REVIEW OF NON-NATIVE SPECIES LEGISLATION AND GUIDANCE

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Contents

Tables

Boxes

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1 EXECUTIVE SUMMARY

The impacts of non-native species can be serious; they can transform ecosystems, damage crops, alter natural habitats and threaten native biodiversity. Non-native species also can bring considerable benefits in terms of both economic gains and quality of life. Although current problems with non-native species are caused by a relatively small percentage of those that have been introduced, the continued increase of global trade and travel is likely to increase the threat posed by non-native species to the UK's economic and ecological interests.

This report reviews and analyses international agreements relevant to the UK which address non-native species. The UK legislative framework concerning non-native species, and the ability of this to meet our international obligations, is assessed. Legislation concerning non-native species in the United States, New Zealand, Germany and Italy is reviewed, and the experience of these other countries is used to inform recommendations for improving the way in which the UK meets the challenge posed by non-native species.

There are over 45 international instruments relating to the control of non-native species. Of these, the Convention on Biological Diversity (CBD) is the only legally binding instrument that addresses non-native species across all groups, vectors and continents. Article 8(h) calls for contracting parties to "*prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species.*"

Numerous UK laws exist which have some bearing upon non-native species. These are generally sectoral in nature, introduced in response to a particular problem. As a result, the legal framework is largely piecemeal, with the strength of controls varying between sectors.

Sanitary measures to prevent the introduction of agricultural or forestry pest species are reasonably comprehensive and effective. However, there is currently little provision to restrict imports on the basis solely of the ecological harm that such imports may cause. The European Community (EC) Wildlife Trade Regulation provides for import restrictions on ecological grounds, but this measure has so far only been applied to two species. The Import of Live Fish Act also provides for restrictions on imports of non-native fish that may have adverse impacts on native fish species.

Controls on releases to the environment are enacted primarily through the Wildlife & Countryside Act 1981. This Act is inconsistent in its treatment of animal, plant and other groups; there is a general prohibition against unlicensed releases of animals but not against plants, fungi or micro-organisms. Controls on the movement of native species outside their natural ranges exist only for fish in England and Wales.

There is no explicit legal requirement for the general control or eradication of non-native species; provisions for control exist under some pieces of legislation relating specific groups or sectors (e.g. agricultural pests and illegally released fish). There is no statutory system for early detection and monitoring of non-native species.

There are grey areas concerning legal definitions of terms relating to non-native species in the legislation.

The legal framework for controlling non-native species is therefore not sufficient to meet our international obligations, and cannot at present prevent the introduction of certain species via certain pathways.

The review of four other countries suggested that non-native species legislation in these countries can be viewed as falling on a scale ranging from a point where non-native species are not explicitly covered to one where the different sectors involved are drawn together under a unified framework. These countries cited an absence of guiding principles as one of the drawbacks of their non-native species policy. Another common problem was that when many agencies and organisations are involved in activities relating to non-native species, there can be insufficient co-operation and information transfer.

New Zealand has gone furthest in introducing consolidated, comprehensive and consistent legislation on non-native species. The United States has made progress towards a consistent approach with the establishment of an Invasive Species Council and the publication of an Invasive Species Management Plan.

It is considered that the problem of non-native species is not severe enough in the UK to merit adopting an approach similar to New Zealand. However, it is also considered that the lack of guiding principles and the sectoral approach to non-natives is hindering the UK's efforts to deal comprehensively with the problem. It is therefore considered that the UK should:

- Establish a Non-native Species Council to oversee policy co-ordination and dissemination of advice and guidance. This Council should be invested with the power to direct actions of organisations involved with non-natives, to assign clear responsibilities to appropriate bodies, to consider the cross-cutting aspects of non-native species issues, and to provide technical and scientific advice to Government.

- Draw up a Non-Native Species Strategy for Great Britain. This strategy should include the collation of existing legislation and guidance; identification of sectors and pathways associated with introductions / use of non-natives; a review of the status and threats of established non-native species; lists of species which have been identified as potentially invasive but not yet established, and for which early warning of introduction is a priority; and procedures for early detection of, monitoring and collation of information on non-native species.

- Ban the keeping and sale of known invasive species.

It is also recognised that the problem of non-native species is best addressed at a global level. With this in mind, the UK should seek to:

- Work with the EC to a) include more known invasive species on the Wildlife Trade Regulation, and b) frame regulations on intra-EC trade, consistent with

the CBD and the Treaty of Rome, to minimise within-species biodiversity loss caused by trade in species native to the EC.

- Participate in the forthcoming CBD COP6 with the aim of working towards the development of guiding principles and international measures for the implementation of Article 8(h) of the CBD.

- Participate in IMO discussions with a view to developing and implementing an international instrument on the treatment of ballast water.

- Encourage the development of international action on hull fouling.

The UK has so far been fortunate that the impacts of non-native species have been less severe than in many other countries. This does not mean, however, that we can afford to be complacent. In order to fully address the present and future threats of non-native species, a clear and unifying approach is undoubtedly required.

2 OVERVIEW

2.1 Issues and scope

The impacts of non-native species can be serious; they can transform ecosystems, damage crops, alter natural habitats and threaten native biodiversity. Non-native species also bring considerable benefits, both in economic and in quality of life terms. However, the continued increase of global trade and travel is likely to increase the threat to the UK's economic and ecological interests posed by non-native species.

A co-ordinated approach is required to deal effectively with this problem, involving Government, industry and conservation bodies; all need to consider the causes of, and problems arising from, the introduction and spread of non-native species.

During the passage of the Countryside & Rights of Way Act 2000, the Government announced that it was instigating a review of policies concerning non-native species. This was further reinforced by the publication of the Rural White Paper *Our Countryside: The Future – A Fair Deal for Rural England* which identified the need to carry out a fundamental review of policy on non-native species. A Review Group was set up, involving members of government departments, conservation agencies, NGOs, trade associations and other relevant organisations.

Non-native species cause problems around the globe, and the UK has obligations under various international instruments to control non-native species. There are currently a number of statutory and non-statutory options available to deal with non-native species in the UK. However, these are uncoordinated, tending to focus on specific sectors.

This study was commissioned by the Department for Environment, Food & Rural Affairs (DEFRA) with the following remit:

- to conduct a review of existing legislation and guidance concerned with non-native species in the UK;
- to review the UK's international obligations, and assess whether the existing situation is sufficient to meet those obligations;
- to review the situation in other countries; and
- to make recommendations to the Review Group based on an analysis of the situation both in the UK and elsewhere.

This report reviews and analyses international agreements relevant to the UK which address non-native species. The UK legislative framework concerning non-native species, and the ability of this to meet our international obligations, is assessed. Legislation concerning non-native species in the United States, New Zealand, Germany and Italy is reviewed, and the experience of these other countries is used to inform recommendations for improving the way in which the UK meets the challenge posed by non-native species.

The scope of this report does not extend to genetically modified organisms (GMOs); it also does not cover practical methods for controlling established non-native species, although this issue is discussed where relevant. The translocation of native species outside their natural ranges within the UK is considered, although the primary focus of the report is on non-native species. Issues relating to the introduction of non-native strains of native species are also discussed.

2.2 Methods

2.2.1 UK review

The work for this report was undertaken using a review of available literature, including web-based sources. The organisations represented on the review group and other people involved with non-native species were contacted, and their viewpoints on the issue of non-native species were sought. A great deal of information was obtained in this manner; see the Acknowledgements for a list of contributors.

2.2.2 Other countries

A review of web-based and other available literature was carried out. In addition, a request for information was distributed on a web-based non-native species list server. Following on from this, contacts were established with individuals and organisations in the countries under review, and their advice and opinions were sought. Again, see the Acknowledgements for a list of contributors.

2.3 Definitions

A great many terms, some of them more or less equivalent, can be found in the literature pertaining to non-native species. For clarity, we have tried to ensure consistent terminology, but in some cases (for example when directly quoting other sources) equivalent terms have been used. We have tried to adhere to the definitions of IUCN (2000), with the exception that *non-native species* has been used throughout as the preferred term; the definitions relevant to this review are listed below.

Biological diversity (biodiversity): 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.

Intentional introduction: 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: 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.

Invasive species: a non-native species which becomes established in natural or semi-natural ecosystems or habitats, is an agent of change, and threatens native biological diversity (or has the potential to do so).

Native species (indigenous): 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 / habitat: an ecosystem / habitat not perceptibly altered by humans.

Non-native species (alien, non-indigenous, foreign, exotic): 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). This includes any part, gametes or propagule of such species that might survive and subsequently reproduce.

Re-introduction: 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 – IUCN 1997).

Semi-natural ecosystem / habitat: an ecosystem which has been altered by human actions, but which retains significant native elements.

Unintentional introduction: an unintended introduction made as a result of a species utilising humans or human delivery systems as vectors for dispersal outside its natural range.

2.4 Acronyms and abbreviations

APHIS	Animal and Plant Health Inspection Service (US)
CBD	Convention on Biological Diversity
CCW	Countryside Council for Wales
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CITES	Convention on Trade in Endangered Species
COP	Council of Parties
CSL	Central Sciences Laboratory
DEFRA	Department for Environment, Food and Rural Affairs
DETR	Department of the Environment, Transport and Regions (now DEFRA)
EC	European Community
EN	English Nature
EPPO	European and Mediterranean Plant Protection Organisation
ERMA	Environmental Risk Management Authority (New Zealand)
FAO	Food and Agriculture Organisation
GISP	Global Invasive Species Project
GMO	Genetically Modified Organism
HSNO	Hazardous Substances and New Organisms Act (New Zealand)
HTA	Horticultural Trade Association
IMO	International Maritime Organisation
IPPC	International Plant Protection Convention
ISSG	Invasive Species Specialist Group
IUCN	The World Conservation Union
JNCC	Joint Nature Conservation Committee
MAF	Ministry of Agriculture and Forestry (New Zealand)
MAFF	Ministry of Agriculture, Fisheries and Food (now DEFRA)
MCS	Marine Conservation Society
NAW	National Assembly for Wales
NAWAD	National Assembly for Wales Agriculture Department
NISA	National Invasive Species Act (US)
OATA	Ornamental Aquatic Trade Association
PCT	Pet Care Trust
PMS	Pest Management Strategy
PRA	Pest Risk Analysis
PRM	Pest Risk Management
SBSTTA	Subsidiary Body for Scientific, Technical and Technological Advice
SEERAD	Scottish Executive Environment and Rural Affairs Department
SEPA	Scottish Environment Protection Agency
SNH	Scottish Natural Heritage
SPS	Sanitary and Phytosanitary
UKBAP	UK Biodiversity Action Plan
USDA	United States Department of Agriculture
WTO	World Trade Organisation

3 INTRODUCTION

3.1 Nature and scope of the non-native species issue

Species have been transported from their native ranges to new areas for as long as humans have travelled over and between land masses. Introductions, both intentional and unintentional, have occurred since the Neolithic period (Webb 1985), but the scale of introductions has vastly increased since the turn of the nineteenth century (UNEP/CBD/SBSTTA/6/INF/3 2001).

Non-native species bring both costs and benefits, which may accrue to different sectors of society. Benefits include new crop or pasture species, attractive plants for the horticulture trade, novel biocontrol agents and others. Costs include damage to existing economic interests, harm to native species and habitats, and the costs associated with preventing introductions of harmful species, monitoring existing populations and conducting control or eradication schemes. Concern about the ecological scale of this issue was raised by Elton (1958); he remarked that "*we are seeing one of the great historical convulsions in the world's fauna and flora*". The number of introductions has continued to increase since Elton made that observation.

The number of species of all groups introduced to new areas worldwide gives some indication of the scale of the problem: over 1300 species of non-native insect have become established in the United States (Mooney & Drake 1989); the US and Australia each have about 2000 species of introduced vascular plants (Vitousek *et al.* 1997), and New Zealand has 1570 introduced plants which comprise nearly half its flora (Heywood 1989); all but one of the mammal species in Hawaii are introduced (Loope & Mueller-Dombois 1989). In the UK, over 1300 non-native plants are established in the wild (Stace 1991 & 1997), with an estimated 55000 non-native plant species occurring in gardens (Nelson 1994). Introduced species are found all over the world (Vitousek *et al.* 1997), and although they are more common in highly modified habitats, no nature reserve which has been studied is free of them (MacDonald *et al*. 1989).

Non-native species are found in all taxonomic groups (viruses, fungi, algae, mosses, lichens, ferns, higher plants, invertebrates, fish, amphibians, reptiles, birds and mammals) (IUCN 2000), and are either:

- intentionally moved to new areas for social or economic reasons; or
- inadvertently transported to new areas.

Introductions occur for a variety of reasons and by a variety of pathways (or vectors). Primary vectors for introduced species in the UK are listed in Section 3.3.

Global trade has enabled people to benefit from the unprecedented movement and establishment of species around the world; many sectors including agriculture, forestry, the pet trade, the horticultural industry and fisheries have benefited and to a greater or lesser extend depend upon non-native species. The lives of people throughout the world have been enriched through access to the world's biodiversity.

However, the movement of species outside of their natural range has also caused significant negative impacts. The majority of non-native species have little impact on native species (Williamson 1996, Mooney & Drake 1996), but a small fraction have caused major problems. Non-native species that become established, proliferate and spread are considered as invasive; invasive non-native species are now recognised as one of the greatest biological threats to the economic and environmental well-being of the planet (McNeely *et al.* in press).

- Non-native species may be as damaging to native species and ecosystems on a global scale as the loss and degradation of habitats (IUCN 2000).
- The economic and social costs of invasive non-native species can be immense.

As an example, the European Zebra Mussel *Dreisena polymorphia*, introduced to the northern American Great Lakes, smothers native clams and mussels, and clusters around warm water outflow pipes from power stations. Clearing the blockages resulting from this has so far cost the US around $5 billion (Marine Conservation Society 2001). The costs of 79 major biological invasions in the US are estimated as $97 billion (Bright 1998). Costs in the UK have been less severe, but as an example the total cost of Rhododendron *Rhododendron ponticum* control in Snowdonia National Park has been estimated as £45 million (Gritten 1995).

Non-native species affect indigenous species in a number of ways: direct predation (including herbivory), competition for resources (food and territories), habitat alteration or degradation (e.g. shading out of native plant species by species such as Rhododendron; toxicity of plant breakdown products inhibiting growth of native species; destruction); spread of disease (e.g. crayfish plague spread by American Signal Crayfish *Pacifastacus lenisculus*, Dutch Elm disease); and genetic pollution (e.g. hybridisation between introduced Sika Deer *Cervus nippon* and native Red Deer *Cervus elaphus*).

The UK has been fortunate to date in that only a minority of the non-native species established in this country have caused serious problems. UK ecosystems are, in general, less susceptible to catastrophic invasions than those which have evolved on isolated islands or continents. Williamson (in press) analysed the invasiveness of non-native species in the UK and suggested the 'tens rule' as a rule of thumb; roughly 10% of introduced species become established, and roughly 10% of these go on to become invasive. This is an average guideline across all species groups; more than 10% of mammal species have caused problems, whereas less than 10% of plant species have. However, this does not assist with predicting *which* 10% of species will become invasive. Predicting the invasiveness of introduced species is fraught with difficulty (Williamson 1996).

There is little evidence that non-native species have caused extinctions in the UK, as has happened in other countries, and it has been suggested that native species are unlikely to be excluded throughout their whole range by non-natives (Manchester & Bullock 2000). However, some non-native species have caused considerable problems. The impacts of non-native species on UK biodiversity have been reviewed by Manchester & Bullock (2000); refer to this paper for further details.

Global warming gives further cause for concern in that species from warmer climates that currently cannot establish in Britain may be able to do so in the future. In the long term, global warming may have a cooling effect on the British climate if the Gulf Stream shifts northwards, which may enable different species to become established. In the event of climate changes, new species may reach these shores through natural colonisation; in this case there may be little point in attempting to prevent them from arriving, particularly if they pose little threat to native species. The establishment of the Colorado Beetle *Leptinotarsa decemlineata* via natural pathways from France has been successfully prevented through monitoring and eradication in the Channel Islands and the mainland, demonstrating that prevention is possible.

However, many species would not be able to cross biogeographic barriers without human assistance; the potential for more invasive non-native species to establish and spread in this manner is a serious cause for concern. We are already seeing the establishment of warm-water aquatic plant species; Parrot's Feather *Myriophyllum aquaticum* has established in Cornwall. It is therefore possible that global warming will exacerbate the problems caused by non-native species. Predicting the responses of species, habitats and ecosystems to climate change is very difficult, and at this stage it is not possible to say with any certainty how global warming will impact upon Great Britain in terms of the non-native species issue.

A further cause for concern is the development through natural selection of acclimatised strains of non-native species that would not normally be able to establish. A cold water tolerant strain of the non-native tropical alga *Caulerpa taxifolia* has established itself across large areas of the Mediterranean; the implications for the UK if cold water varieties of Water Hyacinth *Eichornia crassipes* (which is widely sold in garden centres) became established are severe, as this species has caused immense problems in countries with warmer climates. At present this species cannot overwinter in Britain, but it is often introduced into ponds and left to die back, giving rise to the possibility that tolerant strains may develop.

For further details on non-native species and the theory of invasions see Williamson (1996).

3.2 Introduced species in the UK

Species have been introduced to the UK by humans since the Neolithic period. However, most non-native species have been introduced since approximately AD 1500, when improved marine transportation led to a large increase in the movement of people and goods. Although some recent colonists such as the Collared Dove *Streptopelia ducata* have colonised naturally, most are thought to have been deliberately or accidentally introduced by human activity.

It is not certain exactly how many non-native species are present in the UK; this uncertainty arises in part because historical records are not precise (e.g. it is unclear whether some colonies of European Pond Terrapin *Enys orbicularis* and Wall Lizard *Podarcis muralis* are native or introduced). Another cause for uncertainty centres on whether a species is capable of forming self-sustaining populations. Estimates also vary according to the definition of non-native used. It is usually assumed that species that have arrived since the Neolithic (c 6000 BP) are non-native (Webb 1985).

Williamson (in press) states that the numbers of both native and non-native plant species in the UK is uncertain. With native species the uncertainty is mostly due to hybrids and microspecies. Counts of British species usually omit hybrids, but there are around 400 of them listed in the floras; including these makes a large difference to the counts of taxa. There is also the question of the status of hybrids between natives and non-natives; most floras call them native if they have arisen in the British Isles despite the fact that they are non-native in the sense of having arisen in Britain since 6000 BP. There is also doubt about the number of native macrospecies; Williamson (in press) notes that counts from three floras (Clapham *et al*. 1987; Stace 1991; Stace 1997) give 1311, 1225 and 1552 species. There is also the question of whether these are in fact native; in the floras, roughly 10% of the species have labels of uncertainty such as 'probably native' and 'possibly introduced'. Even when species are clearly introduced, difficulties with the terms *casual, persistent, established* and others lead to very different counts of the number of non-native species. Table 1 gives estimates of the numbers of non-native species in the British Isles, Britain, or individual countries.

Table 1. Estimates of the numbers of non-native species in the British Isles (England, Scotland, Wales and Ireland), Britain (England, Scotland and Wales) or individual countries.

From Manchester & Bullock (2000).

Species / status (region)	Number of species	Reference
Established (British Isles)	23 mammals 24 birds 3 reptiles 7 amphibians 14 fish 170 insects 12 molluscs 286 plants	Brown (1986)
Marine species (British Isles)	16 algae 5 diatoms 1 angiosperm 31 invertebrates	Eno *et al.* (1997)
Freshwater fish (Ireland)	11	Griffiths (1997)
Freshwater fish (England)	12	Grice (1994)
Wild mammals (Britain)	27	Taylor (1979)
Naturalised mammals (Britain)	15	Baker (1990)
Feral birds (British Isles)	29	Marchant (1996)
Flora (British Isles)	1360 1387	Stace (1991) Stace (1997)
Garden plants (British Isles)	55000	Nelson (1994)

Other reviews of non-native species in the UK can be found in Eno (1996) (marine organisms); Jones (1974) (marine algae); Clement & Foster (1994) (plants); and Ryves *et al.* (1996) (grasses).

3.3 Vectors of introduction

Bullock *et al.* (1996) present a detailed review of the main vectors for introductions in the UK, and an assessment of their ecological and genetic impacts. A brief summary of the vectors is presented here.

3.3.1 Aquaculture / mariculture

The international trade in live fish, shellfish and eggs for aquaculture, fisheries and the exotic food market has increased in recent years. Concerns about the over-exploitation of the native fishery resource, coupled with the opportunities for profits from commercial harvesting of non-native species, have encouraged the stocking of non-native species and, within the UK, the movement of native species outside of their natural ranges. Aquaculture and mariculture have long been recognised as an important vector for introductions; Elton (1958) called oyster culture "the greatest agency of all that spreads marine animals to new quarters".

Grice (1994) notes that 12 of the 50 wild fish species in the UK are non-native. Holcik (1991) estimates that in Europe over 30% of introduced inland fish species originate from aquaculture.

In addition, there has been widespread stocking of native fish species outside their natural ranges. Many fish native to England but not naturally found in Scotland such as Ruffe *Gymnocephalus cernua* have been introduced to Scottish lochs.

3.3.2 Biological control

Biological control involves the introduction of a predator, parasite or pathogen of a particular pest species in order to suppress the pest species population.

Non-native biological control agents have rarely been released into the wider environment in the UK; most applications for release licences under the Wildlife and Countryside Act concern the introduction of biological control agents into glasshouses (although these are considered as releases to the environment for the purposes of licensing under the Wildlife & Countryside Act – see Section 4.3). The Forestry Commission uses biological control in woodlands; for example, a licence to release *Rhizophagus grandis* (a predatory beetle) for the biological control of the spruce bark beetle *Dendroctonus micans* in spruce woodlands was issued to the Forestry Commission in 1997.

3.3.3 Wildfowl and game stocking

The UK has a long history of introducing species for sport; past introductions have included Pheasant *Phasianus colchicus*, Red-legged Partridge *Alectoris rufa*, Fallow Deer *Dama dama*, Pike-perch (Zander) *Stizostedion lucioperca* and Rainbow Trout *Oncorhynchus mykiss*.

In addition, plant species have been introduced as game cover (e.g. Snowberry *Synphoricarpos albus*), and fish species have been introduced as live bait.

3.3.4 Amenity and ornamental planting, stocking and collections

A large number of species have been introduced solely for ornamental purposes. Many of these have escaped from private gardens, parks and garden centres and have established wild populations. Some of these species have become seriously invasive. Examples of invasive terrestrial plants introduced in this manner include Rhododendron *Rhododendron ponticum*, Giant Hogweed *Heracleum mantegazzianum*, Japanese knotweed *Fallopia japonica* and Himalayan Balsam *Impatiens glandulifera*.

Invasive ornamental aquatic plant introductions include Canadian Pondweed *Elodea canadiensus* and New Zealand Pygmyweed *Crassula helmsii*. Ornamental fish species which have established naturalised populations include Goldfish *Carassius auratus* and Bitterling *Rhodeus sericeus*. Reptile and amphibian introductions have included Italian Crested Newt *Triturus carnifex*, Fire Salamander *Salamandra salamandra* and Wall Lizard *Podarcis muralis*.

Numerous bird species have established wild populations either through deliberate releases or accidental escapes. Examples include Ring-necked Parakeet *Psittacula krameri*, Ruddy Duck *Oxyura jamaicensis*, Mandarin Duck *Aix galericulata* and Golden Pheasant *Chrysolophus pictus*.

Mammal introductions have included three deer species introduced to deer parks: Sika Deer *Cervus nippon*, Muntjac Deer *Muntiacus reevesi* and Chinese Water Deer *Hydropotes inermis*. Muntjac Deer have invaded woodlands throughout central England, and Sika Deer hybridise with native Red Deer *Cervus elaphus*.

In addition, large-scale planting of e.g. road verges has not only commonly included non-native species, but also non-native strains of native species. Examples of the latter include Bird's-foot Trefoil *Lotus corniculatus*, Oxeye Daisy *Leucanthemum vulgare* and Red Clover *Trifolium pratense*.

3.3.5 Pets and domestic animals

A number of species imported as pets have established wild populations, either through deliberate release or accidental escape. Examples include feral Cats *Felix catus* (which have been known to hybridise with Wild Cats *Felix silvestris* in Scotland), Sheep *Ovis aries*, Goats *Capra hircus*, Rabbits *Oryctolagus cuniculus* and Red-eared Terrapins *Trachemys scripta*.

3.3.6 Fur farming

Three out of the eight mammal species introduced in the 20th century (Mink *Mustela vison*, Coypu *Myocastor coypus* and Muskrat *Ondata zibethicus*) established wild populations after escaping from fur farms (Baker 1990). Muskrat and Coypu were successfully eradicated (see Box 1); mink have become a serious threat to populations

of Water Vole *Arvicola terrestris* and could also be associated with the declines of native bird colonies.

Under the Fur Farming (Prohibition) Act 2000, a ban on fur farming in England and Wales will come into force on a date to be appointed by Ministers which cannot be before 1 January 2003.

3.3.7 Forestry

Many native woodland trees are slow-growing species; the forestry industry has introduced several fast-growing non-native species such as European Larch *Larix decidua*, Norway Spruce *Picea abies*, Corsican Pine *Pinus nigra*, Sitka Spruce *Picea sitchensis*, Western Hemlock *Tsuga heterophylla* and Lodgepole Pine *Pinus contorta*. All these species have been known to invade some semi-natural and disturbed habitats beyond areas where they have been planted.

In addition, planting of native species beyond their natural ranges and the use of non-local provenance stock is common in the forestry, amenity and ornamental planting sectors.

3.3.8 Agriculture

Agriculture has been responsible for many plant introductions over the years. Seeds of other plant species have been accidentally imported with crop seeds, and some crop species themselves have become established in the wild. Examples include Wild Oat *Avena fatua*, and fodder crops such as Alsike Clover *Trifolium hybridum*. Oil Seed Rape *Brassica napus* is now a common sight on roadsides, field margins and disturbed ground adjacent to areas where the crop has been planted.

Box 1: Eradication of Muskrat and Coypu in Britain

Non-native mammal species can cause massive environmental damage. As a percentage of the number of species introduced, more mammal species become pests than most other groups, probably due to their higher intelligence, hardiness and adaptability.

Muskrat (*Ondata zibethicus*) and Coypu (*Myocastor coypus*) were both introduced to Britain for fur farming during the late 1920s, and escapes from these fur farms led to the establishment of wild populations of both species. It is thought that animals kept in captivity in large numbers are more likely to escape in sufficient numbers to form viable populations than animals kept singly or in small groups.

Both species are semi-aquatic, swimming from resting sites in nests and burrows to feeding sites in or near water. They are generalist herbivores which can damage a wide variety of native plants and crops. In Britain, Coypus destroyed large areas of reedswamp; this species also contributed to the decline of Cowbane *Cicuta virosa* (now a Nationally Scarce species in Britain) through selective feeding. Muskrats are also capable of destroying wetland vegetation; fortunately, their numbers did not reach the level at which large-scale damage would have occurred. Muskrats did not cause significant damage to crops in Britain before they were eradicated, but there is little doubt that they would have done had they not been controlled. Coypu caused damage to agricultural crops and also disrupted drainage systems in East Anglia, thus causing a flooding risk, due to their extensive burrow systems in river banks.

The costs of damage likely to be caused by non-native species cannot always be assessed at the early stages of an introduction. In the case of Muskrat, it was known from the experience of other European countries that the species could cause serious damage, and this prompted a government-backed

eradication programme commencing in 1932 before the population had reached damaging levels. The Muskrat control programme also led to the Destructive Imported Animals Act 1932, which allows control over the import and keeping of named species. All keeping of Muskrat was prohibited under this Act in 1933. The situation was different for Coypu, as less was known about the ecology of the species when it was first introduced, and advice from Germany, where Coypus had also escaped, suggested that they would not cause problems. On the basis of this and other advice, little was done to prevent the spread of Coypus. The advice turned out to be misleading; the milder British winters allowed more animals to survive, and the population expanded rapidly. The keeping of Coypus was not prohibited under the Destructive Imported Animals Act until 1962; by this time, the population had reached the level where serious damage was being caused, and a trapping and research programme was also instigated by MAFF in 1962.

Over 4000 Muskrats were trapped at the various sites where the species had become established; trapping ceased in 1938 when the species was successfully eradicated. By contrast, the first trapping campaign against Coypus was not successful, despite an estimated 90% of the Coypu population being killed off by the record cold temperatures occurring during the winter of 1962/63. A succession of milder winters in the early 1970s led to a population explosion, and a second eradication campaign began in 1981. This second campaign was informed by research results and the experience of the previous campaign. Once the population dynamics of the species was sufficiently understood, mathematical models were used to examine the effects of different potential trapping regimes. In addition, the payment scheme for the trappers involved a bonus incentive for eradication within 10 years (the danger with paying people to trap animals on a per capita or year salary basis is that there remains an incentive to reduce trapping effort to ensure that payments continue). This approach proved successful. The maximum size reached by the Coypu population is believed to have been around 200000 in the late 1950s, but the population at the start of the 1981 eradication campaign was estimated at around 5000. This had been reduced to fewer than 40 by April 1986, and the campaign was discontinued in 1989 when over 20 months had passed without any evidence of Coypu presence coming to light.

The Muskrat example demonstrates the benefits of prior knowledge and early action in eradicating a species before it reached problem levels (although perhaps with hindsight it is possible to question why, in the light of this knowledge, the species was permitted to be imported in the first place). The experience of other countries convinced the authorities to mount an eradication campaign before the species had spread to the point where eradication would have been very expensive and possibly ineffectual.

By contrast, the Coypu example demonstrates the need for research in both the potential impacts and the ecology of non-native species in advance of introductions. Even if an eradication campaign had been attempted when the wild population was relatively small, it is questionable whether it would have succeeded without adequate knowledge of the population dynamics of the species. Given that advice from Europe suggested that Coypu was unlikely to cause problems, this provides an excellent illustration of the need for adequate targeted risk assessment and research before any species is deliberately imported, particularly for species that will be imported or bred in large numbers. The experience with Coypu also provides an example of a case where the adoption of the precautionary principle by preventing the import of the species until its ecology was better understood would have saved large amounts of time and money. Finally, the successful eradication of Coypu demonstrates that eradication projects can succeed if they are properly researched, adequately funded and adequately planned.

Main source: Gosling, L.M. & Baker, S.J. (1989). The eradication of muskrats and coypus from Britain. *Biological Journal of the Linnean Society*, **38**, 39-51.

Other sources of information

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Gosling, L.M. & Baker, S.J. (1987). Planning and monitoring an attempt to eradicate coypus from Britain. *Symposium of the Zoological Society of London*, **58**, 99-113.

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3.3.9 Other accidental introductions

The vectors described above have all given rise to established populations of non-native species, either because of deliberate release of the imported species, or their accidental escape. In addition to this, the import and release of species can give rise to unintentional introductions of other species through vectors linked to the international trade in organisms. Species may also be introduced through activities not directly concerned with the transport and trade of organisms. Some common vectors for unintentional introductions are detailed below.

Shipping

Ships use water as ballast when travelling without cargo. This water is generally taken on board in one port and released in another; organisms taken on board in the water can therefore be spread throughout the world by this process (for more detail on ballast water see Box 2). Species can also be transported attached to the hulls of the ships themselves.

The spread of already established non-native marine species can be exacerbated by ships travelling along the coast. For example, one vector contributing to the spread of the non-native alga *Caulerpa taxifolia* in the Mediterranean is thought to be the transport of plant fragments on yacht anchors.

International freight and tourism

Reports of non-native species transported inadvertently in imported goods have included large exotic spiders found in shipments of fruit; such relatively infrequent high-profile cases are often widely reported because of their novelty value, but it is likely that live organisms are transported in this manner on a fairly common basis. In addition, plant pest species can be transported via imports of plants and plant products.

For example, the New Zealand Flatworm *Arthurdendyus triangulatus* was accidentally introduced to the UK in growing media (e.g. soil) traded in pots, trays and root-balled plants. In addition, disease-causing organisms can be imported via imports of live or dead animals or plants.

Box 2: Development of international standards on ballast water discharge

The introduction of marine organisms to new areas through international shipping and transport of marine species is recognised as a major pathway for the introduction of non-native species. The effect of such introductions can be severe in both economic and ecological terms. For example, a toxic dinoflagellate *Gymnodium* species was introduced to an island near Hong Kong in 1998 and destroyed nearly all the mariculture sites around the island within two weeks; the cost of this loss was around $40 million (Marine Conservation Society 2001).

One of the common means of marine introductions is the discharge of ballast water from ships. Ballast water is the water taken on board a cargo vessel to maintain stability in the water and to ensure sufficient displacement for effective propeller immersion. Carrying ballast is therefore essential for unladen cargo ships, and thousands of gallons are required for large ships such as oil tankers. Ballast can be carried for many thousands of miles, and is discharged before cargo is taken aboard. Within the discharged water will be numerous organisms picked up with the water; these species, now non-native, are released into a new environment where they may be able to survive, reproduce and spread.

During the last few decades, ballast water discharges have increased around the world, and the probability of introducing species increases as the number and capacity of ships increases, and as transit time decreases. More than 42 million tonnes of ballast water from foreign sources are discharged annually in British Ports; there are now 50 identified non-native marine species in British waters (Marine Conservation Society 2001). It is very likely that this number will increase unless measures to prevent or minimise introductions from ballast water are taken. In the US, Cohen & Carlton (1998) estimate that the rate of invasions in the San Francisco Bay and Delta region has risen from an average of one new species established every 55 weeks during the period from 1851-1960 to an average of one new species every 14 weeks during the period from 1961-1995.

Given the international nature of shipping, with ships from all over the world travelling from country to country, it is clear that an international approach is needed to control the spread of non-native species. Legislative developments on an international level have been in process in the United Nations International Maritime Organisation (IMO) for nearly a decade. Delegates from all the nations concerned are working with the shipping industry and environmental organisations in attempting to develop regulations to minimise the transfer of harmful aquatic organisms.

The IMO's Working Group on Harmful Aquatic organisms have produced '*Guidelines for the control and management of ships' ballast water to minimise the transfer of harmful aquatic organisms and pathogens*' (Assembly Resolution A.868(20)). The guidelines are the precursor to mandatory regulations that are now in a draft format. It is hoped that these regulations will form part of a new Convention which should be ready by 2003.

The IMO Guidelines endorse the use of ballast water management and in so doing refer to the INTERTANKO / ICS Ballast Water Management Plan as a tool for the development of on-board ballast water management plans.

Some countries that are particularly concerned with the impact of non-native species have introduced national legislation in order to bridge the gap until the development of the IMO's Convention. The shipping industry is keen to ensure that legislation is international, as the multiplication of different unilateral legislation may introduce considerable complexity and confusion.

Countries that have introduced unilateral restrictions on ballast water include Argentina, Australia, Canada, Chile, Israel New Zealand, the United States and, within the UK, the Orkney Islands. The legislation varies from country to country; the US procedure is based on a risk assessment approach, whereas some others stipulate that no organisms at all should be discharged. Australia has voluntary compliance but mandatory reporting; New Zealand requires compulsory treatment. In addition, the means of treatment varies – at present New Zealand requires deep water exchange of ballast water, whereas the Orkney Islands require discharge to on-shore treatment facilities.

There are many potential methods for ballast water treatment; not all are applicable in all circumstances. For example, ballast water exchange in deep water (where the population of organisms is relatively much lower than in coastal waters) can be dangerous if carried out in stormy weather. A list of potential methods is presented below.

Technical methods used to reduce the transfer of harmful aquatic organisms (Intertanko 2000)

Method	Description
Ballast Water Exchange	Ballast water taken on board in harbour is exchanged in the deep ocean; this water contains far less organisms than coastal water. This is deemed the most practical method at present, is recommended in most ballast water legislation, although it has limitations.
Freshwater Ballast	The use of freshwater rather than seawater ballast could provide an inexpensive source of freshwater for irrigation and industrial usage in several major oil-exporting countries. This method has received no further attention.
Heat Treatment	Australia has developed this method in which heated salt water from the main engine cooling circuit is rerouted to the ballast water tank. A full-scale test on a bulk carrier proved successful, but there are concerns about the damage that could be caused to ballast tank coatings by the heated water.
Filtration	This method is based around a filter placed over the ballast water pipe inlet, as a means of controlling organism transferral. During tests, the build-up of organisms and sediment on the filtration screen was removed by using a backwash procedure, but the take-up of ballast water is slowed. A secondary treatment, such as ultraviolet or heat, will probably be necessary to eliminate unwanted organisms like bacteria and viruses. One benefit of filtration is that the amount of sediment taken onboard is reduced.
Hydrocyclones	A joint Norwegian/Canadian project uses hydrocyclones (centrifugal separators), backed by a secondary UV treatment. The former process eliminates the sediments, which are pumped out, while the latter kills organisms in the water. These systems have been used on offshore installations for a number of years.
Biodegradable Chemicals	Germany is developing a biodegradable ballast water treatment chemical. Approximately 50 litres of the chemical would be needed to treat 1,000 tonnes of ballast water.
Electrochemical Control	Japan is considering an electrochemical control concept, in which low potential electric power is applied to ballast water flowing through porous graphite electrodes in order to kill any micro-organisms present. Full-scale tests are planned.

Given the proliferation of ballast water treatment techniques, it will probably be necessary to develop minimum standards for any method employed (e.g. that a method, or combination of methods should destroy at least 90% of the organisms present in the ballast water).

There is no guarantee that the IMO regulations, when developed, will completely remove the risk of the transfer of aquatic species in ballast water, but they will help to greatly reduce this risk, and hopefully limit the number of cases in which environmental and economic damage is caused by unintentional transfer of non-native species.

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3.4 Control theory

Practical methods for the control of non-native species are outside the scope of this report. However, a comprehensive review of measures for the prevention, early detection, eradication and control of invasive non-native species was produced by the CBD SBSTTA for the SBSTTA6 meeting (UNEP/CBD/SBSTTA/6/INF/3 2001), which reviewed worldwide published and grey literature and consulted with expert groups. Control methods have not been developed for all groups. A very brief summary is presented here.

3.4.1 Prevention

Prevention is aimed at reducing the possibility of a non-native species being introduced, and is the preferred approach from a biological perspective. It is also by far the best way of avoiding potential long-term economic and environmental costs associated with the establishment of invasive non-native species.

Prevention can be accomplished by exclusion (keeping the risk out of a country by prohibiting or regulating imports of particular species or goods) or by mitigative measures at the time of entry of a species (e.g. a quarantine period for suspect goods) or at the point of an identified introduction vector (e.g. discharge of ballast water to treatment facilities). Prevention can also be applied to the release of non-native species from containment into the wider environment once they have been imported, by similar methods (e.g. refusing permits to release, specifying conditions for release etc.).

Tools for prevention include risk assessment of imports or releases, based on an assessment of the likelihood of a species entering, establishing and spreading, and on the ease or otherwise with which it could be controlled or eradicated if it did become established.

3.4.2 Early detection

Early detection is, together with eradication, the most neglected phase of the invasion process (Holt 1999). If prevention fails and a non-native species becomes established, the management options that remain are long-term control or eradication. Eradication is usually the preferable option. However, unless non-native species are detected early, eradication is generally difficult to achieve.

Many countries do not possess the infrastructure for the early detection of non-native species. In the UK, monitoring schemes for several groups of species exist, generally operated through a volunteer base such as the British Trust for Ornithology's Breeding Bird Survey. Surveys of marine port biota are also carried out, and there are other schemes for butterflies and other taxa. However, these are generally not designed or co-ordinated with the aim of detecting newly-established non-native species. Detection therefore relies greatly upon luck, and is dependent on reports from groups such as farmers, land managers, professional and amateur naturalists and members of the public.

Tools for early detection include general surveillance or collation of information (from site-specific surveys and / or species-specific surveys); detection of known pest species by diagnosis or taxonomic identification; and public awareness campaigns.

3.4.3 Eradication

Eradication is defined as "*the destruction of every individual of a species from an area surrounded by naturally occurring or man-made barriers sufficiently effective to prevent reinvasion of the area except through the intervention of man*" (Newsome 1978 quoted in Dahlsten 1986).

Eradication programmes have varied considerably in their effectiveness. The following criteria need to be satisfied in order to achieve a successful eradication (from IUCN 2000):

- the rate of population increase should be negative at all densities;
- immigration must be zero;
- all individuals in the population should be at risk of the eradication technique chosen;
- monitoring of the species at very low densities should be achievable in order to eradicate the last remaining individuals;
- adequate funds and commitment must exist continuously over the timescale required to achieve eradication. Monitoring should be funded after eradication is believed to have been successful until there is no reasonable doubt of the outcome; and
- the socio-political environment must be supportive throughout the eradication programme.

There are many methods for eradication, depending on the type of species in question. Eradication often depends upon a combination of such techniques. They are based on either:

- physical or mechanical control (e.g. the destruction of the organism itself via shooting or trapping of animals, cutting or uprooting of plants, destroying host organisms of pathogens);
- chemical control (e.g. poisons, insecticides, herbicides); or
- biological control (e.g. the release of a predator, herbivore or pathogen of the species, releasing sterile organisms to interbreed with the species).

3.4.4 Control

Methods for controlling non-native species are intended to suppress the abundance of a species down to the level where it no longer causes significant ecological or economic harm, or to contain a species within a geographical area and prevent it from expanding beyond that.

Control measures can be categorised as:

- physical and mechanical control (as in Section 3.4.3 above);

- chemical control (as in Section 3.4.3 above);
- biological control (as in Section 3.4.3 above);
- habitat management (e.g. crop rotation, nutrient management); and
- Integrated Pest Management (a combination of the above four techniques).

4 EXISTING LEGISLATION AND GUIDANCE FOR CONTROLLING NON-NATIVE SPECIES IN BRITAIN

This section outlines the various international instruments and domestic legislation that deal with non-native species. This legislation is evaluated in Section 5.3.

There are over 45 international agreements, non-binding documents and Codes of Conduct which contain provision for the introduction, control and eradication of non-native species (Williams 2000). Not all of these are directly relevant to this review, but see Shine *et al.* (2000a) and the GISP/SBSTTA Global Strategy (McNeely *et al.* in press) for comprehensive lists of global instruments.

The sixteen international instruments of most relevance to the UK are discussed in Section 4.1 and summarised in Appendix 1.1. Nine main areas of European legislation which are concerned with non-native species are discussed in Section 4.2 and summarised in summarised in Appendix 1.2. Twenty-nine domestic Acts, Orders and Regulations are discussed in Section 4.3 and summarised in Appendix 1.3. Web addresses for the full text of instruments and legislation are provided in the Appendices where available. The full texts of domestic Acts, Regulations and Orders in force prior to 1987 are not available online. See also Box 3 for a list of references.

International instruments were categorised by Shine *et al.* (2000b) into instruments concerning biodiversity conservation, the aquatic environment, sanitary and phytosanitary measures, trade-related measures and transport-related measures. This classification is followed in this report as far as is practicable, although not all instruments fit neatly into one category. In addition, instruments can be primarily concerned with intentional or unintentional introductions, or focus on a specific aspect of control (i.e. prevention of entry (quarantine), prevention of release and control / eradication).

Items of European and domestic legislation do not necessarily conform to this classification, but they have been categorised along similar lines in Appendices 1.2 and 1.3. Note that the year of entry into force for European legislation often refers to consolidated Regulations or Directives which replaced earlier ones; it is not the case, for example, that Plant Health regulations were lacking before 2000, merely that a consolidating regulation was introduced in that year to draw together all the previous regulations and amendments. There may be subsequent amendments to the EC Regulations and Directives listed here that are not covered in this review. In addition, amendments to domestic legislation are generally not included unless they are particularly relevant to the issue of non-native species control.

Box 3. References relating to reviews of agreements, codes of conduct and legislation

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4.1 International agreements

4.1.1 Biodiversity conservation

Convention on Biological Diversity (CBD)

This convention arose from the UN Conference on Environment and Development (held in Rio in 1992). As of 2000, 179 governments have signed up; signatories are committed to take appropriate measures to conserve biological diversity, ensure the sustainable use of biological resources and promote the fair and equitable sharing of benefits arising from the utilisation of genetic resources. Article 8(h) of the convention requires each contracting party, as far as possible and as appropriate to "*prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species.*"

A considerable amount of research has been compiled on non-natives by the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA); this includes a Global Strategy for Invasive Alien Species (McNeely *et al.* in press). Input to the various SBSTTA publications on non-native species has been provided by the Global Invasive Species Project (see Box 4). The CBD has established the Cartegena Protocol on Biosafety, which although concerned primarily with the release of genetically modified organisms, has implications for non-native species. It has also

established the Global Environmental Facility, which provides funding to projects for implementing the CBD in developing countries.

Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)

Resolution VII.14 on invasive species and wetlands calls upon Contracting Parties to wherever possible address the environmental, economic and social impact of invasive species on wetlands within their jurisdictions. It also urges Contracting Parties to:

- prepare an inventory of alien species in wetlands and assess them to identify and prioritise those which pose a threat to wetlands and wetland species, and those which may be adequately controlled or eradicated;
- establish programmes to target priority invasive species with a view to control or eradication, as well as to implement other related international programmes;
- address, wherever possible in their actions, the environmental, economic and social impact of the movement and transport of alien species on the global spread of invasive wetland species;
- review existing legal and institutional measures and, where necessary, adopt legislation and programmes to prevent the introduction of new and environmentally dangerous alien species and the movement or trade of such species 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 the promotion and enforcement of legislation and best practice management;
- facilitate awareness of, and resource the identification and control of, new and environmentally dangerous alien species; and
- collaborate with other Contracting Parties with a view to exchanging information and experience, increasing overall capacity to deal with wetland invasive species and promoting regional coordination of invasive species programmes.

Sites designated under this Convention (Ramsar Sites) have been accorded statutory status in England and Wales under the Countryside & Rights of Way Act 2000.

Bonn Convention on the Conservation of Migratory Species of Wild Animals

Contracting Parties that host endangered migratory species (Annex I species) are required to prevent, reduce or control factors that are endangering or likely to further endanger the species, including exotic species (Article III (4)(c)).

For species on Annex II, Parties should provide for strict control of the introduction of exotic species (or control of those already introduced) which would be detrimental to these species (Article V (5)(e)).

The African-Eurasian Migratory Waterbird Agreement (AEWA) has been established under the Bonn Convention. This contains a provision that requires Parties to 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 flora and fauna; when non-native waterbird species have already been introduced, Parties are required to take all appropriate measures to prevent these species from becoming a potential threat to indigenous species.

Bern Convention on Conservation of European Wildlife and Natural Habitats

Article 11(2) of this convention requires each contracting party to "*strictly control the introduction of non-native species*". Further to this Article, the Committee of Ministers to Member States issued Recommendation R(84)14 (adopted on 21st June 1984), stating that the introduction of non-native species into the environment should be prohibited. Exceptions to this prohibition may be authorised on the condition that the potential consequences of such introductions are assessed beforehand.

Box 4: The Global Invasive Species Project

At the end of the 20th century, only a few countries had an awareness of the non-native invasive species problem that enabled them to adequately address their responsibilities under Article 8(h) of the CBD.

The need for a global approach to the problem of non-native species was recognised at the Norway/UN Conference on Alien Species (held in Trondheim in 1996). The Global Invasive Species Programme (GISP) was developed as a co-operative venture between specialists on invasive non-native species, including scientists, lawyers, environmentalists, policy makers, economists, resource managers and others. It was established in 1997 to address global threats posed by non-native species that disrupt ecosystem processes and hence threaten biodiversity, health and economies, and to establish a knowledge base.

The aim of GISP is to enable governments and other organisations to use the best available practice to manage non-native species and to promote the development of tools and strategies necessary to improve the global management of non-natives. Since 1999 GISP has supported the CBD by providing input on non-native species to SBSTTA. SBSTTA 6 (held in Montreal in 2001) produced several documents relating to non-native species. These contain a great deal of information on non-native species, and are listed below.

The first phase of GISP contributed to the knowledge base on non-native species. The second phase aims to facilitate the transformation of policy concerning the prevention and management of non-native species into practice.

Key GISP publications to date are:

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Further information is available on the GISP website http://jasper.stanford.edu/GISP/. See also the website of the Invasive Species Specialist Group (ISSG) at http://www.issg.org and the Global Invasive Species Database http://www.issg.org/database/welcome/. This database is an online searchable database containing information on invasive species worldwide, and has been developed by ISSG as a contribution to GISP.

SBSTTA 6 documents on non-native species are available from the CBD SBSTTA website at http://www.biodiv.org/convention/sbstta.asp

UNEP/CBD/SBSTTA/6/INF/3: A comprehensive review of activities for the prevention, early detection, eradication and control of invasive alien species. http://www.biodiv.org/doc/meetings/sbstta/sbstta-06/information/sbstta-06-inf-03-en.pdf

UNEP/CBD/SBSTTA/6/INF/5: Review of the efficiency and efficacy of existing legal instruments applicable to invasive alien species. http://www.biodiv.org/doc/meetings/sbstta/sbstta-06/information/sbstta-06-inf-05-en.doc

UNEP/CBD/SBSTTA/6/INF/6: Report on existing international procedures, criteria and capacity for assessing risk from invasive alien species. http://www.biodiv.org/doc/meetings/sbstta/sbstta-06/information/sbstta-06-inf-06-en.doc

UNEP/CBD/SBSTTA/6/INF/8: A guide to designing legal and institutional frameworks on alien invasive species. http://www.biodiv.org/doc/meetings/sbstta/sbstta-06/information/sbstta-06-inf-08-en.pdf

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More recently, Recommendation R(97)57 on the Introduction of Organisms belonging to Non-Native Species into the Environment was issued. This references Article 8(h) of the CBD and states that Contracting Parties should:

- prohibit the deliberate introduction within their frontiers or in a part of their territory of organisms belonging to non-native species for the purpose of establishing populations of these species in the wild, except in particular circumstances where they have been granted prior authorisation by a regulatory authority, and only after an impact assessment and consultation with appropriate experts has taken place;
- endeavour to prevent the accidental introduction of organisms belonging to non-native species into the environment with the potential to establish populations, where they use anthropogenic routes of dispersal;
- draw up a documented national list of non-native species established in the wild, which are known to be invasive and/or cause harm to other species, ecosystems, public health or damage to economic activities;

- to consider, for the purposes of the application of the Convention, the suggested measures listed in the guidelines set out in the Appendix to the Recommendation, as appropriate to the specific circumstances in their territory; and
- communicate to the Secretariat, so that it may in turn inform the other Contracting Parties, any relevant measures adopted or envisaged as well as any information available on the outcome of the measures adopted.

However, this Recommendation does not apply to:

- genetically modified organisms;
- the introduction of non-native plants cultivated in managed agricultural and forest areas or for the purpose of combating soil erosion;
- the introduction of non-native organisms belonging to non-native species used for the purposes of biological control, if the introduction has been authorised on the basis of regulations for plant protection and pest control, which comprise an assessment of the impacts on flora and fauna;
- the introduction of non-native species maintained into confined space (for example, botanic gardens, greenhouses, arboreta, zoos, aquaculture or animal-breeding establishments or circuses); or
- the use of birds of prey in falconry.

The full text of this Recommendation, including broad guidelines on how Contracting Parties may achieve the objectives set out in the Recommendation, can be found online at http://www.nature.coe.int/english/main/bern/texts/rec9757.htm.

In addition Recommendation R(99)77 urged Contracting Parties to regulate (or even prohibit) the deliberate introduction and trade in their territory of certain species of non-native terrestrial vertebrates. It also called for monitoring and, where practicable, eradication of non-native terrestrial vertebrates, and listed 11 species which have proved to be a threat to biodiversity in Europe. This Recommendation can be found online at http://www.nature.coe.int/english/main/bern/texts/rec9977.htm.

The provisions of this convention are similar to those of the Birds Directive and the Habitats Directive (see Section 4.2).

IUCN Guidelines for the prevention of Biodiversity loss caused by alien invasive species (2000)

These guidelines were prepared by the Invasive Species Specialist Group (ISSG) of the IUCN (the World Conservation Union). Their aim is to prevent further biodiversity loss through the effects of non-native invasive species, and to assist government and management agencies to give effect to Article 8(h) of the CBD (see above).

The guidelines set out a set of Guiding Principles and Recommended Actions for preventing the introduction of, eradicating and controlling non-native species. The guidelines are given in full in Appendix 2.

The IUCN have also produced a Position Statement on Translocation of Living Organisms (IUCN 1987) which states that in general introductions of non-native species should only be considered if clear and well defined benefits to man or natural communities can be foreseen, and if no native species is considered suitable for the purpose for which the introduction is being made. No non-native species should be deliberately introduced into any natural habitat; no non-native species should be introduced into a semi-natural habitat unless there are exceptional reasons for doing so (and only when the operation has been comprehensively investigated and carefully planned in advance). The document also sets out principles for the assessment of the potential effects of a proposed introduction.

Agenda 21

Agenda 21 was a product of the United Nations Conference on Environment and Development held in Rio in 1992. It calls for the increasing protection of forests from disease and uncontrolled introduction of exotic plant and animal species; the adoption of appropriate rules on ballast water discharge to prevent the spread of exotic species; the strengthening of the legal and regulatory framework for mariculture and aquaculture; and the control of noxious aquatic species that may destroy other aquatic species.

Ministerial Conference for the Protection of Forest in Europe

This Conference is an ongoing initiative for co-operation between almost 40 European countries and the EC to address common threats and opportunities related to forests and forestry. The first ministerial conference was held in Strasbourg in 1990. At the second, held in Helsinki in 1993, 37 states and the EC signed four resolutions, setting out pan-European guidelines for sustainable forest management in response to the 1992 Rio Earth Summit.

There are several general principles and guidelines for conserving and enhancing biodiversity which require measures to conserve native species and ecosystems, and one specific guideline addressing the planting of native tree species and provenances. This states that “native species and provenances should be preferred where appropriate. The use of species, provenance, varieties or ecotypes outside their natural range should be discouraged where their introduction would endanger important/valuable indigenous ecosystems, flora and fauna. Introduced species may be used where their potential negative impacts have been assessed and evaluated over sufficient time, and where they provide more benefits than do indigenous ones in terms of wood production and other functions. Whenever introduced species are used to replace local ecosystems, sufficient action should be taken at the same time to conserve native flora and fauna.”

4.1.2 Aquatic environment

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

Article 196 of this Convention requires Member States to take all measures necessary to prevent, reduce and control the intentional or accidental introduction of species

(non-native or new) to a particular part of the marine environment, which may cause significant and harmful changes.

International Council for Exploration of the Sea (ICES) Code of Practice on the Introductions and Transfers of Marine Organisms (1994)

This Code of Practice recommends practices and procedures to reduce the risk of detrimental effects from the introduction and transfer of marine organisms. It provides recommendations for new intentional introductions and suggests that member countries should submit proposals (including a detailed analysis of potential environmental impacts on the aquatic ecosystem) to ICES for an opinion on a proposed introduction.

International Maritime Organisation (IMO) Guidelines for the Control and Management of Ships' Ballast Water to Minimise the Transfer of Harmful Aquatic Organisms and Pathogens

Resolution A.868(29)1997 of the IMO provides guidance and strategies to minimise the risk of unwanted organisms and pathogens from ballast water and sediment discharge.

Every ship that carries ballast water should be provided with a ballast water management plan to assist in the minimisation of the transfer of harmful non-native species and pathogens.

The transfer of organisms through ballast water discharge is dealt with in more detail in Box 2.

Food and Agriculture Organisation (FAO) Code of Conduct for Responsible Fisheries (1995)

This Code of Conduct encourages the setting up of legal and administrative frameworks to facilitate responsible aquaculture. This includes pre-introduction discussion with neighbouring states if non-native stocks are to be introduced to trans-boundary aquatic ecosystems.

The FAO has also produced guidelines on the precautionary approach to capture fisheries and species introductions (FAO 1995), which relate specifically to introductions and supports the Responsible Fisheries Code of Conduct.

4.1.3 Sanitary and phytosanitary measures

International Plant Protection Convention (IPPC)

The IPPC has been in force since 1952, and has 111 governments as Contracting Parties. It was extensively revised in 1997 to, amongst other things, reflect the provisions of the WTO SPS Agreement (see below) such as the requirement for Pest Risk Analysis (PRA). The full text of the revised version is available online at http://www.fao.org/ag/AGP/AGPP/PQ although to date only 21 countries have accepted this version. The purpose of the IPPC is 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." A pest is defined as "*any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products.*" The original purpose and implementation of the IPPC was applied primarily to crops, but it can also extend to the protection of natural flora; the scope of the IPPC covers any invasive non-native species that may be considered a plant pest. The IPPC Secretariat facilitates the development of internationally agreed standards for the application of phytosanitary measures to prevent and control the spread of plant pests by the international plant trade. These standards are recognised by the WTO SPS Agreement. The IPPC is administered by the National Plant Protection Organisations in each Member State. Within Europe, the European and Mediterranean Plant Protection Organisation (EPPO), established under the *Convention for the Establishment of the European Mediterranean Plant Protection Organisation*, is the designated Regional Plant Protection Organisation (RPPO). As such, EPPO is responsible for co-ordinating activities in member countries under the IPPC and for gathering and disseminating information. EPPO has developed standardised pest risk assessment procedures for use in Europe (see Box 5).

FAO Code of Conduct for the Import and Release of Exotic Biological Control Agents (1995)

This Code of Conduct sets out the responsibilities of government authorities and importers and exporters of biological control agents capable of self-replication (parasitoids, predators, parasites, phytophagous arthropods and pathogens) used for research and for environmental release. It is intended to facilitate the safe import, export and release of exotic biological control agents by introducing internationally acceptable procedures for all public and private bodies involved, particularly where national legislation does not exist or is inadequate.

4.1.4 Trade-related agreements

WTO Agreement on Sanitary and Phytosanitary measures (SPS Agreement)

International trade between the current 139 members of the World Trade Organisation is guided by the 1994 Uruguay Round Agreements. These agreements provide binding rules intended to ensure that governments extend free market access to each other's products and services. Under the 1995 SPS Agreement, countries are permitted to implement national regimes to protect human, animal and plant life from the risks arising from the entry, establishment or spread of pests, diseases and disease-carrying organisms. The SPS Agreement is intended primarily to ensure that import restrictions imposed by countries are not used as commercial protectionism; to this end, import restrictions must be based on scientific evidence, and the burden of proof that import restrictions are necessary remains with the recipient country. The Agreement requires SPS measures to be based on international standards, guidelines or recommendations, and to be based on scientific principles.

Box 5: Plant health controls and Pest Risk Analysis

Procedures for the protection of plant health have been in place on a global level following the establishment of the International Plant Protection Convention (IPPC) in 1951. In Europe, the IPPC is administered by the European and Mediterranean Plant Protection Organisation (EPPO).

The IPPC and EPPO were primarily set up to protect agricultural, horticultural and forestry plants from introduced pests and diseases. The scope of the Convention is, however, wide enough to include all non-native species that can be considered to be pests of wild flora.

EPPO's objectives are to:

- develop an international strategy against the introduction and spread of pests that damage crops and forests;
- encourage harmonisation of phytosanitary regulations and all other areas of official plant protection action;
- promote the use of modern, safe and effective pest control methods; and
- provide a documentation service on plant protection

EC Plant Health regulations are implemented in the UK by the Plant Health Act 1967 and subsequent Orders made under this Act. Plant material which hosts serious pests and diseases requires a Plant Passport. Imports of plants from outside the EC require phytosanitary certificates stating that the consignment is free from quarantine pests and diseases. Phytosanitary certificates are not required within the EC.

Controls on the import of invertebrate plant pests listed on Schedules 1 and 2 of the Plant Health (Great Britain) Order 1993 require that they cannot be imported to Britain without a licence. The granting of a licence is conditional upon the findings of a Pest Risk Assessment.

This system is administered by DEFRA within England and Wales and SEERAD in Scotland. The Plant Health Division (PHD) of DEFRA has responsibility for the plant health aspects of imports of plants, plant pests, plant produce, soil and other growing media. The Plant Health and Seeds Inspectorate (PHSI) carries out import and export inspections, issues phytosanitary certificates, oversees eradication campaigns and the operation of the Plant Passport scheme.

Scientific support on plant health measures is provided by the Central Science Laboratory (CSL), an executive agency of DEFRA. CSL conduct risk assessments of pests and commodities, identifies pests on samples submitted by the PHSI and advises on interceptions and outbreaks of pests and diseases.

Pest Risk Analysis (PRA) is central to the identification of potential plant pests; in order to restrict imports, the WTO SPS Agreement requires a risk analysis to justify trade restrictions. Early warning of the potential entry of pest species is required in order to carry out PRA and, if necessary, implement import restrictions before the species becomes established. PRA includes Pest Risk Assessment and Pest Risk Management (PRM), carried out to determine measures by which the species can be controlled or eradicated if it does become established.

PRA follows established guidelines in the form of a series of questions intended to establish:

- whether the species occurs in the EC or arrives as a natural migrant;
- whether the species is already established in the EC;
- the host plants of the species;
- the host plants grown economically (including those of environmental & amenity value);
- the present geographical distribution of the species;
- whether the species has been intercepted previously on entry;
- whether the species is capable of being introduced;
- whether the species could sustain a wild population;
- whether the species is capable of becoming established;
- potential likelihood as a pest or virus vector;
- prospects for continued exclusion; and
- prospects for eradication and how this would be achieved.

The EPPO PRA guidelines contain procedures for the quantitative evaluation of risk. This can be compared against reference levels to determine whether phytosanitary measures should be taken against it (EPPO 1993a, 1993b, 1997, 2001). (A similar computer-based approach is adopted for Weed Risk Assessment in Australia, whereby numerical scores are calculated, and based on these scores a proposed weed is accepted, rejected or evaluated in more detail).

A recent example of Pest Risk Analysis concerns *Anoplophora glabripennis*, an Asian long-horned beetle. This wood-boring pest was found in New York, having arrived there in wooden packing material from China. The American Animal and Plant Health Information Service (APHIS 1996) reported the discovery of the species. This prompted a summary PRA (MacLeod 1998), followed by a full EPPO PRA by CSL and Forest Research (Evans *et al.* 1998). This concluded that there was a risk of the species entering the EC and forming self-sustaining populations, and that the species had the potential to cause serious damage to hardwood trees including willows and poplar species, both of forestry importance in the UK. It recommended that the insect should be considered a quarantine pest and that it would be prudent to introduce phytosanitary measures to protect Britain (and other EC states). A factsheet was produced summarising the identification, distribution, significance and the phytosanitary restrictions imposed (MacLeod & Evans 1999).

The EC imposed emergency legislation to control non-coniferous wood imported as packing originating in China (Anon. 1999), although the species is not yet listed in the EC Plant Health Directive.

This example procedure demonstrates how advance warning, surveillance, the evaluation of existing data and the analysis of risks can be used within the existing legislative framework to prevent the entry of a potentially invasive non-native species. Risk analysis has also been applied to vertebrates (for example, the recent risk assessment of Wild Boar *Sus scrofa* in the UK carried out by CSL (1998); the application of this procedure to other species groups could form a major plank of a comprehensive strategy aimed at preventing the entry of invasive non-native species.

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Western Australia Department of Agriculture website: URL: http://www.agric.wa.gov.au/progserv/plants/weeds/weedsci2.htm

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

CITES is concerned with regulating or preventing trade in endangered species. Species covered under CITES are listed in three Appendices. Trade between countries of live or dead specimens of species in these Appendices is strictly controlled; export and import permits are required, and can only be issued if certain conditions are met (e.g. for species on Appendix I, export licences can only be granted if the export will not be detrimental for the species' survival, the specimen was not obtained illegally, the welfare of the specimen whilst in transit is ensured, and that an import permit has been granted by the destination country).

Appendix I lists species threatened with extinction which are or may be affected by trade. Trade in specimens of these species are subject to particularly strict regulation and can only be authorised in exceptional circumstances. Appendix II includes a) species which may become threatened with extinction unless trade is subject to strict regulation and b) species which need to be regulated in order that trade in species covered under a) can be brought under effective control. Appendix III includes species which any Contracting Party identifies as being subject to regulation within its jurisdiction and which requires the co-operation of other parties to control trade.

This convention is implemented in EC law by the Wildlife Trade Regulation (EC Regulations 338/97 and 939/97 - see Section 4.2).

4.1.5 Transport-related measures

International Civil Aviation Organisation (ICAO) Resolution on Preventing the Introduction of Invasive Alien Species

ICAO Resolution A-32-9 urges all contracting states to use their civil aviation authorities to assist in reducing the risk of introducing (through civil air transportation) potentially invasive species to areas outside their natural range.

4.2 European legislation

Habitats Directive

Article 22 of EC Directive 92/43/EEC (on the conservation of natural habitats and of wild flora and fauna) requires member states to "*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*." This Article is implemented in Great Britain by the Wildlife and Countryside Act 1981 (see Section 4.3).

Birds Directive

Article 11 of EC Directive 79/409/EEC (on the conservation of wild birds) states that "*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 flora and fauna."

This Article is implemented in Great Britain by the Wildlife & Countryside Act 1981 (see Section 4.3).

Wildlife Trade Regulation

Council Regulation 338/97/EC on the Protection of the Species of Wild Flora and Fauna by Regulating Trade Therein and Commission Regulation 939/97/EC which lays down detailed guidelines concerning the implementation of Regulation 338/97 are together termed the Wildlife Trade Regulation.

The Wildlife Trade Regulation implements CITES, and sets out rules for the import, export and re-export of species to which the Regulation applies. In addition to implementing CITES, the Regulation also contains the provision to prohibit or restrict import of species which are considered to be an ecological threat to native EC flora and fauna, and provisions to restrict the internal movement of such species.

Species covered by the Regulation are divided into four Annexes: Annex A is broadly equivalent to CITES Appendix I and contains all Appendix I species, almost 200 Appendix II and III species and some non-CITES species. Annex B includes all remaining Appendix II species, and over 50 Appendix III and non-CITES species. Annex C contains approximately 200 Appendix III species, and Annex D contains non-CITES species imported into the EC in such numbers as to warrant monitoring by a notification procedure. Controls on species listed on these Annexes are stricter than required by CITES. Apart from the inclusion in the Regulations of species not covered by CITES, stricter import conditions apply for Annex A and B species, import permits are required for Annex B species and import notifications are required for Annex C and D species.

The Regulation has been amended several times since its introduction. The amendments most relevant to this review are Regulation 2724/2000 (which replaces the Annexes) and several regulations which suspend the introduction into the EC of certain Annex A and B species. These import prohibitions have been clarified into Regulation 191/2001. For a list of other amending regulations see http://www.ukcites.gov.uk/intro/leg_frame.htm.

In addition to controls on trade in endangered species (CITES and non-CITES), Article 4(6)(d) of the Regulation allows the EC to establish restrictions on the introduction of live specimens of species for which it has been established that their introduction into the natural environment would present an ecological threat to wild species of fauna and flora indigenous to the EC. Article 9(6) provides that the EC may establish provisions on the movement between EC countries of live specimens of species restricted under Article 4(6). This has been used to prohibit the import and internal movement of Red-eared Terrapin *Trachemys scripta* and American Bullfrog *Rana catesbeiana* (see Box 6).

A guide to the Wildlife Trade Regulation has been produced for the EC by TRAFFIC (1998).

Box 6: Case study of American bullfrog in England

The American Bullfrog *Rana catesbeiana* is native to North America, with a natural range extending to the east of the Rocky Mountains from Nova Scotia as far south as north-east Mexico. It is the largest North American frog; adult Bullfrogs can grow up to 20cm in length. Bullfrogs are efficient and unselective predators; their diet includes insects, fish, crayfish, other amphibians, and the young of snakes, birds and small mammals. They have been implicated in the decline of several smaller native amphibians and other species in areas where they have become established in mainland Europe.

The import of Bullfrogs into Britain increased in the late 1970s when the source of imported goldfish changed to North America from Italy. Bullfrogs are common in American goldfish farms, where they are considered as a pest. Tadpoles originally came into Britain in small quantities, but as a market for the species developed in the pet trade, tadpoles were sold in increasing numbers in garden centres and cold-water fish retail outlets. Import of Bullfrogs was banned in 1997 under EC Regulation 2551/97 (now replaced by Regulation 191/2001). This was made under the EC Wildlife Trade Regulation, which allow for import restrictions to be placed on species which might adversely affect native flora and fauna. In addition, movement of the species within the EC has been restricted under Article 9(6) of the Regulation. The Wildlife Trusts and Froglife have been successful in some cases in persuading garden centres to ban the sale of Bullfrogs, but there is no legislative basis for preventing their sale; campaigns have been based on education and voluntary compliance.

Although there are records of several releases and escapes in Britain, until recently there were no reported instances of breeding. This situation changed when large numbers of Bullfrogs were found at a site in East Sussex. The first recorded sighting was in 1996 when a male was found and shot. Another adult was killed in 1997. In summer 1999, large tadpoles were seen in two ponds, which metamorphosed into large froglets. In September 1999, the Environment Agency were informed; an Agency official identified the animals as Bullfrogs and reported them to English Nature and Froglife.

A decision was made by English Nature to attempt eradication while the population was still localised. There is no specific domestic legislative requirement to eradicate non-native species, but the decision was in keeping with Article 11 of the Bern Convention. The eradication project was undertaken by Herpetofauna Consultants International and English Nature, with assistance from the Environment Agency Fisheries Team.

The ponds containing Bullfrogs were surrounded by an amphibian-proof fence, and dusk visits were made to capture the frogs. Following this, the ponds were drained to eliminate any remaining tadpoles and to enable the capture of the remaining metamorphosed frogs. By the end of 1999, 4744 tadpoles, 2269 froglets and one adult female bullfrog had been caught.

It is hoped that none of the froglets dispersed before the fence was put in place; the Bullfrog has the potential to become a serious problem species in Britain. A single female can produce as much as 20000 eggs in one spawn clump.

This case study illustrates firstly the importance of instigating a rapid response to the establishment of a new non-native species. Had the programme been delayed another year, large numbers of Bullfrogs could have dispersed, forming the nucleus of a population which could have spread and increased rapidly. An eradication project would have been vastly more difficult and costly had this happened. Another important point is the necessity for general monitoring and surveillance if introductions are to be detected early. This leads on to the need for public awareness to ensure that unfamiliar species are reported; officials cannot hope to detect all introductions unless they have the support of the general public. Froglife has issued a "*Bullfrog alert*" leaflet, which provides identification pointers and a summary of the potential impacts of the species (Froglife 2000).

The case study also illustrates the lack of a clear co-ordinating body on the control of non-native species. Previous eradications of non-natives (Coypu and Muskrat – see Box 1) were carried out by MAFF; in this case, English Nature undertook the eradication, with assistance from the Environment Agency. A body with a clearly defined responsibility for co-ordinating eradication and control programmes across all species groups would remove the uncertainty about who should fund and undertake control of established non-natives.

Finally, the case study demonstrates the need for import and sale controls on species which have the potential to become invasive. Such a policy is essential for preventing the establishment of species such as bullfrogs which have the potential to become seriously invasive.

Main source

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Import and export controls are the responsibility of HM Customs and Excise; the Customs and Excise Management Act 1979 (not covered in detail in this review) provides all the necessary powers to enforce import and export controls. Domestic offences are the responsibility of the police, enacted through the Control of Trade in Endangered Species (Enforcement) Regulations 1997 (COTES).

Environmental Assessment Directive

This Directive, whilst not directly concerned with non-native species, is relevant in that it requires environmental assessments for certain types of development. Where these developments include the use of non-native species, their potential effects on the environment should be evaluated. For example, forestry projects involving afforestation with non-native species and the construction of forest roads (which can act as vectors for non-native species) would require an environmental assessment under this Directive.

Forest Reproductive Material Directive

This Directive is currently being implemented by each Member State. It allows the prohibition (or restriction) of the marketing of forest reproductive material of unsuitable provenance or origin in all or parts of Member States where it could adversely affect biodiversity or genetic resources. It can apply to 46 species, from which Member States select those they wish to regulate.

Authorisation to prohibit or restrict marketing of forest reproductive material shall be granted only where there is reason to believe:

- That the use of the said reproductive material would, on account of its phenotypic or genetic characteristics, have an adverse effect on forestry, environment, genetic resources or biodiversity in all or part of that Member State on the basis of:
    a) evidence relating to the region of provenance or the origin of the material, or
    b) results of trials or scientific research carried out in appropriate locations, either within or outside the Community.

- On the basis of known results of trials, scientific research, or the results obtained from forestry practice concerning survival and development of planting stock in relation to morphological and physiological characteristics that the use of the said reproductive material would, on account of its characteristics have an adverse effect on forestry, environment, genetic resources or biodiversity in all or part of that Member State.

Plant Health Regulations

EC Plant Health Regulations were originally implemented by Directive 77/93/EC. This Directive has been amended, often substantially, on a number of occasions, and was therefore consolidated in 2000 into Directive 2000/29/EC (on protective measures against the introduction into the community of organisms harmful to plants or plant products and against their spread within the Community). The primary focus of the Directive is the protection of agricultural, forestry and horticultural plant species, but it can also be applied to wild species.

The objective of the Directive is to create a common protection system against the introduction of harmful organisms from countries outside the EC and to reorganise plant health monitoring to prevent the spread of harmful organisms within the EC in the wake of the abolition of trade barriers and controls between EC countries.

The legislation is implemented in UK law by the Plant Health Act 1967, the Plant Health (Great Britain) Order 1993 and the Plant Health (Forestry) (Great Britain) Order 1989 (see Section 4.3).

Animal Health Regulations

Animal health regulations were introduced to prevent the spread of diseases. They are mainly concerned with trade in agricultural animals, but can be applied to wild animals as well. They are primarily implemented by Directive 90/425/EEC (concerning veterinary and zootechnical checks applicable in intra-community trade in certain live animals and products with a view to the completion of the single market), Directive 91/496/EEC (laying down principles governing organisation of veterinary checks on animals entering the EC from outside) and Directive 64/432/EEC (health problems affecting intra-EC trade in bovine animals and swine). This last Directive covers two non-native species (Asiatic Water Buffalo *Bubalus bubalus* and North American Bison *Bison bison*) under controls for tuberculosis, brucellosis and enzootic bovine leukosis. Article 8 of Directive 92/65/EEC (animal health requirements governing trade in and imports into the Community of animals, semen, ova and embryos not subject to animal health requirements laid down in Directive 90/425/EEC) sets out the sanitary requirements for trade in bees (*Apis mellifera*).

As a general rule, in order to be eligible to enter intra-Community trade, consignments of live animals must be inspected by an official veterinarian prior to movement and certified free of infectious or contagious disease.

Completion of the Single Market in the veterinary sector abolished the previous control arrangements involving regular routine veterinary checks at internal borders, replacing them with a system of intensified veterinary checks on animals and animal products at the point of origin, with the aim of ensuring that only those complying with EC rules are moved from one Member State to another.

As a further precaution against the spread of disease, destination countries are empowered to conduct spot checks on imported consignments at the point of destination or at any point in the transport chain, including at points of entry.

With the abolition of internal border controls, effective controls are required at the external border on live animals and animal products imported into the EC from outside. Directive 91/496/EEC requires that live animals and animal products may only be imported into the EC through an approved Border Inspection Post and must undergo full documentary, identity and physical checks by an official veterinarian before being permitted to enter into free circulation within the Community.

The regulations are implemented in Great Britain by the Animals and Animal Products (Import and Export) (England and Wales) Regulations 2000, The Animals and Animal Products (Import and Export) (Scotland) Regulations 2000 and the Products of Animal Origin (Import and Export) Regulations 1996 (see Section 4.3).

Fish Health Directive 91/67

This directive prohibits the import of live or dead fish from zones within the EC not certified as free of certain diseases. It is implemented in UK law by the Fish Health Regulations (see Section 4.3).

Plant Protection Products Directive

EC Directive 91/414/EEC (concerning the placing of plant protection products on the market) establishes an authorisation system whereby plant protection products may not be sold or used in an EC country unless they have been authorised under the Directive by that country. The Directive establishes uniform rules on the conditions and procedures for authorisation, with the purpose of ensuring that plant protection products are effective without causing harm to human or animal health and without adversely affecting plants and ground water or the environment in general.

Plant protection products are defined as active substances and preparations containing one or more active substances intended to protect plants against harmful organisms; “active substance” means any substance or micro-organism, including viruses, which has a general or specific action against harmful organisms or on plants.

The Directive is implemented in UK law by the Plant Protection Product Regulations (see Section 4.3).

4.3 Domestic legislation

Wildlife & Countryside Act 1981

The main piece of legislation regulating the release of non-natives in Great Britain is the 1981 Wildlife & Countryside Act. Under Section 14(1) of this Act, it is an offence to "*release or cause to escape into the wild*" any **animal** which:

a) is of a kind which is not ordinarily resident in and is not a regular visitor to Great Britain in the wild state; or

b) is included in Schedule 9 part I.

Under Section 14(2) of the Act, it is an offence to "*plant or otherwise cause to grow in the wild*" any **plant** on Schedule 9 part II.

Guidelines for the interpretation and implementation of Section 14 have been produced (DETR 1997). These are summarised briefly below.

For Section 14(1), the guidelines state that in addition to direct releases into the open environment (i.e. natural and semi-natural habitats), "*release or causes to escape into the wild*" includes semi-confined situations such as gardens and greenhouses (because animals can and often will escape from such situations). Keeping non-native aquatic animals in cages or pens in lakes, sea lochs and coastal regions is also considered as a release. The guidelines also state that this applies to all species belonging to the Animalia Kingdom, including nematodes, mites, insects and all other invertebrates, and all vertebrate species. "*Kind*" may be specified to subspecies, and includes hybrids between native and non-native species (see Box 7). All stages of the life cycle of non-natives are covered by the legislation, including (as appropriate to the species) eggs, semen, embryos, larvae, pupae and adults.

"*Not ordinarily resident*" encompasses all species which, according to scientific records, do not naturally occur in Great Britain. "*Resident*" is defined as breeding in the wild and producing young that reach maturity without assistance from humans. Migratory species which occasionally reach Britain (e.g. certain species of birds, bats and invertebrates) are not covered by Section 14(1). Schedule 9 Part I includes non-native species which have established wild populations; prohibiting further introductions of these species via this Schedule avoids the issue of releases not being prohibited under Section 14(1) due to their being ordinarily resident.

For Section 14(2), "*plants or otherwise causes to grow*" includes deliberate planting, and also cultivation in confined conditions and subsequently allowing transfer of plant material to where it can become established. All stages of the life cycle and parts of a plant that are capable of dispersal, growth and reproduction are controlled, including reproductive and dispersal structures, seeds and live vegetative or root material capable of regenerating.

Schedule 9 part II contains 13 species, 11 of which are marine algae and two are vascular plants (Giant Hogweed *Heracleum mantegazzianum* and Japanese Knotweed *Fallopia japonica*).

There is, therefore, a general prohibition on the introduction of all non-native animal species, but not for plants. In addition, fungi, lichens, and micro-organisms such as bacteria and viruses are not covered by the legislation.

Section 14(3) allows a defence against a charge brought under Section 14(1) or 14(2) if the accused proves that all reasonable steps were taken, and all due diligence exercised to avoid committing an offence.

Releases of non-natives can be licensed under Section 16 of the Act. An offence under Section 14 is avoided if a release was carried out in accordance with the terms and conditions of a licence granted by the appropriate authority. The appropriate authority is DEFRA in England, NAW in Wales, and SEERAD in Scotland. Licences are issued on a case-by-case basis after consultation with the appropriate statutory conservation bodies and ACRE.

Section 16 licences may be: general or specific; granted to a particular person or to a class of persons; subject to any specified conditions; and modified or revoked at any time by the licensing authority.

Countryside and Rights of Way (CROW) Act 2000

The CROW Act updates and amends parts of the Wildlife & Countryside Act relating to non-native species in England and Wales only. Changes that impinge upon the release of non-natives are summarised here.

The maximum penalties for a Section 14 offence have been increased. A Magistrates Court can impose a maximum fine of £5000 and a maximum of six months in prison. A Crown Court can impose an unlimited fine and a maximum of two years in prison.

Section 81 of the CROW Act also amended the Wildlife & Countryside Act by adding two new sections relating to the powers of Wildlife Inspectors to investigate offences relating to Section 14 of that Act.

The new Section 19ZA of the Wildlife & Countryside Act stipulates that wildlife inspectors may enter any premises (except dwellings) to ascertain whether an offence has been committed. They can require a person to make available for examination a specimen for the purposes of deciding whether an offence occurred. It is also an offence to obstruct an inspector.

Section 19ZB gives police officers and wildlife inspectors the power to obtain a blood or tissue sample from a specimen to be used for analysis (including DNA analysis) to determine the identity or ancestry of the specimen. A sample may also be taken from any other specimen in the control or possession of a person suspected of an offence which is alleged to be a specimen which will establish the identity or ancestry of the relevant specimen. It is an offence to refuse to make a sample available.

In addition, Article 74 of the CROW Act stipulates that it is the duty of all Ministers of the Crown, government departments and NAW, in carrying out their functions, to have regard (as far as is consistent with the proper exercise of these functions) to the purpose of conserving biological diversity in accordance with the CBD. This therefore

implies that the implementation of Article 8(h) of the CBD concerning non-native species should be considered by all Ministers and government departments.

Environmental Protection Act 1990

This Act has very limited provisions for non-native species, but is included here due to the potential classification of soil and other waste containing viable propagules of invasive non-native plant species as controlled waste. This has been applied to Japanese Knotweed *Fallopia japonica*, with the result that waste containing this species must be disposed of in accordance with official Environment Agency guidance designed to prevent the further spread of the plant. See Box 8 for further details.

Box 7: Releases of established non-native animals

One area of the release of non-native species (either those listed on Schedule 9 or others) which requires some clarification is the question of animal welfare as regards the recovery of injured non-native animals. This applies particularly to established non-native species listed on Schedule 9 as these are more likely to be injured and handed in to wildlife hospitals by concerned members of the public.

At present, such animals cannot be released into the wild without a licence; licences can be currently granted for the release of injured Muntjac Deer *Muntiacus reevesi*, but other Schedule 9 species commonly handed in cannot be released. This implies that all such animals should be destroyed or that they should be kept in secure accommodation until they die of natural causes. Animal welfare is an issue which concerns many people, and although most people would deem it acceptable to put down an injured animal which has no chance of making a successful recovery, the destruction of animals which could recover, particularly charismatic species which people commonly perceive as wild (e.g. Grey Squirrel *Sciurus caroliensis*, Muntjac, Canada Goose *Branta canadiensis*) is considered less acceptable.

There is a particular problem with respect to Schedule 9 bird species and the definition of *wild* in the Wildlife & Countryside Act. It is a defence against a charge of killing a wild bird under Section 4(2)(b) of the Act if the bird was so seriously injured that there was no reasonable chance of its recovery. Section 4(2)(a) provides a defence against taking a wild bird if the bird was disabled and was taken solely for the purpose of treating and releasing it when no longer disabled. However, if a Schedule 9 bird was brought to a wildlife hospital but did have a chance of recovery, this defence would no longer apply; killing it would constitute an offence, but so would releasing it: as a bird on Schedule 9 cannot be legally released, the defence of taking for the purpose of treating and releasing does not apply. In this case, failing to treat and release a Schedule 9 bird brought to a wildlife hospital could result in a liability to a charge of taking a wild bird, but releasing the bird would constitute an offence under Section 14(2). Currently, it is not possible to obtain licences for the release of rehabilitated Schedule 9 birds; this situation clearly requires resolving.

Animal welfare issues and ecological issues often conflict. The question here is whether allowing the release of rehabilitated Schedule 9 species has negative ecological impacts that outweigh consideration of the rights of the individual animal concerned. This would appear to be a question that cannot be answered without considering individual species, the potential location of release, and also the number of individuals of a particular species that are treated (i.e. releasing one Muntjac Deer every 10 years would have minimal impact; releasing one every day would not). It can be argued that the release of a rehabilitated Schedule 9 species is ecologically neutral in that the situation upon release is no worse or better than previously. This is true; however, there are obvious problems with this approach for Schedule 9 species which are known to have detrimental impacts on native species. An example of such a species is the Grey Squirrel. In areas where no Red Squirrels *Sciurus vulgaris* remain, and assuming that eradication of Grey Squirrels in such areas is not feasible, it can be argued that releasing rehabilitated Greys could be permitted. In areas where Red Squirrels still occur, and where control of Grey Squirrels is occurring to prevent establishment, release of Greys should not be permitted. The same could be said of any expanding non-native species on the edge of its range regardless of impacts.

Some species such as Mink *Mustela vison* should never be released regardless of location due to the impacts of this species on Water Vole *Arvicola terrestris* and ground-nesting birds. The same approach should be adopted for species which have yet to become established but which are identified as potentially invasive such as Red-Eared Terrapin *Trachemys stricta*. For such species, other options exist, such as the creation of refuge centres where the animals are kept in secure accommodation, but this would be a potentially costly approach; in London alone, the RSPCA receive around 50 reports per year of injured Red-Eared Terrapins from the public (Colin Booty, pers. comm.). An education campaign explaining the reasons for destroying such animals is also worth considering.

Another potential problem with the release of injured Schedule 9 species is that of hybridisation. Hybrids between Red Deer *Cervus elaphus* (native) and Sika Deer *Cervus nippon* (non-native) were recently added to Schedule 9; the purpose of this listing was to conserve the genetic integrity of the Red Deer. There are concerns about the enforceability of this given that it is difficult to morphologically distinguish between "pure" Red Deer and backcrosses of first generation Red x Sika hybrids with Red Deer; DNA analyses would presumably be required in order to ascertain whether an injured animal could be released or not.

These issues require further consideration, but need to be resolved, particularly the question of treating and releasing Schedule 9 birds. In such a wide-ranging review as this, it is not possible to give all the different aspects of non-native species the attention they merit. The problems identified here should, however, be given due consideration as part of the Non-Native Species Strategy and general legislative review proposed in Section 7.3.

Import of Live Fish Act (ILFA) 1980 and *Import of Live Fish (Scotland) Act 1978*

This Act gives the Minister the power to make Orders to prohibit or licence the import, keeping or release of non-native fish species which might harm the habitat of, compete with or prey on any freshwater fish, shellfish or Salmon. The Prohibition of Keeping or Release of Live Fish (Specified Species) Order 1998, made under the ILFA in England and Wales, prohibits the unlicensed keeping or release of 26 species or genera of non-native fish. The Prohibition of Keeping of Live Fish (Crayfish) Order 1996 aims to prevent the further spread of Signal Crayfish, and prohibits the unlicensed keeping of all other non-native crayfish species in England and Wales. In Scotland, three Orders under the ILFA (Scotland) have been made for three separate species or groups of species (Coho salmon *Oncorhynchus kisutch*, Pike-perch *Stizostedion lucioperca* and non-native crayfish).

These Acts also allow the courts to order the removal and destruction of illegally stocked specimens of certain fish species.

A review of Salmon and freshwater fisheries, including recommendations on non-native species, was recently published by MAFF (Anon. 2000), and the recommendations can be viewed online at http://216.31.193.173/fish/shared/flr/index.htm. More information on the import of non-native fish species can be found on the website http://www.efishbusiness.com.

Destructive Imported Animals Act (1932 and as amended)

This Act restricts the import and keeping of certain mammals including Muskrat *Ondata zibethicus*, Coypu *Myocastor coypus*, Grey Squirrel *Sciurus caroliensis*, Mink *Mustela vison*, Arctic Fox *Alopex lagopus* and 'non-indigenous' rabbits. The

appropriate authority (DEFRA in England & Wales, SEERAD in Scotland) may licence imports for research or exhibition purposes.

Orders can be made under this Act specifying controls on particular species. For example, the Mink Keeping Regulations 1975 prescribed the manner in which mink must be kept and the precautions that must be taken to prevent their escape. The Scottish Executive has passed the Mink Keeping (Scotland) Order 2000, which prohibits absolutely the keeping of mink on any Scottish off-shore island (with the exception of Arran) and in the districts of Caithness and Sutherland (these being areas with no mink farms and no feral mink population). Under the Fur Farming (Prohibition) Act 2000, a ban on fur farming of all species in England and Wales will come into force on a date to be appointed by Ministers which cannot be before 1 January 2003. Keeping of Coypus was prohibited under the Coypus (Prohibition on Keeping) Order 1987.

The Act was amended in 1992 to remove restrictions on the import of animals listed on the Act from EC countries. This was required under the Treaty of Rome concerning unrestricted movement of goods within the EC.

Box 8. Japanese Knotweed

Japanese Knotweed *Fallopia japonica* was introduced to the UK in the mid-nineteenth century as an ornamental plant in parks and gardens. It is a problem invasive perennial weed species throughout Europe and most of North America. In Britain, Japanese Knotweed has become a serious problem in a range of habitats including roadsides, riverbanks and derelict land. Where it becomes established, the tall dense summer growth and the mulch-like effect of dead leaves and canes in winter and early spring excludes almost all other native plant species. In addition, the diversity of invertebrates in stands of knotweed is considerably lower than in the native vegetation which is lost.

The plant also has an economic impact beyond biodiversity loss, as it is capable of causing structural damage, penetrating hard surfaces such as tarmac, and it has been known to grow through the floors and even foundations of houses. Swansea has spent over £160000 since 1992 on knotweed control, and the estimated costs of full control are estimated at nearly £8,000,000.

The plant spreads by means of underground rhizomes, which can grow as much as three metres below ground and extend up to seven metres from the parent plant. Seeds are occasionally produced from pollination with related plant species but these are very rarely fertile; all Japanese Knotweed in the UK is thought to be a female clone. Despite the plant's inability to spread via seed dispersal, marginal dispersal via rhizomatous growth is very effective, and mechanical efforts at control often exacerbate the problem; a fragment of rhizome as small as 0.7 grammes in weight can develop into a new plant. Fly-tipping of garden waste containing rhizome fragments is thought to be the main reason for the spread of the plant.

Japanese Knotweed is one of only two non-native vascular plant species included on Schedule 9 Part II of the Wildlife & Countryside Act (1981), meaning that it is an offence to plant, or otherwise cause to grow, the species in the wild. Landowners are therefore liable to prosecution if they allow Knotweed to spread from their land. The issue of Knotweed spreading from one private property to another is less well covered in the legislation; the Environmental Protection Act 1990 provides some support if it can be demonstrated that knotweed is causing a nuisance to private property (defined as an "*unlawful interference with a person's use or enjoyment of land, or some right over, or in connection with it*").

Soil and waste containing Japanese Knotweed is deemed to have the potential to cause ecological harm; it therefore does not qualify for exemption of Section 34 of the Environmental Protection Act 1990, but is considered as controlled waste. Guidelines for disposal of Knotweed waste have been produced by the Environment Agency (Renals & Rene 2001) and the Japanese Knotweed Control

Forum for Cornwall. The waste cannot be disposed of at green composting facilities unless it comprises cut and dried canes only. It can be disposed of at landfill sites with prior arrangement of the local Waste Disposal Authority. Guidelines for disposal on the site of waste production include composting, burning or burial to a depth of at least 5 metres; failure to comply with this code of practice can result in a prosecution.

Knotweed control where it has become established is problematic. Mechanical cutting, mowing or grazing will gradually deplete the rhizome, but it can take ten years of such management to exhaust the carbohydrate reserves to the point where regrowth is suppressed. Mechanical control, unless carried out with great care, also risks spreading the plant to new areas. Herbicide control requires at least three years of treatment before the plant is eradicated. Early treatment of new infestations is more effective, but if carried out by uprooting the plants, disposal of the resulting waste must be undertaken in compliance with the guidelines described above.

A successful approach to limiting the spread of Knotweed requires public education and co-operation between organisations, private individuals and private companies. The Japanese Knotweed Control Forum for Cornwall was set up in 1997 to co-ordinate control programmes. The Forum comprises representatives from a range of organisations including the Environment Agency, County and District Councils, English Nature and Cornwall Wildlife Trust. A similar approach is being adopted in other counties. The Forum collates details of new infestations and co-ordinates guidance on best practice for eradication and disposal. Such targeted approaches for dealing with non-native species are, however, generally only adopted when a species has become well-established and problematic.

The problem of Knotweed control in the UK illustrates the need for monitoring to identify newly-established populations of non-native species, thus enabling eradication programmes to be initiated at a stage when they are cheaper and more likely to be effective. Having such a rapid response mechanism in place should help to prevent other species becoming such a severe problem.

The need for legal controls on disposal of garden and other waste containing invasive non-native plants is also demonstrated. The production of Codes of Practice for the control and disposal of non-native plants, coupled with enforcement against non-compliance, ensures that best practice guidelines are adhered to. Education campaigns warning the public about the risks of spreading invasive species through dumping of garden and other waste are also required.

Many other invasive plant species are not subject to such strict controls, despite the potential harm that they may cause. Non-native species such as Floating Pennywort (*Hydrocotyle ranunculoides*) which are known to be seriously invasive should be subject to the same legal controls to prevent them from reaching the point where they have serious impacts on biodiversity and where eradication or control regimes become prohibitively expensive.

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Salmon and Freshwater Fisheries Act 1975 (as amended by the Environment Act 1995)

Section 30 of this Act makes it an offence to introduce any fish into inland waters without the permission of the Environment Agency in England and Wales. As well as covering non-native species, this Act also prohibits the introduction of native species outside their natural ranges. In Scotland, Section 24 of the Salmon Act (1986) prohibits the introduction of Salmon *Salmo salar* or Salmon eggs into inland waters to a salmon fishery district without the permission of the District Salmon Fishery Board, but there are no controls on other species native to Britain. It is therefore not an offence to introduce species such as Ruffe *Gymnocephalus cernua* (native to southern Britain only) to Scotland (SEERAD 2000).

A review of Salmon and freshwater fisheries, including recommendations on non-native species, was recently published by MAFF (Anon. 2000), and the recommendations can be viewed online at http://216.31.193.173/fish/shared/flr/index.htm.

Fish Health Regulations 1992; Fish Health (Amendment) Regulations 1997

These Regulations implement Council Directive 91/67/EEC and control the movement into Great Britain from elsewhere in the EC of all live fish, their eggs and gametes. These controls were brought in to prevent the spread of fish diseases within the EC; to import fish into Britain, a valid movement document must be obtained. Imports of live salmonid fish from the EC are prohibited to prevent the introduction of the parasite *Gyrodactylus salaris*, which can devastate Atlantic salmon fisheries. Movement documents are currently not required for EC imports of tropical warm water fish provided they are to be kept permanently in aquaria.

Diseases of Fish Act 1937 (and as amended)

This Act controls the import from non-EC countries into Great Britain of live fish and eggs of salmonid and freshwater fish. All imports of live fish of the salmon family are prohibited. Imports of all other live freshwater fish, eggs or gametes must be licensed, and most licensed imports must be accompanied by a health certificate.

Shellfish and Specified Fish (Third Country Imports) Order 1992

This Order controls the import into Great Britain from non-EC countries of all live fish, eggs and gametes of fish species not covered under the Diseases of Fish Act.

Plant Health Act 1967; Plant Health (Great Britain) Order 1993; Plant Health (Forestry) (Great Britain) Order 1989

These pieces of legislation provide protective measures against the introduction of organisms harmful to plants and plant products. The Orders implement EC Directive 77/93/EEC, now consolidated into Directive 2000/29/EC (see above), and is implemented by DEFRA in England, NAW in Wales and SEERAD in Scotland. The Forestry Commission deal with the import of forest trees, wood and bark. The

legislation was designed to control agricultural, horticultural and forestry plants, but is broad enough to cover wild plants as well.

In order to comply with the Treaty of Rome, there are no border checks for plants and plant products travelling between EC countries, although spot checks may take place anywhere along the trade chain. Plant health checks are focused on the place of production; material which hosts the most serious pests and diseases requires a plant passport. Passports are intended to ensure that only plants free from pests and diseases are traded. Phytosanitary certificates are not required for trade within the EC. Article 2(1h) of the Plant Health Directive allows Member States to set up protected zones for particular pests and safeguard these by taking phytosanitary measures against plants and plant products imported from other EC countries.

In general, a phytosanitary certificate must accompany all plants and some categories of plant produce imported from outside the EC. These certificates state that the consignment has been inspected in its country of origin and complies with EC statutory requirements (e.g. free from quarantine pests and diseases). HM Customs and Excise are responsible for detaining shipments that do not possess valid certification. Spot checks can also be made by plant health inspectors regardless of whether or not a phytosanitary certificate is required.

There are a number of controls on the import of invertebrate plant pests. Pests are defined as insects, bacteria, fungi, plants and animals harmful to plants and all other agents which transmit plant diseases. Any pest listed in Schedules 1 and 2 to the Orders, or those which are not normally present in Britain and which are likely to be harmful to plants in this country cannot be imported except under licence from the appropriate authority. A risk assessment must be carried out prior to an import licence being granted. The risk assessment procedure is dealt with in more detail in Box 5. In addition, plants, plant produce and other products from specified countries as listed in Schedule 3 are also prohibited under the Orders.

Terrestrial invertebrates that do not feed on plants, and all marine and freshwater invertebrates are not covered under plant health regulations. Some species from these groups are controlled under the Dangerous Wild Animals Act and the EC Wildlife Trade Regulation.

Animal Health Act 1981

This act gives DEFRA (and SEERAD in Scotland) the power to make Orders to prevent the introduction of disease through the import of animals (live or dead), eggs or any other thing by which disease can be transmitted. This Act is aimed at domesticated animals, but could be used to control imports of wild animals.

Specified Animal Pathogens Order

This Order (made under the Animal Health Act) prohibits the ownership or introduction of specified animal pathogens or carrier organisms of such pathogens without a licence.

Animals and Animal Products (Import and Export) (England and Wales) Regulations 2000; Animals and Animal Products (Import and Export) (Scotland) Regulations 2000; Products of Animal Origin (Import and Export) Regulations 1996.

These Regulations implement the European animal health regulations (see Section 4.3).

Bees Act 1980

This Act gives Ministers the power to make Orders to prevent the introduction into Great Britain (or their spread within the country) of pests and diseases affecting bees. Measures include prohibiting or licensing the importation of bees and combs, bee products, hives, containers and other appliances used in connection with the keeping or transporting of bees that have or may have been exposed to infection with any pest or disease to which an Order applies.

Importation of Bees Order 1997

This Order prohibits the importation of bees or bee pests into Great Britain from non-EC countries except under the provision of a general or specific licence. Licences are not required for EC imports, but these must meet the requirements of Council Directive 92/65/EEC (see Section 4.2).

Plant Protection Products Regulations 1995

These Regulations implement EC Directive 91/414/EEC (as amended) concerning the placing of plant protection products on the market. They will eventually replace the requirements for plant protection products in the Control of Pesticide Regulations 1986, and control the release of non-native fungi, viruses, bacteria, protozoa and other micro-organisms (with the exception of genetically modified organisms) as biological control agents. DEFRA and SEERAD licence the release of organisms under these regulations.

The Regulations impose a prohibition on the placing on the market and use of plant protection products unless they have been approved by the Minister under the Regulations and are placed on the market and used in accordance with any conditions or requirements specified in their approval.

For a product to be approved, the Minister must be satisfied that (amongst other things) the product will not have unacceptable effects on plants or plant products, not cause unnecessary suffering and pain to vertebrates which are to be controlled, have no harmful effect directly or indirectly on human or animal health or on groundwater and have no unacceptable influence on the environment, having particular regard to water contamination and impacts on non-target species.

Endangered Species (Import & Export) Act 1976

This Act was the first piece of UK legislation to give effect to the CITES convention. It has been substantially amended and is now largely superseded by the EC Wildlife Trade Regulation (see above). Amendments have been made by Statutory Instrument

(SI) 2677 (which removes import and export controls on non-CITES species) and SI 2684 (which removes import and export controls on CITES species now implemented by the EC Wildlife Trade Regulation).

Control of Trade in Endangered Species (Enforcement) Regulations (1997) (COTES)

The COTES Regulations make provision for the enforcement of the EC Wildlife Trade Regulation. They allow for offences in relation to this Regulation and, among other things, give police enforcement powers over internal sales and movement offences, certain powers of entry, and the power to obtain samples for DNA analysis. They also include provision for offences by corporate bodies, and make an offence the provision of false information for the purpose of obtaining a permit or certificate for trade in species covered by the legislation.

Dangerous Wild Animals Act 1976

This Act was introduced in response to public concern about the keeping of dangerous animals as pets by private individuals, and the possibility that they might escape into the wild. Licences are required for any animal which appears on a schedule to the Act. These are issued by the relevant local authority, and can only be granted if the authority is satisfied that it would not be contrary to public interest on the grounds of safety or nuisance; that the applicant is a suitable person; and that the animal is kept in adequate and secure accommodation. The local authority is entitled to specify where and how an animal is kept.

Zoos are not covered by this Act; see the Zoo Licensing Act below.

The Schedule of this Act contains many CITES species. It also contains some species such as dangerous invertebrates (e.g. scorpions) that are not covered by the Plant Health Act.

Performing Animals (Registration) Act 1932

This Act requires people exhibiting or training performing animals to be registered with a local authority. A licensing authority may require details of the animals used, but the Act does not control the conditions under which the animals are kept.

Zoo Licensing Act 1981

This Act requires the inspection and licensing of all zoos, and requires suitable precautions to be taken against the escape of captive species considered dangerous to humans.

Pet Animals Act 1951

This Act provides for the licensing of pet shops, and other premises from which a similar trade is carried out, by local authorities. To obtain a licence, they must comply with reasonable standards of animal husbandry, and the local authority may empower their officers to check the condition of premises.

Animals Scientific Procedures Act 1986

This Act requires the inspection or licensing of premises where experiments falling within the scope of the Act are being carried out. Premises must conform to high standards, and are inspected regularly by Home Office inspectors.

Forestry Act 1967 (and as amended)

This Act (and subsequent amendments) provides the statutory powers of the Forestry Commission to regulate and promote good forestry practice, including the duty to achieve a reasonable balance between timber production and afforestation on one hand and nature conservation on the other. This provides a mandate to control forestry pests, which can include non-native species.

Deer Act 1991

This Act, whilst not concerned specifically with non-native species, lays down regulations on the times of year when the non-native species Sika Deer *Cervus nippon* and Fallow Deer *Dama dama* can be killed.

4.4 Domestic institutions with involvement in non-native species

Responsibility for non-native species issues rest with a number of different bodies, relating to prevention of entry and licensing of releases of non-native species. These are described briefly below.

Department for Environment, Food and Rural Affairs (DEFRA)

The Ministry of Agriculture, Fisheries and Food (MAFF) and the environment protection command together with the Wildlife and Countryside Directorate of the Department of the Environment, Transport and Regions (DETR) were merged in June 2001 into DEFRA. Previously, DETR handled applications for releases of all species other than fish and shellfish, which were the responsibility of MAFF. MAFF was also responsible for import controls as they relate to sanitary and phytosanitary controls. These are now all brought together under DEFRA. In Scotland, the equivalent body to DEFRA is the Scottish Executive Environment and Rural Affairs Department (SEERAD).

Responsibilities for different aspects of non-native species are dealt with by different branches within DEFRA. These are:

Chemicals & Biotechnology Unit
Grants licences for the release of non-native species (other than fish or shellfish) after consultation with ACRE and the statutory nature conservation bodies in England and Wales. This Unit handles all licensing for biological control releases in Britain. Licensing for other purposes in Scotland is the responsibility of SEERAD.

Fisheries II Division
Responsible for licences for non-native fish and shellfish in England. NAWAD has responsibility for such licences in Wales. Licences are issued after consultation with EN/CCW, CEFAS and the Environment Agency.

Wildlife Crime and Inspectorate Branch
Responsible for assisting with the enforcement of Sections 14-16 of the Wildlife and Countryside Act and other wildlife crime. It liases with the Police, HM Customs & Excise and other enforcement bodies when necessary.

Animal Health Division, Centre for Environment, Fisheries & Aquaculture Science, Plant Health Division, Horticulture & Potatoes Division, Pesticides Safety Directorate
These departments are responsible for enforcing sanitary legislation for animals, fish & shellfish, plants, bees and biological control products respectively. They liase with HM Customs, the Police, the Environment Agency and the National Bee Unit of CSL when necessary.

Environment Agency
The Environment Agency licences the release of fish into inland waters (except fish farms) in England and Wales. They also carry out control of plant species if affecting the flow of statutory main rivers and issue licences for disposal of controlled waste. In Scotland, the Scottish Environmental Protection Agency (SEPA) deals with waste disposal and water flow. SEERAD handle fisheries issues in Scotland.

Consultative Bodies

Advisory Committee on Releases to the Environment (ACRE)
Set up under the Environmental Protection Act 1990 to give independent advice to the Secretary of State on licensing of genetically modified organisms. They also advise on releases of non-native species.

Joint Nature Conservation Committee (JNCC)
Act as consultees on licence applications to release non-native species. They are also preparing a policy statement on translocations, which includes guidance on non-native species (JNCC, 2000).

English Nature; Scottish Natural Heritage; Countryside Council for Wales
Also provide advice on releases of non-native species. Are involved with the control of non-native species in as much as they affect the conservation status of statutory sites (SSSIs, SPAs, SACs etc.).

Forestry Commission
Responsible for implementing plant health regulations affecting forestry, including conducting risk assessments and overseeing / carrying out control measures.

In many situations, the FC assists with the management of other non-native species which have impacts on trees or biodiversity such as Grey Squirrel *Sciurus canadiensis*, Muntjac *Muntiacus reevesi* and Sika Deer *Cervus nippon*, Rhododendron *Rhododendron ponticum* and non-native trees invading important semi-natural

habitats. Uses incentives and regulations on privately-owned land and directly manages the national forest estate.

HM Customs and Excise
Responsible for enforcing border controls on quarantine species and species restricted under the EC Wildlife Trade Regulation.

Local Authorities
Issue licences for pet shops and other retailers of live animals, and issue licences for keeping of animals controlled by the Dangerous Wild Animals Act. Also have the power under section 25(2) of the Wildlife and Countryside Act 1981 to instigate proceedings for offences under section 14 of that Act.

Internal Drainage Boards
These have powers to carry out control of plant species affecting water flow waters other than statutory main rivers (which are managed by the Environment Agency)

Non-governmental organisations
Organisations such as the Wildlife Trusts, the RSPB and the National Trust are substantial landowners, and are often involved in the control of non-native species on their sites. For example, the Wildlife Trusts have a national policy on Mink *Mustela vison* control and are actively working to control Mink in some areas.

There are a great number of voluntary bodies which are concerned in some way with non-native species. Examples include Plantlife, Froglife and the Marine Conservation Society.

Trade organisations
Organisations such as OATA, HTA and PCT represent business that trade in non-native species and therefore have an interest in the form and operation of legislation and guidance on non-native species.

5 REVIEW OF EXISTING LEGISLATION

For other reviews of international legislation see Shine *et al*. (2000b) and Shine (1999).

5.1 Role of law at national and international levels

The use of legislation is one way in which policy objectives can be achieved and the principles, standards and procedures necessary to achieve these objectives can be determined. Laws may be designed as prescriptive (i.e. the prohibition or regulation of actions) or intended to promote policy aims through the introduction of incentive schemes.

Another important role of national legislation is to establish the institutional mechanisms required to develop the regulations necessary to implement the law. Institutions are required to oversee and enforce implementation and compliance with the law. The establishment of efficient institutions is one of the most important roles of legislation (Shine *et al.* 2000b).

In general, national legislative frameworks for the control of non-native species preceded the development of international instruments. National measures have tended to develop in a reactive way as new pathways for introductions and problems have become apparent. Countries that have been more seriously affected by non-native species have generally been the first to develop comprehensive and effective legal controls (e.g. New Zealand and Australia).

It is apparent that action by one country alone will not be sufficient to successfully address the problem of non-native introductions. Unilateral measures may in any case fall foul of free trade laws designed to ensure that countries do not use trade restrictions to disadvantage other nations. In the UK, any measures adopted must also be consistent with the Treaty of Rome, requiring unrestricted movement of goods and people between EC countries. Co-operative measures are therefore essential, based on common objectives, means and standards agreed and adhered to by all parties.

Global trade, transport and tourism provide vectors for introductions of species beyond biogeographical barriers which would otherwise have remained secure. For example, over 300 tropical species have spread to the Mediterranean since the opening of the Suez Canal in 1869 (Shine 1999).

The impacts of invasive non-native species are rarely confined within political boundaries. The causes and effects of non-native introductions are international in character and therefore require international instruments, standards and guidelines. These instruments can then be implemented by domestic legislation.

International instruments concerned with non-native species have been developed according to different types of perceived threat. The earliest measures were concerned with the introduction of quarantine regulations to prevent the spread of pest species injurious to human, animal or plant health. In relation to plants and animals, these measures were primarily aimed at reducing the economic impacts of non-native

species on agricultural, horticultural and forestry operations. International phytosanitary measures have been in place since 1951 under the IPPC (see Box 5).

As the scale of impacts on biodiversity arising from introductions of invasive non-native species became increasingly apparent, instruments developed from the 1970s onwards on nature conservation have contained specific references to the prevention of introductions and the control of established non-native species.

More recent instruments have been concerned with control of GMOs; these are outside the scope of this review, although some may be relevant to the control of non-natives in that they propose guidelines for international movement and risk analysis of GMOs (e.g. the Cartegena Protocol).

One drawback of international instruments is that they are often very general in character, containing little or no direction on how their objectives are to be achieved. This is often a necessary consequence of the difficultly inherent in obtaining agreement from a large number of different countries at different stages of development. Global instruments are therefore generally not self-executing; they require national legislation to implement them (Shine 1999).

Conforming with obligations arising from international agreements requires a legal framework capable of putting in place, implementing and enforcing necessary actions, in co-operation with other countries and bodies, and in accordance with international law. The prevention of introductions should be the central focus of any national legal framework. The prevention of introductions requires the prior assessment of a proposed activity to determine whether preventative action is necessary. At the national level, the legal system should be able to change or prevent activities that generate unacceptable risks. For intentional introductions, this may take the form of prohibition or regulation. Unintentional introductions should be minimised by identifying and controlling common vectors of introduction.

Precautionary measures are advocated, required or allowed by several international instruments. Perhaps the most widely quoted statement of the Precautionary Principle is Principle 15 of the Rio Declaration: *lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation*; in the Preamble to the CBD itself, it states that the lack of scientific certainty *shall not be used as a reason to postpone measures to avoid or minimize a threat of significant reduction or loss of biodiversity*.

This is particularly relevant to non-native species, as there is an inherent uncertainty involved in predicting the invasiveness of species yet to be introduced. Adopting the precautionary approach provides a legal basis for the use of risk analysis to inform decision-making; it allows decision-makers to take account of scientific uncertainty and to make decisions based on incomplete scientific evidence and available knowledge.

Shine *et al.* (2000b) defined the objectives of non-native species legislation as:

- the protection of animals, plants, and humans from non-native pests (including pathogens);

- the protection of species, subspecies and races from contamination, hybridisation and extinction;
- the protection of native biodiversity from impacts of non-native species (including GMOs); and
- protection against biosecurity threats (defined by IUCN (2000) as matters or activities which individually or collectively present biological risk to ecological welfare or to well-being of humans, animals and plants).

The competent authority must be empowered to take regulatory measures (supported by incentives where appropriate) to:

- implement and enforce international standards in quarantine measures and transport controls;
- apply preventative or precautionary measures to both intentional and unintentional introductions;
- assess the risks and potential environmental impacts of introductions;
- prohibit or strictly control the use and release of non-native species in or near closed or vulnerable ecosystems and protected areas;
- provide for monitoring, early warning and emergency planning systems to support rapid responses to invasions;
- require measures for eradication / control of species that become invasive;
- strengthen compliance by public, commercial and private bodies or individuals; and
- support research, training, public education and awareness.

At the fifth meeting of the CBD Council of Parties (COP5), governments were urged to apply the 'ecosystem approach' to non-native species measures. This approach requires a strategy for the integrated management of land, water and living resources within a given ecological unit. The broad principles of this approach are:

- to decentralise management to the lowest appropriate level;
- to consider the effects of management activities on other ecosystems; and
- to involve all relevant sectors and scientific disciplines.

The main problem with the ecosystem approach is that jurisdictional boundaries rarely correspond to ecosystem ones. In the UK, and in Europe, legislation is organised under sectoral lines (animal health, plant health, fisheries, conservation), which makes the co-ordination of an ecosystem approach problematic. Even within sectors, administrative unit boundaries rarely coincide with ecosystem ones. However, Environment Agency river Catchment Management Plans are one example where an ecosystem approach is being used. The forthcoming EC Water Framework Directive underlies the principles of catchment management rather than management based on administrative boundaries across Europe.

5.2 Evaluation of existing international agreements

The international instruments most relevant to general non-native species control are the CBD, the IPPC and the WTO SPS Agreement. The CBD is the only global treaty to address the introduction and control of non-native species across all vectors, groups

and continents (Shine *et al.* 2000b). The IPPC is important because it has developed a substantial body of knowledge and procedure on the control of non-native plant pests, including tools such as risk analysis of proposed introductions. These techniques could be adapted for other species groups. The SPS Agreement is important because it provides a legal basis for trade restrictions on non-native pest species. Other controls on non-native species not deemed to be a pest or covered under other instruments such as CITES could potentially be challenged under WTO rules governing free trade. However, the EC has the power to develop regulations or recommendations regarding certain aspects of trade in potentially invasive non-native species. The EC Wildlife Trade Regulation provides for the restriction of imports and movements of species where it has been established that their introduction would damage flora and fauna native to the EC.

5.2.1 Convention on Biological Diversity

Although Article 8(h) of the CBD calls for Contracting Parties to prevent the introduction of, control and eradicate non-native species which threaten ecosystems, habitats and species, means for implementing this Article are not prescribed. Implementing the majority of responsibilities under the CBD is left to national governments (Glowka *et al*. 1994).

Other relevant parts of the convention text are the requirements for:

- the integration of biodiversity considerations into sectoral & cross-sectoral plans, programmes and policies;
- Environmental Impact Assessment (EIA) of projects, programmes and policies likely to have significant adverse impacts on biodiversity; and
- the identification and monitoring of processes and categories of activities that may have significant impacts on the conservation and sustainable use of biodiversity, and the regulation of such where adverse effect has been determined.

The CBD Council of Parties (COP) has designated non-native species as a cross-cutting issue that must be taken into account in each of its thematic work programmes. Guiding principles for prevention, introduction and mitigation of impacts of non-native species are being developed by SBSTTA; interim guiding principles were submitted to the 5th COP meeting (COP5). Further actions to be undertaken prior to COP6 in 2002 are the elaboration of the interim Guiding Principles and collaboration with other bodies including other conventions such as Ramsar, IPPC, Bern and Bonn. The COP6 meeting will include the consideration of options for the full and effective implementation of Article 8(h), including the development of an international instrument on non-native invasive species.

The CBD can be regarded as a binding instrument, as it has been suggested that Parties which fail to enforce Article 8(h) are in breach of the rules established by the CBD and can therefore be held to account on that basis. However, a civil liability regime by treaty has yet to be elaborated. The CITES and Bonn Conventions refer to the Permanent Court of Arbitration for the settlement of disputes (Duverger 1999). Within the EC, The European Court of Justice has ruled on intra-EC trade restrictions established to protect a subspecies of Danish bee with reference to obligations under

the CBD (see Box 9). The WTO dispute settlement mechanism is another possible pathway for enforcing CBD rules.

Box 9: EC trade restrictions on species: case study of European Court of Justice ruling

The issue of restricting imports of non-native species is a key one; given that prevention of entry is the most effective way of avoiding problems with non-native species, countries must be able to restrict imports without violating free trade agreements. A ruling by the European Court of Justice (ECJ) in 1998 concerning the import of bees to a Danish island is examined in detail here, as it establishes important principles concerning intra-EC trade and biodiversity conservation.

The ECJ was asked to rule on a case concerning restrictions on the keeping of bees other than the Brown Bee subspecies *Apis mellifera mellifera* on the small Danish island of Læsø, situated 22 km from the mainland. The case raised questions about whether such restrictions come within the scope of Article 30 of the Treaty of Rome (regarding measures equivalent to a quantitative restriction on imports), and if so, whether such restrictions can be justified.

The Danish Minister for Agriculture and Fisheries issued Decision No. 528 in 1993 prohibiting the keeping of nectar-gathering bees on the island of Læsø other than those of the subspecies *Apis mellifera mellifera*; existing swarms of other bees had to be destroyed, removed, or the queen replaced with an inseminated queen of the specified species. The purpose of this Decision was to conserve the population of the Brown Bee subspecies, which did not occur anywhere else in Denmark, from hybridisation with other bee species (or subspecies of *Apis mellifera*).

The Danish government brought criminal proceedings against a resident of Læsø for continuing to keep a swarm of another bee species after the Decision came into force. The defendant argued that the Decision constituted a measure having effect equivalent to a quantitative restriction on imports contrary to Article 30 of the Treaty of Rome. He further contended that the Læsø Brown Bee was not unique to the island and threatened with extinction, so that Article 36 of the Treaty of Rome (permitting import restrictions under certain circumstances) could not be used to justify the restriction. The public prosecutor argued that the effects of the Decision were entirely internal to Denmark, and thus Article 30 did not apply. The national court referred the case to the ECJ for a ruling.

The ECJ has consistently confirmed that all trading rules enacted by Member States which are capable of hindering (directly or indirectly, actually or potentially) intra-Community trade are to be considered as measures having an effect equivalent to quantitative restrictions; such measures are prohibited under Article 30 of the Treaty of Rome unless their application can be justified by a public-interest objective taking precedence over the free movement of goods. Article 36 allows for measures which would otherwise be prohibited under Article 30 if they can be justified on the grounds of the "*protection of health and life of … animals*". The ECJ has described a prohibition on imports as the most extreme form of restriction.

The ECJ considered that if the effect of the Decision on trade in each subspecies of bee was analysed separately, it discriminates in favour of Danish (and in particular Læsø) production of the Brown Bee relative to non-Danish Brown Bees, but is indistinctly applicable in respect of other bee species (the species kept by the defendant was the Golden Bee *Apis mellifera ligustica*). Non-discriminatory restrictions of intra-Community trade can be justified by reference to the public interest in biodiversity, as evidence by the adoption of the Habitats Directive and by the Council's decision to conclude the CBD. The restrictions imposed by the Decision are consistent with the CBD principle of *in-situ* conservation.

The ECJ decided that the Decision did fall under the scope of Article 30 of the Treaty of Rome, but was justified by reference to both Article 36 and the mandatory requirement of environmental protection. The reference in Article 36 to the health and life of animals should be understood as extending to the protection of whole species or subspecies, or of subgroups within a species or subspecies, from extinction. It concluded that the Decision was unjustifiable to the extent that it excludes the import of genetically similar Brown Bees from outside Læsø, but was indistinctly applicable in character is as far as it affects trade in other bee species.

National measures to safeguard the distinctive character of certain animal populations should fall within the scope of Article 36 if the other normal conditions for a derogation from Article 30 are satisfied. It is also possible to justify indistinctly applicable restrictive measures by reference to the mandatory requirement of environmental protection as supported by the CBD; contracting parties affirm that "*the conservation of biological diversity is a common concern of humankind*". However, this does not infer that any and every restrictive measure adopted by a Member State pursuant to the CBD is justified. Restrictive measures cannot be justified if it is possible to achieve the same result by less stringent measures.

The opinion of the Court's Advocate was that the protection of a distinctive animal population even below the subspecies level is a legitimate aim for the purposes of Article 36; the population in question need not be in immediate danger of eradication. The EC's own environmental policy emphasises (Article 130r of the Treaty of Rome) the precautionary principle and the principle that preventative action should be taken. This is consistent with the CBD.

The ruling of the ECJ was that:

(1) A national legislative measure prohibiting the keeping on an island such as Læsø of any species of bee other than the subspecies Apis mellifera mellifera *constitutes a measure having an effect equivalent to a quantitative restriction within the meaning of Article 30 of the EC Treaty.*
(2) A national legislative measure prohibiting the keeping on an island such as Læsø of any species of bee other than the subspecies Apis mellifera mellifera *must be regarded as justified, under Article 36 of the treaty, on the ground of the protection of the life and health life of animals.*

This ruling determines that national conservation law can over-ride trade regulations. However, the judgement itself is specific in that it refers only to Læsø and to the specific bee species in question, and the wording of the judgement states that it does not mean that all trade restrictions are applicable in all circumstances. Nonetheless, the recognition that precautionary measures to safeguard species, subspecies or lower taxa are applicable and justifiable under the EC treaty and with reference to the CBD is important.

Reference:
Judgement of the Court 03-12-1998. Anklagemyndighed v. Ditlev Bluhme. http://www.asser.nl/EEL/cases/HvJEG/697j0067.htm

5.2.2 IPPC and WTO SPS Agreement

The IPPC provides a framework for international cooperation to "*secure common & effective action to prevent spread and introduction of pests of plants and plant products, and to promote appropriate measures for their control.*" IPPC objectives include the development and application of international standards in trade to prevent the introduction and spread of pests. Pests are defined by the Convention as "*any species, strain or biotype, animal life or any pathogenic agent injurious or potentially injurious to plants or plant products.*"

The scope of the IPPC therefore covers non-native species that may be considered to be plant pests. It therefore has the potential to make an important contribution to biodiversity conservation through the control of non-native species introductions. It also has fifty years of experience in the design and application of risk assessment procedures, and phytosanitary trade restrictions adopted under IPPC rules are accepted by the WTO SPS Agreement.

IPPC parties are required to adopt legislative, technical and administrative procedures and standards to identify pests, assess the risks they pose, and prevent their

introduction and spread. International Standards for Phytosanitary Measures (ISPMs) have been designed to encourage international harmonisation, thereby facilitating safe trade and avoiding conflict with free trade agreements.

The WTO SPS agreement allows Members to adopt national measures and standards to protect human, animal and plant health from the risks of pests and to prevent or limit other damage arising from the entry, establishment and spread of pests. Standards must be based on scientific evidence and applied only to the extent necessary to protect human, animal and plant health.

To avoid discriminatory trade restrictions, IPPC international standards are used as the basis for SPS measures, with a Risk Assessment based on scientific principles and evidence. Pest Risk Analysis (PRA) can be used by countries to justify the taking of measures outside IPPC standards. PRA has in the past tended to focus more on the economic impacts of introductions. New standards are currently being prepared to take more account of environmental issues. Pest Risk Analysis must:

- identify the species requiring control, and the potential biological and economic consequences of its introduction, establishment and spread;
- evaluate the likelihood of entry, introduction and spread; and
- evaluate the likelihood of entry, introduction and spread under the proposed SPS measure.

If the available scientific information is limited, precautionary restrictions may be applied until sufficient scientific evidence is available; Parties have a duty to actively seek such evidence.

Import controls may be challenged through the WTO dispute settlement body. Cases which have dealt with non-natives raise issues about the applicability of the precautionary principle to trade restrictions. To date, rulings have held that the precautionary approach is reflected in the SPS agreement, but that this does not override the need for risk assessment based on available evidence (Shine *et al.* 2000b).

The IPPC is administered by EPPO in Europe. Under the WTO SPS Agreement, the EC also has powers to develop regulations or recommendations regarding trade in potentially invasive non-natives. This is developed in the EC legislation by the Wildlife Trade Regulation, but has only been applied to two species to date (see Section 5.4.1).

5.2.3 Summary

A considerable number of binding and non-binding international instruments address non-native species; nearly all have their own institutional mechanisms and decision-making procedures. Most focus on a particular dimension of the issue with regard to a particular protection objective (e.g. migratory species), activity (e.g. aquaculture) or damaging organism (e.g. plant pests).

The CBD should in principle provide a comprehensive legal basis for taking preventative and mitigation measures to address the full range of threats posed by

non-native species. However, Article 8(h) is short and general and provides no direction on how it should be implemented (the recent SBSTTA documents are starting this process, which should be further elaborated at COP6, with the assistance of GISP and IUCN – see Box 4). Also, the means of enforcing the Convention has yet to be established.

The IPPC has developed international standards and procedures for risk analysis of plant pests. It has many years experience of risk analysis, and is supported by regional bodies (EPPO in Europe) and offices with well-established responsibilities at a national level (DEFRA Plant Health Division, CSL, Forest Research).

The relationship between WTO free trade rules and the introduction of trade controls on non-natives has not been fully clarified. However, there is currently no SPS-recognised source of international standards on general environmental and biodiversity protection against non-native species except the IPPC as it relates to plant pests.

It should be pointed out that the drive towards regulating, reducing and preventing the introduction of non-native species runs counter to the prevailing economic trend towards increased and unrestricted global travel and trade. The development and introduction of a legally binding global mechanism (which will be discussed at the CBD COP6) may therefore prove difficult. However, a global instrument is undoubtedly required to deal comprehensively with a global problem.

5.3 Evaluation of the UK legislative framework

The UK is a signatory to several international instruments that explicitly call for the prevention of entry, establishment and spread of non-native species. This section discusses the comprehensiveness and effectiveness of the UK legislation concerning non-native species, and examines whether it meets the requirements of our international obligations.

Legislation is ordered into three sections: prevention of entry into the country; prevention of release into the environment; and control of escaped and / or established non-natives. Intentional and unintentional introductions, different groups and different vectors of introductions are dealt with as subsections of these sections as appropriate.

5.3.1 Prevention of entry

Domestic legislation preventing the entry of introduced species into the country is primarily based on EC Regulations concerning animal health, plant health and wildlife trade. The Plant Health Act (and the various Orders made under this Act), the Animal Health Act, the Fish Health Regulations, the Diseases of Fish Act and the Shellfish and Specified Fish (Third Country Imports) Order provide restrictions of entry into the country unless consignments are accompanied by a valid certificate confirming that no diseases or pests are present. Such sanitary (quarantine) controls were put in place primarily to protect agriculture, horticulture, forestry and fisheries. The Plant Protection Product Regulations control the import and release of certain types of organism for biological control of plant pests.

Certain non-native mammal species which are known to have damaging effects are controlled by the Destructive Imported Animals Act. Imports of non-native fish which may adversely affect native fish or shellfish are controlled by the Import of Live Fish Act.

In addition, the regulation of imports of live or dead specimens of endangered species listed by CITES is implemented through the Wildlife Trade Regulation in the EC and the COTES regulations in the UK.

Import restrictions are essentially trade restrictions, and as such are governed by free trade rules established in Europe under the Treaty of Rome and worldwide by the WTO. It is therefore necessary to demonstrate, through risk analysis, that imports of species not covered by CITES should be restricted in order to prevent the entry of plant pests, plant diseases and animal, fish and shellfish diseases. Currently, risk assessment procedures under the IPPC are the only such standards currently recognised by the WTO SPS Agreement.

The EC Wildlife Trade Regulation also allows restrictions of imports into the EC of species for which it has been established that their introduction into the natural environment would present an ecological threat to indigenous wild species of fauna and flora, and also provides for restrictions on keeping and movement of such species within the EC. In principle, this part of the Regulation could make a considerable contribution to preventing imports of known invasive species which are not covered under other legislation. Laws on the unrestricted movement of goods and services between EC countries reduce the UK's ability to unilaterally restrict imports from other EC countries or inspect them at the point of entry. Such exceptions that exist are at present primarily disease-related; for example, imports of salmonid fish from the EC are prohibited under the Fish Health Regulations to protect UK salmon fisheries from diseases which occur in other EC countries. At present, only two species are listed on Annex B of the Wildlife Trade Regulation for solely ecological reasons; American Bullfrog *Rana catesbeiana* and Red-eared Terrapin *Trachemys scripta*. Species can only be listed on Annex B for this reason on the recommendation of the Scientific Review Group and after consultation with the species' country of origin, and must be shown to be detrimental to native species. However, this Regulation clearly has the potential to further control imports into the EC and intra-EC trade of invasive non-native species.

An important point to note is that the scope of the legislation in relation to general imports of non-native species (intentional or otherwise) is limited in several ways.

Firstly, some groups of species are not covered. For example, there are no comprehensive import restrictions on plants, provided that they meet phytosanitary standards (designed to ensure that unintentional introductions of pest species are prevented) or are not considered as plant pests themselves (currently this applies only to non-European species of the parasitic plant Dwarf Mistletoe *Arceuthobium* spp.). Any non-native plant species can be imported if it meets these standards. Although the IPPC in principle covers plant species if they can be defined as plant pests, phytosanitary measures can only be taken against quarantine pests (i.e. pests of potential economic significance to an area but not yet present, or present but not widely established and being *officially controlled*) and regulated non-quarantine pests

(pests whose presence in plants affects the intended use of those plants with an economically unacceptable impact). *Officially controlled* means the active enforcement of mandatory phytosanitary regulations and procedures intended to eradicate or contain a plant pest. As species such as Himalayan Balsam *Impatiens glandulifera* and Rhododendron *Rhododendron ponticum* (which have a demonstrable negative effect on native plant species where they become well-established) are widely established and not subject to official control in Britain, they cannot be excluded from the country on phytosanitary grounds. The focus of the IPPC has primarily been aimed at the protection of economic, as opposed to environmental, assets.

As another example, the Plant Health Regulations (which implement the IPPC) do not cover aquatic invertebrates (freshwater or marine); shellfish are covered under sanitary legislation relating to fisheries, but other aquatic invertebrates are not.

The second limitation of the current legislation is that there is little scope for restricting the movement of species native to the EC as a whole between EC countries, unless they are known to act as vectors for plant or animal disease. For example, the Italian Crested Newt *Triturus carnifex* has established itself in Britain through the accidental or deliberate release of animals imported for the pet trade. This species is known to hybridise with the Great Crested Newt *Triturus cristatus*, a European protected species, and is therefore a considerable cause for concern in this country. There is currently no legal mechanism to prevent further imports of this species into the UK. A further problem exists concerning imports of non-native genotypes of native species; such imports can reduce the genetic diversity of native species through hybridisation, but again there is no provision for their control. It is also likely that unilateral restrictions on continental strains of UK species would be viewed as an unacceptable trade restriction (see Box 9).

Thirdly, some important vectors are not addressed at all in the national legislation. In particular, there are no requirements for treatment of ballast water, a recognised pathway for introductions of marine organisms. There are also no statutory controls or guidelines on preventing introductions via air transport (apart from the non-binding ICAO guidelines discussed in Section 4.1).

Notwithstanding these gaps in the current legislative framework, how effective is the legislation at achieving its particular aims? This is not easy to determine, since by definition there can be no figures on the number of undetected imports. Entry restrictions have up to now been reasonably effective in the prevention of outbreaks of pest species and diseases through controls of legal imports and the process of determining which imports are safe and can be legalised. Outbreaks of Colorado Beetle *Leptinotarsa decemlineata* have been successfully eradicated 163 times (Richard Baker, pers. comm.).

No system is perfect, however, and the prevention of illegal imports in the current climate of deregulation and reduced intra-EC border controls is particularly difficult. There are concerns about the ability of Customs and the various Inspectorates to cope with the large volume of imports from around the world; increasing or maintaining an adequate level of vigilance to keep out serious pest species which have been identified though Pest Risk Analysis ultimately depends upon the numbers of staff on the

ground and the quality of their training in the recognition of pest species. Resource limitations for bodies involved in the enforcement of non-native species legislation can therefore greatly affect the efficacy of such legislation.

Given the unrestricted movement of goods within the EC, the quantity of goods being imported from the EC and elsewhere, and the limited resources available to enforcement bodies, it is neither legally nor logistically feasible to inspect *all* consignments for illegally or accidentally imported non-native species.

The effective control of imports requires the co-operation of a large number of different bodies: HM Customs and Excise, the Police, the DEFRA Inspectorates and Divisions (Wildlife, Plant Health, Animal Health and Fisheries (CEFAS)), the Environment Agency and the statutory nature conservation bodies. This is complicated further by the existence of equivalent but separate bodies in England, Wales and Scotland (e.g. DEFRA and SEERAD).

Successful prosecutions have been undertaken for offences concerning the import of species protected under the CITES convention (10 cases from 1993 to 2001, with sentences ranging from a fine of £200 to eighteen months in prison; Chris Miller, pers. comm.). However, some of these are concerned with the import of dead specimens.

In the case of illegal imports of fish, progress has been made recently with the CEFAS Fish Movement Database, which provides a national system for the application and issue of licences under the Import of Live Fish Act. This database has recently been extended to include all known movements of fish (native and non-native), and access to the database is now available to all parties concerned with the administration and enforcement of licences. This has assisted the detection of illegal imports; court cases for breaches of the Import of Live Fish Act are currently pending, and more are expected in the future (Steve Maidment, pers. comm.).

However, in general the co-ordination of efforts to prevent illegal imports is hampered by the multitude of organisations involved and the lack of a clear and concise policy framework on the imports of non-native species.

5.3.2 Prevention of release

The main piece of legislation controlling the release of non-native species is the Wildlife & Countryside Act (as amended by the CROW Act). There is a clear distinction between the release of animals and plants; these are therefore considered in turn in this section. The release of fungi, bacteria and other micro-organisms is partly governed by the Plant Protection Products Regulations.

Release of animals

In principle, the Wildlife & Countryside Act prohibits absolutely the release (including release through negligence) of any non-native animal species except under licence. Licenses for the release of organisms which would normally be illegal are granted under Section 16 of the Act. In practice, this prohibition has not succeeded in preventing the release of non-native animal species. Species which have become

established since the Wildlife & Countryside Act became law include American Bullfrog *Rana catesbeiana* (see Box 6) and Wild Boar *Sus scrofa*.

The failure of the prohibition of release is partly due to an almost total lack of enforcement of this legislation – only one successful prosecution has so far been made. This prosecution, in 1994, concerned the release of Chukar hybrid partridges *Alectoris chukar* on an estate in Norfolk. A magistrate's court handed down a fine of £250 with £100 costs. Between 1994 and 1999 five other cases of offences under Section 14(1) of the Wildlife & Countryside Act were investigated (Chris Bear, pers. comm.); all cases were dropped before they came to court.

The reasons for dropping the various cases are useful to illuminate problems with enforcement. Firstly there is the straightforward issue of proof; a case involving releases of Barn Owls *Tyto alba* (which are native but included on Schedule 9) was dropped due to lack of evidence. Secondly, the Wildlife & Countryside Act allows the defence that an accused took all reasonable steps and exercised due diligence to prevent release. A case involving the escape of American Bullfrogs from a garden centre was dropped because of a defence under Section 14(3) that the garden centre had "taken every step to ensure that the bullfrogs did not escape into the wild, and that anyone buying the tadpoles was told to keep them contained in tanks."

A case that would have reached the Crown Court concerning the release of European Eagle Owls *Bubo bubo* was dropped by the Crown Prosecution Service (CPS) as not being in the public interest. If the CPS took this view, it potentially calls into question the point of Section 14(1); if prosecuting the party responsible for the release of a large non-native predatory bird is not in the public interest, what is the point of having a blanket prohibition on the release of non-native species on the statute books? It is perfectly possible to argue that the public interest would have been served by proceeding with the prosecution, given the obligation in the CBD that explicitly calls for the release of non-native species to be controlled. Another case concerned the release of Macaws and other parrot species into the grounds of a bird garden; the intention of the owners was that the birds should return to their aviaries each evening, and the CPS were unhappy about pursuing the case because it would hinge on the legal definition of "release". The police decided to pursue the case, but the CPS dropped it on the grounds that it would go to the Crown Court and the jury would be sympathetic.

Enforcement of Section 14(1) is therefore inadequate because of the difficulty of proof; the defence allowable under Section 14(3) that all reasonable steps were taken to prevent release; and the unwillingness to proceed with prosecutions even when evidence of guilt is available. In the one successful case, the fine of £250 hardly suggested that the courts treat such cases with an appropriate degree of seriousness. The costs involved in investigating and bringing a case to court are another possible reason for lack of enforcement of the Wildlife & Countryside Act.

The case of Wild Boar *Sus scrofa* also serves to illustrate the problem of enforcement. Wild Boar went extinct in the UK in the 17th century, so although it is not strictly a non-native species, the re-introduction of long-extinct native species should be subject to the same scrutiny as the introduction of non-native species (IUCN 1997). Wild Boar are kept in captivity in the UK in Wild Boar farms, wildlife parks and private

collections. Some have escaped and have established wild populations in Kent, East Sussex and Dorset (CSL 1998). However, a risk assessment of Wild Boar, carried out by CSL in 1998, concluded that establishing the origin of escaped Wild Boar is not possible. In addition, the risk assessment states that approximately 40 Wild Boar farms are registered with the British Wild Boar Association, but an "*unknown*" number of Wild Boar farms exist that are not registered. In this context, with an unknown number of potential sources of escaped animals coupled with the inability to distinguish individual animals, it is not surprising that no prosecution has been brought. If the existing legislation cannot prevent the escape of a large animal such as Wild Boar, it is not surprising that releases of other animals ostensibly controlled by the Act have occurred. In a review of the status of non-native mammals in the UK, Baker (1990) states that "*if for any reason the legislation is not effective, we will almost certainly see new species of exotic mammals established in Britain, and Raccoons and Wild Boar will almost certainly be the first.*" This prediction has proved all too accurate in the case of Wild Boar.

Pet shops and scientific research institutions are licensed under the Pet Animals Act and the Animals Scientific Procedures Act, which enable authorised persons to inspect premises. This should in principle ensure that escapes are minimised. However, it is not possible to determine whether established species imported for the pet trade originated from pet shops or pet owners.

Further controls on specific species are enacted through the Destructive Imported Animals Act and the Dangerous Wild Animals Act. The Destructive Imported Animals Act allows Orders to be made which specify the conditions under which animals covered by the Act are kept, or which prohibit absolutely the keeping of certain species. Again, this should in principle ensure that escapes are minimised and that records are kept of the location of such species. The Dangerous Wild Animals Act provides for similar controls on keepers of species of animal deemed to be a potential danger to the public. These Acts can only restrict the release of animals if they are adequately enforced. However, monitoring the keeping of species on private land depends upon initial compliance (i.e. registering the animals with the appropriate authority in the first place) and the ability of the enforcement bodies to monitor compliance with licence conditions. Resource limitations can therefore restrict the efficacy of these Acts. The operation of the Dangerous Wild Animals Act is currently under review by DEFRA with a report awaiting publication.

The Import of Live Fish Act restricts the keeping and release of non-native fish species which may damage native fisheries. This is effective in that it prevents the unlicensed keeping of particular species, and together with the Salmon and Freshwater Fisheries Act in England and Wales, which prohibits unlicensed releases of any fish species, should in principle provide adequate controls on the release of fish and shellfish. There are omissions, however: imports of certain fish species (e.g. tropical aquarium fish) are not controlled (provided they meet sanitary requirements). Licences under the Import of Live Fish Act extend to the keeping and release of specified non-native fish species by all sectors. Releases to fish farms are exempt from licence requirements under Section 16 of the Wildlife & Countryside Act where such farms are not regarded as 'wild'.

The licensing of releases of animal species for biological control agents in glasshouses is controlled by the Wildlife & Countryside Act and the Plant Health Act. A Risk Assessment must be carried out before any release takes place, as it is acknowledged that escapes from glasshouses may occur.

A major gap in the current system is the lack of control on releases of native species outside their natural ranges. An illustration of the dangers posed by this is provided by the intentional introduction of Hedgehogs *Erinaceus europaeus* to offshore islands in Scotland; the hedgehogs have had a serious impact on internationally important populations of ground-nesting birds through the predation of eggs and chicks. There is no legal provision to prevent this from happening again.

Unlicensed inter-catchment transfer of fish is prohibited in England and Wales under the Salmon and Freshwater Fisheries Act. This does not apply in Scotland - there is therefore no prohibition on the introduction of fish native to England into Scotland regardless of the impact such a species may have. As an example of the potential impacts of native fish species beyond their natural ranges, Ruffe *Gymnocephalus cernua* introduced to Loch Lomond in Scotland have replaced the native Powan *Coregonus clupeoides* and altered the entire ecology of the loch from a pelagic-feeding community to a benthic-feeding community. Fish are the only species group whose release of natives is controlled in such a manner in England and Wales.

One area of the release of non-natives that requires some clarification is the release of injured animals that have been handed in to wildlife hospitals. This issue is explored in more detail in Box 7.

Release of plants

There is no general prohibition on the release of non-native plant species under the Wildlife & Countryside Act. Section 14(2) only prohibits the release of two vascular plant species and 11 species or genera of marine algae, all of which are already established. There have been no prosecutions for introductions of prohibited plant species since the law was introduced in 1981.

There are no legal controls on the release of non-native genotypes of native plant species. This is particularly relevant to plants; seed mixes purporting to contain wildflower seed commonly contain cultivated or non-native varieties of native species which may compete or hybridise with native genotypes. The result could be a loss of genetic variability, counter to the requirements of the CBD. At a smaller scale, movement of native species between regions within Britain can have the same effect.

Guidance on sourcing local provenance seed of native plant species is available; this issue has been taken up by Flora Locale; see their website (address www.naturebureau.co.uk/pages/floraloc/floraloc.htm) for further details. Herbert *et al.* (1999) describe a voluntary system intended to facilitate the identification of, and trade in, locally sourced stock for the planting of native trees and shrubs in Britain. The Forestry Commission has introduced several incentive schemes to encourage the use of local provenance stock, and to specify the use of native species and the control of non-native species in semi-natural woodlands (see Section 7.2 for further details).

Groups not covered by the Wildlife & Countryside Act

Releases of fungi and micro-organisms are not covered by the Wildlife & Countryside Act. These groups fall under the Plant Protection Products Regulations if they are released for the purposes of biological control; all releases are licensed and can only be approved if it is demonstrated that no harmful effects will occur on native species. Releases for other purposes, or accidental releases, are not covered anywhere in the national legislation.

5.3.3 Control

There are no pieces of legislation concerned specifically with the control of non-native species. Section 1 of the Wildlife & Countryside Act prohibits the killing of any wild bird except under licence; this applies equally to native and established non-native species. Section 4(1) allows for the killing of wild birds if carried out in accordance with the Agriculture Act 1947 and the Agriculture (Scotland) Act 1948, or under the Animal Health Act. Section 16(1)(cb) allows the granting of licences to kill wild birds for the "*purpose of conserving fauna and flora*". This provision can be used as a basis for control of non-native bird species which are having negative impacts on native fauna and flora once it is clear that a problem has occurred (e.g. the Ruddy Duck *Oxyura jamaicensis* control trial programme was introduced when it became clear that the species was hybridising with White-headed Ducks *Oxyura leucocephala* in mainland Europe). However, the RSPB believes that the precautionary principle does not appear to apply to this Section, and that it is not therefore an appropriate instrument to regulate control of feral species which have the potential to impact upon native species but which have yet to do so (Julian Hughes pers. comm.).

The situation for animals other than birds is different; only species included on Schedule 5 of the Wildlife & Countryside Act are protected from killing; other species are only protected against inhumane killing. There is therefore no legal protection afforded to non-native animal species apart from restrictions on the means and methods which can be used to kill animals. This at least allows control programmes to be carried out provided that they comply with animal welfare legislation. Restrictions on control methods are contained in the Wildlife & Countryside Act and also in other legislation such as the Pests Act 1954, the Deer Act 1991 and the Control of Pesticides Regulations.

Section 13(1)(b) makes it an offence for unauthorised persons to intentionally uproot any wild plant. Again, this applies equally to native and established non-native species. Section 16(3)(c) allows the granting of licences to uproot wild plants for the "*purpose of conserving wild animals or wild plants*"; this again allows for control programmes of non-natives but does not appear to permit the application of the precautionary principle (see above). The Act therefore does not distinguish between native and non-native species for the purposes of general protection; this raises the possibility of a member of the public committing an offence by uprooting a Rhododendron bush on a nature reserve. The issue of definitions is considered further in Section 7.2.6.

Control and eradication programmes have been carried out in the past; examples are given of successful programmes for Muskrat and Coypu (Box 1). A recent eradication

of Bullfrog appears to have been successful (Box 6). A control trial for Ruddy Duck is currently under way, and an attempt to eradicate Mink on offshore Scottish islands will commence in the near future.

Muskrat and Coypu were eradicated primarily because of their economic impact and their status as agricultural pests. The Bullfrog eradication programme made reference to our obligations under the Bern Convention, and the Ruddy Duck control trial programme references Article 8(h) of the CBD. However, there is no UK legislation that requires or provides for the control of these or other non-native species.

Control of vertebrate agricultural pest species is possible under legislation such as the Agriculture Act 1947 and the Destructive Imported Animals Act 1932. Whilst such legislation can be used to control non-native species which have demonstrable economic impacts on agriculture or other industries, it does not permit the control of species which have ecological impacts only, and crucially it does not allow the control of species until they have reached the stage of becoming pests: the legislation in this sense is reactive and is not geared towards the rapid eradication of newly-established non-native species.

Preventing the spread of invasive non-native plant species is potentially covered under the Environmental Protection Act 1990, as soil and waste containing certain plants or plant propagules is considered as controlled waste. This is currently the case for Japanese Knotweed (see Box 8), but has not been extended to other invasive non-natives. In any case, this provision does not require control of a non-native species on a site where it is established, it merely specifies that soil or waste containing the species from that site must be disposed of in a fashion which prevents further spread.

The laws on nuisance may have the potential to be applied to control of non-natives if it can be demonstrated in a court of law that the spread of a non-native species constitutes a nuisance to private property. Fry (2000) provides a review of the common law on public and private nuisance, and on statutory nuisance as set out in Part III of the Environmental Protection Act 1990. The application of nuisance as applied to non-native species has a fairly limited scope, and has not been conclusively developed in the courts. In a review of the legal provisions for the control of the non-native aquatic plant Floating Pennywort *Hydrocotyle ranunculoides*, Fry (2000) concluded that although the Public Health Act 1936 provides that a statutory nuisance is caused where a watercourse is so choked or silted so as to impede water flow, there is uncertainty as to whether this provision could be applied to require the control of aquatic non-native species. Even if this legal route did prove possible, it would only require species to be controlled once infestations had reached a serious level.

It is therefore apparent that legislation which both allows and requires the control of non-native plant and animal species is needed.

One point that needs clarification is the status of non-native species that are protected under European legislation. For example, the Midwife Toad *Alytes obstetricans*, native to central and southern Europe, is established in a few locations in the UK. It is listed on Annex IVa of the EC Habitats Directive. However, Article 12 of the Directive limits protection to a protected species “natural range”. Mandarin Duck *Aix galericulata* is another species which is endangered in its native range; the UK holds a

substantial proportion of the world population, and it could be argued that the UK population is worthy of protection on these grounds. This is discussed in more detail in Section 7.2.6.

One issue that may need to be addressed is that of access to land to carry out control programmes. In some cases (for example under the Weeds Act 1951), local authorities have powers of entry to carry out control of designated weeds and to recover costs from landowners if they refuse to carry out control programmes themselves. Obviously it would be preferable to carry out control programmes with the full backing and co-operation of landowners, but in the event of access for non-native species control being refused, there is currently little legal scope to require that access be granted.

5.3.4 Summary

Prevention of entry - intentional imports

In general, intentional imports of non-native animal species that:

a) are not restricted by sanitary legislation; and
b) are not restricted by the Import of Live Fish Act (and Orders made under this Act), the Wildlife Trade Regulation, the Dangerous Wild Animals Act and the Destructive Imported Animals Act

are permitted. The import of certain listed species is prohibited absolutely (e.g. Coypu, American Bullfrog, Signal Crayfish); for other species (including those listed on domestic legislation under (b) above), imports can occur as long as a licence is issued under the relevant legislation. For Dangerous Wild Animals and Destructive Imported Animals, a licence can specify the conditions under which the animals must be kept.

For animals not covered under these Acts, import permits may be conditional upon the granting of a licence under Section 16 of the Wildlife and Countryside Act (see below). However, there are no general import restrictions on these species.

Any plant species not restricted under the Wildlife Trade Regulation that meets phytosanitary requirements can be imported, regardless of their potential effects on native species or habitats.

Imports of fungi and micro-organisms not covered by sanitary regulations are only controlled if they are to be released for biological control purposes.

The EC Wildlife Trade Regulation is the only current piece of legislation that permits the restriction of imports on grounds of the ecological damage that may potentially be caused by non-native species; only two species are currently restricted under this provision. Under UK law, imports of non-native species are controlled primarily for the purposes of prevention of disease and pest outbreaks.

Perhaps the most important point arising from this review is that although there are various laws which regulate the entry of non-native species, none of them are

concerned specifically with the import of non-natives *per se*: their import is controlled for various reasons reflecting concerns about impacts primarily on economic activity. The only piece of legislation which allows the regulation of imports because of impacts on indigenous wildlife (regardless of their impacts on fisheries etc.) is European in origin (the Wildlife Trade Regulation). Therefore, although the current system is adequate in as far as its intention to prevent pest and disease outbreaks (with perhaps a proviso regarding enforcement; see Section 5.4.1 above), it cannot at present prevent the introductions of certain species via certain pathways.

There is also a gap in the legislation with respect to the introduction of species native to other EC countries but not to Britain, and to non-native races or genotypes of native species.

Prevention of entry - unintentional introductions

In as far as they are covered under quarantine legislation, unintentional introductions of known pest species via imports of plants, plant products and animals are in principle controlled, provided that sanitary and phytosanitary inspection and certification is carried out correctly. The existing system allows the restriction of imports of goods which may inadvertently contain species proven to be potentially damaging by the Pest Risk Analysis process.

The lack of restrictions on unintentional introductions via ballast water and other vectors arising from the international shipping trade is a serious omission in the legislation, particularly as the UK is a signatory to the legally binding UN Convention of the Law of the Sea, which requires states to take "*all measures necessary*" to prevent, reduce and control the introduction of invasive non-native species.

Prevention of release

All releases of non-native animals are prohibited under the Wildlife & Countryside Act, including those already established and listed on Schedule 9 Part I. Licences may be granted for releases under certain circumstances. The conditions under which animals are kept affects whether they require such a licence; for example, keeping amphibian or reptile species in indoor vivaria will probably not require a licence. Keeping the same species in outdoor accommodation will probably require a licence as this could be regarded as a release to the wild. Introductions have occurred since this legislation came into force; to date, however, only one successful prosecution has occurred. There is therefore a problem with the enforcement of this legislation that should be addressed.

Apart from the two vascular plants and 11 marine algae listed on Schedule 9 Part II there are no restrictions on the release of non-native plant species.

Releases of any fish species into a watercourse are prohibited unless a licence has been granted in England and Wales (with the general exception of releases to fish farms). There are no other restrictions on the movement and release of native species except for those relating to translocations of protected species such as the Great Crested Newt *Triturus cristatus*. These restrictions relate to the movement of wild

animals from one location to another; there would be no offence committed if, for example, captive-bred Great Crested Newts were released into the wild.

Control

There is no explicit legislative requirement or provision for the control of non-native species apart from the Destructive Imported Animals Act as it pertains to non-native mammals and the Environmental Protection Act as it pertains to the control of soil and waste containing Japanese Knotweed *Fallopia japonica*. There is also a possible application of the laws on nuisance if non-native species are spreading onto private land or choking watercourses, but this has yet to be tested in the courts. In general there is no explicit legal requirement to carry out eradication and control programmes of non-native species for ecological reasons (and therefore no provision for enforcing access to land for the purposes of control).

General

Having considered the national legislation on non-natives in the UK, it can be concluded that the current system falls short of that required to meet our international obligations under the CBD and other binding international instruments concerning non-native species. These shortfalls can be summarised as:

- No guiding policy on the general import of non-native species.
- Ineffective enforcement of legislation prohibiting the release of animal species.
- No comprehensive controls on the release of non-native plants, fungi and micro-organisms.
- Little provision for the conservation of within-species genetic diversity.
- No legal provision for eradication or control of established non-native species.
- No legal requirement or mechanism for monitoring of non-native species.
- No controls on introductions via ballast water discharge.

Some general points about the problems with the current legislative framework are summarised below.

There is no overall guiding policy on non-native species. The UK Biodiversity Action Plan (Anon. 1994) refers only briefly to this issue (UKBAP paragraphs 4.38-4.40), and does not include it on the list of threats to native biodiversity. In the Section on targets and monitoring, the only target out of 59 that mentions non-native species simply states that the Government and its agencies will aim to: "*update and publicise guidelines on trans-locations, re-establishments, introductions and re-stocking*." In some senses this target was fulfilled with the publication of DETR's guidelines on introductions (DETR 1997); yet, as we have seen, dealing comprehensively with the

issue of non-native species requires more than merely issuing a guidance booklet, no matter how useful that booklet is.

Provisions for dealing with entry and release of non-natives are distributed across legislation and organisations concerned with conservation, agriculture, forestry, fisheries, water resources and quarantine legislation. A considerable number of bodies, both statutory and non-statutory, are concerned with some aspects of non-native species legislation, but there is an absence of a strategic approach guiding the work of all bodies involved, and a lack of co-operation and co-ordination between bodies to the extent where they may be completely unaware of the work carried out by each other.

Treatment of non-native species issues is inconsistent between political and jurisdictional boundaries (e.g. the requirement for licenses to release any fish species in England & Wales but not in Scotland), between species groups (e.g. the different treatment of releases of animals and plants under the Wildlife & Countryside Act) and between vectors for introductions (e.g. the provision of detailed phytosanitary measures to prevent the unintentional introduction of plant pests but the lack of any requirements for the treatment of ballast water). Shine *et al.* (2000b) identify that omissions in national legislation occur in many countries for plants, micro-organisms and marine / coastal environments.

Non-native species-related issues are under-represented in the environmental planning and impact assessment process.

There is little or no use of economic instruments to deter introductions (e.g. recovering costs from responsible parties, making woodland planting grants conditional upon the use of local provenance stock) or to encourage control (e.g. linking agricultural subsidies to the control of non-native species).

The legal provision for eradication, containment, control and monitoring of invasive species is weak.

Enforcement of the existing legislation is generally weak. The situation is improving in some areas (e.g. the enforcement of fisheries legislation through the CEFAS Fish Movement Database), but is inadequate in others (e.g. the enforcement of Section 14 of the Wildlife & Countryside Act).

6 REVIEW OF NON-NATIVE SPECIES LEGISLATION IN OTHER COUNTRIES

6.1 International agreements

The four countries reviewed in this section (USA, New Zealand, Germany and Italy) have ratified a number of binding international agreements that relate to non-native species. These are summarised in Appendix 3. Those that also relate to the UK and are therefore covered in Section 4.1 are indicated in the table; web addresses for further information on those not covered in this review are provided where possible. Non-binding agreements and codes of conduct are not covered here; however, most of those listed in Appendix 1.1 will apply.

Both Germany and Italy, as members of the EC, are bound by the European legislation listed in Appendix 1.2 and covered in Section 4.2.

6.2 United States of America

6.2.1 Summary

Legislation that addresses non-native species (both directly and indirectly) exists at both the federal and state level in the United States; this report is primarily concerned with federal legislation.

As with most countries, the US legislative framework dealing with non-native species has been built up over many years and often in response to concerns raised about particular problems at particular times. As a result there is a plethora of laws, regulations and guidelines that cover different sectors, organisms and pathways of introduction. Again, like most countries, the longest-standing legislation is that aimed at protecting agriculture and other economic interests; consideration of impacts on the natural environment is more recent. However, since President Clinton's Executive Order 13112 of 1999, there have been a number of advances in creating a unified and consistent approach to these issues. The legal framework is undergoing a process of streamlining and consolidation, there is increased funding and increased powers of enforcement, and a national Invasive Species Council has been established to oversee the activities of the federal agencies involved. The publication of a National Invasive Species Management Plan (see below) has laid the foundations for a much more co-ordinated and comprehensive approach to problems caused by non-native species in the United States.

6.2.2 Federal laws

A great number of laws can be interpreted as having some bearing on non-native species policy. The principal Acts are summarised below.

Executive Order 13112 February 3rd 1999 (EO13112)

Executive Orders are issued by the President (in this case, President Clinton) and although they cannot create new government powers, they can direct Federal agencies to act in a particular policy direction. EO13112 aims to:

"*Prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological and human health impacts that invasive species cause.*"

"*Invasive species*" are defined as "*Alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.*" "*Alien species*" means, 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.*"

The Order requires Federal agencies whose actions may affect the status of invasive species to identify such actions, prevent the introduction of invasive species, monitor populations of invasive species and control populations of such species in a cost-effective and environmentally sound manner, "*subject to the availability of appropriations and within Administration Budgetary limits*".

The Order also set up an Invasive Species Council to provide national leadership on invasive species, oversee implementation of EO13112, see that Federal agency activities concerning invasive species are co-ordinated and cost-effective, encourage planning at all levels in cooperation with stakeholders and existing organizations, develop recommendations for international cooperation, develop guidelines for Federal agencies and to facilitate the development of a coordinated network of Federal agencies to document, evaluate and monitor impacts of invasive species. In addition, the Invasive Species Council has set up a non-federal Invasive Species Advisory Committee to advise the Council on its work. In 2001 the Council published a National Invasive Species Management Plan that outlined how the Council was going to carry out its objectives.

Further details as well as the full text of this plan are available online at:
http://www.invasivespecies.gov/council/nmp.shtml

Plant Protection Act 2000 (PPA)

This Act consolidated all or part of 11 existing U.S. Department of Agriculture (USDA) plant health laws into one comprehensive law, including the authority to regulate plants, plant products, certain biological control organisms, noxious weeds, and plant pests. The PPA gives the Secretary of Agriculture, and through delegated authority, USDA's Animal and Plant Health Inspection Service (APHIS), the ability to prohibit or restrict the importation, exportation, and the interstate movement of plants, plant products, certain biological control organisms, noxious weeds, and plant pests. Under the PPA, violators face harsher civil penalties than ever before for smuggling illegal plants or produce that could harbour plant pests or diseases. The PPA gives the Secretary of Agriculture the authority to subpoena documentary evidence and witnesses to prosecute violators. The Act also provides APHIS with a cost recovery

mechanism for expenses related to the disposal of abandoned shipments at U.S. ports of entry.

National Invasive Species Act 1996 (NISA)

This Act aims to prevent the unintentional introduction and subsequent spread of aquatic nuisance species through the Great Lakes, Chesapeake Bay, San Francisco Bay, Honolulu Harbour and the Columbia River system.

NISA re-authorises and amends the Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990. Section 1003 (1) of the 1990 Act defines an aquatic nuisance species as "*a nonindigenous species that threatens the diversity or abundance of native species or ecological stability of infested waters, or commercial, agricultural, aquacultural or recreational activities dependent on such waters.*"

NISA requires the development of guidelines for ballast water exchange, with the intention that vessels with ballast water tanks that enter US waters after operating outside the United States' Exclusive Economic Zone should exchange ballast water at sea (provided that doing so would not compromise the safety of the vessel). The Secretary of Transportation monitors compliance, and periodically reassesses the effectiveness of the guidelines, with a view to introducing regulations if they are not met voluntarily.

Alien Species Prevention and Enforcement Act 1992

This Act prohibits shipment via the US Mail of plants and animals whose transport is regulated under the Lacey Act (see below) and of plants and plant products whose transport is regulated by the Plant Protection Act.

Wild Bird Conservation Act 1992

This Act implements CITES directives as they apply to birds and is mainly aimed at non-US species that are protected in their country of origin.

Non-indigenous Aquatic Nuisance Prevention and Control Act 1990

This Act has been amended and largely superseded by the National Invasive Species Act of 1996 (see above).

Endangered Species Act 1973

This Act protects endangered species. It could be used as basis for the eradication of non-native invasive species when they threaten endangered native species.

Coastal Zone Management Act 1972 (amended 1996)

This Act mainly regulates marine pollution and coastal water quality, but as it directs States and other parties to protect the coastal environment, it may be relevant to managing invasive non-native species where they damage the coastal environment.

National Environmental Protection Act 1970

This Act requires federal government agencies to conduct Environmental Impact Assessments (EIAs) of their activities. Effects of non-native species, if harmful to the environment, must be included in the EIA. Movement of non-native species into containment facilities or interstate movement between containment facilities is excluded from the Act's requirements. In addition, this Act gives the Fish and Wildlife Service authority to undertake control of some problematic non-native species.

Carson-Foley Act of 1968

Section 1241 of this Act, "Control of noxious plants on Government lands", directs Federal departments or agencies to permit the "Commissioner of Agriculture or other proper agency head of any State in which there is in effect a program for the control of noxious plants to enter upon any lands under their control or jurisdiction and destroy noxious plants growing on such land", provided this is not inconsistent with national security and that the means by which the plants are destroyed are acceptable to the head of the department or agency.

Federal Insecticide, Fungicide, and Rodenticide Act 1947 (FIFRA)

This Act authorises the US Environmental Protection Agency to regulate the importation and distribution of substances that are intended to function as pesticides, including organisms.

Organic Act of 1944

This Act provides for "*the control and eradication of certain animal and plant pests and diseases*" and is the legal basis for any such activities carried out by the US Department of Agriculture.

Animal Damage Control Act 1931

This Act gives the US Department of Agriculture the authority to control wildlife damage on federal, state, or private land. It covers damage by mammalian predators, rodents and birds. It aims to protect crops of most kinds; commercial forests; freshwater aquaculture ponds and marine species cultivation areas; livestock on public and private range and in feedlots; public and private buildings and facilities; civilian and military aircraft; and public health.

Lacey Act 1900 (amended 1998)

This is the main Act under which the import of non-native organisms is controlled in the United States. It forbids the import or transport of any live wildlife, except as provided for under the Act, but it does allow the import of almost all species for scientific, medical, education, exhibition, or propagation purposes. It prohibits the import of a list of designated species and other vertebrates, molluscs, and crustaceans that are "*injurious to human beings, to the interests of agriculture, horticulture, forestry, or to wildlife or the wildlife resources of the United States*". The law also

covers all fish and wildlife and their parts or products, plants protected by CITES and those protected by State law.

Those enforcing the Act are authorised to make qualified arrests without a warrant, search and seize property under Attorney General guidelines, issue subpoenas and warrants, and to inspect vessels, vehicles, aircraft, packages, crates and containers on arrival in the United States from outside the United States or prior to departure from the United States.

Fines of up to $10000 may be issued for violation of the Act under civil law. For criminal charges, these fines are increased to a maximum of $250,000 for individuals and $500,000 for organisations.

6.2.3 State laws

Individual states may impose and enforce their own animal import regulations and plant quarantine standards. In addition they may carry out their own non-native species control or eradication programmes. A comprehensive review of all state-level legislation pertaining to non-native species is beyond the scope of this report. However, some information on individual state regulations may be found online at:
http://www.aphis.usda.gov/guidance/regulations/animal/ (animals) and
http://www.aphis.usda.gov/npb/F%26SQS/sqs.html (plants).

The strength of non-native species legislation varies greatly between states. For example, Hawaii completely prohibits all new imports and releases without prior approval, but most states just have a 'black list' of organisms known to cause problems.

6.2.4 Pending legislation

Harmful Non-native Weed Control Act of 2000 (Introduced in the Senate)

This bill proposes to authorize federal cost sharing for local weed groups to manage terrestrial weeds. It acknowledges that weed control is often most effective when managed close to the source of the problem and so aims to allocate federal money to States for distribution to local weed management groups.

Several States are reviewing or considering reviewing their plant pest laws. The National Plant Board (an organization of the plant pest regulatory agencies of each of the states and Commonwealth of Puerto Rico) issued a 'Model Plant Pest Law' in June 2000 as a working tool to assist in this process.

6.2.5 Control of entry

Intentional introductions

A licence is required to import animals, animal products, plants and plant products. The Department of Agriculture Animal and Plant Health Inspection Service (APHIS) is responsible for issuing import permits for organisms or products which may pose a

risk to US agriculture, environments or native species. The Fish and Wildlife Service regulate the import of other animal species, for example those listed under CITES.

The procedure for risk assessment of imported goods and the permit procedure are both currently under review. The review aims to increase the transparency of decision-making (partly to pre-empt allegations of trade protectionism), to make risk assessment procedures more streamlined, faster and more efficient and to improve communication with stakeholders.

The commodities (i.e. fruit and vegetables) regulations serve as an illustration of the current situation. Some commodities are already authorized. Anyone wishing to import fruit and vegetables in this category must apply for a permit prior to shipping and supply certain information such as country of origin and port of first arrival. A permit is issued in most cases.

Products that do not have prior approval must undergo a pest risk assessment. If the importation is deemed to pose an unacceptable risk of introducing a plant pest, then APHIS looks for ways of mitigating the risk. If such ways can be found, then importation may still be allowed under certain conditions.

Unintentional introductions

Prevention of accidental introductions of potential pests is covered in part by the Plant Protection Act and the Non-indigenous Species Act. Pest risk assessments mentioned above and inspection at the border by Customs officials are additional safeguards. Individual States may also require inspection and / or quarantine of goods crossing their borders.

6.2.6 Control and eradication

The authority and responsibility for controlling problem non-native species lies with different federal, state and local agencies. Executive Order 13112 calls upon all the relevant federal agencies to co-operate to achieve timely and effective action in managing incursions of non-native species.

A Memorandum of Understanding signed by 17 Federal Agencies established a Federal Inter-agency Committee for the Management of Noxious and Exotic Weeds. The signatories undertake to "*work cooperatively to accomplish an ecological and integrated approach to the management of noxious and exotic weeds on Federal lands and technical assistance on private lands*."

However the full legal authority to undertake and fund management activities still lies with the agencies themselves. For example, the Department of the Interior has the authority to undertake control of 'undesirable plants' (a term not specifically defined) on land, waterways and facilities under its jurisdiction, and the Fish and Wildlife Service has overall responsibility for control of any species that has a negative impact in National Wildlife Refuges.

Individual states also have their own policies on eradicating pest plants on their land. Private individuals may undertake control programmes, and if the Harmful Non-

native Weed Control Act (see Section 6.2.4 above) is passed they may get state and federal financial assistance for managing weeds.

6.2.7 Evaluation

Non-native species issues are addressed by a complex of laws at different levels in the United States. In the past, this has led to some gaps in the legislation and confusion over which law, if any, applies to certain situations (National Plant Board 1999). For example, the Department of Agriculture once lost a lawsuit over which law to apply to a commercial shipment of grass seed that contained noxious weed seeds (from the opening statement of Hon. Bob Goodlatte at the hearing of the Subcommittee on Department Operations, Nutrition, and Foreign Agriculture regarding the Plant Protection Act).

The US draft report on legal mechanisms to IUCN (Miller 1999), written after Executive Order 13112, states that "*current US statutory law leaves essential aspects of the non-indigenous species problem unaddressed. Moreover, as a social and political matter, non-indigenous species pose a sufficient threat to justify their separate recognition in positive law, including the structural, substantive, public and funding issues that such legal identification would generate*." In addition, the US is well aware of its obligation to provide a transparent and scientifically based risk assessment procedure for imported goods, under WTO agreements.

However, despite these difficulties, there are major recent and ongoing improvements to non-native species law. The complex plant pests and noxious weeds laws have been streamlined into a single piece of legislation that is much easier to understand and implement. The moves to devolve responsibility to local and state levels and build up non-federal capacity, for example via the Harmful Non-native Weed Control Act should take these improvements further.

President Clinton's Executive Order urging cooperation over invasive species issues and the Invasive Species Council it set up also provide a strong national impetus to further clarify and strengthen non-native species policy and legislation. For example, many federal and state agencies have now drawn up memoranda of understanding in order to co-ordinate their activities more effectively. The recently published National Management Plan for invasive species also promises improvements in many areas in order to meet the US's goals in managing non-native species, from research and public awareness raising to legal and budgetary reforms.

6.3 New Zealand

6.3.1 Summary

New Zealand is one of the countries worst affected by invasive non-native species. However in recent years, it has developed one of the most extensive and well-integrated national approaches to dealing with these problems. New Zealand has adopted a hierarchical approach as recommended in the CBD Interim Guiding Principles on non-native species:

- keeping unwanted non-native species out of the country;

- eradicating any unwanted non-native species which are not yet widespread; and
- where eradication is impractical, controlling the impacts of non-native species.

The legal framework is based upon two main items of legislation: the Biosecurity Act 1993, which deals with unwanted organisms and accidental releases; and the Hazardous Substances and New Organisms Act 1996, which deals with licensing intentional imports of new organisms. Administration of these Acts is principally the responsibility of the Ministry of the Environment, the Ministry of Agriculture and Forestry and the specially created Environmental Risk Management Authority (ERMA). Non-native species issues also have cabinet representation in the portfolio of The Minister of Food, Fibre, Biosecurity and Border Control. However, criticisms of the current legislation include a lack of explicit objectives for biosecurity, a strong emphasis on maintaining trade relationships, perhaps at the cost of the precautionary principle embedded in the CBD, and the high compliance cost and complexity associated with the approval process for importing new plant material. In addition, the issue of non-native species management on private land has not yet been fully addressed.

Non-native species cause serious problems throughout New Zealand. About 40% of the flora, 76% of the fish species and nearly 20% of the bird species are exotic in origin (Vitousek *et al.* 1997). Non-native species have been identified as the greatest threat to New Zealand's biodiversity and, given that much of the country's economy depends on tourism (which in part depends on a healthy and attractive environment), non-native species are also perceived as a threat to the economy.

6.3.2 Domestic legislation

Hazardous Substances and New Organisms Act 1996 (HSNO)

This Act deals with the assessment of applications to import new organisms and to release them from containment. It established the Environmental Risk Management Authority (ERMA) to carry out such assessments and decide on the applications. Provisions relating to new organisms took effect in July 1998.

The Act (Section 2(1)) defines a *new organism* as:

- any species of organism (virus, bacterium, plant or animal of any kind) which was not legally present in New Zealand on the date that the Act came into force (July 1998);
- any organism kept only in containment, for example, for further study, or on display at a zoo;
- any genetically modified organism which has not been approved for release;
- any risk species as defined in regulations made under Section 140 of the Act;
- any species of organism not approved for release under Section 38 of the Act; or
- any species which has been eradicated.

The Act is administered by the Ministry for the Environment. However, the implementation of the Act is the responsibility of ERMA. The Authority is an independent regulatory authority. Its key tasks are to operate a public assessment process to approve and impose controls on hazardous substances and new organisms; to monitor compliance and enforcement of the Act; and to promote safe management of hazardous substances and new organisms.

Enforcement of the introduction of new organisms into New Zealand occurs at the border, and is carried out by Customs and the Ministry of Agriculture (MAF). MAF also ensures compliance with controls placed by ERMA on experiments and restricted field trials of new organisms. ERMA oversees the enforcement activity of the other agencies to avoid duplication or gaps in the system. Except in a few special cases the Authority is not involved directly with enforcement. Voluntary compliance is an important part of the compliance system. This includes using codes of practice and following industry standards and guidelines.

There are also provisions for ensuring compliance. Enforcement officers can issue Infringement Notices for infringements specified in the HSNO regulations (although to date no infringement offences are specified), or issue Compliance Orders which either require a person to stop doing something, to do something to ensure compliance, or to remedy the effects of non-compliance.

Fines for breaching the HSNO include up to $NZ 500,000 for an offence and an additional $NZ 50,000 a day for a continuing offence. Offenders can be imprisoned for up to three months. In addition, a court can order a convicted offender to remedy or mitigate the effects of the non-compliance at their own cost, or to pay the costs of such action, and can also require a new organism to be destroyed. Anyone can initiate a prosecution under the Act. For some offences it is not necessary to show that a person intended to commit an offence, and any person with some form of responsibility for an action or event constituting an offence may be held responsible.

The enforcement agencies include:

- ERMA New Zealand - monitoring of enforcement performance and inquiries;
- Maritime Safety Authority - issues on board any ship;
- Civil Aviation Authority - issues with aircraft and airports;
- Land Transport Safety Authority (LTSA) - powers to deal with issues on road and rail;
- Police - deal with vehicles and rail; and
- City and district councils (territorial local authorities) - cover public places when enforcing Resource Management Act provisions.

Allied enforcement agencies are:

- Ministry of Agriculture and Forestry - powers under the Biosecurity Act (see below); and
- Customs Department - deals with border controls.

Biosecurity Act 1993

The Act has two major components: prevention of the introduction of unwanted organisms not already established in New Zealand (i.e. border controls), and management of unwanted organisms that are already, or become, established.

It is an 'empowering' rather than a 'requiring' Act in that there is no requirement on any particular agency to take action in relation to the presence of a harmful organism. It provides for an integrated system of biosecurity risk management comprising import controls, border controls, monitoring and pest management strategies. It allows for declaration of a 'biosecurity emergency' in the event of the incursion of a new organism that has potential to cause significant economic or environmental loss.

In general, the Biosecurity Act can be said to manage 'unwanted' alien species while the HSNO deals with 'wanted' alien species. One distinction is that where the Biosecurity Act sets up a process for ongoing management and monitoring of unwanted organisms, HSNO makes no provision for managing or monitoring the effect of alien organisms once they have been approved for release from containment.

It is possible that a species approved by ERMA could be declared an unwanted organism under the Biosecurity Act.

Four government departments have operational powers under the Biosecurity Act: the Ministry of Agriculture and Forestry, the Ministry of Fisheries, the Ministry of Health and the Department of Conservation. These departments all report on their activities under the Act to the Minister of Food, Fibre, Biosecurity and Border Control, a specific cabinet portfolio created in 1997.

A Biosecurity Council was established at the same time to coordinate biosecurity policy and implementation, to advise the Minister for Biosecurity on policies and procedures and to ensure consistency of approach between agencies. The Council comprises the four Chief Executives of the departments involved; the Chief Executives of the Ministry for Research, Science and Technology, the Ministry for the Environment and the Environmental Risk Management Agency; a representative of local government; and an independent chairperson. A Biosecurity Technical Forum provides the Council with technical and policy advice.

The four main departments take operational responsibility for different aspects of biosecurity. The Ministry of Agriculture and Forestry has an internal Biosecurity Authority. This Authority is responsible for developing Import Health Standards for 'risk goods', Pest Management Strategies, risk analysis, contingency planning and responses to new incursions. The Ministry of Fisheries has special responsibility for marine biosecurity (e.g. issues of hull fouling or ballast water). The Ministry of Health deals with human health aspects of non-native species (e.g. the incursion of exotic mosquitoes or other vectors of human diseases). The Department of Conservation is responsible for New Zealand's obligations under the CBD and for assessing the impacts of non-native organisms on indigenous species.

Resource Management Act 1991 (RMA)

The purpose of the RMA is to promote the sustainable management of natural resources; it does not specifically address issues of non-native species. However, it does place "*an obligation on all persons to avoid, remedy, or mitigate the adverse effects of their activities on the environment*". In as much as non-native species legislation aims to protect native biodiversity, which is an aspect of the environment covered by RMA, it might be strengthened by this Act.

The Act also covers land use planning controls that can be used to restrict activities that might create or exacerbate problems caused by non-native species. For example, district planning has been used to restrict goat farming in order to reduce the risk of re-infestation of a national park after a programme of goat eradication (Warren 2000).

Conservation Act 1987

This Act covers the management of trout and salmon (both non-native species), and requires that no freshwater fish be moved between catchments without explicit permission from the Minister of Conservation.

Wild Animal Control Act 1977

This act aims to control harmful species of non-native wild animals and to regulate the operations of recreational and commercial hunters. It also controls farming and captive holding of wild animals, and controls the export of wild animals. Under this Act, all deer, feral goats, thar, chamois, feral pigs and possums belong to the government.

Wildlife Act 1953

Under this Act, all native and naturalised vertebrates are fully protected by default. This protection may be reduced or withdrawn if, for example, the animal is creating problems. The Act also controls the farming and keeping of ferrets, which are a threat to indigenous bird species. This Act is currently under review.

Forests Act 1949

Section 69 of this Act prohibits the import into or export from New Zealand of any tree, seed, timber or timber product which may be injurious to any tree.

It is administered by MAF, who may make regulations for the purpose of eradicating or preventing the spread of disease that may affect trees. Powers of entry under the Act are subject to certain restrictions unless there is immediate danger to life or property. There is provision for payment of compensation to owners of trees, forest products or buildings destroyed for the purpose of eradicating or preventing the spread of disease.

Where there may appear to be a conflict between the Forests Act and the Biosecurity Act, Section 7 of the Biosecurity Act makes it clear that the exercise of emergency powers is not to be affected by Acts including the Forests Act. An amendment bill is

currently before Parliament, which proposes to repeal sections of the Forests Act now covered by the Biosecurity Act.

6.3.3 Control of entry

Intentional introductions

Anyone wishing to import a new organism as defined by the HSNO must apply for permission from ERMA.

An initial assessment places the application into one of four categories:

1. Organisms listed on Schedule 2 of the Act are prohibited and any application to import such an organism is immediately declined. Organisms on Schedule 2 cannot even be shipped though New Zealand.
2. Section 36 of the Act sets out minimum standards that an organism must meet to be allowed entry. The application is declined if the new organism is likely to:
    a) cause any significant displacement of any native species within its natural habitat;
    b) cause any significant deterioration of natural habitats;
    c) cause any significant adverse effects on human health and safety;
    d) cause any significant adverse effect on New Zealand's inherent genetic diversity; or
    e) cause disease, be parasitic, or become a vector for human, animal or plant disease, unless the purpose of that importation or release is to import or release an organism to cause disease, be a parasite, or be a vector for disease.
3. If ERMA is satisfied that the organism is not an unwanted organism under the Biosecurity Act, that it is highly improbable that it will form a self-sustaining population anywhere in New Zealand and that it meets the conditions set out in Section 36, the application may be approved without controls.
4. If the organism does not fall clearly into one of these categories, the application is assessed under the full application process.

The process for full assessment involves advertising the application, receiving submissions and holding a hearing. Matters that must be considered in the hearing include the ability of the organism to establish an undesirable self-sustaining population, the ease with which the organism could be eradicated and whether the positive effects of the organism outweigh its negative effects. In addition, the ERMA must have particular regard to the views of the Department of Conservation.

The ERMA can then approve the application without conditions, approve for introduction into containment or decline the application. There is no right of appeal on the decision except on points of law. If new information suggests that an organism in containment should have its approval withdrawn, ERMA may reassess the approval and if necessary require the organisms to be destroyed at the owner's expense. If an approval is not used within five years it will lapse.

There are provisions in the Act that allow the use of new organisms without approval where this is necessary to deal with an emergency. The most likely use of these powers would be where a live vaccine is introduced to deal with a disease outbreak.

Control of unwanted introductions

The relevant legislation is the Biosecurity Act 1993; the Minister of Biosecurity has overall control of work carried out under this Act. The Ministry of Agriculture and Forestry manages the main border control system. Other agencies involved are the Ministry of Fisheries, the Ministry of Health and the Department of Conservation.

New Zealand's island status allows greater potential for effective border control than that available to continental nations. All vessels and aircraft must enter at a registered port or airport, all of which have suitable facilities for border control operations. No goods or people may leave the controlled area without an inspector's permission. Inspectors may refuse approval and require goods to be returned to their port of origin, or they may fumigate goods before allowing their release. Biosecurity border control is separate from the main customs and immigration control but is carried out alongside CITES controls.

Before shipping any 'risk good' to New Zealand, the sender must ensure that it complies with the relevant Import Health Standard. The goods cannot be imported if no such Standard exists. A 'risk good' is anything that may cause harm to the natural or physical resources of New Zealand.

6.3.4 Control and eradication

The Biosecurity Act 1993 provides an integrated framework for identifying 'unwanted organisms' and managing risks associated with them across all sectors. Under the Act, a chief technical officer can declare an organism as 'unwanted' if it could cause harm to human health or natural or physical resources in New Zealand.

The risk management system is hierarchical, involving import controls (via import health standards mentioned above), border control, monitoring within borders, pest management strategies and a provision for emergency measures.

Pest Management Strategies (PMS) detail how a proposed programme of control or eradication is to be carried out, who is responsible for the various activities involved, and also set out arrangements for funding and compensation. The aim is to share the costs of control fairly between those exacerbating the problem and those benefiting from control.

There are two types of strategy: national and regional. National PMS can be prepared by any relevant government agency and can be initiated by any person. As of December 2000, two National PMS are in place and were initiated by the private sector: the Animal Health Board Inc. initiated the national bovine tuberculosis PMS and the National Beekeepers Association initiated the national American foulbrood PMS. Regional PMS can be prepared by anyone but must be approved by the relevant regional council. Pest Management Strategies involve public consultation and submissions from interested parties. They are "*proving to be a good mechanism to*

gain community consensus on which species need to be managed and gaining coordinated effort to achieve the management goals. They also remove sources of conflict between sectors and landowners about exacerbator issues" (Warren 2000).

There is the right of appeal to the Environment Court. All PMS must be reviewed every five years and most Regional PMS are now at the first review stage.

Once a strategy has been approved, the management authority involved has considerable powers of implementation. For example, movement of goods and organisms in or out of a certain area may be forbidden and landowners may be required to carry out pest control work at their own expense.

Regional councils may undertake small-scale control work without a PMS in place, subject to certain conditions.

In the most extreme case, the Governor-General may declare a "*Biosecurity Emergency*". This is done on the recommendation of a Minister if there is an incursion of a new organism that has the potential to cause "*significant economic or environmental loss or both*". However, an emergency cannot be declared if there is already the capability to deal with the threat without resorting to such a declaration. If an emergency is declared, Section 145 of the Biosecurity Act provides that "*the Minister may, in the area affected, do all such acts and things and give all such directions, and require all such acts to be done or not done, as the Minister believes on reasonable grounds to be necessary or desirable for the purpose of maintaining, or eradicating the organisms in respect of which the emergency has been declared.*"

The Biosecurity Act appears to take precedence over HSNO (section 142(1) HSNO) where exercise of these emergency powers is invoked.

6.3.5 Evaluation

As discussed in Section 5.4, the success of legislation is dependent upon the success of enforcement. The enforcement of the Biosecurity Act is discussed in more detail in Box 10.

The Office of the Parliamentary Commissioner for the Environment published a review of New Zealand's biosecurity strategy in December 2000 and assessed its strengths and weaknesses. Its key findings were, *inter alia*, that:

- the Biosecurity Council provides good co-ordination of strategic and policy advice; and
- the Ministry of Agriculture and Forestry had received international recognition in managing biosecurity risks to agriculture and trade;

but also that:

- biosecurity emergency management funding and strategies need clarification to ensure that responsibilities are met;

- the role, functions and responsibilities of the Biosecurity Council need to be revised to ensure that the Minister for Biosecurity receives timely and appropriate advice; and
- the proposed Biosecurity strategy needs to explicitly state the government's outcomes and objectives for biosecurity.

The report recommends that, in the light of New Zealand's vulnerability to non-native species, biosecurity issues should be treated with the same concern as issues of national security.

In addition New Zealand has provided the Global Invasive Species Project with a 'Focus Country Report' that reviews invasive species legislation and management (Christenson 2000). This report concludes that "*with its comprehensive legislative framework and the implementation of a co-ordinated national strategy, New Zealand is well placed to effectively control the threat of invasive species to its biodiversity and to its economy, provided that sufficient resources are committed to the task*".

However, it also notes that "*threats from plant and animal pests and domestic stock to indigenous biodiversity on private land are not yet comprehensively or consistently addressed*", and that "*public and community awareness about the treatment of pests and support for pest prevention and control methods is important, but often lacking*."

Box 10: Penalties and convictions under New Zealand's Biosecurity Act 1993

The Biosecurity Act 1993 grants the following **powers** to inspectors and other authorised persons appointed under the Act:

- Request any person to assist in carrying out the provisions of the Act.
- Detain people in a biosecurity control area.
- Search people (Police only)
- Enter a place and inspect.
- Apply for a warrant to inspect a dwelling house or a marae.
- Enter in respect of offences.
- Following entry, record information and take actions necessary to eradicate or manage pests or unwanted organisms.
- Apply articles or substances from aircraft above a place.
- Use dogs and devices to assist in exercising a power.
- Seize and dispose of unauthorised goods.
- Search and seize evidence.
- Seize abandoned goods.
- Intercept baggage.
- Examine organisms.
- Apply an article or substance to a place.
- Prohibit or control certain tests (power through Order in Council.)
- Give direction.
- Vaccinate or treat, etc.
- Destroy organisms on non-payment of fees.
- Give a quarantine direction.
- Destroy imported organisms.
- Act in default where legal directions have not been complied with.
- Declare a restricted place.
- Declare a controlled area.
- Apply roadblocks, cordons, checkpoints etc, on application to a District Court Judge.

Prosecutions

The report states that "*there is generally a high level of compliance with the Act relating to its requirements to manage pests and unwanted organisms. Failure [to comply] is usually enforced by a notice of direction to take action.*"

If a person continues to fail to take the required action, inspectors and other authorised persons may take action on their behalf and recover reasonable expenses from them. In this way, the Courts are only rarely involved in enforcing regulations relating to the management of pests and unwanted organisms.

However, there have been a number of prosecutions under sections of the Act relating to the import of unauthorised goods. Section 154 of the Act defines offences under the Act. Between 28th December 1994 and 15th March 2001 there were 126 convictions, but the number of prosecutions brought was not available at the time of writing. The convictions were as follows:

Section 154(b): Making false or misleading declarations or withholding information. There were 71 convictions for violations under this section of the Act. Penalties were mainly fines of around $NZ200, the maximum fine was $NZ1000 plus costs and two people were imprisoned for four months.

Section 154(f): Possession of unauthorised goods.
There were 44 convictions. The defendants were mainly fined up to $NZ1500, some were made to perform community service and five people were imprisoned, with a maximum sentence of 18 months for someone smuggling birds.

Section 154(n): Failure or refusal to comply with a notice to take action.
There were five convictions, carrying fines of up to $NZ1500 or up to six months imprisonment.

Section 154(s): Erroneous declaration that a person is not in possession of unauthorised goods.
There were four convictions, which carried fines of up to $NZ400. One person was fined $NZ200 for failing to declare possession of one avocado on arrival in New Zealand.

Source: Convention on Biological Diversity: Secretariat Request: Biosecurity Act New Zealand Ministry of Agriculture & Forestry 16/5/01. Response by the Ministry to a request from the Secretariat for the CBD for relevant information on the law of liability and redress for damage caused to biological diversity. Provided by Paula Warren.

The New Zealand Government is currently in the process of developing a biosecurity strategy for New Zealand. This is expected to be launched in December 2002. The purpose of the strategy is to obtain agreement on the goals, objectives and measurable targets for New Zealand's biosecurity programmes. The strategy will be developed with a focus on the future and broad issues affecting biosecurity, rather than debating specific and currently topical issues. The strategy should provide direction and guidance to all involved in biosecurity, and raise biosecurity awareness with stakeholders and the general public.

6.4 Germany

6.4.1 Summary

German legislation takes a sectoral approach to non-native species issues, with many of their laws based on or enacting European and other international laws and guidelines. There is no law specifically focusing on non-native species, and responsibility for action lies with many different bodies at both state and federal levels.

Germany has carried out a number of reviews of its policy and legislation in the last few years and concluded that reforms are needed with regard to monitoring and control procedures, particularly to unify the sectoral approach, and to clarify questions of liability. It is not yet clear whether these reforms will take place and how they will be implemented, but federal conservation agencies are taking considerable steps to monitor and control problem non-native species with the authorisation they already have.

At least 256 non-native plant species are established in Germany, comprising roughly 12% of the country's flora. In addition there are known to be at least 18 non-native species of mammal, 99 birds, 38 fish and numerous invertebrates (Doyle 1999). The freshwater environment has a particularly high load of non-native species. As of May 2001, 20-30 non-native plant species have been classified as problematic and are being controlled, including Giant Hogweed (Federal Office for Nature Protection / Federal Environmental Agency 2001).

Despite these high-profile cases a recent conference on the subject concluded that "*The large numbers of alien organisms introduced into Germany do not generally endanger the biodiversity on a large scale… Alien species, however, create important small-scale ecosystem changes at some locations*." It was acknowledged that there was the possibility of an "*ecological disaster*" such as the introduction of Potato Blight, and that whether, when and how such a disaster might occur is hard to predict (Doyle 1999).

6.4.2 Domestic legislation

The non-native species issue is addressed both directly and indirectly in legislation at the Federal and Länder (State) level.

Federal Nature Conservation Act (Bundesnaturschutgesetz BnatSchG)

Article 20(d)(2) of the Federal Nature Conservation Act states that "*the release, and implantation in nature, of non-native species of wild and non-wild animals and plants shall be subject to permits granted by the competent authority in a given Land. This shall not apply to the cultivation of plants in agriculture and forestry. Such permits shall not be granted in cases where it is not possible to preclude the risk of 'contamination' of native fauna or flora, or of endangering the survival or distribution of native species of wild fauna and flora, or of populations of such species*." However, the term *non-native species* is not explicitly defined. The words used are 'gebietsfremder organismen', which means a species, or sub-species, that does not occur in a region. It refers to a specific time and place of release and so includes species not present at that time, even if they existed there before. This means that re-introductions of native species are covered in the term as well as species that have never existed in Germany. A further complication arises in that species that have reverted to the wild (i.e. have maintained populations without human assistance for "*several generations*"), or have hybridised with native species are no longer regarded as non-native, and come under the general protection of the Act.

Article 26(3)(a) and Section 20(f)(2) prohibit anyone from possessing or placing on the market any animal or plant considered dangerous to any indigenous animal or plant.

The administrative responsibility for this Act and licensing authority lies with the Länder authorities. However, regulations differ considerably between Länders.

Länder level Conservation Acts

These implement the Federal Nature Conservation Act at the Länder level.

Hunting Act & Fishery Acts

Individual states have their own hunting and fishing laws that require permits for the release of species into the wild. They normally provide lists of species that may be released. Where no licence is required under these laws, the Nature Conservation Act still applies.

Forest Acts

Forest laws exist at the federal and Länder level. They do not address non-native species directly, but they do require forests to be managed in such a way as to avoid damage to indigenous species; this could cover release and control of non-native species.

Plant Protection Acts, Animal Diseases Control Acts, Animal Protection Acts

Again, these Acts, at federal and Länder level, do not address non-native species issues directly. They are mainly concerned with cultivated species and forestry plants and aim to protect these plants and animals against pests, some of which are non-native. The Federal Plant Protection Act (Pflazenschutzgesetz, PflSchG) is based on the IPPC and is harmonised with other EC regulations on this topic (see Appendix 1.2 and Section 4.1). Section 3(10) of PflSchG allows the Federal Minister for Food, Agriculture and Forestry to prohibit or restrict the cultivation of certain plant species, which could apply to non-native species, and Section 3(1)(No.17) empowers the Minister to regulate the marketing and use of animals, plants and micro-organisms to combat certain pests.

The Federal Biological Agency is responsible for administering the Federal Plant Protection Act, and Länder authorities enforce the Federal Animal Protection Act.

6.4.3 Control of entry

Intentional introductions

Organisms introduced for agriculture and forestry do not fall under the jurisdiction of the BnatSchG, but are governed by the Plant Protection Act and Animal Diseases Control Act. They must therefore be certified free of pests before they are introduced. However, this does not address the question of whether the species themselves are likely to have any unwanted impacts. Other sectors must apply for a licence to release

non-native species. There are strict requirements that must be met before such a licence is issued: the licence is denied if the risk of contamination of the indigenous flora and fauna and risks to the stock or distribution of indigenous wild animals and plants "*cannot be ruled out*". The (rather heavy) burden of proof lies with the applicant, and there are problems of interpretation. For example, it is not clear what precisely is meant by *contamination*.

The Act calls for licensing of releases into the wild, but this does not include areas such as parks, open areas in cities, cemeteries, greenhouses or gardens, all of which have been identified as important pathways by which non-native species spread into the natural environment. Perhaps as a result of these problems, a survey of administrative practices regarding non-native species reported few applications for licences; those that were reported were mostly for research or hunting purposes, or for re-introduction of native species.

At present, guidelines are being developed to help the Länders conduct the necessary risk assessments and to standardise the licensing procedures throughout Germany (U. Doyle, pers. comm.). Authorities have been criticized for being too restrictive, but no court cases have been reported yet. Licenses for import or release of biological control agents are not required at present but the necessary legislation is under preparation.

Accidental introductions

Imported materials must have prior approval, and German legislation requires that the risk of contamination be ruled out before this is granted. Consistent criteria for assessing this risk are under development, with the goals of making the risk assessment process consistent across all states and of providing a decision-making tool to individual Länders. However, many organisms are released unintentionally; BnatSchG and some state level laws do not state clearly enough what is prohibited (Doyle 2000).

Accidental releases occur from households, breeding centres and via the disposal of garden waste and other pathways. The relevant authorities have issued a few 'clean-up' orders, but in most cases reacted by providing information on the problems that may result from non-native species with the aim of preventing future releases (Gündling 2000).

There are also some problems with legal definitions in this area. The term used in BnatSchG is 'Ausbringen' which can be taken to mean both accidental release and deliberate introduction. It is not possible to require licensing of involuntary releases, but this grey area means that is has been very hard to prosecute people for allowing releases to occur. It has either been impossible to determine who (if anyone) was responsible, or there have been no grounds for prosecution because of confusion over exact licensing requirements (Fisahn 1999).

6.4.4 Control and eradication

Monitoring, control and eradication are not included in the BnatSchG or in any other explicit regulation. The government can assume responsibility via the Federal Environment Agency, but it only acts in extreme cases. Federal states may enact their

own legislation on control programmes in state environmental protection laws. There is the additional problem of the definition of 'alien' referred to above, which means that long-established non-natives and hybrids are protected even if they exclude or damage native species.

6.4.5 Evaluation

While there are a number of laws and provisions relating to non-native species in Germany, there are still gaps and some areas of uncertainty. The Federal Nature Conservation Act (BnatSchG) permit requirement is really the only explicit mechanism for controlling non-native species. In considering applications for permits, the relevant authorities apply the precautionary principle. However, the exemption of sectors often associated with non-native species from this provision rather weakens this legislation. In addition, the regulations refers to release 'into the wild', but the definition of the term 'wild' is rather narrow as it does not include agriculture, forestry, gardens or greenhouses, which are all areas rich in non-native species. BnatSchG covers animal and plants, but it is not clear whether it extends to micro-organisms and fungi. Although Länder regulations can in principle be stricter than federal ones, in practice they usually only meet the minimum standards necessary to implement the Federal Act.

In fact, the existence of both Federal and Länder legislation poses real difficulties for any attempt to create a uniform non-native species policy. Fisahn (1999) comments that the Länder now have a freer hand than previously, but that there is still "*competing jurisdiction in fisheries law, nature conservation law, and hunting law. The jurisdiction over offshore marine fisheries resides with the federal government. The federal states, on the other hand, have jurisdiction over nature conservation and hunting matters, but the federal government has framework jurisdiction.*"

The German country report to the IUCN in 2000 (Gündling 2000) identified some major problems with non-native species legislation in Germany:

- Important terms are not defined, in particular 'non-native' and 'invasive'.
- The definition of 'indigenous' species may also apply to formerly non-native species.
- There are no specific objectives concerning non-native species.
- The control system only addresses the deliberate release of non-native species that require permits; the duty to monitor or control problematic non-native species is not covered.
- The problems of accidental introductions are not covered.
- Key sectors such as agriculture and forestry are totally excepted from the control regulations.
- Provisions for sanctions under the Federal Nature Conservation Act do not apply to Section 20(d)(2) and liability for any damages is not addressed.

These shortcomings, and the need to harmonise laws that apply to different sectors, were also raised in the proceedings of a conference dedicated to assessing legal regulations of non-native organisms in Germany (Doyle 1999).

Some of these issues are being addressed, although generally at an agency, rather than at a government or judicial, level. For example, the Federal Environmental Agency has commissioned a study that aims to develop methods of early detection of problem species, and the Federal Office for Nature Protection plans to set up an Internet site on invasive non-native species that will cover their spread in Germany, the ecosystems they threaten, and effective methods of control.

6.5 Italy

6.5.1 Summary

As yet, there is no general and self-executing legislation (i.e. requiring no further legislation to make it effective) on non-native species in Italy. There are several provisions in various acts that, although they may not be directed at non-native species issues, can be used as tools for prevention and control. There is a lack of awareness about non-native species on the part of both the public and the legal system, and this has led to difficulties in interpreting the laws. In particular, the recent failure of the Grey Squirrel eradication attempt (Box 11) underlines the potential for conflict when there is no clear legal authority for dealing with non-native species.

The lack of concern in Italy about the non-native species issue is reflected in the fact that no information on the numbers of established non-native species, or the economic cost of their control, could be obtained for this review.

6.5.2 Domestic legislation

The Italian legal framework is based on national and regional laws. Regions have some autonomy; their laws must not contradict national laws, but can impose stricter provisions. This review will mainly deal with national legislation.

Decree by the President of the Republic DPR 357 (Decreto del Presidente della Repubblica 8 Settembre 1997, n. 357)

The Decree adopts the EC habitat directive. Article 12 (3) specifies that introductions of 'non-local' species ("*specie non locali*") can only be authorised if the species will not cause any harm to the natural habitats or to local fauna or flora. The Ministry of the Environment is responsible for issuing release licenses, and the National Wildlife Institute (Istituto Nazionale per la Fauna Selvatica INFS) or another "*competent authority*" is responsible for carrying out risk assessments of proposed releases.

The full text (in Italian) of this Decree is available at:
http://www.reteambiente.it/territorio/ND_Dpr357_8_9_97_vige.htm.

Box 11: Grey Squirrel eradication attempt in Italy

This box is based on 'Human dimension aspects in invasive alien species issues: the case of the failure of the Grey Squirrel eradication project in Italy' (Genovesi & Bertolino 2001) and on correspondence with Piero Genovesi, one of the scientists in charge of the Grey Squirrel plan. This is a brief précis of the legal side of the events. Readers wishing for further discussion of the topic, for example in relation to animal rights issues, should consult the main document.

The Grey Squirrel *Sciurus carolinensis* was introduced to Italy in 1948 when two pairs were released in a private park near Turin, in Piedmont. Population growth and spread was initially slow because of a lack of suitable woodland habitat in the area surrounding the park, but the species eventually began to spread along river banks and once it reached the east of the region it found suitable habitat and began to expand at a faster rate. The average rate of expansion has been 17km^2 per year and in 1999 the Grey Squirrel occupied 880 km^2.

The same species had previously been introduced to Great Britain, where it competed with the native Red Squirrel *Sciurus vulgaris*. The Red Squirrel has gradually been excluded from areas where the Grey Squirrel has reached and is now considered threatened. The Grey Squirrel also affects the red squirrel in Italy and the possibility that it could spread through the Alps into the rest of Europe is of grave concern. The IUCN, WWF and other international organisations recommended that the Grey Squirrel be eradicated in Italy.

Responding to these requests, the Italian National Wildlife Institute, L'Istituto Nazionale per la Fauna Selvatica (INFS), prepared an action plan for the eradication of the Grey Squirrel in Italy. Although Italy is a signatory to several international conventions that require the control of non-native species which threaten native wildlife and although this legislation is enacted in national laws and by presidential decree, it is actually the local authorities that are responsible for carrying out any control programme. INFS, then, can provide technical support on the means of eradication, but may not undertake the eradication programme itself. The principal Italian NGOs reviewed the INFS eradication plan and it was decided that INFS should carry out a pilot eradication programme in one area to define technical methods. The local authorities would undertake any further eradication.

Just a few weeks into the trial, in June 1997, animal rights groups took INFS to court to halt the programme. Some of their charges were based on accusations of unnecessary cruelty. They also challenged the legality of the eradication scheme because a trial eradication could not be considered as research and INFS only had authority to carry out research and not eradication programmes, and because the removal of a protected species is damage to State property. This last point arose because all mammals and birds are protected by default under Italian law. The Ministry of the Environment stated that exceptions could be made in the case of non-native species that threaten native species.

In December 1999 the court judged that the eradication could not be carried out by INFS and condemned two employees of INFS to 20 days in prison and a fine. The judgement was appealed and the Appeal Court found the two employees innocent of all charges, but did assert that eradication cannot be legal as law 157 requires the protection of all species extant in Italy. This point is now being debated in the Supreme Court of Appeal (Corte di Cassazione) who will decide whether the eradication of any species is acceptable.

In any case, eradication of the Grey Squirrel is no longer feasible as its range expanded too far during the three years that the matter was before the courts. INFS, at the request of the Ministry of the Environment, has now produced a control strategy, which plans to contain the Grey Squirrel and identify and protect viable populations of the red squirrel.

Genovesi & Bertolino (2001) suggest that "*addressing the threats posed by invasive alien species requires a comprehensive approach, based on information, awareness, an adequate legal framework, public involvement in the decision process, commitment of the political decision makers, and adequate technical means. Weakness in a single link of the chain may result in failure of the entire campaign.*"

National Law 157 Provisions for the Protection of Wildlife and Restrictions on Hunting (Legge 11 Febraio 1992 no.157)

This is Italy's main law on wildlife. Its principal focus is on wildlife conservation and hunting regulations rather than non-native species as such, and is only concerned with mammals and birds (not any other species groups).

Article 11(c)(3) allows the re-introduction of native species, but not non-native species, for restoration purposes in the Alpine regions only, and following advice from the National Wildlife Institute (INFS).

Article 19 allows for the control of mammal and bird species if they have a significant impact on wildlife, human health, agriculture, forestry, animal health, fishes, the soil or Italy's historic or artistic heritage.

Article 20 specifies that species of wild animal may only be imported for re-introduction schemes under licence from the Ministry of Agriculture.

The full text (in Italian) of this law is available at:
http://www.fidc.it/abruzzo/files/legislazione/naz157-92/157-92art.htm.

National Law 150 (Legge 7 Febraio 1992 no.150 and as amended by Decree-Law of 12 January 1993, No. 2, converted into a law by Act of 13 March 1993, No. 59)

This law adopts Italy's obligations under CITES, and is also concerned with the escape of dangerous animals, including non-native species. Among other things, it is used to evaluate the adequacy of fencing at breeding farms; authorisation for such establishments may be refused under this law.

The full, amended, text (in Italian) is available at:
http://ecoitaly.net/sva/legge150.htm#legge150

Phytosanitary & Animal Health Regulations

Imports of plants, plant products, live animals and animal products are covered by EC legislation (see Section 4.2 and Appendix 1.3). Under this legislation, imports of certain goods perceived as high risk are prohibited, imports of low-risk goods, especially from within the EC, are not controlled, and others require some form of phytosanitary certification of freedom from listed plant pests or veterinary certification of freedom from animal diseases. However, there is no blanket provision against imports of non-native species, and the legislation aims to protect plant, human and animal health, rather than the wider environment.

6.5.3 Pending legislation

The Ministry of the Environment has prepared a draft revision of the law on release of non-native species, but this has not been released or approved. Given that it was prepared under a previous government, it is uncertain whether it will be approved in the future.

6.5.4 Control of entry

Intentional introductions

Deliberate introductions of non-native species require authorisation from the Ministry of the Environment under DPR 357 (see above). However, it is not clear which species are covered under this directive, since its overall aim is the protection of species and their habitats. For example, the National Wildlife Institute (INFS) interprets the prohibition to apply to any species, since any kind of species may have an effect on protected species and habitats, but this interpretation has yet to be tested. For example, many non-native fishes are released by recreational fishing organisations, but these are unlicensed; no authorisation has been granted for these releases (P. Genovesi, pers. comm.).

No penalties for offences are specified in DPR 357. Some regions have more restrictive legislation governing the introduction of alien species. For example, Piedmont prohibits new introductions and imposes penalties on those convicted of violating these restrictions.

Accidental introductions

Other than sanitary and phytosanitary controls of imports, there is no specific legislation governing accidental introductions. The National Wildlife Institute has prepared some guidelines covering non-native mammals and birds, but these have no legal standing.

6.5.5 Control and eradication

The legal basis of control and eradication programmes in Italy is not absolutely clear. Law 157 introduces a general principle of conserving wildlife, without specifying that the wildlife must be native, but it also allows the control of species if significant impacts on wildlife arise.

Any such control programme must be authorised by the relevant regional administration and carried out by the provincial administrations. Pertinent issues to note are that the decision is a local one; the Ministry of the Environment, for example, can request but not require a control plan, and control activities must be conducted by provincial personnel, which limits the scope of any such programme.

After the Grey Squirrel eradication programme case (see Box 11), an open case is currently at the Court of Appeal (Corte di Cassazione), considering whether eradication of any species is legally acceptable. This case has yet to be decided.

6.5.6 Evaluation

Non-native species are not addressed directly in Italian law. There are a few provisions in national acts and some local legislation, as well as voluntary guidelines. Accidental introductions are not covered at all in the legislation with the exception of sanitary controls required by European law. The contradictory nature of some of the

wildlife legislation is exemplified by the recent attempt to eradicate Grey Squirrels. Some of these inconsistencies are currently being considered in court.

7 POSSIBLE IMPROVEMENTS TO THE UK SYSTEM

This section examines ways in which the UK framework for dealing with non-native species could be improved, with reference to existing legislation and to the review of other countries presented in Section 6.

We need to consider whether, in the light of the review of UK legislation in Section 5.4, the existing legal framework is sufficient to fully address the issue of non-native species, or whether new legislation is required. A summary of the lessons that can be learned from the experience of the other countries reviewed is presented in Section 7.1. Potential improvements to existing legislation are discussed in Section 7.2 and possible new legislation is discussed in Section 7.3. Overall recommendations are presented in Section 7.4.

7.1 Lessons learned from other countries

The four countries covered in this review differ markedly in their approaches to non-native species and the comprehensiveness of their legislation. To some degree this reflects the extent to which non-native species are perceived as a threat to their economic and environmental well-being in the countries concerned.

The four countries can be thought of as lying on scale ranging from a point where non-native species are not explicitly covered to one where the different sectors involved are drawn together under a unified framework. At one end of the scale, any actions to prevent or control introductions must take their legal authority from fragmentary acts mainly aimed at specific sectors or problems. At the other end, there is clear legal authority, sufficient technical advice and the institutional and budgetary capacity to respond effectively to problems as they arise or are foreseen.

New Zealand is the furthest along this scale. Non-native species are perceived as a grave threat to both the economy and to the country's natural heritage. The legislative approach combines these two aspects of the problem in powerful and explicit laws, backed by a designated cabinet portfolio, an Environmental Risk Management Authority and considerable funding, including cost-sharing initiatives. While an internal review of New Zealand's activities in this area urged even greater attention to non-native species, similar restrictions may prove too stringent in the UK, at least for terrestrial species; our native terrestrial biota seems not to be so vulnerable to invasions. However, this is not the case for freshwater and wetland ecosystems - there is no evidence to suggest that our freshwater and marine ecosystems are less vulnerable than those elsewhere in the world (Louise Bardsley pers. comm.).

Draconian trade restrictions may fall foul of European Union and WTO free trade agreements. Nevertheless, some lessons the UK could take might be a co-ordination of approach across sectors, a precautionary approach in risk assessment and the clarification of legal liability on the part of people releasing unwanted organisms including possibilities for cost-recovery from such people. This approach could, for example, mean that although a defence might be presented under Section 14(3) of the Wildlife & Countryside Act that all reasonable steps were taken to prevent the release of a non-native species, the person responsible could still be held liable for at least

some of the costs of eradication or control (possibly through some cost recovery mechanism such as insurance). This would recognise the fact that keeping non-native species for profit or pleasure inherently involves a risk to native biodiversity and carries an economic risk which should not be solely borne by the taxpayer if these species escape.

The USA has also reviewed and improved its legislative approach; this process is still ongoing. Although not all the relevant legislation has been fully consolidated, this would probably be neither possible nor desirable given the size of the country, the division of state and federal responsibilities and the wide range of ecosystems and primary industries present. However, the US has a clear policy aim with regard to non-native species, outlined in a Presidential Executive Order. It has a single co-ordinating body in the Invasive Species Council and any gaps, duplication and confusion in the law are gradually being addressed. In addition, the Invasive Species Advisory Service and the National Invasive Species Management Plan published earlier this year make information and correct procedures readily available to managers and decision-makers, and outline a cohesive and ambitious strategy for the future. One of the strengths of the developing US system is that it has both a single national co-ordinating body and yet it recognises that responsibility for day-to-day monitoring and management can be more effective at a local level. If the UK is not to adopt the sweeping reforms and consolidation carried out in New Zealand, it would do well to look to the US for examples of streamlined but comprehensive legislation and provision for a central co-ordinating and advisory body.

The EC countries covered in the review have neither the explicit comprehensive legislation of New Zealand nor any body with overall responsibility for co-ordinating activities related to non-native species as in the US. Instead, the legislation is fragmented and sectoral, with an emphasis on protecting agricultural interests, and there is often rudimentary legal authority for action against non-natives that threaten native species or habitats. Where such legislation exists, for example under ratification of the Habitats Directive and the CBD, it may still conflict with other legislation; such discrepancies or confusion can be a disaster for the effective control of problem non-natives, as in the case of the Grey Squirrel eradication programme in Italy (Box 11). Activities relating to non-native species are carried out by many bodies at different levels of administration (for example, national/federal versus regional/state level and agricultural versus protected area management).

It could be argued that as yet, European countries have not faced the same magnitude of costs arising from non-native species as have New Zealand and the United States. Nevertheless, there are grave problems and Germany and Italy have both recently become more aware of these and of the possibility of higher costs to come. Both face similar shortcomings in their legislative approach:

- a sectoral approach, with some areas, such as plant health, well covered and others, particularly threats to native species and habitats barely addressed;
- confusion over questions of liability;
- insufficient attention to accidental introductions;
- insufficient and unclear legal authority to undertake control of problem non-natives; and

- exemption of important sectors from relevant restrictions or licensing requirements.

These are similar to the deficiencies in the UK legislative framework identified in Section 5.4.4. The UK has a more advanced system than Italy in particular (for example, the general prohibition on non-native releases under the Wildlife & Countryside Act); on the other hand, Germany controls introductions of plant species whereas the UK does not.

All four countries covered by this review cited an absence of overarching principles relating to non-native species as an impediment to interpreting law. Also, experience in all four countries shows that, when many parties are involved in activities relating to non-native species, such activities can be hindered or halted by insufficient cooperation and information sharing unless there is a body with ultimate responsibility for co-ordinating action.

Germany, Italy and the UK are signatories to the same principal international agreements relevant to this issue (e.g. WTO, IPPC, CBD, Habitats Directive) and all three are either undertaking or have recently carried out reviews of their policy and legislation in this area. Recognition of these shared problems and opportunities may help the UK in framing a strong, cohesive non-native species policy consistent with our obligations as a member of the European Union.

7.2 Potential improvements to existing UK legislation

7.2.1 Prevention of entry

The EC Wildlife Trade Regulation allows restrictions on imports of species that have been shown to have the potential to cause ecological harm. For the Wildlife Trade Regulation to be effective, import restrictions must be expanded to include all species which are known to be invasive in the UK and elsewhere, or which are known to have the potential to be invasive. It is not realistic to attempt to impose blanket restrictions on the import of non-natives; this may fall foul of WTO free trade laws. However, the New Zealand case study demonstrates that it is possible to impose restrictions on all non-native species that have not been firstly assessed and cleared. It may not be appropriate for Britain to adopt similar measures; it can be argued that such measures are not justifiable given the economic and other benefits that can be obtained from non-native species (e.g. food, timber, revenue from sales of ornamental species). However, if the UK had a system similar to New Zealand's, it is much more likely that future impacts and hence costs arising from new invasive non-native species will be reduced. There is therefore a trade-off between the costs of implementing such a system and the costs saved through the prevention of non-native species which can cause economic and ecological harm.

Under the current SPS Agreement, trade restrictions can only be implemented if the potential for environmental harm has been demonstrated using a Risk Assessment. Precautionary action is allowed if there is insufficient information available for a full risk assessment. New Zealand and Australia have both adopted a 'guilty until proved innocent' approach; it is unclear whether the UK could adopt a similar approach without risking WTO reprisals, as UK habitats appear to be less susceptible to biological invasion than the antipodean countries. There is therefore a need for

international agreement on standards for risk assessments in addition to those administered by the IPPC, which allows countries to restrict imports of potentially invasive non-native species on ecological as well as economic grounds, based on an assessment of the risks of entry, establishment and spread of species, and the environmental consequences of such. Risk Assessments under IPPC rules only apply to species which may harm plants. However, a full Risk Assessment should examine impacts on all taxa, and it would probably not be appropriate for different bodies to carry out a separate Risk Assessment for impacts on each group.

There is also a need for the ability to further restrict imports of known invasive species from other EC countries. Even if the Wildlife Trade Regulation can be used more extensively to ban imports of invasive non-natives to the EC, restrictions are also required on the import to the UK of known invasive species from within the EC. This will obviously require negotiation at the EC level, but a coherent and comprehensive strategy within the EC is essential if introduction pathways resulting from the unrestricted movement of goods are to be adequately controlled.

A recent judgement by the European Court of Justice in 1998 concerning the import of honey bees to Denmark established that free trade regulations can be over-ruled by national conservation law. In this case, a national legislative measure prohibiting the keeping on a Danish island of a subspecies of bee (on the grounds that it would hybridise with an endemic subspecies) was considered to be justified on the grounds of protection of the life and health of animals despite the fact that it constituted a trade restriction which would otherwise be prohibited under the Treaty of Rome (see Box 9 for more details). This judgement establishes the principle that trade restrictions intended to preserve native species can be justified with reference to CBD obligations. However, the judgement refers only to the specific bee species and geographically limited area in question. If the British Government chose to introduce trade restrictions on Italian Crested Newt due to concerns about hybridisation with Great Crested Newts, or chose to ban the import of mainland European races of a British plant species, such restrictions would be liable to challenge through the European courts. In addition, the justification of unilateral import restrictions on a non-native species because of its effects on an unrelated native species through factors such as competition or predation would at present probably also require a judgement from the European Court. Nevertheless, the principle that unilateral trade restrictions on conservation grounds are legally compatible with European law is an important one, and one that has the potential to contribute to the control of non-native species.

Within the existing domestic framework, there is scope under legislation such as the Destructive Imported Animals Act for restricting the importation (from outside the EC) and keeping of known invasive animal species which are not currently controlled. This would at least allow the UK to prevent imports of species known to be problematic in other countries and further control imports of already established invasive species, although imports of these species via other EC states would need to be addressed.

The question of introductions through ballast water discharge is best addressed through an international agreement rather than by unilateral action, to ensure a workable system is devised. The UK should therefore work towards the development of a Global Ballast Water strategy as currently being devised by the IMO, and should

sign, ratify and implement this instrument as soon as it is finalised. In addition, the vector of hull fouling needs addressing; this may also be best addressed at the international level.

7.2.2 Prevention of release

Animals

The general prohibition of non-native animal releases is unworkable in practice unless:

- offenders can be successfully held to account for deliberate or negligent escapes (this will act as a deterrent);
- the location of premises where collections of non-native species are held is known;
- the conditions under which they are kept (i.e. the security of their quarters) can be specified and enforced; and
- escaped animals can be traced back to their owners.

There are obvious logistical problems in introducing such a licensing regime across the board (i.e. to include all non-native animal species kept as pets). It would be needlessly prescriptive for a great many species that are unlikely to form self-sustaining populations in the wild, and would also require considerable expenditure to implement and administrate.

However, there is certainly scope for improving the current system. At present, local authorities issue licenses under the Dangerous Wild Animals Act; however, there is no central authority which collates and reviews licences. Baker (1990) reports the results of a survey of the number and types of animals held under this Act. 522 local authorities in Britain were contacted for information; 24% did not reply. This indicates the difficulty of collating and assessing the numbers of non-native species in the country when records are spread between different administrative bodies. Centrally-held data on licenses (under all legislation pertaining to non-native species which require licensing) would address this problem.

One possible way to improve the enforcement of legislation prohibiting releases is the use of DNA profiling to create a register of licensed captive species. It is obviously neither feasible or desirable to license or profile all non-native species, but it might be appropriate to introduce such a system for species which risk assessments suggest have a high invasive potential. In the event of escape and establishment, DNA analysis of wild animals could be used to trace the origin of the population and identify the party responsible. Baker (1990) notes that the majority of mammals of unknown origin found out of captivity between 1970 and 1988 were likely to have escaped from private collections; the ability to trace such animals would enable the costs of capture to be recovered from the owners, and for prosecutions to be brought. There is evidence to suggest that bringing in the requirement for licensing species not previously covered can inadvertently encourage illegal releases. For example, it is likely that some keepers of Raccoons *Nyctereutes procyonoides* released their animals rather than go to the trouble and expense of licensing them when they were added to the Dangerous Wild Animals Act in 1984 (Baker 1990). However, tighter controls on

the keeping of potentially invasive non-native animals (at the very least concerning the monitoring of numbers and types of species held) should be considered, as it is likely that future escapes may occur. Amendments to the Wildlife & Countryside Act introduced by the CROW Act give wildlife inspectors the authority to take DNA samples to determine whether an offence under Section 14 has been committed. This would be more effective if samples were taken in advance.

The problem of owners releasing animals rather than licensing them could perhaps be tackled by running an 'amnesty' for such animals for a limited time-period. This would require resources for the housing of any animals handed over, but would be preferable to the uncontrolled release of such animals.

Plants

There is no general prohibition on the release of non-native plant species. Only two vascular plants are currently included on Schedule 9 part II of the Wildlife & Countryside Act. This lack of control on releases of vascular plant species in part reflects the difficulty of regulating by legislation the vast number of non-native plant species that are obtainable. However, given that non-native plant species, particularly aquatics, can and are causing serious problems in some parts of the country, it is clear that the current legislation is inadequate. The threat to aquatic habitats in particular needs to be addressed: a survey of waterbodies showed that invasion is now becoming such a problem that one in six of all records of aquatic plant species in lowland ponds was of a non-native species (Williams *et al.* 1998).

The question is, therefore, how can the legislation be improved? Plantlife (Harper 2000) and JNCC (2000a) both give consideration to this. Plantlife proposes that the list of plants for which release into the wild is illegal (i.e. those on Schedule 9 part II of the Wildlife & Countryside Act) be extended to include non-native species which available evidence suggests are likely to cause significant environmental damage, and that a ban be introduced on sales of species known to be invasive such as Himalayan Balsam and New Zealand Pygmyweed. JNCC (2000a) recommends that "*Section 14 of the Wildlife and Countryside Act should be amended to make it an offence to release, allow to escape, or cause to grow in the wild, any plant … which is not ordinarily resident in … Great Britain in a wild state.*" The recommendation continues: "*Provided such action was not undertaken recklessly, we would exempt from this provision plants grown for agriculture, horticulture, forestry or in gardens*".

The Plantlife recommendation would appear to be a realistic approach, striking a balance between the need to restrict releases of known invasive non-natives and the need to avoid placing unnecessary burdens on the horticultural, agricultural and forestry industries and private individuals.

The JNCC recommendation requires some analysis. The wording as it stands would not prohibit the release of non-native species already established in the wild (another of the JNCC recommendations calls for the prohibition of the sale of Schedule 9 Part II species, which would address this aspect if more species were added to the Schedule). There are a large number of non-native plant species which have established in the wild, and the usefulness of attempting to prohibit further releases of all such species is open to question. Nonetheless, restrictions on known problem

species are undoubtedly required. The prohibition of releases of species not yet established would require careful consideration when determining which species are included and how such a ban would be applied. Would species which are commonly found as escapes but which do not appear to form self-sustaining populations be included? If not, this raises the question of determining criteria against which the status of a plant can be assessed. Does the exemption for agricultural, forestry, horticulture and garden species imply that species grown for these purposes are exempt if they escape, or that they are exempt when growing in gardens, farms, etc. but not if they spread from these? If the former, it is questionable what effect such a regulation would have, given that the vast majority of established non-native species originated from the sectors proposed for exemption. If the latter, a landowner who allows any non-native plant species to spread would be committing an offence. For common species which have wind-assisted dispersal, apportioning blame for such escapes would be problematic. Also, it would appear harsh to penalise landowners for the escape of species which are not invasive. Williamson (in press) states that the major costs of control of established non-natives can be attributed to nine or fewer species, with a further nine species having appreciable, but lower, costs. This paper does not cover species which are known to be problematic but which as yet have not incurred significant costs, but despite this proviso, it is clear that at present a relatively small number of non-native plant species are causing significant problems.

A further implication of the wording of the JNCC recommendation is that all non-native species "*ordinarily resident*" in the wild on the date the legislation came into force would be exempt; all other species would not be. This kind of arbitrary cut-off point was introduced in New Zealand with the implementation of the Hazardous Substances and New Organisms Act (Section 6.3.2). In some senses, such a cut-off point is counter-intuitive since it exempts known established invasive non-natives but precludes new species that may be benign.

The JNCC recommendation would certainly prohibit the intentional introduction of non-native species in the wider countryside (either through deliberate seeding, fly-tipping of garden waste, or other means whereby plants or waste containing plant propagules is disposed of in the wider countryside), and there is good reason to prevent this kind of introduction via legislation. However, it is not clear whether it is practicable to include all species which may escape of their own accord from gardens, garden centres etc.

Under the Weeds Act 1959, land occupiers may be served with a notice requiring them to take action to prevent certain specified weeds from spreading Five species of native weeds are covered under this Act (see Section 7.2.3). It will be politically difficult to introduce similar controls on well-established non-natives, especially where they are valued by sections of the general public (e.g. Rhododendron), but it must be said that spending large amounts of time and money on Rhododendron control (as is the case in Snowdonia and Lundy Island, for example) is essentially wasted if there are sources of seed for re-establishment in parks and gardens near to sites where control is carried out. However, it is acknowledged that making landowners liable for control of species which are unintentionally introduced might unfairly penalise owners of land with public access (including nature reserves). It might therefore be appropriate to make grants available for control programmes for landowners who would have difficultly in meeting the full costs themselves.

A suitable approach to plant introductions (assuming that enforcement is enabled by funding and regulatory reforms) would be to:

- list on Schedule 9 Part II invasive non-native species which are a problem in Britain, or which the evidence suggests could cause serious environmental damage;
- ban the planting (including in gardens) and sale of such species;
- make landowners liable to control such species (see Section 7.2.3) on their land (with potential grant aid available for control programmes) and liable for costs of control should they escape; and
- make it an offence to deliberately release or cause to grow (e.g. through fly-tipping) in the wild (i.e. in natural or semi-natural habitats) any non-native species, whether established in the country or not. Gardens, forestry, agricultural and horticultural establishments would be exempt from this definition of *wild*.

This would place stricter controls on known problem species, control deliberate introductions of all non-native plant species but avoid penalising people for escapes of non-native plants which do not pose a threat. As long as species can be quickly added to the Schedule if problems become apparent, invasive species could be controlled whilst avoiding overly-restrictive general regulations.

There is a strong argument for tighter controls on plant releases to the aquatic environment, both freshwater and marine, as invasive non-native aquatic species are often quicker to spread, harder to detect, more difficult to eradicate and harder to control than terrestrial species.

Other groups

JNCC (2000a) has recommended that Section 14 of the Wildlife & Countryside Act be extended to include fungi, lichens and micro-organisms, with exceptions granted for micro-organisms used for specified purposes (for example, medicine, veterinary medicine, brewing and food processing). There is no ecological reason why these groups should be exempt from controls on release, and so it would appear logical to apply consistent restrictions on all types of organism.

Summary

A general point regarding all the legislation governing release is that regardless of the strength or otherwise of the legislative framework, it will be impossible to prevent all unlicensed releases. It is currently generally impossible to attribute blame in such cases. Examples include the illegal release of bait or other fish, the emptying of aquaria containing aquatic species into watercourses or the escape of non-native pet species. Some releases are no doubt carried out in ignorance of the law. Some are carried out accidentally, and still others are carried out in the full knowledge that an illegal act is being committed. The question is, therefore, how can such releases be controlled? It will probably never be possible to prevent the deliberate release of untraceable species (see above section on DNA profiling); other releases can be at least reduced through a campaign of public education and the introduction of Codes of

Practice (see Section 7.2.4), and through a ban on the sale and keeping of known invasive species.

7.2.3 Control and eradication

The importance of a strong legal basis for the control of non-natives can be illustrated with reference to the attempt to cull Grey Squirrels *Sciurus canadiensis* in Italy. The cull was legally challenged by animal rights activists, and the programme was delayed for so long that Grey Squirrels spread beyond the point where eradication was feasible (see Box 11).

There has in the past been uncertainty as to which department should deal with non-native species: Muskrat *Ondata zibethicus* and Coypu *Myocastor coypus* eradications were both the responsibility of MAFF, whereas the recent Ruddy Duck *Oxyura jamaicensis* control programme was originally run by DETR. The merger of MAFF and parts of DETR into DEFRA should lead to greater integration and transparency of policy in this area. In addition, the role of EN, SNH, CCW, JNCC, the Environment Agency and SEPA requires clarification. The Environment Agency / SEPA are involved in non-native species control as regards fisheries licensing and the control of plant species if they affect main river flow. They also administer licences for sites where Japanese Knotweed *Fallopia japonica* may be disposed of, but they have no specific remit to control non-native species. The nature conservation agencies are responsible for non-native species control as it relates to maintenance of features of conservation interest on statutory sites, but again have no specific remit to control non-natives. Internal Drainage Boards and Local Authorities are also involved in non-native control in particular circumstances. There is therefore no organisation which has a specific overall responsibility for control of non-native species; addressing this situation should enable actions to be co-ordinated and targeted more effectively.

The Weeds Act 1959 applies to five injurious weeds which are considered to be a potentially serious threat to agricultural production. The Act contains a permissive power to enable Government to serve a notice upon an occupier of land on which these weeds are growing to take action within a specified time to prevent the weeds from spreading. If the occupier fails to take the action required by the notice within the specified time, the action may be taken on his behalf and reasonable costs recovered from the occupier, if necessary through the Courts. The scope of this Act could be expanded to control non-native plant species which are having a serious impact on natural, semi-natural or man-made habitats (e.g. Rhododendron *Rhododendron ponticum*, Himalayan Balsam *Impatiens glandulifera* and New Zealand Pygmyweed *Crassula helmsii*). This would no doubt be an unpopular move with some sections of the population, but if the political will to control common *native* species existed when the Weeds Act was framed, there is no particular reason why such an approach could not be extended to common (and uncommon) non-native species, especially if the point can be got across that the cost to the public purse of controlling such species can be considerable. Enforcement of the Weeds Act as is currently stands is restricted by resource constraints; there would need to be a careful assessment of the administrative cost of extending the Act with the actual cost to the public purse of controlling the species to be added.

7.2.4 Other approaches

The use of education campaigns (recognised as an essential part of a non-native species strategy by IUCN (2000)), voluntary schemes and financial incentive schemes for controlling releases can play an important role in areas where the legislative approach, for whatever reason, is difficult to implement.

Educating the public about the impacts of non-native species is vital if measures to control established non-native species are to be accepted. There is a long history of collecting and appreciating non-native species in Britain; whilst this is not a problem as it relates to zoos or botanic gardens, it creates difficulties if naturalised non-native species are regarded with affection, as public opinion may turn against measures emplaced to control species such as the Ruddy Duck, or against restrictions of the sale of invasive non-native plant or animal species. The opportunity for public input needs to be taken into account as a way of reducing opposition to control programmes. However, this process can take time, and the need for rapid action to ensure a better chance of successful eradication may conflict with the need to hold discussions with stakeholders. One way to avoid this problem is to develop generic policies with full public participation and support, so that the policy is already in place to allow rapid action when required.

Education can also play an important part in reducing introductions. As an example of the educative approach, the Ornamental Aquatic Trade Association (OATA) has produced a poster stating clearly that pet fish should never be released into the wild. This has been distributed to OATA members and retailers of ornamental fish, with the hope that this will discourage the release of ornamental fish into lakes, streams and rivers. The Plant Health Service publishes posters on plant pests. These are circulated to nurseries, garden centres etc. and have been successful in raising awareness. This publicity has been very important in raising public awareness of the Colorado Beetle *Leptinotarsa decemlineata*, for example, leading to many reports each year. The Garden Centre Association and the Horticultural Trade Association have produced a leaflet advising customers about the risks posed by invasive aquatic plant species.

The question of how effective this kind of approach is remains difficult to establish. There is little doubt that education campaigns and voluntary compliance can be effective; Lincolnshire Wildlife Trust persuaded all the garden centres in the county to ban the sale of American Bullfrog (Neil Pike, pers. comm.). South Africa's Conservation of Agricultural Resources Act 1983 places a requirement on landowners to remove certain non-native plants from their property and to prohibit the import and sale of these species. However, it also provides a list of suitable native alternatives and sometimes allows the removal of non-natives to be delayed until the native plants have become established, if the non-native species are serving some useful purpose. In any case, there have been very few prosecutions under the Act (South African legislation pertaining to non-native species as well as other information can be found at http://www-dwaf.pwv.gov.za/wfw/). The identification and publicising of suitable substitutes for non-native plant species is another way in which education could discourage the use of non-natives.

However, voluntary compliance alone cannot be relied upon to prevent all introductions; retailers are less likely to voluntarily restrict the sales of popular

species unless consumer pressure can be brought to bear upon them. An example of a potential market-based incentive scheme is the use of product marking with certificates indicating compliance with a recognised standard. For example, garden centres could receive a certificate demonstrating that they follow practices designed to minimise the escape of species from their grounds, they do not stock recognised invasive species, and / or their plants are certified free from other invasive species. As another example, seeds of locally-sourced native species could be marked; the local seed zone scheme detailed in Herbert *et al.* (1999) is one possible application of such a scheme. For market-based schemes to be taken up, consumer choice must be directed towards the selection of retailers or products which follow best practice guidelines intended to reduce the spread of non-native species; this will not happen unless public opinion can be influenced by education.

An example of the potential role of certification schemes in the control of non-native species is provided by the UK Woodland Assurance Scheme (http://www.forestry.gov.uk/ukwas/ukwas.html). This is a voluntary scheme that allows for third party independent evaluation and certification of woodland to internationally recognised standards of sustainable forest management. The maintenance and enhancement of biodiversity (which can include the control of non-native species) is a major part of the standards for certification and the criteria for assessment and evaluation.

As another example of the voluntary approach, the USA is monitoring compliance with voluntary guidelines for ballast water treatment (Section 6.2.2); the government recognises that should the voluntary approach prove unsuccessful, legislation to enforce compliance will be required.

The use of directed subsidies could also play an important part. This has a particular application in the case of local provenance seed sources for tree, shrub and wildflower planting. Legislating in this area would be difficult, since it is generally not possible to precisely delimit the range of a species, subspecies, race or strain (one way in which legislation could be possible is to require government agencies which are involved in large-scale planting such as the Highways Agency to exclude non-native species or strains from planting mixtures, or to use locally sourced seed). Subsidies for woodland planting under the Woodland Grant Scheme or other schemes could be made conditional upon the use of local provenance stock of native species. The Forestry Commission is currently developing a policy position on the use of local provenance for native species, and the possible role of incentives and accredited suppliers will be key elements of this (Gordon Patterson, pers. comm.).

The Government (and hence, through the tax system, its citizens) has to meet the costs of preventing and redressing the adverse effects of non-native species. One way of redressing this situation is to look at putting mechanisms in place to recoup at least some of this cost from those responsible for introductions. This can be addressed by internalising the cost of control; a party importing non-native species could be made liable under the polluter pays approach. As an example, the costs of installing ballast water and sediment reception facilities at ports should be met by importers and shipping companies. Costs recovered in this way are likely to be passed to the consumer, and could be controversial in that they are likely to viewed as a form of

taxation. It is nevertheless a more directed form of taxation than raising the tax burden of all citizens to meet the financial costs of controlling non-native species.

One possible mechanism for cost recovery is the use of mandatory insurance. Specialised insurance covering risky activities (e.g. car driving) is a recognised way of covering potential harmful impacts arising from those activities. There are precedents elsewhere in the world for applying this principle to non-native species. Hungarian law requires persons, private entrepreneurs and farmers that use hazardous substances in protected areas or are "*pursuing activities otherwise dangerous to the character or conditions of the natural value*" to provide security or draw up an insurance contract. Argentina's draft Biodiversity Strategy proposes that mandatory insurance should be considered to cover the risks of escapes, damage to third parties and eradication costs of non-native species (Shine *et al.* 2000b). Similar measures could be introduced in the UK.

7.2.5 Review and monitoring of established non-native species

There is currently little systematic monitoring of non-native species. This needs to be addressed, as targeting resources efficiently requires the regular assessment of the status of established non-natives. In addition, early warning of new arrivals is also required, as early eradication has a far greater chance of success.

A review of the status, impacts and potential impacts of non-native species should be a priority, as should be the implementation of a co-ordinated monitoring programme for non-native species. An atlas of non-native species has been produced by SNH for Scotland (Welch *et al*. 2001); this exercise should be repeated in England and Wales, and regularly updated. The JNCC (2000a) recommends that a review should assess the current and potential future damage that established species may cause to native biodiversity and other interests. These species should then be categorised as follows:

- Species which are currently having little significant impact and which have a low risk of causing future damage. No action need be taken against these species except to continue monitoring their distribution, status and impacts. Examples of non-native species falling into this category might include Little Owl and Midwife Toad.
- Species which are currently having little significant impact on native species but which pose a high risk of future damage. Interested parties should be consulted on the acceptability and feasibility of eradication, and eradication proposed if necessary or possible.
- Species which have caused significant impacts and which pose a risk of continued future damage. Eradication or control of these species should be proposed.

In addition, tighter controls may be required on species which are not causing a sufficient problem to merit nationwide control but which occur on or near protected sites. Such species may be prioritised for action on a site-by-site basis. Alternatively, sites could be prioritised for action to control non-native species.

7.2.6 Legal definitions

The current definitions of various terms relevant to the control of non-native species are unsatisfactorily dealt with in the existing legislation. As there are no pieces of legislation specifically relating to non-native species, the terms *native* and *non-native* are not defined. Instead, the Wildlife & Countryside Act confers protection on *wild* birds, animals and plants; this therefore extends protection to established non-native species. It is important that established non-native birds and animals are protected from inhumane treatment; however, a robust legal definition that clearly separates native from non-native species (including plants) is required that does not place non-natives in a 'legal vacuum' (Shine 1999).

Section 14(1)(a) of the Act prohibits the release into the wild of any animal which is *of a kind* which is *not ordinarily resident in and not a regular visitor to Great Britain in a wild state.* The prohibition of releases of non-native species via Section 14(1)(b) and Schedule 9 is therefore necessary because *ordinarily resident* includes established non-natives. In addition, *of a kind* is interpreted in DETR (1997) to indicate that the release of non-native subspecies of native species is prohibited. However, this has yet to be tested in the courts. The definition of *release* needs some clarification; the CPS declined to pursue a prosecution under Section 14(1) partly on the grounds that the birds in question were only released temporarily, and the case would therefore hinge on the interpretation of the word *release* in the Act.

A further problem lies with species which are introduced into one country and then spread by natural colonisation to neighbouring countries. As an example, the House Crow *Corvus splendens* arrived in Europe via ships and is now breeding in the Netherlands. If this species colonised Britain from the Netherlands, it may qualify for protection under the current legislation.

Although European species protected under the EC Habitats Directive are only protected by this Directive within their natural range (for example the Midwife Toad *Alytes obstetricans* is protected by the Directive, but its introduced population in the UK is not covered by the protection), other international instruments are less clear. For example, under the Bern Convention, individual species are not always specified, raising the possibility that species not native to any European country could qualify for protection. Appendix III, a list of protected fauna species, contains "*all amphibian species not included in Appendix II*". Article 7 of the Convention states that "*each Contracting Party shall take appropriate and necessary legislative and administrative measures to ensure the protection of the wild fauna species specified in Appendix III*".

A strict interpretation of this, despite the fact that the Convention also calls for controls on the introduction of non-native species, implies that established non-native species should receive protection, regardless of their invasiveness. The protection of species such as American Bullfrog was obviously not the intention of the Bern Convention; this serves to illustrate the need for precise definitions of native, non-native and protected species. One solution has been suggested by de Klemm (1996); wherever a taxon higher than species is mentioned in a species protection list, wording should be added to the effect 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 deliberately or*

accidentally 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" This as a definition of *native* would exclude species such as House Crow if they spread naturally from the Netherlands to Britain. One potential problem with this definition is that protection would automatically extend to reintroduced species (whether such introductions were authorised or unauthorised). Protection should not extend to species which establish through unauthorised reintroductions. For example, Wild Boar is re-establishing in the UK through accidental releases, but may not be a desirable reintroduction.

It is important that legal ambiguities are resolved, both for any new legislation concerning non-natives and also for existing legislation. In as far as they are currently defined at present in Britain, non-native species are defined with reference to political boundaries, but a definition using ecological parameters would be preferable. IUCN (2000) defines a native species as "*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).*" A cut-off date can be used to define native species as in the example by de Klemm (1996) quoted above. Australia defines any species that was not present before 1400 AD as non-native. Germany defines non-native species as "*alien to a region*" or "*non-local*". The United States defines non-native species with respect to a particular ecosystem as "*any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem*."

The identification of an appropriate cut-off date should such a definition be introduced in the UK would require further consideration.

Non-natives that generate *threat* or *harm* become *pests* or *invasive*. These are a subset of non-native species; a legal definition of non-natives should be broad enough to apply to all non-native species but should also allow a distinction to be made between those assessed to be detrimental and those assessed to be benign and / or beneficial (e.g. non-native forestry trees). IUCN (2000) defines an invasive non-native species as "*an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity*." It might also be appropriate to include man-made habitats in this definition for the UK. It should also be possible to rapidly amend lists of invasive non-native species on any piece of legislation to include those which are initially assessed as benign but which later appear to cause detrimental impacts. This is important given that there is often a considerable time-lag between the establishment of a species and the discovery of adverse impacts. It should also be made clear that species which are transported outside their natural ranges within the UK are also covered by the definition of non-native.

Another discrepancy is the different uses of the term *introduction* by the plant health and conservation sectors. The plant health sector defines it as *entry plus establishment*, whereas the IUCN, CBD, etc. consider it to be intentional or unintentional release into the environment. This difference needs to be reconciled if standard terminology is to be developed across all sectors concerned with non-native species.

7.3 Possible new legislation

Approaches to the framing of new legislation on non-native species (from Shine *et al.* 2000b) are:

- To review and consolidate existing measures into a unitary legislative framework that covers all aspects of non-native species control and can ensure consistent practice. Legislative reform on this scale is technically and politically complex, and can generate resistance from departments with long-established mandates. New Zealand has gone furthest on these lines with the Hazardous Substances and New Organisms Act 1996 (concerning intentional introductions) and the Biosecurity Act 1993 (concerning unintentional introductions and planning of management & control). This approach could be problematic in the UK because of devolution.

- To enact a core piece of legislation to determine common essential elements for the control of non-native species and to harmonise goals, definitions, criteria and procedures. A co-ordinating body would be appointed or established as the lead authority with responsibilities for non-native species policy.

- The third and minimal option is to harmonise existing legislation to ensure a uniform and consistent approach to non-native species. Again, a co-ordinating body is required.

Some agencies will retain certain responsibilities (e.g. HM Customs & Excise). Any potential conflicts of interest should be removed. If a mix of sectoral rules remain, a co-ordinating body will be essential (along the lines of e.g. the US Invasive Species Council)

Few countries have high-level political accountability for non-native species. New Zealand has cabinet-level representation (Minister for Food, Fibre, Biosecurity and Border Control). The DEFRA / SEERAD / NAW responsibility needs to be clearly established.

It is questionable whether it is necessary or feasible to introduce unifying legislation to the extent that New Zealand have, given that the problem of non-native species is less severe in Britain. Nonetheless, as shown in Section 5.4, the existing legislative framework is in need of reform. The question then remains as to whether it is preferable to amend existing legislation (along the lines discussed in Section 7.2 above) or whether new legislation is required.

It is considered that the existing UK legal framework could, if the improvements outlined in Section 7.2 are met, provide the minimum level of protection necessary to meet our international obligations. However, it is recommended that, in addition to improvements to existing laws, new legislation is framed to provide unifying principles and guidance for all sectors involved with non-native species.

This is considered necessary because:

- All countries reviewed in Section 6 identified the need for guiding principles as an essential driving force behind effective and consistent control of non-native species.
- The sectoral approach currently in place has several flaws and gaps, and does not lend itself to co-operation between sectors and co-ordination of efforts.
- At present there is no single body with a remit to direct and co-ordinate guidance and policy on non-native species.
- Non-native species, as recognised by the CBD COP, is a cross-cutting issue – there is consequently a need to draw together concerned parties to ensure conflicts are minimised and agreement is reached.

Gaps in the current system can be addressed up to a point by amending existing legislation. However, it is clear that the lack of a coherent and comprehensive policy on non-native species is hindering efforts to tackle the problem of entry, establishment and spread.

Scottish and Welsh devolution complicates the issue of standardising the non-native species legislative framework; close co-operation will be required between the various executive bodies involved to ensure that a consistent approach is taken across the whole of Great Britain.

We consider that there is, therefore, the need for legislation to establish:

- A Non-native Species Council to oversee policy co-ordination and dissemination of advice and guidance. This Council should be invested with the power to direct actions of organisations involved with non-natives, to assign clear responsibilities to appropriate bodies, to consider the cross-cutting aspects of non-native species issues, and to provide technical and scientific advice to Government.
- Clear legal definitions of the terms discussed in Section 7.2.6.

Enabling legislation would also be required to authorise and establish a specific legal basis for non-native species control (e.g. risk analysis, pest risk management, eradication programmes). This could include:

- Combining schedules of prohibited species under the various Acts, Regulations and Orders discussed in Section 4.3.
- The prohibition on sale and keeping of invasive non-native species.

We therefore concur with the recommendations of both IUCN (2000) and JNCC (2000) that a properly funded body or forum should be established, with the remit of co-ordinating national and local policy on non-native species; such a body should bring together representatives from the various organisations currently involved with non-native species, and should be empowered to define and devolve responsibilities to appropriate existing bodies and to allocate funding for non-native species control. This body would be similar in remit to the United States Invasive Species Council.

The body should draw up a Non-Native Species Strategy for Britain. This strategy should include:

- The collation of existing legislation and guidance, to make the legal situation clear.
- The identification of sectors and pathways associated with the introduction and use of non-natives.
- A review of the status and threats of established non-native species.
- The establishment of responsibilities of the various bodies involved (e.g. which body is responsible for risk assessment, control programmes etc.).
- A systematic monitoring programme for non-native species.
- Lists of species which have been identified as potentially invasive but not yet established, and for which early warning of introduction is a priority.
- Procedures for early detection, monitoring and collation of information on non-native species.

The strategy should also:

- Promote cooperation between relevant involved organisations.
- Identify incentives that promote risky activities, and reduce or eliminate these.
- Support incentives for practices which discourage introductions of non-native species or encourage the use of native species.
- Provide for the establishment of preventative and mitigation measures (building where possible on the contribution that local communities and other stakeholders can provide).

In addition, the strategy should cover:

- Intentional introductions for agriculture, forestry, fisheries, horticulture, landscaping, etc.
- Intentional introductions for containment / captivity (aquaculture, aquaria, pets, etc.) where these present a risk of establishment should they escape.
- Unintentional introductions (e.g. through trade, tourism and transport pathways and as products of trade).

The overall intention of the Strategy should be to prevent or minimise the risk of introducing non-native species that may become invasive. The Strategy should include stakeholder consultation and a public awareness campaign.

The Strategy should set out guidelines for decision-making procedures such as risk analysis, and should determine the criteria for decision-making. Using the licensing of releases as an example, New Zealand has both discretionary criteria (which can be taken into account when issuing a licence) and mandatory criteria (grounds on which a release application must be refused).

Non-native species should be categorised as follows, on the basis of risk assessments:

- Red: species that may cause serious problems and should not be imported.

- Amber: a composite list with different grades: species with known invasiveness, species with unknown invasiveness but reasonable likelihood of introduction, and species with unknown invasiveness and low possibility of introduction.
- Green: species deemed not to be a threat which may be imported.

This categorisation should be flexible, so that species can be re-categorised as and when necessary.

It is worth noting that categorisation of non-native invertebrates in a similar manner is currently used by the Plant Health Inspectorate as detailed in the explanatory booklet on importing invertebrate plant pests (MAFF 1997). The appendices to this booklet list invertebrates which must not be imported live and others which may be imported.

It is recognised that the UK has restricted options for unilateral action in respect of the prohibition or regulation of international trade. If the actual and potential problems of non-native species are to be taken seriously, the trade in known and potentially invasive species **must** be regulated, and known vectors of unintentional introductions **must** be controlled.

The UK should therefore seek to:

- Work with the EC to a) include more known invasive species on the Wildlife Trade Regulation, and b) frame regulations on the intra-EC trade consistent with the CBD and the Treaty of Rome to minimise within-species biodiversity loss caused by trade in species native to the EC.
- Work with the EC to draw up a European-wide red list of invasive non-native species.
- Participate in the forthcoming CBD COP6 with the aim of working towards the development of international measures for the implementation of Article 8(h) of the CBD. This should include provisions for international control and monitoring programmes.
- Participate in the IMO discussions with a view to developing and implementing an international instrument on the treatment of ballast water.
- Encourage the development of international action on hull fouling.

7.4 List of recommendations

7.4.1 Global issues

1) Work with the EC to a) include more known invasive species on the Wildlife Trade Regulation, and b) frame regulations on the intra-EC trade consistent with the CBD and the Treaty of Rome to minimise within-species biodiversity loss caused by trade in species native to the EC.

2) Work with the EC to draw up a European-wide red list of invasive non-native species.

3) Participate in the forthcoming CBD COP6 with the aim of working towards the development of international measures for the implementation of Article 8(h) of the CBD.

4) Participate in the IMO discussions with a view to developing and implementing an international instrument on the treatment of ballast water.

5) Participate in the development of Risk Assessment standards to provide a WTO-recognised basis for trade restrictions on non-native species.

6) Encourage the development of international action on hull fouling.

7.4.2 General UK issues

1) The UK should frame guiding principles on non-native species to ease interpretation of laws and lend support to voluntary practices.

2) Establish a co-ordinating body (as discussed in Section 7.3), perhaps along the lines of the United States' Invasive Species Council, to promote co-operation and information transfer between agencies and organisations involved in activities relating to non-native species.

3) Important terms such as *non-native* and *invasive* should be soundly defined in a way that makes sense both ecologically and in terms of Great Britain's economic and environmental goals. Avoiding ambiguity of definitions in legislation is essential, and existing ambiguities should be resolved.

4) A sectoral approach has been identified as a major weakness by all four countries as well as in the IUCN review of legal mechanisms for controlling non-natives (Shine 1999). This not only results in an inconsistency of approach, but also leads to serious gaps in control as well as inefficient duplication of effort. The question of the current sectoral approach should be addressed in the UK. In particular, legislation addressing non-native species should to be consolidated to avoid contradictions.

5) It is important that the costs and benefits associated with non-native species should be shared equitably. Well-framed procedures for assessing liability and cost recovery from liable parties (e.g. mandatory insurance) are therefore required. However it is also important that people should not be penalised too heavily for events that are not entirely under their control; financial and technical assistance in clearing non-native species from private land should be considered for any species which are added to lists of prohibited species (as recommended for plants in Section 7.2.2).

6) While a single co-ordinating body is necessary as outlined in (2) above, responsibility for day-to-day activities is best managed at a local level and with existing expertise. In Great Britain, separate agencies could take responsibility for non-natives in waterways, in nature reserves and so on, but

should all report to a single body which in turn would provide advice and ensure that activities in the same region are co-ordinated.

7) Non-native species are a cross-cutting issue; there is a requirement under Section 74 of the CROW Act 2000 for government departments in England and Wales to have regard to biodiversity conservation in accordance with the CBD (Section 4.3). The relevance of this requirement to non-native species issues should be clarified and guidance should be produced to assist government departments, local authorities and other bodies which have any involvement with non-native species to consider the impacts (both positive and negative) resulting, and to consider how negative impacts can be minimised.

8) The body recommended under (2) above should draw up a National Non-native Species Strategy as discussed in Section 7.3.

9) An explicit legal basis for control of non-native species of all groups should be established.

10) A comprehensive review of the status, current impacts and potential impacts of non-native species established in the UK should be carried out as a priority; these species should be prioritised as outlined in Section 7.2.5, and acted on accordingly. It might also be necessary to consider the status of non-invasive species in their country of origin.

11) The keeping and sale of known invasive species (including plants) should be prohibited; this could potentially be enacted through existing legislation, but it may be more appropriate to introduce new legislation specific to non-native species to address this.

12) The legal protection status of non-native species established in the UK but protected in other parts of the EC under the Habitats Directive needs to be clarified, as discussed in Section 7.2.6.

13) The UK should develop a co-ordinated monitoring system to detect newly-established non-native species and to collate relevant results from existing surveys and other reported sightings of non-native species.

14) Consideration should be given to requiring parties involved in importing, trading or otherwise using non-native species to take out insurance against the costs of controlling them should they escape and incur costs.

15) Controlling the introduction of native species outside their natural range by legislation is difficult, as the range of a species can be hard to define. However, there are areas where workable legislation could be enacted. Firstly, the introduction of UK species to offshore islands where those species do not naturally occur should be prohibited. The prohibition of releases of any fish to inland waters without a licence should be extended to Scotland. Consideration should be given to extending this level of licensing control to other groups of species where feasible. In particular, inter-

catchment transfer of all native and non-native aquatic species should be more tightly regulated, as aquatic ecosystems are more susceptible to invasive species.

16) The precautionary principle should be adopted when considering actions against newly-discovered invasive species; eradication should be considered if it is thought likely that negative impacts could occur should new species become more widespread.

17) More resources should be allocated to enable adequate enforcement of existing or new legislation.

18) The development of effective Risk Assessment techniques for all groups of non-native species should be a priority.

7.4.3 Legislation-specific issues

These recommendations address existing pieces of legislation; some might not necessarily be appropriate if some of the broader recommendations listed above are adopted.

1) Amend the Wildlife & Countryside Act to control introductions of non-native plants, fungi and micro-organisms as discussed in Section 7.2. This should include the addition of known invasive plant species to Schedule 9 Part II.

2) Amend Wildlife & Countryside Act to remove ambiguity concerning care and release of non-native bird species (see Box 6).

3) Amend Weeds Act to list known invasive non-native plant species.

4) The CEFAS Fish Movement Database represents a step forwards in the administration and enforcement of fish import licences. A similar system should be developed to include licences for other species under other legislation such as the Wildlife & Countryside Act, the Dangerous Wild Animals Act and others.

5) Consider the use of DNA profiling to assist with the enforcement of offences under Section 14 of the Wildlife & Countryside Act. Costs can be offset through charges for keeping or release licences. Penalties for offences should include reparations for the costs of control.

6) Consider amending EIA legislation to require the careful assessment of projects or activities involving the use of non-native species near sites of conservation importance, especially wetlands; introduce stricter controls on the use of non-native species near vulnerable sites or ecosystems.

7.4.4 Non-native species guidance and other measures for control

1) A public education campaign is required to educate the public about the problems posed by non-native species. This is essential if measures taken against non-native species are to be accepted by the general public, and to encourage voluntary reporting of non-native species sightings in the wild.

2) Develop a web-based Clearing House Mechanism for knowledge sharing of control methods, range expansions, new species, etc. A current English Nature project on control methods for non-native species is laying important groundwork for this approach, which will help co-ordinate efforts to control non-native species.

3) Co-operation should be promoted between agencies involved with non-native species.

4) Work with Trade Associations concerned with non-native species to draw up Codes of Practice or other schemes intended to reduce the risk of introductions as discussed in Section 7.2.4.

5) Licensing and registration of pet shops, etc. should include provisions for preventing escapes and the requirement to inform buyers of non-native species about the risks they pose and the legal position regarding intentional and accidental releases.

6) Consider linking grant aid for conservation or other projects to the control of problem non-native species (one possible model for this approach may be the pending US Harmful Non-native Weed Control Act, which proposes cost sharing for the management of terrestrial weeds and aims to allocate federal money for distribution to local weed management groups).

7) Guidance should be developed and publicised on the use of local provenance native plant species as alternatives to non-natives.

8) Further research is necessary to improve assessments of the risks of establishment of non-natives species, improve the cost-benefit analysis of the impacts of use and establishment of non-native species and to improve techniques for eradication, containment, management and mitigation.

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APPENDICES

Appendix 1.1. International instruments concerning non-native species relevant to the UK

Name	Year of entry into force (if applicable)	Main aspects addressed	Control method addressed	Type of introduction addressed	Legally binding?	Web reference
Convention on Biological Diversity	1993	Biodiversity conservation	Prevention of entry / release Control / eradication	Intentional and unintentional	Yes	http://www.biodiv.org
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)	1975	Biodiversity conservation	Prevention of entry / release Control / eradication	Intentional and unintentional	No	http://www.ramsar.org
Bonn Convention on the Conservation of Migratory Species of Wild Animals	1983	Biodiversity conservation	Prevention of entry / release Control / eradication	Intentional and unintentional	No	http://www.wcmc.org.uk/cms/
Bern Convention on Conservation of European Wildlife and Natural Habitats	1982	Biodiversity conservation	Prevention of entry / release	Intentional and unintentional	No	http://conventions.coe.int/treaty/en/Treaties/Html/104.htm http://www.nature.coe.int/english/main/bern/texts/rec9757.htm
IUCN Guidelines for the prevention of Biodiversity loss caused by alien invasive species	2000	Biodiversity conservation	Prevention of entry / release Control / eradication	Intentional and unintentional	No	http://www.iucn.org/themes/ssc/pubs/policy/invasivesEng.htm
Agenda 21	1992	Biodiversity conservation (forestry and aquatic environment)	Prevention of entry / release Control / eradication	Intentional and unintentional	No	http://www.igc.org/habitat/agenda21
Ministerial Conference for the Protection of Forest in Europe	1993	Biodiversity conservation (forestry)	Prevention of entry / release	Intentional	No	http://www.minconf-forests.net/
United Nations Convention on the Law of the Sea (UNCLOS)	1994	Aquatic environment	Prevention of entry	Intentional and unintentional	Yes	http://www.un.org/Depts/los/losconv1.htm

Name	Year of entry into force (if applicable)	Main aspects addressed	Control method addressed	Type of introduction addressed	Legally binding?	Web reference
International Council for Exploration of the Sea (ICES) Code of Practice on the Introductions and Transfers of Marine Organisms (1994)	1994	Aquatic environment	Prevention of entry	Intentional and unintentional	No	http://www.ices.dk/pubs/itmo.pdf
International Maritime Organisation (IMO) Guidelines for the Control and Management of Ships' Ballast Water to Minimise the Transfer of Harmful Aquatic Organisms and Pathogens	1997	Aquatic environment / transport	Prevention of entry	Unintentional	No	http://www.imo.org
FAO Code of Conduct for Responsible Fisheries	1995	Aquatic environment	Control	Intentional	No	http://www.fao.org/fi/agreem/codecond/ficonde.asp
International Plant Protection Convention (IPPC)	1951	Phytosanitary measures	Prevention of entry	Unintentional	Yes	http://www.fao.org/WAICENT/FAOINFO/AGRICULT/agp/agpp/PQ/Default.htm
Food and Agriculture Organisation (FAO) Code of Conduct for the Import and Release of Exotic Biological Control Agents	1996	Phytosanitary measures	Prevention of entry / release	Intentional	No	
WTO Agreement on Sanitary and Phytosanitary measures (SPS Agreement)	1995	Trade-related agreements	Prevention of entry	Unintentional	Yes	http://www.wto.org/english/tratop_e/sps_e/spsagr.htm
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	1975	Trade-related agreements	Prevention of entry	Intentional	Yes	http://www.cites.org
International Civil Aviation Organisation (ICAO) Resolution on Preventing the Introduction of Invasive Alien Species	1998	Transport	Prevention of entry	Unintentional	No	http://www.icao.int/icao/en/res/a32_9.htm

Appendix 1.2. European legislation relevant to non-native species

Name	Year of entry into force	Main aspects addressed	Control method addressed	Type of introduction addressed	Web reference
Habitats Directive: Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora	1992	Biodiversity conservation	Prevention of release	Intentional	http://europa.eu.int/eur-lex/en/lif/dat/1992/en_392L0043.html
Birds Directive: Council Directive 79/409/EEC on the conservation of wild birds	1979	Biodiversity conservation	Prevention of release	Intentional	http://europa.eu.int/eur-lex/en/lif/dat/1979/en_379L0409.html
Wildlife Trade Regulation: Council Regulation (EC) No 338/97 on the protection of species of wild fauna and flora by regulating trade therein Commission Regulation (EC) No 939/97 laying down detailed rules concerning the implementation of Council Regulation (EC) No 338/97 Commission Regulation (EC) No 191/2001 suspending the introduction into the Community of specimens of certain species of wild fauna and flora	1997	Trade-related agreements / Biodiversity conservation	Prevention of entry	Intentional	http://europa.eu.int/eur-lex/en/lif/dat/1997/en_397R0338.html http://europa.eu.int/eur-lex/en/lif/dat/1997/en_397R0939.html http://www.ukcites.gov.uk/pdf%20files/a191_2001.pdf Annexes to Regulation 2724/2000 containing lists of restricted species can be found at: http://www.ukcites.gov.uk/pdf%20files/a2724_2000.pdf
Environmental Assessment Directive Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment Council Directive 97/11/EC amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment	1985 1997	Biodiversity conservation	Prevention of release	Intentional	http://www.europa.eu.int/eur-lex/en/lif/dat/1985/en_385L0337.html http://www.europa.eu.int/eur-lex/en/lif/dat/1997/en_397L0011.html
Forest Reproductive Material Directive Council Directive 1999/105/EC of 22 December 1999 on the marketing of forest reproductive material	1999	Biodiversity conservation	Prevention of release	Intentional	http://europa.eu.int/eur-lex/en/lif/dat/1999/en_399L0105.html
Plant Health Directive: Council Directive 2000/29/EC on protective measures against the introduction into the community of organisms harmful to plants or plant products and against their spread within the community	2000	Phytosanitary measures	Prevention of entry	Intentional / unintentional	http://europa.eu.int/eur-lex/en/lif/dat/2000/en_300L0029.html

Name	Year of entry into force	Main aspects addressed	Control method addressed	Type of introduction addressed	Web reference
Animal Health Directives: Council Directive 90/425/EEC concerning veterinary and zootechnical checks applicable in intra-Community trade in certain live animals and products with a view to the completion of the internal market	1990	Sanitary measures	Prevention of entry	Intentional / unintentional	http://europa.eu.int/eur-lex/en/lif/dat/1990/en_390L0425.html
Council Directive 91/496/EEC laying down the principles governing the organization of veterinary checks on animals entering the Community from third countries	1991				http://europa.eu.int/eur-lex/en/lif/dat/1991/en_391L0496.html
Council Directive 64/432/EEC on animal health problems affecting intra-Community trade in bovine animals and swine	1964				http://europa.eu.int/eur-lex/en/lif/dat/1964/en_364L0432.html
Council Directive 92/65/EEC laying down animal health requirements governing trade in and imports into the Community of animals, semen, ova and embryos not subject to animal health requirements laid down in specific Community rules referred to in Annex A (I) to Directive 90/425/EEC	1992				http://europa.eu.int/eur-lex/en/lif/dat/1992/en_392L0065.html
Fish Health Directive: Council Directive 91/67/EEC concerning the animal health conditions governing the placing on the market of aquaculture animals and products	1991	Sanitary measures	Prevention of entry	Intentional / unintentional	http://europa.eu.int/eur-lex/en/lif/dat/1991/en_391L0067.html
Plant Protection Products Directive: Council Directive 91/414/EEC of 15 July 1991 concerning the placing of plant protection products on the market	1991	Phytosanitary measures	Prevention of entry	Intentional / unintentional	http://europa.eu.int/eur-lex/en/lif/dat/1991/en_391L0414.html

Appendix 1.3. Domestic legislation relevant to non-native species

Name	Year of entry into force	Main aspects addressed	Control method addressed	Type of introduction addressed	Web reference
Wildlife & Countryside Act	1981	Biodiversity conservation	Prevention of release	Intentional / unintentional	
Countryside and Rights of Way Act	2000	Biodiversity conservation	Prevention of release	Intentional / unintentional	http://www.hmso.gov.uk/acts/acts2000/20000037.htm
Environmental Protection Act	1990	Biodiversity conservation	Prevention of release Control	Intentional / unintentional	http://www.hmso.gov.uk/acts/acts1990/Ukpga_19900043_en_1.htm
Import of Live Fish Act Import of Live Fish (Scotland) Act	1980 1978	Biodiversity conservation	Prevention of entry / release	Intentional / unintentional	
Destructive Imported Animals Act	1932	Agricultural protection / biodiversity conservation	Prevention of entry / release	Intentional / unintentional	
Salmon and Freshwater Fisheries Act (as amended by the Environment Act 1995)	1975	Sanitary measures	Prevention of release	Intentional / unintentional	
Fish Health Regulations	1997	Sanitary measures	Prevention of entry	Intentional / unintentional	http://www.hmso.gov.uk/si/si1997/1971881.htm
Diseases of Fish Act	1937	Sanitary measures	Prevention of entry	Intentional / unintentional	
Shellfish and Specified Fish (Third Country Imports) Order	1992	Sanitary measures	Prevention of entry	Intentional / unintentional	http://www.hmso.gov.uk/si/si1992/Uksi_19923301_en_1.htm
Plant Health Act Plant Health (Great Britain) Order Plant Health (Forestry) (Great Britain) Order	1967 1993 1989	Phytosanitary measures	Prevention of entry	Intentional / unintentional	 http://www.hmso.gov.uk/si/si1987/Uksi_19871758_en_1.htm http://www.hmso.gov.uk/si/si1993/Uksi_19931283_en_1.htm
Animal Health Act	1981	Sanitary measures	Prevention of entry	Intentional / unintentional	
Specified Animal Pathogens Order	1994	Sanitary measures	Prevention of entry	Intentional / unintentional	http://www.hmso.gov.uk/si/si1993/Uksi_19933250_en_1.htm

Name	Year of entry into force	Main aspects addressed	Control method addressed	Type of introduction addressed	Web reference
Animals and Animal Products (Import and Export) (England and Wales) Regulations Animals and Animal Products (Import and Export) (Scotland) Regulations Products of Animal Origin (Import and Export) Regulations 1996.	2000 2000 1996	Sanitary measures	Prevention of entry	Intentional / unintentional	http://www.hmso.gov.uk/si/si2000/20001673.htm http://www.hmso.gov.uk/legislation/scotland/ssi2000/20000216.htm http://www.hmso.gov.uk/si/si1996/Uksi_19963124_en_1.htm
Bees Act	1980	Sanitary measures	Prevention of entry	Intentional / unintentional	
Importation of Bees Order	1997	Trade-related measures	Prevention of entry	Intentional / unintentional	http://www.hmso.gov.uk/si/si1997/97031001.htm
Plant Protection Products Regulations	1995	Phytosanitary measures	Prevention of entry / release	Intentional / unintentional	http://www.hmso.gov.uk/si/si1995/Uksi_19950887_en_1.htm
Endangered Species (Import & Export) Act	1976	Trade-related measures	Prevention of entry	Intentional / unintentional	http://www.ukcites.gov.uk/
Control of Trade in Endangered Species (Enforcement) Regulations	1997	Trade-related measures	Prevention of entry	Intentional / unintentional	http://www.hmso.gov.uk/si/si1997/97137201.htm
Dangerous Wild Animals Act	1976	Public safety	Prevention of release	Intentional / unintentional	http://www.defra.gov.uk/wildlife-countryside/gwd/wildact.htm
Performing Animals (Regulation) Act	1925	Public safety	Prevention of release	Intentional / unintentional	
Zoo Licensing Act	1981	Animal welfare / public safety	Prevention of release	Intentional / unintentional	http://www.defra.gov.uk/wildlife-countryside/gwd/zoo.htm
Pet Animals Act	1951	Animal welfare	Prevention of release	Intentional / unintentional	
Animals Scientific Procedures Act	1986	Animal welfare	Prevention of release	Intentional / unintentional	
Forestry Act 1967 (and as amended)	1967	Forestry	Control	Intentional / unintentional	
Deer Act	1991	Hunting	Control	N/A	http://www.legislation.hmso.gov.uk/acts/acts1991/Ukpga_19910054_en_1.htm

Appendix 2. IUCN Guidelines for the prevention of biodiversity loss caused by alien invasive species

Prepared by the SSC Invasive Species Specialist Group (http://www.issg.org/index.html)

Approved by the 51st Meeting of the IUCN Council, Gland Switzerland, February 2000

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 favoured 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 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[3]

"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.
- 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. 7. 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 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:

Translocation of Living Organisms. IUCN Position Statement, 1987. IUCN, Gland, Switzerland.

IUCN Guidelines for Re-introductions. 1995. IUCN, Gland, Switzerland.

Code of Conduct of the Import and Release of Exotic Biological Control Agents. United Nations Food and Agriculture Organisation, 1995. FAO, Rome, Italy.

Harmful Non-indigenous Species in the United States. U.S. Congress, Office of Technology Assessment, OTA-F-565, 1993. US Government Printing Office, Washington DC.

Proceedings. Norway/UN Conference on Alien Species. The Trondheim Conference on Biodiversity. 1-5 July 1996. Norwegian Institute for Nature Research, Trondheim, Norway.

Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ship's Ballast Water and Sediment Discharges. International Maritime Organisation (IMO) Resolution A.774(18)(4.11.93) (Annex).

12. Acknowledgements

IUCN gratefully acknowledges the dedication and efforts of the Invasive Species Specialist Group (ISSG) and other experts on alien invasive species whose collaborative work has made the production of these guidelines possible. Input from the IUCN Environmental Law Programme is also gratefully acknowledged.

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.

Footnotes

1 Definition of Terms in section 3

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.

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.

Appendix 3. Binding international instruments concerning non-native species relevant to the USA, New Zealand, Germany and Italy

Agreement	Countries bound by agreement				Reference
	USA	New Zealand	Germany	Italy	
Agreement on the Application of Sanitary and Phytosanitary Measures SPS Agreement	✔	✔	✔	✔	Appendix 1.1; Section 4.1
Bern Convention on Conservation of European Wildlife and Natural Habitats			✔	✔	Appendix 1.1; Section 4.1
Bonn Convention on the Conservation of Migratory Species of Wild Animals		✔	✔	✔	Appendix 1.1; Section 4.1
Convention on Biological Diversity		✔	✔	✔	Appendix 1.1; Section 4.1
Convention on Great Lakes Fisheries Between the United States and Canada	✔				http://www.glfc.org/pubs/conv.htm
Convention on International Trade in Endangered Species	✔	✔	✔	✔	Appendix 1.1; Section 4.1
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)	✔	✔			Appendix 1.1; Section 4.1
International Plant Protection Convention	✔	✔	✔	✔	Appendix 1.1; Section 4.1
North American Agreement on Environmental Cooperation	✔				http://www.cec.org/pubs_info_resources/law_treat_agree/naaec/index.cfm
North American Free Trade Agreement	✔				http://www.sice.oas.org/trade/nafta/naftace.asp
Plant Protection Agreement for the South East Asia and Pacific Region		✔			http://sedac.ciesin.org/pidb/register/reg-016.rrr.html
Protocol for the Implementation of the Alpine Convention on the Protections of the Alps and the Protocol on the conservation of Nature and Landscape			✔	✔	http://www.ecolex.org/TR/TR/details/EN/003142.htm
UN Convention on the Law of the Sea		✔	✔	✔	Appendix 1.1; Section 4.1