A Guide to Designing Legal and Institutional Frameworks on Alien Invasive Species

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A Guide to Designing Legal and Institutional Frameworks on Alien Invasive Species

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Foreword

The expansion of global trade and transport has allowed modern society to gain greater access to and benefits from the world's biological diversity. As a result, our lives have become enriched through access to and introduction of different varieties of plant and animal species, including non-indigenous or alien species. These species have been used for agriculture, forestry, fishing, ornamental and recreational purposes. Often, however, the introduction to ecosystems of non-indigenous or alien species has carried a heavy price tag, especially in terms of loss of biodiversity and environmental and natural resource damage. As a result, the introduction of alien species has been recognised as one of the most serious threats to our health, and to our ecological, social and economic well-being.

Almost every country is grappling with the problems caused by introduced alien species. Addressing the problem is urgent because the threats increase daily. As just a few examples, Zebra mussels are affecting fisheries and electric power generation in North America, Water hyacinths are choking wetlands and waterways in Africa and China, Brown tree snakes are decimating native bird species on oceanic islands, and Grey squirrels are ousting native Red squirrels in Europe.

The *Guide to Designing Legal and Institutional Frameworks on Alien Invasive Species* seeks to help address this problem. It is a culmination of two years' work by the IUCN Environmental Law Programme, through its Environmental Law Centre and the Commission on Environmental Law. It represents a collaboration with the Global Invasive Species Programme and is the fourth in a series of IUCN publications aimed at supplementing IUCN's *Guide to the Convention on Biological Diversity*. This publication reaffirms IUCN's continuing commitment to assist Parties as they implement the Convention on Biological Diversity.

The goal of this Guide is to provide national law and policy-makers with practical information and guidance for developing or strengthening legal and institutional frameworks on alien invasive species, consistently with Article 8(h) of the Convention on Biological Diversity, as well as pertinent obligations under other international and regional instruments. The Guide focuses on the need for cooperation and coordination between the various sectors and policy-makers in order to effectively address the problem of alien invasions.

The Guide provides a structured framework for dealing with alien invasive species issues. It contains illustrations and practical examples to assist in understanding the impact of alien species introductions. This book complements the work of scientists, ecologists, and economists by demonstrating how laws and institutions can mutually support efforts to control and mitigate the impact of alien invasive species. Each chapter makes an important link between the scientific approaches and legal tools.

Chapter 1 sets alien invasive species in their scientific, ecological, economic, health, and legal context. Chapters 2-3 provide an overview of the current international legal regime that addresses alien species, with particular emphasis on the relationship between relevant measures in international environmental agreements and the international trade regime, drawing together key legal approaches, principles and tools derived from existing international law that should be considered in shaping regional and national frameworks.

Chapters 4-6 discuss and make recommendations for how legal principles, tools, and other elements should be covered in designing national legal measures and procedures to prevent or minimise introduction of alien species and the impact of any introduction. It provides clear indicators for elements that should be covered by regulatory regimes, drawing where appropriate on examples of State practices. Chapter 7 considers the important application of compliance mechanisms to promote accountability and responsibility for alien species introduction. The final chapter provides concluding remarks.

The preparation of this book owes a special debt of gratitude to the late Cyrille de Klemm. It was through his brilliance and dedication, and his work with the Council of Europe in 1996 that the seed for the preparation of this publication was first planted.

The IUCN Environmental Law Programme is very grateful to the Global Invasive Species Programme and the European Commission for their leadership on this important issue and for their generous financial support, without which this project would not have been possible.

Charles Di Leva
Director
IUCN Environmental Law Programme

Editorial Preface

The Global Invasive Species Programme and the Law

The impact of the activities of humans on the Earth is becoming ever more pervasive. Many of these activities are doing harm to the natural and managed ecosystems upon which we depend. In some cases the agents of destruction have been clearly identified and efforts made to mitigate against damage, even at the international level. This was most clearly demonstrated when scientific findings indicated that the stratospheric ozone hole was being depleted by commercial refrigerants. An international protocol called for a reduction in the manufacture of these compounds that was agreed and acted upon by the signatory nations. In this case substitute refrigerants were produced that were environmentally benign.

Most environmental problems are much more complex, with multiple drivers of change, many of which are important to the overall economy of nations, as is the case with the industrial processes that are changing atmospheric composition and subsequently our climate. Then there are those environmental drivers of change, that can be very harmful, and that are truly complex and interwoven among the complex workings of societies. Alien invasive species are just such a global change issue.

Chris Bright in his book "Life Out of Bounds" states that, "Bioinvasion is a deeply unsatisfying policy topic. It is messy, frustrating, depressing, and unpredictable: it does not lend itself to neat solution". This is a rather strong statement and in a sense is the motivation for the Global Invasive Species Programme (GISP). GISP is attempting to bring new approaches and commitment to the invasive species problem. Part of this effort is directed toward developing new tools and capacity within nations as well as globally.

This "Guide to Designing Legal and Institutional Frameworks on Alien Invasive Species" is a very important contribution by the IUCN Environmental Law Centre to the GISP process. It provides abundant examples of the various approaches that have been utilized to deal with alien invasive species from local to global levels. These models will be of great use for the future as we struggle with local problems as well as with building a comprehensive strategy that will help us as we work against the tide of the ever-increasing transport of biological material across borders of all dimensions. This guide will be a template that will be utilized as we all attempt to make what we already have work, as well as in designing new legal and institutional structures that are perhaps more comprehensive and even more effective.

Harold Mooney
Chair
Global Invasive Species Programme

Editorial Note

The *Guide to Designing Legal and Institutional Frameworks on Alien Invasive Species* forms part of a series of legal guides prepared by IUCN to facilitate and strengthen effective implementation of the Convention on Biological Diversity. Three have been published by the IUCN Environmental Law Centre since 1994, dealing with general implementation of the Convention and with implementation of specific provisions.[1]

This Guide aims to provide national policy and lawmakers with practical information and indicators for developing or strengthening legal and institutional frameworks on alien invasive species, consistently with Article 8(h) of the Convention on Biological Diversity (CBD) and other international and regional instruments. Article 8 (h) of the CBD requires Contracting Parties, as far as possible and as appropriate, to "prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats and species."

The Guide also considers the extent to which alien species-related measures may be applicable or relevant to legal frameworks on living modified organisms and biosafety. Article 8(g) of the Convention requires Parties, again as far as possible and as appropriate, to establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking into account the risks to human health. The Cartagena Protocol on Biosafety (adopted in Montreal, January 2000) contains specific requirements on how Parties should implement this provision.

The chapters of the Guide cover the following issues:

Chapter 1 provides an introduction to the scientific context and issues that should be taken into account when developing or strengthening policy and legal measures on alien species. It illustrates the limits of existing scientific understanding with practical examples as well as difficulties related to definitions and use of terms, in order to highlight particular matters that legal review and drafting teams should take into account. It describes why alien invasive species are viewed as a matter of global concern and outlines the potential social, economic, health and ecological impacts.

Chapter 2 gives an overview of existing international obligations and commitments that national policy and lawmakers need to take into account. It shows how alien species introductions are referenced in different thematic areas of international law, with particular reference to the relationship between relevant measures in multilateral environmental agreements and trade-related agreements. This Chapter provides a 'snapshot' of the current international regime as a whole but does not purport to evaluate its effectiveness or to make recommendations on how it should be developed in the future.

Chapter 3 draws together key legal frameworks, approaches and tools derived from existing international law that should be used to shape regional and national legal and institutional frameworks. Some of these are familiar from other areas of environmental law (e.g. public participation and access to information), whilst others are specific to management of environmental risk (precaution, risk analysis and EIA).

Chapter 4 discusses structural considerations for national frameworks. It looks at common problems and provides indicators for the types of laws and institutions that may be best suited to overcoming such difficulties. Specific sections address objectives and scope of legislation, the complex issue of legal definitions, and the importance of a knowledge base for effective operation of regulatory controls on alien species.

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[1] *A Guide to the Convention on Biological Diversity* (1994); *A Guide to Undertaking Biodiversity Legal and Institutional Profiles* (1998); and *A Guide to Designing Legal Frameworks to Determine Access to Genetic Resources* (1998).

Chapters 5 and 6 respectively describe legal measures and procedures that can be used to prevent or minimise unwanted introductions and for remedial action where introduced species become invasive. They provide clear indicators for elements that should be covered by regulatory regimes, drawing where appropriate on examples of State practice.

Chapter 7 discusses issues associated with developing measures to enhance compliance and promote accountability. It considers the application of conventional criminal responsibility and civil liability to unlawful or harmful conduct involving alien invasive species and the emerging role of other compliance mechanisms.

Lastly, **Chapter 8** provides concluding remarks.

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Many experts participating in the Global Invasive Species Programme (GISP), coordinated by the Scientific Committee on Problems of the Environment (SCOPE) in conjunction with CABI Bioscience, the United Nations Environment Programme (UNEP), IUCN-The World Conservation Union, and DIVERSITAS, have provided ongoing advice and been ready to help with specific queries, big or small. Special thanks go to Harold Mooney (GISP Chair), Laurie Neville (GISP Coordinator), Veronique Plocq Fichelet (SCOPE) and Maj de Poorter (IUCN Invasive Species Specialist Group) for sharing their experience and providing sustained enthusiasm, commitment, moral support and assistance for this project. Thanks also to Mick Clout, Jamie Reaser, Richard Mack, Jeff McNeely, Peter Schei, Simon Stuart, and Jeff Waage.

Many of the above kindly made time to review and comment on various drafts of this Guide, as did Stefan Olsson (European Commission), Gretchen Stanton (World Trade Organization), Niek van der Graff and Robert Griffin (Food and Agriculture Organization of the United Nations). We greatly appreciate their detailed and thoughtful remarks. All their comments, suggestions and criticisms have been taken into account, but the opinions expressed are our own and full responsibility for any errors and omissions lies with us.

We would also like to thank colleagues from the IUCN Commission on Environmental Law for taking the time to respond to questions, review and provide comments. Prof. Charles Okidi and Louise de La Fayette deserve special thanks.

Jil Self has done a heroic job of editing and boosting morale. The library staff of the IUCN Environmental Law Centre, Anni Lukács, Raymond Narine and Alexandra Zimmerman, deserve hearty thanks for their detective work on international instruments, national legislation and relevant articles. Alexandra Maury, IUCN Legal Intern, has helped us tremendously to carefully research and edit the legal instruments referenced in the Guide.

Lastly, we would like to thank Charles Di Leva (Director, IUCN Environmental Law Programme) and Françoise Burhenne-Guilmin (Senior Counsel, IUCN Environmental Law Programme) for their support, practical advice and patience during the preparation of this Guide.

Clare Shine
Nattley Williams
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Bonn, August 2000

1.0 Introduction

Complex scientific, social, health and economic issues need to be taken into account when developing or strengthening legal frameworks to address unwanted introductions of alien species.

Legally-backed approaches to alien invasive species are designed to respond to problems identified and documented by sectors of the scientific community over decades. A range of concepts and terms to analyse the issues and risks associated with species introductions and invasive processes has evolved, although these are not always used in the same way or consistently by scientists in different disciplines. More recently, economists and other specialists have brought their own analytical tools and vocabulary into this domain.

Law, for its part, seeks to establish objective principles, rules and criteria to regulate rights, responsibilities and conduct of individuals, communities, commercial interests, governments and administrative agencies. It is used to implement policy objectives approved at international, regional, national or sub-national level and should operate fairly and consistently to promote legal certainty.

Lawmakers face particular challenges in developing effective frameworks and consistent practices on alien species, given the rapidly-evolving body of scientific knowledge, the inherent risk or uncertainty that characterises many actions involving alien species and the economic and social importance attached to alien species in several sectors.

Chapter 1 outlines issues that should inform the development of regulatory regimes.

1.1 Scientific Considerations for Legislation

1.1.1 What is an Alien Species?

Many different words are used to describe species occurring in ecosystems to which they are not indigenous. These include “non-indigenous”, “non-native”, “exotic”, “foreign”, “new”, “pest” and “alien”. This Guide uses the term “alien” consistently to encompass all terms listed above.

The Convention on Biological Diversity (CBD) (Nairobi, 1992) uses the term “alien” (Article 8(h)) but without defining it. A possible working definition, contained in the *Interim Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species*, developed under the framework of the CBD Subsidiary Body on Scientific, Technical and Technological Advice (see 2.2.1.1 below), is as follows:

> **Alien Species: a species occurring outside its normal distribution.**

This concise definition needs some clarification. In biological terms, a species is considered to be **native** in its past or present natural range (the habitats and ecosystems where it lives or lived) or within its natural dispersal potential (the area it can reach using its own legs, wings or wind/water-borne dispersal systems, even if it is seldom found there).

Where members of a species occur outside their “normal distribution”, they are considered to be **alien** in this new location. Because the species cannot reach this location by its own means, human agency of some kind is involved in moving or introducing the species concerned (see 1.2 below). The key factor is that it enables the species or organism to cross some kind of biogeographical barrier that would – ecologically speaking – block its path.

The concept of “normal distribution” is a critical element for any scientific definition of alien species. However, this apparently precise wording may be poorly-suited to legislative definition as in many cases it will not be objectively verifiable for a given species (see further 4.5.2 below).

Another issue for consideration is that the concept of “normal distribution” corresponds to ecological boundaries linked to species’ range. These natural boundaries are quite distinct from the artificial political boundaries between countries and between sub-national units (regions, provinces, cantons, *Länder*). Because nearly all lawmaking follows these jurisdictional boundaries, it is important to find ways to integrate these ecological parameters into conventional legislative and administrative structures (see Chapter 5 below).

The scope of the term “species” also needs to be further developed. Recent IUCN Guidelines on Biological Invasions recommend that it should be interpreted to include subspecies and lower taxa, as well as any part, gametes, seeds, eggs or propagule of such species that might survive and subsequently reproduce (IUCN, 2000). The reason for this broad approach is that damage may be generated even from lower taxonomic units of the same species that are

introduced to places where they were not formerly present. Introduction of alien subspecies or populations can have devastating environmental impacts, including loss of adapted genes or gene complexes or outbreeding depression, which can result in local extinction (see Box 1).

Box 1: Tatra Mountain Ibex

When the Tatra mountain ibex (*Capra ibex ibex*) in Slovakia became extinct through overhunting, ibex were successfully introduced from nearby Austria. Later additions to the Tatra herd of bezoars (*C. ibex aegagrus*) from Turkey and of Nubian ibex (*C. ibex nubiana*) from Sinai resulted in hybrids which gave birth to young during the middle of winter when no young could survive, and the population went extinct. This outbreeding depression was presumably caused by different climatic adaptations in the donor and recipient populations (Templeton, 1996).

1.1.2 What is an Alien Invasive Species?

The term "invasive" also has no standard definition. It is interpreted in varying ways and sometimes used interchangeably with well-established terms like "pest" or "weed" that can apply to native as well as alien species. The common denominator of such terms is often the concept of adverse impact, in the form of damage inflicted on the receiving species, site or ecosystem. The CBD adopts the following definition:

> **Alien Invasive Species: an alien species which threatens ecosystems, habitats or species (Article 2).**

This broad definition potentially covers two categories of alien species.

The first, which corresponds more closely to the popular understanding of invasiveness, includes alien species that escape from human control, go beyond the intended physical boundaries and cause environmental damage. Invasion processes of this kind present particular challenges to regulatory regimes, which are currently often unmet.

The second covers alien species that remain under human control but damage native ecosystems (e.g. alien tree species in monoculture plantations that poison groundwater by releasing resins that do not normally occur). Such damage is linked to species being alien, but not to invasiveness. Problems of this type can usually be addressed through conventional land-use and environmental management regulations or incentives.

For the purposes of this Guide, "invasive" is interpreted consistently with the first category mentioned above, to exclude those alien species that generate threats to ecosystems, habitats or species but remain under human control and do not become established. A working definition to this effect could be:

> **"Invasive species means an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity" (IUCN, 2000).**

Alien invasive species are agreed to be a subset of alien species as a whole, as many introduced alien species do not go on to become invasive. However, there is uncertainty and much debate about the point at which an alien species may be termed "invasive". The following paragraphs try to describe the sequence of events from introduction to actual invasion in a simplified way:

- **Introduction** means, in scientific terms, that the alien species, subspecies or lower taxon has been transported by humans across a major geographic barrier (such introductions within a country are also referred to as translocations). From a legal point of view, this term obviously requires further definition (see 4.5.5 below).
- An **unintentionally introduced** alien species, or an intentionally introduced alien species that spreads beyond the area of human control, may die out within a short time, establish itself for a time and then die out, or remain in the area(s) in which it was first introduced without disrupting local biota or ecosystems. **Naturalisation** may be said to begin when abiotic and biotic barriers to survival are surmounted and when various barriers to regular reproduction are overcome (see generally Richardson *et al.*, 2000).
- **Invasion** may be said to occur when alien species not only persist but proliferate and spread

beyond defined limits. This can happen in different ways: an alien species may find a vacant niche and spread (possibly after remaining non-invasive for decades), or may compete for a niche already occupied by a native species. The state of the receiving ecosystem influences the likelihood of successful invasion (see below).

The fundamental problem, for scientists, lawyers and other experts, is that it is extremely difficult to predict accurately which introduced alien species will have benign effects and which may become invasive in a new habitat, removed from the biotic and abiotic factors that tended to regulate population growth.

Time factors make prediction even harder. While some alien species show their invasiveness quickly, others may have a long 'lag' period. Invasiveness may then be triggered by diverse events. Environmental lags may be ended by habitat alteration or the arrival of another alien species and interactions with it. In New Zealand, for example, the accidental arrival of a pollinating wasp from Australia triggered seed setting by the alien Morton Bay fig tree (the rate went from 0% to 100%). Genetic lags due to relative lack of fitness of the alien species in the novel environment can sometimes be overcome by additional genetic material from subsequent arrivals (Crooks and Soulé, 1999).

Although there are no settled criteria for the minimum damage, spread or size of population needed for a species to be considered invasive, it is clear that a very small number of individuals, representing a small fraction of the species' genetic variation in its native range, can be enough to generate massive environmental damage (see 1.5 below). For this reason, every alien species needs to be treated for management purposes as potentially invasive, unless and until there is reasonable indication that this is not so. This is why the precautionary principle/approach, based on scientific evidence, should underpin all preventive legal frameworks (see section 3.2.2 below).

Legal frameworks need to take account of the particular vulnerability of certain ecosystems to invasion. Geographically or evolutionarily isolated ecosystems, such as oceanic islands, certain mountains and lakes, and the Antarctic, are often characterised by endemic species and high levels of biological diversity. The evolutionary processes associated with isolation over millions of years make such species especially vulnerable to competitors, predators, pathogens and parasites from other areas.

At the other end of the spectrum, degraded and stressed areas also appear to be at high risk. These include urban-industrial areas, habitats suffering from periodic disturbance or undergoing succession, harbours, lagoons, estuaries and the fringes of water bodies, where the effects of natural and anthropogenic disturbances are often linked (Kowarik, 1999). Inland water systems subject to thermal pollution from industrial or energy generation activities may be more vulnerable to invasion by warm water species, whether introduced intentionally or unintentionally.

Factors contributing directly to such degradation include land clearance, intensive exploitation and pollution. Many alien invasives are 'colonising' species that benefit from the reduced competition that follows habitat degradation. Global climate change is also a significant factor assisting the spread and establishment of alien invasive species. For example, increased temperatures may enable alien, disease-carrying mosquitoes to extend their range (Mooney and Hofgaard, 1999).

For legal purposes, the concept of "invasive" (like that of "alien", see 1.1.1 above) must be treated independently of sectoral or jurisdictional boundaries. An alien species that becomes invasive will not necessarily stay within the spatial or political unit into which it was introduced. This means that prohibitions on introducing alien species into protected areas and habitats, though important and possibly adequate in certain cases, should only form one component of prevention and control regimes. Secondly, because vulnerable ecosystems may straddle political boundaries, legal frameworks must provide a basis for transboundary cooperation and, where possible, harmonised prevention/mitigation measures (see 3.1.2 below).

1.1.3 Comparison with Native Invasive Species

Most ecologists probably equate biological invasions with the dynamics of alien species, rather than the colonisation of coastal dunes, abandoned pastures or other ecosystems by native species (Mooney, 1998). However, indigenous species, including pests, can also become invasive.

"Native invasives" (or "local invasives") are species that get into modified habitats by their own means and then go through population explosions, often resulting in great economic damage to crops or other components of biological diversity. Mismanagement of land or other resources may often be the proximate cause for such invasions. Disturbance, land conversion or eradication of natural predators may trigger quite different behaviour by a formerly harmless 'resident' – such as small rodents, lagomorphs and locusts in certain parts of Africa.

Global and domestic trading systems may contribute to these trends, to the extent that they encourage land clearance for monoculture cultivation of cash crops and thus reduce the resilience of the ecosystem in question as well as native biodiversity.

From a legal point of view, the activities generating native invasions tend to be different from those for alien invasions and require different types of prevention and management measures. However, there may be greater similarities at the eradication and control stage as "successful alien species often behave very much like native colonisers" (Thompson *et al.*, 1995).

This Guide only considers alien invasive species, consistently with the scope of Article 8(h) of the Convention on Biological Diversity. However, several of the components discussed below are also relevant to the design of legal systems to address native invasive species.

1.1.4 Comparison with Living Modified Organisms

Living modified organisms (LMOs), including genetically modified organisms (GMOs), may be considered in certain respects as a subset of alien species, as outlined below.

Organisms in this category are organisms in which the genetic material has been altered in a way that does not occur naturally by mating or recombination. Recombinant DNA technology makes it possible to transfer genetic material through biochemical means and thus to genetically modify plants, animals and micro-organisms. Modern biotechnology therefore makes it possible to introduce a greater diversity of genes into living organisms than traditional methods of breeding and selection and to obtain a novel combination of genetic material (see the discussion of the Cartagena Protocol on Biosafety, 2.3 below).

LMOs are by definition "alien" insofar as they have no normal distribution and occur nowhere in the natural environment until released. As with alien species that become invasive, it is possible that the release or escape of transgenic, recombinant or novel DNA might have severe and irreversible effects on environmental safety. On the other hand, like many intentionally introduced alien species, LMOs may have the potential to deliver economic and food security benefits.

For these reasons, a regulatory framework to control the testing, movement and release of LMOs may have many points of similarity with measures to regulate introductions of alien species (Schembri and Lafranco, 1996). Some countries already regulate genetically modified organisms under the same unitary legislation that is used to control alien species introductions (see 4.5.3 below).

It is beyond the scope of this Guide to focus specifically on the complex subject of biosafety.[1] However, the following chapters indicate certain ways in which measures to prevent and mitigate adverse impacts from alien species may be applied or adapted to LMOs.

1.2 Processes and Activities That May Generate Alien Species Invasions

The introduction of plant and animal species beyond their natural range is closely linked to the history of civilisation (Kowarik, 1999). Colonisation, in particular, led to massive transoceanic movements and exposed ecological systems, as well as indigenous communities, to quite new stresses and threats.

In the modern era of globalisation, the 'four Ts' – Trade, Transport, Travel and Tourism – have sharply accelerated the rate of species' movements. Newer, faster and safer methods of transport provide vectors for far more live plants, animals and biological material to be introduced across former barriers. Global markets support the increased flow not only of investment money but also of goods.

In the vast majority of cases, establishment of alien species that may become invasive is generated by three categories of activities with legitimate economic or other objectives (adapted from Veitch, 1999). Legal frameworks therefore need to be designed to cover the following:

- intentional introductions, for use in biological production systems (such as agriculture, forestry, fisheries), landscaping and for recreational and ornamental purposes;
- intentional introductions for use in containment or captivity (zoos, aquaculture, mariculture, aquaria, horticulture, the pet trade, etc.), from which there is a known risk of escape or release to the wild;
- unintentional introductions of species, organisms or pathogens through pathways involving transport, trade, travel or tourism.

[1] A specific guide to the implementation of the 2000 Biosafety Protocol will be published by the IUCN Environmental Law Centre as part of this series in 2001.

1.2.1 Intentional Introductions

Many economies depend heavily on alien species introduced over centuries for agriculture and other biological production systems.

The introduction of cows and other livestock to Australia, Argentina and north-western America is well-known (less so the fact that dung beetles often had to be introduced to process the dung of the introduced ungulates). These introductions led to massive changes in the species composition of temperate grasslands and, in many cases, to the destruction of native plant communities.

In certain countries, modern agricultural production relies increasingly on crops that have been genetically modified for greater productivity, nutritional value or resistance to pests, including tomatoes, grains, cassava, corn and soybeans. Genetically modified soya beans accounted for about half of the soya crop in the United States and Argentina, three years after their launch.[2]

Alien species are also intentionally introduced for **biological control** of species that have become invasive. Alien biological control agents are used to maintain or restore the health particularly of economically important species by preying on or infecting alien pests, parasites and disease agents. A control species is intentionally introduced into the ecosystem concerned in order to control and/or eradicate the alien invasive species. Ideally, the control species will prey only on the target species. However, in some cases alien biological control agents may have adverse impacts on the ecosystem and native species and even become invasive themselves. There are many documented cases in which the control species is known to have preyed on non-target species and even been an agent of extinction to native plants or animals (see Box 2). Use of biological control agents as part of an eradication or control strategy therefore needs to be subject to stringent legal controls (see 2.4.4 below).

Box 2: Cane Toad and Other Biological Control Agents

In Australia, the Cane toad (*Bufo marinus*) was introduced to control insects in canefields. The toad became a voracious predator of native insects, lizards, snakes and small mammals and threatened valuable predators due to its poisonous skin secretions. In New Zealand, an open-ended chain of problems was triggered by attempts to control invaders with other invaders. Three years after rabbits were introduced in 1864, weasels, stoats and ferrets were introduced to keep their population down, but they instead turned on native birds and young tuatara (Tortell, 1996).

Alien tree species are used widely for **commercial forestry** and also for **erosion control, and reforestation**. Many countries are experiencing great problems with alien species of Eucalyptus (*Melaleuca quinquenervia*), which can be particularly harmful in ecological terms because its leaf litter contains chemical exudates and prevents other species from growing. Tamarisk (salt cedar) was introduced from Central Asia to the southwest United States nearly two centuries ago to control erosion along river banks. The tree now forms dense thickets on more than a million acres of riparian habitat, which have little value for most native animals and are estimated to absorb more water each year than all the cities of southern California (Corn, *et al.*, 1999).

Fish are introduced into aquatic ecosystems for **commercial or sport fishing** to augment wild populations. In South Africa, 41 species of alien fish had naturalised by 1988 following introductions for aquaculture, sport fishing, biological control of mosquitoes and algae, or translocations to stock artificial lakes and reinforce populations of rare species (de Moor & Bruton, 1988).

Introductions for **ornamental purposes** are often reinforced by consumer demand for novelty. European colonisers often established acclimatisation societies to introduce familiar animals and plants. Some of these purposes were quixotic: starlings were apparently introduced to the United States in a drive to introduce all species of birds mentioned by Shakespeare! (Corn, 1999). Over 70% of New Zealand's invasive weeds were intentionally introduced as ornamental plants. Around Auckland, over 615 introduced plant species are known to have naturalised – a figure unmatched by any other city in the world – and four new species naturalise there each year (Christensen, 1999).

Alien plants are regularly used in **landscaping projects**, associated with tourist development (for example, around Mediterranean beaches) or infrastructure construction and site rehabilitation.

[2] *The Economist*, 31 July 1999.

1.2.2 Intentional Introductions for Contained Use

Alien species or organisms are routinely introduced to be kept in captivity or cultivated for commercial, scientific or ornamental purposes. Once they have been admitted to a new country or region, there is no such thing as a zero risk of escape or release. A colourful example of a 'fugitive' species concerns the snake *Natrid natrix persa*, which escaped from an Italian circus in Malta. In England, amphibious alien crayfish are known to have escaped from fishmongers' stalls and established themselves in London's channels and ponds (de Klemm, 1996).

The nature and type of risk varies according to the category of species. Alien flora introduced to botanical gardens may have a real heritage value (the *flore castrale* of France, the *Stinzenflora* of the Netherlands), but can bring its own set of problems as seeds are dispersed. Certain introduced taxa may be cultivars that have crossed with indigenous or archaeophytic populations or even with close native species, creating the risk of widespread hybridogenic populations such as those formed by *Hyacinthoides nonscripta* and *H.hispanica* in the Netherlands (Lambinon 1997).

The risks associated with escapes from **aquaculture and mariculture facilities** are well known. In Norway, the Atlantic salmon *(Salmo salar)* was eliminated from many rivers after the introduction of the Baltic salmon for aquaculture.

Alien animals have also been introduced for **fur production** (see Box 3).

Box 3: Fur Production

After the semi-aquatic Nutria was introduced from South America to the United States in 1899, the fur industry failed and surplus animals were released. The species has established itself in at least 22 states, has no natural enemies and has severely damaged marsh vegetation, thus reducing critical habitat for waterbirds and nursery and spawning areas for shrimp, crabs, oysters and many fish species.

Brushtail possums (*Trichosorus vulpeca*) were deliberately introduced into New Zealand between 1855 and 1900 to establish a fur trade. By 1940 they were recognised as pests because of the damage to crops and native forests. Key impacts include damage to native forest and reduction of fruit-crops of native plants (and hence food sources for native birds). There is also competition for hollows with hole nesting species of native birds, such as kiwi, and predation on eggs and chicks of other rare species. Economic impacts include the transmission of bovine tuberculosis by possums to cattle and deer. Millions of dollars are spent per year on possum control (Clout, 1999).

Deliberate or accidental release of pets and aquarium specimens is a serious problem. Even in Antarctica, caged birds were kept as pets on research stations and pigeons were intentionally released until the import of live birds was prohibited (Kerry *et al.*, 1998; see section 2.2.1.3 below). 65% of exotic fish species established in the United States arrived through the aquarium trade (Corn, 1999). In South Africa, three alien fish species imported for aquaria (guppies, sword tails, goldfish) have established naturalised populations (Day, 2000). The desire for novelty stimulates trade in ever more unusual pets. Some are abandoned out of boredom, carelessness or misguided concern for 'animal welfare'. Internet trafficking in live animals is an alarming new development.

Alien aquatic plants and micro-organisms can enter the water cycle through discharges of aquarium water without prior sterilisation. The 'assassin weed' (*Caulerpa taxifolia*) is thought to have been developed as an aquarium plant by biologists at a zoo in Germany, and to have entered the Mediterranean via discharges from the Oceanographic Museum, Monaco in 1984. It has caused irreversible damage to threatened seagrass beds (400 hectares in 1992, 4,000 hectares by 1999).

Discards of other alien biotic material can contribute to cumulative or long-term problems. Examples include the use of alien live bait for fishing and of alien mosses and algae for decorative packing material. In Malta, alien mossy vegetation used in Christmas cribs has been discarded in the wild after the festive season and then established itself (Baldacchino, 1996).

1.2.3 Unintentional Introductions

'Hitchhiker' or 'stowaway' organisms are inadvertently transmitted through diverse trade, travel and transport pathways. Particularly for large trading nations, this type of introduction may be seen as a more serious problem than intentional introductions (Bean, 2000).

The risk of traded commodities being contaminated with alien animals, plants or micro-organisms is well documented. Livestock can bring in seeds in their gut, tubers can bring in insect pests, soil on roots or hooves can harbour diseases for native plants and seed consignments may be contaminated with weedy plants. Many species of terrestrial snail were first introduced with ornamental plants or imported soil or leaf litter (Sastroutomo, 1999). The Japanese alga (*Sargassum muticum*), introduced with Japanese oysters to the French coast in 1966, has now spread as far as the Baltic and Mediterranean Seas.

Contamination problems have been much reduced by border and quarantine controls, combined with improved cleaning, packaging and transport methods and techniques, and stricter international animal and plant health standards (see Box 4 and Chapter 2 below). For example, certain types of imports (e.g. wool, tropical and subtropical fruits) have now become negligible as carriers of aliens in comparison to the nineteenth century (Kowarik, 1999).

Box 4: Quarantine

Stringent quarantine requirements may not always be popular with the general public or business interests. The opening of the flagship National Botanic Garden in Wales was delayed because more than 2,000 plant species were still in quarantine and many tree species imported from Italy were found to harbour disease (*The Sunday Telegraph*, 6 February 2000).

Unprocessed wood products provide a high-risk vector for introductions. Again, this is not a new problem. The plant *Elodea canadensis* crossed the Atlantic Ocean with wood shipments in the 1850s and had become invasive in natural ecosystems in Poland within twenty years (Krzywkowska, 1999). The Asian Long-Horned Beetle (*Anoplophora glabripennis*) is currently causing devastating damage in parts of the United States. It threatens raw materials important to economic interests such as furniture-making, maple syrup extraction and tourism (Corn, 1999).

The growth in international marine, air and land transportation provides diverse pathways for the unintentional introduction of alien species, some of which may go on to become invasive. Vectors range from bilge/ballast water to aeroplane wheel wells to tourists' shoes. In Antarctica, the rapid expansion of tourism has increased the possibility of unintentional introductions of diseases and alien species.

Box 5: Wood-boring Beetles

In Australia, the touring Kirov Ballet's first performances had to be cancelled because the dancers' shoes were impounded on suspicion that wood-boring beetles were present in the soles (*The Independent*, London, Friday 19 November 1999).

Shipping facilitates the translocation of terrestrial, semi-terrestrial and aquatic organisms in cargoes, including mammals, birds, plants, insects, micro-organisms, diseases, bacteria and viruses. The increasing volume of maritime trade provides greater opportunities for such organisms to travel and potentially to invade areas outside their normal distribution. Aquatic organisms may be transported in various ways:

- 'sessile' species foul the hulls of ships, drilling platforms and other structures and are transported to new environments with the ship or with towed structures;
- 'vagile' species cling to the fouling communities and are similarly transported;
- 'stowaway' species are taken on board with ballast (the water/sediment materials that a ship intentionally takes aboard for stability, trim and heel) and released when the ballast is discharged (see Box 6).

Construction of **transport and resource infrastructure** (roads, inter-basin canals, etc.) can provide new pathways for introductions and, significantly, make it possible for alien populations in the new range to be continuously reinforced. Since the Suez Canal opened in 1869, over 300 tropical species have migrated (directly or attached to ships) to the eastern Mediterranean, causing major changes to composition and structure of native flora and fauna. These 'Lessepsian' species include the jellyfish *Rhopilema nomadica*, which now has dense colonies in the

south-eastern Mediterranean and seriously affects fishing and tourism (Galil, 1994).

In South Africa, at least four species (*Austroglanis sclateri, Barbus aeneus, Clarias gariepinus* and *Labeo capensis*) are thought to have been accidentally translocated through inter-basin transfers of water (De Moor & Bruton 1988). Recent massive movements of water between catchments in Namibia are considered by some to present a high risk of establishing new populations of aquatic species beyond their normal distribution (Day, 2000).

The nature and relative seriousness of different pathways may change over time. Railway stations have now declined in importance as centres for the dispersal of new species, whereas ports have an unusually high number of primary colonisations (Kowarik, 1999).

Within a country or region, transportation of soil, garden waste, tree nursery products or seeds of other species can facilitate the establishment of new populations in otherwise inaccessible areas (Kowarik, 1999). Private activities of this kind are very difficult to manage through regulatory means.

Box 6: Ballast Water

Ballast water and sediment probably constitute the most important vector for trans-oceanic and inter-oceanic movements of shallow-water coastal and marine organisms. About 10 billion tonnes of ballast water are transferred each year: depending on its size and purpose, one ship may carry between several hundred and over 100,000 tons. Some 3,000 species are estimated to be transported in ballast water every day. Many species of bacteria, plants and animals can survive in a viable form in the ballast water and sediment carried in ships, even after journeys of several months' duration. The subsequent discharge of ballast water into the waters of port States may result in the establishment of harmful aquatic organisms and pathogens that may pose threats to indigenous human, animal and plant life, and the marine environment. Examples of alien species introduced through ballast water include the European Zebra mussel (*Dreissena polymorpha*) which was introduced to the North American Great Lakes system in the late 1980s. It has infested over 40% of internal waterways in the United States and has required over USD 1 Billion in expenditure to control since 1989. (Ballast Water News, Issue 1, April-June 2000). New Zealand's shell fish industry was once closed to all markets because of a toxic algae bloom generated by alien species introduced through ballast water. In Southern Australia, the Northern Asian kelp (*Undaria pinnatifida*) is invading new areas rapidly, displacing the native seabed communities. Other examples include the Chinese clam *(Potamocorbula)*, now established in San Francisco Bay, and the establishment of the American comb jelly in the Black and Azov Seas, which led to the demise of the already weakened anchovy and sprat fisheries (*Focus on IMO*, October 1998).

The potential for ballast water discharge to cause harm has been recognised by the International Maritime Organization and also by the World Health Organization because of the role of ballast water as a medium for the spreading of epidemic disease bacteria (see 2.6 below).

1.3 Potential Economic and Social Impacts

Introduced species can have economic and sociocultural benefits that, at least until recently, have been considered to outweigh the negative effects of alien species invasions.

In several countries, alien species make a major contribution to the economy. Alien tree species underpin commercial forestry in many parts of the world, pines and eucalyptus being by far the most important genera used in the tropics and sub-tropics. Pine plantations expanded dramatically after the 1950s, with the most dramatic growth in Chile, Australia and New Zealand (Lavery and Mead, 1998). Alien woody legumes are widely used for fuel-wood production, restoring or repairing damaged ecosystems and protecting against soil erosion and desertification. Many do not become invasive.

Even where alien species present known invasive characteristics, some interest groups may strongly support their continued introduction and use. Plants labelled as environmental weeds may, for example, have important ornamental or economic values for some stakeholders. Factors of this kind help to explain why administrators and many groups of stakeholders take an ambivalent or fragmented approach to regulating alien species introductions.

Despite the acknowledged economic benefits of many alien species, several have ancillary dangers

and environmental costs that are difficult to quantify and sometimes poorly understood by policy makers. Environmental, economic and social impacts that are seen as insignificant in the short term can prove to be extremely serious in the longer term or when cumulative effects are taken into account.

Techniques to assess the costs and benefits of alien species are evolving, but much research remains to be done. However, considerable uncertainty remains about the economic costs of invasions. It is notoriously difficult to value components of native biodiversity or the benefits freely provided by ecosystem services (clean and abundant water, clean air, sediment control...) that may be degraded through invasions. Elements for assessment need to include items such as:

- reduction in the value of agricultural land;
- increased operating costs and loss of income;
- collapse of buildings and power failures;
- inefficient irrigation and lowered water tables;
- seed contamination, spread of disease and incremental pest control costs;
- loss of sport, game, endangered species and biodiversity;
- ecosystem disturbance and protection, monitoring and recovery costs;
- loss of scientific value;
- loss of opportunity and ecosystem services for future generations; and
- loss of equitable access to resources (partly based on Corn, 1999).

Available figures (see Box 7 for examples) give an indication of some of the possible costs associated with invasions but rarely cover intangible, non-market or longer term impacts across a range of sectors. For most past invasions, little or no economic data is available.

Box 7: Economic Impacts

A recent assessment calculates the annual loss by alien invasive species of USD 336 billion in six countries: United States USD 137 billion, South Africa USD 7 billion, United Kingdom USD 12 billion, Brazil USD 50 billion, and India USD 117 billion (Pimentel, *et al.*, 2000).

In South Africa, alien invasive plants are estimated to consume around 3,300 billion m^3 of water per year (equivalent to about one third of the water flowing through the rivers of the Western Cape Province each year, or 6.7% of national water flow). This consumption is nearly equal to domestic and industrial consumption in the major urban and industrial centres. The invaded area is estimated to be expanding at 5% per year and estimated clearance and control costs are high (R600 million per year to clear 750,000 ha per year): adjusted for inflation over twenty years, the cost of the control programme would come to R5.4 billion (Wilgen, 1999).

In Hawaii, the greatest single threat to native species is considered to be predation or competition by non-native weeds and animal pests. The alien fruitflies that infest many of the island's crops mean that Hawaiian produce is apparently refused by many potential markets at an estimated cost of USD 300 million per year (TNC, 1992). In the island of Guam, the alien invasive Brown tree snake *(Boiga irregularis)* (probably introduced in aeroplane wheel wells) causes damage to electrical and telephone grids assessed at around USD1 million per year. It also impacts on the tourist industry and endemic Guamanian birds, several of which are now extinct in the wild.

In July 2000, the New Zealand Government announced a two year management plan to control the varroa mite, a serious pest in honey bee hives, estimated to have an economic impact on the honey industry of NZD 400-900 million. It now appears it is too late to eradicate the mite. The mitigation plan is expected to cost the Government NZD 40 million (*New Zealand Government Media Statement*, 12 July 2000).

Social costs and benefits should also be assessed. Alien species may provide indigenous and local communities with alternative forms of subsistence and opportunities to participate in the cash economy. Conversely, invasions can threaten particular components or whole ecosystems on which such communities depend, as well as the traditional knowledge, customs and practices associated with the native species under threat.

There are many examples of mixed costs and benefits associated with alien introductions. The Java deer (*Cervus timorensis*) introduced to Mauritius in 1639, provides popular game meat as well as revenue for private estates during the hunting season. However, they impede regeneration of endemic trees by trampling and browsing seedlings and ring-barking trees with their antlers during rut (Mungroo, 1999). In Lake Victoria, East Africa, the introduction of the Nile perch (*Lates*

niloticus) in the late 1950s greatly boosted the fishery of the three riparian countries, but led to the loss of about 70% of the lake's cichlid species, a unique evolutionary suite of small fish (McNeely, 1999). Water hyacinth (*Eichornia Crassipes*) in Lake Victoria has caused millions of dollars of damage to fishing, transport, water supply, hydropower generation, human health, biodiversity and ecosystem function, but is now used by local communities for secondary economic opportunities.

1.4 Potential Health Impacts

The introduction of alien species presents opportunities for the transmission of certain strands of micro-organisms that affect the health of humans and animals. Transmission occurs through vectors such as mosquitoes, domestic animals and ballast water. Alien invasive species may serve as hosts of diseases that affect human and animal health (see Box 8).

Infectious disease agents are true invaders across most other ranges of occurrence. Unfamiliar types of infectious agents, either acquired by humans from domesticated or other animals, or imported inadvertently (or even on purpose) by human invaders, can have devastating impacts on human populations. Pests and pathogens can undermine local food and livestock production, thereby causing hunger and famine.

Rinderpest, a viral disease, introduced into Africa in the 1980s through infected cattle, subsequently spread to both domesticated and wild herds of bovids throughout the savannah regions of Africa, with devastating impacts. A dramatic example is the influenza virus, which has its origins in birds but multiplies through domestic pigs, which then spread the disease to humans around the world, especially through air transport. The cholera bacterium (*Vibrio cholerae*) was transported from Asia to Latin American coastal waters, probably through discharges of ballast water, and the South East Asian donoflagellates, which causes paralytic shellfish poisoning, have been dumped in Australian waters, harming local shellfish industries (*Focus on IMO,* October 1998).

Long-term preventative and control measures to prevent introductions and the spread of invasive disease organisms will depend on understanding and changing human behaviours (see 2.4.1 below).

Box 8: West Nile Virus

New York City authorities had to spray insecticides in parts of Queens and Brooklyn in July 2000 after mosquitoes were discovered carrying the West Nile virus. This prompted cancellation of a concert by the New York Philharmonic in Central Park on 25 July 2000. In 1999, New York spent USD 10 million to control measures, after the mosquito-borne virus is reported to have caused the death of seven people and sickened sixty-two others. Although the virus mainly infects birds, it can be transmitted to humans by infected mosquitoes that have bitten an infected bird. It is assumed that the virus was introduced to New York through an imported exotic bird (*Reuters,* 25 July 2000).

1.5 Ecological and Genetic Implications

Species operating outside their historic area of distribution are no longer subject to the various brakes and checks that normally limit their population growth. They may enter into direct competition with native species, through predation, herbivory, resource competition, aggression or hybridisation (Randall, 1999). This can displace and even cause the extinction of unique variants or races, resulting in an irreparable loss of genetic diversity. At the global level, alien invasive species are now considered the second cause of biodiversity loss after direct habitat destruction.

Every alien species that becomes established alters the composition of native biological diversity in some way. Although the introduction of an alien species may increase the number of species present in a particular site, at least in the short term, it will lead to a decrease in species diversity (number and abundance of species) if native species are reduced or eventually displaced from the habitat or region.

Alien invasive species are found in all taxonomic groups, from introduced viruses and fungi through to higher plants and mammals. A high number of documented extinctions have been caused by alien invasives, with the irretrievable loss of native species and ecosystems. Particularly between regions with similar climates and soils, there is now a trend toward increasing biological homogenisation or

'biosimilarity'. This goes against the normal evolutionary pattern of ever-greater species divergence between two regions and has led some to call the spread of invasive species "evolution in reverse" (Corn, 1999).

Metastatic plant invasions can "change the rules" by disrupting entire ecosystems (Simberloff, 1999). The Eucalyptus (*Melaleuca quinquenervia*), introduced from Australia to Florida, was until recently increasing its range by 20 ha per day, replacing native cypress, sawgrass and other plants and changing fire and hydrological regimes. Species with a longer life span – perennials rather than annuals, trees rather than shrubs – tend to use available resources more efficiently or gain better access to them. This changes the balance of nutrients, water and light and may adversely affect ecosystem processes and/or productivity (Kowarik, 1999).

Alien animal species can have massive adverse impacts. They can act like a plant (e.g. Zebra mussel), help an invasive plant (e.g. alien pigs disperse seeds of invasive plants) or eat a dominant plant (e.g. the Balsam woolly adelgid has destroyed almost all Fraser fir in the upper montane forests of the southern Appalachians) (Simberloff, 1999).

Alien species may have indirect effects, by transmitting pathogenic agents or parasites to other species or seriously disrupting natural systems, including water supply. Alien aquaculture species, for example, are known to have spread disease to wild fish populations, with serious ecological and genetic implications. Alien species that have contributed to multiple extinctions include protozoans (avian malaria), fungi (amphibian chytrid disease) and the alien bark beetle that provided a vector for Dutch Elm Disease, which virtually wiped out the American Elm in the eastern United States.

Once an introduced species becomes invasive, it will usually be both difficult and expensive to eradicate. If much time has elapsed, it will often be impossible, in which case the damage is irreversible. For these reasons, prevention of unwanted introductions must be the priority (see generally Chapter 5 below).

Virtually all ecosystems have been adversely affected to some degree by biological invasion. The presence of water appears particularly attractive to invaders that may quickly compete with local species. In high-energy marine ecosystems, and also inland water ecosystems, the presence of alien invasive species can be hard to detect and organisms can disperse rapidly (see further 2.2.2 below). In California's Sacramento-San Jaoquin estuary, over 212 alien species have been established and alien vertebrates almost completely dominate the benthos and plankton (Cohen and Carlton, 1995). The diversity and structure of many shallow coastal marine and estuarine communities have been profoundly altered by marine invasions (Carlton, 1999).

Alien invasives are often predominant as biodiversity destroyers in geographically and evolutionarily isolated ecosystems (see 1.1.2 above). Many endemic species on oceanic islands have been made extinct due to alien arrivals, such as alien ants that contributed to the extinction of hundreds of endemic land snails across the Pacific (see also Box 9).

Box 9: Endemic Species Extinction

In New Zealand, the initial arrival of people and the alien organisms which they brought with them, including dogs (*Canis familiaris*) and Polynesian rats (*Rattus exulans*) led to the loss of at least 35 bird species. Several species of large flightless birds, such as moa (*Dinornithidae*), were probably hunted to extinction. The introduced Polynesian rat seems to have eliminated several species of small birds, flightless insects and reptiles.

Since European settlement of New Zealand began, over 80 species of alien vertebrates have been introduced, including three species of rodents, three mustelids, six marsupials and seven deer species. Predatory European mammals, e.g. ship rats (*R. rattus*), stoats (*Mustela erminea*), and cats (*Felis catus*), have caused the extinction of nine endemic bird species in the past 150 years and continue to threaten several more. Herbivorous mammals, including red deer (*Cervus elaphus*), goats (*Capra hircus*) and brushtail possums (*Trichosurus vulpecula*) continue to alter the structure and composition of native plant communities through their selective browsing.

Several of the 1600 introduced species of plants, insects, birds and fish have become invasive and threaten native biodiversity. These include alien fish (salmonids and cyprinids), insects such as social wasps, and at least 240 species of alien plants which are classed as "ecological weeds". The New Zealand government has identified the continuing decline of indigenous biodiversity as the major environmental issue facing the country (Clout and Lowe, in press).

1.6 The Need for Legally-Backed Approaches to Alien Invasive Species

Alien invasive species are well described as a form of "self-regenerating pollution" (de Klemm, 1996).

From a legal point of view, however, the 'pollution' associated with biological invasions is much harder to tackle than more familiar types of pollution. Reasons for this may include:

- the range of production and trade activities that depend on or involve alien species;
- the high number of entry points and pathways for introductions;
- gaps in data on native species, making it harder to determine what is alien;
- problems of predicting which alien species may become invasive;
- difficulties related to defining the objects and activities that should be regulated or managed;
- lack of objective criteria or methodologies for assessing risk;
- logistical and legal difficulties in tackling ongoing invasions, particularly where these result from legitimate past introductions and/or affect private land;
- the value attributed to alien species by many different groups of stakeholders; and
- low political or public awareness of problems posed by alien invasive species.

Alien species issues have long had relatively low visibility at policy-making level, although the position is now improving, partly in response to increased international attention in a range of fora. To date, relatively few national environmental or biodiversity planning processes have taken these issues systematically into account.

Legal and institutional frameworks in most countries still treat alien species introductions in a fragmented way. Measures to exclude unwanted organisms are most developed with regard to economic production sectors, notably agriculture. Other legal measures have often been adopted on a reactive basis as new problems and pathways have become apparent. There is a widespread lack of clear principles, procedures and criteria for analysing risk and dealing with eradication and control across all taxonomic groups.

Well-designed legal frameworks are essential to prevent or minimise the risk of unwanted introductions and to provide a basis for effective eradication and control measures. Legislation may be designed not only to prohibit or restrict actions but also to promote desired goals through provision of economic and other incentives. It also has the important function of establishing the institutional mechanisms needed to develop appropriate implementing regulations, ensure compliance, monitor success and failure, and promote policies for improved implementation and any necessary legislative changes. Establishing efficient institutions is one of the most important roles of legislation, though this is often underestimated.

National experiences and practice have played an important role in the design of international instruments adopted to tackle the international dimensions of alien-related problems. Innovations in national legal frameworks, particularly in countries seriously affected by biological invasions, have played an important role in the design of international instruments and given impetus to the further development and enlargement of international approaches.

As discussed, the causes and effects of many alien species introductions are international in character and threats to native biodiversity are increasingly perceived as a global problem. Because the impacts of biological invasions rarely stop at political boundaries, it is widely accepted that isolated unilateral action by individual States can never be enough to address all activities and processes that generate invasions. Effective management needs to be based on common objectives and agreed means and approaches, supported where appropriate by concerted bilateral, regional or global action.

The next chapter reviews the evolution and scope of existing international instruments in order to show the context within which national lawmakers need to review, develop and/or strengthen legal and institutional frameworks for tackling alien invasive species issues.

2.0 International Legal Regime on Alien Species

The following chapter provides an overview of existing international and regional instruments that reference alien species, with particular emphasis on the relationship between measures and recommendations developed in different fields of international law and policy. A comprehensive survey of relevant international and regional instruments is provided in Appendix I to this Guide.

The chapter provides a 'snapshot' of the current international regime as a whole and highlights areas of current development and fluidity. However, it is not the purpose of this Guide to provide a critical analysis or to assess options for future development and reform.[3]

2.1 Evolution of International Approaches to Alien Species

As shown in Chapter 1, both the causes and effects of alien species introductions are international in character. International action is necessary to deal comprehensively with the problem, backed by internationally agreed legal instruments. The need for internationally coordinated measures related to alien species has been acknowledged in different sectors since the 1950s. More than fifty international and regional instruments now deal in one way or another with the introduction, control and eradication of alien species. This corpus of instruments sets out the international norms and guidelines agreed upon to date: where these exist, they form the baseline for the minimum content of national legal frameworks (see Box 10).

Box 10: Nature of International Instruments

Internationally agreed instruments may be binding or non-binding:

- binding instruments are agreements between states (treaties, conventions) which have a mandatory character: they must be observed and their obligations performed in good faith;
- non-binding instruments, sometimes referred to as 'soft law', are resolutions adopted by intergovernmental fora (recommendations, guidelines, programmes of action, declarations of principles) which are accepted by the States concerned as guidance for future action, even though they are not mandatory. Elements of 'soft law' may be, and often are, included at a later stage in binding instruments, and thus become 'hard law'. This reflects the evolutionary character of international law on a particular subject.

Binding treaties and conventions often require a lengthy negotiation process. They rarely contain detailed rules, although these can be developed in annexes concluded and amended using simpler procedures than the parent instrument. In most cases, they are subject to ratification, a process by which each individual State – whether or not it participated in the adoption of the text – agrees to be bound by its provisions.

The negotiation of non-binding instruments may, however, be achieved within a shorter timeframe, because they are not mandatory and do not require ratification. In the context of alien species control, as in other fields, they provide a useful format for technical guidance and best practices (e.g. codes of conduct).

Non-State actors, including international non-governmental organisations such as IUCN-The World Conservation Union may also develop guidelines and other advisory material that can help States and non-State actors in formulating policies and programmes. Documents of this kind can provide a source of inspiration for the development of internationally agreed instruments, thus influencing the development of hard or soft law.

[3] For discussion of this issue, see Glowka and de Klemm, 1999. *International Instruments, Processes and Non-indigenous Species Introductions: Is a Protocol to the Convention on Biological Diversity Necessary?*

International rules or guidance relevant to alien species have been developed in separate thematic areas. This sectoral pattern of development is currently reflected in current international institutional arrangements and institutional processes.

- The earliest international agreements focused on the establishment of exclusion systems to prevent the introduction and spread of 'pests' and diseases in order to protect human, plant an animal health. A series of quarantine agreements now mandate and discipline sanitary and phytosanitary measures to control these introductions. Technical guidelines addressing the import and release of alien biological control agents have also been adopted.

- From the late 1960s onwards, specific requirements to prevent and/or control alien species introductions have been systematically included in global and regional instruments dealing with nature conservation, environmental protection and sustainable use of natural resources. This reflects growing scientific concern about the impacts of alien invasive species on global biodiversity.

- During the 1990s, technical guidelines to minimise the risk of alien species introductions through international transportation were developed for broad environmental protection objectives.

- The 1990s also saw the first generation of instruments addressing certain movements and releases of living modified organisms (LMOs), in particular those resulting from modern biotechnology (often referred to as genetically modified organisms or GMOs). These organisms may for legal purposes be considered as a subset of alien species as by definition they have no "normal distribution" (see 1.1.4 above).

Box 11: Agenda 21

In response to the threat posed by alien species to environmental security and biodiversity, Agenda 21, adopted at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992, contains a number of proposals for dealing with this issue. Agenda 21 urges States to take action to address the impact of alien species in a wide range of sectors, such as combating deforestation, managing fragile ecosystems, conserving biodiversity, protecting the oceans, seas, and coastal areas, and protecting freshwater resources (more details are provided in Appendix I).

The following section groups international instruments by subject matter, looking at selected globally and then regional instruments in each category. Themes are dealt with in the following order:

- biodiversity conservation, with specific reference to aquatic ecosystems and fisheries;
- living modified organisms;
- sanitary and phytosanitary measures, and alien biological control agents;
- trade-related agreements; and
- international transport operations.

2.2 Conservation of Biological Diversity and Sustainable Use of Biological Resources

2.2.1 Generally Applicable Instruments

2.2.1.1 Convention on Biological Diversity (Nairobi, 1992)

The Convention on Biological Diversity (CBD), currently ratified by over 170 States, is the only globally applicable, legally binding instrument to address generally alien species introduction, control and eradication across all biological taxa and ecosystems. Parties are required, as part of a suite of *in situ* conservation measures and as far as possible and as appropriate, "to prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species" (Article 8 (h)).[4]

This is a binding but broadly phrased obligation, which leaves Parties free to choose appropriate means by which to implement it. However, several general

requirements of the CBD provide important indicators for planning tools and cooperative approaches that should underpin the design of legal frameworks for this purpose:

- integration of biodiversity-related considerations into sectoral and cross-sectoral plans, programmes and policies (Article 6(b));

- identification and monitoring processes and categories of activities that may have significant adverse impacts on conservation and sustainable use of biodiversity (Article 7(c)), and, where a significant adverse effect on biological diversity has been determined, regulation or management of the relevant processes and categories of activities (Article 8(l));

- carrying out of environmental impact assessment for projects, programmes and policies likely to have a significant adverse impact on biodiversity and notification, exchange of information and consultation with neighbouring countries which may be affected by damaging processes and activities (Article 14).

Other CBD provisions that should guide Parties include Article 11 (use of incentives as well as conventional regulatory approaches); Article 12 (promotion of research and training regarding conservation and sustainable use of biodiversity); and Article 13 (promotion of public education and awareness).

The CBD's Conference of the Parties (COP) has designated alien species as a crosscutting issue to be taken into account in the Convention's thematic work programmes, such as inland waters, marine and coastal areas,[5] biodiversity of dry and sub-humid lands, and forest biological diversity. In 1998, it requested the Convention's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) to develop guiding principles for the prevention, introduction and mitigation of impacts of alien species (Decision IV/1).

The *Interim Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species*, prepared by the CBD Secretariat, were discussed by the SBSTTA in January 2000 and submitted for consideration to the fifth meeting of the COP in Nairobi in May 2000 (COP5). As currently drafted, they support a sequenced approach to alien species control along the following lines:

- priority should be given to preventing entry of potential invasive alien species, both between and within States;
- if entry has already taken place, actions should be undertaken to prevent the establishment and spread of alien species;
- the preferred response would be eradication at the earliest possible stage;
- if eradication is not feasible or cost-effective, containment and long-term control measures should be considered.

The SBSTTA and COP discussions on alien invasive species generally, and the *Interim Guiding Principles* in particular, reflect the complexity of the scientific, policy, and legal issues involved, the need for more information and close coordination with relevant institutions, and the range of views currently held by different countries and regions. The COP, at this 5th Meeting, adopted a specific decision (Decision V/8: "Alien Species that Threaten Ecosystems, Habitats and Species") calling for a series of further actions to be undertaken prior to its sixth meeting in 2002 (COP6).
These include:

- submission of case studies to the CBD Executive Secretary;
- further elaboration of the *Interim Guiding Principles*, for consideration by SBSTTA;
- priority attention to geographically and evolutionarily isolated ecosystems and for use of the ecosystem, and precautionary and biogeograghical approaches, as appropriate; and
- collaboration in developing standardised terminology, criteria for assessing risks, processes of assessing the socio-economic and biodiversity impacts, means to enhance the capacity of ecosystems recovery, early warning systems, and priorities for taxonomic work.

The Decision also calls for close cooperation and collaboration in work on alien invasive species between the CBD Secretariat, the Global Invasive Species Programme, the Food and Agriculture Organization, the World Health Organization, the International Maritime Organization, CITES, Ramsar, Bonn Convention, Codex Alimentarius, Office International des Epizooties, UNESCO, and other institutions. Lastly, the Parties have agreed to consider options for the full and effective implementation of Article 8(h) at COP6, based on the information to be compiled and analysed. Specific options to be considered include the possibilities of further developing the *Interim Guiding Principles* and developing an international instrument on alien invasive species.

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[4] See 2.3 below for the treatment of living modified organisms under the CBD.

[5] See 2.2.2.1 below on introductions to marine and coastal ecosystems.

2.2.1.2 Convention on the Conservation of Migratory Species of Wild Animals (Bonn, 1979)

Under the Bonn Convention, Parties are required to prevent, reduce and control the factors endangering migratory species, including "strictly controlling the introduction of, or controlling or eliminating already introduced exotic species" (Article III (4)).

Agreements concluded under the Convention for Annex II species must also provide for strict controls on the introduction of or control already introduced exotic species detrimental to the migratory species (Article V(5)). This provision has been elaborated in the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (The Hague, 1995). The deliberate introduction of non-native waterbird species into the environment is prohibited, and all appropriate measures must be taken to prevent the unintentional release of such species if this would prejudice the conservation status of wild fauna and flora. Where non-native waterbird species have already been introduced, appropriate measures must be implemented to prevent these species from becoming a potential threat to indigenous species (Article III (2)).

The binding Action Plan annexed to the Agreement requires Parties to prohibit alien animal and plant introductions detrimental to listed bird species, to take precautions to prevent accidental escape of captive non-native birds, and to take measures to ensure that already introduced species do not pose a potential hazard to listed species (see Annex 3, Action Plan 2.5).

2.2.1.3 Regional Biodiversity-related Instruments

Many regional nature conservation instruments contain requirements to regulate the introduction of alien species. These vary widely in scope and content: some apply only to intentional introductions, others just to releases within protected areas. The following section outlines key instruments (a comprehensive list is contained in the Table in Appendix I to this Guide).

In **Africa**, the African Convention on the Conservation of Nature and Natural Resources (Algiers, 1968) requires Parties to prohibit any act in a strict nature reserve or national park which is likely to harm or disturb the fauna and flora, including the introduction of zoological or botanical specimens, whether indigenous or imported, wild or domesticated (Article III (4)).

In **Antarctica**, rigorous provisions have been developed under the Antarctic Treaty regime to control introduction of alien species (see Box 12). The Committee on Environmental Protection established under the Antarctic Treaty regime has formed an Intersessional Contact Group to consider practical measures to diminish the risk of the introduction and spread of diseases to Antarctic wildlife.

In the **Asia-Pacific region**, the ASEAN Agreement on the Conservation of Nature and Natural Resources (Kuala Lumpur, 1985) requires Parties to endeavour to regulate and, where necessary, prohibit introduction of alien species (Article 3(3)). The Convention on Conservation of Nature in the South Pacific (Apia, 1976) provides that Parties shall carefully consider the consequences of deliberate introduction into ecosystems of species not previously occurring therein (Article V(4)).

In **Europe**, the Convention on the Conservation of European Wildlife and Natural Habitats (Bern, 1979) generally requires Parties to strictly control the introduction of non-native species (Article 11(2)). The Standing Committee to the Bern Convention has actively promoted the development of more effective legal measures to deal with alien invasive species, by commissioning legal research and analysis (e.g. de Klemm, 1996) and by developing specific recommendations regarding introductions, and eradication of alien invasive species (see 6.2) and re-introductions of native species (see 6.3.1). The Committee plays a much greater role than most treaty secretariats in monitoring implementation and pursuing cases of non-compliance, in close partnership with relevant non-governmental organisations. In 1999, the Standing Committee opened a case file concerning the failure by the United Kingdom and certain other Parties to control the proliferation of the introduced species *Oxyura jamaicens*, which hybridises with the European endemic *Oxyura leucocephala* (protected under the Bern Convention). This high-level action has helped to build political awareness and support for trials of control methods, with the long-term aim of eradicating the Ruddy duck within ten years (Report of 19th meeting, December 1999).

The Protocol for the Implementation of the Alpine Convention in the Field of Nature Protection and Landscape Conservation (Chambery, 1994), concluded under the Convention Concerning the Protection of the Alps (Salzburg, 1991), prohibits the introduction of species of wild fauna and flora not native to the region in the recorded past (Article 17). Exceptions to this principle are possible when the introduction is needed for specific uses, provided it will not adversely affect the environment.

Box 12: The Antarctic Treaty Regime

Parties to the Convention on the Conservation of Antarctic Marine Living Resources (Canberra, 1980) are required to prevent changes or to minimise the risk of changes in the marine ecosystem not potentially reversible over two or three decades, taking into account the state of available knowledge, including the effect of the introduction of alien species (Article II (3)(c)). To date, alien species issues have not been considered at any meeting of the Parties.

The Madrid Protocol on Environmental Protection (1991) provides that no species of animal or plant not native to the Antarctic Treaty Region may be introduced onto land or ice shelves or into the water except in accordance with a permit. Article 4 of Annex II provides that:

- a permit shall only be issued for importation of animals/plants listed in Appendix B, which is limited to domestic plants and laboratory animals/plants, including viruses, bacteria, yeasts and fungi (Article 4(3)). Certain exceptions are made for foodstuffs, provided they are not live animals;
- a permit must be very specific and include precautions to be taken to prevent escape or contact with native fauna and flora (Article 4(3)). Plants and animal parts and products must be kept under carefully controlled conditions;
- a permit must specify the obligation to remove the organism(s) from the Antarctic Treaty Area, or dispose of them by incineration or other effective means that eliminates risk to native flora and fauna. The same obligation applies to any other plant or animal introduced to the Antarctic Treaty Area or its progeny (by implication through an unintentional introduction) unless it is determined that they pose no risk to native flora or fauna (Article 4(4));
- additional precautions apply to prevent the introduction of micro-organisms not present in native flora and fauna (Article 4(6); Appendix C of Annex II). Risk pathways identified to date include poultry products, which could transfer Newcastle disease to penguins, and non-sterile soil, which could contain nematodes. Non-sterile soil is included in a list of prohibited products that shall not be introduced onto land or ice shelves or into water in the Antarctic treaty area (Article 7, Annex III);
- specific precautions also apply to waste disposal (Annex III). Under Article 2(3), the generator of defined wastes must remove them from the Antarctic Treaty Area or incinerate, autoclave or otherwise treat them to be sterile. These wastes include (a) residues of carcasses of imported animals, (b) laboratory cultures of micro-organisms and plant pathogens, and (c) introduced avian products.

Parties to the Benelux Convention on Nature Conservation and Landscape Protection (Brussels, 1982) are required to prohibit the introduction of alien animal species into the wild without authorisation from the competent national authority, based on prior assessment of the consequences, and to notify each other of any plant introductions (Council of Ministers Decision, 17 October 1983).

At the supranational level, two biodiversity-related Directives adopted by the European Community (EC) contain relevant obligations. Member States of the European Union must take measures to ensure that any introduction of a species of bird which does not occur naturally in the wild state in the European territory of the Member States does not prejudice the local fauna and flora (EEC Directive 79/409/EEC (1979) on the Conservation of Wild Birds). They must also regulate the deliberate introduction into the wild of any species which is not native to their territory so as not to prejudice natural habitats within their natural range or the wild native fauna and flora (EEC Directive 92/43/EEC (1992) on the Conservation of Natural Habitats and of Wild Fauna and Flora).

In **Latin America**, the Convention for the Conservation of the Biodiversity and the Protection of Wilderness Areas in Central America (Managua, 1992) requires the adoption of mechanisms to control or eradicate all exotic species which threaten ecosystems, habitats and wild species (Article 24).

2.2.2 Instruments Dealing Specifically with the Aquatic Environment

Marine and freshwater ecosystems are considered to be particularly vulnerable to invasion by alien species (see 1.5 above). Moreover, many eradication and control options applicable to terrestrial ecosystems cannot

be used in their aquatic counterparts. For these reasons, international instruments dealing with the aquatic environment show an early focus on the need for preventive measures related to alien species introductions.

2.2.2.1 Introductions to Marine and Coastal Ecosystems

The United Nations Convention on the Law of the Sea (Montego Bay, 1982) generally requires Parties to take all measures necessary to prevent, reduce and control 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 (Article 196). Consistently with this broad provision, guidelines for controlling pathways that may generate risks to the marine and coastal environment may be developed by national authorities (see section 2.6 below on international transport).

Under the Convention on Biological Diversity, specific guidance on introductions to marine and coastal ecosystems has been developed in accordance with the Jakarta Mandate on Marine and Coastal Biological Diversity (Decision II/10, 1995). The Mandate recommends that "because of the difficulties of complete containment, introduction of alien species, products of selective breeding, and living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of marine and coastal biodiversity should be responsibly conducted, using the precautionary principle/approach" (Annex I, para. XI). The Work Programme adopted in 1998 (Decision IV/5) calls for identification of gaps in existing or proposed legal instruments, guidelines and procedures to counteract the introduction of and adverse effects exerted by alien species and genotypes which threaten marine ecosystems, habitats or species, paying particular attention to transboundary effects. This was reinforced by the 5th meeting of the COP (Decision V/3).

At the regional seas level, relevant provisions are laid down by certain protocols to regional seas conventions developed within the framework of the UNEP Regional Seas Programme:

- the Protocol concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region (Nairobi, 1985): Parties are called on to take all appropriate measures to prohibit the intentional or accidental introduction of alien or new species which may cause significant or harmful changes to the region (Article 7). They must also take measures to regulate any activity likely to harm or disturb the fauna or flora in protected areas, including the introduction of non-indigenous animal or plant species (Article 10(f)).

- the Protocol concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region (Kingston, 1990): each Party must take all appropriate measures to regulate or prohibit the intentional or accidental introduction of non-indigenous or genetically altered species to the wild that may cause harmful impacts to the natural flora, fauna and other features of the Wider Caribbean Region (Article 12).

- the Protocol for the Conservation and Management of Protected Marine and Coastal Areas of the Southeast Pacific (Paipa, 1989): Parties must to take measures to prevent, reduce and control environmental deterioration in marine protected areas, including, as far as possible, the introduction of exotic species of flora and fauna.

- the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (Barcelona, 1995): with regard to 'specially protected areas' (SPAs), Parties must regulate the introduction of any alien species to the SPA as well as the introduction or re-introduction of species that are or have been present in the SPA (Article 6(d)). More generally, they must take all appropriate measures to regulate the intentional or accidental introduction of alien species and GMOs to the wild and prohibit such introductions where these may have harmful impacts on the ecosystem, habitats or species in the area covered by the Protocol (see also 2.3.2 below).

The non-binding 1995 Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities lists alien species as a potential threat to the integrity of marine ecosystems (paras. 149-154), but does not provide any specific guidance for addressing the problem.

2.2.2.2 Introductions to Wetlands

The Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, 1971) contains no explicit provision on alien invasive species. However, in 1999, the Ramsar Conference of the Parties adopted a detailed resolution on *Invasive Species and Wetlands* (Resolution VII/14), which emphasises the threat that alien species pose to the ecological character of wetlands and to wetland spe-

cies, terrestrial and marine, if they become invasive. It acknowledges that adequate control of invasive species is often expensive and eradication is usually impracticable once these species are established, which means that prevention and early intervention are the most cost-effective techniques that can be employed against invasive species.

The Resolution directs the Ramsar Scientific and Technical Review Panel (STRP) to prepare guidance for Parties on legislation or other best practice management approaches that incorporate risk assessment, in order to minimise the introduction of new and environmentally dangerous alien species into a jurisdiction, as well as the movement or trade of such species within a jurisdiction. Parties are urged *inter alia* to:

- address the environmental, economic and social impacts of invasive species on wetlands;
- prepare inventories and assessments of alien species in wetlands within their jurisdictions;
- establish control or eradication programmes;
- review existing legal and institutional measures pursuant to Resolution VII.7 and, where necessary, adopt legislation or programmes to prevent the introduction of new and environmentally dangerous alien species into their jurisdiction and their movement or trade within their jurisdictions;
- develop capacity for the identification of new and environmentally dangerous alien species (including those being tested for agricultural and horticultural use); and
- facilitate awareness of, and resource the identification and control of, new and environmentally dangerous alien species.

The STRP has established an Expert Working Group on Invasive Species to implement this mandate.

Box 13: Water Hyacinth

The Water hyacinth (*Eichornia Crassipes*) has in the last 100 years invaded many aquatic systems both in the tropics and sub-tropical regions. In Kenya, it was first reported in 1957 where it was grown as an ornamental plant. It has invaded Lake Victoria in East Africa, and began to cause problems in 1990 when it started to spread around the lake. By late 1998, it was estimated to cover 1% of the lake's surface, adversely affecting the lake's biodiversity, water quality and supply, hydro-electric generation, navigation, fishing, people's access to the lake, and human health. The Governments of Kenya, Uganda and Tanzania are cooperating on management strategies to control and manage this weed (see 2.2.2.3 below) (Kiringe, 1999; Howard, 1999).

In China, it has become the worst weed in many aquatic habitats, leading to the loss of species in both plants and animals. In Dianchi Lake, just outside Kunmin, Yunnan, the total number of fish species has declined from 68 to about 30, and Chinese scientists attribute this decline to the Water hyacinth (McNeely, 2000; Jinqing, 1995).

2.2.2.3 Introductions to Inland Water Systems

At the global level, the Convention on the Law of Non-Navigational Uses of International Watercourses (New York, 1997) requires "watercourse States" to take all necessary measures to prevent the introduction of species, alien or new, into an international watercourse, which may have effects detrimental to the ecosystem of the watercourse resulting in significant harm to other watercourse States (Article 22).

At the regional level, the Convention on Fishing in the Danube (Bucharest, 1958) was the first instrument to require States to prohibit the introduction of new species into an inland water ecosystem. The Convention applies to waters that comprise the tributaries of the Danube up to the maximum extent of its flood waters, and to legs, estuaries and pools permanently or temporarily connected with the Danube, in the Danube flood-basin in the territory of the Contracting Parties. Acclimatisation and breeding of new fish species, other animals and aquatic plants were prohibited except with the consent of the Commission established under the Convention (Article 10).

In East Africa, two instruments are in place to control alien species introductions in the Lake Victoria region.

Under the Agreement for the Preparation of a Tripartite Environmental Management Programme for Lake Victoria (Dar es Salaam, 1994), Kenya, Uganda and Tanzania have agreed to implement a five-year programme to strengthen regional environmental management, including the implementation of control measures for alien species, notably the Water hyacinth.

The Convention for the Establishment of the Lake Victoria Fisheries Organization (Kisumu, 1994) establishes a regional organisation with authority to advise on the effects of the direct or indirect intro-

duction of any non-indigenous aquatic animals or plants into the waters of Lake Victoria or its tributaries. The Organization has power to adopt measures regarding the introduction, monitoring, control or elimination of any such animals or plants. Parties agree to adopt, enforce and maintain in effect laws and regulations prohibiting the introduction of non-indigenous species to Lake Victoria, other than in accordance with the decision of the Council of Ministers (Article XII(3)).

Box 14: Nile Perch

The Nile Perch (*Lates niloticus*) is a large and edible predatory fish that was introduced to Lake Victoria, East Africa, from its native waters in the separate sub-catchment of the Albertine Rift lakes and from Lake Turkana in the 1950s. It was brought to the lake to enhance the fishery and make large fish more available to many millions of residents of the region. Currently, it is the basis of a large export industry to markets in Europe, North America and other countries. This invasive alien species has reduced many other species and may have caused several species extinctions and other changes to the biodiversity of the lake (Howard, 1999).

2.2.2.4 Technical Guidelines for Fisheries and Aquaculture Operations

As noted above, aquaculture and mariculture can present high risks of introduction of alien species into the aquatic environment. The associated problems have become more pressing, given the rapid growth in this sector in recent years. Non-binding sectoral codes of conduct have therefore been adopted to establish principles and standards and provide best practice guidance for these rapidly growing industries.

At the global level, the 1995 FAO Code of Conduct for Responsible Fisheries[6] sets out principles and standards for responsible fisheries practices that are designed to ensure the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity. The Code is generally directed to all persons and entities concerned with fishery resources management and development.

Specific provisions apply to the introduction of non-native species or genetically altered stocks for aquaculture. Some of these are particularly relevant to the international context.[7] The Code calls on States to adopt measures to prevent or minimise harmful effects of introducing such species or stocks into waters, especially where there is significant potential for them to spread into waters under the jurisdiction of other States as well as waters under the jurisdiction of the State of origin. States should cooperate in the elaboration, adoption and implementation of international codes of practice and procedures for the introduction and transfer of aquatic organisms (Article 9.3.2).

In 1994, the European Inland Fisheries Advisory Commission (EIFAC) of the FAO and the International Council for the Exploration of the Sea (ICES) issued the Code of Practice on the Introductions and Transfers of Marine Organisms. This establishes procedures and practices to reduce the risk of intentional and unintentional introductions of alien marine species into aquatic ecosystems. The Code includes recommendations relating to:

- the steps to take prior to introducing a new species;
- steps to take after deciding to proceed with an introduction;
- the prevention of unauthorised introductions by Member Countries;
- policies for ongoing introductions or transfers which have been an established part of commercial practice; and
- the steps to take prior to releasing genetically modified organisms.

2.3 Living Modified Organisms

Like alien species, living modified organisms (LMOs), including genetically modified organisms (GMOs), have the potential to disrupt native biodiversity, natural resources and ecological processes unless appropriately assessed, regulated and managed. A small number of recent instruments contain relevant provisions that are summarised below.

6 Adopted by the Twenty-eighth Session of the Conference, Food and Agricultural Organisation of the United Nations, November 1995.

7 Other provisions are discussed in 5.2 below.

2.3.1 Cartagena Protocol on Biosafety (2000)

The Convention on Biological Diversity requires Parties, as far as possible and as appropriate, to establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking into account the risks to human health (Article 8(g)).

Pursuant to this provision, the Parties to the CBD have recently concluded the Cartagena Protocol on Biosafety (Montreal, 2000). The Protocol is intended to "contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology". It defines an organism of this kind as "any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology" (Article 3(g)). Parties must ensure that the "development, handling, transport, use, transfer and release of any living modified organisms are undertaken in a manner that prevents or reduces the risks to biological diversity, taking also into account risks to human health" (Article 2).

The main focus of the Protocol is on transboundary movements of LMOs. The applicable provisions vary depending on the purpose of such movements. Transboundary movements for intentional introduction into the environment are subject to advanced informed agreement (AIA) of the importing State. The AIA procedure is the cornerstone of the Protocol: it includes notification to the importing Party, as well as risk assessment to be carried out prior to the transboundary movement. Elements of risk assessment are set out in Annex II. Parties must also take risk management measures that include monitoring of organisms released and the preparation of emergency plans. Transboundary movements of LMOs for food, feed and processing (FFPs) are subject to a less restrictive procedure. In both cases, specific requirements for identification are laid down: these differ depending on the purpose of the transboundary movement.

In addition, if a Party knows of a release of LMOs which may lead to an unintentional transboundary movement with possible significant adverse effects, it must notify and consult with potentially affected States as well as relevant international organisations.

Parties are also required to cooperate in identifying LMOs that have adverse effects on biodiversity and in taking "appropriate measures" regarding the treatment of or trade in LMOs having such effects. However, the Protocol does not specify the content of such measures, and does not yet have rules on liability of damage.

2.3.2 Treatment in Other International and Supranational Instruments

Several of the instruments referred to above (see 2.2.1-2) apply to GMOs as well as alien species. Examples of this integrated approach include:

- the 1994 ICES Code of Practice on the Introductions and Transfers of Marine Organisms (includes procedures for the release of GMOs into marine and freshwater ecosystems);
- the 1995 FAO Code of Conduct on Responsible Fisheries (covers both non-native species and genetically altered stocks in its recommendations on responsible aquaculture operations);
- the 1995 Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (requires Parties to regulate the introduction of GMOs as well as alien species to Specially Protected Areas, to take appropriate measures to regulate intentional or accidental introductions of GMOs to the wild and to prohibit those which could have harmful impacts on ecosystems, habitats or species in the area covered by the Protocol).

At the supranational level, the European Union has adopted two directives on contained use of microorganisms and deliberate release of GMOs (EC Directives 90/219 and 90/220). These are currently being reviewed and the latter is at an advanced stage of revision.

2.4 Sanitary and Phytosanitary Measures (Quarantine)

The main objective of sanitary and phytosanitary (quarantine) measures is to protect humans, animals and plants, wild and cultivated, from damage due to pests and diseases. Such measures involve the use of import and export controls for this specific objective, rather than for environmental protection in general.

Because quarantine measures may involve trade restrictions, they need to be considered not only in their

own right but also in the context of the international legal regime established to promote free trade. The relationship between sanitary and phytosanitary measures and trade-related agreements is discussed in the next two sections.

The following discussion focuses mainly on the international regime applicable to human health and plant protection. There is no global convention for the protection of animals which corresponds to the International Health Regulations, or the International Plant Protection Convention discussed below. However, the Office International des Epizooties has the power to adopt international standards related to animal health, and it periodically issues recommendations to prohibit or restrict the movement of live animals and fish in order to prevent the spread of diseases.

2.4.1 International Health Regulations

As noted earlier, alien invasive species may serve as hosts or vectors for diseases that affect human and animal health (see 1.4 above). Measures are therefore necessary to control the introduction and spread of invasive disease organisms.

The International Health Regulations (IHR) (Geneva 1969, as amended, 1982) were adopted by the World Health Assembly of the World Health Organisation. They are designed to ensure maximum security against the international spread of infectious diseases to humans. The IHR requires mandatory declaration of three main infectious diseases: cholera, plague, and yellow fever (smallpox was removed from the list in 1981 after its global eradication).

The goals of the IHR are to:

- detect, reduce or eliminate sources from which infections spread;
- improve sanitation in and around ports and airports; and
- prevent dissemination of vectors.

The IHR are currently being revised and updated to adapt to changes in disease epidemiology and control, and to the increase in international traffic. Proposed changes would require notification of any disease outbreak of urgent international public health importance, and changes to the text to include core modifications, with annexes giving specific and current technical recommendations As the proposed changes to the IHR are likely to impact other international trade regimes, namely the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement, see 2.5 below), discussions were held between WHO, WTO and Codex Alimentarius Commission (which sets standards on food safety and human health) in 1999 to discuss the possible impact of key proposals to the IHR for the WHO and the WTO. The revisions are expected to be completed in 2002.

2.4.2 International Plant Protection Convention

The International Plant Protection Convention (IPPC) (Rome, 1951, as revised 1997 but not yet in force) is an international instrument that provides a framework for international cooperation to "secure common and effective action to prevent the spread and introduction of pests of plants and plant products, and to promote appropriate measures for their control" (Article 1.1). The IPPC's objectives include the development and application of international standards in international trade to prevent the introduction and dissemination of plant pests, taking into account internationally approved principles governing the protection of plant, human and animal health, and the environment. There are currently 111 Contracting Parties to the IPPC.

The IPPC defines "pest" broadly as "any species, strain or biotype, animal life or any pathogenic agent injurious or potentially injurious to plants or plant products". The Convention's scope is therefore not limited to cultivated plants or to direct damage from pests: it also covers weeds and other species, as well as diseases that may have indirect effects on plants. Inasmuch as an (alien or native) invasive species may be considered to be a plant pest, it falls within the scope of the IPPC and the corresponding standards and procedures. The Convention can thus extend to the protection of natural flora and make an important contribution to the conservation of plant diversity.

Parties to the IPPC are required to adopt legislative, technical and administrative procedures and standards to identify pests that threaten plant health, assess their risks and prevent their introduction and spread. In addition to issuing phytosanitary regulations, Parties may prohibit the introduction of certain plants or other commodities; prescribe restrictions on the import of plants, plant products or other regulated articles; execute inspections; detain particular consignments; and treat, destroy or refuse entry to such consignments. Parties are also required to distribute information regarding plant pests and means of prevention and control.

Each Party is required to establish a national plant protection organisation, with responsibility for:

- inspecting plants on national territory;
- reporting on the existence, outbreak or spread of plant pests among cultivated and wild flora, as well as among plants and plant products in storage or in transportation;
- controlling those pests;
- conducting pest risk analysis;
- inspecting and disinfecting commercial consignments of plants and plant products and other regulated articles moving in international traffic;
- issuing phytosanitary certificates for exports of plants, plant products and other regulated articles, in a form that can be accepted in importing countries;
- ensuring that phytosanitary security of consignments after certification is maintained prior to export; and
- protecting endangered areas against pests and designating, maintaining and surveying pest free areas and areas of low pest prevalence.

The IPPC Secretariat facilitates the development of International Standards for Phytosanitary Measures (ISPMs), which are adopted by the IPPC's governing body, the Interim Commission on Phytosanitary Measures (ICPM). ISPMs are designed to encourage international harmonisation of phytosanitary measures to facilitate safe trade and avoid the use of unjustified measures as barriers to trade. These standards are recognised under the World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement, see further 2.5 below) as the reference point for international harmonisation. Governments that adopt phytosanitary measures based on IPPC standards do not need to justify their measures with risk analysis and are protected from challenge by their trading partners.

The IPPC recognises that States have the sovereign right to utilise phytosanitary measures for the protection of their plant resources, by preventing the introduction of pests and undertaking their eradication or control. Under the IPPC, however, phytosanitary measures should only be used when necessary, should be the least trade restrictive and be harmonised or made consistent with international standards, where possible. Countries are required to use pest risk analysis to determine the need for and appropriateness of phytosanitary measures. While measures need not be identical, they must produce the same or equivalent results. To ensure transparency and promote understanding of the measures, countries must make information available publicly, including information on the legislation and the measures applied in the event of non-compliance.

IPPC standards are used by many countries as the basis for developing import legislation and administrative procedures. Pest risk analysis (PRA) is used to justify measures when particular standards do not exist or when governments do not follow the IPPC standards.

Pest risk analysis is now a key component of many national phytosanitary systems. A three-stage process described in IPPC standards is involved in PRA: initiating the process for analysing the risk, assessing the risk, and managing the pest risk. These procedures provide the basis for deciding whether phytosanitary measures are required and, if so, the appropriate strength of such measures. The strength of the measure should be appropriate to the levels of risk assessed through PRA, and must be based on scientific principles and evidence.

In the past, pest risk analysis standards focused on the economic implications of particular pests. However, the IPPC is now taking more cognisance of environmental issues and is currently preparing new standards on "Pest Risk Analysis for Quarantine Pests."

2.4.3 Regional Plant Protection Organisations

Regional plant protection organisations have been established to facilitate the implementation of the IPPC. These are:

- the Asia and Pacific Plant Protection Commission (established 1956);
- the Caribbean Plant Protection Commission (established 1967);
- the Comité Regional de Sanidad Vegetal para el Cono Sur (established 1980);
- the European and Mediterranean Plant Protection Organisation (established 1951);
- the Inter-African Phytosanitary Council (established 1954);
- the Junta del Acuerdo de Cartagena (established 1969);
- the North American Plant Protection Organization (established 1976);
- the Organismo Internacional regional de Sanidad Agropecuaria (established 1953); and
- the Pacific Plant Protection Organization (established 1995).

2.4.4 Use of Alien Biological Control Agents

Most alien species in their natural range show no sign of "invasive" behaviour – their ability to grow vigorously is kept in check by physical barriers and a host of co-evolved organisms. Where a species is transported to a new range without the attendant co-evolved enemies and becomes invasive, biological control may be used to reduce the effects of this phenomenon, and to achieve a situation where the formerly alien invasive species becomes a non-invasive, naturalised species (see also 1.2.1 above).

The Code of Conduct for the Import and Release of Exotic Biological Control Agents (adopted as an international standard for phytosanitary measures under the IPPC) aims to facilitate the safe import, export and release of such agents. The Code addresses the importation of exotic biological control agents capable of self-replication (parasitoids, predators, parasites, phytophagous arthropods and pathogens) for research as well as the field release of control agents used in biological control and those used as biological pesticides. It contains procedures of an internationally acceptable level for all public and private entities involved, which should be followed in particular where national legislation to regulate their use does not exist or is inadequate. The Code provides a detailed list of the responsibilities of government authorities and the responsibilities of the exporters and importers of biological control agents.

Box 15: Biological Control Agents

Biological control has been hailed as an effective replacement for noxious chemicals to control pests and alien invasive species. Biological control agents however may also threaten ecosystems and species if introduced without research and tests on the potential ecological impact before release, and if their use is not regulated. The Russian wheat aphid, a tiny insect that was annihilating agricultural harvests, forcing farmers to used chemicals, was successfully brought under control through the use of biological control agents in some regions in the United States. However, the seven-spot ladybird (*Coccinella septempunctata*), one of the species released on the Russian wheat aphid, is now threatening native ladybirds. Weevils such as *Rhinocylus conicus*, introduced to remove non-native thistles from ranchland in the United States, have been found to eat and therefore threaten native thistles, causing a ripple effect on ecosystems. Caterpillars of the moth *Cactoblastis cactorum*, introduced in the Caribbean to remove native cacti from ranchland, have since island-hopped and have now been discovered in the United States infecting rare species of cactus (Louda, 1997; Hamilton, 2000).

2.5 Trade-related Agreements Relevant to Alien Species

Alien species may be introduced through international trade:

- intentionally, as the imported products themselves (e.g., trade in alien plants, fishes and animals);
- unintentionally, as by-products of trade, through cross-breeding of aliens with local populations, as parasites of traded products, or as hitchhikers or stowaways in the ships, aeroplanes, vehicles or containers that deliver products or services.

The use of trade-related measures as part of strategies to enhance environmental conservation and the sustainable use of natural resources has recently raised questions of compatibility with the international trade regime established under the World Trade Organization. The issue of compatibility is particularly relevant to legal measures adopted to regulate alien species introductions, because these are based to a large extent on the control of transboundary movements, often due to imported or exported commerce.

2.5.1 WTO Agreement on the Application of Sanitary and Phytosanitary Measures (1995)

International trade in goods, services and intellectual property between the currently 138 Members of the World Trade Organization (WTO) is disciplined by the 1994 Uruguay Round Agreements. This regime provides for binding rules, enforced by a compulsory dispute settlement mechanism, designed to ensure that governments extend free market access to each other's products and services. These rules

are based on the key principles of non-discrimination, transparency and predictability.

One of these Agreements is particularly relevant to alien species, to the extent that they are characterised as pests or diseases. The WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) (1994) allows Members to adopt national measures or standards to: (1) protect human, animal and plant life or health from the risks arising from the entry, establishment or spread of pests, diseases, or disease-carrying organisms or disease-causing organisms; and (2) prevent or limit other damage within the territory of the Member from the entry, establishment or spread of pests (Annex A). The Agreement is primarily designed to ensure that import restrictions are not used as a disguised form of commercial protectionism. It is not a mechanism to ensure that governments have adequate standards in place. However, these standards must be based on scientific evidence and applied only to the extent necessary to protect human, animal or plant life or health.

The SPS Agreement seeks to ensure the principles of free and fair trade, and makes provision for safe trade by promoting or requiring the use of:

- international standards as a basis for SPS measures;
- risk assessment based on scientific principles and evidence;
- consistency in the application of appropriate levels of protection;
- least trade restrictive alternatives;
- acceptance of equivalent measures;
- transparency through notification of trade measures.

These criteria are discussed in more detail in Box 16.

Box 16: Criteria for National Sanitary and Phytosanitary Measures Under the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement)[8]

- ***International Standards***

Three international organisations are currently recognised under the SPS Agreement as standard-setting organisations in the area of food safety and human, animal and plant health. These are the Codex Alimentarius Commission (which sets standards on food safety and human health), the International Office of Epizootics (which sets standards on pests and diseases of animals but not animals themselves as pests), and the International Plant Protection Convention (which sets standards for phytosanitary measures).

Where an international standard exists, WTO Members are required to base their national SPS measures on that standard (Articles 3 and 12.4). Basing a national SPS measure on an international standard does not excuse a Member from fulfilling its other obligations under the SPS Agreement. However, if a Member's SPS measure "conforms to" an international standard, the measure enjoys the benefit of a presumption (albeit a rebuttable one) that it is consistent with the relevant provisions of the SPS Agreement. The WTO Appellate Body has indicated that a measure in conformity with an international standard is one which "would embody the international standard completely and, for practical purposes, converts it into a municipal standard" (EC Hormones).

If the national SPS measure results in a level of protection higher than that based on an international standard, this must be justified by a risk assessment.

- ***Risk Assessment***

In order to promote free and non-discriminatory trade, SPS measures must be based on scientific principles (Article 2.2). Unless national SPS measures are in conformity with international standards, they must be justified by a risk assessment based on scientific principles and evidence. The risk assessment provides the rationale for setting an appropriate level of protection and for designing a national SPS measure necessary to address the assessed risk.

Decisions of the WTO Appellate Body have begun to provide guidance on the elements of a risk assessment, and the relationship between assessing risk, setting an appropriate level of protection and designing the measure. SPS disputes to date have turned, at least in part, on the adequacy of the risk assessment relied upon by the importing States and the relationship between the assessment and the measure on which it was based.

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Box 16: Criteria for National Sanitary and Phytosanitary Measures Under the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement)[8]

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In the context of alien potentially invasive species, the risk assessment must:

(1) identify the alien species whose entry, establishment or spread a Member wants to prevent within its territory, as well as the potential biological and economic consequences associated with the entry, establishment or spread of that alien species;

(2) evaluate the likelihood of entry, establishment or spread of the alien species, as well as the associated potential biological and economic consequences (it is not sufficient for a risk assessment to conclude that there is a mere possibility of entry, establishment or spread of an alien species); and

(3) evaluate the likelihood of entry, establishment or spread of that species in the context of the national SPS measure to be adopted (Australia-Salmon).

There should be a rational or objective relationship between the national SPS measure and the available scientific information. Whether there is such a rational relationship must be determined on a case-by-case basis and will depend on the particular circumstances of the case, including the characteristic of the measure and the quality and quantity of the scientific evidence.

Where relevant scientific information is insufficient, restrictions may be applied provisionally until such time as sufficient scientific evidence is available (Article 5.7). Members applying provisional measures have a duty to actively seek to obtain this evidence. Provisional measures may not be maintained unless additional information for a more objective risk assessment and review of the measure is obtained and the measure reviewed within a reasonable period of time.

There have been differences in perception between importers and exporters on whether the assessment of risks associated with certain products were based on "sufficient" science and the degree to which uncertainty in risk assessment provides the basis for deciding on conservative measures. The irreversibility, or potential irreversibility, of the threats posed by the introduction of alien species is likely to raise questions about the applicability of the precautionary principle/approach principle to the design and application of trade measures. As matters currently stand, the WTO Appellate Body has ruled that while the precautionary principle/approach "finds reflection in Article 5.7 of the SPS Agreement", it does not override the need for risk assessment based on available scientific evidence (EC Hormones).

- ***Consistency***

The SPS Agreement provides that "with the objective of achieving consistency in the application of the concept of appropriate level of sanitary or phytosanitary protection against risks to human life or health, or to animal and plant life or health, each Member shall avoid arbitrary or unjustifiable distinctions in the levels it considers to be appropriate in different situations, if such distinctions result in discrimination or a disguised restriction on trade" (Article 5.5). SPS measures should not arbitrarily or unjustifiably discriminate between Members where identical or similar conditions prevail (Article 2.3).

Members must therefore be consistent when dealing with risks over a range of measures or products. A SPS measure is considered to be inconsistent if:

(1) different appropriate levels of sanitary protection are adopted in several different situations;

(2) those levels of protection exhibit differences that are arbitrary and unjustifiable; and

(3) the measure embodying those differences results in discrimination or disguised restriction on trade (EC-Hormones).

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Box 16: Criteria for National Sanitary and Phytosanitary Measures Under the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement)[8]

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Situations are considered to be comparable if either the hazard (disease) was the same or similar, or the consequences would be the same or similar.

The SPS Committee has adopted guidelines to assist governments to ensure the consistency of SPS measures.

- ***Least Trade Restrictive***

The national SPS measure must not be more trade restrictive than is necessary to achieve the appropriate level of protection (Article 5.6). A measure is deemed to be trade-restrictive if there is another SPS measure which is reasonably available and, taking into account technical and economic feasibility, would achieve the appropriate level of protection in a less restrictive way than the measure contested.

By way of example, the WTO Appellate Body has ruled that in order to determine if agricultural products were contaminated with the codling moth pest, adopting a "testing by product" method was significantly less restrictive than testing each imported variety of apples, cherries, peaches and other products (Japan-Varietals).

- ***Acceptance of Equivalent Measures***

Equivalence or mutual recognition is a principle of the SPS Agreement which recognises that different measures can achieve the same level of protection (Article 4). Members are required to accept SPS measures of other Members as equivalent, even if they are different from their own or those used by other Members. An exporting country may propose alternatives that achieve the objective without following requirements specified by the importing country, provided that it can demonstrate that its procedures achieve the same level of protection. The principle is also referenced in the IPPC's ISPM Principles of Plant Quarantine as related to international trade (ISPM No. 1).

- ***Transparency***

Members are required to notify other countries in advance, except in emergency situations, of any new or changed SPS measure which affects trade and to solicit comments from trading partners on the proposed measure. These notifications are publicly available documents and each Member must establish an office to respond to requests for more information. To enhance transparency and protect against disguised barriers to trade, Members must promptly publish all SPS measures in a manner to enable interested Members to become acquainted with them (Article 7, Annex B).

[8] These criteria are based on an assessment of the following WTO Reports of the Appellate Body: EC Measure Concerning Meat and Meat Products (EC-Hormones), WT/DS26/AB/R, WT/DS48/AB/R (19 January 1996); Australia-Measures Affecting Importance of Salmon (Australia-Salmon), WT/DS18/AB/R (20 October 1998); and Japan-Measures Affecting Agriculture Products (Japan-Varietals), WT/DS76/AB/R (22 February 1999).

2.5.2 Regional Trade Agreements

At the regional level, at least three regional economic integration organisations have powers to develop regulations or recommendations regarding certain aspects of trade in potentially harmful alien species:

- the North American Free Trade Agreement (NAFTA) (1993). The Council of the Commission on Environmental Cooperation (CEC) has discretion to develop recommendations regarding introduction of exotic species which may be harmful;
- Mercosur, for the Southern Cone countries of South America (1991). Decision 6/96 of the Mercosur Consejo Mercado Común (CMC) has approved the WTO SPS Agreement;
- the European Community, for the currently 15 member States of the European Union.

2.6 Technical Guidelines for International Transport

In response to identified problems of alien species introductions through international transportation (see 1.2.3 above), relevant international organisations have developed or begun work on technical sectoral guidelines and instruments to minimise the risk associated with such pathways.

The International Maritime Organization (IMO) has been working on ways to prevent the spread of marine alien organisms in ballast water and sediments since the mid-1970s. In 1997, the IMO Assembly adopted *Guidelines for the Control and Management of Ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens* (Annex to Resolution A.868(20), Twentieth Assembly).[9]

The Guidelines are intended to assist Governments and appropriate authorities, ship masters, operators and owners, and port authorities, as well as other interested parties, in minimising the risk of introducing harmful aquatic organisms and pathogens from ships' ballast water and associated sediments while protecting ships' safety. They recognise that several States have unilaterally adopted binding regulations to minimise such risks through ships entering their ports, but call for this issue of worldwide concern to be addressed through action based on globally applicable regulations, together with guidelines for their effective implementation and uniform interpretation (see further 5.3.3 below).

The Resolution requests the IMO's Marine Environment Protection Committee to work towards completion of legally binding provisions on ballast water management, either as an Annex to the International Convention on the Prevention on Pollution from Ships (MARPOL, 1973, as amended, 1978) or as a completely new instrument. At the current time, negotiations are continuing on the development of a legally binding instrument.

Box 17: Possible Solutions to Minimise the Risk of Transferring Harmful Aquatic Organisms with Ballast Water

- Ballast water exchange in deep sea – as far as possible from shore;
- Non-release of ballast water;
- Taking on only "clean" ballast water;
- Treating the ballast water en route, such as with chemicals, heating, chlorine or ultraviolet radiation;
- Depositing the ballast water in special reception tanks at the port; or
- Biological treatment by adding predatory or parasitic organisms to ballast water.

(*Ballast Water News, Issue 1,* 2000*; IMO News, No. 4*, 1999.)

Turning to air transportation, the International Civil Aviation Organization (ICAO) adopted the Resolution on preventing the Introduction of Alien Invasive Species in 1998 (Assembly Resolution A-32-9, 1998). This urges ICAO Members to use their civil aviation to assist in reducing the risk of introducing, through civil air transportation, potentially alien invasive species to areas outside their natural range. The Resolution calls on the ICAO Council to work with other UN organisations to identify the approaches that the ICAO might take to assist in reducing the risk of introductions of alien invasive species.

2.7 Issues Related to Responsibility and Liability under International Law

In international law, States have a general responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or to areas beyond the limits of national jurisdiction. With regard to alien species, the question is whether States may be liable for "ac-

[9] The Assembly has power to adopt regulations and guidelines concerning prevention and control of marine pollution from ships (Article 15(j), Convention on the International Maritime Organization). Two relevant sets of guidelines have been adopted to date: the earlier 1993 *Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships' Ballast Waters and Sediment Discharges* (A.774 (18)) were revoked upon the adoption of Resolution A.868 (20).

tivities" that involve the intentional or unintentional export of a species to the territory of another State where it then becomes invasive.

At present, public international law on liability is under-developed, both generally and on the possible liability of States for this kind of damage. Such questions of liability raise complex questions of how different sets of international rules (biodiversity, biosafety, quarantine, and trade) fit together in the current state of international law. This extensive topic is beyond the scope of this Guide.

In general terms, however, it is important to lay the foundations for a system to strengthen international responsibility for activities generating biological invasions and, where feasible, to repair the damage caused to the environment of other States by introduced alien species.

States of export should recognise the risk that they may pose as a source of potentially alien invasive species and take appropriate actions to minimise that risk. These actions include the supply of information on potential invasiveness of the species to the importing/receiving State; compliance with internationally-agreed standards and procedures; and possibly support for capacity-building programmes for risk assessment of imports in States that lack the necessary framework. At the same time, a balance needs to be struck that takes account of the importance of international trade to developing economies and the resource and capacity demands that are potentially involved.

A few instruments do establish specific rules or recommended procedures for the State of export:

- the ISPM Code of Conduct for the Import and Release of Exotic Biological Control Agents (an international standard under the IPPC) sets out specific responsibilities for authorities of an exporting country, who should ensure that relevant regulations of the importing country are followed in exports of biological control agents;

- the FAO Code of Conduct on Responsible Fisheries recommends that States develop international agreements for trade in live specimens where there is a risk of environmental damage *inter alia* in importing States (section 11.2.10);

- the 2000 Cartagena Protocol on Biosafety requires the State of export to provide detailed information to each importing State in advance of the first shipment of living modified organisms that are subject to Advanced Informed Agreement provisions. Parties acting through the Conference of the Parties are called upon to set up a procedure to develop liability rules (Article 27).

Biodiversity-related instruments are essentially silent on this question.[10] At the current time, the Bern Convention seems to be the only treaty under which a formal recommendation covering liability has been adopted (see 2.2.1.3 above). The non-binding *Recommendation on the Eradication of Non-native Terrestrial Vertebrates* (No. 77, 1999), adopted by the Standing Committee to the Convention, provides that where a species introduced into the territory of a State spreads to neighbouring States or entire regions and damages their environment, this should give rise to the liability of the State from which it originated.

The counterpart of liability for damage caused to the environment in other States is the recognition of the right of victims to seek reparation. Principle 13 of the Rio Declaration calls on States to develop national law regarding liability and compensation for the victims' environmental damage and to cooperate in the development of further international law on the subject.

The Convention on Civil Liability for Damage Resulting from Activities Dangerous to the Environment (1993) may be regarded as a direct consequence of the adoption of Principle 13. It establishes a system of strict liability for damage caused to persons, property and the environment by activities carried out in a professional capacity which are considered as dangerous owing to their very nature. These include the production, culturing, handling, storage, use, destruction, disposal and release or any other operation dealing with genetically modified organisms or micro-organisms that present a significant risk for man, the environment or property. However, the Convention does not apply to introduced species other than GMOs and micro-organisms, nor does it cover carriage operations.

A public or private person engaged in inherently dangerous activities as defined is therefore liable for the damage caused by them, even if he has committed no fault and is able to prove that he has taken all possible precautions to avoid the accident. The few exceptions relate essentially to war or *force majeure*. Under the Convention, compensation for damage to the environment is limited to the cost of measures of reinstatement actually undertaken or to be under-

[10] The 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lays down specific obligations for States of export and import, but these have quite different objectives as they are designed to protect certain indigenous species against any or unsustainable international trade.

taken, the cost of preventive measures and any loss or damage caused by such measures.

Significantly, the Convention recognises the right of environmental protection organisations to request the prohibition of an unlawful dangerous activity that poses a great threat of damage to the environment or an order to force an operator to take measures to prevent damage or make reinstatement. It is therefore unfortunate that activities involving all categories of alien species introductions are not covered by the Convention.

2.8 Overview of the Existing International Regime

A series of brief observations may be made about the international instruments described above.

International instruments, like the scientific literature, use different terms to refer to alien species and invasiveness. Institutional practices and preferences vary, with some of the terms in current use being seen as unduly emotive or non-objective. The absence of standardised terminology is internationally agreed to constitute a problem and to impede communication and progress in this field. The Secretariat of the CBD has been requested to develop international standardised terminology on alien species in collaboration with other organisations such as FAO, IMO, UNESCO, GISP, relevant convention secretariats, and other international and regional organisations.

A mosaic of binding and non-binding international instruments address alien species. Some are well established, whilst others are extremely recent. Most focus on a specific dimension of alien-related issues, with regard to a particular protection objective (e.g. migratory species), kind of activity (e.g. introductions for aquaculture) or potentially damaging organism (e.g. pest). Some international instruments apply to living modified organisms, including genetically modified organisms, as well as alien species but there is no consistent practice in this respect. Nearly all of these instruments have their own institutional mechanisms and decision-making procedures.

The Convention on Biological Diversity provides a comprehensive legal basis for taking preventive and mitigation measures to address the full range of threats posed by alien invasive species (to genetic diversity, species diversity and ecosystem diversity). However, the single provision on this subject (Article 8(h)) is short, general and reliant on Parties' best endeavours. It provides little or no direction to Parties on how to go forward on implementation. The CBD's institutions have focused over the last five years on integrating alien species issues into the Convention's work programmes and on developing guiding principles (in interim form at the time of writing). This process is time-consuming as it calls for open exchange of experience, expertise and views between the various regions, institutions and sectors concerned. The possible development of a protocol on this subject, which will be further discussed at the sixth meeting of the Conference of the Parties in 2002, is even more complex.

The International Plant Protection Convention was adopted more than forty years before the CBD. In a narrower field primarily focused on agro-biodiversity, it imposes binding rights and obligations on its Parties. The IPPC has taken years to develop detailed standards and procedures and has significant experience of risk analysis for biological hazards. It is supported by a network of regional plant protection organisations and, at national level, by offices with well-established lines of institutional responsibility.

Turning to the international trading regime, the relationship between the WTO rules and trade-related controls on alien species introductions is still unclear to many governments. There are currently three organisations recognised under the WTO-SPS Agreement as international standard-setting organisations in the areas of food safety, animal and plant health. From the perspective of biodiversity conservation, however, these do not directly or explicitly address biodiversity or impacts of invasive species on the natural environment as much as may be desired under the Convention on Biological Diversity. There is currently no SPS-recognised source of international standards regarding general environmental and biodiversity protection against alien invasive species, except the IPPC as it relates to plant pests.

There is growing recognition that harmonisation and improved linkages need to be promoted between the parallel regimes dealing with phytosanitary, biosafety and biodiversity issues. The expertise vested in different institutions at international and national levels needs to be retained and strengthened, whilst building a basis for systematic consultation and co-operation with regard to new or broader standards and criteria.

At the present time, States should fully implement existing international rules and technical guidelines that provide important orientation on regulatory approaches and tools for dealing with alien invasive species issues. They should also contribute as appropriate to cooperation and dialogue on the questions discussed in this Chapter, with a view to addressing gaps, weaknesses and possible inconsistencies in existing international instruments and promoting greater harmonisation and effectiveness.

3.0 Key Legal Frameworks, Approaches and Tools

The international instruments discussed in Chapter 2 support a number of approaches, principles and tools to address alien invasive species issues. These are briefly outlined in this chapter and referenced later in the Guide where appropriate. The chapter contains the following sections:

- general frameworks for action (ecosystem management; international and transboundary cooperation);
- approaches for action (prevention; precaution; cost recovery/polluter pays; public participation);
- tools and procedures (risk assessment; environmental impact assessment).

3.1 Frameworks

3.1.1 Ecosystem Management

"Ecosystem" may be defined as a "dynamic complex of plant, animal, and micro-organism communities and their non-living environment interacting as a functional unit" (CBD, Article 2). The ecosystem approach is a strategy for the integrated management of land, water and living resources within a given ecological unit, that promotes conservation and sustainable use in an equitable way, based on the application of appropriate scientific methodologies.

The CBD, at the 5th meeting of the Conference of the Parties, urged other governments and relevant bodies to apply the ecosystem approach in their work on alien invasive species (Decision V/8). At the same meeting, it adopted twelve broad principles for the application of the ecosystem approach, together with a clear rationale underlying each principle (see Box 18). Those of particular relevance to the prevention and management of alien invasive species include:

- **Principle 2** (decentralise management to the lowest appropriate level). The rationale considers that where management is closer to the ecosystem level, this may increase the responsibility, ownership, accountability, participation, and use of local knowledge. This is pertinent to the design of measures for eradication and control of invasive species on community and privately-owned land (see Chapter 6 below);

- **Principle 3** (consideration of effects of management activities on adjacent and other ecosystems). This again recalls the importance of transboundary and inter-jurisdictional consultation given that ecological boundaries rarely coincide with political ones;

- **Principle 4** (economic context for ecosystem management). Applied to alien invasive species, this supports the removal of perverse incentives for unwanted introductions and the introduction of positive incentives for restoration and rehabilitation of native biodiversity (see also 4.3 below on reviewing legal frameworks to align incentives appropriately);

- **Principle 5** (conserve ecosystem structure and functioning). The rationale notes that conservation and restoration of ecological interactions and processes is of greater significance for the long-term maintenance of biological diversity than simply protection of species;

- **Principle 8** (varying temporal scales and lag-effects that characterise ecosystem processes). Given the problems of lag associated with biological invasion (see 1.1.2 above), a long-term approach must be taken to prevention and management of invasion processes;

- **Principle 12** (involve all relevant sectors and scientific disciplines). The problem of alien invasive species involves many different sectors and stakeholders (see 1.2 above). Approaches to address the problem should involve all relevant stakeholders and expertise at the local, national, regional and international levels.

From the scientific perspective, an ecosystem approach to alien species management needs to be based on the best available science which is continually adjusted to adapt to new information. Scientific research and data exchange enhances the predictive and quantitative basis for decision-making, and should inform the development of national standards consistent with international law.

From the legal perspective, implementation of the ecosystem approach tends to face two particular difficulties. First, jurisdictional boundaries within which legal systems operate seldom correspond to those of ecological units. Second, sectoral legal approaches often prevail over integrated ones. As a result the need for inter-jurisdictional cooperative management agreements and for mechanisms to operate cross-sectoral integration is acutely felt, both within national boundaries and between States.

Box 18: CBD Principles for the Ecosystem Approach[11]

The following 12 principles, adopted by the 5th COP of the CBD, are complementary and interlinked.

1. The objectives of management of land, water and living resources are a matter of societal choice.
2. Management should be decentralised to the lowest appropriate level.
3. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
4. Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should: (a) reduce those market distortions that adversely affect biological diversity, (b) align incentives to promote biodiversity conservation and sustainable use, and (c) internalise costs and benefits in the given ecosystem to the extent feasible.
5. Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.
6. Ecosystems must be managed within the limits of their functioning.
7. The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.
8. Recognising the varying temporal scales and lag-effects that characterise ecosystem processes, objectives for ecosystem management should be set for the long term.
9. Management must recognise the change is inevitable.
10. The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity
11. The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
12. The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

[11] Decision V/6 Adopted at the 5th Conference of the Parties, May 2000.

3.1.2 International and Transboundary Cooperation

As discussed above, prevention and management of alien invasive species are by their very nature international problems. The obligation of States to cooperate with each other derives from the very essence of general international law and is explicitly supported by many of the instruments outlined in Chapter 2. Concerted action at a global or regional scale is essential to address many of the pathways and activities that enable invasions to occur. This is fundamental for environmental reasons: first, because ecosystems and natural resources may straddle national boundaries, and second, because threats to ecosystems and natural resources often cannot be adequately addressed and regulated by States individually.

Alien invasive species issues illustrate these points well. Alien invasive species may move beyond the boundaries of the State where they were introduced, making bilateral or regional cooperation particularly important. International cooperation is also essential to come to grips with the various pathways and activities which enable invasions to occur, often making global cooperation a necessity. Because both the causes and consequences of invasions are shared, they can only be effectively addressed by concerted cooperative action.

In some regional or transboundary contexts, cooperative planning and management is particularly important. In isolated regions, not limited to those containing many island units, it may be appropriate for individual States to liase with neighbouring countries to identify common interests and to build complementarities in relevant policies, legislation, and practices.

Regional coordination is needed because of the ways in which unwanted introductions can occur. One possibility is where an alien species present in one country crosses a land or marine boundary and goes on to become invasive. A second is where an already alien invasive species spreads across a boundary and continues its invasion in another country. In both cases, the States concerned need to share information and data on a regular basis and to strengthen institutional, operational and management coordination. In the second case, it is essential that the State at risk of invasion is fully informed and consulted over appropriate strategies for eradication, containment or control.

Based on the above outline, legal frameworks on alien invasive species need to:

- provide for effective mechanisms to support international cooperation in developing international standards and procedures; and
- provide for bilateral and regional cooperation, with specific measures for notification, exchange of information and consultation between neighbouring states.

Many of these observations also apply to inter-jurisdictional cooperation between central and decentralised governments (discussed at 4.3.4 below).

Box 19: International Cooperation on Ballast Water Management

The International Maritime Organization (IMO) has joined forces with the Global Environment Facility (GEF) and the United Nations Development Programme (UNDP) on a new initiative: ***Global Ballast Water Management Programme – Globallast***. Globallast aims to provide USD 10.2 million to assist developing countries to reduce the transfer of marine alien species and protect their coastal and marine resources from marine alien species (*Ballast Water News, Issue 1,* 2000).

3.2 Approaches

3.2.1 Prevention

The duty to take preventive measures is laid down by all international instruments that concern alien species and also forms the cornerstone of most national legal frameworks that address this subject. Prevention is more cost effective and environmentally desirable than remedial measures taken after the introduction of alien invasive species. Once an introduced species becomes invasive, eradication may be impossible and the ecological damage irreversible.

In general terms, prevention applies to activities that may have serious adverse effects on the environment. It does not impose an absolute duty on States to prevent all harm (which is in any event impossible) but requires them to exercise due diligence and act reasonably and in good faith in prohibiting or regulating activities that could have such results. They should also put measures in place to prevent or minimise damaging consequences of activities that are permitted.

Many international and national instruments establish a threshold above which preventive measures should be taken. A common formula to describe this threshold is a phrase such as "which may have effects resulting in significant harm". The application of the preventive measure to a particular activity thus involves a prior assessment of the proposed activity, to determine whether it reaches this threshold.

In the context of alien species introductions, prevention applies to situations where the impact or risk associated with a proposed introduction or particular pathway is identified with sufficient precision to make it acceptable or unacceptable (c.f. the precautionary principle/approach, see 3.2.2 below). National legal systems need to provide procedures and criteria for preventing activities that are considered to fall outside this threshold.

Preventive actions will be different for intentional and unintentional introductions. For intentional introductions, prevention may take the form of total prohibition or partial prohibition, usually under a permit to which conditions may be attached. For unintentional introductions, the likelihood of unwanted introductions should be minimised by identifying and controlling common pathways through appropriate controls (quarantine systems, ballast water regulations, etc.) (see generally Chapter 5 below).

3.2.2 Precaution

Precaution relates to decision-making in situations of scientific uncertainty. The much-quoted formulation (Rio Declaration, Principle 15) holds that "lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation" (or, in the formulation used in the CBD Preamble, "shall not be used as a reason to postpone measures to avoid or minimise a threat of significant reduction or loss of biodiversity").

In international legal circles, there is much debate about whether the application of precautionary measures in environmental management reflects a policy approach or is derived from a legally established principle. What is clear is that precautionary measures are advocated, required or allowed by several international instruments, including the CBD, the Biosafety Protocol, the SPS Agreement (Article 5.7, in a limited way) and FAO Code of Conduct on Responsible Fisheries, and that this approach is being progressively consolidated in international environmental law.

Precaution is particularly relevant to alien invasive species issues because of the inherent scientific uncertainty and limitations on predictive capacity discussed in Chapter 1. The precautionary principle/approach provides a legal basis for using risk analysis tools (see 3.3.1 below) to inform decision-making of proposed introductions, activities and control strategies. It requires – or at least allows – decision-makers to take account of scientific uncertainty and to make judgements, based on objective, inconclusive scientific evidence and available knowledge, as to the level of acceptable uncertainty in a given context (which means that the conditions of prevention are not met, at least not yet). Environmental measures based on precaution should be proportionate to the anticipated risk and non-discriminatory (see also 2.5 above).

At the national level, many legal systems incorporate the precautionary principle/approach into general environmental or biodiversity legislation. With regard to alien species legislation, some contain relevant measures, with or without an explicit reference to precaution. By way of example, New Zealand's legislation on intentional introductions provides that all persons exercising functions, powers and duties under the Act must take account of the need for caution in managing adverse effects where there is scientific and technical uncertainty about those effects (Hazardous Substances and New Organisms Act of 1996).

3.2.3 Cost Recovery (The Polluter Pays Principle)

Governments and individuals who are required to bear the economic burden of preventing and redressing harm from alien invasive species may put mechanisms in place to obtain restitution from those responsible for the harm and the damage.

In some situations, traditional liability mechanisms may be adequate for this purpose. As is popular under some strict liability theories, the person most responsible for the harm should ensure that the government or private party is made whole. However, some traditional liability mechanisms have proved difficult to apply to cases of damage generated by alien invasive species. Reasons include difficulties of proof and timelag (see section 7.1 below on problems of compliance and accountability).

One way to address this deficit is to seek to internalise the 'external' cost of environmental damage through various mechanisms. Some contend that a party who imports the alien invasive species could be viewed as a polluter and liable under the "polluter pays" principle or approach. This holds that the polluter who creates an environmental harm is liable to pay the costs of remedying that harm. The natural or legal person responsible – who often stands to benefit commercially from the activity or process that generates the pollution – should therefore bear the cost of pollution prevention and control measures. In practice, this means that a polluter should not be subsidised for polluting activities and should have to pay for the installation of pollution control equipment.

Policy approaches of this kind are beginning to be applied more widely and innovatively in environmental management. Based on the underlying concept that the beneficiary of a damaging activity or process should pay for that benefit, or that 'consumers' of natural resources should pay for such uses, they may apply to developers, water users and, arguably, to introducers of alien species. In such cases, any incremental cost is likely to be passed on to the ultimate consumer.

However, the application of the polluter pays principle/approach to alien species control is both complex and controversial. An opposing view holds that the approach is not applicable to biological pollutants, because the invasion ('pollution') is ongoing, not site-limited and would involve more than a one-

time payment. Because of the numbers of actors and pathways involved in alien species introductions, mechanisms to promote accountability in accordance with this principle/approach should be treated as a priority matter (see Chapter 7).

There is a perceived danger that measures based on this principle/approach might undercut prevention/precaution by conferring a right to introduce alien potentially invasive species without the normal regulatory safeguards.

3.2.4 Public Participation and Access to Information

Public participation in environmental planning and decision-making is mandated by many international instruments, notably the Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters (Aarhus, 1998). It is increasingly reflected in national legal systems and administrative procedures.

Planning and decision-making procedures on alien species issues are complex and may require the involvement of governmental and non-governmental stakeholders in different sectors and at all levels. Open and transparent procedures involve creating opportunities for the participation of affected and interested parties, communities, and even the general public, in planning, permit-issuing procedures and development of invasive species mitigation and management strategies. Such participation may have educational effects and raise public awareness without which no regulatory system can be effective.

Participatory approaches need to be complemented by judicial review procedures to guarantee individual rights. Affected parties should be given the right to appeal decisions for the refusal of permits. On the other hand, there should be judicial remedies available for interested individuals/groups to challenge administrative decisions related to alien species introductions that are considered to be unlawful or inconsistent with protection or conservation objectives of relevant legislation.

3.3 Tools

3.3.1 Risk Analysis

Risk analysis procedures are mandated by certain international instruments, such as the IPPC (see 2.4.2), the WTO SPS Agreement (see 2.5 and Box 16), and the Cartagena Protocol on Biosafety (see 2.3.1). At the current time, international standards for this purpose have only been developed under the IPPC.

The risk analysis process is made up of three components: risk assessment, risk management and risk communication. The process seeks to identify the relevant risks associated with a proposed introduction and to assess each of those risks. "Assessing risk means looking at the size and nature of the potential adverse effects of a proposed introduction as well as the likelihood of them happening. It should identify effective means to reduce the risks and examine alternatives to the proposed introduction" (IUCN, 2000).

As noted earlier, uncertainty is an integral part of the scientific evaluation involved in risk analysis. Determining risk involves identifying possible harm and carrying out qualitative analysis and quantitative measurement, including probability of occurrence in comparison with other risks. The analysis should be designed to provide decision-makers with objective information needed to make technically justified decisions. Scientific evidence is a major element of these procedures.

Rating methods are often used in an attempt to measure relative risk. These range from simple methods based on qualitative measures (high, medium, and low) to quantitative systems using probability theory. Economic and ecological models may be used to estimate potential impacts of a pest becoming established. However, it is harder to attribute monetary values to natural resource values than to items with established market value such as agricultural crops. Some impacts – on species conservation status, on landscape quality, on aesthetic and spiritual values – do not lend themselves to economic analysis (Space, 1999).

Existing assessment models are still fairly primitive, based on chemical models that do not always account for processes of evolution and autonomous dispersal. As there are few shortcuts in predicting which introductions will become problematic, intensive biological research is needed on the species and the target community, particularly natural history research, as well as research on risk analysis procedures (Simberloff, 1999).

Regulatory frameworks should provide a legal basis for carrying out risk analysis not only of proposed introductions but also, where appropriate, of pathways for unintentional introductions and of eradication/control strategies, including any possible use of alien biological control agents. As mentioned in 3.2.2

above, risk analysis feeds into and informs the decision-making process.

To promote transparency and accountability, each stage of the risk analysis procedure should be documented and publicly available. In the context of alien species introductions, the analysis should:

- identify the likely ecological, social and economic consequences of introduction;
- identify and compare alternative measures, including likely ecological, social and economic implications, and their feasibility;
- review the choice of management strategies;
- evaluate the likelihood of introduction, spread or establishment of the alien invasive species under the proposed control or management measures (this should be assessed through a review of the scientific literature, use of experts' opinions and information on risk factors supplied by the applicant);
- determine how the proposed measures can be effectively implemented, including evaluation, monitoring and adjustment in light of new information.

3.3.2 Environmental Impact Assessment

Environmental impact assessment (EIA) is a familiar component of general environmental law and practice at both international and national level. It is mandated under the CBD not only for specific projects but also in a strategic perspective for programmes and policies that are likely to have significant adverse effects on biodiversity (Article 14). The CBD has called on Parties to integrate EIA into work programmes on alien species (Decision V/18). The Interim Guiding Principles recommends the use of EIA before making a decision on whether or not to authorise a proposed introduction of an alien species (see 2.2.1.1 above).

EIA seeks to ensure that adequate and early information is available on the likely environmental consequences of a project, on possible alternatives, and on measures to mitigate harm. It is generally a prerequisite to decisions to undertake or authorise designated processes or activities. It serves to inform decision-makers of the environmental consequences of decisions, and to integrate environment matters into other spheres of decision-making (see 5.2.3 below).

Procedural and substantive requirements for assessment of transboundary impacts are laid down by the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991). This requires that any potentially affected party be notified as early as possible of any proposed listed activity that is likely to cause significant adverse transboundary impacts. All stakeholders should have an opportunity to participate in EIA procedures and decision-making. The public in the affected area should be informed and have the right to participate in the decision-making procedure (see 3.2.4 above).

In applying this tool to alien species, a non-exhaustive list of factors that should be considered include:

- the cumulative, long-term, long-distance, direct and transboundary effects of alien species introductions;
- alternative actions, including prohibiting the proposed introduction;
- measures to avert or minimise the potential impact of the proposed introduction; and
- periodic review and monitoring to determine whether the introduction is in compliance with the conditions set out in the approval, and to evaluate the effectiveness of mitigation measures.

4.0 National Legal and Institutional Frameworks

4.1 Relationship between International and National Instruments

International instruments are often, though not always, fairly general in character. This tends to be the case particularly for global instruments, where the challenge to secure consensus between States with different levels of development (let alone different constitutional, legislative and administrative systems) is most apparent.

Legally-binding instruments generally use two techniques: 'performance' obligations, which require Parties to comply with obligations to achieve certain goals (*obligation de résultat*); and obligations to use prescribed means (*obligation de moyens*). Performance obligations leave individual Parties a choice as to the methods by which they will achieve the prescribed goal.

Provisions of international instruments are often couched in such a way that they are not 'self-executing'. This means that national legislation and regulations are necessary to make them operational in national legal systems. This may be done through existing national measures, or, if these are insufficient, by amending existing measures or adopting new ones. Such measures should include necessary steps to equip an administrative framework with appropriate decision-making powers.

Whether national measures should be legislative or regulatory will depend on the internal law of the State concerned. Certain matters usually have to be dealt with by legislation, notably the establishment of offences and penalties. Others can be dealt with at the level of regulations, issued by the relevant ministry or department, which can be updated and amended more easily.

4.2 Common Weaknesses of National Regimes

Recent case studies carried out within the framework of the Global Invasive Species Programme, together with a review of legislation and literature, point to considerable unevenness in the treatment of alien invasive species in existing national regimes.

National law, like international law, has developed by sectors over a long timescale. In most countries, alien-related provisions are distributed across nature and biodiversity conservation, water resources, agroforestry, fishing and quarantine legislation, and in some, in recent instruments dealing with the control of genetically modified organisms. Relevant provisions may also be found in hunting, fishing and wildlife regulations that address the introduction or release of species for purposes of re-stocking. The reasons for this sectoral approach are usually historical or administrative rather than scientific or technical.

Common problems may be loosely divided into the following categories:

- Fragmented Legal and Institutional Frameworks
  - Absence of a strategic approach to the problem, with alien-related issues ignored or having low visibility in national environmental or biodiversity planning processes.
  - Low levels of coordination and/or familiarity between agencies responsible for phytosanitary matters, trade, natural resource and biodiversity conservation and other sectors, with regard both to international standard setting and to legislative development and implementation.
  - Dispersed character of existing provisions and inconsistent legislative treatment, reflected in different institutions, definitions, criteria, standards and procedures.
  - Weak articulation between different levels of government, particularly in some federated or decentralised countries.
- Weaknesses Related to Coverage and Terminology
  - Gaps in taxonomy: frameworks do not specify whether they go beyond the species and subspecies level.
  - Gaps in scope of regulatory frameworks: common omissions include alien fish and microorganisms and introductions to certain types of ecosystems.
  - Lack of explicit objectives, reflecting a lack of awareness and conceptual ideas on how to deal with alien invasive species, or the presence of narrow objectives: some countries have no legal basis for prohibiting introductions of alien species unless these would harm agroforestry or fisheries interests.

  - Non-existent or inconsistent definitions of key terms.

- Problems Related to Compliance, Enforcement and Remedies

  - Exclusive reliance on 'command and control approaches', with little use of incentive measures or economic instruments to deter unwanted introductions or promote eradication and control.

  - Absence of legal measures to address pathways or vectors for unintentional introductions.

  - Risk analysis and permit procedures that are cumbersome, time-consuming and costly.

  - Absence of legally backed requirements for monitoring.

  - Absence of clear powers and obligations for eradication, containment or control; crisis management approach towards invasions.

  - Enforcement deficit (low levels of compliance, poor accountability) because conventional criminal and civil law procedures are difficult to apply in the alien species context.

4.3 General Considerations for Designing National Frameworks

4.3.1 Integrating Alien Species Issues into Strategic Planning Processes

National environmental and/or biodiversity planning processes may cover alien invasive species issues as one component of a comprehensive plan or as a stand-alone plan 'nested' within a broader strategic framework. They should seek to address any conflicts of interest and openly balance positive and negative aspects of alien species introductions. Due consideration should be given to long-standing and legitimate interests of many stakeholder groups (commercial forestry, horticulture, pet trade, private actors, etc.). This is important for building political and public awareness and contributing in the longer-term to improved compliance.

From a legal and institutional point of view, a strategic planning process should aim to:

- identify sectors and pathways associated with alien species introduction and/or use;
- identify all government departments and agencies at all levels that have a mandate for aspects of alien invasive species control and management;
- promote cooperation within and between relevant institutions and sectors;
- provide opportunities for participation of affected stakeholders and all interested parties;
- review existing policy, legal and institutional measures to identify gaps, weaknesses and inconsistencies;[12]
- identify and provide for the progressive elimination of "perverse incentives" (that promote risky or damaging practices) and support use of incentives for environmentally friendly practices;
- provide for the establishment of cost-effective preventive and mitigation measures tailored to national conditions and capacity, building where possible on the contribution that local communities and other stakeholders can provide; and
- support strategic assessment of programmes and policies that involve authorising or facilitating introductions of alien potentially invasive species.

The planning process provides a useful framework to evaluate and rationalise regulatory components of alien species control, management and monitoring systems. Many countries already have a suite of regulatory tools and criteria (e.g. risk analysis, environmental impact assessment, permit systems, periodic review, operational standards for transport and containment, etc.). At the strategic level, it is important to carry out a realistic appraisal of how these tools fit together, bearing in mind the needs and capabilities of the various agencies. The latter should not have to devote excessive amounts of time to consider each application *ab initio*. Administrative streamlining should also help to make alien species-related regulatory tools manageable for users and thus enhance acceptance and compliance.

The planning process should also support the development or expansion of a knowledge base, at national or regional level (see 4.3.2 below). Given the pace of change in scientific information, criteria for control of introductions, transport and other activities need to be capable of amendment, probably on a regular basis. This has important implications for the

[12] Guidelines for carrying out such a review have been adopted by the Ramsar Convention Conference of the Parties (see *Reviewing Laws and Institutions to Promote the Conservation and Wise Use of Wetlands.* Volume 3, Ramsar Toolkit).

design of regulatory tools and procedures: many conventional permit mechanisms have only limited provisions for mandatory amendments. Implementation programmes related to alien species control and management need instead to be designed for adjustment to the unexpected.

Strategic frameworks are important for countries and regions with geographically and evolutionarily isolated ecosystems and other vulnerable ecosystems. Isolation may be used constructively by improving government capacity to prevent unwanted introductions, through better knowledge, improved laws and greater management capacity, backed by quarantine and customs systems that are capable of identifying and intercepting alien invasive species (IUCN, 2000). The 1994 Programme of Action for the Sustainable Development of Small Island Developing States recommended that such States consider formulating integrated strategies and quarantine measures at national level.

A good example of regional cooperation for this purpose comes from the South Pacific Regional Environment Programme (SPREP) which has prepared a Regional Invasive Species Strategy. In the longer term, the Strategy may provide a common framework to support the development of harmonised legal frameworks for border controls and mitigation strategies.

4.3.2 Building a Knowledge Base

Decision-making related to alien species should be informed by an accurate scientific and technical knowledge base. Timely information is needed to make objective decisions on proposed introductions, allocate scarce resources and implement effective control options. It is also important for taking a strategic approach to the design of regulatory controls and procedures (see 4.3.1 above).

Few countries or management agencies currently have access to adequate information. Where statistics are incomplete or hard to obtain, impacts of invasions are often grossly under-estimated. This can make it hard to build political will for new or improved legislation. Lack of information also makes it harder to promote consistent decision-making by different administrative officers in different geographical areas, holding different functions.

As a minimum, legal frameworks should support identification and monitoring of alien species, as part of broader requirements for identifying and monitoring components of biological diversity. In many cases, it will be possible to use existing inventory procedures for gathering and processing information. A useful first step would be to fill gaps in basic information on local biodiversity, including taxonomic knowledge on native species, their status and distribution and the extent to which they are threatened by alien invasive species.

In addition, there should where possible be legal backing for the establishment of a knowledge base (Miller, 1999; see Box 20). The appropriate level for this will vary. Local (sub-national and national) databases facilitate the collection of smaller scale information applicable to local circumstances. The regional level may be most appropriate for certain parts of the world, including but not limited to groups of island States in the same biogeographical region. In the longer term, individual databases could contribute to the development of a global database (or linked databases) of all known alien invasive species (IUCN, 2000).

State practice

Some national Biodiversity Strategies specifically provide for inventories of alien species. In Poland, specific funding has been allocated to monitoring invasive species and updating records: scientific institutions and botanical gardens have been given responsibility for this task (Krzywkowska, 1999). Argentina's draft biodiversity strategy provides for the creation of a database of native and alien species, to include historical precedents and available data on harmful impacts (Di Paola and Kravetz, 1999).

In Australia, the Commonwealth's Environment Protection and Biodiversity Conservation Act (no. 91 of 1999) establishes formal requirements for identifying and monitoring biodiversity, linked to the criteria laid down in Annex I of the CBD. This extends to information about processes or activities that are likely to have a significant impact on conservation and ecologically sustainable use of biological diversity. Specific planning and management requirements apply to processes determined to be "threatening" to the survival, abundance or evolutionary development of a native species or ecological community (section 188). Invasions by alien species may clearly fall within this category.

New Zealand has a specific legal basis for gathering, recording and disseminating information on invasive species present on national territory, under its Biosecurity Act of 1993. This information is used as the basis for developing pest management strategies at national/regional level.

At the regional level, the Regional Invasive Species Strategy prepared by the South Pacific Regional

Environment Programme (see 4.3.1 above) provides for a regional system of information collection and exchange. Contributing states will collaborate on the compilation of black lists of invasive species (see 5.2 below).

Box 20: Suggested Content and Uses of a Knowledge Base

- Information on the status, distribution and history of native species (baseline data for comparison with information on invasives).
- Information on the status, distribution and characteristics of alien species known to exist in each country and, where applicable, its sub-national units.
- Case histories on past invasions, including information on time lag, which can obscure human perception of the invasion process.
- Information on ecological and economic impacts associated with different alien invasive species, to improve prevention and prioritise mitigation strategies.
- Records of commercial practices leading to invasions (e.g. shipping, trading patterns between and within countries) and other pathways, to provide a basis for developing new regulations or sectoral codes of conduct as necessary.
- Statistical information and models to develop and strengthen predictive capacity on:
  - taxonomy and ecology of likely invasive species;
  - which alien species pose the greatest risk of harm;
  - what species have proved invasive elsewhere under similar conditions;
  - what conditions are necessary for successful invasions;
  - the implications of genetic variability for invasiveness;
  - where an invasive species is likely to go next; and
  - implications of environmental change, including global climate change.
- Technical advice and support to border control and quarantine officers, for use in applying regulations and developing contingency plans and rapid response tools. This may include generating advance lists of likely problem pests so that they can be identified and appropriate responses developed before they arrive.
- Information on longer-term response mechanisms, including the various control options and the results of their application elsewhere.
- Inventory of areas that are pest-free and/or of importance for biodiversity or other reasons, so that particularly stringent contingency plans and required resources or technical personnel can be put in place.

(Bax, 2000; Fowler 1999; Miller 1999; Sherley 1999).

4.3.3 Primary Goals and Components of Legislation

Based on an overview of international instruments and national best practice, a checklist of elements that should feature in comprehensive national frameworks on alien invasive species may be offered. Competent authorities need to be empowered to take regulatory measures, supported where appropriate by incentives, to:

- implement and enforce international standards in quarantine measures and transport controls;
- apply preventive and precautionary measures, using risk analysis, permits, or other appropriate tools, to controlling introductions into and within a country or province;
- prohibit, or strictly regulate, the use and release of alien species in or near closed or vulnerable ecosystems and protected areas;
- provide for monitoring, early warning and emergency planning systems to support rapid responses when biological invasions are detected;

- require timely measures for eradication or control of species that are already invasive or become invasive in the future, subject as necessary to prior assessment of techniques to be used;
- strengthen compliance by public, commercial and private actors; and
- support research, training, education and public awareness.

Regarding education and public awareness, it should be emphasised that regulatory frameworks alone cannot solve problems related to alien invasive species. They need to be complemented by non-regulatory efforts, particularly information, education and awareness-raising campaigns. A well-educated public is a prerequisite of a well designed and a well-enforced legal system. Experience in many countries shows that there is a dramatic lack of knowledge, awareness and commitment with regard to the problems of alien invasive species. National planning processes and regulatory regimes should therefore provide for the duty and the means to improve public awareness of alien invasive species problems.

4.3.4 What Kinds of Laws: Unitary or Multiple Approaches?

Various options may be considered to address sectoral fragmentation.

The first – and most ambitious – is to review and consolidate existing measures into a unitary legislative framework that covers all categories of species, all sectors, all ecosystems and the full range of actions to be taken, and has the potential to ensure consistent practice.

Legislative reform on this scale is politically and technically complex and may generate resistance from powerful administrations with long-established mandates. At the current time, no country seems to have concentrated its legislative effort into a single law. New Zealand, which is widely considered to have some of the most comprehensive and consistent legislation on the subject, has enacted two main statutes. These deal respectively with intentional introductions of aliens and GMOs (Hazardous Substances and New Organisms Act of 1996) and unintentional introductions and management/control planning (Biosecurity Act of 1993).

A second option is to enact core legislation on the control and management of alien invasive species to determine common essential elements and to harmonise goals, definitions, criteria and procedures (Miller, 1999). An instrument of this kind could also be used to nominate or establish a co-ordinating body as lead authority.

A third option – taking a minimalist but probably realistic approach – is to harmonise relevant sectoral laws and regulations to ensure the absence of conflicting provisions and promote more uniform and consistent practice in the country concerned. Again, a co-ordinating body would be necessary to establish indicators for harmonisation and provide necessary advice.

4.3.5 What Kinds of Institutions and Coordination Mechanisms?

In most countries, responsibility for alien invasive species control is shared between various sectors at various levels. There is often no coordinating framework to link the high number of administrations and agencies with relevant powers or duties or to ensure consistent implementation.

As a minimum, steps should be taken to identify any institutional and administrative conflicts of interest. Such a conflict may arise where the same agency is legally responsible both for regulating and promoting trade. For example, the same department may have a statutory duty to promote agricultural, forestry or fisheries development and to enforce quarantine controls. Practical difficulties can arise where sectoral officials come under pressure from traders to release consignments from post-entry quarantine earlier than scientific caution might dictate (Hedley, 1999). It is preferable for these line responsibilities to be clearly separated.

Appropriate institutional arrangements depend on the regulatory system and on which government sectors are involved in alien invasive species control and how they are supposed to cooperate. Under a unitary framework, lead responsibility may be given to an existing authority (such as the nature conservation authority, agriculture department, or public health authority) or to a specially established body. New Zealand has established two special bodies to control intentional introductions. The Biosecurity Authority, which is part of the Ministry of Agriculture & Forestry, is primarily responsible for controlling unintentional introductions, while eradication/control of alien species that have already been introduced is handled by local government.

Even in a system with an overall regulatory authority, other competent agencies will retain certain generic responsibilities, particularly for planning and enforcement purposes. Customs authorities play an

important role in the application and enforcement of border controls. In the island State of Samoa, for example, the Customs Department administer the Plants and Soil Importation (Disease Control) Regulations, which effectively doubles the enforcement capacity of the Quarantine section (Peteru, 1999).

In countries where (parallel) sectoral laws and regulations remain in place, responsibility for alien invasive species control will be shared between the relevant sectoral institutions and agencies. Coordination is essential to ensure consistent practice. Mechanisms for this purpose may take the form of cross-sectoral commissions or committees involving the representatives of all governmental institutions involved. In the United States, a federal Invasive Species Council has recently been established[13] to coordinate activities regarding alien invasive species.

A coordination mechanism may have permanent members and *ad hoc* members who are involved in particular cases. It may be appropriate to include permanent or *ad hoc* representatives of non-governmental organisations as well as relevant government institutions and possibly representatives of local government (see 4.3.4 below). A coordination body usually has mainly advisory functions but can also be given powers to resolve conflicts.

States should also consider establishing a scientific authority for alien species control. The authority would provide scientific input to planning and decision-making procedures, including EIA and risk analysis, and advise on the design and amendment of regulatory measures and criteria. Legislation should specify the respective functions of the regulatory and scientific authorities and provide for necessary cooperation mechanisms between the two bodies.

4.3.6 Relationship between National and Sub-national Laws and Institutions

Particularly in federated or decentralised systems, the structure of government can present additional problems. In accordance with the constitution, law-making and enforcement powers will be divided between national and sub-national institutions depending on the subject matter and the type of government activity. For alien species, divisions of powers for biodiversity conservation, agricultural pest control, release of genetically modified organisms and other matters can raise difficulties with regard to coordination and consistent practice (Di Paola, Kravetz, 1999).

In federal States, certain subjects are usually the exclusive responsibility of national government. These include matters related to external trade, such as international trade in commodities and species as well as quarantine and pest control measures that may involve import restrictions. National governments also have the power to negotiate and ratify treaties on all subjects.

Powers and duties of sub-national units (provinces, cantons, *Länder*) vary depending on the constitution and applicable laws of the country concerned. Those most relevant to alien species management may cover domestic trade and transport, infrastructure development, land and water management and nature conservation.

In all countries, lower levels of government carry out important planning, implementation and enforcement functions. Provincial, regional, district or local institutions may be responsible for development planning, environment and nature conservation planning, and for issuing licences and monitoring compliance. These powers are directly relevant to on-the-ground management of alien species and responses to possible invasions.

In countries where relevant powers are exercised by different tiers of government, steps should be taken to promote consistency and harmonisation concerning inter-jurisdictional movements of goods and organisms and the applicable standards and procedures (e.g. for risk analysis, permit systems and operating conditions). Consistent rules are needed to avoid situations where stringent measures adopted in one sub-national unit are undermined by weaker measures in a neighbouring unit (e.g. where a species lawfully imported into one unit crosses a political boundary and becomes invasive in a unit that prohibits its import). It may be appropriate for basic rules and standards to be adopted at the highest level of government, to provide a consistency framework within which sub-national units can develop more detailed regimes suited to provincial circumstances and practices. One option to promote harmonisation could be to organise sub-national conferences on thematic issues aimed at developing common elements for provincial legislation.

The above observations are relevant *mutatis mutandis* to regional economic integration organisations that promote free movement of goods within their borders and between their member States, and thus require defined areas of domestic legislation to be consistent with supra-national legal measures.

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[13] Executive Order 13112 (February 3, 1999) (William J. Clinton), 64 Federal Register 6183.

4.4 Objectives and Scope of Legal Frameworks

As lawmakers move beyond a piecemeal approach to alien species, they need to consider carefully the purpose and scope of the laws and policies they wish to amend or adopt. The following sections discuss aspects that are relevant to all types of regulatory frameworks, whether unitary or sectoral.

4.4.1 Objectives

Explicit objectives are necessary to provide a conceptual framework to develop the legislation itself, guide implementation, set priorities and build awareness. These should be consistent with the general objectives for conservation and sustainable use of biodiversity laid down by the Convention on Biological Diversity.

Specific objectives for alien species legislation may include:

- protection of animals, plants, plant products and human health against alien pests, including pathogens;
- protection of species, subspecies and races against contamination, hybridisation, and extinction or extirpation;
- protection of native biodiversity, biological resources and ecological processes against adverse impacts generated by alien invasive species (and, if covered by the same legislation, by genetically modified organisms);
- protection against biosecurity threats, defined as matters or activities which, individually or collectively, may constitute a biological risk to the ecological welfare or to the well-being of humans, animals or plants of a country (IUCN, 2000).

4.4.2 Species Coverage

Legislation should clearly indicate the taxonomic coverage of its provisions, to provide legal certainty for administrative agencies and all parties involved in the introduction and use of alien species.

As noted in Chapter 1, invasions can be generated by organisms throughout the taxonomic scale, from fish and microscopic plants to bacteria and viruses. Alien species that go on to become invasive can come from any taxonomic group. Documented invasives include introduced fungi, algae, mosses, ferns, higher plants, invertebrates, fish, amphibians, reptiles, birds and mammals.

Legislation on alien invasive species should cover all groups of species. Where national frameworks comprise several laws and regulations, it should be checked that no taxonomic groups are omitted. Information on the taxonomic coverage of each instrument needs to be easily accessible.

Legislation should also provide a definition of "species" that unambiguously covers lower taxonomic units, since these are capable of generating invasions (see 1.1.2 above). A broad-based definition for this purpose would include subspecies and lower taxa, as well as any part, gametes or propagule of such species that might survive and subsequently reproduce (IUCN, 2000).

Decisions on species coverage may also pertain to living modified organisms, including genetically modified organisms. Lawmakers need to consider whether LMOs/GMOs should be covered by a special regime or treated for legal purposes under more general legislation. There is no settled practice in this area, at present: some examples of possible approaches are discussed in 4.5 below, which focuses on legal definitions.

4.4.3 Geographic Coverage

Invasion processes may affect all types of ecosystem, although some are known to be particularly vulnerable (geographically or evolutionarily isolated ecosystems, including oceanic islands, aquatic ecosystems, etc.). All parts of the national territory may be affected if an invasion takes place.

Legal frameworks therefore need to provide a basis for regulating introductions of alien species to any type of ecosystem and for monitoring and managing their use wherever this takes place. At the current time, however, regulatory coverage is often much stronger for terrestrial ecosystems, particularly areas used for agriculture and forestry, than it is for the coastal and marine environment or inland water systems.

In States with islands, other vulnerable ecosystems or federated or decentralised systems, special measures may need to be taken to apply regulatory controls to introductions, especially across internal jurisdictional boundaries (see 5.1.3-4 below).

4.5 Legal Definitions and Use of Terms

4.5.1 The Importance of Consistent Terminology

Definitions are used in legislation and regulations to provide an agreed meaning for a particular term, whenever it is used in a specific text, and to clarify the scope of the legislation. They underpin many operational components of legislation. The definitions discussed below, for example, determine what administrative powers actually cover as well as the basis for listing species, formulating technical criteria and possibly attributing liability.

Definitions therefore go to the heart of legal certainty. All actors, from quarantine personnel to shippers, traders and farmers, need to know where they stand. Consistent use of terms helps to facilitate communication between different sectors and to build public awareness of alien invasive species issues.

Terms should be defined when their meaning is unclear, highly technical or where the selected interpretation differs from that in normal usage (Glowka *et al.*, 1998). Where possible, internationally agreed terminology and standards should be used in relevant legislation and regulations to promote consistency and clarity. The CBD Secretariat, in collaboration with other international and regional organisations, is currently developing standard terminology on alien species for presentation to the Parties at the 6th Meeting of the COP (Decision V/8).

At present, many national legal frameworks are faced with non-existent, inconsistent or incomplete definitions. The difficulties this creates are often neglected or underestimated. Particular problems arise where the same terminology is used to mean something different in different sectoral laws or in different provinces. Conversely, different terminology is sometimes used to mean the same thing! The term "biological diversity", as defined by the CBD and reproduced in several national laws, does not distinguish between native and alien components of biological diversity.

The first task is to ensure that key terms are clearly defined, and that the relevant provisions can be made operational. Where definitions are lacking, this may demonstrate a lack of legislative focus on invasive species (Peteru, 1999). Samoa, for example, has a legal basis to issue regulations for outlying islands for the "preservation of their *indigenous* or *introduced* fauna or flora", but neither of these terms is defined (Section 146(f), Lands, Surveys and Environment Act of 1989).

The second general task is to ensure that terms are used without ambiguity to achieve their intended purpose. Legislators need to decide whether the same law is intended to apply to both alien invasive species and native invasive species. If both are to be covered by the same law, it is probably clearest to provide separate definitions and draft separate provisions because the legal and management issues are somewhat different (see 1.1.3 above). Shorter laws are always appealing, but can lead to confusion if the same term is used to refer to rather different phenomena.

The following sections discuss the legal definition of selected terms and give some examples of State practice in this area.

4.5.2 "Native"

A legal definition of "native" (or synonyms such as "indigenous") may be generally useful, particularly in the context of biodiversity conservation legislation (see further the discussion in 6.1.2). It is particularly important if the legislation also provides for conservation and recovery measures for native species and ecosystems, for example through species re-introduction. In such cases, it is desirable to be able to define objectively what constitutes "native" and may therefore qualify for re-introduction under appropriate safeguards.

Temporal and spatial dimensions are central to defining "native". Movements of alien species are an integral part of world social and economic history, as revealed through oral as well as written historical records. However, there is no scientific consensus on how long an introduced species must have been established on national territory to be considered part of native biodiversity (if this is ever possible).

In deciding what is "native" for legal purposes, a cut-off date is often drawn at some point in the past. Only species introduced before that date will be deemed to be "native". The approach taken is likely to vary between countries and regions, depending partly on biogeographical conditions and past experience of biological invasions.

The legal effects of a cut-off date or period depend on when it is set. If it is far back, species that have been introduced subsequently and have naturalised or even become invasive will not fulfil the definition of "native". This may provide a legal basis for tak-

ing control measures for such species, even though they may have been present on national territory for a very long time (human timescale).

Historical cut-off dates raise clear difficulties with regard to proof: intensive natural history research will be needed to determine whether or not a particular species meets the definition of "native". For ease of implementation, the simplest approach is probably for legislation to provide that a species will be deemed not to be "native" unless the applicant (for an introduction or related action) can prove to the competent authority that it does indeed meet the definition.

State practice

Australia has recently adopted an exhaustive definition of "native species", which uses both temporal and geographic parameters.[14] The definition covers a species:

(a) that is indigenous to Australia or an external Territory;
(b) that is indigenous to the seabed of the coastal sea of Australia or an external Territory;
(c) that is indigenous to the coastal shelf;
(d) that is indigenous to the exclusive economic zone;
(e) members of which periodically or occasionally visit:
    (i) Australia or an external Territory; or
    (ii) the exclusive economic zone; or
(f) that was present in Australia or an external Territory before 1400.

Hungarian legislation links the definition of "native" not only to time but also to the concept of human agency. "Native organism" is defined to mean any wild creature which lived or still lives in the natural geographic region of the Carpathian Basin in the last two thousand years, and not as a result of introduction, whether or not intentional. Usefully, the Act provides a separate definition of a "resettling species", namely any native living species which once became extinct in Hungary, but through natural range expansion, reappears in the Hungarian flora or fauna.[15]

In Germany, the definition of "native" (*heimisch*) shows how a definition can be ambiguous if it is not sufficiently precise. The federal Nature Conservation Act of 1976, as amended, defines the term to cover any animal or plant species which has or previously had its area of distribution or regular migration wholly or partly in Germany or which spread by natural means into Germany.

This definition potentially applies to alien species that have reverted to the wild state or become naturalised by human influence and have maintained populations in the natural environment for several generations without human support. It may lead to conflicts of legal principle where the re-introduction of a formerly indigenous species is under consideration. Moreover, because the same legal status applies to species with rather different origins, it may be difficult to provide a legal basis for targeted control mechanisms (Gündling, 1999).

4.5.3 "Alien" and its Relationship to Living Modified Organisms

Where legislation does not define "native", it is obviously essential to define "alien". Even where "native" is defined, however, there are several advantages to providing a corresponding definition of "alien". Without such a definition, the meaning of "alien" has to be worked out by deduction (i.e. everything not covered by the definition of "native"). This may make it harder to promote consistent interpretation and practice and to build clear avenues of communication and advice between lawyers and scientific advisors. It may also reduce the general visibility of alien invasive species.

Any attempt to define "alien" (or equivalent terms such as "exotic" or "non-native") raises the question, "alien to what?". For scientists, the response may refer to a species occurring outside its "normal distribution". For lawmakers, however, this formulation needs to be translated into terms more capable of objective verification within the legal process (see 1.1.1).

The definition of "alien" should exclude any concept of threat or invasiveness. As discussed earlier (1.1.2), alien species that become invasive are a small and unpredictable subset of alien species as a whole. The legal definition of "alien", and the suite of regulatory measures that attach to species covered by the definition, therefore need to cover all alien species without any limiting reference to possible harm. It must be able to cover 'sleeping species' that have not displayed invasive characteristics but which breed and might eventually become invasive, possibly far into the future. This comprehensive stance, consistent with the precautionary principle/approach, is essential because of low predictive capacity, problems

[14] Sec.528, Environmental Protection and Biodiversity Conservation Act of 1999.
[15] Sec.8, Nature Conservation Act of 1996.

of timelag and the failure of reactive or crisis management approaches (see further 4.5.4 below).

Three parameters appear to be useful when drafting a legal definition of "alien". These are spatial, temporal and process-related, and may be used in combination.

Spatial (area-based) parameters may be aligned with national jurisdictional boundaries or with ecosystem boundaries.

The jurisdictional approach may be adequate for species introduced from distant regions, for example through transoceanic pathways, as they are unlikely to occur naturally anywhere in national territory. However, it has important disadvantages. It does not permit a species to be qualified as "alien" if introduced from one part of a country to a different part in which it does not already occur. This is unsatisfactory from an ecological point of view, especially in larger countries with several biogeographical regions and also in multi-island states. The latter can be extremely vulnerable to transfers between islands because these may each have different endemics, even though they are relatively close to each other. The Galapagos Islands, Ecuador, provide a good illustration of this situation.

The ecosystem-based approach is more satisfactory in scientific terms. From a legal/administrative point of view, it probably requires a case-by-case prior determination of what the "ecosystem" is in a given case in order to determine whether a species is actually alien (See 3.1.1).

Temporal parameters situate the concept of "alien" by reference to a particular date or timeframe. They work *mutatis mutandis* in the same way as the cut-off date described for definitions of "native" above.

Process-related parameters concern the possible inclusion of modified organisms within the definition of "alien". As discussed in 1.4 above, it is possible to view LMOs/GMOs as a subset of alien species for legal purposes and to integrate these strands of regulation within one biosecurity framework. National practice, like international instruments, varies in this respect. Where broad terms such as "living organisms" are used, these could also be applied to LMOs/GMOs unless the latter are specifically excluded from the scope of the definition.

The following examples show how States have used different parameters in reaching a legislative definition of "alien".

State practice

Costa Rica's modern biodiversity legislation uses jurisdictional parameters. It defines an alien species as "a species of flora, fauna or micro-organism, *whose natural area of geographic dispersion does not correspond to the national territory* and is found in the country, be it a product of voluntary human activity or the activity of the species or not" (Article 7.17, Biodiversity Act 1998, italics added).

Several countries support the use of ecological parameters, rather than political-jurisdictional ones.

In the United States, Executive Order 13112 of 1999 defines "alien species" as meaning "with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem." South Africa's 1997 White Paper on the Conservation and Sustainable Use of Biodiversity[16] describes alien organisms as plants, animals and micro-organisms which do not naturally occur in an area, and which are deliberately or accidentally introduced by humans to ecosystems outside of their natural range.

German legislation uses the word "alien" in the sense of "alien to a region" or "non-local" (*gebietsfremd*) (Section 20(d)(2), federal Nature Conservation Act of 1976).

Temporal parameters are used as part of New Zealand's definition of "new organism" (Section 2, Hazardous Substances and New Organisms Act of 1996). The definition covers *inter alia*:

- an organism belonging to a species that was not present in New Zealand immediately before 29 July 1998;
- an organism belonging to a species, subspecies, infrasubspecies, variety, strain or cultivar prescribed as a risk species under the Act, which was not present in New Zealand when the Act was promulgated;
- an organism that belongs to a species, subspecies, infrasubspecies, variety, strain or cultivar that has been eradicated from New Zealand.

On the relationship between "alien" definitions and LMOs/GMOs, many countries define and regulate LMOs/GMOs separately from alien species. Some have gone much further in developing regulatory frameworks for LMOs/GMOs than for controlling alien invasive species. In India, for example, the draft biodiversity legislation is apparently silent on alien invasive species issues but establishes detailed measures for GMOs (Desai, 1999).

[16] *White Paper on the Conservation and Sustainable Use of South Africa's Biological Diversity*: GNR 1095. Government Gazette 18163, 28 July 1997.

A small number of countries support more or less integrated approaches. Hungarian law, for example, provides for the development of specific regulations on GMOs that must be consistent with the objectives of the Nature Conservation Act of 1996. Costa Rica's Biodiversity Act of 1998 takes a broadly similar approach.

New Zealand seems to have gone furthest towards a streamlined approach. "New organism" is defined to include a genetically modified organism which has not previously been approved for release in New Zealand (in addition to the matters listed above and organisms that have not been approved for importation for release or release from containment).

4.5.4 Concepts of Threat and Harm ("Invasive and "Pest")

The Convention on Biological Diversity does not apply to all alien species but only to those "which threaten ecosystems, habitats or species."

Relatively few national frameworks provide for the protection of all components of biodiversity against invasive processes, as mandated under the CBD. It is more common to find a legislative focus on protection of agriculture, forestry and fisheries production systems. This is not surprising, because the most developed sectoral regimes relevant to alien species have long been located in departments with specific expertise on quarantine issues. The broader environmental focus now being elaborated at international level (notably within the IPPC) is not always reflected at national or sub-national level, where linkages between agriculture and natural resource conservation departments may be underdeveloped.

Because threat is not in itself an objective concept, lawmakers need to find a way of expressing the threat/harm aspect of invasiveness with a reasonable degree of precision. Interested parties and administrative agencies need to know when particular management and control measures should be triggered. In other words, there has to be some kind of legally defined filter to identify the subset of alien species that should be subject to eradication, containment or control strategies.

Many countries already have long-established definitions of "pest" and/or "weed", though these are often applied to native as well as introduced species. "Pest" is generally used to refer to all kinds of organisms (see 2.4.1 above on the IPPC definition of "pest"), whereas "weeds" refer exclusively to plants. However, it may be necessary to review this terminology to ensure that it is broad enough to cover threats to all components of biodiversity or to ecological functions.

Emerging State practice shows a trend towards specifically defining the subset of alien species that are considered to present particular risks and thus to warrant particular regulatory safeguards.

State practice

Hungary's Nature Conservation Act of 1996 focuses exclusively on ecological impacts in its definition of "harmful introduced species". This refers to any living organism which does not qualify as native from the phytogeographical or zoogeographical point of view, and in case it establishes and adapts itself, may be capable of modifying the natural processes of the Hungarian wildlife communities unfavourably for the native species (Article 8 (3-4)).

A broader approach is taken in the United States, Executive Order 13112 of 1999. This defines "invasive species" as "alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." South Africa's 1997 White Paper proposes that alien organisms be divided into two categories: (a) those that are problematic and harmful, in that they negatively impact on biodiversity; and (b) those that are benign and serve useful purposes.

New Zealand uses twin concepts of "new" and "unwanted" organisms. Under the Biosecurity Act of 1993, an "unwanted organism" means "any organism that a Chief Technical Officer believes is capable or potentially capable of causing unwanted harm to any natural and physical resources or human health." If import approval is refused for a "new organism" (see 4.5.3 above), it is automatically classified as an "unwanted organism". This classification provides a legal basis for implementing pest management strategies.

4.5.5 "Introduction"

All legislation needs to define the actions, activities and processes to which it applies. In the context of alien species, it is important to define the term "introduction", as the act that gives rise to the possibility of later invasion.

Once a movement of an alien species has taken place, there is no such thing as a zero risk of escape, release or spread. Given this inherent uncertainty and consistent with the precautionary principle/approach, the definition of introduction needs to be broadly for-

mulated to cover all actions that involve the risk of such movement.

The IUCN Guidelines offer a comprehensive definition. "Introduction" is defined as "the movement, by human agency, of a species, subspecies, or lower taxon (including any part, gamete or propagule that might survive and subsequently reproduce) outside its natural range (past or present). This movement can be either within a country or between countries" (IUCN, 2000).

Within this all-encompassing definition, a distinction may be made by reference to human intention: this has implications for the selection of regulatory controls (see generally Chapter 5).

Intentional introduction may be defined as "an introduction of a species made deliberately by humans, involving the purposeful movement of a species outside its natural range and dispersal potential (such introductions may be authorised or unauthorised)" (IUCN, 2000). This definition is broad enough to cover not only the intentional introductions for purposes described in section 1.2.1 above but also the escape or release of alien species from situations of lawful containment in captivity (see 1.2.2).

Unintentional introduction is an unintended introduction made as a result of a species utilising humans or human delivery systems as vectors for dispersal outside its natural range (IUCN, 2000). This covers the range of potential pathways described in 1.2.3 above.

State practice

Hungary's Nature Conservation Act of 1996 uses an inclusive but fairly general definition. "Introduced organism" is defined to include any organism that has become part of Hungary's flora or fauna due to man's intentional or unintentional introduction.

United States Executive Order 13112 of 1996 sets out a more exhaustive list of the actions that are deemed to constitute an "introduction", which provides a clearer basis for application and enforcement. The definition includes "intentional and unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity." This is broad enough to cover situations where alien species are introduced to the wild from containment or captivity.

Some countries use introduction-type terminology but without specific definitions. In Germany, for example, the federal Nature Conservation Act of 1976 uses the terms "release" and "installation" but does not define them. In practice, however, there is a consensus that "release" means setting free without control or management measures, whereas "installation" means setting free with control or management measures. The Act does not define or regulate unintentional introductions (Gündling, 1999).

5.0 Measures to Prevent or Minimise Unwanted Introductions

Legal frameworks should be designed to prevent and minimise the risk of introduction of alien species that may become invasive, both between and within countries. Particular measures should be taken to exclude such species from areas of high biodiversity, including protected areas, and other isolated or vulnerable ecosystems. The appropriate locus for legal controls is discussed in 5.1 below.

For legal and practical purposes, a distinction must be drawn between intentional introductions (including those for situations of captivity or containment) and activities presenting risks of unintentional introductions.

In the first category, there is an identifiable party proposing the introduction as well as an identified alien species under consideration (except of course where clandestine introductions are made illegally). Risk and uncertainty about the possible consequences of the introduction will still be present in many if not most cases, but may be directly addressed through appropriate assessment tools. The activity concerned should generally be made subject to approval, possibly subject to conditions (see generally 5.2 below).

In the second category, the legal process has to attach to parties who conduct activities that provide pathways for introduction and to projects presenting such risks. Some pathways are known and already subject to specific regulation, at least in some countries. Some are known but not addressed in any systematic way. Still others are connected to private actions and handling of alien species, which makes regulatory intervention and enforcement difficult (see generally 5.3 below).

Whatever the category of introduction, legal frameworks need to make proper provision for monitoring and early warning systems (see 5.4 below).

5.1 Where Should Control Measures be Applied?

Many introductions of alien species occur, intentionally or unintentionally, in the context of international trade, transport, travel and tourism. Control measures in this situation may be applied at the point of origin (export), destination (import) or both. The next two sections outline considerations and State practice in this area (see 2.5 above on the compatibility of import controls for environmental purposes with the international trading regime).

5.1.1 At the Point of Origin or Export

To the extent possible, procedures should be put in place to minimise the risk of transferring alien species to countries or ecosystems in which they may become invasive.

At the international level, certain standards or guidance are applicable to States of export (see 2.7 above). In addition, some international instruments mandate procedures based on Prior Informed Consent (PIC) or Advanced Informed Agreement (AIA), whereby defined goods or products may not be imported unless the importing State has first been notified and given its consent. AIA is specifically required for transboundary movements of LMOs intended for introduction into the environment, under the Cartagena Protocol on Biosafety (see 2.3 above).

Measures of this kind are closely dependent on information exchange and cooperation in good faith between the States concerned. Possible indicators have been suggested in the draft Interim Guiding Principles under consideration within the CBD framework. These relate to:

- the supply of information: if a State of origin is aware that a species being exported has the potential to be invasive in the receiving State, it should provide information, if available, on the potential invasiveness of the species to the importing/receiving State. Particular attention should be paid where the States concerned have similar environments;
- development of bilateral or multilateral agreements between States to regulate trade in certain alien species, with a focus on particularly damaging alien invasive species;
- support for capacity-building programmes for risk assessment of imports in States that lack the expertise and financial or other resources to assess the risks of introducing alien species.

State practice

At national level, few countries seem to have a legal basis for controlling exports of alien species that might present risks for native biodiversity *per se*.

In the United States, the earlier Executive Order on alien species (11987 of 1977) contained an innovative provision. It directed executive agencies to prevent the export of native species "for the purpose of introducing such species into ecosystems outside the United States where they do not naturally occur." However, this was never followed up by implement-

ing legislation and there is no equivalent provision in Executive Order 13112 adopted in 1999 (Miller, 1999).

New Zealand's Biodiversity Strategy (2000) proposes that wherever possible, biosecurity risks are managed offshore. This is to be done by way of import health standards and border controls which identify what has to be done prior to goods being acceptable in New Zealand. That includes certain requirements for certification of fumigation and quarantine requirements which have to be carried out in the exporting country rather than in New Zealand. This provision also provides for the sharing of available information on whether a native species to be exported is a pest elsewhere.

In some countries, general biodiversity or wildlife legislation could probably be used to support this kind of measure even though the provisions concerned are not specific to alien species. Costa Rican law, for example, provides for transboundary cooperation on the conservation, use and exchange of components of biodiversity on national territory and in transfrontier ecosystems of common interest. The State is required to regulate the entry to and exit from the country of biotic resources consistently with this approach (Article 12, Biodiversity Act of 1998). In Taiwan, there is general authority for listing wildlife or wildlife products which may not be imported or exported under trade laws for cultural, hygiene, ecological protection or policy reasons (Article 26, Wildlife Conservation Law of 23 June 1989, amended 29 October 1994).

5.1.2 At the Point of Import or Release

Border control and quarantine measures are necessary to subject intentional introductions to prior authorisation and to minimise unintentional introductions and unauthorised (illegal) introductions.

All countries have some form of customs and quarantine legislation. Competent officials generally have powers to prohibit imports, impose restrictions on certain products, execute inspections, detain particular consignments and treat or destroy living material.

Whilst some countries have a legal basis to address risks to wild plants and animals under their phytosanitary or sanitary legislation, in others quarantine personnel may have no powers to exclude consignments that contain alien species that could be harmful to native biodiversity but are not known to present risks to commercial production systems (Baldacchino, 1996; Peteru, 1999; Stein, 1999).

All countries should have legal frameworks in place to provide a basis for restricting imports and internal movements of alien species that might threaten native biodiversity and make it possible to vary the level of restriction, depending on the assessed level of risk. Officials should have adequate powers to intercept potential alien (invasive) species and to halt unauthorised introductions.

State practice

Australia has comprehensive legislation to control transfers and trade in "listed alien species" (see 5.2 below). Competent authorities may regulate or prohibit members of a listed alien species from being brought into the Australian jurisdiction or traded between Australia and another country, between two States, between two territories, between a State and a Territory or by a constitutional corporation. Actions involving or affecting members of a listed alien species may be regulated or prohibited where "appropriate and adapted to give effect to Australia's obligations under an agreement with one or more other countries" (section 301A, Environment Protection and Biodiversity Conservation Act of 1999).

5.1.3 Controls on Domestic Movements

Alien species present on national territory may become invasive for the first time when moved (intentionally or unintentionally) to a new part of the same country. Legal frameworks should therefore provide a basis for regulating intentional domestic movements of alien species and for assessing projects and activities that may create pathways for subsequent invasions (e.g. infrastructure development, inter-basin transfers of water). Domestic controls are also needed to help contain the spread of an alien species that has established itself in one part of the country. Where there is no framework for domestic controls, it is likely to be harder to detect subsequent invasions and reactive measures may be put in place too late to be effective. In transboundary ecosystems, invasion on one side of a boundary may of course spread quickly to a neighbouring State.

Internal domestic controls should be developed as a priority in certain contexts. Island States and States with islands need to minimise the risk of inter-island or mainland-to-island introduction of alien species.

At present, this is often not the case. Mauritius, for example, has no internal quarantine controls, even though Rodrigues Island is 574 km east of Mauritius and is biologically quite separate (Mauremootoo, 1999). In French Polynesia, regulations have only recently been issued to control inter-island introductions and transport of thirteen listed alien plants considered to threaten native biodiversity (Meyer, 1999).

In countries with federated or regionalised systems of government, inter-jurisdictional controls on domestic trade, transport and containment of alien species should be harmonised or at least be made consistent. Similar considerations should apply in Member States of regional economic integration organisations that promote free movement of goods across political borders within the area of the organisation. Common rules at a regional scale can help to minimise situations in which a species lawfully imported into one country or state escapes and makes its way to countries or states in which its import is prohibited.

State practice

In Argentina, there is a legal basis for controlling inter-provincial movements of alien invasive species but only for alien animal species introduced from another country. Proof of species identification is required prior to internal possession, transport and sale of imported alien animals. However, these requirements do not apply to internal movements of species which are not known to be invasive in one part of the country but could become invasive elsewhere. At present, the only requirements to internal movements of the latter are sanitary and phytosanitary measures (Di Paola, Kravetz, 1999).

Box 21: American Bullfrog

The American bullfrog (Rana Catesbeiana) from the eastern parts of North America has now invaded large areas of British Columbia, Canada. These giant voracious predators are eating indigenous frogs, snakes, fish, and young birds. It is believed that they were brought to the west coast of the United States for sale as a delicacy or as live ornaments for garden pools (*Reuters*, 24 July 2000).

In the United States, where interstate trade and transport is a federal matter, the 'Lacey Act' (1900, amended 1998) prohibits inter-state or foreign trade involving fish, wildlife or plant material taken, possessed, transported or sold in breach of state or foreign law. It potentially provides a legal basis for regulating introductions of alien species from one state to another. However, the Act cannot 'bite' if the sale of an alien species is permitted in one state, even if that species were to be introduced into another state and become invasive.

The above examples link controls to jurisdictional boundaries. As discussed earlier, it may also be necessary to link regulatory controls to movements of species to a different ecosystem. In Norway, a permit is required before releasing a species or subspecies of wildlife in an area where it does not previously occur. Other European countries that regulate introductions from one region to another include France, Switzerland, Sweden (for the Island of Gotland), the Czech Republic and Germany.

Some countries regulate a range of actions (possession, sale, transport and subsequent release) within national territory. In Australia's Northern Territory, the sale of any live alien animal is prohibited except for species listed by regulations. A permit is required to transport any live mammal, amphibian or reptile within State territory.

5.1.4 Special Controls for Protected Areas and Vulnerable Ecosystems

Consistently with requirements under several international instruments (see 2.2 above), introduction of alien species to protected areas and vulnerable ecosystems should be prohibited or subject to extremely strict regulation.

Site-specific controls of this kind are a key component, but not a substitute, for an ecosystem approach to alien invasive species management. It is important to implement complementary measures around protected areas to avoid creating refuges of native biodiversity in close proximity to degraded areas vulnerable to invasion. This integrated approach is particularly important for wetland protected areas, as alien aquatic organisms may be easily translocated from beyond the protected area boundaries.

State practice

Argentina prohibits the introduction, transportation and propagation of alien species in all protected areas (Law no. 22,351 of 1980). In the marine context, the United States prohibits the introduction or release of any exotic species of plant, invertebrate, fish,

amphibian, or mammal into the Florida Keys National Marine Sanctuary (regulations issued by the National Oceanic and Atmosphere Administration).

In New Zealand, special controls apply in coastal and marine ecosystems. The introduction of any exotic plant species to the "coastal marine area", as defined by the Resource Management Act of 1991, is classified as a "restricted coastal activity", unless the plant is already present in the area and its planting is provided for under a regional coastal plan (Coastal Policy Statement 1994, Schedule 1).

5.2 Procedures for Regulating Intentional Introductions

5.2.1 Rationale for a Comprehensive Permit System

Because the effects of an introduction are (by definition) unknown, procedures need to be in place to screen applications in order to distinguish between wanted and unwanted introductions of alien species.

Permit systems or equivalent authorisation procedures, supported by scientific assessment, can provide a transparent framework for this purpose. At the international level, permits for the introduction of any alien species are specifically required under certain international instruments, including the UN Convention on the Law of the Sea, the ASEAN Agreement and the Antarctic Treaty regime.

Basic components for a workable permit system should include:

- clear statement of what species are subject to the permit requirement (on the role of species listing techniques in this context, see 5.2.2 below);
- clear statement of information to be supplied by the applicant;
- public access to information on applications, criteria, hearings and decisions;
- risk analysis and environmental impact assessment, based on scientific principles and evidence (see 5.2.4);
- provision of objective and technically-sound information to guide decision-makers in determining permit applications;
- possibility of permit conditions (monitoring, emergency plans, containment procedures) (see 5.2.4 below);
- possibility for allocating the cost of permit procedures to the applicant;
- sanctions for breach and non-compliance with the permit (see 7.1 below).

The approach most consistent with the precautionary principle/approach is to control all categories of alien species proposed for introduction or release, whatever their origins or the purpose of the introduction (de Klemm, 1996). This means that no intentional introduction should take place without proper authorisation – usually in the form of a permit or licence – from the relevant authority or agency. Under a comprehensive system, all candidates for introduction are to be assumed for legal purposes to be potentially invasive until such time as information gathered through risk analysis, monitoring or other scientifically-supported procedure makes it possible to review this status. This broad scope can have additional benefits: by screening a larger proportion of candidate organisms, the risk of unintentional introductions of hitchhiker organisms should be significantly reduced.

To make a permit system more manageable, risk-based screening may be used to compile lists of alien species that must be excluded from a country or region, or may be subject to simplified requirements. The role – and limitations – of species listing techniques are discussed in 5.2.2 below.

At the national level, the scope of existing permit systems varies widely with regard to taxonomic coverage. Existing national permit systems do not always apply to all taxonomic groups (see 4.4.2-3 above). The most common omissions concern micro-organisms (including fungi), wild plants, fish and subspecies or geographic races foreign to the country or province. Viruses are rarely mentioned by name.

The scope of permit systems also varies according to the purpose of the introductions. Depending on the country, common exemptions include introductions for agricultural and forestry purposes and also those for recreational and ornamental purposes, such as horticulture, sport fishing and hunting. Introductions by tourists and travellers often fall through the net unless the specimens concerned belong to CITES-listed species.

For genetically modified organisms, the trigger for a permit requirement for introduction/release is often linked to the process of genetic modification (the manufacturing method) rather than the risk characteristics of the modified organism or product. This is the case under many modern GMO laws, particularly in Europe. This means that an identical product produced by a different technique (e.g. traditional selective breeding techniques) may not be subject to

the same regulatory controls, even though it might give rise to similar hazards when released into the natural environment (Kinderlerer, 1999).

State practice

In Argentina, import permits are required for alien aquatic organisms, species listed as pests and potentially to all types of wild fauna. However, there are no equivalent measures for alien plants. An environmental impact assessment is required for forestry projects using alien tree species, but there is no corresponding permit requirement for the introduction of such species into the country (Di Paola, Kravetz, 1999).

Poland generally prohibits the introduction to the environment or movement of alien species. However, the Environment Ministry may grant exemptions after consultation with the National Nature Protection Council (Article 42, Act on Nature Protection of 16 October 1991). There are no criteria for granting such exemptions (Krzywkowska, 1999).

Relatively few European countries regulate introductions of alien wild plants. Certain countries that do have legal powers for this purpose, such as Germany and Switzerland, qualify permit requirements with sweeping exemptions. Significantly, there are no restrictions on introducing alien plants to the natural environment where such imports are made for agricultural or forestry purposes (de Klemm, 1996).

A small number of countries operate comprehensive permit systems applicable to all categories of alien species as defined under the relevant legislation. Australia and New Zealand provide comprehensive examples (see 4.5.2 above and 5.2.2 below). At subnational level, the island state of Hawaii applies a presumption of prohibition to the import or release of any alien organisms. In Germany, the *Land* of Thüringen prohibits, as a matter of principle, the release of alien animals and plants, although certain exceptions may be made.

In Hungary, a permit is required to introduce any alien living organism. It may only be issued if colonisation would not harm natural processes to the detriment of native species (Articles 13(4) and 9(4), Nature Conservation Act of 1996). The same Act establishes provisions for GMOs that "influence biodiversity". Production, experimentation, breeding, distribution, export and import of such GMOs are to be separately regulated, but must be carried out consistently with the provisions of the Nature Conservation Act. Under the Act, it is also prohibited to modify artificially the genetic material of wild organisms, distribute individuals thus produced or intentionally transfer them to another wildlife community (Article 9(3) and 9(6)).

5.2.2 Using Species Listing Techniques in Association with Permit Systems

If a permit system is to be applied to all alien species, it should be designed to be legally and administratively workable. Lawmakers need specifically to consider how the system will operate in practice, both on the ground and before the courts.

Under most legal systems, where legislation establishes a prohibition or restriction, it is usually for the competent authority to prove that the relevant prohibition or restriction applies to a given case, in accordance with a defined standard of proof. By way of exception, legislation may expressly provide for the 'burden of proof' to be reversed: in such cases, it is for the individual or entity concerned to prove that the prohibition or restriction is not applicable in that particular situation.

Turning to alien species, where a permit system applies a 'presumption of prohibition' to all alien species proposed for introduction, the competent authority will normally be required to prove that a candidate species is indeed "alien" (or not "native"). This presupposes that the legislation actually defines the necessary terms, which is not always the case. Proving this can present significant difficulties, as definitions of "alien" all tend to be phrased in a negative way as a species that is not native/naturally or currently occurring in the region (see 4.5.3 above). The authority thus has to prove a negative which in legal terms is difficult and, depending on the standard of proof, sometimes impossible.

A possible option is for legislation to specify that the burden of proof should be reversed to the applicant for an introduction. Depending on the terms of the legislation, the applicant would thus be required to prove that the species concerned is actually "native" or that it is not "alien" as defined. It must be recognised, however, that this may present a near insuperable hurdle.

Separately or in addition to the above, general prohibitions may be combined with species lists to provide clearer risk-based indicators for officials and applicants on the ground.

Species listing techniques can facilitate the operation of permit systems by differentiating between alien species on the basis of risk. They should be compiled with reference to available databases and in close collaboration with competent authorities elsewhere in the same region and in key trading partner countries, and be regularly updated.

'Black' lists are used to identify alien species that are deemed to be high risk: they may be known pests elsewhere in the region and/or be considered to be capable of reproducing in the wild in the country concerned. Their introduction, even into situations of containment, should wherever possible be prohibited, as should their possession, sale and transport if they are inadvertently introduced. 'White' lists tend to work in the opposite way by identifying alien species that are assessed to be harmless or even beneficial. 'Grey' lists are a composite tool that provide guidance on different grades of risk (see Box 22).

Box 22: Overview of Species Listing Techniques

Black lists (of known alien invasive species) can be drawn up at national, regional and global levels. Species on such lists are those that may pose a serious threat to ecosystems, habitats and species. Their intentional introduction should be prohibited. Black lists make an important contribution to border control and monitoring, but should not be seen as a successful management tool in their own right. They are reactive: species are listed after they have been shown to be invasive, often based on a crisis management approach (Mooney, 1999). Such lists can never be fully accurate or exhaustive, or virtually all the world's flora and fauna would be covered. Many species that never get on black lists may nonetheless become invasive upon their introduction into a new range.

White lists (species assessed as harmless or beneficial that may be introduced) can work well for categories of native organisms with relatively few members, such as vertebrates and some groups of invertebrates like crayfish. However, it is unworkable for most invertebrates, for flora, especially lower flora, and for micro-organisms. White lists are also cumbersome for controlling internal introductions: separate lists would be needed for each sub-national unit or biogeographical region (de Klemm, 1996). White lists can be used in association with risk assessment procedures for intentional introductions. Where a species is assessed as harmless or beneficial and given an entry permit, it can be included on a white list to simplify future assessments. However, requirements for white list entry must be very stringent and even then, mistakes will occur (Simberloff, 1999).

Grey lists can provide a useful tool for risk-rating species proposed for introduction. Species (other than white-listed) may be grouped into categories of: species of known invasiveness; species of unknown invasiveness, but with a reasonable likelihood of entering the country; species where the risk of invasiveness is not yet known; and species are very unlikely to enter the country anyway (low risk).

Listing techniques can make a major contribution to the operation of permit systems, but have important limitations as they are inherently reactive and can never be fully accurate or up-to-date. They should not be used as a substitute for permit controls and risk analysis, except for black lists that provide for the exclusion of named alien species.

The legal effects of species listing also need careful consideration, particularly with regard to possible liability/responsibility. Legislators need to address two specific questions:

- how does the inclusion or omission of a species from a list affect legal responsibility for the consequences of a subsequent invasion?
- what happens to pre-approved introductions if the species is subsequently added to a black or grey list?

State practice

Australia's Northern Territory operates a combined permit/list system for alien aquatic organisms. The Fisheries Act of 1979 prohibits the issue of a permit except where the proposed introduction is for native species or species listed by regulations. The Director of Fisheries must consider the environment, disease prevention and the background, experience and motivation of the permit applicant before granting a permit for a listed species (Pech, 1996).

Western Australia has enacted a graded series of restrictions on the import and possession of alien animals, based on risk assessment. These are respectively: species for which the import is totally prohibited except for scientific or educational purposes or under special permit; species which may only be kept under special licence; and species for which an ordinary permit procedure is sufficient. Animals imported or kept in breach of these provisions may be confiscated and destroyed.

At commonwealth level, Australia excludes all alien species unless they can be shown by a risk assessment not to be invasive. In addition, a risk-based black list may be compiled of alien species whose members (i) do or may threaten biodiversity in the

Australian jurisdiction; or (ii) would be likely to threaten biodiversity if they were brought into the Australian jurisdiction (section 301A, Environment Protection and Biodiversity Conservation Act of 1999). Based on this list, specific restrictions or prohibitions may be imposed at a comprehensive range of entry and exit points.

In New Zealand, an import/release application is required for any "new organism" as defined, except for "prohibited organisms" included in a black list annexed to the Hazardous Substances and New Organisms Act of 1996.

The United States has a series of laws that concern different aspects of alien species control and management. The federal Noxious Weed Act of 1974 provides for the listing of alien plant species that may not be imported or sold. In 1999, *Caulerpa taxifolia* was listed under the Act and its import and sale prohibited (it was detected for the first time in June 2000 in California).

The US State of Minnesota has developed a multi-level list system. Alien species may be classified as "prohibited", "regulated", "unlisted", or "unregulated". Introduction of a "regulated" species is subject to permit and, for an "unlisted" species, a determination that the species is appropriate for introduction. Criteria for determining the listing categories include:

- the likelihood that the species would naturalise in the state if it were introduced;
- the magnitude of potential adverse impacts of the species on native species and on outdoor recreation, commercial fishing, and other uses of natural resources in the state;
- the ability to eradicate/control the spread of the species once introduced into the state (Miller, 1999).

5.2.3 Using Risk Analysis and Environmental Impact Assessment in Permit Systems

In accordance with international instruments (see 3.3 above), an assessment of risk and possible environmental impacts should be carried out as part of the evaluation process, before the competent authorities determine whether or not to authorise a proposed introduction of an alien species. Where available, internationally agreed standards and norms should be followed in the design and content of assessment procedures.

National legal frameworks should clearly specify that risk analysis and environmental impact assessment must be carried out prior to the determination of a permit application. They should provide for the issue of regulations setting out appropriate methodologies, criteria and administrative aspects, as well as the information to be supplied by the applicant to the competent authority.

To promote efficient administration, such procedures should be streamlined as far as possible so that applicants do not have to go through a series of separate regulatory stages for different regulatory authorities. Procedures should be transparent and provide opportunities for public input and participation (see Box 23).

Box 23: Characteristics of a Successful Assessment Process

- **comprehensiveness:** systematic assessment of all candidate organisms (including those to be used for biological control and those that have been genetically modified);
- **flexibility:** support for differentiated assessments of risk (to avoid generalisations covering the entire group of alien species or organisms);
- **suitability:** for the country concerned (operational possibilities are very different in isolated island states and big continental landmasses shared by many countries);
- systematic **consideration of transboundary effects:** (the probability that a given species will eventually be distributed throughout its available range unless stopped by a significant physical barrier);
- administrative **efficiency and cost-effectiveness:** (where possible, use of standardised forms, information requirements, common database protocols etc.);
- **transparency and accountability:** (standards and processes should be understandable, equitable and open to public participation; results should be documented).

(Miller, 1999; Space, 1999).

Relatively few countries have a comprehensive legal basis to conduct risk analysis of proposed introductions. In developing the necessary regulations, lawmakers should give special consideration to the need for flexibility and regular updating in line with scientific developments (see the example of New Zealand below). The IUCN Guidelines provide a useful checklist of generic questions that should be applied in risk analysis (see IUCN, 2000).

Many countries have well-established rules on environmental impact assessment, but few of the relevant laws specifically apply EIA requirements to alien species introductions. In practice, alien species issues may slip through the net of EIA regimes. This is due to several factors. Most legal frameworks attach EIA requirements to a limited list of 'major' categories of projects or to any project that is likely to cross a defined threshold of harm (words like "significant" or "serious" are commonly used). In the context of alien species, there is great uncertainty about which introduced species might generate impacts of this magnitude. Another difficulty is that conventional EIA regulations rarely provide for adequate assessment of cumulative effects of small-scale actions.

In some countries, EIA regulations are primarily directed at the actions of government agencies and/or to projects concerning publicly owned land. They may not be applicable to corporate or individual activities that involve introductions of alien species, or indeed to relevant programmes and actions carried out by local authorities.

Legislators may therefore need to review and possibly amend existing procedures to ensure that EIA tools are applicable to intentional introductions, whether by public or private entities.

State practice on risk analysis

In New Zealand, the Environmental Risk Management Authority has a legal mandate to develop and apply a decision-making methodology, including an assessment of monetary and non-monetary costs and benefits (section 9, Hazardous Substances and New Organisms Act of 1996). The Methodology has been approved by the Government and established as an Order in Council. To supplement the Methodology, a set of Protocols are drawn up and periodically updated.[17] These clarify how key concepts are to be interpreted, problem issues addressed and stakeholder views and needs taken into consideration.

Protocol 6, approved in July 1998, is entitled *General Requirements for Identifying and Assessing Risks, Costs and Benefits*. This clearly specifies the responsibilities of permit applicants. Particular attention should be paid to assessment of the most significant risks, costs and benefits to the environment and health and safety of people and communities. Where risks are judged to be negligible, a cost benefit analysis will not normally be required.

The Protocol identifies two aspects of risk identification: the source of the risk (e.g. the invasive characteristics of an alien plant) and the elements at risk (e.g. the ecosystems which could potentially be disturbed). Because of the uncertainties associated with particular outcomes, all possibilities of harm must be carefully identified, "regardless of the likelihood of occurrence". Applicants are required to provide evidence of the results of risk assessment and the methods used to assess risks. The latter may be qualitative or quantitative: if required, they should be justified by reference to common practice, accepted science or use in other jurisdictions. Assessment should take account of the scope for managing risks through the controls specified in the Hazardous Substances and New Organisms Act of 1996 and regulations.

State practice on environmental impact assessment

Some countries require an EIA to be prepared as part of a permit application to introduce an alien species or organism.

In Taiwan, an Impact Assessment Report must be prepared prior to the import for the first time of any "exotic wildlife which is not endemic to Taiwan" (Article 27, Wildlife Conservation Law of 1989, as amended 1994). The applicant must provide the National Principal Authority (the Council of Agriculture) with all relevant information concerning that species. The Report must specifically address the possible effect of the alien wildlife upon native fauna and flora. All such imports are subject to the Authority's approval.

Regulations made under the Wildlife Conservation Law specify what should be included in the EIA report. It should include information on the ecology and life history of the alien species, including its diet, natural habitat, reproductive rate, natural predators and local climate of its country of origin. The report should specify whether there are any similar species in Taiwan and give an assessment of the possible impact of the introduced species on native flora, fauna and ecosystems, as well as details of preventive measures.

In Argentina, an EIA is required prior to the intentional import of any alien animal species. It must be

[17] They are publicly accessible on the Government Website at http://www.ermanz.govt.nz.

supported by formal consent from the province where the alien species will be installed (Resolution Nº 376/97, issued pursuant to Law of Wild fauna). The EIA is required to cover:

- objectives of and justification for the project involving an introduction;
- description of the project and alternatives considered (including not introducing the species at all);
- an environmental profile of the area that will be affected;
- an assessment of potential impacts, covering loss or change in biodiversity, human zoonosis problems, economic and productive risks, genetic pollution, animal or plant sanitation risks and pests. Impacts should be classified according to their characteristics: magnitude, duration, persistence and reversibility;
- prevention, mitigation and neutralisation measures for human and environmental health;
- monitoring and surveillance to ensure compliance and necessary corrective measures;
- a contingency plan to cover unforeseen impacts.

Where alien species are to be imported as pets, the enforcement authority may adapt the information requirements as appropriate in each case.

The Argentine federal Department of Wild Flora and Fauna forms an Assessment Committee to review the EIA and must present an Environmental Impact Statement to the decision-making Authority within thirty days. The two documents are then made available for public consultation and comment for ten working days. The Department must consult the relevant authorities of neighbouring provinces before determining whether to authorise the introduction, as the latter may be affected by the eventual escape or dispersion of the introduced species. A new EIA is required for subsequent transfers of the introduced alien species to other provinces in Argentina.

EIA is also required prior to the import of aquatic organisms for aquaculture, under separate regulations (Resolution 987/97).

Argentina's draft National Biodiversity Strategy recommends that the scope of EIA for introductions should be extended to include assessment of socio-economic aspects (Di Paola and Kravetz, 1999).

5.2.4 Standards and Criteria to be Applied in Decision-making

Once the competent authorities are equipped with the results of assessment procedures, they should have an objective technical basis on which to make an informed decision on a permit application. However, it is still necessary for legal frameworks to set standards and criteria to guide the exercise of these decision-making powers and to promote consistency and transparency.

Some general indicators or thresholds are offered at the international level. The *Interim Guiding Principles* under consideration within the CBD framework provide that States should only authorise introduction of alien species that, based on prior assessment, are unlikely to cause unacceptable harm to ecosystems, habitats or species, both within that State and in neighbouring States. The IUCN Guidelines state that anticipated benefits of an introduction should strongly outweigh any actual and potential adverse effects and related cost. Intentional introductions should not be permitted if experience elsewhere indicates that the probable result will be extinction or significant loss of biological diversity. Such introductions should only be considered if no native species is considered suitable for the purposes for which the introduction is being made (IUCN, 2000).

State practice

New Zealand provides sequenced criteria for determining applications, based on an assessment of the "effects" of the organism concerned. "Effect" is defined to include any potential or probable effect; any temporary or permanent effect; any past, present or future effect; any acute or chronic effect; and any cumulative effect which arises over time or in combination with other effects (see Box 24).

In Argentina, the national enforcement authority must refuse an import or installation permit for live specimens, semen, embryos, eggs for incubation and larvae of any alien animal species that might alter the ecological balance, affect economic activities or modify the fulfilment of the goals stated in the Law (section 5, Law no. 22,421 of 1981 and its implementing decree). With regard to alien aquatic organisms for aquaculture, an import permit may be refused where the National Department of Fishing and Aquaculture considers that the introduction could alter the environment or affect other production systems (Resolution 987/97). The draft National Biodiversity Strategy recommends as an 'action rule' that future introductions of alien species for mariculture should be avoided, due to the high probability of escape.

In Germany, a permit for release or installation of alien species must be refused if the risk of contamination of native flora and fauna or populations of such species "cannot be ruled out" (section 20(d)(2), federal Nature Conservation Act of 1976). This is a rigorous application of the precautionary principle/approach, but the Act does not specify any criteria

or methodology to be used in making this determination. In contrast, detailed criteria are established for decision-making concerning the release of GMOs. A permit can only be issued if harmful consequences are not expected to the life or health of humans, animals and plants, the environment and property. The operator must be reliable and the project leader and security expert have the necessary competence. Where these conditions are fulfilled, there is no discretion to refuse a permit (Federal Genetic Engineering Act, implementing EC Directives 90/219/EEC and 90/220/EEC).

Box 24: Legally-backed Criteria to Guide Decision-making – New Zealand Environmental Risk Management Authority

The New Zealand Environmental Risk Management Authority, when considering applications for imports or releases of new organisms under the Hazardous Substances and New Organisms Act of 1996, must "recognise and provide for":

- the safeguarding of the life supporting capacity of air, water, soil and ecosystems;
- the maintenance and enhancement of the capacity of people and communities to provide for their own economic and social well being and for the reasonably foreseeable needs of future generations.

- In addition, the Authority must "take into account":

  - the sustainability of all native and valued introduced flora and fauna;
  - the intrinsic value of ecosystems;
  - public health;
  - the relationship of Maori and their culture and traditions with their ancestral land, water, sites, waahi tapu (sacred sites), valued flora and fauna, and other taonga (treasures); and
  - the economic and related benefits to be derived from the use of a particular hazardous substance or new organism (section 6).

- The Authority has no discretion to approve an application in prescribed risk conditions (section 36). It must refuse an application where any of the following is likely to result:

  - significant displacement of any native species in its natural habitat;
  - significant deterioration of natural habitats;
  - significant adverse effects on human health and safety;
  - significant adverse effect on New Zealand's inherent genetic diversity;
  - cause disease, be parasitic, or a vector for human/animal/plant diseases unless that is the purpose for the importation or release.

New Zealand has also developed a "rapid assessment" procedure under the HSNO, to streamline administrative controls for organisms that do not present high risks. The procedure may be used where the organism is not listed as an "unwanted organism" and it is "highly improbable" that after release the organism could do any of the following:

- form self-sustaining populations anywhere in New Zealand, taking into account the ease of eradication;
- displace or reduce a valued species;
- cause deterioration of natural habitats;
- cause disease, be a parasite, vector for human/animal/plant diseases; or
- have any adverse effects on human health and safety or the environment (section 35).

5.2.5 Determination of Permit Applications

Under most legal systems, a decision-making authority may refuse to issue a permit, issue a permit outright or issue a permit subject to conditions. Certain generic matters – procedural aspects of issuing, refusing or appealing against permit decisions – are not discussed below as they are familiar from other areas of environmental management.

5.2.5.1 General Terms and Conditions

Where an introduction permit is granted, legislation should provide a basis for attaching conditions, consistent with the precautionary principle/approach, to minimise the risk of alien species escaping from human control and becoming invasive. Appropriate conditions may include preparation of a mitigation plan, monitoring procedures, containment requirements and emergency plans.

Permit conditions make it possible for those responsible for introductions to be bound by enforceable rules. Such rules can be flexibly designed to cater for individual circumstances and to ensure a flow of information to the competent authorities. Financial charges (fees, levies, and deposit bonds) may be attached to permits (see 7.3 below).

In the event of non-compliance, it should be possible for permits to be revoked in addition to other types of sanctions (see 7.1 below).

State practice

Many laws confer general discretion on permit-issuing authorities for this purpose. For example, in Australia, the Northern Territory Fisheries Act of 1979 provides that permits may be issued with such conditions as the Director deems necessary.

In Argentina, an importer must make an advance commitment to take emergency measures, including the eradication of members of the alien species, as a condition of obtaining the permit. The importer must also sign a commitment not to release specimens into the wild (Resolution Nº 376/97).

In Costa Rica, the Biodiversity Conservation Act of 1998 lays down specific provisions on permits for genetically modified organisms (Articles 47-48). Any person may participate in the permit procedure and may also request the repeal or revision of a permit that has been granted. Based on technical, scientific or security criteria, the Technical Office can modify or repeal any permit: in the event of imminent danger, an unforeseeable situation or non-compliance, it may retain, confiscate, destroy or send back GMOs or other types of organism.

5.2.5.2 Duration of Permits

Some legal frameworks provide for conditional and definitive permits for alien species introductions. In such cases, authorisation is given to import an alien species for a defined trial period, during which time it must be monitored. The conditional permit may only be converted into a full permit after satisfactory completion of ‘probation’. This interim period provides a good opportunity for monitoring and, where necessary, modification of conditions or containment requirements.

State practice

Several countries operate some type of dual permit system. These include South Africa, New Zealand and Argentina. The latter applies a one-year trial period to all introductions of alien wild animals. For first entry aquatic organisms, the Certificate of Import is provisional until the enforcement authority issues the Definitive Certificate. During the trial period, it is prohibited to sell or release these first entry specimens. If the Definitive Certificate is not granted, all introduced specimens must be eradicated.

5.2.6 Special Conditions for Containment Facilities

Many intentional introductions involve the import of alien species for contained use or situations of captivity. Relevant facilities include zoos, aquaculture and mariculture installations, research institutions, captive-breeding facilities, horticultural establishments where artificial propagation is carried out, pet shops and even travelling circuses.

As discussed, zero risk of escape or release is not a biological reality. A captive or cultivated species will usually find some way to escape, possibly as a result of fires, earthquakes, floods or sabotage. Such escapes can present significant risks for native genetic diversity, particularly where the ‘fugitive’ members belong to the initially imported stock. Risks may also be generated by the escape of genetically modified organisms from situations of containment.

To minimise these risks, a permit or licence to hold alien species in containment facilities or installations

should be subject to special conditions. These fall into two categories: operational aspects and siting.

In many countries, installations of this kind are already subject to phytosanitary and sanitary regulations and to strict operating controls. A checklist of possible components of a control framework could include:

- environmental impact assessment prior to the creation of a containment facility;
- requirement for all containment facilities to hold an operating licence, renewable periodically;
- registration of operators and precise monitoring and reporting requirements;
- strict standards of security and hygiene for cages, enclosures, plots and tanks;
- for larger animal organisms, indelible marking of specimens so that their origin can be identified in the event of their escape;
- prohibition on the release of species belonging to the initially imported stock;
- strict control of subsequent releases: for fish, the ICES Code recommends that only members of the first generation (born and bred in captivity) be set free, after a period of quarantine (see 2.2.2.4 above);
- in support of the above, a permit requirement for transport of captive-bred organisms under strict security conditions; and
- strict rules in the event of the establishment closing down to prevent specimens being deliberately freed or negligently left to establish themselves.

Siting conditions should be designed, where possible, to avoid the establishment of containment facilities in the vicinity of protected areas, other areas of high biodiversity or endemism or on small islands. Where a full prohibition is not possible, such establishments should be subject to even stricter security conditions than elsewhere.

Aquaculture and mariculture facilities are associated with particularly high risks of escape and invasions. Such facilities should, as far as possible, be prohibited where there is communication with open water and be located outside the 100-year or even 500-year flood zone. Legal frameworks should be consistent with the detailed recommendations laid down by the FAO Code of Conduct for Responsible Fisheries (see Box 25 and 2.2.2.4 above).

Box 25: Recommendations from the FAO Code of Conduct for Responsible Fisheries

- States should, with due respect to their neighbouring States, and in accordance with international law, ensure responsible choice of species, siting and management of aquaculture activities which could affect transboundary aquatic ecosystems.

- States should consult with their neighbouring States, as appropriate, before introducing non-indigenous species into transboundary aquatic ecosystems.

- States should conserve genetic diversity and maintain integrity of aquatic communities and ecosystems by appropriate management. In particular, efforts should be undertaken to minimise the harmful effects of introducing non-native species or genetically altered stocks used for aquaculture including culture-based fisheries into waters, especially where there is a significant potential for the spread of such non-native species or genetically altered stocks into waters under the jurisdiction of other States as well as waters under the jurisdiction of the State of origin. States should, whenever possible, promote steps to minimise adverse genetic, disease and other effects of escaped farmed fish on wild stocks.

- States should, in order to minimise risks of disease transfer and other adverse effects on wild and cultured stocks, encourage adoption of appropriate practices in the genetic improvement of broodstocks, the introduction of non-native species, and in the production, sale and transport of eggs, larvae or fry, broodstock or other live materials. States should facilitate the preparation and implementation of appropriate national codes of practice and procedures to this effect.

Legal frameworks to control introductions for horticultural purposes seem to be generally weaker than for alien animals. This is a major problem, given the risk of cultivated alien tree species or ornamental plants (rhododendrons, buddleia, etc.) spreading to the wild. Although several countries have legislation to regulate the nursery industry, restrictions under such laws may be limited to protection of endangered native species and/or CITES-listed plant species. In such cases, the legislation may not provide

an adequate basis to minimise the risk of unintentional releases of alien plants into the natural environment.

State practice

In Hungary, it is prohibited to introduce alien fish species into natural or near-natural waters, or to transfer such species from fish farms into any other wetland (section 14, Nature Conservation Act of 1996).

Argentina imposes special regulations on "aquatic production facilities" (any installation within a limited geographic site where live alien or native aquatic organisms are cultivated, grown or maintained for re-population of aquatic environments, sport fishing or other purposes). In addition, alien aquatic organisms entering the country for the first time may not be transferred to other hatcheries, whether in the same province or a different one. Juvenile specimens may not be sold for ornamental purposes without prior authorisation by the National Department on Fishing and Aquaculture (Resolution 987/97). Safety regulations must be issued to avoid any release of alien wild animals from captivity or breeding facilities or during transport (section 10, Regulatory Decree 666/97 of the Law of Wild Fauna 22.421/81).

In South Africa, the Plant Improvement Act of 1976 regulates the nursery industry and related organisations involved in the breeding and commercial propagation, import and export of plants and plant materials. Plants and plant parts have to be registered and comply with certain requirements. The Act does not explicitly prohibit the propagation of invasive plants (weeds), but as weeds are not included in the list of acceptable species and varieties, such propagation is currently illegal. Specific prohibitions on weed dispersal are contained in the Conservation of Agricultural Resources Act of 1983 (Stein, 1999).

Poland has specific legislation applicable to botanical gardens and zoos (Executive Act on Principles of Botanical and Zoological Gardens Protection of 1980). There is a prohibition on changing land use or plant cultivation within such gardens unless this is justified for research or management needs. The Polish Academy of Sciences must be consulted in the preparation of botanical gardens management and development plans (Krzywkowska, 1999).

In the United States, The Nature Conservancy (TNC) is working with nursery industry representatives to develop protocols for screening newly introduced species for their potential to become invasive. Once such protocols are adopted, potential invaders that are identified by the protocol will not be introduced or distributed by nurseries participating in the programme. The Nature Conservancy is also working with US and Canadian arboreta and botanical gardens to develop similar protocols for these institutions (Randall, 1999).

5.2.7 Special Conditions for Private Handling of Alien Species (Pets)

In some countries, the abandonment or deliberate release of alien pets is a growing problem and, cumulatively, may have severe ecological impacts (see 1.2.2 above). For example, terrapins, small crocodiles and other species released into ponds and streams or down toilets find their way quite efficiently into the water cycle.

Introductions by private individuals are particularly difficult to control through exclusively regulatory systems. Particularly where awareness of invasion risks is low, there may be considerable resentment at apparent interference in recreational activities or private life. Detection of offences and enforcement present huge logistical problems. Information, education and awareness-building programmes should therefore be central to management strategies. Basic regulatory requirements should be complemented where possible with measures to maximise voluntary approaches to compliance.

Legal frameworks should provide for sequenced preventive and management measures to control unauthorised introductions of alien pets. To facilitate implementation, it may be appropriate to develop a two-tier level of introduction controls.

The first step is to draw up a list of species that could survive in the wild in the country concerned if they escaped. Listed pet species should be subject to stringent assessment and where appropriate, their import and trade restricted or prohibited. Because people travel with their animals, rules of this type should be harmonised between neighbouring provinces and even countries, to exclude all animals capable of surviving anywhere within the geographical unit selected.

A second list may be drawn up of pets that can be adequately controlled through normal quarantine channels without the need to go through EIA/risk assessment procedures (e.g. cats, dogs and canary birds).

Once alien species imported as pets have gone through post-entry quarantine, their subsequent handling is not always subject to legal control. This can create a legal 'grey' area. For this reason, legislators should give consideration to the following additional components:

- a general prohibition on setting alien species free;

- a requirement for pet/aquarium merchants to notify customers of this prohibition;
- the establishment of criminal offences, supported by meaningful penalties;
- a recovery system for animals their owners wish to get rid of (see also 7.3).

To be effective, approaches of this type should be developed in close collaboration with the pet breeding and retail industry and supported by public awareness campaigns.

State practice

As noted, Western Australia uses a multi-tiered system to distinguish between prohibited alien animals, those that may be kept under special licence and species for which an ordinary permit procedure is sufficient. Animals imported or kept in breach of these provisions may be confiscated and destroyed (see 5.2.2 above).

In Tasmania, it is prohibited to import live fish that can survive in water below 10°C. A ban of this kind would not stop the trade in tropical fish because such species would clearly be unable to survive in the wild (de Klemm, 1996).

Several countries have registration systems for some categories of exotic or alien species held in containment, including Australia. Taiwan, for example, provides for registration of the possession of "exotic wildlife dangerous to the environment, people or animals". Persons involved in raising or breeding alien animals, or who had lawfully imported or otherwise received such animals, are required to file data records with the relevant municipal or city authority by a specified date and to update such records promptly after any change in status. Such animals may be marked by the competent authorities or a commissioned organisation or group, who may also conduct regular or random investigations: these must not be refused or obstructed by the owner or keeper. Registered holders may continue to rear their animals, but no breeding is now allowed except under permit for academic or educational purposes. No animal may be released with a permit from the competent authorities (Articles 31-2, Wildlife Conservation Law of 1989, as amended in 1994).

5.3 Minimising the Risk of Unintentional Introductions

5.3.1 Strategic Considerations

Risk management frameworks for unintentional introductions have to focus on a particular pathway or process rather than on a specific alien species or group of species. Sectoral activities that are often pathways for introduction include fisheries, agriculture, forestry, horticulture, shipping, ground and air transportation, construction projects, landscaping, ornamental aquaculture, tourism and game-farming.

The risk associated with different pathways varies between countries and regions, partly in accordance with the scope and effectiveness of legal measures already in place. In New Zealand, the risk of unintentional introductions through tourist baggage and plant breeders is now considered much greater than those through agricultural and forestry-related pathways (Christensen, 1999).

Legal and institutional frameworks need to provide for the identification of common pathways, adequate powers and resources for competent authorities and appropriate response measures for rapid and effective action.

Whilst some pathways are known to present high risks of unintentional introductions (e.g. ballast water discharges), regulatory controls should not be limited to already-identified pathways. Consistently with the precautionary principle/approach, legal frameworks need to be sufficiently flexible to respond to new and emerging pathways that were previously unconsidered or had been considered as low-risk.

A comprehensive framework should ideally provide for the identification and risk analysis of possible pathways as part of a strategic planning process. At the current time, however, strategic approaches to possible invasion pathways are under-developed in many countries. This is a serious deficit, because it makes it harder to anticipate likely problems and implement appropriate measures at the national or regional level where new pathways are suspected (see Box 26).

Strategic assessment should be developed and applied as a priority in certain contexts. These include:

- when States/regions negotiate new or amended trade agreements that open up new pathways for species introductios and may increase risks of invasion;[18]

[18] Note that the US Administration is required to conduct environmental assessments of most future trade agreements under Executive Order of 16 November 1999 on *Environmental Review of Trade Agreements*.

- in regional development, land and resource use policies that provide opportunities for alien species to reach new parts of national territory or cross political boundaries and then become invasive; and

- in the design of transport infrastructure that can open up new vectors for introductions and make it possible for alien populations in the new range to be continuously reinforced (e.g. translocation of species through inter-basin transfers of water).

At the operational level, legal frameworks should contain corresponding measures to minimise risks in each of these areas. Such measures should be consistent with applicable international law and internationally agreed codes of conduct or other guidance on best practice, where available. All companies dealing with transport or movement of living organisms should be required to comply with biosecurity regimes established by governments in exporting and importing countries. These activities should be subjected to appropriate levels of monitoring and control (IUCN, 2000).

Because of the range of possible pathways, many public and private entities are directly concerned with the problem of unintentional introductions. Legal and institutional measures need to be broadly based to cover relevant actions of such entities and individuals, within a coordinated framework (see 4.3 above). Partnerships to secure higher standards and improved compliance should be developed between administrative agencies and key stakeholders.

Box 26: Regional Variations and Priorities with Regard to Invasion Pathways

In the South Pacific region, constraints to a strategic approach include lack of data on commercial practices that lead to invasions and their relative importance. Shipping cargo movements and patterns need to be assessed for invasion risks, but at present the trading patterns between countries and islands are not monitored, let alone regulated (Sherley, 1999). Samoa has high volumes of boat traffic, both recreational and linked to commercial tuna fisheries and canning plants, which is considered to present foreseeable risk of unintentional introductions: however, no preventive measures are currently in place (Peteru, 1999).

5.3.2 Measures Associated with Trade Pathways

Border and quarantine controls should be designed to detect 'stowaway' organisms in consignments of living material and other commodities. Improved human, animal and plant health standards and quarantine controls are of critical importance in reducing the incidence of alien organisms transported with traded commodities.

To be effective, controls on particular consignments or commodities must be based on accurate and up-to-date information and be implemented in a timely way (i.e. before an unintentional introduction occurs or is repeated; see Box 27). This is closely tied to regular information exchange between trading partners and the existence of sound knowledge bases and monitoring and early warning systems (see 5.4 below).

Quarantine procedures should not be limited to ships or freight coming from specific points of pestilence or to pests which might impact on the economy (Veitch, 1999). A pre-emptive response is consistent with the precautionary principle/approach, but may place strain on available resources and may be opposed by trading interests as unduly restrictive or arbitrary. Delay in implementing border controls can sometimes lead to irreversible damage. In the United States, for example, unprocessed wood consignments (dunnage) were known from 1985 onwards to present a risk of harbouring potentially invasive alien organisms. The first legal restrictions were only imposed in 1991 (on proposed shipments of untreated logs from Siberia). Gaps in the regulatory framework were identified in 1992 and remained in place as of 1999 (Jenkins, 1999).

Box 27: White Grub

Mauritius has implemented strict pre-emptive regulations to prevent the transfer of the white grub (*Holoplochelus marginatus*) (a root feeding beetle that feeds on sugar cane and other crops) from La Réunion to Mauritius. The grub flies between December and January around dusk and is attracted by light. In consequence, all aircraft flights between 18.30 and dawn have been prohibited between the two islands during those months (Mungroo, 1999).

The most rigorous systems combine a presumption of risk for certain types of goods with rigorous quality standards that must be satisfied prior to import. Where States have a less comprehensive framework in place, they should at a minimum ensure that risk assessment is carried out for species likely to move internationally in trade and that appropriate regulations and restrictions are developed to deal with identified threats (Space, 1999).

As discussed earlier, it may be necessary to amend legislation to give competent authorities the power to control consignments and commodities that present risks for native biodiversity or ecosystem functions.

State practice (see Box 28).

Box 28: Management of Unintentional Introductions in New Zealand

New Zealand's Biosecurity Act of 1993 is designed to control the management of all risks associated with the introduction of living organisms. Any organism is considered to be "risk goods" until it has satisfied legislatively backed tests or controls. Risk goods include: "*any organism, organic material, or other thing or substance that (by reason of its nature or origin) it is reasonable to suspect constitutes, harbours or contains an organism that may cause unwanted harm to natural and physical resources or human health in New Zealand; or interfere with the diagnosis, management, or treatment, in New Zealand, of pests or unwanted organisms*" (section 2).

A product imported into New Zealand for the first time must undergo a "disease risk analysis" conducted by the Ministry of Agriculture and Forestry. The results of this analysis may be used to develop an "import health standard" (IHS) which specifies the safeguards or conditions that have to be met before the product can enter and be released into New Zealand (section 22).

Import health standards provide direction to potential importers on what measures must be met before goods can be brought into the country, and objective criteria for inspectors to assess whether or not the goods should be given biosecurity clearance (section 25). Over 350 import health standards have been developed (accessible on the Ministry's web site). Because IHS conditions are known in advance, it is possible for potential importers to ensure that such conditions are met before the goods arrive in New Zealand. Upon arrival, the goods are inspected by the national Quarantine Service. Once the inspector is satisfied that the conditions for risk goods to enter New Zealand have been met, "biosecurity clearance" may be issued and the goods released to the importer.

Special health regulations may apply to other categories of goods. Tourists and passengers may be obliged to go to a biosecurity control area, answer any questions put to them and comply with any reasonable request made by the health inspector (Christensen, 1999).

5.3.3 Measures Associated with Transport Pathways

Transport operations – by air, sea, inland waterways or over land – should be conducted in accordance with agreed international standards, where available, and with applicable sectoral codes of best practice. Legal frameworks may provide a basis for linking the grant or renewal of an operating licence to compliance with available design and operational standards, within an appropriate timeframe.

Risk management measures need to be appropriate to different transport methods and to the scale of assessed risk. For air transport, prophylactic measures might include the spraying of aircraft with insecticide and inspection of aircraft wheel wells (the pathway for the introduction of the Brown tree snake (*Boiga irregularis*) to Guam).

With regard to shipping, legal frameworks should be consistent with the *Guidelines for the Control and Management of Ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens* (International Maritime Organization, 1997: see 2.6 above). The Guidelines request Governments to take urgent action for their application, to disseminate them to the shipping industry, and to use the Guidelines as a basis for any measures they adopt. Matters covered include:

- training and education for ships' masters and crews;
- procedures for port States and for ships. Every ship that carries ballast water should be provided with a ballast water management plan to assist in the minimisation of transfer of harmful aquatic organisms and pathogens. The intent of the plan should be to provide safe and effective procedures for ballast water management;

- recording and reporting procedures for ships and port States;
- ships' operational procedures, covering detailed precautionary practices and ballast water management options (exchange; non-release or minimal release; discharge to reception facilities; and emergent and new technologies and treatments); and
- enforcement and monitoring.

Technical and regulatory measures are needed to tackle other invasion pathways associated with transport operations. Options under consideration for sessile and vagile species (see 1.2.3 above) include antifouling paints, although these can prove toxic for marine fauna, particularly seed-oysters. Legal frameworks should combine regulatory standards and evaluation procedures for appropriate products with incentives for the development of environmentally acceptable alternatives.

Tourists and travellers provide human pathways for unintentional introductions, through their shoes, baggage and souvenirs. The feasibility of regulatory controls for such pathways varies in different parts of the world. Stringent controls on tourist baggage and footwear can be implemented in islands with a limited number of entry points, as in Australia and New Zealand. Capacity for this purpose needs to be developed in other isolated islands with high levels of biodiversity and endemism. However, such controls are unrealistic in the crowded continental context of Europe or parts of Asia, where there are a high number of land borders and far too many points of entry to permit the examination and fumigation of shoes, clothes or personal effects of travellers.

As with private handling of pets, education and awareness-building should therefore be seen as a central part of a preventive strategy for such movements. It may be appropriate for competent authorities to develop voluntary programmes targeted at specific groups. A possible target group in some regions might be travelling workers engaged in seasonal horticultural work who may inadvertently spread fruit pests on their picking bags or other items as they move between areas or countries.

The IUCN Guidelines suggest that eco-tourism businesses can play an important role in raising awareness of problems caused by alien invasive species. They can contribute to the development of industry guidelines to prevent the unintentional transport or unauthorised introduction of alien plants, especially seeds, and animals into ecologically vulnerable island habitats and ecosystems, such as lakes, mountain areas, nature reserves, wilderness areas, isolated forests and inshore marine ecosystems (IUCN, 2000).

State practice

Many States have already enacted legally binding measures to minimise the risks of introducing harmful aquatic organisms and pathogens through ships entering their ports.

One of the earliest countries to do so was the United States. The Non-Indigenous Aquatic Nuisance, Prevention and Control Act of 1990 provided for comprehensive prevention and control measures against ballast water introductions of the Zebra mussel (*Dreissena polymorpha*) into the Great Lakes. It established a federal inter-agency Task Force to reduce risk from alien invasive species and to assess threats from aquatic nuisance species threats to "the ecological characteristics and economic uses of U.S. waters other than the Great Lakes." The scope of this Act was extended in 1996 (under the National Invasive Species Act) to provide a legal basis to regulate the introduction and spread of other aquatic nuisance species. Its geographic scope has also been extended to cover research on aquatic aliens in Chesapeake Bay, San Francisco Bay, Honolulu Harbour and the Columbia River System (Miller, 1999).

5.3.4 Measures Associated with Infrastructure Development

Infrastructure development programmes, often involving the construction of new transportation corridors, may provide opportunities for alien species to reach new parts of national territory or cross political boundaries and then become invasive (see generally 1.2.3 above).

In the aquatic context, the construction of the Suez Canal now provides a permanent pathway for alien marine fauna to reach the eastern Mediterranean. The construction of channels between inland water systems clearly presents similar risks for transfers of aquatic organisms. Water impoundment resulting from dam construction can also generate risks of invasion notably by alien aquatic vascular plants.

Programmes and projects of this kind should be designed consistently with the precautionary principle/approach and EIA in order to assess and minimise risks of introductions. In an integrated perspective, this calls for coordinated planning by departments of transport and infrastructure, planning, regional development and nature conservation.

An environmental impact assessment should always be required for major infrastructure and construction projects. Where necessary, EIA legislation should be amended to ensure that criteria specific to alien invasive species risks are taken into account and that alternatives are given full consideration (see also 5.2.3 above).

Box 29: Exotic Fish in the Mediterranean

The Mediterranean is now experiencing an influx of tropical fish that have migrated through the Suez Canal from the Red Sea or Indian Ocean. Exotic species include Barracudas, the Saddled snake eel and the poisonous Scorpion fish, as well as commercial fishes, such as the Gold band goatfish, Striped fin goatfish, Haifa grouper, and the Brazilian lizard fish. The exotic fishes have attracted tourists to the Mediterranean, who no longer have to travel to the Indian Ocean to admire these tropical beauties. However the new invaders are placing stress on indigenous species, through competition for food and habitat (*The Times*, 15 July 2000).

Where possible, physical linkage of drainage basins should be avoided if an impact study reveals a serious risk of unwanted introductions. In Greece, there is a judicial ruling to support this approach. The Greek Council of State ruled against linking up two drainage basins to divert the waters of the Acheloos *inter alia* because this would decrease the biological diversity of the respective basins (Case No.2759/ 1994, cited in de Klemm, 1996).

Where existing infrastructure corridors have already been constructed, it should be possible under legal frameworks to adopt mitigation measures, where appropriate and feasible. In the context of canals, a possible containment mechanism might be to create a pocket of fresh water across the canal to block the passage of marine species. Technical measures of this type would need to be complemented by targeted legal controls, notably a specific prohibition on discharging ballast water in the other drainage basin (de Klemm, 1996).

South Africa's 1997 White Paper on Biological Diversity recommends the development of national measures to regulate inter-basin transfers considered to present a possible pathway for introductions (Stein, 1999).

5.3.5 Measures for Other Types of Pathway

Unintentional introductions occur through a variety of other pathways, known and not yet known. Legislation should confer sufficiently broad powers on competent authorities to take appropriate action to tackle pathways that come to their knowledge.

The risks associated with the discharge of aquarium water are well-known (see discussion of *Caulerpa taxifolia*, at 1.2.2 above). Risks of this kind can be minimised by prohibiting discharges to open water or to sewers not connected to a waste water treatment plant or without sterilisation. However, it is harder to achieve compliance from private aquarium owners than from managers of public aquaria and dealers in aquarium animals. Once again, this problem needs to be addressed through information tools and by issuing instructions or guidelines to the purchasers of aquaria and aquatic organisms.

The use of live bait for fishing can lead to unintentional introductions of organisms that are not naturally present in that drainage basin, even if they come from neighbouring drainage basins in the same country (de Klemm, 1996). Legal frameworks should therefore restrict the sale and use of live bait to species naturally present in the waters concerned.

Under Tasmania's Inland Fisheries Regulations, it is prohibited to keep any fish, amphibian or living vertebrate in a bait box or any other container on or near to riverbanks or lakeshores, where the species concerned is not already present in the watercourse or lake in question.

5.4 Monitoring and Early Warning Systems

Legal frameworks should provide a formal basis for monitoring and surveillance of both terrestrial and aquatic environments. Detection and early warning systems are essential preconditions for rapid responses to new invasions. Results of research and monitoring should be fed back into the relevant knowledge base (see 4.3.2 above).

Box 30: Chickens at the Border

Facing an invasion? Posting a line of guards along your border is a good idea. Canadian health authorities stationed sentinel chickens along 2,500 kilometres of its southern border with the United States to serve as an early warning system to detect the deadly West Nile virus. The virus mainly infects birds and is transmitted to humans by mosquitoes. It was responsible for the death of seven people in New York in 1999 (see Box 8). Although the virus has yet to move north to Canada, the Canadian authorities plan to catch it if it does, by testing the sentinels once a week (*New Scientist,* 25 May 2000).

Monitoring should form an integral part of a regional strategy, where appropriate. The IUCN Guidelines recommend that neighbouring countries consider the desirability of cooperative action to prevent alien potentially invasive species from migrating across borders. Cooperation might include agreements to share information and warnings and to consult and develop rapid responses in the event of such border crossings (IUCN, 2000).

Few countries have systematic procedures for monitoring to detect alien species invasions, which is one reason why responses to invasions are often piecemeal, late and ineffective. The position appears to be similar for genetically modified organisms that are cultivated on a large scale (transgenic crops), rather than in containment (Kinderlerer, 1999).

A well-designed monitoring programme may support both preventive and control measures, where it has the following objectives:

- to oversee the behaviour of intentionally introduced alien species and immediately detect signs of invasiveness;
- to detect the presence on national territory of alien species that have been unintentionally or unlawfully introduced;
- to detect the spread of established aliens due to secondary transfers and spontaneous dispersal processes, so that eradication measures can be taken while infestations are limited;
- to detect the emergence of invasive characteristics of species, particularly woody plants, that were introduced a long time ago.

From a legal point of view, monitoring requirements may be varied depending on the nature of the introduction.

Where an introduction or release is intentional, there is a known 'author' and the relevant permit may be subject to monitoring and reporting conditions (see examples under State practice).

Where an introduction is unintentional (or unlawful), detection has to rely on general and targeted surveys. Because of resource constraints, surveys may need to be targeted in accordance with the predicted levels of risk. Surveys need to be species-specific (taking account of high-risk species), seasonally-timed (where appropriate), habitat selective and quite intensive (Veitch, 1999). Two types of area should generally be given priority:

- 'weak links', including likely ports of entry to the country and disturbed ecosystems;
- protected and/or pest-free areas, for which early detection and rapid responses are essential. Contingency plans and financial and technical resources should be made available to tackle invasions that may occur in or near to these categories of areas (Sherley, 1999).

Local communities and many different stakeholders can contribute to such monitoring programmes. People likely to encounter and recognise new species of plants and animals include botanists, herbarium curators, entomologists, pathologists, horticulturists, gardeners, crop pest consultants, farmers, land agents, weed scientists, native plant society members, nature conservancy stewards, plant and animal health inspectors and quarantine officials. In some cases it may be appropriate to create financial incentives and/or formal recognition for those who report new species that are determined to be invasive (Westbrooks, 1999).

All newly recorded species must be screened to see if they are known pests elsewhere or if they are likely to become pests in the country where they are now present (Stein, 1999).

Regulations should preferably provide for a standardised reporting system for use by all agencies and other stakeholders involved in monitoring and early detection. Coordination and pooling of information on alien invasive species is particularly important where legal frameworks are fragmented. It may be appropriate to nominate a focal point or lead agency to record, collate and maintain all such data.

Box 31: Global Invasive Species Database and Early Warning System

As part of the Global Invasive Species Programme, *a Global Invasive Species Database and Early Warning System* is being developed. This user friendly database is designed to provide comprehensive information on alien species – their taxonomy and ecology, their native and invaded distributions (including both habitat and location), reports on control and eradication, and contacts and references for further information. The database will also contain a list of the "100 worst alien species." Its aim is to promote awareness and knowledge of the range of negative impacts, pathways, etc. The "early warning" component will be designed to predict potential new invasion sites for any species by a comparison of habitat types (*IUCN Invasive Species Specialist Group. URL: http://www.issg.org*).

State practice

With regard to intentional introductions, several countries have adopted binding monitoring requirements.

In Taiwan, the municipal or city authority of an area into which alien animal species has been introduced is required to investigate and monitor the imported species regularly. If it is found that their import has adversely affected the habitat of native fauna or flora, the authorities must order the owners or users to prepare a prevention or rehabilitation plan within a certain time limit and must monitor this process. Risk situations of this type must be reported to the National Principal Authority (the Council of Agriculture) (Article 27, Wildlife Conservation Law of 1989, as amended, 1994).

In Argentina, the party responsible for introducing an alien species to the country must implement and finance an environmental monitoring and surveillance plan (Resolution 376/97).

New Zealand places a general duty on every person who imports, possesses or uses a new organism to ensure that any adverse effects caused by their actions or omissions are avoided, remedied or mitigated, and that no action or omission by them will contravene any requirement or control on that organism imposed by the Hazardous Substances and Noxious Organisms Act of 1996 (section 13).

In contrast, Germany's federal Nature Conservation Act of 1987 does not require permit holders to monitor or control the alien animal or plant species that they introduce. At sub-national level, Thüringen seems to be the only *Land* to impose a legal requirement to carry out such monitoring and to prepare documentation (section 31(N), Thüringen Nature Conservation Act of 1993).

With regard to unintentional introductions, monitoring provisions are more variable. Unsurprisingly, countries with high levels of past damage from alien invasions have the most advanced legislation in this respect.

The State of Hawaii makes formal provision for surveying its lands for areas that are relatively pristine, and those that have been harmed by alien species. The competent department is required to maintain constant vigilance for incipient infestations of specific noxious weeds on islands declared reasonably free from those weeds, and to use feasible and practicable procedures and methods to control or eradicate such infestations (Miller, 1999).

The State of Idaho and a few other American States have implemented a qualitative census system in which certain landscapes, waterways or coastlines are routinely searched for alien terrestrial and aquatic species. The federal Non-Indigenous Aquatic Nuisance, Prevention and Control Act of 1990 (see 5.3.3 above) established a national information centre responsible for coordination, detection and monitoring of introductions of alien aquatic organisms as well as monitoring and surveillance of species that have already been introduced.

A reward and recognition incentive scheme has apparently proved successful in the cooperative State/Federal Witchweed Eradication Project in the Carolinas and elsewhere (Westbrooks, 1999).

Australia has established a targeted monitoring and detection programme along its northern coastline to detect the transfer of species across the Torres Strait from New Guinea to northern Queensland, and to identify and investigate problem species in Indonesia and Papua New Guinea that might be of risk to Australia (Space, 1999).

In Argentina, on the other hand, there is no legal basis for monitoring and detecting species that are or may be potentially invasive, unless the species is first formally classified as a pest.

6.0 Measures for Responding to Invasions: Eradication, Containment or Control

The Convention on Biological Diversity (CBD) establishes a legal obligation for Parties to control and eradicate alien invasive species, "as far as possible and as appropriate".

The *Interim Guiding Principles* developed within the CBD framework recommend that once the establishment of an alien invasive species has been detected, States should take a sequenced approach to mitigate the adverse effects: eradication (where feasible and cost-effective); containment; or long-term control measures. Techniques used should be cost-effective, safe to the environment and humans, animal and plant health or life, as well as socially, culturally and ethically acceptable. Mitigation measures should take place in the earliest possible stage of invasion, on the basis of the precautionary principle/approach.

The IUCN Guidelines emphasise the need to act rapidly to eradicate or control new alien invasive species, even if there is scientific uncertainty about the long-term outcomes of the invasion (IUCN 2000).

At the national level, legal and institutional frameworks tend to be stronger on preventing introductions than on mitigating their impacts. There is often no basis for taking legal measures to tackle accumulated problems linked to past, untreated invasions. Put more colourfully, existing law often "focuses on the front lines, but pays little attention to the enemy that has arrived, and is spreading within" (Miller, 1999).

Where legislation does provide for eradication and control measures, these are often implemented in a piecemeal way rather than as part of a more strategic ecosystem approach. Measures to control alien invasive species (negative biodiversity) are rarely supported by positive measures for the restoration of degraded ecosystems and, where appropriate, re-establishment of native species formerly present on national territory.

Several factors may contribute to legislative weaknesses regarding eradication and control measures. Issues for lawmakers to consider may include:

- how to tackle deeply-rooted legal obstacles to eradication and control measures;
- how to develop or strengthen institutional capacity and coordination;
- how to design and plan for short- and long-term responses; and
- what kinds of obligations and incentives should attach to communities and private or public landowners with regard to control of alien invasive species.

6.1 Removing Legal Obstacles to Eradication and Control

Eradication or control measures involve killing members of an alien invasive species or, through chemical or other means, sterilising them to prevent future reproduction. In law, this may be done deliberately only if the legal status of the target species is compatible with such actions and the department, agency or person concerned has authority to undertake such actions.

6.1.1 Common Constraints Related to Legal Status

In the growing number of countries that confer legal protection on biodiversity *per se*, all wild species may be automatically protected unless they have a specific status providing for necessary control measures. This means that without a special classification, alien species will be treated for legal purposes like native species.

Older species protection laws also tend not to distinguish between native and alien species. Alien species that have successfully established themselves are treated as native species living naturally on the territory of the country concerned.

In both cases, culling or control measures will probably be unlawful unless a species is listed as a pest, nuisance or equivalent. As legislative listing rarely keeps up with biological reality (see 5.2.2 above), this can create major problems in practice.

Problems related to legal status can take different forms, as outlined below.

- **Introduced animal species may not be hunted**

In many countries, the only species that may be hunted are those designated as 'game'. Unless alien invasive species are included in the list of game species, it will be unlawful to use hunting as a control method. In Ireland and the United Kingdom, for example, the alien invasive bird *Oxyura jamaicensis* is not included in the

list of game species (though its release is now strictly prohibited in the United Kingdom).

In Poland, the invasive American mink was on the list of game species issued by the Ministry of Environment until 1996. It has now been removed from the list, which means it may not be lawfully hunted (Krzywkowska, 1999).

- **Introduced animal species are treated like any other game species**

In some cases, an alien species unlawfully introduced for hunting purposes is subsequently designated as a game species. Although this means that hunting is permitted, it conveys inappropriate signals because the authors of the unlawful introduction have been 'rewarded'. On the other hand, to prohibit its hunting removes an important control mechanism for containing the species' range.

A concrete example concerns the American cottontail (*Sylvilagus floridanus*) intentionally introduced into some European countries and now classified by the Bern Convention's Standing Committee as a recognised invasive. In Italy, the American cottontail was long classified as a game species which could be hunted for a limited season. Its import was subject to permit, but not strictly prohibited: its breeding and release were not restricted in any way. There was accordingly no requirement or incentive to prevent the uncontrolled spread of the species (de Klemm, 1996).

- **Introduced species qualify for legal protection**

Problems may arise where a species protection instrument lists a taxon higher than 'species' (genus, family, order or class) and does not specify that species in that taxon must be indigenous to qualify for protection.

In Europe, the 1979 Bern Convention provides an example of this potential difficulty. The Convention does not specify that species listed in its Appendices must be indigenous to the territory of the Contracting Parties. In cases where an Appendix listed a higher taxon that included an alien species, that species thus qualified for legal protection. This was the position of the alien American bullfrog (*Rana castebeiana*), until the Convention's Standing Committee formally declared it to be a recognised invasive (Standing Committee, 1999).

Where a species is protected under an international instrument, Parties will generally be unable to take control or eradication measures. Although such instruments usually provide for States to make derogations, the relevant provisions are usually narrowly drafted to ensure that any derogation would not be detrimental to the survival of the (protected) species in question. The purpose and content of such provisions are quite ill-suited to control and eradication measures for alien invasive species.

At the national level, protected area legislation often does not distinguish between alien and native species. To tackle invasive species, the competent management authority may have to rely on general powers to protect the area against damaging processes or activities. It would be preferable for legislation to contain a specific mandate for measures to protect native species of flora and fauna against alien invasive species.

In some countries, alien invasive species may be specifically protected for cultural heritage reasons. In the United States, for example, the Wild Free-Roaming Horses and Burros Act of 1971 protects some feral horses and burros from elimination or control (Miller, 1999).

6.1.2 Formulating a Legal Status Compatible with Eradication and Control

Alien species need to have a legal status that is compatible with eradication and control measures should they become invasive.

This is comparatively straightforward under special biosecurity legislation, as enacted in New Zealand. It is likely to be more complex in those countries (the majority) that rely on biodiversity/nature conservation legislation to protect native components of biodiversity and to control threats generated by alien components thereof. Lawmakers need to select terminology that systematically excludes alien species from protection whilst retaining automatic protection for accidental species, species that are new to science, and natural range extenders.

One approach is to adapt species listing techniques to distinguish more clearly between protected and unprotected species.

Positive listing should list all protected species individually instead of referring to higher taxa. This gets round the problem of alien species being inadvertently listed as protected. On the other hand, it means that there is no automatic protection for accidental or newly described species (e.g. many reptiles and amphibians in Europe in recent years) or for species that have extended their range naturally (e.g. the collared turtle-dove (*Streptopelia decaocto*) within Europe). Positive listing is also administratively cumbersome, as new regulations must be issued every

time taxonomic changes are made. Competent authorities have to be trained to recognise a high number of protected species rather than a small number of unprotected ones.

The opposite technique is to compile a negative list of alien species (species that do not qualify for legal protection), adding entries on a case-by-case basis as invasions are reported. However, such approaches are necessarily reactive and usually incomplete (5.2.2). Invasions have to be detected and reported before the competent authorities can initiate procedures to amend the relevant regulations. Unless and until lists are amended to include an alien species, the latter will remain protected, often at a time when urgent measures are required.

Lawmakers therefore need to find a compromise solution between these two extremes in order to define a status compatible with eradication and control. A model provision (de Klemm, 1996), that could be inserted into nature conservation legislation whenever a taxon higher than species is listed for protection and might cover an introduced species, could provide that legal protection applies to:

> "all species that are present, have been present in the past or become present in the future, in a wild state, on the [national] territory, except for species which have been intentionally or unintentionally introduced into that territory as a result of human action after [insert appropriate cut-off date] and species introduced in the same way on the territory of another country and now present on the [national] territory".

Wording to this effect would give automatic protection to re-introduced species, to future newly described species, to species newly found to be present on the national territory and to accidental species. It excludes introduced species, including those introduced in another state which have extended their range naturally to the territory of the country concerned.

6.2 Developing Legal Tools for Eradication, Containment or Control

6.2.1 Basic Legal and Institutional Requirements

A suitable legal status is only the starting point. Relevant institutions and agencies need a clear mandate to take necessary measures for eradication and control, both in emergencies and on a longer-term basis. Legal frameworks need to establish a minimum set of general rules to minimise the opportunities for further spread of alien species that have already been introduced.

An indicative checklist of legal measures for this purpose should include:

- a prohibition on further releases of alien invasive animals and plants to the natural environment, whether intentionally or through negligence;
- powers to regulate the containment, possession, transport and trade in introduced species (see 5.2 above);
- a notification requirement for all land owners and occupiers promptly to inform the relevant authority of the presence of listed alien species on their land;
- authority for competent officials to notify, cooperate and consult with counterparts in neighbouring countries on possible invasions and harmonised programmes for eradication and control;
- authority for competent officials to use cost recovery mechanisms and/or revenues from national or regional Environment Funds to finance eradication and control programmes.

State practice

Regarding institutional mandates, New Zealand probably has the clearest lines of institutional responsibility for biosecurity issues at all administrative levels. Since 1997, alien potentially invasive species issues have been represented at Cabinet level within the portfolio of the Minister of Food, Fibre, Biosecurity and Border Control. Chief Technical Officers have been appointed in all key ministries. At the decentralised level, Regional Councils now have express legal duties for eradication and control: each Council has compiled a 'black list' of weeds present in New Zealand that are not yet present in its region, in order to prioritise monitoring effort.

Regarding notification requirements, in Minnesota (United States), a person that allows introduction of an alien species must notify the Commissioner within 48 hours of learning of the introduction, and make every reasonable attempt to recapture or destroy it. It is a criminal offence to fail to provide notification of such an introduction.

Hawaii's quarantine legislation provides that, in the event of an escape, the person responsible must pay

the cost of the preparation and execution of a plan for recapture, control or eradication. Similar requirements are now laid down by recent provisions of the French Rural Code (Article L.211.3 of 1995).

In Western Australia, landowners must declare the presence on their land of alien species included in a list annexed to regulations and carry out operations to eradicate them.

Regarding cost recovery, New Zealand's two flagship laws provide for recovery of costs by the competent authorities. In Samoa, under the Noxious Weeds Ordinance of 1961, the Agricultural Department may recover the cost of clearing an occupier's land, even where such weeds were not introduced by the current occupier (ss. 4 and 7(2); Peteru, 1999).

6.2.2 Short-term Measures: Contingency Planning and Rapid Responses

Contingency planning is necessary to provide a basis for competent authorities to implement rapid response measures as soon as an invasion is detected. Regulatory frameworks should provide for the development of contingency plans, in consultation with relevant agencies and affected communities and individuals.

Contingency planning is also important in a transboundary and regional context. Because organisms introduced into the territory of a State can spread to neighbouring States and become invasive, mechanisms should be put in place to promote inter-State consultation and coordination well in advance of actual emergencies.

Rapid response measures may need to be implemented for unauthorised introductions, authorised introductions that have unanticipated adverse effects, and unintentional introductions as soon as the invasion is detected. Where feasible and cost-effective, priority should be given to eradicating the alien invasive species during early stages of invasion.

For emergency prophylactic measures to be taken promptly, the necessary legal provisions must already be in place and familiar to the relevant officials. The element of speed is particularly important in freshwater or marine environments, where invasive organisms disperse rapidly and many eradication options available to terrestrial managers will not work.

Box 32: Case Study of Legal Powers used to Support Rapid Response Measures

Mytilopsis sp., an organism known to be invasive in Southeast Asian ports and taxonomically close to the notorious Zebra mussel, was recently found in a Darwin marina in Australia. Under the Northern Territory's Fisheries Act, fishery officers already had the powers to enter, seize and, if necessary, destroy private property. The Territory's government was able to declare the infected marina a National Disaster area two days after being informed of the problem. National quarantine officers had similar legislative powers once the organism was listed.

Early quarantine was considered essential to effective eradication. 420 vessels that had left potentially infected areas during the previous four months were tracked down and checked for infection. Eight infected yachts were found outside the marina: they were removed from the water, the anchorages they had visited were surveyed and two further marinas were closed. Fishing vessels that had used these closed marinas were monitored at sea.

The mussel was eradicated only because of these comprehensive legal measures. The case study raises some important issues:

- most Australian states do not have similar legislation and could not have taken such measures;
- most marinas do not keep detailed records of recreational yachts entering and leaving. Foreign recreational vessels entering Australian waters are given a cruising permit that allows them to travel anywhere and their ports of call are not officially reported;
- unusually, the Darwin marinas have double locks at the point of entry and the lockmasters record the names of vessels passing through the locks. If the invasion had occurred other than in a locked marina, the ability to impose effective quarantine would have been compromised.

(*Bax, 2000*).

The legal toolbox should where possible include the following powers: inspections; confiscation; disinfection of equipment; destruction of infested material; direct chemical or other control of the invasive organisms; closure of contaminated areas to navigation or traffic (i.e. delineation of a safety/quarantine zone); prohibitions/restrictions on transfers of living material from contaminated to 'clean' areas; and, in a marine context, a ban on anchorage and provision of alternative buoys or moorings. The appropriate mix of tools in a given situation will of course vary from one case to another.

In some situations, it may be appropriate to combine regulatory tools with economic incentives to enhance compliance. In a recreational marine context, for example this might involve differential mooring fees or even free mooring away from high risk zones.

State practice

In New Zealand, a "biosecurity emergency" may be declared by the Governor-General on the recommendation of a Minister. For the areas in which a state of emergency is proclaimed, the relevant Minister may take any necessary or desirable steps to prevent the propagation of the organism or to eradicate it, including the requisition of property, buildings, ships or aircraft. A declaration lasts up to four months, unless revoked earlier or extended by Parliament (Part VII, Biosecurity Act of 1993). Strict criteria govern such a declaration:

- the organism to be managed or eradicated must have the potential to cause significant economic and/or environmental loss if it becomes established;
- it must be in the public interest that immediate action is taken against the organism;
- sufficient powers must not be otherwise available to manage or eradicate the organism.

In most cases, the powers available under Pest Management Strategies will usually be adequate (Christensen, 1999; see below).

In Australia's Northern Territory, fisheries officers have extensive powers to take rapid response measures under fisheries legislation (see Box 32).

6.2.3 Strategic Planning for Long-term Containment and Control

On a longer-term basis, issues related to alien species management and control need to be addressed in a strategic way through a transparent and participatory planning process. This is particularly important where established alien species have economic and/or socio-cultural benefits, such as cropping/harvesting values as fruit, fodder, herbs or firewood; timber; erosion control; ornamental value and so on (Fowler, 1999). There should be an opportunity for conflicting views to be aired. Where a decision is taken to implement control measures, local populations should where possible be involved in formulating management plans and taking the relevant measures. This is already happening in parts of East Africa affected by Water hyacinth (GBF, 1999).

Management strategies may be developed at the national or regional level, for large-scale projects (e.g. South Africa's *Working for Water* programme (see Box 35)) or for individual sites or species. Legal frameworks should provide for risk analysis and environmental impact assessment of possible control methods (see Box 33).

State practice

In New Zealand, "pest management strategies" (PMS) are the main mechanism for the eradication or control of invasive species once established or introduced. PMS may be developed at regional or national level and used to allocate fiscal, managerial and operational responsibilities for mitigation.

For a national PMS, a descriptive proposal document is publicly notified by the Minister. Written submissions are sought from any person or group whose interests may be affected by the proposal. If the Minister considers that there is significant opposition, a Board of Inquiry must be set up to review the proposal. A recommendation is then made by the Minister to the Governor General to issue a regulation approving the PMS when she/he is satisfied with the proposal (sections 56-70, Biosecurity Act of 1993).

A regional PMS may be prepared by any person or organisation approved by the regional council in the relevant region(s). The proposal is made publicly available by the regional council, submissions are invited and a public hearing must be held (conducted by the regional council or a specially-appointed hearings commissioner). The regional council must publicly notify its decision as well as the final PMS. Each submitter must be advised of the council's decision and may refer a particular matter to the Environment Court. A regional PMS must be reviewed within five years. In the interim, minor amendments may be made provided that the individual rights and obligations of any person are not significantly affected by the change (sections 71-83, Biosecurity Act of 1993).

PMS provide some significant benefits in comparison to direct exercise of government powers under Biosecurity Emergencies (Christensen, 1999). The management agency and those responsible for undertaking control or eradication measures do not have

to be government bodies or employees. Obligations and duties can be targeted at specific groups of people. Compensation requirements can be varied for loss or damage inflicted on private property as a result of the use of statutory powers to manage the harmful organism. Financial contributions may also be secured by way of a levy.

Box 33: Control of Alien Invasive Species: Toolbox

Control methods need to be designed and selected according to the circumstances and an assessment of long-term environmental social and economic costs. These control methods should be applied with the fullest possible scientific understanding.

- **Mechanical control**: involves removing the species by hand or with appropriate machines such as harvesting vehicles (e.g., the Water hyacinth), or firearms (e.g., for culling large mammals), or traps (for some vertebrates or insects).
- **Chemical control**: involves the use of herbicides and insecticides, including ensuring that only the target species are affected and avoiding the potential problem of resistance developing over time.
- **Biological control**: involves the intentional use of populations of natural enemies of the target alien invasive species or other methods that involve, for example, mass release of sterile males of the target species, inducing resistance in the host against the alien species that is attacking it, releasing the natural enemy to control the alien invasive species. Biological control may give long-term suppression of an alien invasive species without recurrent costs. It should be implemented in line with existing national regulations, international standards and prior risk analysis (see 2.4.4 above).
- **Habitat Management**: involves measures like prescribed burning, grazing, etc.
- **Integrated Pest Management**, which combines the methods described above, based on ecological research, regular monitoring and careful coordination.

(*Wittenberg, 2000; and Howard, 2000*).

In Australia, the Commonwealth Environment Protection and Biodiversity Conservation Act of 1999 establishes detailed planning measures to reduce, eliminate or prevent the impacts of listed alien species on biodiversity in the Australian jurisdiction (section 301A). All plans must give consideration to the precautionary principle/approach (section 391) and are binding on the Commonwealth government and Commonwealth agencies. One provision is of particular interest. Where a Recovery Plan (for listed threatened species and ecological communities) or a Threat Abatement Plan (for key threatening processes) provides for the eradication of an alien species *that is threatened in a country in which its native habitat occurs* (italics added), the Commonwealth government must offer to provide stock of the species to that country before carrying out such eradication (section 272). Equivalent requirements apply where provisions to eradicate alien species are included in wildlife conservation plans for listed migratory species, listed marine species, cetacean species occurring in the Australian Whale Sanctuary, and 'conservation-dependent' species (sections 285-8).

6.2.4 Regulatory and Incentive Measures to Control Alien Animals

Legislation may provide for the control of alien invasive mammals and birds by formally reclassifying them as "non-protected", "harmful" or "pest" species and authorising their destruction, hunting or trapping on a seasonal or permanent basis.

Regulations to this effect exist in several European countries for coypu, American mink, raccoon-dog, raccoon and feral cat. Such measures may be voluntary or mandatory.

A specific recommendation on the eradication of certain species was adopted by the Standing Committee to the Bern Convention in 1999. Although these primarily concern Parties to the Bern Convention, they are of wider relevance (see Box 34).

Box 34: Recommendations for the Eradication of Non-native Terrestrial Vertebrates

- methods of eradication should be as selective, ethical and without cruelty as possible, consistent with the aim of permanently eliminating the invasive species;
- feral animals of domestic species and commercial non-native species (e.g. Rat *(Rattus rattus)*, mouse *(Mus musculus)*, etc.) can be some of the most aggressive and damaging alien species to the natural environment, especially on islands;
- their removal should therefore be a management option in certain circumstances;
- where eradication of populations is deemed feasible, the effect of such eradication on native fauna and flora should be monitored;
- States should seek the involvement and cooperation of all interested parties, including organisations and operators, who were at the origin of the voluntary release, local and regional authorities, as well as the scientific communities;
- eradication campaigns should be supported by public awareness and education measures to inform the general public of the threat represented by introduced alien species for native wildlife and its natural habitats.

(Standing Committee to the Bern Convention, 19th Meeting, December 1999).

Control programmes should ideally combine regulatory and voluntary measures to maximise the involvement by groups responsible for or affected by the impacts of invasions. Indigenous and local communities and land users are often best placed to monitor the impacts of alien species on local ecosystems, to identify when those species become invasive and to participate actively in mitigation measures.

Legislative authority is necessary to establish the principles and conditions under which economic benefits from invasive control may be realised and distributed.

For alien animals, bounty systems are sometimes used to deliver payment for catching or destroying target invasive species. They can help to promote local community involvement in eradication and control programmes. However, price-setting is a sensitive matter (Corn, 1999). Bounties must be high enough to attract sufficient take-up to have a substantial effect on the target species' population. On the other hand, if they are set too high, this can provide a perverse incentive to slow down the control rate to ensure the continued supply of the lucrative organism!

Samoa introduced a bounty system in the 1980s to control the African snail (a few cents per snail killed). This was halted when it was found that snails were being bred for this purpose. Instead, cars imported from American Samoa are now steam-sprayed as a prophylactic measure to minimise new introductions.

An effective bounty system would therefore need to have clear legal parameters, backed by some kind of quantitative commitments and compliance criteria.

State practice

In Hungary, the Nature Conservation Directorate may issue a liquidation order for alien or non-naturalised species. Hunting permit holders can be required to reduce or liquidate the populations of such animals (sections 12-13, Nature Conservation Act of 1996).

In Argentina, hunting of alien invasive species is also permitted for control purposes (Decree 666/97). In protected areas, the National Parks Administration may authorise hunting, sport fishing or eradication of alien species where this is justified for biological, technical or scientific reasons. However, commercial hunting of these species is subject to an environmental impact assessment (Resolution Number 16/94).

In Mauritius, the alien Java deer is culled in Conservation Management Areas by volunteers through the supervision of National Park staff and the venison is sold to an approved contractor. Alien monkeys, which impact on native forest biodiversity and also spread the seeds of some alien invasive plants, are controlled on a cooperative basis by two companies that export monkeys for medical research. The monkeys are trapped in protected areas at the request of conservation managers and in agricultural lands at the request of planters (Mungroo, 1999).

Incentives linked to the use of invasives for economic opportunities are a delicate issue needing more research. In 1999, for example, the California Department of Fish and Game was still debating whether authorisation of commercial harvest of alien Chinese mitten crabs (*Eriocheir sinenis*)would contribute to their control or actually encourage further introductions (Corn, 1999).

6.2.5 Regulatory and Incentive Measures to Control Alien Plants

From a legal point of view, it is more complex to introduce requirements for alien plant eradication and control, particularly where land is privately-owned and/or is cultivated with alien species as part of existing commercial practice.

Whereas wild animals usually have the status of *res communis* or *res nullius*, many legal systems consider that plants attach to the land and are entirely a matter for the owner. The latter can generally treat such plants as she/he wishes, unless they are subject to legal rules for their protection, management or destruction.

A growing number of countries have adopted specific requirements, usually through agricultural or forestry legislation, for owners/occupiers to clear their land of 'noxious weeds' or 'invader plants' and to prevent their spread to neighbouring land. Such laws may also provide for site-specific eradication/control orders to be issued (see examples below).

Incentive measures should be given greater attention in designing management strategies for invasive plants. As discussed, unsustainable land management practices and vegetation clearance contribute to invasions (see 1.2 above). Logically, sustainable management practices and restoration of native vegetation should be actively promoted – through direct payments, tax breaks or market-based instruments – to restore environmental resilience and underpin eradication/control efforts (Bean, 1996). The experience and vested interests of indigenous and local communities, other land owners and occupiers and all other stakeholders should be harnessed for this purpose (GBF, 1999).

Incentive programmes used in other areas of environmental management (habitat conservation, native vegetation management and agro-environment measures) could potentially be adapted for this purpose. Possible mechanisms might include:

- contractual management agreements for eradicating particular species and keeping the land clear for a defined period (payment linked to results or 'outputs');
- reduction or exemption from land taxes in return for similar commitments;
- cross-compliance mechanisms, whereby crop support payments or other grants/subsidies are linked to agreed control targets or land management objectives.

In each case, non-compliance with the terms of the incentive scheme should mean that sums received must be repaid or that tax exemptions are withdrawn.

Regulatory and incentive measures may be combined to reduce the use of alien plants in replanting, rehabilitation and landscaping, with a particular focus on tourist development projects. Targeted incentives may help to increase the supply and use of native plant species for these purposes. Such measures could be designed to encourage nurseries to cultivate native species, possibly supported by new types of plant certification scheme. In some cases, however, it will not be practicable to impose regulatory restrictions until steps have been taken to ensure availability of indigenous seedlings (Baldacchino, 1996).

Voluntary cost-sharing by landowners, local governments and States can be another way to support control programmes. This type of mechanism has been used in parts of the United States to control the invasive Leafy Spurge (*Euphorbia esula*) a plant which crowds out other vegetation in open pasture or rangeland, prevents grazing, causes precipitous drops in land values and thus threatens agricultural jobs (Corn, 1999).

State practice

Under Poland's Forestry Act of 1991, all forest owners have the responsibility to eradicate harmful species if they become invasive and to detect and prevent invasions of harmful species. This obligation is enforceable by the district administrative authority (*Starostwo*), whose decisions are subject to judicial review by higher administrative courts where necessary (Krzywkowska, 1999).

Under South Africa's Conservation of Agricultural Resources Act of 1983, the Minister has broad powers to adopt regulations declaring any plant (or seed of such plant and any vegetative part of such plant which reproduces itself sexually) to be a weed or an invader plant (section 2(3)). The declaration may apply throughout the Republic or any part of the Republic. Nominated officers in local authorities may enter any land to determine whether weeds or invader plants occur on that land (section 18). The Minister may prescribe mandatory control measures for landowners and resource users, including those who harvest wood or other organic matter from the land, and for local authorities. It is a criminal offence to sell or spread declared weeds, including on agricultural produce and on livestock (section 5).

Regulations adopted under the Act in 2000 provide for the classification of alien invasive plants into three categories with adapted management requirements: weeds (considered the most serious threat); invader plants with commercial value; and invader plants with ornamental value. Riparian areas must be cleared of any invasive plants.

Subsidies and grants are available under the Act for controlling weeds or invader plants, as well as weed killers and advisory services. Landowners and users must comply with the specifications of the scheme to qualify for subsidies and must refund payments if they fail to comply.

In the Province of Mpumalanga (South Africa), the owner or occupier of land upon which invader weeds and plants are found and which threaten the natural biodiversity must take steps to eradicate or destroy such plants on such land. Breach of these requirements constitutes a criminal offence (Mpumalanga Nature Conservation Act of 1998).

The South African forestry industry has developed an environmental code of conduct that seeks to manage the spread of alien plants. The code of conduct recommends that commercial planting should not be carried out within 20-30 metres of wetlands or riparian zones and professional forestry companies should keep these buffer strips clear of all alien plants.

Hawaii has established detailed procedures for the control or eradication of noxious weed infestations. Where the competent department determines that this is practicable and feasible, it must adopt methods that cause as little damage to crops and property as possible. The department must serve notice on both the landowner and the occupier of the infested property, setting out all pertinent information with respect to the infestation and the proposed procedure and methods of control or eradication. It may enter into a cooperative agreement with the owner/occupier for such control or eradication. Alternatively, it may carry out the eradication or control itself, provided that the owner, occupier or lessee will not benefit materially or financially as a result. The department must carry out the control itself where the infestation is on state-owned land not leased or privately controlled (Revised Statutes, sections 152-6; see also 4.7 above).

The concept of 'weed management areas' originated in the Greater Yellowstone Area in Wyoming (United States). A local, state or regional partnership committee is formed to control weeds that impact on public and private lands and across jurisdictional boundaries. Area designations of this kind provide a mechanism for interagency cooperation on a common problem as well as skills exchange and cost sharing (Westbrook, 1999).

Box 35: South Africa's Working for Water Programme

This is the biggest ecosystem management programme in Africa and combines large-scale control and eradication of alien invasive trees in upper catchments. The programme was started in 1995 with SAR 25 million grant from the South African Government. The goal of the programme is to control and eradicate alien invasive species in South Africa within 20 years.

The primary objectives are to:

- enhance water security through regaining control over alien invasive plants;
- restore agricultural capacity and security;
- improve the ecological integrity of the natural systems;
- maximise social benefits as a community-based public works programme;
- develop economic benefits from clearing these plants; and
- demonstrate sectoral partnerships.

A cost-benefit analysis was carried out prior to the development of the Programme. It found that removal of water-demanding alien trees would maximise the delivery of an ecosystem service (water supply) and be more economically efficient than building dams or developing other water supply schemes. The analysis also found a linkage between delivery of ecosystem services and socio-economic development. Initially, 7,000 jobs were created for the labour-intensive clearing projects, reaching over 35,000 jobs in March 1998. This potential for job creation has proved a catalyst for private sector funding and foreign aid.

The South Africa Water Act of 1998 has significantly extended the linkage between water catchment management and control of invasive plants. Catchment Management Agencies now have responsibilities for control of alien plants in view of their impact on water resources, and thus on a catchment's ability to provide water. The Act establishes a charging system applicable to all uses of water, wherever it occurs in the hydrological cycle. Certain activities, including plantation forestry, which is heavily reliant on alien tree species, are categorised as "streamflow reduction activities". Persons or entities responsible for such activities may be charged for the water consumption involved.

(*Working for Water Programme Business Plan (1999-2003*); Wilgen, 1999).

Several countries have a legal basis for site-specific eradication/control orders:

- Hawaii has designated a series of representative Special Ecological Areas from which alien animals and vegetation are systematically removed.
- In South Africa's Cape Floral Kingdom, a specific executive order was issued on 9 August 1985 requiring that Acacia, Hakea and any other alien invasive species threatening the survival of indigenous plant species should be eradicated.
- Mauritius has established eight Conservation Management Areas to conserve plant genetic resources in representative vegetation communities. Alien plant species are systematically removed, either directly by the National Parks and Conservation Service or under contract by non-governmental organisations and volunteers (Mungroo, 1999).
- An invasive species reduction programme for the Galapagos Islands, Ecuador, is managed by the World Wide Fund for Nature with funding from the United Nations Foundation.
- South Africa's Working for Water Programme provides an ambitious example of an incentive-based control programme for alien invasive plants (see Box 35).

6.3 Legal Measures to Support Restoration of Native Biodiversity

Alien invasive species management is one of many interlinked policies needed to conserve native biodiversity. Control of alien species that threaten native species, habitats and ecosystems is an essential precondition for maintaining or restoring the latter to a favourable conservation status in the long term.

Legal frameworks to address alien invasive species tend to be primarily negative. Legal tools are designed to exclude species that may damage native biodiversity and to mitigate the impacts of established or newly-introduced alien species. Where possible, frameworks should be expanded to include positive measures to conserve and enhance native biodiversity. Tools for this purpose could include:

- measures to re-introduce or re-establish populations of native species formerly present in all or part of the national territory;
- measures to restore native habitats and ecosystems that have been degraded as a result of invasion by alien species.

Recovery measures can also be designed to address other damaging processes, such as desertification, erosion and siltation. In some cases, a single re-introduction can bring multiple benefits. One example involves the proposed re-introduction of the giant tortoise to Mauritius, from where it has been extinct for several hundred years. Although the islands' native flora often evolved to be tortoise resistant, alien weeds have invaded several areas (e.g. *Leucaena leucocephala*). These alien weeds are apparently palatable to the tortoises, which would therefore act as a biological control agent for the invasive plants (Fowler, 1999).

6.3.1 Re-introduction or Re-establishment of Native Species

"Re-introduction" is commonly understood as an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct (IUCN, 1995). For some commentators, "re-establishment" is a preferable term for species that were once present on the territory in question.

The re-introduction of a species from other parts of its range can in certain circumstances be a recommended action to save an endangered species and to enhance native biological diversity. However, this has to be done under stringent conditions as it involves certain direct or indirect impacts on the animals and plants already present in the area designated for re-introduction. Specific precautions must be taken to ensure that the candidate for re-introduction belongs to the subspecies, where applicable, that died out and to minimise the risk of the re-introduced subspecies breeding with domesticated or cultivated subspecies.

At the national level, the terms "re-introduction" and "re-establishment" are rarely defined. Many existing laws subject re-establishment to the same rules as introductions or completely ignore them. In the latter case, re-introductions can only be regulated if the species is legally protected and its import, possession and transport controlled. This would be the case, for example, for species listed in CITES Appendix 1.

Legal frameworks should establish procedures and conditions for the assessment and control of re-introduction/re-establishment programmes. The following paragraph sets out a checklist of suitable provisions, based largely on internationally agreed guidelines or recommendations (see de Klemm, 1996):

- a permit from the nature conservation authorities should be required for any operation to re-introduce a species in any part of the national territory from which it has disappeared;
- each State/sub-national unit should consult neighbouring countries/units where re-introduced specimens are liable to cross a boundary and, where possible, coordinate such re-introductions among the countries/units concerned (recommendations to this effect are set out in Recommendation (R(85)15) of the Committee of Ministers of the Council of Europe);
- a permit should not be granted unless the original causes of extinction have been removed; the habitat requirements of the species are satisfied; and re-introduced specimens are of the closest available race or type to the original stock and preferably of the same race as that previously occurring in the area (criteria taken from IUCN, 1987);
- permits should only be granted for specimens that do not harbour diseases or pathogenic agents;
- the re-introduction must not cause substantial damage to farming or forestry;
- the permit determination procedure should include an assessment of possible environmental and socio-economic impacts; consultation of a scientific body designated for this purpose; and public hearings or consultation with potentially affected parties, local authorities and landowners;
- penalties should be established for any re-introduction carried out without a permit or in violation of the permit conditions;
- those responsible for unlawful re-introductions should be liable for resulting damage and the cost of any necessary eradication measures;
- re-introduced species should be legally protected, though exemptions should be possible where serious damage is caused. The capture or killing of re-introduced specimens should only be carried out by nature conservation authorities or under their supervision;
- compensation should be payable for damage caused by authorised re-introductions.

State practice

In New Zealand, the legal procedure to re-introduce a native species is the same as for "new organisms", if such a species was not present in New Zealand on 29 July 1998 (the cut-off date established by the Hazardous Substances and New Organisms Act of 1996). This appears to be a workable approach for an island country, as there are no indications of native species existing overseas that are not also present in New Zealand.

Hungary establishes specific permit requirements for re-introductions of wild animal species and for introductions of protected plant and animal species. A permit is also required to restock the population of any animal species protected under national legislation or international law with individuals from foreign populations (Nature Conservation Act of 1996).

Under Germany's federal Nature Conservation Act of 1987, re-introduction provisions are included in Chapter 5 on *Protection and management of wild animal and plant species*. Species protection is defined to include protection and management of wild species in their natural and historically developed diversity. It specifically comprises "the installation of animals and plants of displaced wild species in appropriate biotopes within their natural areas of occurrence" (section 20).

The Act establishes a permit requirement for the release or installation of all displaced or extinct indigenous species. However, this raises potential difficulties due to the legislative definition of "native" (see 4.2 above). Because the German definition covers not only native species that were formerly present but also alien species that established themselves some time in the past, the permit requirement for re-introductions would appear to apply to both categories of species (Gündling, 1999). From a biological point of view, however, only the first group of species is "native" in the strict sense of the term and thus suitable for re-introduction.

6.3.2 Restoration of Degraded Habitats and Ecosystems

In international and national law, increasing emphasis is placed on measures for rehabilitation of degraded areas and restoration of ecosystem functions. Control of alien invasive species is seen as an integral component of species or habitat recovery measures.

In a broad perspective, the counterpart to invasive-related restrictions should be positive measures for the use of native species within ecosystem management and restoration. The following section gives some examples of how this approach can be supported under national legislation and regional policy.

State practice

European countries have been recommended to encourage the use of native plant species of known local provenance in habitat creation or restoration (First European Conference for the Conservation of Wild Flora; Planta Europaea, September 1995). The same Conference noted the risk that habitat restoration schemes funded under the European Union's agro-environment regulations might make use of alien plant species in replanting operations. It specifically recommended that programmes partially funded under the European Union's Common Agricultural Policy should be required to use native plant species of known local provenance.

Some European countries have legal requirements to this effect. In Switzerland, regulatory standards have been adopted for the production and use of seeds and plants suited to local conditions for the development of "compensatory environmental areas" and for the replanting of roadway and railway embankments as well as leveled areas (Commission for the Conservation of Wild Plants, 1994). The system involves a determination of the local origin for different categories of native plants, defined by reference to a framework of ten natural regions. In the Alpine region, for example, seeds used for revegetation should come from within a 20 km radius (Lambinon, 1997).

Hungary's Nature Conservation Act of 1996 provides for afforestation to be carried out primarily with native tree species, using nature-friendly techniques, whenever the habitat conditions make it possible. Stricter requirements apply to forests in "protected natural areas", where reforestation must be carried out with indigenous tree species occurring naturally on the given site (Articles 16 and 33).

The Walloon Region of Belgium has revised the lists of plant species recommended for the application of agro-environmental measures and subsidises the cultivation of local ecotypes of several dozen species (Lambinon, 1997).

In the United States, Executive Order 13112 of 1999 generally directs federal agencies to "provide for restoration of native species and habitat conditions in ecosystems that have been invaded." Certain sectors have already established objectives and criteria giving preference to native species.

One example concerns regulations adopted by the Office of Surface Mining, Reclamation and Enforcement (OSM). These provide that introduced species may be used to revegetate reclamation sites only if field trials have demonstrated they are of equal or superior utility for the approved post-mining land use, or are necessary to achieve a quick, temporary, and stabilising cover. The substitution of alien for native species must be approved by the OSM. Introduced species must comply with applicable state and federal legislation on seeds and introduced species and must not include poisonous or potentially toxic species (30 CFR 715.20(b), 717.20(b), 816.111(b)(5) and 817.11 1(b)(5), cited in Corn, 1999).

In another example, the federal Bureau of Land Management prohibits the use of alien plant species on public grazing lands unless native species are not available in sufficient quantities or are incapable of maintaining or achieving properly functioning conditions and biological health.

In New Zealand, the Coastal Policy Statement of 1994 issued under the Resource Management Act of 1991 specifies that coastal policy statements and plans should indicate that when restoration plantings are carried out, preference should be given to the use of indigenous species, with a further preference for the use of local genetic stock (Policy 3.2.10). The 1997 White Paper on the Conservation and Sustainable Use of South Africa's Biodiversity also supports provisions for the use of local, indigenous species in rehabilitation and revegetation schemes.

Legal authority for tackling invasive species within species recovery plans exists in several countries. At the federal level, Australia provides a legal basis for the eradication of alien invasive species as part of recovery planning for threatened species or ecological communities (Environment Protection and Biodiversity Conservation Act 1999; see 4.8.2.3 above).

In the United States, the federal Endangered Species Act of 1973 provides for the development of recovery plans for species listed as endangered. Where alien invasive species threaten listed species due to predation, competition or displacement, recovery plans commonly provide for eradication or control measures (OTA, 1993). The federal courts have upheld an order to the Hawaiian Department of Land and Natural Resources to remove alien goats and sheep that threatened the endangered palila bird (Miller, 1999).

7.0 Measures to Enhance Compliance and Promote Accountability

It is important for legal frameworks to promote a culture of accountability and civil and administrative responsibility at all levels. Education and public awareness measures are necessary to reduce the risks involved in private handling of alien species and to modify consumer attitudes and preferences over time. In the longer term, awareness building strategies amongst citizens, commercial stakeholders and administrations may make the biggest contribution to lowering the rate of introductions and effectively controlling invasions. Transparency in administrative decision-making is an important part of this process.

7.1 Criminal and Civil Liability

It is important to emphasise that many invasive-related problems result from actions that are already prohibited or restricted (e.g. unauthorised introductions of alien animals or plants, unlawful trade in wild species, breach of quarantine regulations). Others result from recklessness or gross negligence and should be subject to appropriate criminal or administrative penalties. Unintentional introductions may result from non-compliance with operating regulations (e.g. controls on discharge of ballast water), which should also constitute an offence.

Depending on a country's institutional framework, one or several agencies may have oversight and enforcement powers. Functions and duties should be clearly defined and attributed to the various environment, customs or other inspectors. A minimum set of powers to investigate and enforce alien-related offences could include powers to enter premises, request oral or written information and documents, take samples and collect evidence, seize property, and issue arrest warrants.

Regulatory frameworks should provide for a full suite of enforcement and penalty mechanisms to reinforce policy on alien species control. There should be no gaps in the applicable regulations and meaningful penalties should be available to reflect the seriousness of such actions. Legislation should provide a basis for 'stop orders' (to stop a damaging activity or remove an identified threat) and authorise the competent authority to order or carry out control measures and recover the costs from the owner or occupier responsible. Other appropriate penalties should include, as appropriate, the withdrawal of permits, the temporary or permanent closure of the establishment and confiscation of specimens.

An indicative checklist of offences should include:

- permit-related violations (failure to obtain, breach of permit conditions, etc.);
- operational violations (non-compliance with operating rules for breeding/cultivation facilities, safety standards, breach of transport regulations etc.);
- unlawful international and domestic trade in specimens of alien species;
- unlawful subsequent releases;
- breach of monitoring and notification requirements;
- failure to take mandatory control and eradication measures;
- breach of contractual undertakings for eradication and control.

Lawmakers need to give careful attention to the standard of conduct required to find liability. It may be necessary to vary this standard depending on the type of species or activity concerned, taking into account difficulties related to matters of evidence and proof.

Where appropriate, and permitted under national legal systems, invasions that result from grossly negligent acts or omissions should be punishable. In the United Kingdom, the intentional or negligent introduction of an alien animal or subsequent release of an already introduced animal constitute criminal offences (Wildlife and Countryside Act of 1981, as amended). For some categories of animals, it may be possible to establish a compulsory registration and marking system to make it possible to identify the owner, but this is only workable for large captive animals.

In certain cases, it may be possible to go further and impose strict liability for some types of conduct involving the introduction of alien invasive species. By analogy with other areas of environmental law focused on hazardous activities, this approach may be particularly suitable for activities known to present high risks of escapes or releases (e.g. certain types of containment facilities, escapes from zoos etc.).

State practice

Legislation may establish specific offences and penalties with regard to alien invasive species or address unlawful conduct through general provisions of criminal law. The first option is to be preferred, as it promotes legal certainty and is likely to facilitate enforcement.

In the American State of Minnesota, the person who allows the release of alien species is liable for costs incurred by the state in the capture or control of the

animal "and its progeny". In France, where a permit is required to establish captive-breeding facilities for non-game species, the courts have imposed penalties on clandestine breeders of *Sylvilagus*. In Western Australia, animals imported or held in breach of applicable provisions may be confiscated and destroyed.

With regard to alien animal species, some laws establish a presumption that the person last known to be in possession of the species is liable, unless that person can adduce proof to the contrary. Under the legislation in Western Australia, if an alien animal escapes from a vehicle, the burden of proof is on the driver to show that he was not responsible.

Penalty levels tend to be highest in countries that have suffered most from invasive species. In South Africa, the Mpumalanga's Nature Conservation Act of 1998 provides for the imposition of unlimited fines and/or four year terms of imprisonment for offences related to alien invasive species.

Hungary's Nature Conservation Act of 1996 provides a broad basis for recovering costs for damage to protected areas, which could potentially apply to damage generated by invasions (sections 73, 81). Any legal person, private entrepreneur or full time farmer using hazardous substances in protected natural areas or "pursuing activities otherwise dangerous to the character or conditions of the natural value" shall provide security or draw up an insurance contract in accordance with special regulations. Civil liability may be incurred for infringement of nature conservation legislation or regulations. The responsible party may be required to reimburse not only property damage and loss of profit, but also "the immaterial costs resulting from the damage to natural conditions and quality." "Natural rehabilitation" expressly includes the cost of "reinstating the original conditions". The Prosecutor may institute legal proceedings to secure compensation of certain costs, such compensation is to be paid to the Central Environmental Fund.

In Poland, any person may bring a civil action for damages against a person responsible for an introduction (Civil Code of 1964, as amended). In addition, any individual or NGO has legal standing in the administrative court against alleged introducers of invasive species (Environment Protection Act of 1980, as amended).

7.2 Difficulties with Compliance Mechanisms

Despite the above, use of conventional compliance mechanisms presents significant difficulties in the area of alien species control. On one level, this is due to low public awareness and/or institutional commitment and capacity. On a deeper level, however, this is because traditional standards of knowledge, intent, and causality are hard or impossible to apply to many cases of biological invasion.

Lawmakers need to address important policy issues concerning the appropriate treatment of introductions that were lawful, either because there were no controls or screening requirements at the time or because the species/pathway was not included on the relevant list. Legal considerations are likely to include the following factors:

- intentional introductions that are lawful (e.g. a permit was granted because the introduced alien was not identified as potentially invasive and was not included on a list of species to be excluded);
- liability may not be retrospectively imposed (the case of a pre-approved introduction where the species concerned is subsequently added to a black or grey list);
- unauthorised introductions are hard to detect, particularly given the number of possible pathways, vectors, and private actors involved;
- an unintentional introduction takes place via a pathway that has not been identified as high-risk and is not subject to operating regulations or recommended best practices;
- the law does not cover negligent conduct that gives rise to introductions;
- because of time lags, it is impossible to determine what caused an introduction, to identify a specific introducer with the certainty required by law or to allocate remediation costs to a particular party;
- the damaged values (native wild species, ecosystems, ecological processes) do not have an 'owner' capable of seeking compensation and remediation;
- financial and technical resources for monitoring (evidence-gathering) are low.

Where such factors apply, it may be impossible to identify a person or entity responsible for an introduction who can be fined or otherwise made to compensate for a damaging introduction. In many cases, the invasion may have resulted from a category of activity carried out by numerous companies, facilities or individuals but it is difficult to know whose actions or omissions actually led to the introduction.

Conventional approaches to personal or corporate liability can therefore play only a partial role in enforcement strategies. Innovative approaches to promote accountability for such actions need to be developed as a priority to promote improved standards and compliance amongst groups of stakeholders.

7.3 Complementary Approaches to Promote Accountability

Unintentional introductions, in particular, present particular challenges with regard to compliance and accountability. To the extent that it is legally or practically impossible to make a finding of individual liability for such introductions, innovative approaches are needed to promote a culture of collective 'responsibility' amongst actors involved in particular activities (e.g. traders of a particular commodity, including timber; certain groups of cargo transporters; the agriculture sector; pet retailers; horticulturists; tourist companies; etc.).

Such approaches should be developed in close consultation between the groups concerned and other groups of stakeholders. Their common objective should be to promote best practice and reduce the risk of unwanted introductions or unaddressed invasions. They may be voluntary (self-imposed regulatory systems); underpinned by regulatory standards; or mixed (e.g. a voluntary code of conduct combined with some form of mandatory insurance or financial mechanism).

Specific consideration needs to be given to developing mechanisms to generate sustainable up-front funding for regulatory and remediation programmes (administrative and management costs of screening, risk analysis, quarantine, monitoring, eradication and control).

Where States have established national or regional Environment Funds, it should be possible to use revenues from such funds to finance eradication and control programmes. Taxes, fees, fines and levies as well as public budget allocations may generate funds of this kind. Funds may be used to cover rewards, bounties, contract payments and incentives to individuals and communities who participate in control and eradication programmes.

Lawmakers should give consideration to precedents developed in other legal areas characterised by similar difficulties related to causation and/or potential scale of costs. There are several points of similarity between alien invasive species and other fields requiring management of environmental risk. Like diffuse or non-point source pollution, small-scale actions contribute to the cumulative effects of biological invasions. Like contaminated land, the invasion may long predate the acquisition by or installation of the current owner or operator (difficulties related to retrospective liability). Like marine pollution or nuclear power generation, the scale of the risk involved may justify the use of risk-spreading mechanisms (collective insurance, joint funds, etc.).

Possible options that could be adapted to alien species control include:

- mandatory insurance;
- deposit/performance bonds;
- fees or changes;
- levies/taxes.

Mandatory Insurance

Many forms of mandatory special insurance exist to cover possible harmful impacts resulting from known risk actions (e.g. driving cars). In the area of nature conservation, as noted, Hungarian law requires any person using hazardous substances in protected areas or "pursuing activities otherwise dangerous to the character or conditions of the natural value" to provide security or draw up an insurance contract in accordance with special regulations (Nature Conservation Act of 1996).

Argentina's draft Biodiversity Strategy proposes that mandatory insurance should be considered to cover the risk of escapes, damage to third parties and the cost of eradication measures in the event of abandonment.

Professional animal breeders or traders may also be required to insure against risk of escapes and/or be subject to a levy to finance necessary surveillance procedures.

Deposit/Performance Bonds

Under construction law, contractors are routinely required to post a bond to ensure that funds will be available to pay the costs of completing and cleaning up the project if the contractor fails.

In the Philippines, mechanisms of this type are used in at least two areas. Under the legislation applicable to plant imports, the successful permit applicant may be required to deposit a bond equal to the estimated cost of the material to be imported (Sastroutomo, 1999). Under the Regulations on Prospecting of Biological and Genetic Resources (96-20), the applicant for a commercial access permit relating to access to genetic resources may be required to deposit a performance, compensation and ecological

rehabilitation bond as a condition of the access agreement. In the event of non-compliance, the competent authority may revoke the permit and retain the deposited bond (section 8.2(4), Implementation Rules and Regulations on the Prospecting of Biological and Genetic Resources 96-20, adopted under Philippines Executive Order 247 of 1995).

In Costa Rica, a permit holder may be required to contribute to administrative costs and also to deposit up to 10% of its research budget and up to 50% of the bonuses which it collects in favour of the National System of Conservation Areas, the indigenous community or the private owner providing access to these components (Biodiversity Act of 1998, Article 76).

One option for alien species control would be to require performance/deposit bonds, guarantees or similar assurances from commercial permit holders or operators of facilities where alien species are kept in containment or captivity.

Deposit bonds could be adapted for private users of alien species, with purchasers of pets and aquarium specimens being required to pay refundable deposits that would be repaid to any pet owner making use of the recovery system.

Fees and Charges

As a minimum, costs directly linked to permit applications, risk analysis and environmental impact assessments should be met by the applicant. Where possible, the revenue generated (from this and other sources) could be used to fund operating costs of a specialist independent assessment body.

Argentina's draft National Strategy of Biodiversity proposes that applications for the introduction of alien species should include a determination of anticipated profits linked to the introduction. The competent authority should be able to require the interested party to finance impact assessment *a posteriori*.

Charges are routinely applied to water or fuel consumption. There is growing interest in developing a system of charges related to land or water use referable to alien species linked to percentage of the rents, profits or royalties earned from concessions, leases or equivalent instruments.

South Africa's Water Act of 1998 provides a legal basis for the use of land for afforestation which has been or is being established for commercial purposes to be classified as a "streamflow reduction activity" for which landowners are required to pay charges linked to acreage. The government can declare the use of alien invasive species as a "streamflow reduction activity" and impose a tax by the acreage under alien plant cultivation unless managed to agreed standards and precautions.

Corrective Taxes/Levies

Several States use taxes or levies to implement provisions of multilateral environmental agreements. Pursuant to the MARPOL treaty which covers marine pollution, some States levy charges on shipments/passengers to cover the cost of port waste treatment facilities.

A special tax is levied in Western Australia to fund the eradication of alien invasive species. In New Zealand a levy may be imposed to generate financial contributions for specific pest management strategies. The Biosecurity Act of 1993 contains comprehensive provisions for cost recovery.

8.0 Concluding Remarks

The introduction, control and eradication of alien invasive species are problems that have become increasingly important in the recent past. It is no longer a problem of a few "exotic" species in a few countries. In highly mobile societies and in a globalised economy the impacts of alien species have become a threat to biodiversity world-wide. Deliberate introduction into the environment, particularly of living modified organisms, have increased in numbers. International trade, travel, transport and tourism have intensified and increased the pathways for unintentional introductions.

As discussed throughout this guide, international and national legal frameworks are not yet in place to respond effectively to the problems. It is evident that clear, comprehensive and harmonised rules and regulations are needed. They must cover both intentional and unintentional introductions of well defined alien species that have the potential of being invasive. Reliable monitoring systems need to be in place as well as tools for eradication, containment and control where alien species have become invasive.

One serious gap is the lack of effective rules on liability. Such rules are, however, crucial because of the preventive effect they may have if they are well designed and if the political will is there to enforce them. In both national and international law, liability rules urgently need to be further developed.

Experience in many countries shows that the problems of alien invasive species have not yet attracted the attention they deserve. It is, therefore, not only necessary to develop the law further; equally or even more important is to increase public information and education so that the problems associated with alien invasive species are taken seriously.

The preceding chapters set out principles, criteria and tools that should guide the development or strengthening of national and institutional legal frameworks. These are not repeated here, to avoid duplication. Instead, the following list seeks to highlight the most important priorities for action:

- develop standardised terminology for alien species and issues related to biological invasions that can be used in international and national instruments and processes;

- initiate and extend coordination and cooperation between relevant international organisations and institutions with activities and programmes pertaining to alien species. Options for improved coordination include memoranda of cooperation and joint work programmes (already used routinely by the CBD). Consideration should be given to establishing a broadly-based *ad hoc* working group to address the full range of issues faced by the governmental and private sectors, local communities and all relevant stakeholders;

- develop integrated rules and guidelines that consolidate principles and provisions under existing international instruments and cover gaps, possible omissions and matters not adequately addressed by existing international instruments;

- provide greater clarity and predictability about the compatibility of trade-related measures for environmental protection objectives and the trade rules established by the international trade regime. The preferred approach is for cooperative action to be taken by the CBD, WTO, IMO, FAO, Ramsar and other appropriate organisations to formulate standards regarding general environmental and biodiversity protection against alien invasive species, which should be formally recognised as a source of internationally-agreed standards in the WTO-SPS Agreement. An alternative option would be to develop clear indicators for trade impacts under the CBD's various ecosystem themes (Downes, 1999);

- develop international guidance on risk analysis for alien species introductions and for proposed eradication/control techniques. Such guidance could include or cross-refer to indicators for incorporating invasion-related criteria into general environmental and social impact assessment procedures. It should be fully coordinated with any IPPC guidance on pest risk analysis;

- build capacity, especially in developing countries, to design, implement and enforce requirements laid down by relevant international instruments as well as internationally-agreed best practices;

- actively encourage research and practical recommendations on economically and socially sound incentive measures, to enhance compliance and promote accountability by individual or collective actors involved in activities that intentionally or unintentionally present a risk of alien species introductions.

APPENDIX I
Table of International and Regional Instruments and Institutions With Provisions/Programmes/Activities Related to Invasive Alien Species

A. Binding International and Regional Instruments

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
1. Convention on Biological Diversity (Nairobi,1992) http://www.biodiv.org	29.12.1993	Article 8 In-situ Conservation Each Contracting Party shall, as far as possible and as appropriate: (g) Establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking also into account the risks to human health; (h) Prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species.	Decision IV/1 C -- "Alien species that threaten ecosystems, habitats and species". Requests the SBSTTA (Subsidiary Body on Scientific, Technical and Technological Advice) to develop guiding principles for the prevention, introduction and mitigation of impacts of alien species and to report on those principles and related work programme to the COP at its 5th meeting. Decision IV/5 "Conservation and sustainable use of marine and coastal biological diversity, including a programme of work" Decision V/8: "Alien Species that Threaten Ecosystems, Habitats and Species"	UNEP/CBD/SBSTTA/IV/4 -- SBSTTA Recommendation IV/4 requesting the Executive Secretary to develop, in co-operation with the GISP (Global Invasive Species Programme), principles for the prevention, introduction and mitigation of impacts of alien species, for consideration by the Subsidiary Body at its fifth Meeting. UNEP/CBD/SBSTTA/V/4 -- "Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species".
2. Cartagena Protocol on Biosafety to the CBD (Montreal, 2000) http://www.biodiv.org/biosafe/protocol/Index.html	Date of adoption 29.01.2000	Objective is to contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into		

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
		account risks to human health, and specifically focusing on transboundary movements.		
3. United Nations Convention on the Law of the Sea (Montego Bay, 1982) http://www.un.org/Depts/los/losconv1.htm	16.11.1994	Article 196 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.		UNGA/A/54/429 UNCLOS Report to the 54th Session of the UNGA (30.09.99) "Protection and Preservation of the Marine Environment, Pollution from Vessels". Para. 417. "Progress by IMO in the drafting of new instruments -- Harmful Aquatic Organisms in Ballast Water" UNGA/A/53/456 UNCLOS Report to the 53rd Session of the UNGA (05.10.98) "Harmful aquatic organisms in ballast water"
4. Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, 1971) http://www.ramsar.org	21.12.1975		COP7 - Resolution VII.14 on Invasive Species and Wetlands	Scientific and Technical Review Panel Expert Working Group on Invasive Species. Workplan for 1999-2002 --- Prepare Wetland-Specific Guidelines for identifying, establishing priorities for action, and managing alien species which pose a threat to wetlands and wetland species, in cooperation with SBSTTA of CBD, GISP and other programmes established under international conventions. IUCN/Ramsar Joint Project on "Wetlands and Harmful Invasive Species in Africa - Awareness and Information"
5. Convention on the Conservation of Migratory Species of Wild Animals (Bonn, 1979) http://www.wcmc.org.uk/cms/	01.11.1983	Article III (4) (c) Range State Parties of a migratory species listed in Appendix 1 shall endeavour: to the extent feasible and appropriate, to prevent, reduce or control factors that are endangering or are likely to further endanger the species, including strictly		

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
		controlling the introduction of, or controlling or eliminating, already introduced exotic species. Article V (5) (e) Where appropriate and feasible, each agreement (for Annex II) should provide for, but not be limited to protection of such habitats from disturbances, including strict control of the introduction of, or control of already introduced, exotic species detrimental to the migratory species.		
6. Agreement on the Conservation of African-Eurasian Migratory Waterbirds (The Hague, 1995) http://www.wcmc.org.uk/cms/aew_bkrd.htm	01.11.1999	Article III(2)(g) Parties shall prohibit the deliberate introduction of non-native waterbird species into the environment and take all appropriate measures to prevent the unintentional release of such species if this introduction or release would prejudice the conservation status of wild fauna and flora; when non-native waterbird species have already been introduced, the Parties shall take all appropriate measures to prevent these species from becoming a potential threat to indigenous species. Annex 3 Action Plan 2.5 Parties shall, if they consider it necessary, prohibit the introduction of non-native species of animals and plants which may be detrimental to the populations listed in Table1. Parties shall, if they consider it necessary, require the taking of appropriate precautions to avoid the accidental escape of captive birds belonging to non-native species. Parties shall take measures to the extent feasible and appropriate, including taking, to ensure that when non-native species or hybrids thereof have already		

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
		been introduced into their territory, those species or their hybrids do not pose a potential hazard to the populations listed in Table1.		
7. Convention on the Law of the Non-navigational Uses of International Watercourses (New York, 1997) http://www.un.org	Date of Adoption 21.05.1997	Article 22 Watercourse States shall take all measures necessary to prevent the introduction of species, alien or new, into an international watercourse, which may have effects detrimental to the ecosystem of the watercourse resulting in significant harm to other watercourse States.		
8. Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington, 1973) http://www.cites.org	01.07.1975	Permits and certificates granted under the provisions of Article III, IV and V are required for the trade in specimens of species included in Appendix I, II and III. Represents alternate model for regulating invasive species not already covered by the IPPC or other agreements. Convention intended to prevent harm in *exporting* country; however, can only be applied when species is endangered in exporting country and considered an invasive in importing country. Regulates only intentional movements.		
9. United Nations Framework Convention on Climate Change (New-York, 1992) http://www.unfccc.de	21.03.1994	Article 2 Objective The ultimate objective stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Strives to stabilise (and eventually reduce) greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with		

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
		the climate system [changes in temperature and rainfall patterns can induce new invasions and exacerbate existing invasions].		
10. Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction (Washington, London and Moscow 1972) http://sun00781.dn.net/nuke/control/bwc/text/bwc.htm	26.03.1975	Article I Each State Party to this Convention undertakes never in any circumstances to develop, produce, stockpile or otherwise acquire or retain: (1) microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes.		
11. International Plant Protection Convention (Rome, 1951, Revised in 1997 by the FAO Conference but not yet entered into force) http://www.fao.org/WAICENT/FAOINFO/AGRICULT/agp/agpp/PQ/Default.htm	03.04.1952	Applies primarily to quarantine pests in international trade. Creates an international regime to prevent spread and introduction of plant and plant product pests premised through the use of sanitary and phytosanitary measures. Parties have established national plant protection organisations with authority in relation to quarantine control, risk analysis and other measures required to prevent the establishment and spread of pests that, directly or indirectly, are pests of plants and plant products.	International Standards for Phytosanitary Measures: • Principles of Plant Quarantine as Related to International Trade • Guidelines for Pest Risk Analysis • Code of Conduct for the Import and Release of Exotic Biological Control Agents • Requirements for the Establishment of Pest Free Areas • Glossary of Phytosanitary Terms • Guidelines for Surveillance • Export Certification System • Determination of Pest Status in an Area • Guidelines for Pest Eradication Programmes	Report of the meeting Interim Commission on Phytosanitary Measures Exploratory Working Group on Phytosanitary Aspects of GMOs, Biosafety and Invasive Species, Rome, June 2000.

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
			• Requirements for the Establishment of Pest Free Places of Production and Pest Free Production Sites	
12. Agreement for the Establishment of the Near East Plant Protection Organisation (Rabat, 1993)	Date of adoption, 18.02.1993	The Organisation objectives to promote the implementation of the provisions of the International Plant Protection Convention with particular attention to measures for the control of pests, and advise Governments on the technical, administrative and legislative measures necessary to prevent the introduction and spread of pests of plants and plant products.		
13. Plant Protection Agreement for the Asia and Pacific Region (Rome, 1956) http://sedac.ciesin.org/pidb/register/reg-016.rrr.html	02.07.1956	The Contracting Governments, desiring to prevent, through concerted action, the introduction into and spread within the South East Asia and Pacific Region of destructive plant diseases and pests, have concluded the Agreement, which is a supplementary agreement under Article III of the International Plant Protection Convention		
14. Convention for the Establishment of the European and Mediterranean Plant Protection Organisation (Paris, 1951) http://sedac.ciesin.org/pidb/register/reg-008.rrr.html	01.11.53	The functions of the Organization shall be: 1) to act, in agreement with the Food and Agriculture Organization of the United Nations, as a recognised regional plant protection organization under Article VIII of the International Plant Protection Convention of December 6, 1951; 2) to advise Member Governments on the technical, administrative and legislative measures necessary to prevent the introduction and spread of pests and diseases of plants and plant products.		

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
15. Phyto-sanitary Convention for Africa (Kinshasa, 1967)	1974	Heads of African State and Government of the Organization of African Unity: Considering that all possible steps should be taken - (a) to prevent the introduction of diseases, insect pests, and other enemies of plants into any part of Africa; (b) to eradicate or control them in so far as they are present in the area; and (c) to prevent their spread to other territories within the area.		
16. Agreement concerning Co-operation in the Quarantine of Plants and their Protection against Pests and Diseases (Sofia, 1959) http://sedac.ciesin.org/pidb/texts/quarantine.of.plants.1959.html	19.10.1960	The Parties undertake to apply measures to prevent the introduction from one country into another, in exported consignments of goods or by any other means, of quarantinable plant pests and diseases and weeds specified in lists to be drawn up by agreement between the parties concerned. Annex - List of the Principal Quarantinable Pests, Diseases and Noxious Weeds		
17. The WTO Agreement on the Application of Sanitary and Phytosanitary Measures (Marrakech, 1995) http://www.wto.org/english/tratop_e/sps_e/spsagr.htm	01.01.1995	A supplementary agreement to the World Trade Organisation Agreement. Provides a uniform framework for measures governing phytosanitary measures for human, plant and animal life or health. Sanitary and phytosanitary measures are defined as any measure applied a) to protect human, animal or plant life or health (within the Member's Territory) from the entry, establishment or spread of pests, diseases, disease carrying organisms; b) to prevent or limit other damage (within the Member's Territory) from the entry, establishment or spread of pests.		

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
18. North American Free Trade Agreement (NAFTA) (1992) http://www.sice.oas.org/tradee.asp#NAFTA	01.01.1994	Chapter 7 Section B Sanitary and Phytosanitary Measures Article 712 Each Party may, in accordance with this Section, adopt, maintain or apply any sanitary or phytosanitary measure necessary for the protection of human, animal or plant life or health in its territory, including a measure more stringent than an international standard, guideline or recommendation.		
19. International Health Regulations (Geneva, 1982, adopted by the 22nd World Health Assembly in 1969, amended by the 26th World Health Assembly in 1973, and the 34th World Health Assembly in 1981) http://ww.who.int/IHR/int_regs.html	01.01.1982	Purpose is to ensure the maximum security against the international spread of diseases. Goals are to: (1) detect, reduce or eliminate sources from which infection spreads; (2) improve sanitation in and around ports and airports, and (3) prevent dissemination of vectors. The Regulations require mandatory declaration of cholera, plaque and yellow fever (in 1981, the regulation was amended to remove small pox, in view of its global eradication).		The IHR are being revised and modernized to adapt to changes in disease epidemiology and control and to substantial increases in the volume of international traffic. These revisions will include modifications in notification and structural changes to require notification of any disease outbreak or "event of urgent international public health importance" rather than for only the 3 diseases currently covered; and regulations to be changed to a document containing core obligations with annexes giving specific and current technical recommendations. The revisions are expected to be completed in 2002. WHO held meeting with WTO and the Codex-Alimentarius Commission (CAC) in 1998 to examine the impact of key proposed changes to the IHR. .
20. Agreed Measures for the Conservation of Antarctic Fauna and Flora (Brussels, 1964)	01.11.1982	Article IX Each Participating Government shall prohibit the bringing into the Treaty Area of any species of animal or plant not indigenous to that Area, except in accordance with a permit.	ACTM XXIII, Lima Peru, May 1999, discussion on measures to prevent the introduction and spread of diseases in Antarctic wildlife. The Committee for Environmental Protection (CEP II) agreed that an	A Report on the Workshop on Diseases of Antarctic Wildlife hosted by Australian Antarctic Division, August 1998. Workshop recognised that there was a significant risk of the introduction of disease

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
http://www.antcrc.utas.edu.au/opor/Treaties/aff64.html		Permits under paragraph 1 of this Article shall be drawn in terms as specific as possible and shall be issued to allow the importation only of the animals and plants listed in Annex C. When any such animal or plant might cause harmful interference with the natural system if left unsupervised within the Treaty Area, such permits shall require that it be kept under controlled conditions and, after it has served its purpose, it shall be removed from the Treaty Area or destroyed.	open-ended contact group be formed when all Parties, SCAR and COMNAP have considered the report of the Workshop on Diseases of Antarctic Wildlife and will operate under the specific Terms of Reference	into Antarctic wildlife species and that should it occur the consequences are likely to be serious and a response will be required. The Workshop made a number of recommendations to minimise the risk of the introduction and spread of disease.
21. Protocol to the Antarctic Treaty on Environmental Protection (Madrid, 1991) http://www.umweltbundesamt.de/antarktis-e/gzusp.htm	14.01.1998	Annex II, Article 4 1. No species of animal or plant not native to the Antarctic Treaty Area shall be introduced onto land or ice shelves, or into water in the Antarctic Treaty Area except in accordance with a permit. 4. Any plant or animal for which a permit has been issued in accordance with paragraphs 1 and 3 above, shall, prior to expiration of the permit, be removed from the Antarctic Treaty Area or be disposed of by incineration or equally effective means that eliminates risk to native fauna or flora. The permit shall specify this obligation. Any other plant or animal introduced into the Antarctic Treaty Area not native to that area, including any progeny, shall be removed or disposed of, by incineration or by equally effective means, so as to be rendered sterile, unless it is determined that they pose no risk to native flora or fauna.		
22. Convention on the Conservation of Antarctic Marine Living	07.04.1982	Article II (3) Any harvesting and associated activities in the area to which this Convention applies		

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
Resources (Canberra, 1980) http://sedac.ciesin.org/pidb/texts/antactic.marine.resources.1980.html		shall be conducted in accordance with the provisions of this Convention and with the following principles of conservation: (…) (c) prevention of changes or minimization of the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades, taking into account the state of available knowledge of the direct and indirect impact of harvesting, the effect of the introduction of alien species, the effects of associated activities on the marine ecosystem and of the effects of environmental changes, with the aim of making possible the sustained conservation of Antarctic marine living resources.		
23. Convention Concerning Fishing in the Waters of the Danube (Bucharest 1958)	20.12.1958	Annex Part V Article 10 The acclimatization and breeding of new species of fish and other animals and of aquatic plants in the waters of the Danube to which this Convention applies may not be carried out save with the consent of the Commission.		
24. Convention on the Conservation of European Wildlife and Natural Habitats (Bern, 1979) http://www.coe.fr/eng/legaltxt/104e.htm	01.06.1982	Article 11(2)(b) Each Contracting Party undertakes: to strictly control the introduction of non-native species.	Committee of Ministers of the Council of Europe Recommendations: • Recommendation n° 18 (1989) on the protection of indigenous crayfish in Europe • Recommendation No. 45 (1995) on controlling proliferation of Caulerpa taxifolia in the Mediterranean • Recommendation No. 61 (1997) on the conservation of the White-headed Duck (Oxyura	Standing Committee of the Bern Convention has prepared the following reports: - Legal Aspects of the Introduction and Re-introduction of Wildlife Species in Europe, by Isabelle Trinquelle T-PVS (92) 7. - Introduction of no-native organisms into the Natural Environment. (1996) by Cyrille de Klemm Nature and Environment Series 73 - Introduction of non-native plant species into the Natural environment (1997) by

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
			leucocephala) • Recommendation No. 78 (1999) on the conservation of the Red squirrel (Sciurus vulgaris) in Italy • Recommendation No. 57 (1997) on the Introduction of Organisms belonging to Non-Native Species into the Environment • Recommendation No. 77 (1999) on the eradication of non-native terrestrial vertebrates	Jacques Lambinon, Nature and Environment series No 87 - Methods to control and eradicate non native terrestrial vertebrates (1998) by Jorge Fernández Orueta T-PVS (98) 67 - The status of the Ruddy Duck (Oxyura jamaicensis) in the western Palearctic and an action plan for eradication, 1999-2002 (1999) T-PVS/Birds (99) 9. Two reports are in preparation: - Guidelines for the eradication of non-native vertebrate species (by Piero Genovesi 2000) - Identification of non-native freshwater fish established in Europe, assessing their potential threat to native biological diversity (by Benigno Elvira, 2000) The Standing Committee has held a number of Workshops and meetings of the Group of Experts on Introduction and Re-introduction of species. The two most recent workshops are: - Workshop on the Control and Eradication of Non Native Terrestrial Vertebrate (Malta, 1999). - Workshop on the Control of Ruddy Ducks (UK, 2000). Other meetings and workshops have been published: - Reports of the Meetings and Workshops of the Group of Experts on Introductions and Re-Introductions, T-PVS (93) 14, T-PVS (95) 30, T-PVS (97) 16, and Environmental encounters 41 (2000).

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
25. Benelux Convention on Nature Conservation and Landscape Protection (Brussels, 1982) http://sedac.ciesin.org/pidb/texts/benelux.landscape.protection.1982.html	01.10.1983	Article 1 The present Convention aims at regulate the concentration and the cooperation between the three Governments in the field of the conservation, the management and the restoration of nature and landscapes.	Benelux Council of Ministers Decision 17.10.83. Parties to the 1982 Benelux Convention are required to prohibit the introduction of non-native animal species into the wild without authorisation from the competent national authority; pre-introduction assessment required; communications between parties about planned introductions.	
26. Protocol for the Implementation of the Alpine Convention in the Field of Nature Protection and Landscape Conservation (Chambery, 1994)	Date of adoption 20.12.1994	Article 17 The Contracting Parties guarantee that species of wild fauna and flora not native to the region in the recorded past are not introduced. Exceptions are possible when the introduction is needed for specific use and may not have adverse effects for nature and for the landscape.		
27. Protocol Concerning Mediterranean Specially Protected Areas (Geneva, 1982) Http://sedac.ciesin.org/pidb/texts/acrc/mspecp.txt.html	23.03.1986	Article 7 The Parties, having regard to the objectives pursued and taking into account the characteristics of each protected area, shall, in conformity with the rules of international law, progressively take the measures required, which may include the prohibition of the destruction of plant life or animals and of the introduction of exotic species; the regulation of any act likely to harm or disturb the fauna or flora, including the introduction of indigenous zoological or botanical species.		

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
28. Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean (Barcelona, 1995)	Date of adoption 10.06.1995	Article 6 The Parties, in conformity with international law and taking into account the characteristics of each specially protected area, shall take the protection measures required, in particular: the regulation of the introduction of any species not indigenous to the specially protected area in question, or of genetically modified species, as well as the introduction or reintroduction of species which are or have been present in the specially protected area. Article 13 The Parties shall take all appropriate measures to regulate the intentional or accidental introduction of non-indigenous or genetically modified species to the wild and prohibit those that may have harmful impacts on the ecosystems, habitats or species in the area to which this Protocol applies. The Parties shall endeavour to implement all possible measures to eradicate species that have already been introduced when, after scientific assessment, it appears that such species cause or are likely to cause damage to ecosystems, habitats or species in the area to which this Protocol applies.		
29. Agreement on the Conservation of Nature and Natural Resources (Kuala Lumpur, 1985) http://sunsite.nus.edu.sg/apcel/kltreaty.html	Date of Adoption, 09.07.1985	Article 3 The Parties shall, wherever possible, maintain maximum genetic diversity by taking action aimed at ensuring the survival and promoting the conservation of all species under their jurisdiction and control. In order to fulfil the aims of the preceding paragraphs of this Article the Contracting		

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
		Parties shall, in particular, endeavour to regulate and, where necessary, prohibit the introduction of exotic species.		
30. Protocol for the Conservation and Management of Protected Marine and Coastal Areas of the South East Pacific, (Paipa, 1989)	Date of adoption 21.09.1989	Article VII The Contracting Parties shall take measures, individually or jointly, to prevent or reduce and control environmental deterioration, including pollution in the protected areas, deriving from any source or activity, and they shall make every effort to harmonize their policies in the matter. Such measures shall include, inter alia, those designed to: prevent, reduce and control, to the extent possible: the introduction of exotic species of flora and fauna, including transplants.		
31. Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP Convention) (Nouméa, 1986) http://sedac.ciesin.org/pidb/texts/natural.resources.south.pacific.1986.html	22.08.1990	Article 14 Specially Protected Areas and Protection of Wild Flora and Fauna The Parties shall, individually or jointly, take all appropriate measures to protect and preserve rare or fragile ecosystems and depleted, threatened or endangered flora and fauna as well as their habitat in the Convention Area. To this end, the Parties shall, as appropriate, establish protected areas, such as parks and reserves, and prohibit or regulate any activity likely to have adverse effects on the species, ecosystems or biological processes that such areas are designed to protect. The establishment of such areas shall not affect the rights of other Parties or third States under international law. In addition, the Parties shall exchange information concerning the administration and management of such areas.		

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
32. Convention on Conservation of Nature in the South Pacific (Apia, 1976) http://sedac.ciesin.org/pidb/texts/nature.south.pacific.1976.html	28.06.1990	Article V (4) Each Contracting Party shall carefully consider the consequences of the deliberate introduction into ecosystems of species which have not previously occurred therein.		South Pacific Regional Environment Programme: Invasive Species Technical Review.
33. African Convention on the Conservation of Nature and Natural Resources (Algiers, 1968) http://www.unep.org	16.06.1969	Article III (4)(a)(ii) and (b) In a strict nature reserve or national park, "any act likely to harm or disturb the fauna or flora, including introduction of zoological or botanical species, whether indigenous or imported, wild or domesticated, are strictly forbidden."		
34. Convention for the Establishment of the Lake Victoria Fisheries Organization (Kisumu, 1994) http://www.inweh.unu.edu/lvfo/convention.htm	Date of Adoption 30.06.1994	35. Agreement on the Preparation of a Tripartite Environmental Management Programme for Lake Victoria (Dar es Salaam, 1994)		
	05.08.1994	Attachment 1 §7 Control of Water Hyacinth The proliferation of water hyacinth on Lake Victoria poses an urgent management problem which needs joint attention of the three riparian countries and other neighbouring countries. It is recognized that such action (at the regional level), which is expected to include biological control methods, will need to proceed with due recognition of the environmental implications of biological control. Thus, it has been agreed that the implementation of control programs using biological agents is		

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
		to proceed once the national authorities responsible for testing such agents are satisfied that the environmental risks of using such agents are acceptable.		
36. Protocol concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region (Nairobi, 1985)	30.05.1996	Article 7:Introduction of Alien/New Species The Contracting Parties shall take all appropriate measures to prohibit the intentional or accidental introduction of alien or new species which may cause significant or harmful changes to the Eastern African region. The Parties, taking into account the characteristics of each protected area, shall take measures required to achieve the objectives of protecting the area, which may include: the regulation of any act likely to harm or disturb the fauna or flora, including the introduction of non-indigenous animal or plant species.		
37. Convention on Great Lakes Fisheries Between the United States and Canada (Basic Instrument for the Great Lakes Fisheries Commission - GLFC) (Washington, 1954) http://www.glfc.org/pubs/conv.htm	11.10.1955	Article 1 This Convention shall apply to Lake Ontario, Lake Erie, Lake Huron, Lake Michigan, Lake Superior and their connecting waters and tributaries. The Convention between the United States and Canada established the GLFC whose purpose is to control and eradicate the non-native, highly invasive Atlantic sea lamprey from the Great Lakes		

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
38. North American Agreement on Environmental Co-operation (1993) http://www.cec.org	01.01.1994	Article 10 Council Functions 2. The Council may consider, and develop recommendations regarding exotic species that may be harmful.		
39. Convention for the Conservation of the Biodiversity and the Protection of Wilderness Areas in Central America (Managua, 1992)	Date of adoption 05.06.1992	Article 24 Parties agree that all mechanisms shall be established for the control or eradication of all exotic species which threaten ecosystems, habitats and wild species.		
40. Protocol Concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (SPAW) (Kingston, 1990) http://www.cep.unep.org/pubs/legislation/spaw.html	18.06.2000	Article 5 Each Party to take measures to regulate or prohibition of the introduction of non-indigenous species. Article 12 Each Party shall take all appropriate measures to regulate or prohibit intentional or accidental introduction of non-indigenous or genetically altered species to the wild that may cause harmful impacts to the natural flora, fauna or other features of the Wider Caribbean Region.		
41. EU Council Directive 79/409/EEC on the Conservation of Wild Birds (as mended) http://www.ecnc.nl/doc/europe/legislat/birdan21.html	02.04.79	Article 11 Member States shall see that any introduction of species of bird which do not occur naturally in the wild state in the European territory of the Member States does not prejudice the local fauna and flora.		

Instrument	Date of Entry into Force	Relevant Provisions	COP Decision(s)	Work Programme(s)
42. EU Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora http://www.europa.eu.int/eurlex/en/lif/dat/1992/en_392L0043.html	21.5.92	Article 22 In implementing the provisions of this Directive, Member States shall: ensure that the deliberate introduction into the wild of any species which is not native to their territory is regulated so as not to prejudice natural habitats within their natural range or the wild native fauna and flora and, if they consider it necessary, prohibit such introduction.		

B. Non-binding (Soft-law) Instruments

Institution	Instrument	Purpose	Work Programme
1. IUCN-The World Conservation Union Http://www.iucn.org	IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species (2000) http://www.iucn.org/themes/ssc/pubs/policy/invasivesEng.htm	Guidelines designed to increase awareness and understanding of the impact of alien species. Provides guidelines for: prevention, eradication, control and re-introduction	Invasive Species Specialist Group, IUCN Species Survival Commission
	IUCN Guidelines for Re-introductions (1995) http://www.iucn.org/themes/ssc/pubs/policy/reinte.htm	Guidelines on the introduction of endangered species. Mentions non-indigenous species as a threat to reintroduction, but also recognizes potential dangers of re-introduction itself.	Re-introduction Specialist Group, IUCN Species Survival Commission
	IUCN Position Statement on Translocation of Living Organisms: Introductions, Reintroductions, and Re-stocking (1987) http://www.iucn.org/themes/ssc/pubs/policy/transe.htm	This IUCN statement describes the advantageous uses of translocations and the work and precautions needed to avoid the disastrous consequences of poorly planned translocations.	IUCN Species Survival Commission
2. International Maritime Organisation http://www.imo.org	IMO Resolution A.868 (20)1997 Guidelines for the Control and Management of Ships´ Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens. Appendix 2 : Guidance on safety Aspects of Ballast Water Exchange at Sea. IMO Resolution A.74 (18) 1991: Guidelines for preventing the Introduction of Unwanted Organisms and pathogens from Ships' Ballast Water and Sediment Discharges.	All Member State Governments, ship operators, other appropriate authorities and interested parties are requested to apply these Guidelines. They provide guidance and strategies to minimise risk of unwanted organisms and pathogens from ballast water and sediment discharge.	Marine Environment Protection Committee Working Group - Draft International Convention for the Control & Management of Ships' Ballast Water and Sediments, MEPC 44/4, 2 December 1999. The proposed instrument is intended to address the environmental damage caused by the introduction of harmful aquatic organisms in ballast water, used to stabilise vessels at sea. In July 2000, a Global Task Force convened by the IMO in co-ordination with United Nations Development Programme (UNDP) and the Global Environment Facility (GEF). The Task Force launched

Institution	Instrument	Purpose	Work Programme
			the Global Ballast Water Management Programme (“GloBallast”) as a concerted response to the problem of harmful marine organisms.
3. Council of Europe http://www.coe.int	Recommendation No. R (84) 14 (1984) of the Committee of Ministers to the Council of Europe Member States Concerning the Introduction of Non-native Species.	Recommends that Member State governments prohibit non-native species introductions into the natural environment; exceptions allowed provided study undertaken to evaluate probable consequences for wildlife and ecosystems.	Workshop on the Control and Eradication of Non Native Terrestrial Vertebrate (1999)
4. United Nations Conference on Environment and Development	Non-Legally binding Authoritative Statement of Principles for a Global Consensus on the Management Conservation and Sustainable Development of all types of Forests. (UNCED 1992) http://www.un.org/documents/ga/conf151/aconf15126-3annex3.htm	Principles 2(b) Take appropriate measures to protect forests against harmful effects of pests and diseases 6(a) Recognise the potential contribution of indigenous and introduced species to provide wood for fuel and industrial uses.	
	Agenda 21 (UNCED, 1992) http://www.igc.org/habitat/agenda21/	Chapter 11 Combating Deforestation 11.13(g) Increase protection of forests from pests and diseases and from the uncontrolled introduction of exotic plant and animal species. Chapter 12 Managing Fragile Ecosystems: Combating Desertification and drought 12.18(b) Accelerate afforestation and reforestation using drought-resistant, fast- growing species, in particular native ones. 12.19(b) Develop, test and introduce, with due regard to environmental security considerations, drought resistant fast growing and productive plant	

Institution	Instrument	Purpose	Work Programme
		species appropriate to the environment of the regions concerned. Chapter 15 Conservation of Biological Diversity 15.3 Acknowledgement that the inappropriate introduction of foreign plants and animals has contributed to the loss of the world's biological diversity and continues. 15.4 (h) Implement mechanisms for the improvement, generation, development and sustainable use of biotechnology and its safe transfer, particularly to developing countries, taking account the potential contribution of biotechnology to the conservation of biological diversity and the sustainable use of biological resources. 15.7(g) Improve international co-ordination for effective conservation and management of endangered/ non-pest migratory species, including appropriate levels of support for the establishment and management of protected areas in transboundery locations. Chapter 16 Environmentally Sound Management of Biotechnology 16.3(a) Increase to the optimum possible extent the yield of major crops, livestock, and aquaculture species. 16.3(c) Increase the use of integrated pest, disease and crop management techniques to eliminate over-dependence on agrochemicals, thereby encouraging environmentally sustainable	

Institution	Instrument	Purpose	Work Programme
		agricultural practices. 16.23(f) Develop processes to increase the availability of planting materials, particularly indigenous varieties, for use in afforestation and reforestation and to improve sustainable yields from forests, 16.23(h) Promote the use of integrated pest management based on the judicious use of bio-control agents. 16.32 Internationally agreed principles on risk assessment and management needed for all aspects of biotechnology. Chapter 17 Protection of the Oceans, all kinds of Seas, Including Enclosed and Semi-enclosed Seas, and Coastal Areas and the Protection, Rational Use and Development of their Living Resources. 17.30(vi) States to assess individually, regionally and internationally, within IMO and other relevant international organisations, need for adopting appropriate rules on ballast water discharge to prevent spread of non-indigenous organisms. 17.79(c) (d) Strengthen the legal and regulatory framework for mariculture and aquaculture. 17.83 Analyse aquaculture's potential and apply appropriate safeguards for introducing new species. Chapter 18 Protection of the Quality and Supply of Freshwater Resources: Application of Integrated	

Institution	Instrument	Purpose	Work Programme
		Approaches to the Development, Management and Use of Water Resources 18.40(e)(iv) control of noxious aquatic species that may destroy other water species.	
5. Global Conference on the Sustainable Development SIDs, (1994)	Programme of Action for the Sustainable Development of Small Island Developing States http://www.unep.ch/islands/dsidscnf.htm	Paragraph 41 Introduction of certain non-indigenous species noted as one of a number of significant causes of biodiversity loss. Paragraph 45 (A)(i) Formulate integrated strategies at national level for conservation and sustainable use of marine and terrestrial biodiversity including protection from certain non-indigenous species. Paragraph 45(B)(i) At regional level encourage countries to give priority to sites of biological significance; strengthen community support for their protection, including their protection from non-indigenous species introduction. Paragraph 55(A)(iii) Address quarantine problems at national level and requirements stemming from changing transport situations and longer-term climate change. Paragraph 55(B(ii) Regionally develop effective quarantine services; upgrade existing plant protection and related programmes.	

Institution	Instrument	Purpose	Work Programme
		Paragraph 55(C)(ii) Internationally co-operate with national and regional bodies to design and enforce effective quarantine systems. Paragraph 99 Undertake study of effects of trade liberalisation and globalisation on SIDs sustainable development.	
6. International Council for the Exploration of the Sea (ICES) and the European Inland Fisheries Advisory Commission (EIFAC)	Code of Practice on the Introductions and Transfers of Marine Organisms (1994) .	Recommends practices and procedures to diminish risks of detrimental effects from marine organism introduction and transfer, including those genetically modified. Drafted in co-operation with the FAO European Inland Fisheries Advisory Commission (EIFAC) and applicable to freshwater organisms. Requires ICES members to submit a prospectus to regulators, including a detailed analysis of potential environmental impacts to the aquatic ecosystem	Working Group on Introductions and Transfers of Marine Organisms.
7. Food and Agriculture Organisation of the United Nations	Code of Conduct for Responsible Fisheries (1995) http://www.fao.org/fi/agreem/codecond/feconde.asp	Article 9.3.2 States should co-operate in the elaboration, adoption and implementation of international codes of practice and procedures for introductions and transfers of aquatic organisms. Article 9.3.3 States should, in order to minimize risks of disease transfer and other adverse effects on wild and cultured stocks, encourage adoption of appropriate practices in the genetic improvement of broodstocks, the introduction of non-native species,	

Institution	Instrument	Purpose	Work Programme
		and in the production, sale and transport of eggs, larvae or fry, broodstock or other live materials. States should facilitate the preparation and implementation of appropriate national codes of practice and procedures to this effect. Sets out principles and international standards of behaviour for responsible fishing practices, including aquaculture. The aim is to ensure effective conservation, management and development of living aquatic resources, respecting ecosystems and biodiversity. Legal and administrative frameworks are encouraged to facilitate responsible aquaculture. Pre-introduction discussion with neighbouring states when non-indigenous stocks are to be introduced into transboundary aquatic ecosystems. Harmful effects of non-indigenous and genetically altered stocks to be minimised especially where significant potential exists for spread into other states or country of origin. Adverse genetic and disease effects to wild-stock from genetic improvement and non-indigenous species to be minimised; environmental damage to importing and exporting states exists; FAO to develop implementation guidelines.	
	Code of Conduct for the Import and Release of Exotic Biological Control Agents (1995)	The Code aims to facilitate the safe import, export and release of exotic biological control agents by introducing procedures of an international level for all public and private entities involved, particularly	

Institution	Instrument	Purpose	Work Programme
		where national legislation to regulate their use does not exist or is inadequate. Standards are described that promote the safe use of biological control agents for the improvement of agriculture, and human, animal and plant health.	
8. International Civil Aviation Organisation	The ICAO Assembly passed Resolution A-32-9: Preventing the introduction of invasive alien species (1998). http://www.icao.int/icao/en/res/a32_9.htm	The Assembly. Requests the ICAO Council to work with other United Nations organizations to identify approaches that ICAO might take in assisting to reduce the risk of introducing potentially invasive alien species to areas outside their natural range. Contracting States to support efforts to reduce the risk of introducing, through civil air transportation, potentially invasive alien species to areas outside their natural range. ICAO Council to report on the implementation of this Resolution at the next ordinary session of the Assembly.	
9. United Nations Environment Programme	Global Programme of Action for the Protection of the Marine Environment from Land-based Activities V- Recommended Approaches by Source Category (1995) http://www.unep.org/unep/gpa/pol2a.htm	Physical Alterations and destruction of habitats Paragraph 149 : Introduction of alien species acknowledged to have serious effects upon marine ecosystem integrity	
	Technical Guidelines for Safety in Biotechnology http://biosafety.ihe.be/Biodiv/UNEPGuid/UNEP_I.html	Used as interim mechanism during the development of the Biosafety Protocol; now used for “purposes of facilitating the development of national capacities to assess and manage risks, establish adequate information systems and develop	

Institution	Instrument	Purpose	Work Programme
		expert human resources in biotechnology." Paragraph 26 An organism with novel traits which is considered to be harmless in one region might be potentially harmful in another region which offers different environmental conditions. Therefore, there is a need for the exchange and supply of scientific information in cases where organisms with novel traits are intended to be released into new environments and when transfer of such organisms across national boundaries is being considered. Paragraph 42 The potentially affected country should be given notice of the intended use and the opportunity to state whether particular measures will be needed to protect its interests, in particular its biodiversity; (and) should be informed immediately in the event of an adverse effect of the use of a organism with novel traits which could affect it. Annex 3 Potentially relevant information for introductions	
10. American Fisheries Society (AFS)	North American Fisheries Policy (1995) http://www.fisheries.org/resource/page1.htm	Article V Aquaculture facilities and practices should have minimal impact on natural aquatic environments and populations. Aquaculture must work closely with federal, state, and provincial regulators to control	

Institution	Instrument	Purpose	Work Programme
		epizootic disease outbreaks, to prevent the release of exotic species into the wild (…)Where possible, federal, state, and provincial managers will encourage the aquaculture industry to use indigenous species in its facilities.	
	Guidelines for Introduction of Threatened and Endangered Fishes http://www.fisheries.org/resource/page17.htm	Recognition that introduction of threatened fishes can alter biodiversity and survival of other organisms. Restrict introductions to within the native or historic habitat whenever possible. Prohibit introductions into areas where the endangered or threatened fish could hybridize with other species or subspecies. Prohibit introductions into areas where other rare or endemic taxa could be adversely affected. Examine introduction stock for presence of undesirable pathogens.	
11. United States, United Kingdom, and the Russian Federation	Joint US/UK/Russian Statement on Biological Weapons (1992) http://sun00781.dn.net/nuke/control/bwc/text/joint.htm	The three Governments confirmed their commitment to full compliance with the Biological Weapons Convention.	

Appendix II
IUCN Guidelines for the Prevention of Biodiversity Loss Due to Biological Invasion

1. BACKGROUND[1]

Biological diversity faces many threats throughout the world. One of the major threats to native biological diversity is now acknowledged by scientists and governments to be biological invasions caused by alien invasive species. The impacts of alien invasive species are immense, insidious, and usually irreversible. They may be as damaging to native species and ecosystems on a global scale as the loss and degradation of habitats.

For millennia, the natural barriers of oceans, mountains, rivers and deserts provided the isolation essential for unique species and ecosystems to evolve. In just a few hundred years these barriers have been rendered ineffective by major global forces that combined to help alien species travel vast distances to new habitats and become alien invasive species. The globalisation and growth in the volume of trade and tourism, coupled with the emphasis on free trade, provide more opportunities than ever before for species to be spread accidentally or deliberately. Customs and quarantine practices, developed in an earlier time to guard against human and economic diseases and pests, are often inadequate safeguards against species that threaten native biodiversity. Thus the inadvertent ending of millions of years of biological isolation has created major ongoing problems that affect developed and developing countries.

The scope and cost of biological alien invasions is global and enormous, in both ecological and economic terms. Alien invasive species are found in all taxonomic groups: they include introduced viruses, fungi, algae, mosses, ferns, higher plants, invertebrates, fish, amphibians, reptiles, birds and mammals. They have invaded and affected native biota in virtually every ecosystem type on Earth. Hundreds of extinctions have been caused by alien invasives. The ecological cost is the irretrievable loss of native species and ecosystems.

In addition, the direct economic costs of alien invasive species run into many billions of dollars annually. Arable weeds reduce crop yields and increase costs; weeds degrade catchment areas and freshwater ecosystems; tourists and homeowners unwittingly introduce alien plants into wilderness and natural areas; pests and pathogens of crops, livestock and forests reduce yields and increase control costs. The discharge of ballast water together with hull fouling has led to unplanned and unwanted introductions of harmful aquatic organisms, including diseases, bacteria and viruses, in marine and freshwater systems. Ballast water is now regarded as the most important vector for trans-oceanic and inter-oceanic movements of shallow-water coastal organisms. Factors like environmental pollution and habitat destruction can provide conditions that favour alien invasive species.

The degradation of natural habitats, ecosystems and agricultural lands (e.g. loss of cover and soil, pollution of land and waterways) that has occurred throughout the world has made it easier for alien species to establish and become invasive. Many alien invasives are “colonising” species that benefit from the reduced competition that follows habitat degradation. Global climate change is also a significant factor assisting the spread and establishment of alien invasive species. For example, increased temperatures may enable alien, disease-carrying mosquitoes to extend their range.

Sometimes the information that could alert management agencies to the potential dangers of new introductions is not known. Frequently, however, useful information is not widely shared or available in an appropriate format for many countries to take prompt action, assuming they have the resources, necessary infrastructure, commitment and trained staff to do so.

Few countries have developed the comprehensive legal and institutional systems that are capable of responding effectively to these new flows of goods, visitors and ‘hitchhiker’ species. Many citizens, key sector groups and governments have a poor appreciation of the magnitude and economic costs of the problem. As a consequence, responses are too often piecemeal, late and ineffective. It is in this context that IUCN has identified the problem of alien invasive species as one of its major initiatives at the global level.

While all continental areas have suffered from biological alien invasions, and lost biological diversity as a result, the problem is especially acute on islands in general, and for small island countries in particular. Problems also arise in other isolated habitats and ecosystems, such as in Antarctica. The physical isolation of islands over millions of years has favored the evolution of unique species and ecosystems. As a consequence, islands and other isolated areas (e.g. mountains and lakes) usually have a high proportion of endemic species (those found nowhere else) and are centres of

[1] Definition of Terms in section 3.

significant biological diversity. The evolutionary processes associated with isolation have also meant island species are especially vulnerable to competitors, predators, pathogens and parasites from other areas. It is important to turn this isolation of islands into an advantage by improving the capacity of governments to prevent the arrival of alien invasive species with better knowledge, improved laws and greater management capacity, backed by quarantine and customs systems that are capable of identifying and intercepting alien invasive species.

2. GOALS AND OBJECTIVES

The goal of these guidelines is to prevent further losses of biological diversity due to the deleterious effects of alien invasive species. The intention is to assist governments and management agencies to give effect to Article 8 (h) of the Convention on Biological Diversity, which states that:

"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*."

These guidelines draw on and incorporate relevant parts of the 1987 IUCN Position Statement on Translocation of Living Organisms although they are more comprehensive in scope than the 1987 Translocation Statement. The relationship to another relevant guideline, the IUCN Guidelines for Re-introductions, is elaborated in Section 7.

These guidelines are concerned with preventing loss of biological diversity caused by biological invasions of alien invasive species. They do not address the issue of genetically modified organisms, although many of the issues and principles stated here could apply. Neither do these guidelines address the economic (agricultural, forestry, aquaculture), human health and cultural impacts caused by biological invasions of alien invasive species.

These guidelines address four substantive concerns of the biological alien invasion problem that can be identified from this background context. These are:

- improving understanding and awareness;
- strengthening the management response;
- providing appropriate legal and institutional mechanisms;
- enhancing knowledge and research efforts.

While addressing all four concerns is important, these particular guidelines focus most strongly on aspects of strengthening the management response. This focus reflects the urgent need to spread information on management that can quickly be put into place to prevent alien invasions and eradicate or control established alien invasives. Addressing the other concerns, particularly the legal and research ones, may require longer-term strategies to achieve the necessary changes.

These guidelines have the following seven objectives.

1. To increase awareness of alien invasive species as a major issue affecting native biodiversity in developed and developing counties and in all regions of the world.

2. To encourage prevention of alien invasive species introductions as a priority issue requiring national and international action.

3. To minimise the number of unintentional introductions and to prevent unauthorised introductions of alien species.

4. To ensure that intentional introductions, including those for biological control purposes, are properly evaluated in advance, with full regard to potential impacts on biodiversity.

5. To encourage the development and implementation of eradication and control campaigns and programmes for alien invasive species, and to increase the effectiveness of those campaigns and programmes.

6. To encourage the development of a comprehensive framework for national legislation and international cooperation to regulate the introduction of alien species as well as the eradication and control of alien invasive species.

7. To encourage necessary research and the development and sharing of an adequate knowledge base to address the problem of alien invasive species worldwide.

3. DEFINITION OF TERMS[2]

"**Alien invasive species**" means an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity.

"**Alien species**" (non-native, non-indigenous, foreign, exotic) means a species, subspecies, or lower taxon occurring outside of its natural range (past or present) and dispersal potential (i.e. outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans) and includes any part, gametes or propagule of such species that might survive and subsequently reproduce.

"**Biological diversity**" (biodiversity) means 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 a part; this includes diversity within species, between species and of ecosystems.

"**Biosecurity threats**" means those matters or activities which, individually or collectively, may constitute a biological risk to the ecological welfare or to the well-being of humans, animals or plants of a country.

"**Government**" includes regional co-operating groupings of governments for matters falling within their areas of competence.

"**Intentional introduction**" means an introduction made deliberately by humans, involving the purposeful movement of a species outside of its natural range and dispersal potential (Such introductions may be authorised or unauthorised).

"**Introduction**" means the movement, by human agency, of a species, subspecies, or lower taxon (including any part, gametes or propagule that might survive and subsequently reproduce) outside its natural range (past or present). This movement can be either within a country or between countries.

"**Native species**"(indigenous) means a species, subspecies, or lower taxon, occurring within its natural range (past or present) and dispersal potential (i.e. within the range it occupies naturally or could occupy without direct or indirect introduction or care by humans).

"**Natural ecosystem**" means an ecosystem not perceptibly altered by humans.

"**Re-introduction**" means an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct (From IUCN Guidelines for Re-Introductions).

"**Semi-natural ecosystem**" means an ecosystem which has been altered by human actions, but which retains significant native elements.

"**Unintentional introduction**" means an unintended introduction made as a result of a species utilising humans or human delivery systems as vectors for dispersal outside its natural range.

4. UNDERSTANDING AND AWARENESS

4.1 Guiding Principles

- Understanding and awareness, based on information and knowledge, are essential for establishing alien invasive species as a priority issue which can and must be addressed.

- Better information and education, and improved public awareness of alien invasive issues by all sectors of society, is fundamental to preventing or reducing the risk of unintentional or unauthorised introductions, and to establishing evaluation and authorisation procedures for proposed intentional introductions.

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[2] At the time of adoption of these Guidelines by IUCN, standard terminology relating to alien invasive species has not been developed in the CBD context. Definitions used in this document were developed by IUCN in the specific context of native biodiversity loss caused by alien invasive species.

- Control and eradication of alien invasive species is more likely to be successful if supported by informed and cooperating local communities, appropriate sectors and groups.

- Information and research findings which are well communicated are vital prerequisites to education, understanding and awareness (See Section 8).

4.2 Recommended Actions

1. Identify the specific interests and roles of relevant sectors and communities with respect to alien invasive species issues and target them with appropriate information and recommended actions. Specific communication strategies for each target group will be required to help reduce the risks posed by alien invasive species. The general public is an important target group to be considered.

2. Make easily accessible, current and accurate information widely available as a key component of awareness raising. Target different audiences with information in electronic form, manuals, databases, scientific journals and popular publications (See also Section 8).

3. Target importers and exporters of goods, as well as of living organisms as key target groups for information/ education efforts leading to better awareness and understanding of the issues, and their role in prevention and possible solutions.

4. Encourage the private sector to develop and follow best practice guidelines and monitor adherence to guidelines (Refer 5.2 and 5.3).

5. As an important priority, provide information and recommended actions to travellers, both within country and between countries, preferably prior to the start of journeys. Raising awareness of how much human travel contributes to alien invasive problems can improve behaviour and be cost-effective.

6. Encourage operators in eco-tourism businesses to raise awareness on the problems caused by alien invasive species. Work with such operators to develop industry guidelines to prevent the unintentional transport or unauthorised introduction of alien plants (especially seeds) and animals into ecologically vulnerable island habitats and ecosystems (e.g**.** lakes, mountain areas, nature reserves, wilderness areas, isolated forests and inshore marine ecosystems).

7. Train staff for quarantine, border control, or other relevant facilities to be aware of the larger context and threats to biological diversity, in addition to practical training for aspects like identification and regulation (See Section 5.2).

8. Build communication strategies into the planning phase of all prevention, eradication and control programmes. By ensuring that effective consultation takes place with local communities and all affected parties, most potential misunderstandings and disagreements can be resolved or accommodated in advance.

9. Include alien invasive species issues, and actions that can be taken to address them, in appropriate places in educational programmes and schools.

10. Ensure that national legislation applicable to introductions of alien species, both intentional and unintentional, is known and understood, not only by the citizens and institutions of the country concerned, but also by foreigners importing goods and services as well as by tourists.

5. PREVENTION AND INTRODUCTIONS

5.1 Guiding Principles

- Preventing the introduction of alien invasive species is the cheapest, most effective and most preferred option and warrants the highest priority.

- Rapid action to prevent the introduction of potential alien invasives is appropriate, even if there is scientific uncertainty about the long-term outcomes of the potential alien invasion.

- Vulnerable ecosystems should be accorded the highest priority for action, especially for prevention initiatives, and particularly when significant biodiversity values are at risk. Vulnerable ecosystems include islands and

isolated ecosystems such as lakes and other freshwater ecosystems, cloud forests, coastal habitats and mountain ecosystems.

- Since the impacts on biological diversity of many alien species are unpredictable, any intentional introductions and efforts to identify and prevent unintentional introductions should be based on the precautionary principle.

- In the context of alien species, unless there is a reasonable likelihood that an introduction will be harmless, it should be treated as likely to be harmful.

- Alien invasives act as "biological pollution" agents that can negatively affect development and quality of life. Hence, part of the regulatory response to the introduction of alien invasive species should be the principle that "the polluter pays" where "pollution" represents the damage to native biological diversity.

- Biosecurity threats justify the development and implementation of comprehensive legal and institutional frameworks.

- The risk of unintentional introductions should be minimised.

- Intentional introductions should only take place with authorisation from the relevant agency or authority. Authorisation should require comprehensive evaluations based on biodiversity considerations (ecosystem, species, genome). Unauthorised introductions should be prevented.

- The intentional introduction of an alien species should only be permitted if the positive effects on the environment outweigh the actual and potential adverse effects. This principle is particularly important when applied to isolated habitats and ecosystems, such as islands, fresh water systems or centres of endemism.

- The intentional introduction of an alien species should not be permitted if experience elsewhere indicates that the probable result will be the extinction or significant loss of biological diversity.

- The intentional introduction of an alien species should only be considered if no native species is considered suitable for the purposes for which the introduction is being made.

5.2 Unintentional Introductions – Recommended Actions

Unfortunately, it can be very difficult to control unintentional introductions that occur through a wide variety of ways and means. They include the most difficult types of movement to identify, control and prevent. By their very nature the most practical means of minimising unintentional introductions is by identifying, regulating and monitoring the major pathways. While pathways vary between countries and regions, the best known are international and national trade and tourism routes, through which the unintentional movement and establishment of many alien species occurs.

Recommended actions to reduce the likelihood of unintentional introductions are:

1. Identify and manage pathways leading to unintentional introductions. Important pathways of unintentional introductions include: national and international trade, tourism, shipping, ballast water, fisheries, agriculture, construction projects, ground and air transport, forestry, horticulture, landscaping, pet trade and aquaculture.

2. Contracting parties to the Convention on Biological Diversity, and other affected countries, should work with the wide range of relevant international trade authorities and industry associations, with the goal of significantly reducing the risk that trade will facilitate the introduction and spread of alien invasive species.

3. Develop collaborative industry guidelines and codes of conduct, which minimise or eliminate unintentional introductions.

4. Examine regional trade organisations and agreements to minimise or eliminate unintentional introductions that are caused by their actions.

5. Explore measures such as: elimination of economic incentives that assist the introduction of alien invasive species; legislative sanctions for introductions of alien species unless no fault can be proved; internationally available information on alien invasive species, by country or region, for use in border and quarantine control, as well as for prevention, eradication and control activities (See also Section 8).

6. Implement the appropriate initiatives to reduce the problems of alien invasives arising from ballast water discharges and hull fouling. These include: better ballast water management practices; improved ship design; development of national ballast water programmes; research, sampling and monitoring regimes; information to port authorities and ships' crews on ballast water hazards. Make available existing national guidelines and legislation on ballast water (for example Australia, New Zealand, USA**).** At the national, regional and international level, disseminate international guidelines and recommendations, such as the International Maritime Organisation's guidelines on ballast water and sediment discharges. (See also Section 9.2.2.)

7. Put in place quarantine and border control regulations and facilities and train staff to intercept the unintentional introduction of alien species. Quarantine and border control regulations should not be premised only on narrow economic grounds that primarily relate to agriculture and human health, but, in addition, on the unique biosecurity threats each country is exposed to. Improved performance at intercepting unintentional introductions that arrive via major pathways may require an expansion of the responsibilities and resourcing of border control and quarantine services (Also see 9.2).

8. Address the risks of unintentional introductions associated with certain types of goods or packaging through border control legislation and procedures.

9. Put in place appropriate fines, penalties or other sanctions to apply to those responsible for unintentional introductions through negligence and bad practice.

10. Ensure compliance by companies dealing with transport or movement of living organisms with the biosecurity regimes established by governments in the exporting and importing countries. Provide for their activities to be subjected to appropriate levels of monitoring and control.

11. For island countries with high risks and high vulnerabilities to alien invasive species, develop the most cost-effective options for governments wanting to avoid the high costs of controlling alien invasive species. These include more holistic approaches to biosecurity threats and better resourcing of quarantine and border control operations, including greater inspection and interception capabilities.

12. Assess large engineering projects, such as canals, tunnels and roads that cross biogeographical zones, that might mix previously separated flora and fauna and disturb local biological diversity. Legislation requiring environmental impact assessment of such projects should require an assessment of the risks associated with unintentional introductions of alien invasive species.

13. Have in place the necessary provisions for taking rapid and effective action, including public consultation, should unintentional introductions occur.

5.3 Intentional Introductions – Recommended Actions

1. Establish an appropriate institutional mechanism such as a 'biosecurity' agency or authority as part of legislative reforms on invasives (Refer to Section 9). This is a very high priority, since at present the legislative framework of most countries rarely treats intentional introductions in a holistic manner, that is, considers all organisms likely to be introduced and their effect on all environments. The usual orientation is towards sectors, e.g. agriculture. Consequently the administrative and structural arrangements are usually inadequate to deal with the entire range of incoming organisms, the implication for the environments into which they are being introduced, or with the need for rapid responses to emergency situations.

2. Empower the biosecurity agency, or other institutional mechanism, to reach decisions on whether proposed introductions should be authorised, to develop import and release guidelines and to set specific conditions, where appropriate (Operational functions should reside with other agencies. See 9.2.1)

3. Give utmost importance to effective evaluation and decision-making processes. Carry out an environment impact assessment and risk assessment as part of the evaluation process before coming to a decision on introducing an alien species (See Appendix).

4. Require the intending importer to provide the burden of proof that a proposed introduction will not adversely affect biological diversity.

5. Include consultation with relevant organisations within government, with NGOs and, in appropriate circumstances, with neighbouring countries, in the evaluation process.

6. Where relevant, require that specific experimental trials (e.g. to test the food preferences or infectivity of alien species) be conducted as part of the assessment process. Such trials are often required for biological control proposals and appropriate protocols for such trials should be developed and followed.

7. Ensure that the evaluation process allows for the likely environmental impacts, risks, costs (direct and indirect, monetary and non-monetary) benefits, and alternatives, to have been identified and assessed by the biosecurity authority in the importing country. This authority is then in a position to decide if the likely benefits outweigh the possible disadvantages. The public release of an interim decision, along with related information, should be made with time for submissions from interested parties before the biosecurity agency makes a final decision.

8. Impose containment conditions on an introduction if and where appropriate. In addition, monitoring requirements are often necessary following release as part of management.

9. Regardless of legal provisions, encourage exporters and importers to meet best practice standards to minimise any invasive risks associated with trade, as well as containing any accidental escapes that may occur.

10. Put in place quarantine and border control regulations and facilities and train staff to intercept unauthorised intentional introductions.

11. Develop criminal penalties and civil liability for the consequent eradication or control costs of unauthorised intentional introductions.

12. Ensure that provisions are in place, including the ability to take rapid and effective action to eradicate or control, in the event that an unauthorised introduction occurs, or that an authorised introduction of an alien species unexpectedly or accidentally results in a potential threat of biological invasion. (See Sections 6 and 9.)

13. As well as taking the efforts that are required at global and regional levels to reduce the risk that trade will facilitate unintentional introductions (Section 5.2), utilise opportunities to improve international instruments and practices relating to trade that affect intentional introductions. For example, the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) are addressing the implications alien invasive species may have on the operation of the Convention. Similar initiatives should be made with respect to relevant international trade authorities and industry associations.

6. ERADICATION AND CONTROL

When a potential or actual alien invasive species has been detected, in other words, when prevention has not been successful, steps to mitigate adverse impacts include eradication, containment and control. Eradication aims to completely remove the alien invasive species. Control aims for the long term reduction in abundance or density of the alien invasive species. A special case of control is containment, where the aim is to limit the spread of the alien invasive species and to contain its presence within defined geographical boundaries.

6.1 Guiding Principles

- Preventing the introduction of alien invasive species should be the first goal**.**

- Early detection of new introductions of potential or known alien invasive species, together with the capacity to take rapid action, is often the key to successful and cost-effective eradications.

- Lack of scientific or economic certainty about the implications of a potential biological alien invasion should not be used as a reason for postponing eradication, containment or other control measures.

- The ability to take appropriate measures against intentionally or unintentionally introduced alien invasive species should be provided for in legislation.

- The best opportunities for eradicating or containing an alien invasive species are in the early stages of invasion, when populations are small and localised (These opportunities may persist for a short or long time, depending on the species involved and other local factors).

- Eradication of new or existing alien invasive species is preferable and is more cost effective than long-term control, particularly for new cases.

- Eradication should not be attempted unless it is ecologically feasible and has the necessary financial and political commitment to be completed.

- A strategically important focus for eradication is to identify points of vulnerability in the major invasive pathways, such as international ports and airports, for monitoring and eradication activities.

6.2 Eradication – Recommended Actions

1. Where it is achievable, promote eradication as the best management option for dealing with alien invasive species where prevention has failed. It is much more cost effective financially than ongoing control, and better for the environment. Technological improvements are increasing the number of situations where eradication is possible, especially on islands. Eradication is likely to be more difficult in the marine environment**.** The criteria that need to be met for eradication to succeed are given in the Appendix.

2. When a potentially alien invasive species is first detected, mobilise and activate sufficient resources and expertise quickly. Procrastination markedly reduces the chances of success. Local knowledge and community awareness can be used to detect new alien invasions. Depending on the situation, a country's response might be within the country, or may require a cooperative effort with other countries.

3. Give priority to eradication at sites where a new alien invasion has occurred and is not yet well established.

4. Ensure eradication methods are as specific as possible with the objective of having no long-term effects on non-target native species. Some incidental loss to non-target species may be an inevitable cost of eradication and should be balanced against the long-term benefits to native species.

5. Ensure that persistence of toxins in the environment does not occur as a result of eradication. However, the use of toxins that are unacceptable for long-term control may be justified in brief and intensive eradication campaigns. The costs and benefits of the use of toxins need to be carefully assessed in these situations.

6. Ensure that methods for removing animals are as ethical and humane as possible, but consistent with the aim of permanently eliminating the alien invasive species concerned.

7. Given that interest groups may oppose eradication for ethical or self-interest reasons, include a comprehensive consultation strategy and develop community support for any proposed eradication as an integral part of the project.

8. Give priority to the eradication of alien invasive species on islands and other isolated areas that have highly distinctive biodiversity or contain threatened endemics.

9. Where relevant, achieve significant benefits for biological diversity by eradicating key alien mammalian predators (e.g. rats, cats, mustelids, dogs) from islands and other isolated areas with important native species. Similarly, target key feral and alien mammalian herbivores (e.g. rabbits, sheep, goats, pigs) for eradication to achieve significant benefits for threatened native plant and animal species.

10. Seek expert advice where appropriate. Eradication problems involving several species are often complex, such as determining the best order in which to eradicate species. A multidisciplinary approach might be best, as recommended in the IUCN Guidelines for Re-introductions.

6.3 Defining the Desired Outcomes of Control

The relevant measure of success of control is the response in the species, habitat, ecosystem or landscape that the control aims to benefit. It is important to concentrate on quantifying and reducing the damage caused by alien invasives, not concentrating on merely reducing numbers of alien invasives. Rarely is the relationship between pest numbers and their impacts a simple one. Hence estimating the reduction in the density of the alien invasive species will not necessarily indicate an improvement in the wellbeing of the native species, habitat or ecosystem that is under threat. It can be quite difficult to identify and adequately monitor the appropriate measures of success. It is important to do so, however, if the main goal, namely preventing the loss of biodiversity, is to be achieved.

6.4 Choosing Control Methods

Control methods should be socially, culturally and ethically acceptable, efficient, non-polluting, and should not adversely affect native flora and fauna, human health and well-being, domestic animals, or crops. While meeting all of

these criteria can be difficult to achieve they can be seen as appropriate goals, within the need to balance the costs and benefits of control against the preferred outcomes.

Specific circumstances are so variable it is only possible to give broad guidelines of generally favoured methods: specific methods are better than broad spectrum ones. Biological control agents may sometimes be the preferred choice compared to physical or chemical methods, but require rigorous screening prior to introduction and subsequent monitoring. Physical removal can be an effective option for clearing areas of alien invasive plants. Chemicals should be as specific as possible, non-persistent, and non-accumulative in the food chain. Persistent organic pollutants, including organochlorine compounds should not be used. Control methods for animals should be as humane as possible, consistent with the aims of the control.

6.5 Control Strategies – Recommended Actions

Unlike eradication, control is an ongoing activity that has different aims and objectives. While there are several different strategic approaches that can be adopted they should have two factors in common. First, the outcomes that are sought need to achieve gains for native species, be clearly articulated, and widely supported. Second, there needs to be management and political commitment to spend the resources required over time to achieve the outcomes. Badly focused and half-hearted control efforts can waste resources which might be better spent elsewhere.

Recommended actions are as follows:

1. Prioritise the alien invasive species problems according to desired outcomes. This should include identifying the areas of highest value for native biological diversity and those most at risk from alien invasives. This analysis should take into account advances in control technology and should be reviewed from time to time.

2. Draw up a formal control strategy that includes identifying and agreeing to the prime target species, areas for control, methodology and timing. The strategy may apply to parts of, or to a whole country, and should have appropriate standing as, for example, the requirements of Article 6 of the Convention on Biological Diversity ("General Measures for Conservation and Sustainable Use"). Such strategies should be publicly available, be open for public input, and be regularly reviewed.

3. Consider stopping further spread as an appropriate strategy when eradication is not feasible, but only where the range of the alien invasive is limited and containment within defined boundaries is possible. Regular monitoring outside the containment boundaries is essential, with quick action to eradicate any new outbreaks.

4. Evaluate whether long-term reduction of alien invasive numbers is more likely to be achieved by adopting one action or set of linked actions (multiple action control). The best examples of single actions come from the successful introduction of biological control agent(s). These are the 'classical' biological control programs. Any intentional introductions of this nature should be subject to appropriate controls and monitoring (See also Sections 5.3, 9 and Appendix). Exclusion fencing can be an effective single action control measure in some circumstances. An example of multiple action control is integrated pest management which uses biological control agents coupled with various physical and chemical methods at the same time.

5. Increase the exchange of information between scientists and management agencies, not only about alien invasive species, but also about control methods. As techniques are continuously changing and improving it is important to pass this information on to management agencies for use**.**

6.6 Game and Feral Species as Alien Invasives – Recommended Actions

Feral animals can be some of the most aggressive and damaging alien species to the natural environment, especially on islands. Despite any economic or genetic value they may have, the conservation of native flora and fauna should always take precedence where it is threatened by feral species. Yet some alien invasive species that cause severe damage to native biodiversity have acquired positive cultural values, often for hunting and fishing opportunities. The result can be conflict between management objectives, interest groups and communities. In these circumstances it takes longer to work through the issues, but resolution can often be achieved through public awareness and information campaigns about the damaging impacts of the alien invasives, coupled with consultation and adaptive management approaches that have community support. Risk analysis and environmental impact assessment may also help to develop appropriate courses of action and solutions.

Recommended actions are as follows:

1. Consider managing hunting conflicts on public land by designating particular areas for hunting while carrying out more stringent control to protect biodiversity values elsewhere. This option is limited in its application to situations where there is high value attached to the alien species and yet biological diversity values can still be protected through localised action.

2. Evaluate the option of removal of a representative number of the feral animals to captivity or domestication where eradication in the wild is planned.

3. Strongly encourage owners and farmers to take due care to prevent the release or escape of domestic animals that are known to cause damage as feral animals, e.g. cats, goats.

4. Develop legal penalties to deter such releases and escapes in circumstances where costly economic or damaging ecological consequences are likely to follow.

7. LINKS TO RE-INTRODUCTION OF SPECIES

7.1 Guiding Principle

- Successful eradications and some control programmes can significantly improve the likely success of re-introductions of native species, and thereby provide opportunities to reverse earlier losses of native biological diversity.

7.2 Links Between Eradication and Control Operations and Re-introductions

An eradication operation that successfully removes an alien invasive species, or a control operation that lowers it to insignificant levels, usually improves the conditions for native species that occupy or previously occupied that habitat. This is especially true on many oceanic islands. Eradications are often undertaken as part of the preparation for re-introduction(s).

The IUCN Guidelines for Re-introductions (May 1995) were developed to provide "…direct, practical assistance to those planning, approving or carrying out re-introductions." These guidelines elaborate requirements and conditions, including feasibility studies, criteria for site selection, socio-economic and legal requirements, health and genetic screening of individuals, and issues surrounding the proposed release of animals from captivity or rehabilitation centres. They should be referred to as part of the planning of eradication or control operations where re-introductions might be an appropriate and related objective. They should also be referred to if reviewing any re-introduction proposal.

The socio-economic considerations that apply to eradication and control operations largely apply to re-introductions as well, namely the importance of community and political support, financial commitment and public awareness. This makes it cost-effective to combine consultation over the eradication objective with proposals to re-introduce native species. It has the added advantage of offsetting the negative aspects of some eradications (killing valued animals) with the positive benefits of re-introducing native species (restoring heritage, recreation or economic values).

8. KNOWLEDGE AND RESEARCH ISSUES

8.1 Guiding Principle

- An essential element in the campaigns against alien invasive species at all levels (global, national, local) is the effective and timely collection and sharing of relevant information and experiences, which, in turn, assist advances in research and better management of alien invasive species.

8.2 Recommended Actions

1. Give urgency to the development of an adequate knowledge base as a primary requirement to address the problems of alien invasive species worldwide. Although a great deal is known about many such species and their control, this knowledge remains incomplete and is difficult to access for many countries and management agencies.

2. Contribute to the development of an easily accessible global database (or linked databases) of all known alien invasive species, including information on their status, distribution, biology, invasive characteristics, impacts and control options. It is important that Governments, management agencies and other stakeholders should all participate in this.

3. Develop "Black Lists " of alien invasive species at national, regional and global levels that are easily accessible to all interested parties. While "Black Lists" are a useful tool for focusing attention on known alien invasive species, they should not be taken to imply that unlisted alien species are not potentially harmful.

4. Through national and international research initiatives**,** improve knowledge of the following: ecology of the invasion process, including lag effects; ecological relationships between invasive species; prediction of which species and groups of species are likely to become invasive and under what conditions; characteristics of alien invasive species; impacts of global climate change on alien invasive species; existing and possible future vectors; ecological and economic losses and costs associated with introductions of alien invasive species; sources and pathways caused by human activity.

5. Develop and disseminate better methods for excluding or removing alien species from traded goods, packaging material, ballast water, personal luggage, aircraft and ships.

6. Encourage and support further management research on: effective, target-specific, humane and socially acceptable methods for eradication or control of alien invasive species; early detection and rapid response systems; development of monitoring techniques; methods to gather and effectively disseminate information for specific audiences.

7. Encourage monitoring, recording and reporting so that any lessons learned from practical experiences in management of alien invasive species can contribute to the knowledge base.

8. Make better use of existing information and experiences to promote wider understanding and awareness of alien invasive species issues. There need to be strong linkages between the actions taken under Sections 4 and 8.

9. LAW AND INSTITUTIONS

9.1 Guiding Principles

- A holistic policy, legal and institutional approach by each country to threats from alien invasive species is a prerequisite to conserving biological diversity at national, regional and global levels.

- Effective response measures depend on the availability of national legislation that provides for preventative as well as remedial action. Such legislation should also establish clear institutional accountabilities, comprehensive operational mandates, and the effective integration of responsibilities regarding actual and potential threats from alien invasive species.

- Cooperation between countries is needed to secure the conditions necessary to prevent or minimise the risks from introductions of potentially alien invasive species. Such cooperation is to be based on the responsibility that countries have to ensure that activities within their jurisdiction or control do not cause damage to the environment of other countries.

9.2 Recommended Actions

9.2.1 National level

1. Give high priority to developing national strategies and plans for responding to actual or potential threats from alien invasive species, within the context of national strategies and plans for the conservation of biological diversity and the sustainable use of its components.

2. Ensure that appropriate national legislation is in place, and provides for the necessary controls of intentional and non-intentional introductions of alien species, as well as for remedial action in case such species become invasive. Major elements of such legislation are identified in previous sections, particularly sections 5 and 6.

3. Ensure that such legislation provides for the necessary administrative powers to respond rapidly to emergency situations, such as border detection of potential alien invasive species as well as to address threats to biological diversity caused by intentional or non-intentional introductions of alien species across biogeographical boundaries within one country.

4. Ensure, wherever possible, for the designation of a single authority or agency responsible for the implementation and enforcement of national legislation, with clear powers and functions. In cases where this proves impossible, ensure there is a mechanism to coordinate administrative action in this field, and set up clear powers and responsibilities between the administrations concerned. (Note : these operational roles regarding implementation and enforcement are different from, and in addition to the specific function of the 'biosecurity' agency that was recommended in Section 5.3.)

5. Review national legislation periodically, including institutional and administrative structures, in order to ensure that all aspects of alien invasive species issues are dealt with according to the state of the art, and that the legislation is implemented and enforced.

9.2.2 International level

1. Implement the provisions of international treaties, whether global or regional, that deal with alien invasive species issues and constitute a compulsory mandate for respective Parties. Most prominent among these treaties is the Convention on Biological Diversity, and a number of regional accords.

2. Implement decisions taken by Parties to specific global and regional conventions, such as resolutions, codes of conduct or guidelines related to introductions of alien species, for example the International Maritime Organisation's guidance on ballast water.

3. Consider the desirability, or as the case may be, necessity, of conducting further agreements, on a bilateral or multilateral basis, or adapting existing ones, with respect to the prevention or control of introduction of alien species. This includes, in particular, consideration of international agreements related to trade, such as those under the auspices of the World Trade Organisation.

4. For neighbouring countries, consider the desirability of cooperative action to prevent potential alien invasive species from migrating across borders, including agreements to share information, through, for example, information alerts, as well as to consult and develop rapid responses in the event of such border crossings.

5. Generally develop international cooperation to prevent and combat damage caused by alien invasive species, and provide assistance and technology transfer as well as capacity building related to risk assessment as well as management techniques.

10. ROLE OF IUCN

1. IUCN will continue to contribute to the Global Invasive Species Programme (GISP),[3] together with CAB International, the United Nations Environment Programme (UNEP) and the Scientific Committee on Problems of the Environment (SCOPE).

2. IUCN will actively participate in the processes and meetings of the Convention on Biological Diversity (CBD) to implement article 8(h) by providing scientific, technical and policy advice.

3. The components of IUCN (including its Commissions, Programmes and Regional Offices) will act together to support the IUCN Global Initiative on Invasive Species.

4. IUCN will maintain and develop links and cooperative programmes with other organisations involved in this issue, including international organisations such as the United Nations Environment Programme, Food and Agricultural Organisation, Scientific Committee on Problems of the Environment, World Trade Organisation

[3] SCOPE, UNEP, IUCN and CABI have embarked on a programme on invasive species, with the objective of providing new tools for understanding as well as dealing with invasive species. This initiative is called the Global Invasive Species Programme (GISP). GISP engages the many constituencies involved in the issue, including scientists, lawyers, educators, resource managers and people from industry and government. GISP maintains close cooperation with the CBD Secretariat on the issue of alien species.

and international NGOs. IUCN will work with work with Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Parties to the Convention on Biological Diversity (CBD), Parties to the RAMSAR Convention, and with regional programmes such as the South Pacific Regional Environment Programme (SPREP).

5. IUCN regional networks will play a significant role in raising public awareness at all levels on the issues of alien invasive species, the various threats to native biological diversity and the economic implications, as well as options for control.

6. The IUCN Invasive Species Specialist Group (ISSG) of the Species Survival Commission (SSC) will, through its international network, continue to collect, organise and disseminate information on alien invasive species, on prevention and control methods, and on ecosystems that are particularly vulnerable to alien invasion.

7. The separate work of IUCN/SSC on identifying species threatened with extinction and areas with high levels of endemism and biodiversity will be supported. This work is valuable when assessing alien invasion risks, priority areas for action, and for practical implementation of these guidelines.

8. The ongoing work of the ISSG will be supported, including the following actions: the development and maintenance of a list of expert advisors on control and eradication of alien invasive species; expansion of the alien invasive species network; production and distribution of newsletters and other publications.

9. IUCN, in association with other cooperating organisations, will take a lead in the development and transfer of capacity building programmes (e.g. infrastructure, administration, risk and environmental assessment, policy, legislation), in support of any country requesting such assistance or wishing to review its existing or proposed alien invasive species programmes.

10. IUCN will take an active role in working with countries, trade organisations and financial institutions (e.g. World Trade Organisation, World Bank, International Monetary Fund, International Maritime Organisation) to ensure that international trade and financial agreements, codes of practice, treaties and conventions take into account the threats posed to biological diversity and the financial costs and economic losses associated with alien invasive species.

11. The ISSG will support the work of the IUCN Environmental Law Programme in assisting countries to review and improve their legal and institutional frameworks concerning alien invasive species issues.

12. The ISSG will develop regional databases and early warning systems on alien invasive species and work with other cooperating organisations to ensure efficient and timely dissemination of relevant information to requesting parties.

11. BIBLIOGRAPHY AND RELATED INFORMATION

The guiding principles and text of these guidelines are partially based on, or sourced from the following important documents:

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APPENDIX

1. Environmental Impact Assessment (EIA)

Generic questions in the EIA process concerning impacts a proposed introduced species may have on the environment should include the following:

- Does the proposed introduction have a history of becoming invasive in other places? If yes, it is likely to do so again and should not be considered for introduction.
- What is the probability of the alien species increasing in numbers and causing damage, especially to the ecosystem into which it would be introduced?
- Given its mode of dispersal, what is the probability the alien species would spread and invade other habitats?
- What are the likely impacts of natural cycles of biological and climatic variability on the proposed introduction? (Fire, drought and flood can substantially affect the behaviour of alien plants.)
- What is the potential for the alien species to genetically swamp or pollute the gene pool of native species through interbreeding?
- Could the alien species interbreed with a native species to produce a new species of aggressive polyploid invasive?
- Is the alien species host to diseases or parasites communicable to native flora or fauna, humans, crops, or domestic animals in the proposed area for introduction?
- What is the probability that the proposed introduction could threaten the continued existence or stability of populations of native species, whether as a predator, as a competitor for food, cover, or in any other way?
- If the proposed introduction is into a contained area(s) with no intention of release, what is the probability of a release happening accidentally?
- What are the possible negative impacts of any of the above outcomes on human welfare, health or economic activity?

2. Risk Assessment

This refers to an approach that seeks to identify the relevant risks associated with a proposed introduction and to assess each of those risks. Assessing risk means looking at the size and nature of the potential adverse effects of a proposed introduction as well as the likelihood of them happening. It should identify effective means to reduce the risks and examine alternatives to the proposed introduction. The proposed importer often does a risk assessment as a requirement by the decision-making authority.

3. Criteria to be Satisfied to Achieve Eradication

- The rate of population increase should be negative at all densities. At very low densities it becomes progressively more difficult and costly to locate and remove the last few individuals.
- Immigration must be zero. This is usually only possible for offshore or oceanic islands, or for very new alien invasions.
- All individuals in the population must be at risk to the eradication technique(s) in use. If animals become bait- or trap-shy, then a sub-set of individuals may no longer be at risk to those techniques.
- Monitoring of the species at very low densities must be achievable. If this is not possible survivors may not be detected. In the case of plants, the survival of seed banks in the soil should be checked.
- Adequate funds and commitment must continuously exist to complete the eradication over the time required. Monitoring must be funded after eradication is believed to have been achieved until there is no reasonable doubt of the outcome.
- The socio-political environment must be supportive throughout the eradication effort. Objections should be discussed and resolved, as far as practicable, before the eradication is begun.

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