



lebensministerium.at

Austrian Action Plan on Invasive Alien Species



Preface

Over the past few centuries and in particular today, in an age of higher mobility and fast, world-wide transfer of goods, natural barriers that prevent the spread of species have become porous. Humans have, intentionally or unintentionally, transferred great numbers of plant, fungi and animal species from one part of the world to another. These alien species are now considered to be the second-most important threat to the conservation of biological diversity. Some of these “new species” (neobiota) may displace native species, cause long-lasting changes in ecosystem structure and function, and lead to substantial economic and health problems.

The Convention on Biological Diversity of the United Nations, which Austria ratified in 1994, therefore requests the Contracting Parties to prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habi-

tats or species (Article 8h). In 2002 the Sixth Conference of the Parties to the Convention on Biological Diversity at its meeting in The Hague worked out Guiding Principles on alien species.

The present Action Plan on Invasive Alien Species is based on the respective international requirements and has been approved by Austria's National Biodiversity Commission. It contains objectives and measures for four fields of prime importance and attaches particular importance to information and awareness-raising.

The Action Plan is addressed to all institutions and organisations concerned. They are urged to pay attention to and address the objectives and measures set out in the Action Plan on Invasive Alien Species within the framework of their activities and responsibilities.

I M P R I N T

Publisher and editor:

Federal Ministry of Agriculture, Forestry, Environment and Water Management
Stubenbastei 5, 1010 Vienna, Austria
www.lebensministerium.at

Authors:

Franz Essl, Wolfgang Rabitsch (Federal Environment Agency)

General co-ordination:

Gabriele Obermayr (Lebensministerium, Dept. II/4)

Translation:

Mirjam Freund (Lebensministerium, Dept. PR/7c)

Photos: Cover – big picture: Common day lily, flowering (*Hemerocallis fulva*) and Giant knotweed, leaves (*Fallopia japonica*) (Photo credit: F. Essl)
Cover – small pictures: Giant hogweed (*Heracleum mantegazzianum*) (Photo credit: F. Essl), Signal crayfish (*Pacifastacus leniusculus*) (Photo credit: W. Weißmair), Kanadian goldenrod (*Solidago canadensis*) (Photo credit: F. Essl)
Page 7: Photo credits F. Essl (4 x)
Page 9: Photo credits F. Essl (2 x)
Page 11: Mandarin duck (Photo credit: P. Buchner/BirdLife), Pheasant (Photo credit: C. Roland), Linden ground bug (Photo credit: W. Rabitsch), Signal crayfish (Photo credit: W. Weißmair)
Page 13: Scyamore lace bug (Photo credit: R. Rabitsch), (Photo credits 4 x: F. Essl)

Layout and production:

Skibar Grafikdesign

Printing:

AV+Astoria Druckzentrum, 1030 Vienna, Austria

Vienna 2004

Content

Introduction	6
1 Basic situation	7
1.1 Present situation	7
1.2 Ecological, economic and health impacts of alien species	8
1.2.1 Ecological impacts	8
1.2.2 Adverse economic impacts	8
1.2.3 Health impacts	9
1.3 National and International Framework Conditions and Legal Basis	10
1.3.1 International level	10
1.3.2 National level	10
1.4 Structure of the Action Plan	11
1.4.1 Scope	11
1.4.2 Terminology	11
1.4.3 Structure	13
2 Action plan on invasive alien species: Objectives and activities	14
2.1 Objectives	14
2.2 Education and awareness-raising	14
2.3 Capacity building	16
2.4 Research and monitoring	17
2.5 Legal and organisational implementation	20
3 Bibliography	22
Annex: List of invasive, potentially invasive, economically problematic, and health affecting species	24

Introduction

The ecological, economic and health-related impacts of non-indigenous species (= neobiota, alien species) are considerable in many countries. They have been recognised to be one of the most important causes of biodiversity loss all over the world and, in many countries, lead to serious economic damage.

The term “alien species” encompasses species which have been directly or indirectly introduced by man into a specific area after the year 1492. A distinction is made between “neophytes” (newly introduced plant species), “neozoans” (newly introduced animal species) and “neomycetes” (newly introduced fungal species).

Recently a study has been completed which provides a comprehensive survey of the plant, fungal and animal species that have entered or have been introduced into Austria through humans (ESSL & RABITSCH 2002; ESSL & WALTER in press; RABITSCH & ESSL in press; RABITSCH et al. in press). These technical investigations lay the groundwork for evaluating the extent of the ecological (e.g. Signal crayfish, Black locust), economic (e.g. Western corn rootworm, Chestnut leaf miner) and health (e.g. Common ragweed) consequences of alien species in Austria. The outcomes provide also the technical basis to develop measures, objectives and time-periods, priorities concerning prevention, as well as mitigation activities.

The Convention on Biological Diversity (CBD) was adopted in 1992 and ratified by Austria in 1994 (Federal Law Gazette No 213/95). According to Article 6 of the CBD every Contracting Party shall either develop **national strategies, plans or programmes for the conservation and sustainable use** of biological diversity, or adapt its existing strategies, which in any case, are to reflect the measures set out in the Convention. According to this provision the National Biodiversity Commission in April 1998 set out the Austrian Strategy for the Implementation of the Convention on Biological Diversity based on the preparatory work of the Federal Environment Agency and presented it to the Federal Government.

On the basis of the evaluation of the Austrian Biodiversity Strategy (UMWELTBUNDESAMT 2003) it was decided to revise and further develop the Biodiversity Strategy. As a new instrument, action plans on topical issues which are to supplement the Austrian Biodiversity Strategy are being introduced. The Austrian Action Plan on Invasive Alien Species (“Aktionsplan Neobiota”) is to serve as a tool to further develop, and put into more concrete terms, the Austrian Biodiversity Strategy. This Action Plan is to be supplemented by detailed measures for selected species.

1 Basic situation

1.1 Present situation

Austria’s present fauna and flora is the result of natural processes and anthropogenic influence. Apart from immediate changes in landscapes and habitats, man has considerably modified the composition of species through the intentional and unintentional introduction of plant and animal species and as this process, which has been going on for thousands of years now, is known to have substantially intensified over the past few decades, it is considered to be an important cause of the global loss of biodiversity and to involve high economic costs (MACK et al. 2000; SALA et al. 2000; PIMENTEL 2002). In this context Europe has been primarily an exporter of species (“ecological imperialism”, CROSBY 1986). The natural ecosystems of continental mainlands, like Central Europe, and thus also Austria, have been less frequently conquered by alien species. However, also in these areas animal and plant species are found which have adverse economic and ecological impacts.

As a result of increasing long-distance trade the total number of alien species has been clearly rising over the past decades, a trend which will undoubtedly continue (RITZER 1997) because the spread of alien species is often observed only several years or decades after their first occurrence (“time-lag”, KOWARIK 2003). Nature conservation experts and ecologists as well as the broad public are therefore paying heightened attention to biological invasions.

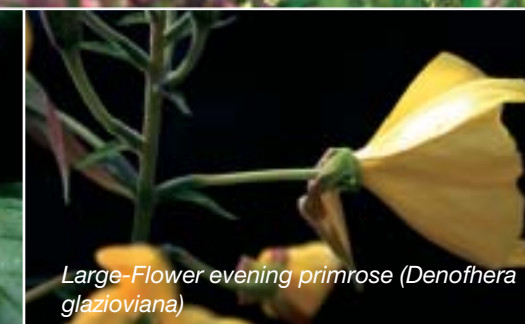
Although the adverse economic impacts and health consequences of alien species have received rising attention over the past few years, hardly any reliable data have been compiled so far. However, the few estimations and calculations of costs available for individual countries demonstrate the high economic importance of alien species (MACK et al. 2000; PIMENTEL 2002). Except for the study of REINHARDT et al. (2003), comprehensive financial impact analyses are almost completely lacking for Central Europe.



Garden lupin (*Lupinus polyphyllus*)



Tatarian dogweed (*Cornus alba* s.l.)



Large-Flower evening primrose (*Denofthera glazioviana*)



Chinese aster (*Callistephus chinensis*)

1.2 Ecological, economic and health impacts of alien species

1.2.1 Ecological impacts

The conservation and sustainable use of global biodiversity represent the most important goals of nature protection which are globally recognised and laid down in international agreements (e.g. Convention on Biological Diversity, see also IUCN 2001; STEIOF 2001; KIEHN & NOUAK in press). Through its ratification of a number of international agreements the Republic of Austria has expressly committed itself to the protection of biological diversity. Biodiversity covers the levels of genetic, species, and ecosystem diversity.

The competition and predation pressure through non-indigenous animal species are considered the major risk for 50% of all endangered species in North America (WILCOVE et al. 1998). On isolated oceanic islands which have large numbers of endemic species this rate is even higher. Neozoans are thus contributing to the global loss of biodiversity.

Aquatic habitats are particularly prone to biological invasions. A scenario of the development of global biodiversity until the year 2100 shows that alien species have to be considered the most important factor of changes in standing waters (SALA et al. 2000). In world-wide comparison changes in biodiversity which are due to global causes (land use, climate change, nitrogen deposition, biological invasions, rise in carbon dioxide) will probably be most significant in Mediterranean ecosystems. However, also temperate terrestrial animal and plant communities will suffer from the impacts of biological invasions (SALA et al. 2000).

In Austria, problematic alien species occur primarily in anthropogenically influenced habitats and in some near-nature lowland habitats (e.g. waters, riparian forests). As opposed to this, biological invasions are hardly ever found in highland habitats and in certain close-to-nature habitats (e.g. bogs, fens). The majority of alien species found in Austria do not lead to any problems concerning nature conservation, but some have very strong impacts (e.g. crowding out of indigenous plant species, threat to indigenous species through parasitism and hybridisation).

In specific habitats (e.g. in cities) alien species may also lead to a nominal increase in diversity. These new species are usually very common, easily adaptable, and hardly ever imperilled. Such a rise in biodiversity is thus not desirable with respect to nature conservation, even though the species may be welcome to urban ecology or hold aesthetic value.

Alien species are of relevance for biodiversity conservation where they can establish themselves. There are some strongly anthropogenically influenced habitats in Austria where the share of neophytes is particularly high, but which are of minor value for nature conservation (mainly in urban set-aside areas, root-crop fields). However, in some types of near-nature biotopes, e.g. in riparian forests and riparian shrub stands, at riparian pioneer sites and in Pannonian forests, the effect of neophytes is problematic from the point of view of nature conservation (ESSL & RABITSCH 2002; ESSL & WALTER in press).

1.2.2 Adverse economic impacts

In Austria, economically relevant problems pertaining to alien species arise first and foremost in agriculture (e.g. *Amaranthus* spp.) and forestry. To a lower extent they affect also other economic activities (e.g. maintenance of waters).

Agricultural utilisation is adversely affected by neophytic weeds, which, especially in communities of Chenopodietaea, can often become stand-forming and are therefore combated in arable farming (e.g. *Panicum* spp., *Amaranthus* spp., *Galinsoga* spp.). Some species cause problems as forest weeds (*Solidago gigantea*) or in connection with water maintenance (*Fallopia* spp.).

Austrian forestry-relevant neophytes include Black locust and, to a smaller extent, also Tree-of-Heaven and Ash-leaved maple. Except for Black locust, they produce low-value timber, are difficult to control, and may grow in competition with high-value species. In some regions of the Pannonian east of Austria, Black locust is also of great economic importance.

Some of the neomycetes found in Austria are playing an important role as parasites attacking commercial and ornamental plants (e.g. *Phytophthora infestans*, *Ustilago maydis*).

Many of Austria's neozoans are more or less harmful "pests". Their impacts range from minor damage in wood imports (e.g. wicker baskets, carved articles) to important stored food pests. In agriculturally or silviculturally used areas non-indigenous species cause serious output losses and are controlled in targeted ways. However, the cost of manual, chemical or biological control measures and of indirect impacts has so far not been quantified in Austria.

Globally, the detrimental economic impacts attributed to invasive alien species must be called considerable, even though exact data are available only for individual regions (PIMENTEL 2002). In the U.S.A., the economic loss for agriculture caused by neozoans alone due to harvesting losses and costs of

control is estimated at 27 billion dollars annually (MACK et al. 2000). Taking everything into account the U.S.A. are incurring costs of over 137 billion dollars annually due to invasive alien species (PIMENTEL 2002).

For some countries and regions there are data describing the extent of the economic loss caused by invasive alien species: U.S.A. (MACK et al. 2000; PIMENTEL et al. 2002), Australia (CANYON et al. 2002), Great Britain (WHITE & HARRIS 2002), and New Zealand (CLOUT 2002). REINHARDT et al. (2003) estimate the financial loss caused by 20 alien species in Germany 109-263 million euros annually. With one exception (a loss of 88,000 euro pertaining to the 89 specimen of the Asian longhorned beetle, *Anoplophora glabripennis*, so far detected at Braunau – ESSL & RABITSCH 2002), no data are available for Austria.

1.2.3 Health impacts

There are two rather widely distributed neophytes which are known to cause health problems in the form of allergies and skin reactions: Common ragweed (*Ambrosia artemisiifolia*) and Giant hogweed (*Heracleum mantegazzianum*). Their effects can be very unpleasant for those concerned (KÜBLER 1995; JÄGER & LITSCHAUER 1998; ZWANDER 2000). In addition, either of the two species has been spreading considerably in Austria over the past few years (ESSL & WALTER in press). Also the neophyte *Iva xanthiifolia* contains highly allergenic pollen. It is so far rare in Austria, but already widely distributed in some of our neighbouring countries (e.g. Slovakia).

Horseweed (*Conyza canadensis*)



Garden lupin (*Lupinus polyphyllus*)



1.3 National and International Framework Conditions and Legal Basis

1.3.1 International level

At the international level efforts are taken to further a uniform practice and legal basis for addressing the issue of alien species (IUCN 2001; McNEELY et al. 2001; KIEHN & NOUAK in press). The present Action Plan on Invasive Alien Species is based on the requirements elaborated in this context.

Of particular importance are the “Guidelines for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species” adopted at the 6th Conference of the Parties to the CBD (CBD/COP6/VI/23) as well as the relevant EU provisions. In these “guidelines to alien species” Member States are urged to pay particular attention to the prevention and scientific investigation of the impacts of invasive alien species (BIODIV 2002).

The recommendations are based on the obligation set out in Article 8(h) of the Conference on Biological Diversity (CBD) “to prevent, as far as possible and as appropriate, the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species”.

As a part of the programme “Environment for Europe”, in which the countries of Eastern and Western Europe jointly advocate and support an environmentally benign and sustainable economic recovery of the Eastern European countries, the Pan-European Biological and Landscape Diversity Strategy has been developed as a tool for the implementation of the CBD in Europe. As one of its principles the Second Intergovernmental Conference held in Budapest in February 2002 emphasised the control of the introduction of exotic species into natural habitats¹.

At the 5th Ministerial Conference “Environment for Europe” (Kiev, May 2003) the Ministers of the Environment of the Pan-European region adopted a resolution on biodiversity. This resolution also sets forth the target to implement the “European Strategy on Invasive Species” by the year 2008 in the Pan-European Region. The Strategy was devised on the initiative of the Council of Europe and adopted by the Standing Committee of the Bern Convention in December 2003 (COUNCIL OF EUROPE 2003).

The Bonn Convention on the Conservation of Migratory Species of Wild Animals and the Bern Convention on the Conservation of Wildlife and Natural Habitats contain recommendations on measures relating to the introduction, the re-introduction, but also the eradication of alien species. Although

Austria ratified the Bern Convention already in 1982 (Federal Law Gazette No 372/1983), these recommendations have not yet been implemented e.g. in the Austrian laws regulating fishery or hunting. For instance, in the case of stocking with non-indigenous fish there are so far no mandatory inspections for detrimental effects with autochthonous species and ecosystems. Also the release of non-indigenous game birds like pheasants has not yet been regulated in this respect.

Within the framework of the Ramsar Convention on the “conservation of wetlands” a resolution was adopted in 1999 which pays particular attention to addressing the issue of “invasive species and wetlands” and since the year 2000 also the Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora contains a decision which refers to synergies with other international agreements (like the CBD) in the treatment of this issue.

At the level of the European Union, research activities have been intensified over the past few years with the goal of improving the understanding of biological invasions. Examples of these activities are the projects GIANTALIEN (study on the invasion process of Giant hogweed), EPIDEMIE (impacts of biological invasions on Mediterranean islands), ALARM (risk analysis of biological invasions), BALLAST (transport of alien species in ballast water from ships), and DAISIE (delivering alien invasive species inventories for Europe).

1.3.2 National level

Since October 2002 the study “Neobiota in Österreich” is available for Austria; it was conducted on behalf of the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW) and the Austrian Federal Environment Agency and published as a paper of the latter (ESSL & RABITSCH 2002). The alien species (neophytes, neomycetes and neozoa) listed in the study are characterised in terms of spread and current status, importance for nature conservation, and adverse economic impacts. The study contains also information concerning geographic origin, spread and colonized habitats of alien species in Austria. To provide information to a broader public, the BMLFUW already published a booklet, entitled “Die ‘Aliens’ kommen!” (The ‘aliens’ are coming!). Information on alien species is offered also on the BMLFUW’s homepage (www.lebensministerium.at) and under www.biodiv.at and www.naturschutz.at. Also a volume of the BMLFUW’s so-called “Grüne Reihe” (Green Series), which is presently being published, is dedicated to the issue.

In October 2002 the BMLFUW organised an expert meeting on neobiota. Also the outcomes of the meeting on alien species (12 February 2003) held by the working group for the implementation of the CBD/COP6 resolutions of the Austrian National Biodiversity Commission were taken into account. As a result of the existing studies the pressing need for a continued, technical and differentiated approach to this topic was emphasised.

The issue of alien species is addressed in several substantive laws. Many of the relevant legal matters are within the competence of Austria’s Federal Provinces (e.g. laws pertaining to the conservation of nature, hunting and fishery), which means that always nine provincial laws are concerned.

Other relevant subjects of law fall under the competence of the Republic of Austria (e.g. Forest Acts, Environmental Control Act). The examination and harmonisation of existing subjects of the law with respect to gaps, obstacles or counterproductive provisions constitute important activities under the Action Plan on Invasive Alien Species (Chapter 2.5).

1.4 Structure of the Action Plan

1.4.1 Scope

The Action Plan on Invasive Alien Species relates to alien species as defined in the CBD (Chapter 1.4.2) of all taxonomic groups und taxonomic levels (species, sub-species, strains, varieties etc.). This definition complies with the criteria applied in the study on alien species in Austria (ESSL & RABITSCH 2002²).

The Action Plan on Invasive Alien Species does not refer to genetically modified organisms (GMO).

1.4.2 Terminology

The terminology is based on the definitions applied in the “Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species” of the 6th Conference of the Parties to the CBD (CBD/COP6/VI/23):

² Due to a lack of data adequate consideration of low taxonomic levels (strains, varieties) was not feasible.

Mandarin duck (*Aix galericulata*)



Pheasant (*Phasianus colchicus*)



Linden ground bug (*Oxycarenus lavaterae*)



Signal crayfish (*Pacifastacus leniusculus*)



¹ [http://www.strategyguide.org/docs/budapest/STRA-CO%20\(2002\)%2042.doc](http://www.strategyguide.org/docs/budapest/STRA-CO%20(2002)%2042.doc)

- I **“alien species”** refers to a species, subspecies or lower taxon, introduced outside its natural past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce;
- II **“invasive alien species”**³ means an alien species whose introduction and/or spread threatens biological diversity;
- III **“potentially invasive alien species”** means an alien species whose introduction and/or spread has the potential to pose a threat to biological diversity. Potentially invasive alien species are species which are presently spreading so strongly that they will probably be invasive alien species within a period of several years or decades. In many cases these potentially invasive alien species occur already in regions of neighbouring countries.
- IV **“introduction”** refers to the movement by human agency, indirect or direct, of an alien species outside of its natural range (past or present). This movement can be either within a country or between countries or areas beyond national jurisdiction;

- V **“intentional introduction”** refers to the deliberate movement and/or release by humans of an alien species outside its natural range;
- VI **“unintentional introduction”** refers to all other introductions which are not intentional;
- VII **“establishment”** refers to the process of an alien species in a new habitat successfully producing viable offspring with the likelihood of continued survival;
- VIII **“risk analysis”** refers to
 - 1 the assessment of the consequences of the introduction and of the likelihood of establishment of an alien species using science-based information (i.e., risk assessment), and
 - 2 to the identification of measures that can be implemented to reduce or manage these risks (i.e., risk management), taking into account socio-economic and cultural considerations.

The definitions given above have been used (slightly modified) also in the study “Neobiota in Österreich” (ESSL & RABITSCH 2002).

³ In scientific literature the term “invasive” is used to define a status category and therefore has two meanings, depending on the context (KOWARIK 2003).

1.4.3 Structure

The Action Plan on Invasive Alien Species is structured according to the following topical issues:

- Education and awareness-raising (Chapter 2.2)
 - Capacity building (Chapter 2.3)
 - Research and monitoring (Chapter 2.4)
 - Legal and organisational implementation (Chapter 2.5)
- In the topical fields the assigned objectives and goals are numbered and summarised by superordinate goals, and presented in uniformly structured tables:
- **Objectives:** Indication of the sub-goals to be reached within the framework of the Action Plan on Invasive Alien Species.
 - **Measures:** Indication of the measures required to reach the defined objectives. In some cases more than one measure has been assigned to one objective.
 - **Time-periods:** Indication of the period within which the proposed measures are to be launched.
 - Short-term: < 3 years
 - Medium-term: 3–5 years
 - Long-term: > 5 years

- **Priority:** Indication of the degree of priority with which the proposed measures are to be implemented.
 - Low: Implementation of the proposed measures is moderately urgent to reach the objective.
 - Medium: Implementation of the proposed measures is highly urgent to reach the objective.
 - High: Implementation of the proposed measures is of essential importance to reach the objective.
 - **Actors:** Indication of the institutions, groups of individuals, vocational groups and organisations concerned by the implementation of proposed measures. Indicated are all actors that may be of importance for the implementation of measures. This concerns the fields of funding and implementation (e.g. project management, integration of existing data, information and preparatory work).
- A brief general text setting out the priorities is placed at the beginning of each topical issue.



Sycamore lace bug (*Corythucha ciliata*)



Late goldenrod (*Solidago gigantea*)



Snapdragon (*Antirrhinum majus*)



Black locust (*Robinia pseudacacia*)



Black locust (*Robinia pseudacacia*)

2 Action plan on invasive alien species: Objectives and activities

2.1 Objectives

The Action Plan on Invasive Alien Species strives to develop and implement coordinated and internationally harmonised measures with the intention of minimising, or preventing, present and future adverse impacts of alien species on biodiversity, the economy and health.

The species referred to in greater detail in the Action Plan have been selected taking into account whether they pose a threat to biological diversity or cause either economic or health problems. This group of species includes also invasive alien species which are considered problematic because they are presently spreading rapidly or because problematic experiences have been made with them in countries close to Austria. As opposed to this, the Action Plan is not directed towards the majority of alien species, which do not cause any economic or ecological problems.

When implementing the Action Plan on Invasive Alien Species activities are to be launched primarily for those species that are invasive or potentially invasive and that pose a problem for the conservation of nature or for the economy. Furthermore, species posing a risk to human or veterinary health are to be considered.

2.2 Education and awareness-raising

The technically differentiated communication of the issue to political decision-makers and administrative authorities as well as to the broad public is considered an essential step towards efficient awareness-raising. Information and awareness-raising in this field have to be provided at different levels (e.g. science, agricultural secondary colleges, owners of aquariums and terrariums, animal breeders, persons trading in animals, market gardens and nurseries, trade, hotel and catering industry). It will also be of particular importance to address the issue in connection with the information of decision-makers, the training of multipliers (e.g. teachers and eco-coaches), groups of individuals and vocational groups concerned (farmers and foresters, hunters, fishermen). In many cases introduction is also the result of travelling, which means that providing information to, and awareness-raising of, travellers by air(port) staff and travel agencies are of great importance.

No	Objectives	Measures	Time-periods	Priority	Actors
Information, awareness-raising, and establishment of networks at the national level					
2.2.1	Establishment of an information centre	<ul style="list-style-type: none"> Establishment of an information centre to offer competence, public relations work, press releases (see Chapter 2.3) 	short-term	high	BMLFUW ⁴ , Provincial Governments, Austrian Federal Environment Agency, Universities, Museum of Natural History, various media, other
2.2.2	Awareness-raising and public relations work for individuals and vocational groups concerned	<ul style="list-style-type: none"> Preparation of brochures and information material for individuals and vocational groups concerned Addressing the issue of invasive alien species (IAS) in curricula and teaching kits Organisation of voluntary seminars and training programmes e.g. for farmers and foresters, owners of aquariums and terrariums, animal and plant breeders and dealers, market gardeners, hunters, fishermen etc. Preparation of a popular scientific book with short descriptions of important IAS 	short-term and medium-term	high	BMLFUW, Provincial Governments, administrative offices of biosphere parks and national parks, NGOs (e.g. Forum Umweltbildung), secondary technical schools for farmers and foresters, associations of interest, tourism, trade, other

⁴ BMLFUW: Federal Ministry of Agriculture, Forestry, Environment and Water Management

No	Objectives	Measures	Time-periods	Priority	Actors
Information, awareness-raising, and establishment of networks at the national level					
2.2.3	Information of multipliers	<ul style="list-style-type: none"> Technically differentiated communication of the issue to the political decision-makers and administrative authorities as well as to the broad public Addressing the issue of alien species in the training of multipliers (e.g. teachers at secondary high schools and Universities, technical Universities, and agricultural and forestry technical schools, guides in national parks and eco-coaches) 	medium-term	medium	BMLFUW, Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ⁵ , media, NGOs (e.g. Forum Umweltbildung), Universities, administrative offices of biosphere parks and national parks, vocational colleges, associations of interest, other
2.2.4	Spreading and imparting of topical, up-to-date information and data at the national level	<ul style="list-style-type: none"> Regular distribution of an email newsletter ("neobiota austria") (information about new publications, projects, meetings etc.) Access to the database on alien species, e.g. via www.biodiv.at (see Chapter 2.4) 	medium-term	low	BMLFUW, Provincial Governments, Austrian Federal Environment Agency, Universities, Museum of Natural History, various media, other
Information, awareness-raising, and establishment of networks at the international level					
2.2.5	Spreading and imparting of information and data at the international level	<ul style="list-style-type: none"> Stronger involvement into international projects and strategies relating to the management of IAS (e.g. GISP, ISSG, IUCN, IPPC, EPPO, ERNAIS and others) Improving the transfer of national data and information to neighbouring countries (e.g. Internet database on IAS) Stronger participation in international meetings, seminars and workshops 	medium-term and long-term short-term	high	BMLFUW, Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL, Universities, Museum of Natural History, other

⁵ AGES-BFL: Austrian Agency for Health and Food Safety – Agricultural Inspection Service and Research Centre

2.3 Capacity building

The complex nature of the issue of biological invasions requires a high degree of harmonisation and streamlining as well as committed cooperation with many experts, authorities and representations of interest both on national and international level. Where measures to control problematic alien species are

to be implemented in an efficient and purposeful way, reliable, speedy and accurate information exchange is a must.

A focal point for alien species, which is to serve as an information pool and contact point both on national and international level, is to be established at a central location.

No	Objectives	Measures	Time-periods	Priority	Actors
Building national capacities and linking them					
2.3.1	Establishment of a central information body	<ul style="list-style-type: none"> Establishment and funding of a national focal point on alien species at a central location (e.g. Austrian Federal Environment Agency) 	short-term	high	BMLFUW ⁶ , Provincial Governments, Austrian Federal Environment Agency, Universities, Museum of Natural History, various media, other
2.3.2	Establishment of a national "Neobiota" working group for alien species	<ul style="list-style-type: none"> Establishment of a "Neobiota" working group in the Austrian Biodiversity Commission (exchange of data, information and experiences) 	short-term	medium	BMLFUW, Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ⁷ , Universities, NGOs, representations of interest
2.3.3	National cooperation, discussion and networking with different user groups and stakeholders	<ul style="list-style-type: none"> Stronger incorporation of the issue of IAS in expert committees (e.g. Advisory Board for Fishery, Working Group on Plant Genetic Resources and others) Organisation of interdisciplinary seminars and events with representatives from science, user groups and stakeholders 	short-term	medium	BMLFUW, Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ⁷ , NGOs, associations of interest, tourism, trade, fishery and hunting unions, other
2.3.4	Stronger establishment of the issue of alien species on university level	<ul style="list-style-type: none"> Establishment of lectures on the issue of alien species Establishment of a professorial chair for invasion ecology 	medium-term long-term	low	Universities
Capacity-building on international level and interlinkage of the capacities built					
2.3.5	International cooperation and networking in consideration of the necessity of coordinated acting and priority-setting	<ul style="list-style-type: none"> Enhancing bilateral and multilateral cooperation between neighbouring countries and trade partners (e.g. Interreg, Phare) Improving international know-how transfer (e.g. efficient dissemination of information on ecological aspects, problems and mitigation activities relating to IAS to neighbouring countries) Enhancing international harmonisation and further development of education and training programmes Stronger participation in international workshops and meetings 	short-term and long-term	high	BMLFUW ⁶ , BMBWK ⁸ , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ⁷ , Austrian Academy of Sciences, Universities, other

6 BMLFUW: Federal Ministry of Agriculture, Forestry, Environment and Water Management

8 BMBWK: Federal Ministry for Education, Science and Culture

7 AGES-BFL: Austrian Agency for Health and Food Safety – Agricultural Inspection Service and Research Centre

2.4 Research and monitoring

Even though research in the field of alien species has increased in Europe over the past few years, our knowledge is still rather incomplete. As concrete studies on ecology, spread, commonness or rarity, on competitive behaviour and relevant changes in biotopes are lacking, assessing the impacts of alien species on Central European communities and species is presently often possible only provisionally or to a limited extent. For assessments of economic impacts, the situation is similar.

Also in the case of Austria impacts are but inadequately documented. In particular, the scattered key data would require synthetic evaluation and processing; without them the quantification of the extent of economic, ecological and health problems and the development of effective strategies at the political and administrative level are impossible. The existing data on the occurrence, spread, commonness, impacts and control

measures relating to invasive alien species are therefore to be collected in a central database of alien species. This database should be harmonised with a EU research project (DAISIE) on the establishment of a European database on alien species.

Successful containment of established and commonly found invasive alien species is very difficult and requires huge efforts (at minor chances of success). Particular attention has therefore to be paid to the documentation and preventive scientific investigation of potentially invasive alien species to ensure that problematic species are detected as early as possible (early-warning system). Furthermore, species which have established themselves should be monitored in order that ongoing changes can be identified at an early stage (control system). Austria should aim at a harmonisation with the national biodiversity monitoring which is being prepared as well as with monitoring standards developed on EU level (ALTER-Net).

No	Objectives	Measures	Time-periods	Priority	Actors
Management, updating and supplementing of key data					
2.4.1	Guaranteed continuous management and interlinkage of data on the spread of alien species in Austria	<ul style="list-style-type: none"> Establishment of a database in line with the research project of the European Union (FP6, Subpriority 1.1.6.3 Call 2) Taking over the data describing spread and public presentation (e.g. at www.biodiv.at) 	short-term	high	BMLFUW ⁹ , BMBWK ¹⁰ , Austrian Federal Environment Agency, national data collections on biodiversity (e.g. floristic mapping of Austria, survey database Zobodat, GÖTZL 2003)
2.4.2	Updating of the data on alien species in Austria and improvement of data quality and data management	<ul style="list-style-type: none"> Regular updating of the database for alien species (approx. every 5 years) Continuous management and updating of the database on alien species 	medium-term	high	BMLFUW ⁹ , BMBWK ¹⁰ , Austrian Federal Environment Agency, national data collections on biodiversity (e.g. floristic mapping of Austria, survey database Zobodat, GÖTZL 2003)
2.4.3	Working out maps showing the spread of the relevant species	<ul style="list-style-type: none"> Working out up-to-date maps showing the spread of all invasive alien species Presentation of the "spread maps" (e.g. at www.biodiv.at) 	short-term	medium	BMLFUW ⁹ , BMBWK ¹⁰ , Austrian Federal Environment Agency, national data collections relating to biodiversity (e.g. floristic mapping of Austria, survey database Zobodat, GÖTZL 2003)
2.4.4	Study of important systematic groups of species not yet considered	<ul style="list-style-type: none"> Carrying out of research projects concerning the collection of supplementary systematic groups (micro-organisms, low-order fungi, invertebrates, specific insect orders) 	long-term	low	BMLFUW ⁹ , BMBWK ¹⁰ , Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, Universities, Museum of Natural History

9 BMLFUW: Federal Ministry of Agriculture, Forestry, Environment and Water Management

10 BMBWK: Federal Ministry for Education, Science and Culture

No	Objectives	Measures	Time-periods	Priority	Actors
Scientific study of the ecology, the impacts and mitigation of impacts of alien species					
2.4.5	Case studies on individual, particularly problematic alien species	<ul style="list-style-type: none"> Conducting case studies on ecology, impacts and mitigation of impacts (e.g. Black locust, Common ragweed, Spanish slug) Formulation of concrete measures for selected, particularly important species 	medium-term	high	BMLFUW ¹¹ , BMBWK ¹² , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ¹³ , Universities, Museum of Natural History, administrative offices of biosphere parks and national parks, Austrian Academy of Sciences
2.4.6	Enhanced scientific examination of the ecology, impacts and mitigation of impacts of alien species of relevance to economy and health	<ul style="list-style-type: none"> Stronger integration of the issue in national research programmes (e.g. ProVision, PFEIL05¹⁴, Jubilee Fund of the Austrian National Bank, MaB research) Stronger participation of Austrian institutions in international research projects (e.g. FP6 of the EU) 	medium-term	high	BMLFUW ¹¹ , BMBWK ¹² , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ¹³ , Universities, Austrian Academy of Sciences, other
2.4.7	Enhanced scientific examination of the ecology, impacts and mitigation of impacts of potentially alien species of relevance to nature conservation	<ul style="list-style-type: none"> Stronger integration of the issue in national research programmes (e.g. ProVision, PFEIL05, Austrian Science Fund (FWF), MaB research) Stronger participation of Austrian institutions in international research projects (e.g. FP6 of the EU) 	medium-term	medium	BMLFUW ¹¹ , BMBWK ¹² , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ¹³ , Universities, Museum of Natural History, administrative offices of biosphere parks and national parks, Austrian Academy of Sciences
2.4.8	Case studies on disputed alien species between different groups of interest	<ul style="list-style-type: none"> Investigation of the economic significance and of potential conflicts concerning nature conservation in connection with disputed alien species Carrying out cost-benefit and risk analyses on disputed alien species 	medium-term	medium	BMLFUW ¹¹ , BMBWK ¹² , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, Universities, Museum of Natural History, Austrian Academy of Sciences, representations of interest, trade
2.4.9	Application, documentation, review of progress and further development of measures to mitigate the impacts of invasive alien species	<ul style="list-style-type: none"> Working out and carrying out a plan for the implementation of measures to mitigate impacts of important problematic IAS Conducting case studies for the further development and testing of mitigation activities Documentation of the success of mitigation activities 	short-term medium-term long-term	medium	BMLFUW ¹¹ , BMBWK ¹² , Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, Universities
2.4.10	Scientific examination of pathways	<ul style="list-style-type: none"> Scientific examination of the importance of pathways in different sectors (e.g. fisheries, agriculture and forestry, horticulture, shipping, ground and air transportation, landscaping, aquaculture, tourism etc.) and formulation of mitigation activities 	short-term and medium-term	low	BMLFUW ¹¹ , BMBWK ¹² , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, Universities, Museum of Natural History, Austrian Academy of Sciences, fishing and hunting associations

11 BMLFUW: Federal Ministry of Agriculture, Forestry, Environment and Water Management

12 BMBWK: Federal Ministry for Education, Science and Culture

13 AGES-BFL: Austrian Agency for Health and Food Safety – Agricultural Inspection Service and Research Centre

14 PFEIL05: Programme for research and development of the Austrian 'Ministry of Life' (BMLFUW)

No	Objectives	Measures	Time-periods	Priority	Actors
Scientific study of the ecology, the impacts and mitigation of impacts of alien species					
2.4.11	Compilation of a Black/Grey/White List of alien species	<ul style="list-style-type: none"> Carrying out a research project on the formulation of Black/Grey/White List of alien species (Switzerland, SKEW 2002) 	medium-term	low	BMLFUW ¹⁵ , BMBWK ¹⁶ , Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, Universities, Museum of Natural History, associations of interest, NGOs, other
Monitoring of alien species					
2.4.12	Elaboration of a monitoring plan for IAS which are problematic for nature conservation or involve problematic economic or health consequences (early warning and control system). As the establishment of problematic IAS is usually irreversible, preventive measures are of particular importance	<ul style="list-style-type: none"> Working out a monitoring plan for alien species (identification of indicators, design of the survey) Harmonisation of the monitoring plan for alien species with national biodiversity monitoring which is in the preparatory phase 	medium-term	high	BMLFUW ¹⁵ , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ¹⁷ , Universities
2.4.13	Monitoring of established alien species (early warning and control system)	<ul style="list-style-type: none"> Implementation of the monitoring plan for alien species taking into account the national biodiversity monitoring which is in the preparatory phase 	long-term	high	BMLFUW ¹⁵ , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ¹⁷ , Universities
2.4.14	Monitoring and scientific study of alien species in protected areas (biosphere parks, national parks, Natura 2000 areas, nature protection areas)	<ul style="list-style-type: none"> Including alien species into the monitoring programme for protected areas (e.g. Natura 2000 monitoring, BRIM, national parks) Scientific examination of the impacts of alien species in protected areas 	short-term	low	BMLFUW ¹⁵ , Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, Provincial - Governments, administrative offices of biosphere parks and national parks, Universities, NGOs, Austrian Academy of Sciences
Working out of forecast models					
2.4.15	Assessment of the impacts of "global change" (climate change, eutrophication, changes relating to habitats etc.) on established and not (yet) established IAS (e.g. RABITSCH 2003)	<ul style="list-style-type: none"> Working out forecast models on the response of IAS to "global change" (e.g. forecast models, correlation analyses on the dependence of selected parameters) Scientific examination of the impacts of climate change on IAS Conducting of case studies on the assessment of climate change to important problematic IAS (e.g. Black locust, Common ragweed) 	medium-term	high	BMLFUW ¹⁵ , BMBWK ¹⁶ , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ¹⁷ , Universities, Museum of Natural History, other
2.4.16	Analyses of the ecological and socio-economic impacts of alien species	<ul style="list-style-type: none"> Carrying out of a project on the post-hoc presentation of the economic and ecological costs incurred due to problematic alien species (PIMENTEL 2002) Cost-benefit analyses of ecological and socio-economic impacts of alien species 	medium-term	medium	BMLFUW ¹⁵ , BMBWK ¹⁶ , Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ¹⁷ , Universities, Museum of Natural History, other

15 BMLFUW: Federal Ministry of Agriculture, Forestry, Environment and Water Management

16 BMBWK: Federal Ministry for Education, Science and Culture

17 AGES-BFL: Austrian Agency for Health and Food Safety – Agricultural Inspection Service and Research Centre

2.5 Legal and organisational implementation

To mitigate present, and avoid future, negative impacts, legal and organisational implementation are of utmost importance. The required activities are to be carried out on the basis of the key technical data and in compliance with international requirements and developments.

Presently most of the alien species found in Austria cause no, or only minor, impacts, but a few of them involve severe ecological, economic or health consequences. The legal and organisational implementation will therefore focus on the group of the problematic and potentially problematic species.

No	Objectives	Measures	Time-periods	Priority	Actors
Prevention					
2.5.1	Development of preventive measures: Implementation of the principle of prevention (CBD and CBD/COP6/VI/23)	<ul style="list-style-type: none"> Analysis of deficits relating to preventive measures (e.g. import regulations, border controls, phytosanitary measures, quarantine measures, mitigation activities) Improvement of preventive measures Provisions to minimise unintentional introduction (e.g. through tourism, agriculture and forestry, horticulture, shipping of goods and the like) Organisation of (capacity-building) training programmes for customs authorities Examination of possibilities to introduce – on EU level – regulations requiring approval for the introduction or inspection of species already known to be problematic after completion of risk analyses, incl. Environmental Impact Assessment 	medium-term	high	BMLFUW ¹⁸ , Provincial Governments, Austrian Federal Environment Agency, AGES-BFL ¹⁹ , Austrian Federal Office and Research Centre for Forests, NGOs, Associations of interest, tourism, trade, customs authorities, other
Implementation of legal and organisational countermeasures					
2.5.2	Early and coordinated acting upon the introduction of problematic alien species ("Guiding Principle 2" of the CBD/COP6/VI/23)	<ul style="list-style-type: none"> Devising a plan of measures for alien species expected to be problematic Early containment, control and eradication of problematic alien species 	long-term	high	BMLFUW ¹⁸ , Provincial Governments, Austrian Federal Environment Agency, AGES-BFL ¹⁹ , Austrian Federal Office and Research Centre for Forests, NGOs, associations of interest, trade, customs authorities, other
2.5.3	Examination and streamlining of existing subjects of laws, primarily laws on nature conservation, forestry and hunting	<ul style="list-style-type: none"> Checking the relevant substantive laws for gaps, barriers and counterproductive provisions 	short-term	high	BMLFUW ¹⁸ , BMBWK ²⁰ , Provincial Governments
2.5.4	Development of recommendations for action to associations of interest and political decision-makers	<ul style="list-style-type: none"> Deducing well-founded recommendations for action on the basis of research results and cost-benefit analyses 	short-term and long-term	medium	BMLFUW ¹⁸ , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ¹⁹ , Universities, NGOs, associations of interest

18 BMLFUW: Federal Ministry of Agriculture, Forestry, Environment and Water Management

19 AGES-BFL: Austrian Agency for Health and Food Safety – Agricultural Inspection Service and Research Centre
20 BMBWK: Federal Ministry for Education, Science and Culture

No	Objectives	Measures	Time-periods	Priority	Actors
Implementation of legal and organisational countermeasures					
2.5.5	Harmonisation of national and international practices concerning the implementation of phytosanitary measures	<ul style="list-style-type: none"> Considering relevant international regulations in the fields of plant protection, seeds and horticulture etc. (mainly IPCC standards²¹) More efficient harmonisation of national and international legal and organisational activities with neighbouring states Active cooperation of Austria in the further development of international regulations pertaining to phytosanitary and quarantine measures Active cooperation of Austria in the further development of international strategies relating to IAS (e.g. ISSG, CBD, European Strategy on Invasive Alien Species, GISP, MaB-programme) 	medium-term	medium	BMLFUW ²² , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ²³ , botanic gardens, market gardens, tree nurseries, trade, customs authorities, other
2.5.6	Settlement of the question of liability concerning alien species	<ul style="list-style-type: none"> Active participation in the development of guidelines for the regulation of liability on EU level ("Guiding Principle 10" of the CBD/COP6/VI/23) 	long-term	low	BMLFUW ²² , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ²³
Assessment and provision of the resources required for the implementation of the Action Plan on Invasive Alien Species					
2.5.7	Assessment of resource requirements and resource providers for the implementation of the Guiding Principles (CBD) and the Action Plan on Invasive Alien Species	<ul style="list-style-type: none"> Assessment of the resource requirements and resource providers Provision of the funds required to implement the Action Plan on Invasive Alien Species 	short-term	high	BMLFUW ²² , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ²³ , Universities
2.5.8	Comparative analyses of the costs of mitigation activities concerning problematic alien species	<ul style="list-style-type: none"> Conducting comparative analyses of the costs of mitigation activities concerning problematic alien species 	medium-term	low	BMLFUW ²² , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ²³ , Universities
Evaluation and further development of the Action Plan on Invasive Alien Species					
2.5.9	Evaluation of the Action Plan on Invasive Alien Species	<ul style="list-style-type: none"> Evaluation of the progress made with respect to the objectives of the Action Plan on Invasive Alien Species (after approx. 5 years) Analysis and presentation of factors hindering or helping the accomplishment of goals 	medium-term	high	BMLFUW ²² , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ²³ , Universities
2.5.10	Further development and revision of the Action Plan on Invasive Alien Species	<ul style="list-style-type: none"> Further development and revision of the Action Plan on Invasive Alien Species on the basis of the evaluation results 	long-term	high	BMLFUW ²² , Provincial Governments, Austrian Federal Environment Agency, Austrian Federal Office and Research Centre for Forests, AGES-BFL ²³ , Universities

21 <http://www.ipcc.int>

22 BMLFUW: Federal Ministry of Agriculture, Forestry, Environment and Water Management

23 AGES-BFL: Austrian Agency for Health and Food Safety – Agricultural Inspection Service and Research Centre

3 Bibliography

- BIODIV (2002): Decision VI/23: Alien species that threaten ecosystems, habitats or species. (<http://www.biodiv.org/decisions/default.asp?lg=0&m=cop-06&d=23>) (Access: December 2002).
- CANYON, D.; SPEARE, R.; NAUMANN, I. & WINKEL, K. (2002): Environmental and Economic Costs of Invertebrate Invasions in Australia. In: PIMENTEL, D. (2002): Biological Invasions. Economic and Environmental Costs of Alien Plant, Animal and Microbe Species. CRC Press (Ithaca, New York), 369 pp.
- CLOUT, M. N. (2002): Ecological and Environmental Costs of Alien Vertebrates in New Zealand. In: PIMENTEL, D. (2002): Biological Invasions. Economic and Environmental Costs of Alien Plant, Animal and Microbe Species. CRC Press (Ithaca, New York), 369 pp.
- COUNCIL OF EUROPE (2003): European Strategy on invasive alien species. Final version. 50 pp.
- CROSBY, A. W. (1986): Ecological Imperialism: The biological expansion of Europe, 900–1900. Cambridge Univ. Press, Cambridge.
- ESSL, F. & RABITSCH, W. (2002): Neobiota in Österreich. Umweltbundesamt, 432 pp.
- ESSL, F. & WALTER, J. (in press): Ausgewählte neophytische Gefäßpflanzenarten Österreichs. Grüne Reihe des Bundesministeriums für Landwirtschaft und Forstwirtschaft, Umwelt und Wasserwirtschaft.
- GÖTZL, M. (2003): Die österreichischen Sammlungen und Datenbanken zur Artenvielfalt. Eine interdisziplinäre Studie im Rahmen der Global Biodiversity Information Facility. Umweltbundesamt, 185 pp.
- IUCN (2001): Guidelines for the Prevention of Biodiversity Loss caused by Alien Invasive Species. (<http://www.iucn.org/themes/ssc/pubs/policy/invasivesEng.htm>) (Access: December 2001).
- JÄGER, S. & LITSCHAUER, R. (1998): Ragweed in Austria. In: SPIEKSMÄ, F. (ed.): Ragweed in Europe, 6th International Congress on Aerobiology, Satellite Symposium Proceedings, pp. 22–26.
- KIEHN, M. & NOUAK, A. (in press): Neobiota und internationale Natur- und Artenschutzabkommen – ein Situationsbericht mit Überlegungen zu Strategien und Einschätzungen betreffend potenziell schädigender Arten. Grüne Reihe des Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft.
- KOWARIK, I. (2003): Biologische Invasionen: Neophyten und Neozoen in Mitteleuropa. Ulmer, Stuttgart, 380 pp.
- KÜBLER, R. (1995): Versuche zur Regulierung des Riesen-Bärenklaus (*Heracleum mantegazzianum*). In: BÖCKER, R.; GEBHARDT, H.; KONOLD, W. & SCHMIDT-FISCHER, S. (eds): Gebietsfremde Pflanzenarten. Auswirkungen auf einheimische Arten, Lebensgemeinschaften und Biotope, pp. 83–87.
- LONSDALE, W. M. (1999): Global patterns of plant invasions and the concept of invasibility. Ecology 80: 1522–1536.
- MACK, R. N.; SIMBERLOFF, D.; LONSDALE, W. M.; EVANS, H.; CLOUT, M. & BAZZAZ, F. (2000): Biotic Invasions: Causes, Epidemiology, Global Consequences and Control. Issues in Ecology 5, 23 pp.
- MCNEELY, J. A.; MOONEY, H. A.; NEVILLE, L. E.; SCHEI, P. J. & WAAGE, J. K. (2001): Global Strategy on Invasive Alien Species. Gland, IUCN, 50 pp.
- PIMENTEL, D. (2002): Biological Invasions. Economic and Environmental Costs of Alien Plant, Animal and Microbe Species. CRC Press (Ithaca, New York), 369 pp.
- PIMENTEL, D.; LACH, L.; ZUNIGA, R. & MORRISON, D. (2002): Environmental and Economic Costs associated with Non-indigenous Species in the United States. In: PIMENTEL, D. (2002): Biological Invasions. Economic and Environmental Costs of Alien Plant, Animal and Microbe Species. CRC Press (Ithaca, New York), 369 pp.
- RABITSCH, W. (2003): Klimaänderung und Invasionen – Auswirkungen der Klimaänderung auf nicht-heimische Tierarten (Neozoen) in Österreich. In: KROMP-KOLB, H. & GERERSDORFER, T. (Red.): Auswirkungen von Klimaänderungen auf die Tierwelt. Endbericht Inst. f. Meteorologie und Physik der Univ. f. Bodenkultur.
- RABITSCH, W.; LETHMAYER, C. & GRABENWEGER, G. (in press): Insekten und Spinnentiere. Grüne Reihe des Bundesministeriums für Landwirtschaft und Forstwirtschaft, Umwelt und Wasserwirtschaft.
- RABITSCH, W. & ESSL, F. (in Druck): Biological invasions in Austria: patterns and case studies. Biological Invasions.
- REINHARDT, F., HERLE, M., BASTIANSEN, F. & STREIT, B. (2003): Ökonomische Folgen von Neobiota. Skriptenreihe des Umweltbundesamtes 79/03, 248 pp.
- RITZER, G. (1997): Die McDonaldisierung der Gesellschaft. Fischer Taschenbuch, 336 pp.
- SALA, O. E.; CHAPIN, F. S. III; ARMESTO, J. J.; BERLOW, E.; BLOOMFIELD, J.; DIRZO, R.; HUBER-SANWALD, E. et al. (2000): Global biodiversity scenarios for the year 2100. Science 287: 1770–1774.
- SKEW (2002): Schwarze Liste und Graue Liste und „Watch list“. (http://www.cps-skew.ch/deutsch/schwarze_liste.htm) (Access: May 2003).
- STEIOF, K. (2001): Die Evolution als maßgebliches Kriterium für die naturschutzfachliche Bewertung von Tierarten fremder Herkunft. Natur und Landschaft 76/11: 485–491.
- UMWELTBUNDESAMT (2003): Evaluierung der österreichischen Strategie zur Umsetzung des Übereinkommens über die Biologische Vielfalt. Umweltbundesamt, Berichte 186, 90 pp.
- WHITE, P. C. L. & HARRIS, S. (2002): Economic and Environmental Costs of Alien Vertebrate Species in Britain. In: PIMENTEL, D. (2002): Biological Invasions. Economic and Environmental Costs of Alien Plant, Animal and Microbe species. CRC Press (Ithaca, New York), 369 pp.
- WILCOVE, D. S.; ROTHSTEIN, D.; DUBOW, J.; PHILLIPS, A. & LOSOS, E. (1998): Quantifying threats to imperiled species in the United States. BioScience 48: 607–615.
- ZWANDER, H. (2000): Neue Daten zum Pollenflug des Traubenkrautes (*Ambrosia artemisiifolia*) in Klagenfurt (Kärnten). Linzer biol. Beitr. 32/2: 738–739.

Annex:

List of invasive, potentially invasive, economically problematic, and health-affecting species

The Action Plan on Invasive Alien Species (“Aktionsplan Neobiota”) focuses on invasive and potentially invasive species as well as on economically problematic and health-affecting species (Table 1). In the implementation of the Action Plan on Invasive Alien Species activities are to be carried out primarily with these abovementioned species which are invasive or potentially invasive and not economically benign. Also species which involve impacts on human health are to receive strong consideration (cf. Tables 1 and 2). The classification is based on the study of ESSL & RABITSCH (2002). Modifications in the list of the invasive and potentially invasive species are possi-

ble as a result of new scientific findings or the unexpectedly strong spread of new invasive alien species.

According to the list seventeen of the vascular plant species are invasive, an additional eighteen have been classified as potentially invasive²⁴. Of the fungal species, five have been classified as invasive, one as potentially invasive. Six animal species have been classified invasive, an additional 41 as potentially invasive. Some of these animal and plant species are also economically problematic or pose a risk to health, others are economically benign (mainly in agriculture, forestry and commercial horticulture).

Table 1: List of invasive and potentially invasive alien (plant, fungal and animal) species according to ESSL & RABITSCH (2002). Separate columns show whether species involve problematic economic or health consequences or are economically benign. Black locust and ash-leaved maple appear in the column “economically problematic” as well as in the column “economically benign”, which is due to the fact that they can have positive or negative impacts, depending on the respective user group. For the definitions regarding the columns “invasive” and “potentially invasive” see Chapter 1.4.2 and Chapter 2.3.4 in ESSL & RABITSCH (2002). Legend: (X) = partly applying. X? = doubtful, if applying.

Taxonomic group	Scientific name	Common name	Invasive	Potentially invasive	Economically problematic	Econ. benign	Problematic for health
Vascular plants	<i>Acer negundo</i>	Ash-leaved maple	X		X	(X)	
Vascular plants	<i>Ailanthus altissima</i>	Tree-of-Heaven	X			(X)	
Vascular plants	<i>Ambrosia artemisiifolia</i>	Common ragweed		X	(X)		X
Vascular plants	<i>Amorpha fruticosa</i>	Bastard indigobush		X			
Vascular plants	<i>Asclepias syriaca</i>	Common milkweed		X			
Vascular plants	<i>Aster lanceolatus</i>	Narrow-leaved Michaelmas-daisy	X				
Vascular plants	<i>Aster novi-belgii</i>	Confused Michaelmas-daisy	X				
Vascular plants	<i>Bidens frondosa</i>	Devils beggarticks	X				
Vascular plants	<i>Buddleja davidii</i>	Butterfly-bush		X		(X)	
Vascular plants	<i>Duchesnea indica</i>	Indian mock-strawberry		X			
Vascular plants	<i>Elaeagnus angustifolia</i>	Oleaster		X			
Vascular plants	<i>Elodea canadensis</i>	Canadian pondweed	X				
Vascular plants	<i>Elodea nuttallii</i>	Nuttall's pondweed		X			
Vascular plants	<i>Epilobium ciliatum</i>	American willowherb	X				
Vascular plants	<i>Fallopia japonica</i>	Japanese knotweed	X		X		
Vascular plants	<i>Fallopia japonica x sachalinensis</i> (= <i>F. x bohemica</i>)	Hybrid knotweed		X	X		
Vascular plants	<i>Fallopia sachalinensis</i>	Giant knotweed		X	X		
Vascular plants	<i>Fraxinus pennsylvanica</i>	Patmore ash	X			(X)	
Vascular plants	<i>Glyceria striata</i>	Fowl manna grass		X			
Vascular plants	<i>Heracleum mantegazzianum</i>	Giant hogweed		X	(X)		X
Vascular plants	<i>Helianthus tuberosus</i>	Jerusalem artichoke	X			(X)	
Vascular plants	<i>Impatiens glandulifera</i>	Himalayan balsam	X				
Vascular plants	<i>Impatiens parviflora</i>	Small balsam	X				
Vascular plants	<i>Lupinus polyphyllus</i>	Garden lupin		X			
Vascular plants	<i>Mahonia aquifolium</i>	Holly mahonia		X			
Vascular plants	<i>Pinus strobus</i>	Eastern white pine		X		(X)	

²⁴ Half-highbush blueberry (*Vaccinium angustifolium x corymbosum*), which has recently been found wild for the first time in Austria and is invasive in Germany, has to be added to these species.

Taxonomic group	Scientific name	Common name	Invasive	Potentially invasive	Economically problematic	Econ. benign	Problematic for health
Vascular plants	<i>Populus x canadensis</i>	Canadian poplar	X			X	
Vascular plants	<i>Prunus serotina</i>	Black cherry		X			
Vascular plants	<i>Pseudotsuga menziesii</i>	Douglas-fir		X		X	
Vascular plants	<i>Robinia pseudacacia</i>	Black locust	X		X	X	
Vascular plants	<i>Rudbeckia laciniata</i>	Cutleaf coneflower	X				
Vascular plants	<i>Senecio inaequidens</i>	South African ragwort		X			
Vascular plants	<i>Solidago canadensis</i>	Canadian goldenrod	X				
Vascular plants	<i>Solidago gigantea</i>	Late goldenrod	X		X		
Vascular plants	<i>Syringa vulgaris</i>	Lilacs		X		(X)	
Moss	<i>Campylopus introflexus</i>	-		X?			
Fungi	<i>Aphanomyces astaci</i>	causes crayfish plague	X		X		
Fungi	<i>Cryphonectria parasitica</i>	causes chestnut blight fungus	X		X		
Fungi	<i>Ophiostoma novo-ulmi</i>	causes Dutch elm disease	X		X		
Fungi	<i>Ophiostoma ulmi</i>	causes Dutch elm disease	X		X		
Fungi	<i>Phytophthora cambivora x fragariae</i>	causes alder decline	X		X		
Fungi	<i>Mycosphaerella dearnessii</i>	-		X			
Mammals	<i>Mustela vison</i>	American mink		X?	(X)		
Mammals	<i>Nyctereutes procyonoides</i>	Raccoon dog		X?	(X)		
Mammals	<i>Ondatra zibethicus</i>	Muskrat	X?		(X)		
Mammals	<i>Rattus norvegicus</i>	Brown rat		X?	(X)		
Mammals	<i>Procyon lotor</i>	Raccoon		X?	(X)		
Birds	<i>Alectoris chukar</i>	Chukar partridge		X		(X)	
Birds	<i>Alectoris rufa</i>	Red-legged partridge		X		(X)	
Birds	<i>Phasianus colchicus</i>	Pheasant		X		X	
Fish	<i>Ctenopharyngodon idella</i>	Grass carp		X		(X)	
Fish	<i>Hypophthalmichthys molitrix</i>	Silver carp		X		(X)	
Fish	<i>Hypophthalmichthys nobilis</i>	Bighead carp		X		(X)	
Fish	<i>Lepomis gibbosus</i>	Pumpkinseed sunfish		X			
Fish	<i>Neogobius kessleri</i>	Bighead goby		X			
Fish	<i>Oncorhynchus mykiss</i>	Rainbow trout		X		X	
Fish	<i>Pseudorasbora parva</i>	Stone moroko		X			
Reptiles	<i>Emys orbicularis</i> ssp. (non <i>orbicularis</i>)	European pond turtle		X			
Reptiles	<i>Trachemys</i> sp., <i>Pseudemys</i> sp., and other	Various turtle species		X			
Butterflies	<i>Argyresthia trifasciata</i>	-		X			
Butterflies	<i>Coleotechnites piceaella</i>	Kearfott		X			
Butterflies	<i>Phyllonorycter issikii</i>	Lime leaf miner		X			
Butterflies	<i>Theresimima ampelophaga</i>	Vine bud moth		X			
Crustaceans	<i>Chelicorophium curvispinum</i>	-	X?				
Crustaceans	<i>Cyclops vicinus</i>	-		X	X?		
Crustaceans	<i>Dikerogammarus villosus</i>	-	X?				
Crustaceans	<i>Eurytemora velox</i>	-		X	X?		
Crustaceans	<i>Hemimysis anomala</i>	European freshwater shrimp		X			
Crustaceans	<i>Orconectes limosus</i>	Spiny-cheek crayfish	X		(X)		
Crustaceans	<i>Pacifastacus leniusculus</i>	Signal crayfish	X		X	(X)	
Spiders	<i>Dictyna civica</i>	Wall spider		X	X		
Spiders	<i>Pholcus phalangoides</i>	Long-legged cellar spider		X	X		
Spiders	<i>Tegenaria atrica</i>	Common house spider		X?	X		
Harvestmen	<i>Opilio canestrinii</i>	-		X			

Taxonomic group	Scientific name	Common name	Invasive	Potentially invasive	Economically problematic	Econ. benign	Problematic for health
Snails	<i>Arion distinctus</i>	Common garden slug		X	X		
Snails	<i>Arion vulgaris</i>	Spanish slug	X		X		
Snails	<i>Ceruella neglecta</i>	Neglected dune snail		X	(X)		
Snails	<i>Chilostoma cingulatum gobanzi</i>	–		X			
Snails	<i>Cornu aspersum</i>	Brown garden snail		X	(X)		
Snails	<i>Deroceras panormitanum</i>	Brown field slug		X?	X		
Snails	<i>Deroceras reticulatum</i>	Reticulated slug		X	X		
Snails	<i>Deroceras sturanyi</i>	–		X	X		
Snails	<i>Physella heterostropha</i>	–		X?			
Snails	<i>Potamopyrgus antipodarum</i>	New Zealand mud snail		X			
Mussels	<i>Corbicula fluminea</i>	Asiatic clam		X	X?		
Mussels	<i>Dreissena polymorpha</i>	Zebra mussel		X	X		
Mussels	<i>Sinanodonta woodiana</i>	Eastern Asiatic freshwater clam		X	X?		
Nematodes	<i>Anguillicola crassus</i>	Swim-bladder nematode		X	X		
Turbellaria	<i>Dendrocoelum romanodanubiale</i>	–		X?			

Totally, fourteen neophytic vascular plant species cause serious economic loss (Table 2). In five out of the fourteen species economic loss is presently still limited to small regions or risk of economic loss exists only upon further spread of these expansive species.

Two neophytic vascular plants cause severe problems for human health.

Thirty of the fungal species have more or less adverse economic impacts. About 150 of the animal species are known to have detrimental economic impacts. Also in this case the extent of impacts varies widely and only few species are very important agricultural or forest pests or are of relevance from the point of view of veterinary medicine.

Table 2: List of neophytes (plant species) involving problematic economic and health consequences.
Legend: (X) = economic loss presently locally restricted or risk of economic loss only upon further spread of the expansive species, X = significant economic loss. Black locust and ash-leaved maple have positive as well as negative economic impacts, depending on the respective user group (Table 1).

Taxonomic group	Scientific name	Common name	Economically problematic	Problematic for health
Vascular plants	<i>Abutilon theophrastii</i>	Velvetleaf	(X)	
Vascular plants	<i>Acer negundo</i>	Ash-leaved maple	(X)	
Vascular plants	<i>Amaranthus powellii</i>	Powell amaranth	X	
Vascular plants	<i>Amaranthus retroflexus</i>	Redroot amaranth	X	
Vascular plants	<i>Ambrosia artemisiifolia</i>	Common ragweed	(X)	X
Vascular plants	<i>Fallopia japonica</i>	Japanese knotweed	X	
Vascular plants	<i>Fallopia japonica x sachalinensis</i> (= <i>F. x bohemica</i>)	Hybrid knotweed	(X)	
Vascular plants	<i>Fallopia sachalinensis</i>	Giant knotweed	(X)	
Vascular plants	<i>Galinsoga ciliata</i>	Hairy Galinsoga	X	
Vascular plants	<i>Galinsoga parviflora</i>	Small-flower Galinsoga	X	
Vascular plants	<i>Heracleum mantegazzianum</i>	Giant hogweed	(X)	X
Vascular plants	<i>Panicum dichotomiflorum</i>	Fall panicum	(X)	
Vascular plants	<i>Robinia pseudaccacia</i>	Black locust	X	
Vascular plants	<i>Solidago gigantea</i>	Late goldenrod	X	

