Terrestrial and Aquatic Animal Health Codes, which "contain science-based recommendations for disease reporting, prevention and control and for assuring safe international trade in terrestrial animals (mammals, birds and bees) and aquatic animals (amphibians, fish, crustaceans and molluscs) and their products". The goal of the Codes is to prevent the "introduction and spread, via animals and their products, of agents that are pathogenic for animals and/or humans" (ibid). Within the Codes, specific diseases are listed for which standards are provided. In the absence of specific animal health standards for a specific animal or animal product, countries are expected to use risk analysis to determine if the proposed import presents an unacceptable risk to animal health. The OIE Handbook on Import Risk Analysis for Animals and Animal Products (see Box 15) provides a framework for countries to conduct risk analysis. As outlined in Chapter 2, the SPS Agreement allows WTO Members two options in setting animal health measures: (i) to base their measures on OIE international standards; or (ii) to use scientific risk analysis to determine whether importation of a particular commodity poses a significant risk to human or animal health and, if so, what health measures could be applied to reduce that risk to a level acceptable to the importing country.

Box 15	OIE definitions

Risk analysis: means the complete process composed of hazard identification, risk assessment, risk management and risk communication.

Risk assessment: means the evaluation of the likelihood and the biological and economic consequences of entry, establishment and spread of a hazard within the territory of an importing country.

Risk management: means the process of identifying, selecting and implementing measures that can be applied to reduce the level of risk.

Source: OIE Terrestrial Animal Health Code Glossary (http://www.oie.int/index.php?id=169&L=0&htmfile=glossaire.htm) and OIE Aquatic Animal Health Code Glossary (http://www.oie.int/index.php?id=171&L=0&htmfile=glossaire.htm)

62. To date, the OIE has not established explicit standards for IAS except for those OIE-listed pathogens considered to be IAS. Seven of the 17 pathogens listed in the GISD and/or DAISIE databases were OIE-listed diseases in 2011-2012. The OIE is therefore providing standards for only a sub-set of animal health-related IAS. There were 116 OIE-listed pathogens in 2011-2012. These diseases affect a wide variety of host animals and include infectious diseases caused by prions, viruses, bacteria, fungi and macroparasites (e.g. tapeworms and mites), as well as some diseases caused by larger pests (e.g. flies and beetles). These diseases affect people as well as an array of animal species (e.g. cattle, sheep, goats, equids, swine, rabbits, camel, fish, amphibians, crustaceans, molluscs, bees). Currently, an IAS will only be considered by the OIE if it causes an animal disease or results in animal infections that can cause human disease (zoonotic disease). The decision process for listing a terrestrial animal disease relies on criteria concerned with the distribution of the pathogen, its capacity to spread, its novelty and its capacity to cause disease or result in death of animals and (for zoonotic diseases) humans. The criteria for the selection of aquatic pathogens are similar, with specific additional attention paid to the consequences of the disease on wild aquatic animals and the capacity to diagnose the disease.

63. The OIE's 5th Strategic Plan (2011-2015) describes the OIE's core mandate as "the improvement of animal health, veterinary public health and animal welfare world-wide" because "it is recognized that controlling the spread of animal diseases is best achieved by ensuring the health and welfare of animals wherever they are" (Chapter 1, paragraph 1). Welfare is defined in Chapter 7.1 of the OIE Terrestrial Code as, "how an animal is coping with the conditions in which it lives". It goes on to say, "An animal is in a good state of welfare if (as indicated by scientific evidence) it is healthy,

comfortable, well nourished, safe, able to express innate behaviour, and if it is not suffering from unpleasant states such as pain, fear, and distress". Article 7.1.3 further clarifies animal welfare by describing elements that can be used to assess welfare such as: "the degree of impaired functioning associated with injury, disease and malnutrition… " and "information on the animals' needs and affective states such as hunger, pain and fear…the physiological, behavioural and immunological changes or effects that animals show in response to various challenges". It could be argued that this definition of welfare could accommodate consideration of both pathogenic and ecological IAS effects on wild and domestic animals.

64. The OIE's 5th Strategic Plan pays significant attention to the contribution of environmental changes on the occurrence and distribution of diseases and disease vectors, including IAS (page 6, paragraph 32). Within the 5th Strategic Plan there are a number of recommendations relevant to participation in programmes to manage or prevent IAS-associated risks (see Box 16). These include supporting collaborative, multi-agency dialogue and cooperation on animal health issues; expanding the suite of diseases under OIE observation or guidance; developing protocols for trans-boundary diseases; developing standards and recommendations for prevention of diseases as well as improvements in animal welfare; encouraging a greater diversity of specialization among scientists in OIE *ad hoc* groups in order to incorporate new subjects (e.g. ecology) and increase interaction and interdisciplinary work across diverse areas of science; undertaking research into pathogen dynamics in market chains; and undertaking research into inter-species pathogen transmission and migration patterns in collaboration with the wildlife sector. Key principles for implementing the 5th Strategic Plan include adopting multidisciplinary, multi-sectoral, multinational approaches; establishing broad partnerships across sectors; and engaging the wildlife and ecosystem communities (page 5, paragraph 27). An example of such cooperation, indicated in the Strategic Plan, is OIE-FAO collaboration in an emergency response to epizootic ulcerative syndrome, a fish disease introduced into parts of Southern Africa previously not known to have this disease (see Case Study 8).

Box 16 Elements of the OIE 5th Strategic Plan relevant to IAS

1. Establish a framework for the surveillance of the effects of environmental and climate changes including on the emergence and spread of exotic diseases and alien invasive species.
2. Develop tools to assess the impacts of environmental and climate change, including the problems linked with IAS, especially in relation to vector-borne disease and aquatic animal health.
3. Assist veterinary authorities to develop foresight and other decision-making frameworks that take into account new information about the evolving relationship between ecosystems, invasive species and emerging and re-emerging animal diseases,
4. Particular attention will be paid to the effects of climate and environmental changes on aquatic animal health, including problems linked with invasive species.
5. Address the food security and animal production food safety implications of diseases in aquatic animals, the effect of climate and environmental changes [and] consideration of alien invasive aquatic species….
6. Continue work on the standardisation of diagnostic techniques and control measures against wildlife diseases and alien invasive species.

Source: www.oie.int/fileadmin/Home/eng/About_us/docs/pdf/5th_StratPlan_EN_2010_LAST.pdf

Case Study 8 OIE and FAO collaboration on Epizootic Ulcerative Syndrome (EUS)

EUS is an OIE-listed disease of fresh-water finfish that affects a large number of species and is widely-spread geographically. EUS can cause high losses and market rejection, which can lead to reduced farmer income and increased food insecurity. Control in natural waters is thought to be impossible. First seen in Pakistan in the 1970s, the disease was detected in Southern Africa in 2006. Routes of entry into Africa are believed to include unregulated fish product imports or bait fish used by sport anglers.

The OIE and FAO have developed a coordinated emergency response to EUS. Following the confirmed presence of EUS by an OIE reference laboratory, the OIE Aquatic Animal Health Code has been used to provide guidance and support on detection, surveillance, zoning, and the importation of fish and fish products. At the same time, an FAO Regional Technical Cooperation Programme has worked to: (i) strengthen capacity of the competent authorities in affected countries; (ii) increase education and awareness of EUS; and (iii) facilitate emergency planning. OIE regional workshops have: (i) promoted dialogue between public and private sector actors; (ii) reviewed legislation; (ii) developed surveillance priorities; (iv) enhanced cross-border cooperation; and (v) coordinated and support regional aquatic animal health networks.

(FAO, 2007)

Source: http://www.fao.org/docrep/012/i0778e/i0778e00.htm

65. The OIE is engaged in a suite of other activities supportive of managing the impacts of IAS on biodiversity. In December 2011, the OIE assembled an expert group to brainstorm on guidance for Member Countries to assess the risk of non-native ("alien") animals becoming invasive. The expert group was asked to make recommendations on the use of risk assessment as a tool to evaluate and manage the risks to ecosystems presented by trade in animals and on a proposed definition of "invasive animals" for the purposes of that work. Three OIE Specialist Commissions (Aquatic Animal Health Standards Commission, Scientific Commission for Animal Diseases and Terrestrial Animal Health Standards Commission) reviewed the work of the group and concluded that the guidelines should be uploaded on the OIE website.[19] As the document was not intended to be a chapter in the Codes, publication could proceed without seeking Member Country comments.

66. The OIE is a member of the Inter-Agency Liaison Group on Invasive Alien Species (see para 22), which is tasked with facilitating cooperation among relevant organizations to support Article 8h of the CBD. Part of the task of this group is to address gaps in the international regulatory framework. In light of the OIE's commitment to the One Health concept (an approach linking human, animal and ecosystem health), it is developing working relationships with agencies and partners specializing in wildlife conservation.

4.6. Identification of gaps in the regulatory framework relevant to the animal kingdom

67. The OIE's mandate is set by its Member Countries. The principles and activities recommended in the 5th Strategic Plan seem to provide flexibility for engagement with the various stakeholders involved in IAS management and regulation. They might be able, in principle, to accommodate the many ways IAS affect animal health and biodiversity, but their application is subject to how OIE Member Countries define terms such as "welfare", "safe" and "health", as well as the scope and variety of the animal species (pathogens or otherwise) the OIE will be mandated to consider. The focus of the 5th Strategic Plan on environmental issues may provide capacity to accommodate specific work on IAS. However, to date, the OIE focus is on infectious disease risks at the human-animal-ecosystem interface and "the contribution of animal production practices to climate change" (Kahn and Pelgrim, 2010).

68. The OIE has undertaken work in areas potentially relevant to IAS risk management, notably the recommendations of the OIE Working Group on Wildlife. To the extent that the recommendations of this Working Group have been adopted in the Terrestrial Code, the OIE reported that the products of these activities have a legal standing under the SPS Agreement. If recommendations have not been adopted by the OIE World Assembly, the resulting recommendations and voluntary guidelines of the Working Group are not OIE standards. They may nonetheless, according to the OIE, be taken into account by the WTO in dispute settlements.

69. Should the OIE's Member Countries wish the OIE to address IAS more specifically, implying an expanded mandate, there would be a need for additional resources to support an expansion of OIE activities. Therefore, while there may be a philosophical foundation for the development of standards on IAS in the OIE mandate and the 5th Strategic Plan, implementing those philosophies would require a formal decision by Member Countries.

70. OIE standards currently focus on pathogens, not on animals *per se*. Hence the OIE does not specifically consider hazards that are not infectious diseases, or the ecological impacts that invasive animal species may have on the biodiversity of a country. The impacts of accidental and unintentional introductions of pathogens (e.g. via infected "hitch hiker" animals, shipping containers or other objects or materials that can transmit infectious agents) are taken into account, for example, in specific articles in the Aquatic Animal Health Code. Other international conventions address the movement of IAS in shipping containers and vessels (see Box 17 and Annex 1). For instance, parties to the International Maritime Organization (IMO) must prevent, minimize and ultimately eliminate the transfer of harmful aquatic organisms and pathogens by controlling and managing ships' ballast water and sediments. More stringent measures may be taken to prevent, reduce or eliminate the transfer of harmful aquatic organisms and pathogens by controlling and managing ships' ballast water and sediments, consistent with international law.

19 http://www.oie.int/en/our-scientific-expertise/specific-information-and-recommendations/invasive-alien-animal-species/

Box 17	Conventions and guidelines addressing IAS risks associated with ocean transport and ship movement

International Maritime Organization (IMO)

1. The International Convention for the Control and Management of Ships' Ballast Water and Sediments, adopted in 2004, aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments. It does not consider the role of hull fouling organisms in moving invasive animals
2. The Guidelines for the Control and Management of Ships' Bio-fouling to Minimise the Transfer of Invasive Aquatic Species aim to reduce the risk of translocation of invasive aquatic species from "bio-fouling" present on immersed areas of ships.

United Nations Convention on the Law of the Sea (UNCLOS)

1. Article 196 (1) of the Convention states that: "States shall take all measures necessary to prevent, reduce and control pollution of the marine environment resulting from the use of technologies under their jurisdiction or control, or the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto."

71. Consistent with its mandate under the WTO, OIE standards focus on international rather than within-country movement of animals and their products. However, as stated in the foreword of the Terrestrial Code, there are also provisions on "disease reporting, prevention and control", reflecting the rationale for the OIE's establishment in 1924. Assessment of IAS risk and management plans is best developed when based on ecological rather than political borders. Most OIE standards and guidelines are concerned with how to identify pathogens (surveillance), assess risks, declare areas free of specific diseases and undertake measures relating to pathogens such as testing, quarantine and prophylaxis. Guidance on the risks associated with animal species and risk management relevant to specific pathways for entry is not found in the OIE Codes. Thus standards on managing invasive species that are animals (as opposed to listed pathogens) are not currently available, leading to gaps in the capacity to identify, assess or manage risks.

72. Consistent with the Organic Rules under which the OIE was established, the organization mainly liaises with veterinary services in Member Countries, although this has expanded with the development of the Aquatic Code and more recent activity in wildlife. IAS risk identification and management is typically the role of other government agencies and involves a wide portfolio of stakeholders, which increases the challenge for a single organization to effectively develop necessary relationships with all regulatory bodies and interest groups.

5. Enhancing capacity to control risks related to IAS

73. International and regional organizations involved in IAS-related work, as well as other stakeholders such as research institutes, NGOs, academia and private sector associations, have recognized the magnitude and diversity of the needs that exist in order to enhance capacity to control IAS risks. The preceding chapters underline the importance and urgency of developing and strengthening national and regional capacity to prevent, control and/or eradicate risks related to the entry, spread and establishment of IAS. Whenever possible, the IAS literature advocates the adoption and implementation of policies and programmes that focus on prevention, based on an assessment of the risks associated with specific venues or mechanisms of animal/plant movement (pathways). While preventing the introduction of IAS is preferable, in many cases, particularly for developing and least developed countries, prevention is likely to be impossible to achieve, particularly given the need to assess all possible risks for all possible IAS and pathways. It is important to approach capacity enhancement for IAS prevention, control and/or eradication, as appropriate, in this context. It is also essential to set strategic priorities and leverage and make effective use of existing capacities, expertise, infrastructure and resources, wherever possible.

74. Strengthening the capacity of existing SPS authorities offers an effective approach to enhance capacity to respond to and manage IAS-related risks. The majority of trade-related IAS can be managed effectively by operational national SPS systems comprising, *inter alia*, border controls, quarantine, control and eradication measures, and risk assessment. In some countries, SPS systems are well-equipped to address the majority of trade-related IAS. However, many developing countries, and particularly least-developed countries, require substantial additional resources and support to strengthen their SPS systems. Ongoing challenges exist, for instance, with regard to institutional

and management capacity, legal and regulatory frameworks, technical knowledge and skills, and capacity for the surveillance, monitoring and assessment of IAS risks. Developing countries also need to be able to participate effectively in the technical work of the relevant international standard-setting organizations (IPPC and OIE) to ensure that their concerns are reflected in the development of international standards related to SPS and IAS. Yet, in some cases, the scientific expertise and resources needed to facilitate this participation are in short supply.

75. This chapter discusses some of the key elements required to develop and enhance capacity to prevent and/or control the entry, spread and establishment of IAS. Table 2 provides some examples of the types of themes and topics that deserve attention. Given the extent and diversity of needs faced, and the number of organizations that play a role in the area of IAS, capacity building efforts should ideally be based on a collaborative, inter-disciplinary and cross-cutting approach. In many cases, working at a regional level is likely to be most meaningful, cost-effective and sustainable given the ease with which IAS can cross borders.

Table 2: Themes for IAS capacity development

Theme	Possible topics for capacity development
Awareness	- Building awareness and generating evidence to convince the general public and policy-makers of the importance of managing IAS-related risks
Policy and legal framework	- Enhancing skills and developing tools to support policy development, monitoring and evaluation - Developing and implementing coherent IAS-related policies across sectors and government authorities
Strategic development	- Developing and applying tools to evaluate capacity building needs focused on plant and animal health, and IAS - Developing IAS capacity building strategies
Synergy and coordination	- Promoting regional and/or international approaches to prevent and control IAS - Strengthening coordination among international and regional organizations with a role in IAS, and synergies in the development and implementation of relevant agreements, conventions, standards, procedures, etc. - Facilitating collaboration across national government authorities involved in different thematic and technical areas (e.g. environment, agriculture, trade, public health) of relevance to IAS - Creating mechanisms to engage academia, industry, civil society and indigenous people in planning and responding to IAS
Knowledge	- Facilitating access to scientific and technical knowledge related to IAS - Creating mechanisms to mobilize and share IAS-related knowledge quickly and easily - Developing and disseminating new technologies and methodologies - Investing in research to support evidence-based decision-making
Human resources	- Enhancing skills in research, management and risk assessment - Developing expertise and competencies to implement the SPS Agreement as a foundation for IAS risk prevention and management, and to effectively implement other IAS-related policies and responsibilities - Enhancing coordination and management skills to implement multi-stakeholder and/or multi-disciplinary initiatives to prevent and manage IAS risks - Finding solutions to overcome human resource limitations in small countries (including island states)
Resources	- Allocating and securing adequate public, private and external donor financial resources to enhance capacity and develop and implement IAS-related policies and strategies - Developing and maintaining the infrastructure required for IAS- risk prevention and management.

5.1. Awareness

76. Given the number and variety of challenges facing developing countries, concerns about IAS are often secondary to other public policy priorities. It is therefore critical to effectively demonstrate the linkages between IAS and broader public policy objectives, for instance, focused on public health, food security, agricultural productivity, trade and economic growth. Addressing IAS-related risks can make an important contribution to these objectives and national development. Similarly, ignoring or not taking prompt action to address the risks posed by IAS is likely to have considerable negative and costly consequences. Understanding and clearly communicating the economic impacts of IAS can help to build political support for activities to address IAS (CBD, 2012). Ideally, awareness about the impacts of IAS and high-level commitment to address the risks faced should exist at a broad political level to facilitate the integration of IAS-related activities into a wide range of capacity development activities, beyond those focused solely on environmental, biodiversity or SPS-related objectives.

77. Awareness about the importance of addressing IAS should be present at multiple levels, from the senior political level to the general public. Raising such awareness should be a high priority for any IAS action plan (McNeely et al, 2001). Limited awareness amongst high-level decision- and policy-makers often represents a significant barrier to effective action by government authorities responsible for agriculture, animal/plant health and the environment. Awareness about the potentially devastating effects of IAS at the level of the general public, private sector and civil society, can help to encourage public sector action, facilitate earlier detection and rapid response, and improve the effectiveness of control measures. For instance, the 2003 European Strategy on IAS suggested that "most biological invasions now threatening Europe might have been prevented by greater awareness of IAS issues and a stronger commitment to address them".[20]

78. International organizations involved in IAS as well as regional plant protection organizations can play an important role in raising awareness about the challenges posed by IAS and why prompt action to address the risks faced is necessary. For instance, the European Plant Protection Organization (EPPO) undertakes a range of activities (including workshops and an electronic reporting service[21]) aimed at raising awareness about invasive alien plants in Mediterranean-type regions, and sharing information and experiences (e.g. on new pest and disease outbreaks, prevention and control, management measures, research findings) (Brunel, 2012).

5.2. Policy and legal framework

79. A supportive policy and legal framework is an essential part of an enabling environment for IAS programmes. In general, a holistic and inter-disciplinary approach to IAS policy development is recommended given the number of institutions involved and the linkages between IAS and broader public policy goals. Policy shortcomings which leave important areas related to IAS unaddressed, or create duplication and inconsistencies in the planning and implementation of IAS programmes, should be avoided. In reality, however, the basic policy mechanisms for comprehensive IAS risk prevention, management and control still need to be established in several countries. In other countries, efforts are required to strengthen coordination between different government (central and/or provincial) authorities that share responsibility for various aspects of laws and regulations related to IAS, as well as with other institutions (public sector or NGOs) that have developed relevant voluntary codes or practices, in order to promote a harmonized and integrated approach to prevent and mitigate risks related to IAS.

80. As part of the effort to enhance the legal framework for IAS prevention and control, additional work is required in several countries to review and revise phytosanitary laws and regulations, which is frequently identified as a major shortcoming (Canale 2003). Given the importance of phytosanitary measures in protecting against IAS, improving phytosanitary legislation, and enhancing capacity for its implementation, provides an effective means to enhance capacity to regulate and control IAS.

81. Developing up-to-date national legislative frameworks covering both the phytosanitary and IAS areas will be important in the mid-term future. Gaps in the policy and legal framework, including confusion regarding roles and responsibilities and weak enforcement capacity, may be overcome by learning from and mirroring functional systems for IAS prevention and control that already exist in other countries (Reaser et al, 2011). Assistance and resources to enhance the policy and legal framework for IAS at the national level are also available internationally. For instance, the Global Invasive Species Programme (GISP) has developed policy support tools to assist countries to create, review and integrate IAS-related policy, in particular related to Article 8(h) of the CBD (see Box 18).

20 See: http://www.ec.gc.ca/eee-ias/78D62AA2-55A4-4E2F-AA08-538E1051A893/European%20strategy%20on%20invasive%20alien%20species.pdf

21 EPPO Reporting Service: http://www.eppo.int/PUBLICATIONS/reporting/reporting_service.htm

Box 18	Global Invasive Species Programme

The Global Invasive Species Programme (GISP) was established as a partnership in 1997, with a mission to conserve biodiversity and sustain human livelihoods by minimizing the spread and impact of IAS. GISP's partner organizations included CABI, IUCN, The Nature Conservancy (TNC) and the Secretariat of the CBD. Since its creation, the focus of GISP was on policy development, awareness raising and information exchange. In its first phase, GISP undertook focused IAS assessments and developed guides and toolkits for policy, regulation, prevention and management.[1] GISP's work led to adoption by the CBD Conference of Parties of the Convention on Biological Diversity of a work programme on IAS. During a second phase, GISP implemented activities to engage and inform governments and stimulate action and cooperation, between governments and different sectors (e.g. environment and agriculture) to address IAS threats. Following the global economic recession, GISP faced difficulties in securing funds and was forced GISP to close its Secretariat and become dormant. GISP therefore faces the same fate as so many of the species it tried to protect – extinction.

1 https://www.ippc.int/publications/side-event-presentation-gisp-cpm-5-25-march-2010

82. While the existence of a sound and coherent policy and legal framework is essential, developing capacity to effectively implement, enforce, monitor and evaluate policy is crucial for policy to be effective. In some cases, the absence of effective and feasible policy instruments sometimes presents a challenge to the implementation of IAS programmes in both developed and developing countries. For instance, the 2003 European Strategy on Invasive Alien Species noted challenges with compliance and enforcement of policies relevant to IAS. Consultation with stakeholders during policy and legislative development can help to support the development of policies that are workable within the legislative and resource context of a country, and enhance "ownership" of the instruments to be developed.

5.3. Assessing needs to enhance strategy development and capacity building

83. Given the diversity of IAS risks faced by countries, as well as different national contexts, resources and priorities, strategies to build capacity to control and manage IAS should be tailored to the particular country/regional setting. Assessing capacity building needs is therefore an important first step. The IPPC and OIE have developed dedicated tools, programmes and resources to facilitate the evaluation of capacity needs in the phytosanitary, veterinary and aquatic areas (see Box 19). Using the IPPC tool provides an effective approach to respond to IAS-related needs given that the use of existing phytosanitary institutions and resources provides a cost-effective way to prevent the introduction of, control or eradicate plant pests. The OIE PVS Tool is well suited for assessing compliance with OIE standards for preventing the spread of pathogens through trade. In addition, the OIE PVS Tool: Aquatic provides a useful tool given the increasing global production of, and trade in, aquatic animals and their products. However, it is difficult to evaluate the effect of improved governance in veterinary services on managing risks from IAS other than pathogens.

Box 19	IPPC and OIE Capacity Evaluation Tools

The IPPC's Phytosanitary Capacity Evaluation (PCE) is a management tool to help a country identify strengths and gaps in its existing and planned phytosanitary systems. It generates a snapshot of a country's phytosanitary capacity at a particular time and provides a framework for rational strategic planning. The PCE tool allows for prioritizing activities/resources to fill capacity gaps and thereby enhance the effectiveness of the overall phytosanitary system. The PCE process is implemented through a consensus driven and confidential process amongst concerned stakeholders (public and private) to identify the strengths and weaknesses of the phytosanitary system. The results are intended to be used by NPPOs, and more broadly by government agencies, as a basis to identify capacity building or infrastructure needs and actions to address them. National strategic plans developed through the PCE also provide the basis for dialogue with development partners and thus improve the likelihood of resource mobilization (IPPC, 2003b). For more information, see: https://www.ippc.int/core-activities/capacity-development/phytosanitary-capacity-evaluation

The OIE's Tool for the Evaluation of Performance of Veterinary Services (OIE PVS Tool, 2010) is designed to assist veterinary services to establish their current level of performance, to identify gaps and weaknesses in their ability to comply with OIE international standards, to form a shared vision with stakeholders (including the private sector) and to establish priorities and carry out strategic initiatives. Based on the OIE PVS Tool, the OIE has also developed a Tool for the Evaluation of Performance of Aquatic Animal Health Services (OIE PVS Tool: Aquatic). The OIE capacity evaluation tools address four fundamental components of capacity: (i) human, physical and financial resources; (ii) technical authority and capacity; (iii) sustained interaction with stakeholders; and (iv) ability to access markets through compliance with existing standards and the implementation of new disciplines such as the harmonisation of standards, equivalence and zoning. As of May 2012, the OIE had completed 109 PVS and 54 Gap Analysis missions. For more information, see: http://www.oie.int/support-to-oie-members/pvs-evaluations/oie-pvs-tool/

84. An analysis of the outcomes of the PCE in 2003 concluded that the PCE can be used as a cross-disciplinary tool for assessing capacity needs and that the PCE results can be extrapolated to IAS that are pests (Canale, 2003). It further concluded that the fragmentation of competencies for regulating IAS, which poses problems to all countries, is particularly problematic for developing countries. Other mechanisms also exist within the IPPC which can help to address specific issues and constraints related to IAS. For instance, based on difficulties in several developing countries to implement ISPM 15[22], which aims to prevent the spread of invasive pests in wood packaging materials made of unprocessed raw wood, the IPPC's Implementation Review and Support System (see Box 20) carried out a stocktaking exercise to compile the major challenges reported by countries in implementation of this standard. The results of this exercise enable the IPPC Secretariat and others to plan specific technical assistance activities to address the challenges faced.

Box 20	The IPPC Implementation Review and Support System

The Implementation Review and Support System (IRSS) was created to facilitate and promote the implementation of the IPPC and ISPMs. The IRSS is an evaluation tool which provides assistance to countries in identifying their plant protection challenges and best practice. Funded by the EU, it consists of two main components: (i) review activities; and (ii) a support system. The review component includes activities to analyse the causes for implementation difficulties in countries. It includes surveys and case studies, such as a recent study on the risks of internet trade of plants (IPPC 2012b). The data obtained from the review activities help to establish targeted support activities to overcome the implementation difficulties faced. The support system encompasses the operation of an implementation help desk in the IPPC, as well as the establishment of a resource and country database. Data obtained through the review process may also be used to assist FAO and other donors in the design of phytosanitary capacity building activities.

http://irss.ippc.int/

5.4. Improving knowledge, expertise and skills

85. Improving knowledge and expertise about IAS-related risks and how to respond to them effectively is a critical component of efforts to enhance capacity, particularly in developing countries. Countries require technical knowledge and skills to be able to determine whether a species is invasive or not, to determine how to detect the species in question, prevent entry, contain and/or eradicate the risk faced, as appropriate. The ability to predict the likelihood that a plant or animal movement will result in an IAS with negative effects on an ecosystem remains limited. The challenge is compounded by the complex combination of social and ecological factors that influence the patterns and impacts of an IAS, combined with their ability as living organisms to move or persist over time, as well as to adapt to changing conditions. For instance, the effects of introduced pathogens can be modified by concurrent diseases or pollution and even after invasion it is difficult to differentiate between the proportion of a population's decline that is attributable to the IAS in question, as compared to other factors such as climate change or habitat loss. The challenge of predicting the effects of a new or invading pathogens also exist for well-known diseases, such as Foot and Mouth Disease or Bovine Spongiform Encephalopathy (BSE), even though the species affected in such cases have been under observation and study for centuries. These difficulties are compounded for IAS by limited global capacity to identify taxonomically and map accurately the location and trans-boundary movements of all species, thus complicating the purportedly "simple" task of determining if a species has moved and ascertaining that it is not native to an area.

86. Capacity to properly assess and manage IAS risks requires detailed knowledge of the natural history and ecology of local and neighbouring species. It also requires new knowledge and methodologies. For instance, historic approaches to forecasting the possible impacts of animal movement have typically focused more on the risks associated with the entry of a pathogen and on species of agricultural importance, rather than on the entry of new animal species, or risks for wildlife or biodiversity. Historic approaches have not considered the effects of changes over time (e.g. climate change) and have typically dealt with political rather than ecological boundaries. Current approaches to risk assessment are recognizing some of these limitations but, as the scope of risk assessment grows (e.g. consider more animals over longer times over different spaces), prediction becomes more tenuous.

87. The challenges of forecasting risks associated with an IAS are illustrated in trans-located pathogens. One impediment to pathogen risk forecasting is the inability to ascertain the magnitude of the effects of an IAS. Risk and risk assessment, as defined by the OIE, focus on the probability and impact of an adverse outcome. But for many animals, especially wildlife, major scientific gaps make it extremely difficult to determine what might be the outcome and the magnitude of these effects. "The practical difficulties in measuring the prevalence, incidence, and pathogenicity of diseases in wild populations cause serious problems in determining the possible implications of disease" (McVicar, 1997). For IAS that are not pathogens, risk assessment and management to prevent accidental and unintentional entry (e.g. in shipping containers and other objects and materials) is especially challenging.

22 ISPM 15: Regulation of wood packaging material in international trade.

88. The IPPC and OIE provide international guidance and leadership on systematic approaches to risk assessment. However, knowledge gaps remain an important deficit in the ability to predict the risk of an IAS with certainty. For instance, climate change introduces particular data problems in pest risk analysis. Climate matching is often used to determine the similarity between climatic conditions in the area at risk to pest invasion and the area of origin, but the climatic data available for 1960-1990 may not accurately reflect the situation today, nor circumstances in the future when climate change accelerates. At present, risk assessments are made for current conditions because the long-term effects of climate change are difficult to assess. Furthermore, climate change models only generate average predictions, while regional and local climate change could have a major influence on pest invasions (STDF 2011), and hence on the potential of an introduced species to become invasive.

89. New methods to detect and assess risks are needed to deal with the increasing number of global pathways and non-tangible impacts of potential IAS. For instance, visual inspections have proven unreliable for detecting contaminating organisms in plants with adhering soil or with latent infections. New and highly discriminatory methods for detecting invasive alien pests and pathogens may be required, along with novel uses of quarantine facilities and sentinel areas. Ideally, an analysis of the costs and benefits of an importation would also recognize the complexity of the importation context. For example, when calculating the cost-benefit of an importation in New Zealand, legislation requires decision-makers to consider all effects related to the environment, human health, the economy, society and the community, and to take into account Maori (indigenous people) culture and traditions.

90. A substantial amount of existing information (e.g. country reports, assessments, databases, etc.) offers access to valuable IAS-related resource materials, which could be used as a basis to enhance capacity to prevent, control and manage IAS-related risks (see Annex 3). Much of this information is available free-of-charge online. Yet many developing countries continue to face challenges in accessing this information for various reasons (e.g. limited internet access, language barriers, inadequate financial resources) or in interpreting, adapting and applying it to their local needs.

91. Difficulties in addressing IAS risks linked to knowledge gaps affect developing and developed countries alike. An additional challenge for developing countries relates to the gap between the need for information to support risk assessment, surveillance and research, and the capacity to generate and use knowledge to prevent and respond to IAS risks. The availability of sufficient scientific expertise and technical skills – including the knowledge and skills needed to implement IPPC and OIE standards, and to carry out risk assessments – is an important challenge in many developing countries. Expertise and skills to carry out core SPS tasks, for instance related to risk assessment, surveillance, export certification, inspection and diagnostics, frequently need to be strengthened. The results of PCE assessments also indicate that more attention is needed to assist developing countries to develop and implement documented procedures related to all aspects of national phytosanitary systems, including the introduction and control of IAS.

92. While much of the discussion on human resource development emphasizes aspects related to enhancing technical expertise, the availability of a sufficient number of non-technical staff is also important to adequately implement IAS-related plans and policies. This may include staff involved in programme administration, border inspection, surveillance and detection, enforcement, etc. A shortage of non-technical staff, and trained technical experts, is often a particular challenge for small developing countries and island states spread over geographically, ecologically and politically distinct areas. In addition to an adequate number of personnel, flexibility to allocate and mobilize staff in a timely and efficient manner is necessary to effectively address emerging IAS threats. Engaging industry, the private sector, civil society and the public to be part of a comprehensive IAS strategy can be useful, particularly where human resources are limited.

93. Developing human resources and skills to effectively implement the obligations of the SPS Agreement is an important first step. A large number of initiatives have already taken place or are underway in developing countries to enhance SPS capacity, including competencies to implement international phytosanitary and animal health standards. These efforts contribute significantly towards global efforts to strengthen knowledge, expertise and skills to manage IAS. The IPPC and OIE have developed a range of technical resources and training tools to help countries implement international phytosanitary and animal health standards, which support capacity building efforts focused on IAS. For instance, the IPPC has developed a range of electronic training resources focused on pest risk analysis concepts and practices, which contain provisions on IAS.[23] The IPPC, OIE and other organizations also deliver a large number of training programmes. In the Pacific Region, the PII is providing technical support and mentoring, together with formal and on-the-job training, to enhance capacity (see Case Study 9).

23 The IPPC's training course on PRA was developed by an international advisory group of PRA experts. It includes 14 presentations, explanatory manuals and practical exercises. For more information, see: http://phytosanitary.info/content/ippc-e-learning-course-pest-risk-analysispra

Case Study 9	Pacific Invasive Initiative (PII)

Islands often present unique ecosystems with landforms and biota not found on continents. Globally, they also contain a disproportionate percentage of endemic species and are often important wildlife breeding grounds. Extinction rates of bird, mammal and reptiles are disproportionately greater on islands than on continents due to human effects and the impacts of invasive species threaten further extinction of endemic island species. Adverse impacts include predation, competition and introduction of disease. Many islands are small developing countries, with low levels of development. Most are net-importing countries of food and non-food products (e.g. building materials, used equipment, used cloths, used cars, soil, sand, aggregates) which can carry all sorts of unwanted species (Suma, 2012).

In the Pacific Island Countries and Territories, a shortage of trained personnel and limited access to information and tools are major constraints to manage and control IAS effectively. The Pacific Invasive Initiative (PII) was established, in consultation with key stakeholders in the region, in response to the need for increased cooperation and coordination on invasive species management. The PII aims to provide long-term support to government and non-governmental agencies undertaking or planning IAS management. It provides planning assistance, peer review of plans and studies, and access to information and experts. It also provides technical support and mentoring together with on-the-job training.

The PII strongly champions strengthening biosecurity at regional, national and inter-island levels and works closely with the Secretariat of the Pacific Regional Environment Programme (SPREP), the Secretariat of the Pacific Community (SPC) and other key actors in the region. PII has been instrumental in establishing key structures for managing invasive species, such as the Pacific Learning Network (PILN) and the Pacific Invasives Partnership (PIP). It supports IAS management for a range of species such as the yellow crazy ant, European rabbits and myna birds. It also provides specific tools (e.g. resource kit for rodent and cat eradication[1]) that can be used for planning and implementing IAS programmes. The PII contributed to the establishment of the Pacific Ant Prevention Programme (PAPP) which had many achievements initially, but stalled recently due to the lack of adequate support.

1 http://www.pacificinvasivesinitiative.org/rk/index.html

5.5. Access to infrastructure and other resources

94. Implementing SPS measures and managing IAS effectively requires countries to have a certain amount of hard infrastructure in place. In countries where adequate SPS infrastructure already exists, this can effectively be used to help prevent and control risks related to IAS. In such cases, capacity building programmes focused on biodiversity should be encouraged to consult NPPOs, veterinary, fisheries and public health institutions to explore options to utilize and/or further enhance existing infrastructure, rather than seeking to start from scratch.

95. Yet in several other countries, addressing challenges related to phytosanitary and veterinary infrastructure remains a priority. For instance, an analysis of the results of the IPPC's PCE tool demonstrates the need for additional support to improve infrastructure (e.g. proper inspection facilities at entry points, diagnostic laboratories, glass- and screen-houses, computer systems) to support phytosanitary authorities. Similarly, the results of OIE PVS evaluations indicate the importance of adequate physical infrastructure and financial resources for animal health, as a fundamental component of veterinary services.

5.6. Promoting cooperation, synergies and inter-disciplinary approaches

96. Collaborative, inter-agency initiatives focused on the eradication and/or mitigation of pests/IAS at a national, regional and/or international level should be encouraged as part of capacity building. At the country level, strengthening collaboration between phytosanitary, veterinary and environmental authorities has considerable advantages, particularly in developing countries where resources are scarce. Coordination of national efforts to prevent damages from IAS can reduce the need for substantial new investments infrastructure and minimize the duplication of activities (Lopian, 2005). For instance, phytosanitary authorities in many countries have a long history and experience in preventing the introduction of quarantine pests. Several have established efficient structures including border controls, national surveillance programmes, technical and scientific institutions and export-oriented certification programmes. Environmental authorities, as well as other programmes and initiatives focused on IAS, could effectively utilize these resources and knowledge to implement the CBD's guiding principles, and also address risks posed by plant pests and IAS that are plant pests. A coordinated approach also helps to ensure that different authorities implement procedures related to IAS (e.g. border controls and import requirements) in a coherent and consistent manner.

97. Developing national IAS strategies provides a practical instrument to identify linkages and synergies between different types of government and non-governmental stakeholders, and to enhance coordination at the country level. Different approach and mechanisms can be used including the development of memoranda of understanding or cooperation, establishment of inter-agency groups or task forces focused on one specific IAS or IAS in general, and/or the development of cross-cutting and inter-disciplinary strategies. For instance, in Mexico, different government authorities (notably the Secretariat of the Environment, the Secretariat of Agriculture, the Secretariat of Communication and Transportation and the Naval Secretariat) collaborated with academia and NGOs to produce a National Strategy on Invasive Alien Species (2010), which received funding from GEF in 2012 (Gonzalez, 2012). In another example, the establishment of Biosecurity New Zealand brought a number of government agencies under one roof, thereby improving coordination and delivery. In the USA, the National Invasive Species Council (NISC) was created in 1999 to provide high-level interdepartmental coordination of federal invasive species actions and work with other federal and non-federal groups to address invasive species issues at the national level (Burgiel, 2012).

98. Improved cooperation is also important at the regional and global level. Countries that share borders and ecological and climatic conditions face similar risks related to the introduction of pests/IAS. Many pests/IAS introductions can only be successfully prevented or controlled where the affected countries cooperate at a regional or international level. This can be illustrated by the cooperation among phytosanitary, agricultural and environmental authorities in Kenya, Tanzania and Uganda to successfully eradicate water hyacinth (*Eichhornia crassipes*) from Lake Victoria (see Case Study 10). Given the limited resources available to developing countries to respond to introductions of IAS/pests, developing multi-country collaborative projects can help to support the mobilization of donor resources and enhance the outcomes achieved.

Case Study 10 A regional approach to control water hyacinth in Lake Victoria

Native to the Amazon Basin in South America, water hyacinth has been identified as one of the most aggressive invasive species (UNEP, 2013). Characterized by rapid growth rates, extensive dispersal capabilities, rapid reproductive output and broad environmental tolerance, water hyacinth has spread widely outside its native habitat. Although it is still mainly found in pan-tropical regions, it also occurs in warm temperate regions, as well as in the Mediterranean Basin.

While water hyacinth was initially introduced to Africa between 1879 and 1892, many invasions on the continent were first noticed in the 1980s. It is currently identified as the most widespread and damaging aquatic plant species in Africa (UNEP, 2013). Regional bans have been placed on its transportation, and numerous control efforts have been implemented, yet this species continues to invade many African waterways (EPPO, 2008). The plant now exists throughout much of eastern and southern Africa (Lindsey & Hirt, 2000). Its economic costs on the continent are estimated at some US$100 million annually (UNEP 2006).

Water hyacinth was found for the first time on Lake Victoria in 1989 (CABI, 2012). The plant spread dramatically in the early 1990s, in part due to the lake's increasingly poor water quality. By the late 1990s, tens of thousands of hectares of the lake's surface were covered with water hyacinth plants (Wilson et.al., 2007). The ecological, social and economic impacts were severe and affected some 30 million people. Transportation on the lake was affected, including difficulties to access ports and increased fuel costs. Dense mats of water hyacinth covered bays and other important fishing grounds making the use of fishing nets impossible, and reducing the number of fish species and marginal plants. Water intake points became blocked and decaying plant matter reduced water quality, which negatively affected the supply of freshwater available to people living around the lake. The plant's spread interfered with the production of hydro-electric power production, resulting in power cuts for millions of people in urban and industrial areas. Human health was also negatively affected. Water hyacinth provided a breeding ground and habitat for several vectors of disease (e.g. mosquitoes, flies and snails), which raised the risk of malaria, filariasis, sleeping sickness, river blindness and bilharzias. The plant further increased transpiration from the water surface by 40-50%, which reduced water flow into the Nile by an estimated 10% (Lindsey & Hirt, 2000).

The rapid spread of water hyacinth, and the devastating environmental and economic impacts, pushed Lake Victoria's riparian states (Kenya, Tanzania and Uganda) to take action. Various methods were used (e.g. physical removal of plants, chemical control and efforts to reduce water pollution identified as a factor contributing to the plant's rapid spread) (Lindsey & Hirt, 2000). The application of biological control agents using weevils (*Neochetina eichhorniae* and *N. bruchi*) proved to be the most effective mitigation measure. Uganda initiated the use of bio-control agents in late 1995. Other countries followed resulting in the reduction of water hyacinth on the lake.

Cooperation among Kenya, Tanzania and Uganda was essential to control water hyacinth. This included collaboration between environmental and agricultural/plant protection authorities at the country and regional level. These efforts were supported by the Lake Victoria Environmental Management Project (LVEMP), a comprehensive regional development programme covering Lake Victoria and its catchment areas, funded by the World Bank, through the Global Environment Facility (GEF) and the International Development Association (IDA). Initiated in 1997, the LVEMP aimed to "establish regional collaboration in reducing water pollution and eutrophication and in fisheries management, bio-diversity and water hyacinth control". Currently in its second phase (2009 - 2017), LVEMP is implemented in Burundi, Kenya, Rwanda, Tanzania and Uganda, the five member states of the East African Community (EAC). The main objective, besides addressing environmental concerns, is to address the resurgence of water hyacinth and other invasive weeds.

99. Transnational efforts to eradicate and control a new species of fruit fly (*Bactrocera invadens*), which has spread across Sub-Saharan Africa at an unprecedented speed over the last decade with negative effects on fruit production, trade and food security, provide another example. In particular, inter-agency and inter-state cooperation in West Africa has led to the adoption and planned implementation of a Regional Action Plan (see Case Study 11). A similar initiative in the Pacific Region, which engaged national government authorities, alongside regional and international partners, enabled fruit fly species to be eradicated from some Pacific Islands and opened up new markets for fruit and vegetables exports.[24] These examples demonstrate the value and important benefits to be achieved by encouraging inter-disciplinary collaboration to address the risks related to IAS and pests at a regional and international level. They also highlight that aquatic weeds can be addressed as plant pests using pest risk analysis and regulation, if appropriate (Wersal & Madson, 2012) and point to the relevance of conventional plant protection activities (e.g. use of biological control agents) based on the relevant ISPMs.

Case Study 11 Controlling the spread of the fruit fly in West Africa

Since 2004, a new fruit fly species (*Bactrocera invadens*) has had devastating effects on the production of mangoes, citrus and other tropical fruits in West Africa, as well as exports and incomes. The fly has spread rapidly through the continent since its introduction. In May 2010, it was detected for the first time in South Africa (IPPC, 2010b).

Eradication and/or control of the fruit fly has been very difficult, if not impossible, for individual countries in Africa to achieve. The widespread distribution of the fruit fly in West Africa, and the substantial economic damages generated, encouraged plant protection authorities in the countries most affected, with the support of international development partners, to search for a regional response. A regional project to detect the fruit fly was initiated by the International Institute of Tropical Agriculture (IITA) and the "Centre de coopération internationale en recherche agronomique pour le développement" (CIRAD), with the support of the STDF and the World Bank. The EU, STDF and World Bank also supported the development of an Action Plan to control fruit fly in West Africa.[1] This Action Plan, budgeted at US$25 million, includes national and regional capacity building activities. The EU recently pledged €17 million to implement the Action Plan.

Based on development of the regional approach in West Africa, other regions, notably Eastern and Southern Africa, have expressed their desire for a similar initiative. Given the continued spread of fruit fly across the continent, a Pan-African initiative deserves consideration.

1 See: http://www.standardsfacility.org/Files/Briefings/STDF_Briefing_No4_EN_web.pdf

5.7. Promoting partnerships with the private sector, academia and civil society

100. Non-government stakeholders can make an important contribution to efforts to prevent and control IAS. A number of IAS introduction pathways that are not fully covered by international regulatory frameworks (e.g. intentional introduction of alien species for non-food purposes including trade in pets and aquatic species) depend on the leadership and motivation of the private sector to develop and implement standards of practices, guidelines and/or codes of conduct. In particular, where government regulatory frameworks do not exist, industry can play a proactive role in seeking to minimize or eliminate unintentional introductions that might negatively affect their business interests and reputation. Some industry partnerships, such as the Pet Industry Joint Advisory Council, are engaged in efforts intended to reduce IAS risk, for instance by educating pet owners about responsible pet choices,

24 The "Regional Management of Fruit Flies in the Pacific" project, launched in 1990, aimed to increase fruit and vegetable production in the Pacific Islands and to protect food security and export markets. The project was initially funded by the FAO, the Australian Agency for International Development (AusAID), the United Nations Development Programme (UNDP), and the Secretariat of the Pacific Community (SPC). Due to its success, the project was extended several times and, in the process, the SPC and the Pacific Plant Protection Organization (PPPO) have integrated fruit fly activities into their work programme.

reducing pet abandonment and reducing risks of trans-locating an invasive amphibian pathogen.[25] Industry has also helped to develop useful resources such as the "Pet Pathway Toolkit: Tools and best practices to minimize the risk of introducing invasive species through the release or escape of pets" (Meyers, 2012).

101. In some cases, industry has initiated its own alliances related to IAS. For instance, the Global Industry Alliance for Marine Biosecurity was formed to reduce the transfer of harmful invasive species and pathogens via ships' ballast water and to maximize global environmental benefits from addressing these issues in a sustainable and cost-effective manner.[26]

102. The importance and value of developing partnerships with industry, academia, research institutes and civil society is reflected in several of the examples discussed above. Such stakeholders can provide valuable expertise and knowledge on IAS that contributes to the success and sustainability of capacity building efforts. The private sector can also contribute resources, technical capacity and managerial expertise to IAS prevention and control initiatives. Ideally these non-state stakeholders should be involved from the outset in planning and designing IAS-related capacity building programmes at the country level. Partnerships provide a useful mechanism to support and enhance capacity to prevent and control IAS. The "InovaDefesa" project in Brazil, which aims to strengthen the relationship between academia, regulatory organizations and the private sector provides an example of a multi-stakeholder partnership for plant and animal health protection and product inspection (Vilela, 2012).[27]

6. Conclusions and recommendations

103. The preceding chapters illustrate that IAS have profound negative economic, ecological, social and health impacts on people and domesticated and wild animals and plants. Article 8(h) of the CBD requires contracting parties to prevent the introduction of, control or eradicate those IAS that threaten ecosystems, habitats or species. Increased international trade in plants and animals and their products, in particular, has been identified as a critical pathway for the introduction of IAS beyond their natural ranges. Introductions can be intentional, for instance in the case of trade in new plant species or animals (pets, aquaculture, etc.) or through the deliberate release of bio-control agents. Unintentional introductions are frequently associated with increased trade, changed trade patterns and tourism.

104. The SPS Agreement recognizes the right of WTO Members to protect the life and health of humans, animals and plants through SPS measures. It also covers measures taken to prevent or limit damage within the territory of Members from the entry, establishment or spread of pests. Although the Agreement does not use the term "invasive alien species" as such, any measure applied in relation to an IAS that corresponds to the definition of an SPS measure in Annex A of the Agreement should nevertheless be compatible with the provisions of the Agreement. Since the Agreement does not mention IAS specifically, however, this notion may need to be further clarified and disseminated.

Recommendation 1

The SPS Committee should consider developing guidance regarding the relationship between IAS and the SPS Agreement, for the purpose of providing legal clarity and firmly embedding IAS into the global trade regulatory framework. Such guidance should seek to clarify, *inter alia*, notification requirements for SPS measures taken by national environment/ biodiversity institutions to prevent the introduction of IAS other than animal and plant pests or diseases.

105. The IPPC and the OIE are the standard setting bodies for plant and animal health measures, respectively, under the SPS Agreement. WTO Members are encouraged to base their measures on IPPC and OIE standards, guidelines and recommendations, where they exist, to facilitate harmonization and application of common SPS measures by different Members, without unduly restricting international trade. SPS measures based on IPPC and OIE standards,

25 https://www.cbd.int/doc/newsletters/news-biz-2008-02/?articleid=37

26 http://globallast.imo.org/index.asp?page=GIA.html

27 For details on the Innovation for Plant and Animal Health Protection and Product Inspection Project (InovaDefesa), see: http://inovadefesa.ning.com/

guidelines or recommendations are presumed to be consistent with the SPS Agreement. Members who base their measures on these standards, guidelines and recommendations can be confident of their compliance with the SPS Agreement.

106. CBD coverage of IAS corresponds to that of the IPPC in relation to pests of plants and plant products, and to that of the OIE in relation to animal diseases. By definition, many quarantine pests and animal diseases are IAS, and the IPPC and OIE have been working for decades to prevent their spread, including through standard-setting. Consequently, the IPPC and the OIE are directly relevant to the national implementation of Article 8(h) and other relevant articles of the CBD. A gap is identified, however, concerning invasive animals that are not plant pests or OIE-listed pathogens and parasites. This gap in the international SPS regulatory framework, also identified by the CBD, is also mirrored at the national level in many countries.

Recommendation 2

OIE Member Countries should consider the establishment of a specific definition of "animal health" for the purposes of the OIE Terrestrial and Aquatic Animal Health Codes. There would be potential for setting standards and providing advice relevant to IAS that are animals if the objectives of the OIE were expanded to address impacts other than those directly resulting from the interaction between a pathogen and the host animal. An expansion of the definition of animal health beyond traditional definitions, which focuses on infection/disease, would require increased collaboration with other agencies, in addition to Veterinary Services and Aquatic Animal Health Services.

107. Measures to prevent the introduction of IAS are usually at the forefront of national strategies to protect biodiversity. The CBD recommends that states implement border controls and quarantine measures to minimize the risks of introducing alien species that are, or could become, invasive. Measures to prevent the introduction of species are generally cheaper and easier to implement than measures to eradicate, contain or control those species after their introduction.

108. The SPS Agreement requires WTO Members to base SPS measures, such as import regulations or quarantine measures, on an assessment of the risks to human, animal or plant life or health (unless Members base their measures on international standards, if they exist). In doing so, Members are to take into account the risk assessment techniques developed by the IPPC and the OIE. In the case of the IPPC, various ISPMs have been developed and/or amended over the years to provide detailed guidance for assessing pest risks to the environment and in relation to IAS. These standards should be used to assess species that may be invasive and that directly or indirectly affect plants or plant products, or that may be used as biological control agents. Various OIE standards also focus on risk assessment and analysis. In addition, the OIE recently issued guidelines to assist countries in assessing the risk of non-native animals (other than pathogens) becoming invasive.

109. Preventing the introduction of IAS, however, may not always be possible or effective. Numerous incursions have occurred world-wide as illustrated by some of the case studies in this paper. In these situations, the focus of national biodiversity strategies shifts to establishing eradication, containment and/or control measures. Again, such activities should be closely monitored following effective surveillance practices. The IPPC and the OIE have a portfolio of standards and guidelines for IAS that are quarantine pests of plants or diseases of animals that countries should use in this regard.

Recommendation 3

Countries should assess, monitor and manage species that may be invasive and that directly or indirectly affect plants or plant products, or that are diseases of animals, in accordance with the relevant IPPC and OIE provisions and standards, guidelines and recommendations. Countries should use existing phytosanitary and veterinary border control and quarantine systems and procedures to prevent the introduction of IAS, in line with their obligations under the SPS Agreement, also in order to minimize trade repercussions.

110. The CBD urges its parties and other governments to develop policies, legislation and institutions to address the threats posed by IAS. In most countries responsibilities for IAS are attributed to environmental authorities, while SPS-related functions are usually handled under trade and/or agricultural authorities. Given this fragmentation of responsibilities, it is essential that national activities concerning IAS, plant pests and animal diseases are coordinated

at a national level to avoid duplication and overlap. This is all the more important since the capacity to address IAS-relevant obligations overlaps significantly with the capacity required to address obligations under the IPPC, the OIE and the SPS Agreement.

111. After their introduction, the prevention of the establishment and spread of IAS, as well as their resulting impacts, requires a cross-disciplinary and coordinated approach that takes into account the use of existing SPS capacity. Early involvement and participation of all relevant stakeholders, including industry, research and academia, civil society, and local communities, in policy and strategy development is essential in establishing broad-based support for IAS management efforts at different levels. The creation of public-private partnerships should be stimulated to share knowledge and disseminate information, promote innovative approaches, mobilize resources and/or address particular IAS challenges. Experiences in other areas have shown that such partnerships can be very useful in increasing understanding about different roles and responsibilities, creating a culture of "shared responsibility", and enhancing dialogue among different public and private sector stakeholders.

Recommendation 4

National environmental, animal health and plant health authorities and other relevant stakeholders, as appropriate, should be engaged in policy and strategy formulation related to IAS at an early stage. Activities should be coordinated in a manner that creates coherence and efficiencies and that increases the use and effectiveness of existing SPS regulatory frameworks and institutions to address the control and management IAS. Public-private partnerships should be promoted.

112. Improving the SPS capacity of developing countries will improve their capacity to prevent the introduction, establishment and spread of IAS, as well as their control and/or management. Some countries lack adequate legal frameworks and/or have limited diagnostic capacities, which, along with overlaps and gaps in the organizational set-up of SPS authorities and lack of resources, means that they are less able to handle IAS incursions , which harms their environments and economies disproportionately. Strengthening the SPS capacity of developing countries, whether using public, private and/or donor resources, has the dual benefit of protecting their environment and enhancing their participation in international trade. Developing, supporting and sustaining capacity to address SPS obligations, standards, guidelines and recommendations should be at the core of national IAS strategies.

113. The starting point for any intervention is the application of a proper needs analysis. The PCE tool of the IPPC and the OIE PVS Tool are effective instruments to identify strengths and gaps in existing and planned national phytosanitary, veterinary and aquatic health systems, and prioritise investment to address the identified gaps and needs. Developing countries are encouraged to apply the PCE and PVS Tool in a setting that includes SPS, environmental and trade agencies, private sector stakeholders and academia. National plans developed through the PCE and PVS Tool should be used as the basis for further SPS capacity enhancement by national authorities and/or donors providing technical cooperation.

114. As part of understanding the needs and possible responses, governments should take into account the costs and benefits of proposed interventions to be able to establish priorities across different capacity building options and to allocate resources efficiently. Studies on the economic costs and benefits of prevention versus control, and on returns on investment, can provide compelling evidence in support of proposed capacity building interventions, further support awareness raising efforts and help in generating high-level support for managing the risks associated with IAS.

115. In many cases, incursions and introductions of IAS are not limited to the territory of one country. Biological organisms spread according to favourable ecological and climatic conditions and not according to geopolitical considerations. Eradication measures for IAS incursions or introductions are often not limited to the authority of one country, but concern several countries in the endangered area. As illustrated by the case studies on water hyacinth and cactus moth, cooperation among countries is essential in carrying out large and major eradication campaigns. Regional approaches and networks may also have further benefits in terms of sharing experiences and resources.

Recommendation 5

Strengthening the SPS capacity of developing countries has the dual benefit of protecting their environment and enhancing their participation in international trade. Countries are encouraged to apply the PCE and PVS Tool as the basis for further SPS capacity enhancement using public, private and/or donor resources. Countries are also encouraged to use the results of economic analysis to justify financing for preventing and/or controlling specific IAS and generate high-level support, and to pursue regional approaches in prevention and control.

116. Finally, given the relevance of IPPC and OIE standards, guidelines and recommendations to assess, manage and control IAS, participation by countries in the international standard setting process in the IPPC and the OIE is all the more important. The SPS Agreement encourages countries to play a full part, within the limits of their resources, in the IPPC and the OIE to promote the development and periodic review of standards, guidelines and recommendations with respect to all aspects of SPS measures. Developing countries in particular often lack the resources, expertise and scientific information to participate effectively in the international standard setting process. Increasing their capacity to participate would ensure that their specific concerns can be taken into account and reflected in the relevant standards, guidelines and recommendations. Enhanced "ownership" of the standards, guidelines and recommendations will in turn facilitate their implementation.

Recommendation 6

Countries should participate effectively in the standard setting process of the IPPC and the OIE, and in the work of the SPS Committee, within the limits of their resources. Where appropriate, donors should consider the provision of additional support to increase the capacity of developing countries in this regard.

Annex 1: Relevant international conventions / agreements

Convention/agreement	Relevance to IAS
Cartagena Protocol on Biosafety of CBD www.cbd.int	The Cartagena Protocol on Biosafety to the CBD addresses transboundary movements of living modified organisms that may have adverse effects on biological diversity. The Protocol on Biosafety is an international agreement which aims to ensure the safe handling, transport and use of living modified organisms (LMOs) resulting from modern biotechnology that may have adverse effects on biological diversity.
Convention on the conservation of European wildlife and natural habitats (Bern Convention) www.coe.int/	The Bern Convention is a binding international legal instrument in the field of nature conservation which covers most of Europe and some states of Africa. It entered into force on 1 June 1982, and is particularly concerned about protecting natural habitats and endangered species, including migratory species. The European Strategy on Invasive Alien Species was adopted under the Bern Convention in 2003. The Strategy offers advice on measures to prevent unwanted introductions and tackle IAS.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) www.cites.org	The Convention on International Trade in Endangered Species of Wild Fauna and Flora aims to ensure that international trade in wild animals does not threaten their survival. 175 Member States adhere to the agreement. The Conference of the Parties14 recommends that Parties consider the problems of invasive species when developing national legislation and regulations that deal with the trade in live animals or plants; and seek synergies between CITES and CBD. Guiding principles for the prevention, introduction and mitigation of impacts of alien species were developed under CITES.
International Health Regulations (IHR) www.who.int	The International Health Regulations (IHR) are an international legal instrument that is binding on 194 countries. The IHR aim to help prevent and respond to acute public health risks that have the potential to cross borders and threaten people worldwide. Parties to the IHR are required to strengthen their capacities for public health surveillance and response at designated airports, ports and land border crossings both in routine circumstances and when responding to events that may constitute a public health emergency of international concern. These emergencies may include chemical, biological and nuclear hazards, so zoonotic and other pathogens could be considered under the IHR regulations. Likewise, vectors such as mosquitoes can cross the boundaries of their natural habitat carrying major disease-causing pathogens that can result in severe epidemics such as dengue fever or yellow fever.
International Plant Protection Convention (IPPC) www.ippc.int	The International Plant Protection Convention (IPPC) is an international agreement on plant health which aims to protect cultivated and wild plants by preventing the introduction and spread of pests. The IPPC's plant and quarantine rules aim to tackle the problems presented by invasive alien species.
United Nations Convention on the Law of the Sea www.un.org/depts/los/convention_agreements/convention_overview_convention.htm	The United Nations Convention on the Law of the Sea lays down a comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources. It enshrines the notion that all problems of ocean space are closely interrelated and need to be addressed as a whole. The Convention entered into force in accordance on 16 November 1994. Article 196 (1) of the Convention states that: "States shall take all measures necessary to prevent, reduce and control pollution of the marine environment resulting from the use of technologies under their jurisdiction or control, or the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto."
UN Convention on the Law of the Non-Navigable Uses of International Watercourses untreaty.un.org/cod/avl/ha/clnuiw/clnuiw.html	The 1997 Convention on the Law of the Non-Navigable Uses of International Watercourses refers to the introduction of IAS, but it has yet to be fully ratified.

Convention/agreement	Relevance to IAS
Ramsar Convention on Wetlands www.ramsar.org	The Ramsar Convention is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their Wetlands of International Importance and to plan for the "wise use", or sustainable use, of all of the wetlands in their territories. Resolution VIII.18 of the Conference of the Parties to the Ramsar Convention on Wetlands, on invasive species and wetlands, was adopted in 2002 and urges Parties to address wetland issues related to IAS making use of tools and guidance developed by various institutions and under other conventions.
WTO Agreement on the Application of Sanitary and Phytosanitary Measures www.wto.org/english/docs_e/leg_l_e/15-sps.pdf	The Agreement on the Application of Sanitary and Phytosanitary Measures (the "SPS Agreement") entered into force with the establishment of the WTO on 1 January 1995. It concerns the application of food safety and animal and plant health regulations. The SPS Agreement covers all measures whose purpose is to protect human or animal health from food-borne risks; human health from animal- or plant carried diseases; animals and plants from pests or diseases and the territory of a country from damage caused by pests. These disciplines can be applied to the spread of invasive alien species.

Annex 2: Relevant international / regional organizations

Organization	Relevance to IAS
Centre for Agricultural Bioscience International (CABI) www.cabi.org	CABI is a not-for-profit international organization that improves people's lives by providing information and applying scientific expertise to solve problems in agriculture and the environment. CABI has developed the crop protection compendium that is widely used as a scientific phytosanitary resource and is developing the Invasive Species Compendium, an encyclopaedic resource concerning IAS. CABI also engages in capacity building activities.
Food and Agriculture Organization of the United Nations (FAO) www.fao.org	FAO implements a wide range of capacity development activities related to IAS in several areas and sectors, including animal health and production, plant health and production, fisheries, etc. Most of FAO's work on IAS is undertaken within the framework of the IPPC. One exception is some recent work on IAS in the area of forestry (e.g. working paper on IAS within a forestry context, *Alien Invasive Species: Impacts on Forests and Forestry*[28]. In the area of fisheries and aquaculture, FAO, in collaboration with other partners, has developed various frameworks, codes of practice and guidelines, including the following: - The Code of Conduct for Responsible Fisheries (CCRF) (1995)[29] is an overarching international, voluntary, legally non-binding instrument. It "sets out principles and international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity". It also covers the capture, processing and trade of fish and fishery products, fishing operations, aquaculture, fisheries research and the integration of fisheries into coastal area management. The Code provides guidance on the use of non-native species in Aquaculture. Alien aquatic species are not covered by any binding instrument as the FAO only encourages States to apply the Code. - The International Council for the Exploration of the Sea (ICES) Code of Practice[30] on the Introductions and Transfers of Marine Organisms (2004) – voluntary framework - protocols for implementing the CCRF and other international agreements prepared in cooperation with the FAO European Inland Fisheries Advisory Commission (EIFAC).The ICES Code of Practice sets forth recommended procedures and practices to diminish the risks of detrimental effects from the intentional introduction and transfer of marine (including brackish water) organisms. It provides a framework to evaluate new intentional introductions and also recommends procedures for species that are part of current commercial practices to reduce the risk of unwanted introductions, and of the adverse effects that can arise from species movement. - The FAO *Technical Guidelines on the Precautionary Approach to Capture Fisheries and Species Introductions* (1996)[31] includes a section on species introduction, voluntary or accidental (including through ballast water and sediment discharge). The guidelines are aimed at raising awareness about the need for precaution in fisheries, by providing background information on the main issues and implications, and at providing practical guidance on how to apply such precaution. - The FAO Technical Guidelines on Genetic Resource Management in Aquaculture (1998) provides support to sections of the FAO's CCRF on aspects of aquatic genetic resource management in aquaculture as a way to promote sustainable use and conservation of aquatic biodiversity - The FAO/NACA Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals and their associated implementation plan, the Beijing Consensus and Implementation Strategy (BCIS) (2000) provide expert guidance for national and regional efforts in reducing the risks of disease due to trans-boundary movement of live aquatic animals.

28 http://www.fao.org/docrep/008/j6854e/j6854e00.htm
29 ftp://ftp.fao.org/docrep/fao/005/v9878e/v9878e00.pdf
30 http://www.fao.org/fishery/topic/14782/en
31 http://www.fao.org/docrep/003/W3592E/W3592E00.HTM

Organization	Relevance to IAS
Global Environment Facility (GEF) www.thegef.org	The GEF was established as the financial mechanism of the CBD and the United Nations Framework Convention on Climate Change (UNFCC), the United Nations Convention to Combat Desertification (UNCCD) and Stockholm conventions. Today the GEF is the largest public funder of projects to improve the global environment. An independently operating financial organization, the GEF provides grants for projects related to biodiversity (including IAS), climate change, international waters, land degradation, the ozone layer, and persistent organic pollutants. Within the current biodiversity strategy (GEF-5), GEF support is focused on implementing invasive alien species management frameworks (objective 2). GEF supports interventions allowing the development of sectoral policy, regulations, and institutional arrangements for preventing and managing invasions that emphasize a risk management approach. Priority is given to establishing policy measures that reduce the impact of invasive species on the environment, including by preventing new incursions, establishing early detection and devising institutional frameworks to respond rapidly to new incursions.
International Atomic Energy Agency (IAEA) www.iaea.org/	The Joint FAO/IAEA Programme on Nuclear Techniques in Food and Agriculture undertakes specific activities with regard to pests/IAS. Through its work on the application of the sterile insect technique (irradiation of male insects to render them infertile) it contributes to eradication efforts of countries, especially in relation to fruit flies. IAEA also contributed assistance to eradicate the cactus moth from Mexico. The joint FAO/IAEA joint programme also cooperates with the IPPC in the development of standards on fruit flies and the development of irradiation treatments.
International Civil Aviation Organization (ICAO) www.icao.int	A specialized agency of the UN, the International Civil Aviation Organization (ICAO) was created in 1944 to promote the safe and orderly development of international civil aviation throughout the world. It sets standards and regulations necessary for aviation safety, security, efficiency and regularity, as well as for aviation environmental protection. A 2007 Resolution by the ICAO "urges all Contracting States to support one another's efforts to reduce the risk of introducing, through civil air transportation, potentially IAS to areas outside their natural range".
International Maritime Organization (IMO) www.imo.org	The International Maritime Organization is the UN specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships. In 2004, IMO adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments, which aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments. It does not consider the role of hull fouling organisms in moving invasive animals.
International Union for the Conservation of Nature and Natural Resources (IUCN) www.iucn.org www.issg.org	The IUCN is the world's oldest and largest global environmental organization. Its mission is "to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable". IUCN has more than 1,200 member organizations, including more than 200 government and 900 NGOs. IUCN has taken a leadership role on IAS, working to build knowledge, capacity and partnerships through various voluntary mechanisms. Under the auspices of the IUCN the Invasive Species Specialist Group (ISSG) operates as a global network of scientific and policy experts on invasive species. The ISSG aims to reduce threats to natural ecosystems and the native species they contain by increasing awareness of IAS and of ways to prevent, control or eradicate them. It does that primarily through providing technical and policy advice, information exchange and networking. The Global Invasive Species Database is one of the main sources of information on IAS.

Organization	Relevance to IAS
Regional Plant Protection Organization (RPPO) www.ippc.int/partners/regional-plant-protection-organizations	A Regional Plant Protection Organization (RPPO) is an inter-governmental organization that functions as a coordinating body for National Plant Protection Organizations (NPPO) at the regional level. Not all contracting parties to the IPPC are members of RPPOs, nor are all members of RPPOs contracting parties to the IPPC. Certain contracting parties to the IPPC belong to more than one RPPO. There are currently 10 RPPOs. The functions of RPPOs are laid down in the Article IX of the IPPC. These include coordination and participation in activities among their NPPOs in order to promote and achieve the objectives of the IPPC; cooperation among regions for promoting harmonized phytosanitary measures; gathering and dissemination of information, in particular in relation with the IPPC and cooperation with the CPM and the IPPC Secretariat in developing and implementing international standards for phytosanitary measures.
United Nations Development Programme (UNDP) www.undp.org	UNDP strengthens national capacity to manage the environment in a sustainable manner to advance poverty reduction efforts. Through country teams in 135 developing countries, the programme helps partners to build their capacity to integrate environmental considerations into development plans and strategies, UNDP serves as one of the implementation agencies for the GEF (see also example on GEF IAS project in Cuba).
United Nations Environmental Programme (UNEP) www.unep.org/	UNEP is the designated authority of the United Nations system on environmental issues at the global and regional level. Its mandate is to coordinate the development of environmental policy consensus by keeping the global environment under review and bringing emerging issues to the attention of governments and the international community for action. UNEP maintains an extensive on-line library concerning IAS.
World Bank www.worldbank.org	The World Bank has increased capacity building activities over recent years in the SPS area, which also include IAS. In most countries, however, SPS components are usually integral parts of lending projects and programmes for export promotion, diversification, upgrading institutions for inspection, certification, containment of plant pests and animal diseases. For example, a WB project in Bosnia and Herzegovina includes considerable investments for improving the phytosanitary and veterinary infrastructure which would also improve the countries' ability to prevent the introduction of IAS. Besides the activities in the SPS field, the WB is also active in environmental and biodiversity preservation. As an implementation agency for GEF projects, it is involved in capacity building activities concerning IAS. For example, in South Africa one of the components of the C.A.P.E. programme (Cape Action for People and the Environment) funded from 2004-2009 by the GEF through the World Bank related to IAS. This project, amongst others, focuses on the development of an IAS strategy for the Cape region and to survey for IAS in that region.
World Organisation for Animal Health (OIE) www.oie.int	The need to fight animal diseases at global level led to the creation of the Office International des Epizooties through the international Agreement signed on January 25th 1924. In May 2003 the Office became the World Organisation for Animal Health but kept its historical acronym OIE. The OIE is the intergovernmental organisation responsible for improving animal health worldwide. It is recognised as a reference organisation by the WTO and in 2013 had a total of 178 Member Countries. The OIE maintains permanent relations with 45 other international and regional organizations and has regional and sub-regional offices on every continent.

Annex 3: Examples of relevant online resources (including databases, web sites, guidelines, training kits, etc.)

Resource	Web link
Aquatic Nuisance Species Handbook for Government Officials (USA)	http://www.michigan.gov/documents/deq/deq-water-greatlakes-aquatics-government-handbook_249291_7.pdf
ASEAN Centre for Biodiversity	http://www.aseanbiodiversity.org
Baltic Sea Alien Species Database	http://www.corpi.ku.lt/nemo/mainnemo.html
Biosecurity New Zealand	http://www.biosecurity.govt.nz/
Bras D'Or Lakes Collaborative Environmental Planning Initiative (Canada)	http://brasdorcepi.ca/projects/invasive-species/
Brazilian Invasive Species database	http://www.institutohorus.org.br/index.php?tipoLingua=ingles
CABI Invasive species compendium	http://www.cabi.org/isc/
CIESM Atlas of Exotic Species in the Mediterranean	http://www.ciesm.org/online/atlas/index.htm
CITES Global Strategy on Invasive Alien Species	http://www.cites.org/common/com/AC/16/E16-Inf-12.pdf
Decision Support tool for the Management of Freshwater Fish Incursions (Australia and New Zealand)	http://www.feral.org.au/dss/
Delivery Alien Invasive Species Information in Europe (DAISIE)	http://www.europe-aliens.org/aboutDAISIE.do
Guidelines for the management of invasive alien plants or potentially invasive alien plants which are intended for import or have been intentionally imported - EPPO	http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2338.2006.01031.x/full
European Commission Alien Invasive Species Webpage	http://ec.europa.eu/environment/nature/invasivealien/index_en.htm
European Strategy on Invasive Alien Species	http://www.ec.gc.ca/eee-ias/78D62AA2-55A4-4E2F-AA08-538E1051A893/European%20strategy%20on%20invasive%20alien%20species.pdf
FAO Database on Introductions of Aquatic Species	http://www.fao.org/fishery/dias/en
GISP Guidelines and toolkits	http://www.issg.org/gisp_guidelines_toolkits.htm
Global Invasive Species Database	http://www.issg.org/database/welcome/

Resource	Web link
Global Invasive Species Information Network	http://www.gisin.org/DH.php?WC=/WS/GISIN/home.html&WebSiteID=4
Global Islands Invasive Vertebrate Eradication Database	http://eradicationsdb.fos.auckland.ac.nz/
ICES Code of Practice on the Introductions and Transfers of Marine Organisms 2003.	http://www.ices.dk/reports/general/2003/Codemarineintroductions2003.pdf
Information on vertebrate pest animal species in Australia and New Zealand	http://www.feral.org.au/
Island Biodiversity and Invasive Species (IBIS) Website	http://ibis.fos.auckland.ac.nz/
Management Guidelines for Invasive Alien Species in Canada's National Parks	http://www.ecospherics.net/AlienSpecnew.htm
Training and Implementation Guide for Pathway Definition, Risk Analysis and Risk Prioritization - ANSTF and NISC	http://anstaskforce.gov/Documents/Pathways_Training_and_Implementation_Guide_Jan_2007.pdf
NOBANIS – European network on Invasive Alien Species	http://www.nobanis.org/About.asp
OIE Guidelines for assessing the risk of non-native animals becoming invasive	http://www.oie.int/fileadmin/Home/eng/Our_scientific_expertise/docs/pdf/OIEGuidelines_NonNativeAnimals_2012.pdf
Pacific Island Ecosystems at Risk project (PIER)	http://www.hear.org/pier/
Plant Quarantine data Retrieval system (PQR) - EPPO database on quarantine pests	http://www.eppo.int/DATABASES/databases.htm
South African National Biodiversity Institute	http://www.sanbi.org/index.php?option=com_content&view=article&id=181&Itemid=106
The Caribbean Invasive Alien Species Network	http://www.greenantilles.com/2011/02/03/caribbean-invasive-alien-species-network/
The Cooperative Islands Initiative	http://www.issg.org/cii/
The Tematea website - UNEP and IUCN	http://www.tematea.org
Tri-national Risk Assessment Guidelines for Aquatic Alien Species (North America) – Commission for Environmental Cooperation	http://www.cec.org/Storage/62/5516_07-64-CEC%20invasives%20risk%20guidelines-full-report_en.pdf

Resource	Web link
United States Department of Agriculture National Invasive Species Information Center	http://www.invasivespeciesinfo.gov/animals/main.shtml
United States Department of Agriculture Invasive Animal Management	http://www.invasivespeciesinfo.gov/animals/control.shtml
United States Geological Survey Nonindigenous Aquatic Species	http://nas.er.usgs.gov/

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